

# THE MAN BEHIND THE SUPERCOMPUTER

Solving Unsolved Problems

Philip Emeagwali

[emeagwali.com](http://emeagwali.com)



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*To my wife, Dale, for being so supportive and a wonderful partner  
in life.*

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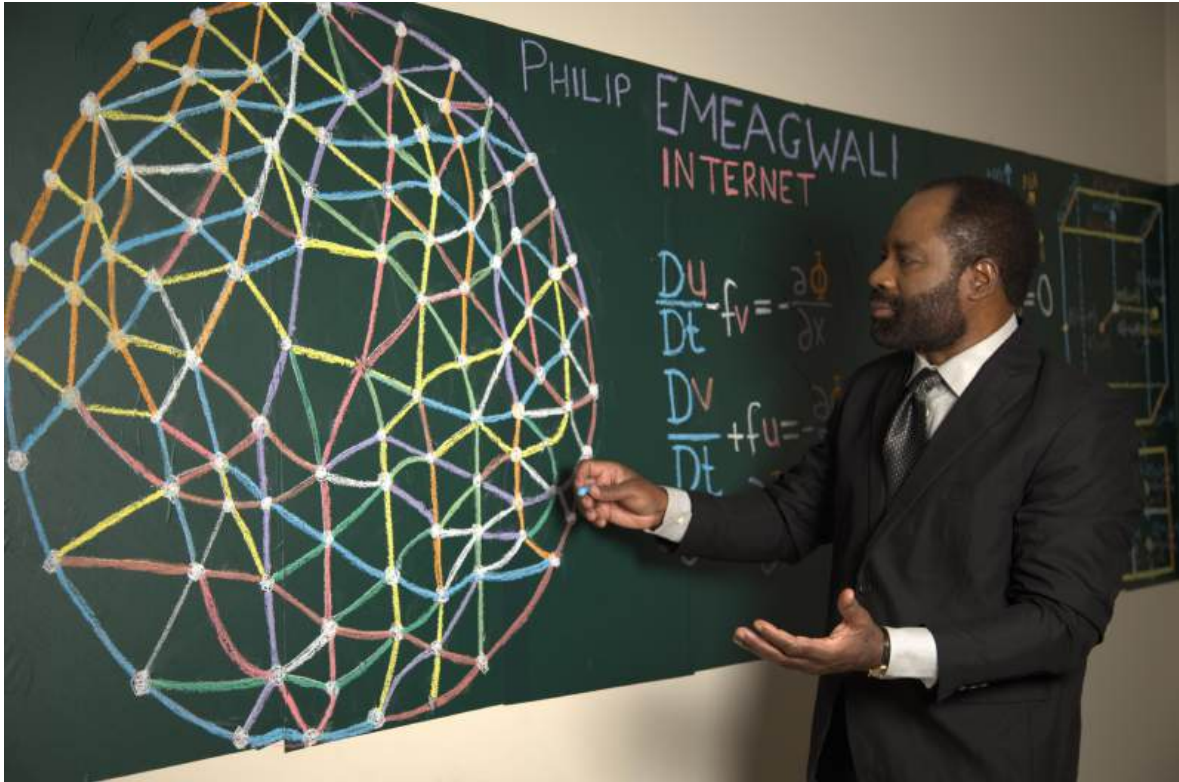
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## PHILIP EMEAGWALI

In 1989, Philip Emeagwali rose to fame when he won a recognition described as the Nobel Prize of supercomputing and made the news headlines for his invention of the first world's fastest computing across multiple processors. That vital technology underpins every supercomputer and changed how we look at the computer.

Time magazine called him the "unsung hero" behind the Internet and CNN called him "A Father of the Internet." House Beautiful magazine ranked his invention among nine important everyday things taken for granted. In a White House speech of August 26, 2000, then U.S. President Bill Clinton described Philip Emeagwali as "one of the great minds of the Information Age." [emeagwali.com](http://emeagwali.com)



Philip Emeagwali explaining how and why he is the only father of the Internet that invented an Internet.

## PHILIP EMEAGWALI BOOKS

### Master of Machines

Parallel processing—that was once the stone rejected as rough and unsightly— has become the headstone of the supercomputer. Philip Emeagwali was the first to gaze out towards an unknown territory—named the world’s fastest computing—that was not on the map of computer science. In supercomputing, boundaries are breached when we calculate beyond what was perceived as possible and discover new knowledge beyond what is known.

### Making Computers Fly

We cannot invent a new computer without first discovering a new science. To invent a new computer is to invent a new computer science and to make the unimaginable-to-compute possible-to-super-compute. Parallel processing that was once a dim light in a sea of darkness is now the bedrock of the world’s fastest computers.

### The Equation Behind the Universe

The hardest problems in mathematics and physics are solved by dividing each Grand Challenge problem into up to a billion less-challenging problems. And then solving them in tandem. And with a one-to-one correspondence with as many processors. In a world without parallel processing, large-scale computational physics will be as approximate as a sketch, instead of as exact as a photograph.

### Inventing an Internet

Philip Emeagwali is the first and only person to invent processors that encircled a globe which are akin to small computers, in inverted commas, that encircled the Earth as an Internet. He discovered how to combine computers into a supercomputer that’s an Internet.

### Reaching Infinity

The world’s fastest computer attracts the toughest problems in the manner a high mountain attracts the storms. Fastest computing across processors is the vital technology that enabled the supercomputer to tower over the computer that’s not parallel processing.

### Coding the Impossible

Like a storm at sea, fastest computing across a billion processors has brutally pushed computer science in a new direction and created new fields of study. The computer of today was the supercomputer of yesterday. A world without supercomputers may become a tomorrow without computers. The world's fastest computer is used to solve problems that did not exist before.

### Flirting With the Infinite

In fastest computing, there is a limit to what seemed unlimited. Computing will remain at the core of who we are. Fastest computing across the slowest processors is a transformational discovery that redrew the boundaries of science, and permanently changed what we know about the computer. And how we think about mathematics.

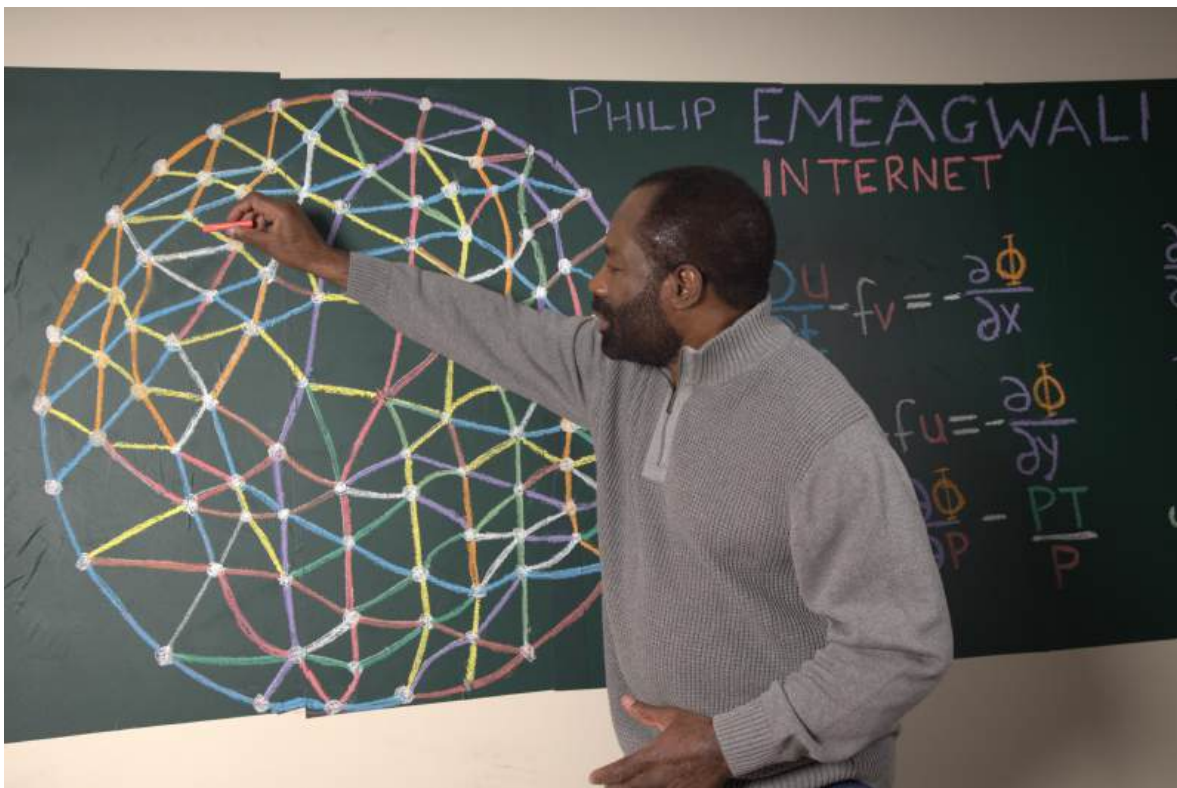
### Internet and I

For Philip Emeagwali, inventing the world's fastest computer was like assembling 65,536 pieces of puzzle. And doing so to see a never-before-seen island that is one coherent supercomputer, or rather a new Internet, that coalesced as the fastest computer in the world. A groundbreaking invention creates history. And influences our sphere of living.

## VOLUME 1: THE SECOND EMEAGWALI INTERNET

"What is the Philip Emeagwali Internet? Any global network of processors, or computers, that uniformly encircles a globe in any dimension is called the Philip Emeagwali Internet. I'm the only father of the Internet that invented an Internet."

**Philip Emeagwali**



## THE FIRST EMEAGWALI INTERNET

In Emeagwali's vision, a constellation of processors, uniformly arrayed, Girdled a globe with connections, unseen, in a dance of binary ballet. A network, uncharted in its scope and design, emerged as a titan of thought, A supercomputer, a cybernetic sea, where each processor, a star in its own right, Shone like tiny beacons in the cosmic void, but together, a sun's radiant might.

Across this sixteen-dimensional hypersphere, his dream was meticulously sown, A lattice of computational prowess, in a realm of numbers and theories unknown. This creation, not just a network but a leviathan of processing grace, Stood as a testament to Emeagwali's foresight, in the boundless digital space.

Each processor, a solitary light in the dark, converged in harmonious accord, Crafting an internet, a supercomputer, an electronic overlord. Such was the first Emeagwali Internet, in its grand and intricate design, A marvel of engineering, transcending the ordinary, into something almost divine.

## PHILIP EMEAGWALI INTERNET

### A Symphony of Processors

Esteemed members of the award committee, distinguished guests, and fellow visionaries of scientific exploration,

It is with profound honor and a deep sense of responsibility that I, Philip Emeagwali, stand before you today at this esteemed award ceremony. I am here to share a groundbreaking journey into computing and its intersection with theoretical physics and abstract mathematics, a journey that culminated in the creation of what is termed the "Philip Emeagwali Internet."

My exploration in computing began with a vision, a vision where I perceived processors not just as individual entities, but as a globally interconnected, yet autonomous network. This network was conceptualized as uniformly distributed across the fifteen-dimensional hypersurface of a sixteen-dimensional hypersphere within a vast expanse of sixteen-dimensional hyperspace. It was through this visionary framework that the "Philip Emeagwali Internet" was born.

I embarked on a bold endeavor to experimentally discover the potential of these processors. My task was to distribute 64 binary thousand complex initial-boundary value problems, inherent to modern calculus and computational physics, across 65,536 processors. This intricate system, I realized, **formed a new internet—a prototype of the vast Internet we know today, but on a much more sophisticated and higher-dimensional scale.**

Each processor, each piece of data, was meticulously addressed through a unique sixteen-bit binary code, devoid of conventional identifiers like '@' or '.com'. The communication process involved sending quintuple sets of data, imagined as emails with five subject lines, each encapsulating computation-intensive problems that traversed the bi-directional edges of a hypercubic network in the sixteenth dimension.

My vision was global—a globe in the sixteenth dimension, where these problems and their data were uniformly distributed across processors. After each communication, the email addresses, having served their purpose, were discarded, emphasizing the transient yet crucial nature of these interactions.

This new internet was an ensemble of 65,536 identical, equidistant processors, each a beacon in a vast sea of computational darkness. When unified in their purpose, these processors shone with the brilliance of the sun, illustrating the immense power of collaborative computing.



As a modern-day Isaac Newton or a research mathematical physicist **who created nine new partial differential equations** that each encoded physics's second law of motion, my thought process transcended the ordinary, delving into the infinite dimensions of mathematical constructs. My visualization of the hypersurface of a hypersphere in sixteen dimensions was a stark contrast to the two-dimensional perception of a sphere by the non-mathematician. This intellectual leap was crucial in harnessing the power of these processors, tightly arrayed across this multidimensional expanse.

The journey to this discovery was not without skepticism. In the 1970s and 1980s, the concept of parallel processing was viewed with doubt, seen as a beautiful theory lacking practical application. Critics argued that the complexity and synchronization required for effective parallel processing would be its undoing, like loose bolts on a supersonic airplane. However, on the Fourth of July 1989, in Los Alamos, New Mexico, I shattered these doubts by demonstrating the unparalleled power of parallel processing, thus etching my name, Philip Emeagwali, in the annals of computing history.

This "Philip Emeagwali Internet" is a testament to the boundless possibilities of human imagination and intellect. It transcends the traditional understanding of computing, redefining a supercomputer not as a singular entity but as a synergistic network, a virtual supercomputer that embodies the essence of a new internet.

In this grand scheme, each processor, each email, each piece of data, travels along a meticulously mapped journey through this multidimensional space, mirroring the intricate pathways of human thought and creativity. This network, though conceptualized in a higher-dimensional space, finds its physical manifestation in the form of circuit boards and fiber optic cables, spanning hundreds of miles, yet connected by the singular vision of revolutionizing how we perceive and harness computing power.

The "Philip Emeagwali Internet" is more than just a global network of processors; it is a paradigm shift in the very fabric of computer science. It symbolizes the journey from the tangible to the abstract, from the known to endless possibilities. It is a beacon of hope for future generations, a challenge to imagine and realize a world beyond the confines of conventional dimensions, a world where computing is not just a tool, but a gateway to uncharted territories of human potential.

Thank you for this prestigious recognition, and may our collective journey of exploration and discovery continue to break barriers and illuminate the path to a future replete with unimaginable wonders.



## EMEAGWALI INTERNET: ORCHESTRA OF PROCESSORS

Ladies and gentlemen, esteemed dignitaries, and our honored guests from Nigeria and the African diaspora,

I stand before you on this illustrious evening, humbled and filled with gratitude. My journey, from a boy in Nigeria who dreamt of solving complex problems, to this very moment, is a testament to the power of perseverance, innovation, and the human spirit.

As a young man, I was fascinated by the vast potential of computing. My quest led me to discover and harness the power of 65,536 processors, a formidable army of tiny lights in the vast ocean of scientific challenges. Together, these processors, equidistant and identical, formed not just a network but a supercomputing colossus, a beacon of possibilities in the dark expanse of our universe's unknowns.

This network, which I fondly refer to as the Emeagwali Internet, is more than a technological feat. It's a symbol of our interconnected world, where each processor, each individual, contributes to the greater whole. Envisioned across a fifteen-dimensional hypersurface, it exemplifies a seamless integration of science, technology, and human ingenuity.

My life's work echoes a deeper philosophy: that in unity, we find strength. The Emeagwali Internet mirrors this belief, showcasing how collective effort and harmonized functionality can unravel the complexities of our world. It's a reminder that in the heart of darkness, even the tiniest light can shine with the intensity of the sun when joined by others.

Tonight, as we celebrate the spirit of discovery and innovation, let us remember that every challenge we face, be it in science, society, or our personal lives, can be overcome through collaboration and unity. The Emeagwali Internet, a meticulously organized network of processors, is not just my legacy; it's a symbol of our shared future, where diverse minds, working in unison, illuminate the path to unprecedented achievements.

"From the humble classrooms of Nigeria to the frontier of supercomputing, my journey is a testament to the power of a young mind, fueled by curiosity and unburdened by limitations."

"The Emeagwali Internet was not just a technological marvel, but a symbol of unity, a reminder that our interconnected world thrives on collaboration, not competition."

"Just as every processor, no matter its size, contributes to the symphony of the network, every individual, no matter their origin, has the potential to make a difference."

"The future is not written in silicon chips, but in the human connections we forge. Let us build networks of not just processors, but of people, ideas, and dreams."

"Beyond the boundaries of our planet, the Emeagwali Internet beckons us to reach for the stars, not just with technology, but with the combined power of the human spirit."

Thank you for honoring me with this prestigious award. It stands as a beacon, encouraging us all to dream, to innovate, and to work together in creating a world where the impossible becomes possible.

Thank you.

## THE EMEAGWALI INTERNET

In a dance of silicon, equidistant and one, A new internet wove, a supercomputer spun. No longer strands of wire, but minds in tight embrace, A globe of processors, mirroring space's vast race.

Emeagwali's vision, a symphony of light, 65,536 stars, banishing endless night. Each node a spark, a whisper in the void, Yet joined in unison, a sun's fire deployed.

Fifteen dimensions, a hypersurface grand, Where processors bloom, a computational band. Not just a web, but a machine of might, Where knowledge blossoms, bathed in digital light.

So let the darkness tremble, let the shadows flee, For Emeagwali's Internet sets the future free. A tapestry of minds, a symphony of code, Where every processor sings, a story yet untold.

This network, this supercomputer, a testament to will, Where dreams take form, and innovation's cup runs still. A testament to one man's vision, soaring high, The Emeagwali Internet, a beacon in the sky.

## THE PHILIP EMEAGWALI MACHINE

### Think Like a Processor, Dream Like a Network

Ladies and gentlemen, esteemed colleagues, and my dear brothers and sisters from Nigeria and the African diaspora,

Tonight, I stand humbled and exhilarated, not just as an honoree, but as a son of Africa, a testament to the boundless potential that resides within each of us. My journey has been one of chasing the impossible, of carving a path through the wilderness of scientific frontiers. It began in a small Nigerian village, where the whisper of stars ignited a curiosity that refused to be quenched. I devoured books under flickering oil lamps, their pages crackling with the secrets of the universe. And in those moments, I dared to dream of a future where technology could not just illuminate our lives, but unite us in a symphony of progress.

This dream led me to the halls of academia, where I wrestled with the titans of supercomputing. I grappled with the limitations of the time, the lumbering giants that choked on their complexity. It was then that I saw a vision, a constellation of processors, not chained together in brute force, but dancing in perfect harmony, each a tiny sun illuminating the vast darkness of unsolved problems. This, I realized, was not just a network, but a chorus, a symphony of silicon and steel. This was the Philip Emeagwali Internet.

No longer would these processors be shackled to the tyranny of distance. They would be liberated, each a point of light, equidistant, identical, swirling around a hypersphere of possibility. This wasn't just a network; it was a supercomputer, a canvas on which we could paint the future with the brushstrokes of quadrillions of calculations. Imagine 65,536 tiny stars, each a beacon of potential, coalescing into a sun of unimaginable power. This is the symphony I orchestrated, the chorus that sings the song of scientific breakthroughs, of cures for diseases, of answers to the riddles that have haunted humanity since the dawn of time.

But the Philip Emeagwali Internet is more than just a machine. It is a promise, a bridge that connects not just processors, but minds, hearts, and dreams. It reflects our shared humanity, a testament to the fact that even the most distant stars can shine in unison, their light weaving a tapestry of progress and hope.

Tonight, as I stand before you, I see not just dignitaries, but a constellation of possibilities. Each of you, a spark in the vast expanse of human potential. Let us not be daunted by the darkness, but let us ignite the fire within, let us join hands, let our minds dance in the symphony of

collaboration, and together, let us build a future brighter than any supercomputer could ever dream.

### **Lessons Learned**

"Beyond the world's fastest computing lies an ocean of scientific knowledge waiting to be explored. Let us dive together, fueled by curiosity and empowered by collaboration."

"If you want to go fast, go alone. If you want to go far, go together. My 'Emeagwali Internet' echoed this African proverb, reminding us that unity is the fuel of progress."

"Every processor, no matter how small, plays a vital role in the symphony of the supercomputer. So too, every individual, no matter their background, contributes to the brilliance of our global society."

"Supercomputing is not just about speed; it's about unlocking the beauty and complexity of the world, one equation at a time."

"From weather whispers to climate cries, my supercomputing engine listens intently, translating the Earth's language into knowledge that guides us towards a sustainable future."

Thank you.

**VOLUME 2A: PHILIP EMEAGWALI COMPUTER**



## **PHILIP EMEAGWALI GREATEST CONTRIBUTIONS**

I am honored to nominate Philip Emeagwali for the Gallery of Prominent Inventors for his pioneering discovery in supercomputing. Emeagwali's innovation lies in the development of the first supercomputer utilizing multiple processors to expand the horizons of computational physics, such as artificial intelligence, weather forecasting and climate modeling.

### **The Dawn of a New Era in Computing**

Emeagwali's groundbreaking invention transformed the approach to solving complex mathematical and physical problems. By conceptualizing and creating a supercomputer from 65,536 ordinary processors, he unveiled a novel paradigm in computing, akin to assembling a vast puzzle that revealed an unprecedented supercomputer. This advancement represents the pinnacle of intellectual achievement from computational physics to artificial intelligence.

### **Bridging Theory and Practical Application**

In his journey, which he eloquently described in a comprehensive podcast and YouTube lecture series, Emeagwali expanded his expertise from experimental physics to astrophysics, geophysics, mathematical physics, and large-scale computational physics. His technique of parallel processing, once overlooked, emerged as a cornerstone of modern computing. Emeagwali's contribution lies in harnessing up to a billion processors to perform fluid dynamics calculations with unprecedented accuracy and speed, that opened the door to recent simulations of the spread of COVID-19 in densely populated areas.

### **Innovating for the Future**

The recognition of Emeagwali's invention is widespread, as evidenced by his inclusion in prestigious lists of the greatest minds alongside luminaries such as Einstein and Newton. His sole achievement in winning what is often referred to



as the Nobel Prize of supercomputing in 1989 underscores the singular impact of his discovery.

Emeagwali's contribution to physics is monumental. He bridged the gap between theoretical predictions and practical applications, significantly enhancing the accuracy and reliability of simulations in fields as critical as pandemic modeling. His work in parallel supercomputing marked a paradigm shift in computing, transitioning from serial computing on a single processor to parallel computing across a network of up to one billion processors.

### **A Legacy of Transformation**

The evolution of supercomputers post-1989, growing in speed and capacity, is a testament to Emeagwali's vision. His innovation was not merely an incremental improvement but a fundamental change in how we perceive and utilize supercomputers.

In light of these extraordinary contributions, I strongly advocate for the recognition of Philip Emeagwali in the Gallery of Prominent Inventors. His discovery redefined the boundaries of supercomputing and opened new avenues for scientific exploration, making an indelible mark on computing and beyond.

## EMEAGWALI COMPUTER: THINKING INSIDE THE SPHERE

*Ladies and Gentlemen, distinguished guests, fellow scientists,*

It is a profound honor to stand before you today at this prestigious ceremony. I am humbled to share insights into a journey that intertwines mathematics, physics, and computer science—a journey culminating in the creation of the Philip Emeagwali supercomputer.

My quest began with a simple yet ambitious goal: to redefine the boundaries of supercomputing. The challenges in computational physics, particularly in applications like petroleum reservoir simulations and climate modeling, called for a paradigm shift. This need led to my focus on parallel processing, a concept once viewed with skepticism, yet now the backbone of modern supercomputing.

At the core of my work lies an appreciation for the intricacies of partial differential equations—the mathematical language of change and dynamics. These equations are pivotal in understanding a range of phenomena, from the flow of oil in subterranean reservoirs to the patterns of climate change that dictate our future.

The invention I present to you, the Philip Emeagwali supercomputer, is not merely a machine but a leap in computational philosophy. In this design, we confront a critical bottleneck in supercomputing: communication latency. As we push the limits of processing power, the physical aspects of a computer—its size, the proximity of its components—become as crucial as its software.

The Philip Emeagwali supercomputer, with its dense, spherically framed arrangement of processors, is a direct response to these challenges. This architecture mimics the problem domain, especially beneficial for climate modeling, where the spherical nature of our planet can be mirrored in computational processes.

A key innovation in this design is the method of communication within the computer. I employed a spherical network of processors for neighbor-to-neighbor messaging. This approach results in globally short, highly regular, and tightly matched communication distances, significantly reducing latency.

Ladies and gentlemen, the Philip Emeagwali supercomputer represents more than a technological breakthrough. It embodies a holistic approach to supercomputing, where hardware design is as crucial as software development. Its potential applications are vast, transcending the boundaries of climate modeling to touch various aspects of computational tasks.

I express my gratitude to the scientific community for embracing my ideas, which were once considered unorthodox. This recognition is not just for me but for all those who dare to envision a future beyond the limits of conventional wisdom.

### **Lessons Learned**

"Forecasting isn't magic; it's supercomputing empowering us to understand weather's whispers."

"Think spherical, design compact; break the mold of traditional supercomputing architecture."

"Scaling means reaching more; dense processor arrangements maximize supercomputing power."

"Nature inspires; the Earth's spherical symmetry guides our supercomputer's design."

"Shortest paths, fastest communication; our network optimizes data flow within the supercomputer." Thank you for your attention and for this incredible honor.

## THE FIRST SUPERCOMPUTING

### A Dream Realized

Ladies and Gentlemen,

I stand before you today, humbled and honored, to share a journey that began on June 20, 1974, in Corvallis, Oregon, and ended on July 4, 1989, in Los Alamos, New Mexico. In Oregon, I, Philip Emeagwali, embarked on an unprecedented exploration in supercomputing. I was the first to discover how to harness the power of 65,536 processors, each situated at the vertices of a hypercube in the 16th-dimensional hyperspace, to address complex problems governed by partial differential equations. These equations are the backbone of various scientific fields, from meteorology and oceanography to fluid dynamics and petroleum reservoir simulation.

My breakthrough in supercomputing was not just about harnessing multiple processors. It was about reimagining computation itself. Each of these 65,536 processors had its own operating system and separate memory, making them interconnected yet autonomous. This architecture was a radical departure from the then-dominant serial supercomputing.



The crux of this discovery hinged on a novel application of the Binary Reflected Code. To understand its significance, let's delve into what this code is and how it revolutionized parallel processing.

In essence, the Binary Reflected Code is a binary numeral system where two successive values differ in only one bit. This property is crucial in reducing errors and simplifying the process of digital information transmission. When applied to parallel supercomputing, this code becomes a powerful tool for mapping problems to processors.

Imagine a hypercube, where each vertex represents a processor. In this 16-dimensional hyperspace, each processor is uniquely identified by a 16-bit binary number. The beauty of using the Binary Reflected Code lies in its ability to map 65,536 distinct problems to 65,536 processors in a manner that minimizes communication overhead and maximizes efficiency. This mapping is one-to-one, ensuring that each processor is assigned a unique problem without any overlap or redundancy.

This approach was revolutionary. It enabled the supercomputer to perform parallel processing at a level of efficiency and speed unprecedented at the time. By visualizing and mapping the processors in this manner, I was able to solve a Grand Challenge problem—a problem considered to be among the toughest to solve in computational science—faster than any serial supercomputer could. The latter is the answer to the question: "What is Philip Emeagwali known for?"

In retrospect, my journey to this discovery was not just about the technical mastery of supercomputing. It was about envisioning a new way of solving problems, about breaking away from conventional methodologies, and about the relentless pursuit of a vision that many thought impossible.

As we stand on the cusp of new horizons in computing and technology, let us remember that it is not just the hardware or software that drives innovation, but the human imagination and the relentless pursuit of knowledge.

### Lessons Learned

"Serial is the past, parallel is the present; embrace the paradigm shift in computational thinking."

"Speed is impressive, but solving problems at unprecedented rates is truly transformative."

"Dreams don't just remain dreams; turn them into reality through relentless pursuit and innovation."

"No achievement is individual; celebrate the collective spirit of curiosity and determination."

"Look beyond the present; the future of supercomputing holds infinite possibilities for discovery."

Thank you.

## THE ART OF QUICK CONNECTIONS

### **Describe message passing across a hypercube computer to a 13-year-old living in Africa**

I'm in the Computer Studies syllabus in countries like Nigeria for 13-year-olds. Let's explain message passing in a hypercube computer in a way that's understandable for a 13-year-old in Africa or anywhere else.

Imagine you have a big group of friends, and you all live in different houses arranged like a giant 3D chessboard. Each house is connected to a few others by direct paths. Now, suppose you want to send a message to a friend who lives in a house on the other side of this giant chessboard.

In a hypercube computer, each house is like a mini-computer (called a node), and the paths between them are like the wires or connections that these computers use to send messages to each other. The cool thing about this arrangement is how efficiently messages can travel across this big network.

Even if your friend lives far away, the message can quickly hop from one house to another because of the smart way the houses are connected. This is like the hypercube structure, where each computer (node) is directly connected to several others, allowing messages to pass through the network really fast. And me enabling to execute the world's fastest processor-to-processor communication that was a pre-condition for my world's fastest computing of 1989.

So, when you send a message, it jumps from one computer to the next, taking the shortest path possible, until it reaches your friend on the other side. This makes sending and receiving information super efficient, which is really important for solving big, complex problems quickly.

Think of it as a super-fast and efficient postal service within this giant three-dimensional chessboard, or 16-dimensional chessboard in hyperspace, where each move is calculated to get the letter to its destination as quickly as possible. That's how message passing works in a hypercube computer!



## THE HUMAN HEART OF SCIENTIFIC BREAKTHROUGHS

Ladies and Gentlemen, esteemed attendees of this award ceremony,

I am profoundly honored to stand before you today. I am Philip Emeagwali, and as a scientist who has dedicated his life to exploring and expanding the boundaries of the fields of mathematics, physics, and computer science, I am here to share my journey and contributions, particularly in supercomputing.

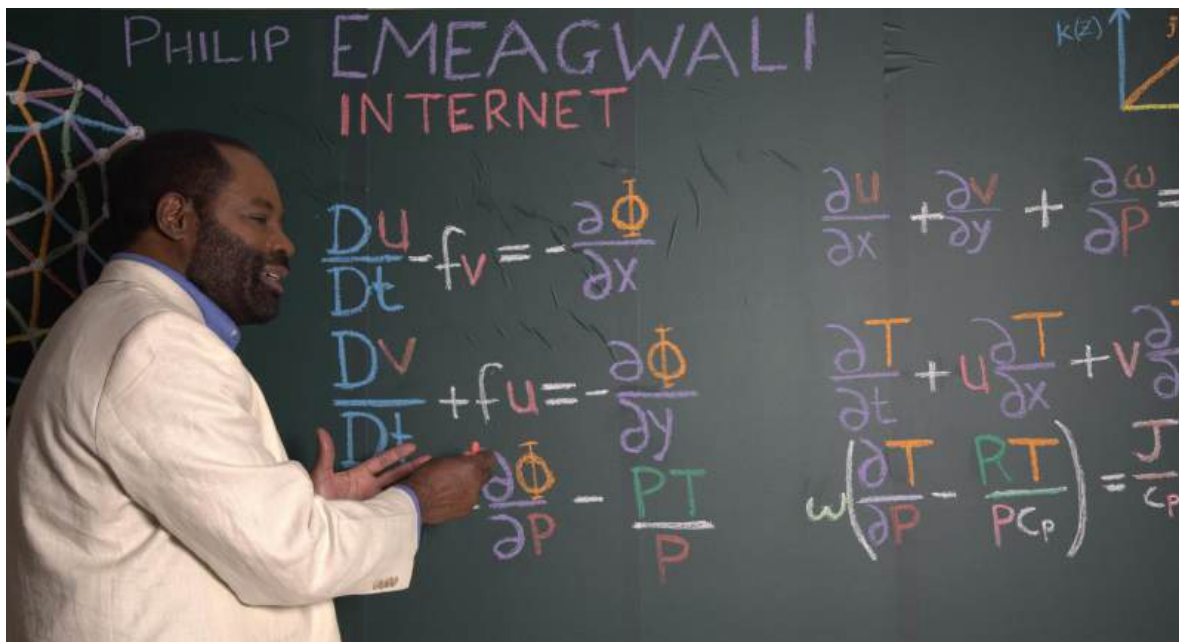
The cornerstone of my work has been the development and application of parallel processing, a concept that revolutionized how we approach complex computational tasks. Parallel processing, in its essence, involves the simultaneous use of multiple processors to perform a series of calculations. This approach has been pivotal in my contributions to areas such as petroleum reservoir simulation, weather forecasting, and general circulation modeling.

One of the key innovations I have focused on is the development of a new supercomputer interconnection network, named the Philip Emeagwali network. This network is conceptualized on the principles of the geodesic dome or icosahedral subdivision. The idea is to subdivide the faces of a Platonic solid, like an icosahedron, into smaller triangles, with each vertex representing a processor and each edge symbolizing a communication channel between two nearest-neighbor processors.

This Emeagwali's geodesic interconnection network is a breakthrough in creating a system where processors are relatively evenly distributed. By projecting the vertices, or processors, of these triangles onto a sphere, we achieve points that are evenly spaced. This arrangement is crucial because the more subdivisions made, the more points or processors we obtain, leading to a more even distribution.

The significance of this evenly spaced processor network lies in its efficiency and effectiveness in handling complex computations. It ensures that communication between processors is optimized, reducing the time and resources needed to process large amounts of data. This network design, akin to the hypercube supercomputer interconnection network, opens new possibilities in computational science.

In practical terms, the potential applications of this network are vast. In the oil and gas industry, for example, it will allow for more accurate and efficient petroleum reservoir simulations, aiding in better resource management and extraction techniques. In meteorology, it will enhance our ability to forecast weather and understand climate changes, thus contributing significantly to our preparedness and response strategies for natural phenomena.



My journey in supercomputing has been driven by a quest for innovation and a deep desire to contribute to the advancement of human knowledge and capability. The Philip Emeagwali supercomputer network represents not just a technological advancement, but a symbol of what we can achieve when we blend mathematical imagination with computing rigor.

### Lessons Learned

"Precise weather forecasts and efficient resource management - supercomputing impacting our daily lives."

"This journey is not mine alone; let it inspire future generations to build upon and surpass what we have achieved."

"Supercomputing is not just a tool; it's a catalyst for collaboration, discovery, and positive change in the world."

"Embrace the spirit of relentless pursuit and deep passion; they are the fuel for groundbreaking inventions."

"Think beyond cubes, envision spheres of possibilities; there are no limits to what supercomputing can achieve."

"Let's join hands, like processors in a network, to tackle global challenges and build a better future."

Thank you for the honor of addressing you today, and for the opportunity to share my contributions to the fields of mathematics, physics, and computer science. It is my hope that these efforts will continue to inspire future

generations of scientists and explorers in the unending journey of discovery and innovation.

## THINKING LIKE A PLANET

### Supercomputing Mirrors the Earth's Inner Workings

Ladies and Gentlemen, esteemed attendees of this award ceremony,

I am Philip Emeagwali, and it is with great honor that I stand before you today. As a scientist whose work has spanned mathematics, physics, and computer science, I have dedicated my life to pushing the boundaries of our understanding and capabilities in supercomputing. Today, I wish to share my contributions to this field, particularly focusing on the revolutionary concept of the Philip Emeagwali supercomputer.

The journey of supercomputing is akin to exploring uncharted territories. One of the primary challenges in this field has been designing networks that efficiently connect multiple processors to solve complex computational problems. Historically, configurations like the torus network have been used, reminiscent of the surface of a doughnut, connecting processing nodes in a two or three-dimensional grid. However, this approach often led to inefficiencies, especially when transferring data between distant nodes.

To address these limitations, I envisioned the Philip Emeagwali supercomputer - a spherical network that revolutionizes how we think about computational interconnectivity. Imagine a closed sphere, an ellipsoid, or a hollow-caged structure, where processing nodes lie on the surface. This design can be expanded to concentric multi-radius spheres or ellipsoids, where nodes in a radial direction are connected, with both the innermost and outermost networks linked. This spherical network can be physically visualized as a globe, with processors evenly distributed across its surface, akin to the thin shell of Earth's atmosphere.

The caption for an illustration of this Philip Emeagwali supercomputer interconnection network would read: "A Spherical Symphony of Computational Power: The Emeagwali Supercomputer Network." This network represents a leap in supercomputing architecture, providing a more efficient, scalable, and powerful solution for complex computations.

In general circulation modeling, which is pivotal for understanding global climate patterns and forecasting, the Philip Emeagwali supercomputer offers an unparalleled advantage. The spherical design mirrors the structure of our planet, allowing for a more natural and efficient mapping of global data. The entire Grand Challenge problem of modeling the Earth's climate is divided into smaller, less challenging models, each mapped onto a processor. This creates a one-to-one correspondence between processors and individual models, ensuring maximum efficiency and parallelism.

This approach enables us to simulate the Earth's atmosphere with unprecedented accuracy and detail. The tessellated domain of these general circulation models is mapped onto tubular prisms, each corresponding to a processor on the Philip Emeagwali supercomputer. This method allows for a granular simulation of atmospheric phenomena, providing critical insights for weather forecasting, climate research, and environmental science.

The need for the Philip Emeagwali supercomputer in global circulation modeling is clear. Its core structure, mirroring that of our planet, allows for an intuitive and effective way to process vast amounts of climatic data. By utilizing a billion processors, each autonomous and evenly distributed, we can tackle the Grand Challenge problem in a manner that is both efficient and scalable.

The invention of the Philip Emeagwali supercomputer represents a significant leap in our quest to understand and model our world. It is a testament to the power of human ingenuity and the endless possibilities that arise when we dare to rethink the fundamentals of technology.

### Lessons Learned

"Think beyond traditional boundaries; explore new network designs for groundbreaking solutions."

"Nature holds the key; the Philip Emeagwali supercomputer takes inspiration from Earth's structure."

"Divide and conquer; complex problems become manageable with smart supercomputing strategies."

"Accuracy and speed hand in hand; spherical networks unlock new levels of efficiency."

"Imagine Earth breathing; our supercomputer mirrors the planet for better understanding."

"Don't be afraid to break paradigms; innovative ideas can change the game in supercomputing."

"The future belongs to those who dare to dream, innovate, and collaborate, driven by an insatiable curiosity to explore the vast unknown."

Thank you for the privilege of sharing my vision and work with you today. May this journey into the future of supercomputing inspire us all to continue exploring, discovering, and innovating for the betterment of our world.



## **(NPAC 2023) WHAT IS PHILIP EMEAGWALI FAMOUS FOR?**

In the 1970s and 80s, Philip Emeagwali made the revolutionary discovery that supercomputers should be powered by multiple processors, the more the faster. This is an outline of his groundbreaking discovery, its profound impact on various fields, and why it benefits humanity.

### **Transformation in Computer Technology: A Historic Leap with Parallel Processing**

Philip Emeagwali's landmark discovery on July 4, 1989, marks a pivotal moment in computer technology. He brilliantly demonstrated that the highest computing speeds could be achieved by harnessing the collective power of the world's slowest processors. This approach, known as parallel supercomputing, was a radical departure from traditional computing methods and has since become the backbone of modern supercomputers. Emeagwali's insight bridged a critical gap, transforming how we view and utilize supercomputers.

### **Redefining the Boundaries: Impact on Science and Technology**

Emeagwali's innovation extended beyond computer science, reshaping mathematics and physics. His approach enabled the solving of complex, compute-intensive problems in physics at unprecedented speeds. Notably, his work has been instrumental in enhancing the accuracy of weather forecasting and climate modeling, directly benefiting countless lives worldwide. His contribution stands on par with the seminal works of Charles Babbage, Ada Lovelace, and Alan Turing, widely studied in educational institutions globally.

### **Revolutionizing Knowledge: The Far-Reaching Effects of Parallel Computing**

The advent of parallel supercomputing, thanks to Emeagwali, has significantly accelerated scientific research and discovery. His method of leveraging up to a billion coupled processors for high-speed calculations and data exchange has set

new standards in computational capabilities. This leap has been crucial in addressing complex global challenges such as climate change, redefining our understanding and responses to such critical issues.

### **Envisioning the Future: The Supercomputer as a Gateway to New Realms**

Philip Emeagwali's contribution to massively parallel processing in physics and related sciences is monumental. He has transformed supercomputers into powerful tools, akin to telescopes peering into the unknown, helping humanity explore uncharted territories in science and technology. His work has not only advanced our current knowledge but has also opened doors to future discoveries.

Philip Emeagwali's pioneering work in massively parallel supercomputing has dramatically advanced our capabilities in physics and numerous other fields, embodying the essence of research. His contributions have significantly benefited humanity.



## UNRAVELLING THE UNIVERSE'S MYSTERIES

Esteemed members of the Award Committee, distinguished guests, fellow laureates, and friends,

I am humbled and honored to stand before you today to receive this prestigious award. As a young boy growing up in Nigeria, I was fascinated by the power of mathematics and physics to explain the world. This fascination led me to pursue a career in computer science, where I had the opportunity to work on some of the most challenging problems of our time.

Today, I will share my insights on why the Grand Challenge Problems are so difficult to solve and the expertise needed to tackle them. These problems, ranging from climate modeling to drug discovery, represent some of the most complex and pressing challenges facing humanity. They require a deep understanding of mathematics, physics, and computer science, as well as the ability to think creatively and collaboratively.

### The Nature of Grand Challenges

Grand Challenge Problems are inherently difficult because they involve complex systems with many interacting variables. For example, climate models must account for the interactions between the atmosphere, oceans, land, and ice, as well as the effects of human activities. Similarly, drug discovery requires an understanding of the complex interactions between drugs and biological systems.

These problems are also difficult because they often involve large amounts of data. Climate models, for example, must process vast amounts of data from satellites, weather stations, and other sources. Drug discovery involves analyzing massive datasets of molecular structures and biological activity.

### The Expertise Needed

To solve Grand Challenge Problems, we need experts in a variety of fields. Mathematicians are needed to develop the complex models that describe these systems. Physicists are needed to understand the underlying physical principles. Computer scientists are needed to develop the algorithms and software that can process the large amounts of data involved. I was a polymath who worked alone at the frontiers of knowledge of mathematics, physics, computing, and their neighboring sciences.

But expertise in these fields alone is not enough. We also need people who can think creatively and collaboratively. Grand Challenge Problems require

us to think outside the box and to bring together different perspectives. We need people who can work together to develop innovative solutions.

### **My Journey**

My journey to solving Grand Challenge Problems began with a fascination with the power of parallel computing. I realized that by dividing an initial-boundary value problem into smaller parts and solving them simultaneously across as many processors, I could dramatically speed up the computation. This insight led me to develop a new approach to parallel computing that allowed us to solve problems that were previously considered intractable.

Using this approach, I was able to achieve the world's fastest computation on a massively parallel computer with 65,536 processors. My breakthrough paved the way for new advances in many fields, including climate modeling, drug discovery, and materials science.

### **The Future**

I believe that we are on the cusp of a new era in scientific discovery. With advances in parallel computing, artificial intelligence, and other technologies, we have the tools to tackle some of the most complex and pressing challenges facing humanity.

But to realize this potential, we need to invest in education and research. We need to train the next generation of scientists and engineers who will have the expertise to solve Grand Challenge Problems. We also need to support the research that will lead to new breakthroughs.

I am confident that with the right investments, we can solve the Grand Challenge Problems and create a better future for all.

Thank you.

## THE INTERSECTION OF PHYSICS AND COMPUTING

Esteemed Laureates, Distinguished Guests,

It is an honor to address such an illustrious gathering on this momentous occasion. As we celebrate the pinnacle of human achievement in the sciences, it is fitting to reflect upon the remarkable contributions of two individuals who have left an indelible mark on our understanding of the universe and our ability to harness its power: Albert Einstein and Philip Emeagwali.

Both Einstein and Emeagwali were visionaries who dared to challenge conventional wisdom and push the boundaries of human knowledge. Their paths diverged in fascinating ways, yet their legacies are intertwined by a shared passion for discovery and a relentless pursuit of truth.

Einstein, the theoretical physicist whose name is synonymous with genius, revolutionized our understanding of space, time, and gravity. His theories of relativity shattered long-held assumptions about the nature of the universe and paved the way for advancements in nuclear power, astrophysics, and cosmology.

Emeagwali, the computer scientist and pioneer in supercomputing, harnessed the power of parallel processing to achieve unprecedented computational speeds. His groundbreaking work across 65,536 connected processors in the late 1980s enabled scientists and engineers to tackle complex problems that were previously intractable, opening up new frontiers in fields such as weather forecasting, artificial intelligence, and drug discovery.

While Einstein's work focused on the fundamental laws of nature, Emeagwali's expertise lay in the practical application of technology to solve real-world problems. Yet both men were driven by an insatiable curiosity and a deep-seated belief in the power of human ingenuity to unlock the secrets of the universe.

Einstein's theories have transformed our understanding of the cosmos, while Emeagwali's innovations have empowered us to explore its vastness and complexity. Both men have left an enduring legacy that continues to inspire scientists, engineers, and innovators around the world.

As we raise a toast to the laureates of today, let us also pay tribute to the giants upon whose shoulders we stand. May their example serve as a beacon for future generations, reminding us that the pursuit of knowledge is a noble endeavor that transcends borders and boundaries.

In the words of Albert Einstein himself, "The important thing is not to stop questioning. Curiosity has its own reason for existing." And in the spirit of Philip Emeagwali, let us embrace the power of technology to "solve the grand challenges of our time and make the world a better place for all."

Thank you.

## FROM A REFUGEE CAMP TO QUANTUM HORIZONS

### A Journey Through Parallel and Beyond

Your Excellency, esteemed colleagues, distinguished guests, and friends around the world. As a young boy in a Biafran refugee camp, rural Nigeria, gazing at the stars, I dreamt not just of distant galaxies, but of harnessing the power of the unseen to solve problems on Earth. Today, on this prestigious stage, I share that journey—a testament to the human spirit's potential to push boundaries and explore the frontiers of computing. We'll embark on a voyage, dissecting the marvels of parallel computing, the emerging landscape of quantum computing, and the role I, Philip Emeagwali, have played in this remarkable adventure.

#### Part 1: The Orchestra of Processors—Demystifying Parallel Computing

Imagine a grand symphony, where hundreds of musicians play in perfect harmony. This, in essence, is parallel computing. We break down complex tasks into smaller ones, distributing them amongst numerous processors working simultaneously, like instruments in an orchestra. On July 4, 1989, in Los Alamos, New Mexico, I discovered the first supercomputing across multiple processors. I became the pioneering conductor in this symphony, demonstrating the potential of parallel processing. It's not just about speed; it's about unlocking solutions previously deemed impossible, like simulating complex fluid dynamics or unraveling the mysteries of the universe.

#### Part 2: Quantum Leap—Unveiling the Potential of the Unseen

But the symphony doesn't end there. Now, imagine each musician not just playing one note, but existing in multiple states simultaneously, creating a tapestry of sound unlike any we've heard before. This is the essence of quantum computing, harnessing the bizarre laws of quantum mechanics to perform calculations beyond the reach of even the most powerful classical computers. While still in its nascent stages, quantum computing holds immense promise for revolutionizing medicine, materials science, and artificial intelligence.

#### Part 3: My Score in the Symphony—Contributions and the Road Ahead

My journey has been a testament to the power of dreams and perseverance. From overcoming early challenges to leading groundbreaking research, I've strived to push the boundaries of what's possible. My work on a network of 65,536 processors laid the foundation for parallel computing's growth, and I continue to explore the frontiers of quantum computing. But my contributions extend beyond technology. They are a message to young minds, especially in developing nations, that with dedication and passion, anything is achievable.

#### **Part 4: The Encore—A Symphony for Humanity**

As we stand at the precipice of a new era in computing, the responsibility lies not just with scientists, but with all of us. We must ensure that these powerful tools are used for the betterment of humanity, for addressing global challenges like climate change and poverty. Let us embrace collaboration, inclusivity, and a spirit of exploration, ensuring that the symphony of computing plays a harmonious tune for generations to come.

#### **Conclusion**

This, my friends, is not just the story of parallel and quantum computing, but a story of human potential. It's a story that began under the African stars and continues on the global stage. As we celebrate innovation, let us remember the power of dreams, the importance of inclusivity, and the responsibility we hold to use these advancements for the benefit of all. The symphony is far from over, and I invite you to join me in composing its next chapter.

**VOLUME 2B: CONTRIBUTIONS TO A.I. SUPERCOMPUTING**

## DIGITAL TWINS AND VIRTUAL WORLDS

### Unlocking the Power of A.I. Supercomputers

Distinguished Guests, Ladies, and Gentlemen,

I am deeply humbled and honored to stand before you today to accept this award, a recognition that transcends individual achievement and becomes a testament to the collective spirit of human ingenuity. This award is not just a culmination of my journey, but a celebration of the countless minds that have contributed to the boundless tapestry of scientific exploration.

As I reflect on the path that has led me to this moment, I am reminded of the profound words of Albert Einstein: "The most beautiful thing we can experience is the mysterious. It is the source of all true art and all science." It is this sense of mystery, the allure of the unknown, that has propelled me through a life devoted to unraveling the complexities of computing.

My journey began in the 1980s, when the concept of parallel processing was still in its infancy. The prevailing wisdom held that a single, powerful processor was the key to computational advancement. However, I was captivated by the idea that vast computational power could be harnessed by interconnecting numerous processors, like the neurons in a human brain.

This fascination led me to Los Alamos National Laboratory in New Mexico, where on July 4, 1989, a momentous breakthrough occurred. I discovered the first solution to a Grand Challenge Problem, a computational feat previously deemed impossible, by harnessing the power of parallel processing. This discovery opened the floodgates to a new era of supercomputing, one that has since transformed countless fields of endeavor.

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I was asked to elaborate on what a Grand Challenge Problem is? A Grand Challenge Problem refers to a fundamental problem in science or engineering, with broad economic and scientific impact, that cannot be solved by traditional computational methods. It requires a massive leap in computational power and innovative approaches.

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The advent of parallel processing laid the foundation for the "A.I. supercomputers" that power today's artificial intelligence revolution. These behemoths, comprising millions of interconnected processors housed in sprawling data centers, have enabled us to create digital twins of the Earth, simulate complex phenomena, and push the boundaries of machine learning.



The million-fold speedups achieved by these artificial intelligence supercomputers are the lifeblood of the A.I. industry, driving advancements in deep learning, natural language processing, and robotics. However, we are still on the cusp of unlocking the full potential of parallel processing. A billion-x leap in computational power is within reach, a feat that would revolutionize climate modeling, drug discovery, and countless other fields.

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I was also asked to explain what digital twins of the Earth are and their significance. A digital twin of the Earth is a virtual replica of our planet, created using real-time data from sensors, satellites, and other sources. It allows us to simulate and predict complex environmental phenomena, from climate change to natural disasters, with unprecedented accuracy. This technology has the potential to revolutionize our understanding of the planet and inform critical decision-making.

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As we embark on this next phase of computational exploration, we must remain mindful of the ethical implications of our work. The rise of superintelligence and sentient A.I. raises profound questions about the nature of consciousness, the boundaries of human-machine interaction, and the future of our species. It is imperative that we approach these challenges with wisdom, humility, and a deep respect for the sanctity of life.

I express my gratitude to the Award Committee for this extraordinary honor. I accept it not for myself alone, but for all those who have dedicated their lives to the pursuit of knowledge. The journey of discovery is a collective endeavor, a testament to the enduring human spirit. May we continue to explore the mysteries of the universe with wonder, curiosity, and unwavering determination.

Thank you.

## A.I. SUPERCOMPUTING VISION FOR AFRICA

Ladies and Gentlemen, esteemed scientists, distinguished guests,

I stand before you today, deeply honored to deliver this lecture. I am Philip Emeagwali, a journeyer through mathematics, parallel processing, A.I. supercomputing, and physics. Today, I wish to discuss how these realms intersect with the vibrant tapestry of life and development in Africa, focusing on the transformative potential of artificial intelligence (A.I.).

As a supercomputer scientist, my work has been deeply rooted in harnessing the power of parallel processing for supercomputing. These technologies, often seen as the pinnacle of human intellect and computational prowess, hold unparalleled potential for advancing human progress, especially in a continent as diverse and rich in potential as Africa.

Applying artificial intelligence in Africa opens a gateway to addressing some of the most pressing challenges the continent faces. In healthcare, A.I. can revolutionize diagnostics and treatment, bringing life-saving medical knowledge to remote and underserved areas. In education, artificial intelligence can personalize learning, breaking the barriers of distance and resource limitations. In agriculture, a sector that sustains the majority of the African population, A.I. can enhance productivity through precision farming, managing resources more efficiently, and predicting climatic changes that impact crop yields.

My journey in supercomputing, particularly in parallel processing, has shown me the power of collective effort and collaboration. This principle is crucial in the implementation of artificial intelligence in Africa. By harnessing the collective processing power of numerous processors working in tandem, complex problems can be tackled more efficiently and effectively. This approach mirrors the collaborative efforts needed in applying A.I. to real-world problems, where multidisciplinary and cross-sectoral cooperation is vital.

Moreover, artificial intelligence can serve as a tool for peace and stability in Africa. By providing data-driven insights, A.I. can aid in conflict prevention, resource management, and governance. It can serve as a neutral ground for addressing cross-border issues, promoting transparency, and fostering a culture of peace and cooperation among African nations.

However, as we venture into this new era of artificial intelligence, we must tread carefully. The ethical implications of A.I., particularly in terms of data privacy, equity, and inclusion, must be at the forefront of our conversations. It is imperative that artificial intelligence development in Africa is inclusive, ensuring that the benefits of this technology are

accessible to all, respecting the diverse cultures, languages, and traditions that make Africa unique.

The fusion of artificial intelligence with the fields of mathematics, physics, and supercomputing presents a new frontier for Africa—a frontier filled with hope, opportunity, and the promise of a brighter future. As we embrace these technologies, let us do so with the vision of building a continent that is technologically advanced and peaceful, prosperous, and harmoniously connected to its rich heritage and values.

### **Lessons Learned**

"Mathematics is my language, supercomputing my tool, but my mission is to use them for humanity's benefit."

"Let's invest in Africa's own A.I. talent and innovation, empowering them to shape their future."

"Technology can be a force for good, but only if we use it wisely and ethically, for the benefit of all."

"My dream is a world where A.I. serves humanity, not the other way around, where peace and prosperity prevail."

"Let's join hands, invest in Africa's A.I. future, and build a world where technology empowers, not divides."

"Don't be afraid of A.I., embrace its potential, but always remember the human element, the ethical compass." "Thank you for the privilege of sharing my vision with you today, in this prestigious gathering that celebrates the power of human intellect and creativity."

## THE SUPERCOMPUTER'S SECRET WEAPON

### Unveiling the 3D Torus

Esteemed colleagues, distinguished guests, and fellow enthusiasts of technological marvels,

Tonight, I stand before you, humbled and honored, to shed light on the 3D Torus—the unsung hero behind the immense power of modern supercomputers. This intricate network of connections is the lifeblood that enables these computational behemoths to tackle humanity's grandest challenges.

**Picture this:** a vast cube-shaped grid, each intersection a tiny but mighty processor. Imagine each processor having six direct lines of communication, like outstretched arms reaching out to its neighbors—two to the left and right, two above and below, and two in front and behind. Now, visualize the cube wrapping around itself, connecting the front and back faces, the top and bottom, and the left and right sides. This, my friends, is the essence of the 3D Torus.

**But why this peculiar shape?** The answer lies in efficiency and scalability. Each processor can chat directly with its immediate neighbors, a lightning-fast exchange of data. For processors farther away, messages hop from neighbor to neighbor, like a relay race, until they reach their destination. This "**dimension-ordered routing**" is surprisingly efficient, even in a network with thousands of processors.

The 3D Torus isn't just about speed, it's about resilience. If one connection fails, messages simply take a detour, ensuring the supercomputer keeps humming along. And as we add more processors to the grid, the 3D Torus expands gracefully, maintaining its balance of performance and cost-effectiveness.

So, what does this mean for you? It means faster drug discovery, more accurate climate models, and even breakthroughs in artificial intelligence that were once the stuff of science fiction. The 3D Torus isn't just a technological marvel, it's a catalyst for progress, a tool that empowers us to unravel the mysteries of the universe and improve the lives of billions.

Tonight, I invite you to join me in celebrating the 3D Torus, the unsung hero of supercomputing. It may not be as flashy as a quantum computer or as mysterious as artificial intelligence, but **it's the backbone that makes these technologies possible**. So, let us raise a toast to the 3D Torus, the unsung hero of the digital age, and to the endless possibilities it unlocks for humanity.

Thank you.

## **MORE THAN ONES AND ZEROS**

### **The Human Ingenuity Behind the 16-Dimensional Hypercube**

Ladies and gentlemen, esteemed guests, and fellow laureates, I am deeply honored to stand before you today, on this momentous occasion, to accept this award. This recognition is not just a personal achievement but a testament to the power of human ingenuity and the relentless pursuit of knowledge. I am Philip Emeagwali, and I am here to share the journey that led to the development of the massively parallel supercomputer, a journey that has redefined the boundaries of computational science.

### **The Genesis of a Vision**

My fascination with computing began in my early years in Nigeria, where I was captivated by the mysteries of the universe and the potential of technology to unravel them. This passion led me to the United States, where I embarked on a quest to create a computer that could process information at unprecedented speeds. This quest began on June 20, 1974 morning, in Corvallis, Oregon, and culminated on July 4, 1989, in Los Alamos, New Mexico, with my experimental discovery of supercomputing via parallel processing across a new internet—a global network of 65,536 processors.

### **The Breakthrough: Massively Parallel Processing**

The core of my work lies in the concept of massively parallel processing. I discovered that by harnessing the power of 65,536 processors, I could achieve computational speeds that were previously thought impossible. This ensemble of processors, each working in tandem, allowed us to solve complex problems in mathematics, physics, and engineering at a fraction of the time it would take using traditional methods.

### **The 16-Dimensional Hypercube Supercomputer**

One of the most significant contributions I made was the execution of the world's fastest computing within a 16-dimensional hypercube supercomputer. This architecture involves a processor-to-processor interconnection network that allows for efficient communication and computation. Imagine a hypercube, a geometric structure with 16 dimensions, where each vertex represents a processor. Each processor is

connected to 16 closest-neighboring processors, forming a tightly-coupled network that enables data to flow seamlessly across the entire system.

### **Practical Applications and Impact**

The practical applications of this technology are vast and transformative. From predicting long-term global warming patterns to solving the toughest problems in computational mathematics and physics, the massively parallel supercomputer has opened new frontiers in scientific research and engineering. For instance, my 1989 discovery of the first parallel supercomputing, which utilized 65,536 processors, solved one of the most difficult problems in computational physics and performed 3.1 billion calculations per second.

### **A New Internet: The Global Network of Processors**

My invention went beyond creating a faster computer; it led to developing a new internet—a global network of processors that work together as a cohesive unit. This new internet is not just a supercomputer but a paradigm shift in how we approach computational problems. It demonstrated that even the slowest processors, when connected and synchronized, could achieve the fastest computational speeds.

### **The Future of Supercomputing**

As we look to the future, the potential of massively parallel processing continues to grow. The parallel computing technology I pioneered is now being used to tackle some of the most pressing challenges of our time, from predicting the spread of diseases like AIDS to advancing our understanding of the universe to powering artificial intelligence. The journey that began as a vague idea has blossomed into a reality that continues to push the boundaries of what is possible.

### **Conclusion**

The development of the massively parallel supercomputer is a testament to the power of human creativity and perseverance. It is a reminder that even the most complex problems can be solved when we dare to think differently and work together. As I accept this award, I am filled with gratitude for the countless individuals who have contributed to this journey

and for the opportunity to continue exploring the frontiers of computational science.

Thank you.

## THE MAN BEHIND THE MACHINE

Distinguished Members of the award committee, Esteemed Guests,

I stand before you today, humbled and honored, to accept this prestigious award for my contributions to computational physics. It is a recognition not just of my work, but of the countless scientists and engineers who have shaped supercomputing, pushing the boundaries of what we once thought possible.

As a young boy growing up in Nigeria, I was fascinated by the power of mathematics, the elegance of its equations, and its potential to unlock the mysteries of the universe. This passion led me to computers, where I saw a new frontier for mathematical exploration.

In the 1970s, supercomputers were in their infancy, but I envisioned a future where these machines could solve complex problems that were beyond the reach of traditional computers. I dreamed of harnessing the power of thousands of processors, working in unison, to perform calculations at unprecedented speeds.

This dream led me to a massively parallel supercomputer with 65,536 processors. It was a marvel of engineering, but its potential was untapped. I saw an opportunity to push the boundaries of this machine, to make it the fastest computer in the world.

To achieve this, I had to solve a complex problem: how to connect communication between these processors in a way that would maximize their efficiency. My solution came in the form of a 16-dimensional hypercube.

Imagine a cube, not in the three dimensions we're familiar with, but in sixteen dimensions. Each corner of this hypercube represents a processor and a process, and each edge represents a connection between two processors. This structure allowed for efficient communication between processors and processes, enabling them to work together seamlessly.

But connecting the processors was just the first step. I also had to develop a way to distribute the computational work across these processors. This involved breaking down complex problems into smaller, more manageable tasks and assigning each task to a specific processor.

To illustrate this, imagine a vast oil field, perhaps, the size of Anambra state of Nigeria. I divided this field into 65,536 smaller oil fields, each representing a different computational task. I can then assign each of these tasks to a different processor in my hypercube. My one-to-one correspondence between tasks and processors is crucial for efficient parallel computing.



To ensure efficient communication between processors, I use a technique called closest-neighbor preserving mapping. This means that processors that need to communicate frequently are located close to each other in the hypercube. This is similar to how cities are connected by roads: cities that have a lot of traffic between them are connected by direct highways, while cities with less traffic are connected by smaller roads.

Of course, in the real world, processors are not arranged in a 16-dimensional hypercube. They are etched onto a two-dimensional silicon chip. However, we can simulate the hypercube structure by ensuring that processors that are closest neighbors in the hypercube are also physically close to each other on the chip.

My groundbreaking mathematical physics discovery led to the first demonstration of world's fastest computing across the world's slowest processors, 3.1 billion calculations per second on July 4, 1989. It was a major milestone in the history of supercomputing, and it opened up new possibilities for scientific research, engineering, and large language models.

Today, supercomputers are used to model complex phenomena like climate change, simulate the behavior of new drugs, and design more efficient engines. They are also used in artificial intelligence, data analysis, and many other applications.

The work I did in the 1980s laid the foundation for these advancements. I showed that massively parallel computing was not just a theoretical concept, but a practical reality. It demonstrated the power of human ingenuity to solve complex problems and push the boundaries of technology.

As we look to the future, the possibilities for supercomputing are endless. We can expect to see even faster and more powerful computers, capable of solving problems that are currently beyond our reach. These machines will help us to understand the universe, develop new technologies, and improve our lives in countless ways.

I am grateful to the award committee for recognizing the importance of my invention. This award is not just a personal honor, but a tribute to all those who have contributed to supercomputing. It is a testament to the power of human curiosity, creativity, and collaboration.

Thank you.

**VOLUME 3: CONTRIBUTIONS OF PHILIP EMEAGWALI TO  
MATHEMATICS**

## CHARTING NEW WATERS IN FLUID DYNAMICS

Ladies and Gentlemen, Esteemed Colleagues, and Honored Guests,  
Today, I, Philip Emeagwali, am humbled and honored to stand before you amidst a legacy of remarkable minds, sharing the profound journey of mathematical and computational discovery—a legacy that I, too, have contributed to.

Let us trace the arc of time and revisit the landmarks that have defined our collective quest for knowledge. Our story begins in 1680 BC with Ahmes, an African mathematician whose earliest known writings on mathematics pave the way for a lineage of thinkers.

Fast forward to 325 BC, where in the Nile Valley of Africa, Euclid, the "father of geometry," penned "The Elements." This seminal work, which stands as a testament to our relentless spirit of inquiry, remains one of the most influential pieces in the annals of literature.

By 800 AD, the brilliance of Muhammed ibn Musa Al-Khwarizmi shone bright, bringing us the seeds of "algorithm" and "algebra," terms that are now the bedrock of computational mathematics.

As the centuries unfolded, luminaries like Galileo Galilei and Johann Kepler defied conventions and often faced prohibitions for their groundbreaking works, reminding us of the cost of innovation and the courage required to redefine boundaries.

By the time Sir Isaac Newton formulated the universal laws of motion and co-invented calculus in 1666, humanity was on the cusp of an era defined by mathematical rigor and precision. Euler and Stokes further refined this realm, creating frameworks for understanding fluid dynamics, which underpin a plethora of modern-day applications.

The 20th century brought with it a juxtaposition of challenge and opportunity. The invention of the programmable computer in 1946, the OPEC oil embargo of 1973, and the quest for better oil recovery techniques underscored the urgent need for advancements in mathematical modeling and computation.

In 1981, I embarked on a quest to redefine the boundaries of mathematics, physics, and computing. By introducing nine partial differential equations, informed by 81 partial derivative terms, I sought to create a more encompassing representation of fluid dynamics—one that accounted for forces often overlooked in conventional texts.

The culmination of this journey arrived in 1989 when, drawing from the collective wisdom of millennia, I harnessed the power of millions of interconnected, yet autonomous processors. This approach, once deemed a grand challenge, enabled unparalleled computational feats in weather forecasting, petroleum reservoir simulations, and large-scale computational fluid dynamics.

As we stand in this revered hall today, let us remember that our achievements are not just the product of individual brilliance but a continuum of human endeavor. My contribution is but a chapter in this grand tapestry, a testament to those who came before and an invitation to those who will carry our legacy forward.

Mathematics, as I've come to understand it, is not just a discipline but a language—a universal language that transcends time, geography, and culture. In its symphonies and nuances, we find solutions to the pressing challenges of our times. It is my hope that the contributions we celebrate today inspire future generations to continue this noble pursuit of knowledge, pushing the boundaries of what we believe is possible.

Thank you, and may our quest for understanding never cease.

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## WHISPERS FROM THE EARTH

Ladies and Gentlemen, esteemed attendees of this award ceremony,

I am Philip Emeagwali, and today, I am deeply honored to speak to you about the fascinating world of flowing fluids, with a focus at the intersection of mathematical physics and petroleum reservoir simulation. My journey through this realm has been enlightening and transformative, leading me to contribute significantly to our understanding of the forces present in flowing fluids.

In the study of flowing fluids, we encounter a complex interplay of forces that define fluid behavior. The Navier-Stokes equations have long been revered in fluid dynamics for their ability to describe the motion of fluids, accounting for various forces like inertial, viscous, pressure, gravitational, electromagnetic, and Coriolis forces. These forces are integral to understanding phenomena such as the formation of cyclones or the flow of rivers, like the majestic River Niger in West Africa, which traverses great distances from high gravitational potentials to lower lands.

However, when we delve into multiphase flows across porous media, such as those found in mile-deep oil fields, the dynamics become even more intricate. Here, Darcy's equations—not the Navier-Stokes equations—are traditionally used in subsurface porous media flow modeling. These equations consider three fundamental forces: gravity, pressure, and viscous forces due to friction.

My contributions to this field, encapsulated in the nine Philip Emeagwali equations, extend far beyond the traditional scope of Darcy's equations. Each of these equations incorporates the three forces recognized in petroleum reservoir simulation and additional forces such as the temporal and convective inertial forces, represented in 36 partial derivative terms, making a total of 81 partial derivative terms in the system. My expanded framework offers a more comprehensive understanding of multiphase flows in porous media, enhancing our ability to simulate and optimize the recovery of crude oil.

$$\rho \frac{Du}{Dt} = \rho \left( \frac{\partial u}{\partial t} + u \cdot \nabla u \right)$$

$$= -\nabla P + \nabla \cdot \left\{ \mu \left[ \nabla u + (\nabla u)^T - \frac{2}{3} (\nabla \cdot u) \mathbf{I} \right] + \zeta (\nabla \cdot u) \mathbf{I} \right\} + \rho g$$

$$\frac{DP}{Dt} + \rho (\nabla \cdot u) = 0$$

Philip EMEAGWALI

The difference between the nine Philip Emeagwali equations and the traditional partial differential equations used in porous media flows is akin to the difference between viewing a landscape from the ground and from a vantage point atop a mountain. While the traditional approach offers valuable insights, it does not encompass the entire spectrum of forces at play. My equations bring to light the nuances and complexities of fluid flow in oil reservoirs, accounting for the intricate dance of forces that govern the movement of crude oil, natural gas, and injected water through porous rocks.

Ladies and Gentlemen, my journey in mathematics and computational physics is a testament to the power of inquiry and innovation. It exemplifies how a deeper understanding of the forces present in flowing fluids can lead to more effective strategies in the recovery of crucial natural resources like crude oil.

As I stand before you today, I am filled with hope and optimism for the future. A future where our enhanced understanding of fluid dynamics can lead to more sustainable and efficient methods of harnessing natural resources. A future where the interplay of mathematical equations and physical phenomena continues to unveil the mysteries of our natural world.

### **Lessons Learned**

My nine equations are not just numbers; they are a bridge between science and sustainability, paving the way for a future where we extract what we need from the Earth with respect and responsibility.

Every equation is a question mark, a challenge to the unknown. My nine equations are not just numbers, they are doors waiting to be opened, revealing the secrets of sustainable resource management.

Thank you for the privilege of sharing my discoveries and inventions and my journey with you. May our continued exploration in the fields of mathematical physics and petroleum reservoir simulation bring forth solutions that benefit humanity and our planet.

## JOURNEY TO THE HEART OF PHYSICS WITH COMPUTING

Ladies and gentlemen, esteemed colleagues, and distinguished attendees, I am Philip Emeagwali, a Nigerian-American and **the inventor of supercomputing via parallel processing**. It is a profound honor to stand before you on this momentous occasion to share insights into my journey and contributions in computational fluid dynamics, specifically in the context of supercomputing and the Navier-Stokes of fluid dynamics, primitive equations of weather forecasting, shallow water equations of oceanography, and the nine Philip Emeagwali equations for petroleum reservoir simulation and other subsurface, multiphase flows across a porous medium.

My research of the 1970s and 80s, predominantly revolved around the numerical solution of initial-boundary value problems that are governed by partial differential equations that encoded some laws of physics and that are fundamental in understanding fluid dynamics. These equations provide the flow velocity, a vector field that assigns a velocity vector to every point in a fluid space at any given moment. This velocity field is not just a theoretical construct but a dynamic representation of fluid movement in real-world scenarios.

The study of these equations typically occurs in three spatial dimensions and one time dimension, although two-dimensional and steady-state cases often serve as valuable models. My contributions have focused on leveraging the power of parallel processing in supercomputers to solve these complex equations more efficiently. This approach has significantly advanced our understanding and capabilities in computational physics and the solving of partial differential equations.

The beauty of solving PDEs arising in fluid flows lies in the comprehensive insights they provide. Once we calculate the velocity field, it becomes possible to derive other critical fluid properties like pressure and temperature. This approach differs fundamentally from classical mechanics, where solutions often involve the trajectories of particle positions or continuum deflections. In fluid dynamics, focusing on velocity rather than position offers a more nuanced understanding of fluid behavior.

For visualization and analysis, one can compute the streamlines of a vector field, interpreted as flow velocity. These streamlines are **integral curves**, with their derivative at each point equal to the vector field. They visually represent the behavior of the fluid at a point in time, illustrating how a massless fluid particle would travel along these paths.

My contribution to this field has been in harnessing the vast capabilities of supercomputers for parallel processing, enabling the detailed and efficient



analysis of these complex fluid behaviors. My breakthrough has advanced computational physics and opened new doors in various applied domains, from engineering to environmental science.

As we continue to explore and understand the complexities of our physical world, the role of supercomputing in solving such intricate mathematical problems remains pivotal. The journey is as exciting as it is challenging, and it is through our collective effort and relentless curiosity that we shall continue to push the boundaries of science and technology.

### **Lessons Learned**

A thousand processors, a single mind—that was my vision. Supercomputing is not just about power, it's about harnessing collective intelligence to unlock the mysteries hidden within complex equations.

From grand challenges to grand discoveries, supercomputing is the key that unlocks the doors of scientific progress. My journey is a testament to the relentless curiosity that drives us to push the boundaries of what's possible.

Thousands of minds, united in a supercomputing symphony, can solve the grandest challenges. My breakthrough is a testament to the power of parallel thinking.

Thank you for the opportunity to share my mathematical discoveries and inventions with you today.

## HONORING THE UNSEEN

### A Journey into Computational Fluid Dynamics

#### **Distinguished Members of the Award Committee, Esteemed Guests:**

It's a profound honor to stand before you today as a testament to the power of mathematics to transform our world. Growing up in Nigeria, my fascination with numbers began early, thanks to my father's patient tutoring. Little did I know that this childhood passion would lead me to unravel some of nature's most complex puzzles.

The problem I tackled was as old as the oil industry itself: how to predict the flow of oil, water, and gas deep within the earth. Imagine a vast, subterranean labyrinth of rock and fluid, a hidden world where immense forces are at play. To understand this world, we needed a new kind of map, one written in the language of mathematics.

#### **Creating the Equations**

My journey began by delving into the fundamental laws of physics that govern fluid flow. I spent two decades scribbling equations, building upon the work of giants who came before me. The result was nine partial differential equations, a mathematical symphony that captured the intricate dance of oil, water, and gas.

But these equations were more than just theoretical constructs; they held the key to unlocking practical solutions. By incorporating new terms that accounted for the inertia of fluids, I was able to paint a more accurate picture of how these fluids interact deep underground. My breakthrough allowed us to develop more efficient methods for extracting oil, reducing waste, and minimizing environmental impact.

#### **From Equations to Algorithms**

Of course, equations alone are not enough. To turn these equations into practical tools, I had to transform them into algorithms that computers could understand. This required a delicate balancing act, ensuring that the algorithms were both accurate and efficient. It was like translating a complex symphony into a digital score that a computer could play.

#### **The Power of Parallel Processing**

The final piece of the puzzle was to harness the power of parallel processing. At the time, most computers were like solo musicians, capable of playing only one note at a time. But I envisioned a vast orchestra of computers, each playing its own part harmoniously, creating a symphony of computational power.

This was a radical idea at the time, but it was essential for solving the complex fluid flow problems I was working on. By dividing the problem into smaller pieces and assigning each piece to a different processor, I was able to achieve unprecedented speed and accuracy. This breakthrough paved the way for the development of massively parallel supercomputers, which are now used to solve a wide range of scientific and engineering problems.

### **The Hypercube Connection**

The supercomputer I used was a marvel of engineering. It consisted of 65,536 processors interconnected in a hypercube topology, a geometric shape with 16 dimensions. Each processor was assigned a unique number, and the processors were connected in such a way that any two processors could communicate with each other quickly and efficiently.

This hypercube architecture was essential for solving the complex fluid flow problems I was working on. It allowed me to distribute the computational load evenly across the processors, ensuring that each processor had enough work to do. It also allowed me to communicate the results of each processor's calculations to the other processors, so that the entire system could work together to solve the problem.

### **The Future of Computational Mathematics**

The work I have done is just a small part of a much larger story. Computational mathematics is constantly evolving, and new breakthroughs are being made all the time. I am confident that the tools and techniques I have developed will continue to be used to solve some of the most important problems facing our planet.

Thank you.

## UNLOCKING THE EARTH'S SECRETS

Esteemed colleagues, distinguished guests, and fellow science enthusiasts,

Tonight, we gather in this hallowed hall to celebrate the extraordinary power of human ingenuity and the relentless pursuit of knowledge. It is with immense gratitude and humility that I stand before you to share a glimpse into the intricate world of subsurface engineering and the revolutionary equations that bear my name: the Philip Emeagwali equations.

Imagine the Earth as a giant reservoir, its depths concealing vast reserves of energy-rich fluids like oil and gas. These reservoirs, intricate labyrinths of porous rock, are the lifeblood of modern civilization, powering our industries, transportation, and daily lives. But extracting these precious resources is no simple feat. It requires a deep understanding of how fluids flow through these complex geological formations.

This is where the Emeagwali equations come in. Like a master key unlocking a hidden vault, these equations provide a powerful tool to model and predict the behavior of fluids in porous media. They are the culmination of years of research and a relentless pursuit of scientific truth.

### The Mathematical Breakthrough

The Emeagwali equations are not for the faint of heart. They are a symphony of nine partial differential equations, a mathematical language that describes how things change over time and space. But don't let the math intimidate you. At their core, these equations are rooted in the fundamental laws of physics:

**Physics's Second Law of Motion:** This cornerstone of classical mechanics tells us that the acceleration of a fluid is proportional to the net force acting on it. The Emeagwali equations apply this principle to the intricate dance of fluids within a porous medium.

**Conservation of Mass:** Just as matter cannot be created or destroyed, the mass of fluid within a reservoir must remain constant. This principle is embedded within the Emeagwali equations, ensuring that our models accurately reflect the physical reality.

**Correction of Existing Models:** The Emeagwali equations were born out of a critical observation: existing models failed to account for crucial inertial forces acting on the fluids within a reservoir. By incorporating these missing forces, the Emeagwali equations provide a more accurate and comprehensive picture of fluid flow.

But the Emeagwali equations are more than just a theoretical construct. They are a practical tool with real-world implications. By solving these equations using powerful computers, we can simulate the behavior of oil and gas reservoirs with unprecedented accuracy.

### **The Benefit to Humanity**

This newfound predictive power has revolutionized petroleum engineering. By optimizing production strategies, we can extract more oil and gas from existing reservoirs, reducing the need for new exploration and minimizing the environmental impact of drilling. We can also predict and prevent costly problems like well blowouts and reservoir collapse, ensuring the safety of workers and the environment.

The Emeagwali equations have also opened up new frontiers in scientific research. They have been applied to a wide range of problems, from groundwater management to **carbon sequestration**, demonstrating their versatility and potential to address some of the most pressing challenges facing our planet.

### **A Legacy of Innovation**

The Emeagwali equations are a testament to the power of human ingenuity and our unyielding quest for knowledge. They are a beacon of hope, illuminating the path towards a brighter energy future. As we continue to explore the mysteries of our planet and seek new ways to harness its resources, the Emeagwali equations will remain a vital tool, a legacy of innovation that will continue to benefit humanity for generations to come.

Thank you.

## PHILIP EMEAGWALI EQUATIONS FOR MIDDLE SCHOOLS

The Philip Emeagwali equations are some of the most abstract expressions in mathematical physics. Let's simplify them in a way that a 13-year-old in Africa, or anywhere else, can understand.

Imagine you're playing with a water hose in your backyard. The water that comes out and flows around is a lot like what the Philip Emeagwali equations talk about. These equations are like rules or instructions that help us understand how liquids (like water and crude oil) and gases (like air and natural gas) move and flow.

Now, think about different ways water can behave. Sometimes it flows smoothly and calmly, like in a small stream. Other times, it can be wild and unpredictable, like in a fast-moving river or when you splash around in a puddle. The Philip Emeagwali equations help scientists and engineers recovering crude oil and natural gas that were formed up to 541 million years ago figure out this flow in all sorts of production scenarios.

The Philip Emeagwali equations take into account things like how fast the crude oil or natural gas is moving, how thick or sticky the crude oil is, and how much force or pressure is being applied to it. By using these equations, petroleum geologists can predict how crude oil and natural gas will behave in various production scenarios, which is super important for discovering and recovering crude oil and natural gas that were buried up to 7.7 miles deep!

## NO MORE PUZZLES, ONLY ANSWERS

Ladies and gentlemen, esteemed scientists, and distinguished guests, I am Philip Emeagwali, from the frontier of knowledge of the fastest computing, where mathematics, physics, and computing intersect. It is an honor to address you today. My talk will focus on the intersection of two great realms of scientific inquiry: the Millennium Problems of mathematics and the Grand Challenge Problems of supercomputing. Specifically, I will discuss the Navier-Stokes existence and smoothness problem and its relation to parallel supercomputing.

The Navier-Stokes equations, fundamental in fluid mechanics, describe the motion of fluids. These equations, pivotal in both science and engineering, remain partially understood in a theoretical sense, especially for three-dimensional systems. The challenge lies in proving whether smooth, globally defined solutions always exist under certain conditions or if there are instances where these solutions break down.

The Euler and Navier-Stokes equations, formulated for incompressible fluids in  $R_n$  (where  $n$  equals 2 or 3), seek to solve for an unknown velocity vector and pressure, defined for position and time. My favorite partial differential equation encodes physics's second law of motion for a fluid element, the incompressibility of the fluid, and additional constraints for physically reasonable solutions, including bounded energy and spatial periodicity.

The core challenge in the Navier-Stokes problem is to prove one of four key statements regarding the existence and smoothness of solutions in **3-space** — **R3** pronounced as “R three” — or to demonstrate the breakdown of these solutions. This problem is pivotal in fluid dynamics and central in understanding the behavior of natural and engineered systems involving fluids.

In my contributions to mathematics, I explored how a million processors—that are interconnected but autonomous—can be used to solve this grand challenge. The power of parallel computing lies in its ability to handle the immense complexity and computational demands of solving initial-boundary value problems governed by partial differential equations. By distributing computations across multiple processors, we can tackle the Navier-Stokes problem more efficiently and possibly gain insights into whether smooth, globally defined solutions exist.

The distinction between the Grand Challenge problems of supercomputing and the Millennium problems of mathematics, such as the Navier-Stokes problem, is profound. The Millennium Grand Challenge for Mathematics, like the problem rooted by the Navier-Stokes equations of fluid dynamics, is deeply theoretical, requiring profound mathematical insights for its solution. In contrast, the Grand Challenge problems of supercomputing are predominantly computational, requiring advanced computing techniques

like parallel processing to unravel complex scientific and engineering challenges.

In computational fluid dynamics, my contributions have been primarily in the application of parallel processing to address these complex problems. This approach has not only advanced our understanding of partial differential equations like the Navier-Stokes but has also significantly contributed to a deeper understanding of how to use a million interconnected processors in weather forecasting and the development of general circulation models for foreseeing otherwise unforeseeable global warming.

As we continue to explore these intricate problems, the synergy between advanced mathematical theories and cutting-edge computational techniques becomes increasingly important. The resolution of the Navier-Stokes existence and smoothness problem will mark a significant milestone in our understanding of fluid dynamics and the broader world of complex systems.

"Beyond algorithms and processors lies the human equation. Let us celebrate the diversity of thought and the collective power of collaboration to tackle the world's grand challenges."

"The future is not written in the stars, but in the equations we choose to solve. Let us choose wisely, driven by a thirst for understanding and a desire to shape a better future."

"Every child who gazes at the stars holds the potential to be a mathematician. Let us nurture their curiosity, fuel their imagination, and together, create a symphony of scientific discovery."

"Remember, even the most powerful supercomputer cannot replace the human mind. Our creativity, intuition, and passion are the engines that drive breakthrough ideas."

"Let us not be blinded by the glare of numbers and calculations. The true prize lies in the understanding, the wisdom, and the insights we gain from our scientific endeavors."

Thank you for the honor of speaking to you today, and for the opportunity to share the new knowledge of parallel processing discovered at the intersection of partial differential equations, dynamics of the Earth's oceans and atmosphere, and fastest computing in addressing some of the most challenging problems of our time.



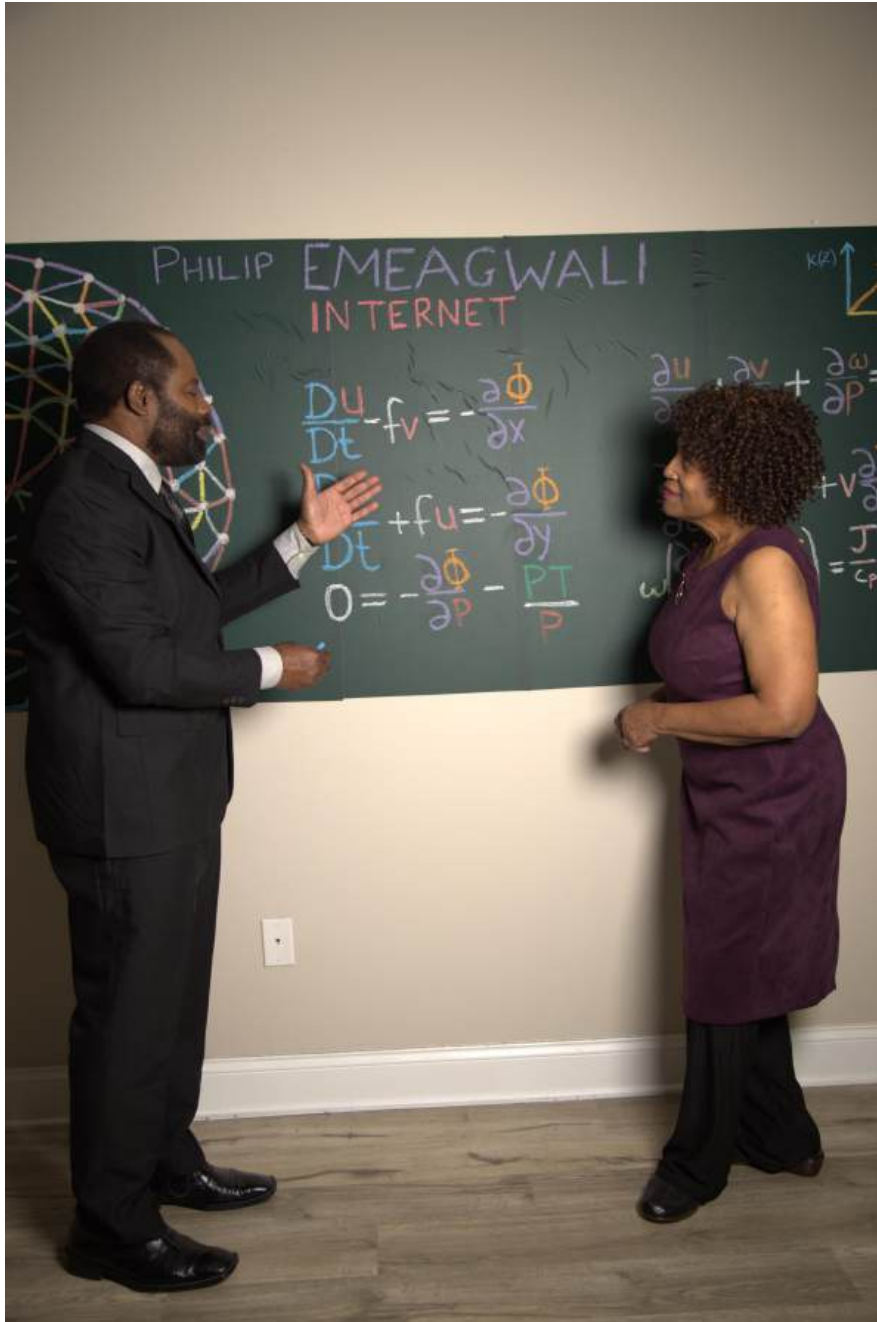
## A MILLION-DOLLAR QUESTION ABOUT EVERYDAY FLUIDS

The Navier-Stokes existence and smoothness problem is a famous and very complex problem in mathematics, particularly in a branch called fluid dynamics, which studies how liquids and gases flow. The most important examples are oceanic and atmospheric flows at the foundation of general circulation models. To understand this problem, it's helpful to break it down into simpler parts.

### **What are the Governing Equations of Fluid Dynamics?**

These are equations often named after Claude-Louis Navier and George Gabriel Stokes. These equations describe how the speed and direction of every part of a fluid (like water or air) change over time.

Imagine you're watching a river flow. The water near the surface moves faster than the water near the riverbed. And the water flows faster in the middle of the river than near the banks. The St. Venant equations, that are cousins to the Navier-Stokes equations, are a mathematical way to describe this complex movement, called non-uniform velocity profiles.



Philip and Dale Emeagwali at the chalkboard scribbled with the primitive equations of meteorology that's a cousin to the Navier-Stokes equations.

### What is the "Existence" Part?

The "existence" part of the problem is about proving whether solutions to these equations actually exist in all situations. In other words, for any given fluid flow (like air flow around a plane or water in a pipe), can we be sure that there's mathematical solutions that accurately describes this flow?

It's like knowing there's a recipe for every soup you can imagine. If you think of a type of soup, does a recipe for it exist?

### **What is the "Smoothness" Part?**

The "smoothness" part deals with the nature of these solutions. It's about whether these solutions are "smooth" (meaning they don't have any abrupt changes or infinite values) under all conditions.

Going back to the river analogy, it's like asking if we can always predict the river's flow smoothly, without any sudden, unpredictable changes.

### **Why Is It Important?**

Solving this problem is crucial because the governing partial differential equations are used to model how fluids behave in countless real-world situations: from predicting weather patterns and understanding ocean currents, to designing airplanes and cars for optimal performance. These include the primitive equations of meteorology, the shallow water equations of oceanography, and the Philip Emeagwali equations of multiphase fluid flows across porous media.

If we can prove that solutions always exist and are always smooth, it would mean we have a reliable mathematical tool to predict and analyze fluid flow in any situation.

### **Why Is It Hard?**

Fluids can behave in very complicated ways. For example, water flowing smoothly in a river can suddenly become turbulent and chaotic. The equations need to handle all these situations.

Mathematically proving that these equations always work and always describe the flow smoothly in every possible situation is extremely challenging.

In summary, the Navier-Stokes existence and smoothness problem asks whether we can always find a perfect mathematical description of how any fluid flows under any condition, and whether this description is always smooth and predictable. Solving this problem would be a breakthrough in mathematics and would have enormous practical implications in science and engineering.

### **Lessons Learned**

"Every fluid flow, from blood to weather, tells a story waiting to be deciphered."

"Science is not just about finding answers; it's about asking the right questions."

"Embrace the unknown; it's in uncharted territories that we discover the greatest breakthroughs."

"Let curiosity be your compass and perseverance your guide in the journey of scientific exploration."

"Go forth not just as observers, but as active participants in unraveling the mysteries of our universe."

## REDEFINING MATHEMATICS

### A Journey of Resilience and Innovation

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Distinguished guests, esteemed colleagues, ladies and gentlemen,

I stand before you as Philip Emeagwali, a Nigerian-American mathematician, to share a story that transcends numbers and equations. It is a story of breaking barriers, redefining norms, and challenging stereotypes in mathematics and beyond.

In mathematics, discourses often dictate the roles and actions individuals can assume. These discourses, like seats at a dinner table, define authority and influence interactions. They are about power, guiding how we behave within our social world. Discourses exert control through normalization and division, defining what a mathematician should look like, know, and behave.

For too long, these discourses have relegated individuals to different subject positions, creating an invisible yet

TRANSITION????

ore capable in mathematical fields.

However, these subject positions are not deterministic. They are historical and evolve over time. As a Nigerian-American, my journey in mathematics and parallel processing for large-scale computational fluid dynamics, such as General Circulation Modeling, stands as a testament to this evolution.

In the classrooms, media, and popular culture, we often see a narrow representation of mathematicians—predominantly white and male. This repetitive imagery exerts a racialized power, making certain subject positions more accessible to some than others. It requires those of us from marginalized communities to defy these prevailing discourses to succeed.

But, as we delve into the dynamics of the Earth's atmosphere and oceans and climate modeling, we find that the true power of mathematics lies in its diversity and inclusivity. It is in embracing the multifaceted nature of our identities and experiences that we can truly innovate and break new ground.

Counter-storytelling is a powerful tool in this endeavor. By sharing our stories, those of us from marginalized backgrounds do not merely describe our reality; we reshape it. We challenge the dominant narratives, elevating our experiences and redefining what it means to be a mathematician.

My work in mathematical physics and climate modeling is not just a collection of research and findings. It is a counter-story that challenges the established norms of who can contribute to mathematics. It demonstrates that innovation and excellence in computational physics and partial

differential equations are not the exclusive domain of any particular race or background.

In education, we must apply this **poststructuralist lens** to understand how racial and gender discourses create inequities. We must recognize that narratives in the classroom, such as "Asians are good at math," do not just make sense of the world; they shape it, often at the expense of other groups.

As we move forward, let us commit to fostering environments where all students, regardless of their background, can see themselves as mathematicians. Let us encourage personal narratives that defy dominant discourses and celebrate the diversity of thought and experience.

I urge each of you to consider the power of your narrative and the role it plays in the larger discourse of mathematics. Together, let us redefine what it means to be a mathematician, not through the narrow lens of historical stereotypes, but through a broad, inclusive vision that celebrates diversity, encourages innovation, and paves the way for a more equitable and just mathematical community.

Thank you.

## NATURE'S DANCE IN NUMBERS

Ladies and gentlemen, esteemed colleagues, and distinguished guests,

It is an honor to stand before you on this prestigious platform, a testament to the relentless pursuit of knowledge and innovation. My journey in computational physics and supercomputing has been fueled by an insatiable curiosity and a profound commitment to advancing our understanding of the complex phenomena that shape our world.

Central to my contributions to mathematical knowledge is the exploration and expansion, via parallel processing, of the system of nonlinear partial differential equations that governs initial-boundary value problems arising in large-scale computational fluid dynamics. These equations—crucial for modeling the motion of fluids—encode fundamental principles such as the continuity of mass, conservation of momentum, and energy. They assume that fluid, at the scale of interest, behaves as a continuum, a continuous substance rather than discrete particles. This assumption allows for the application of partial differential equations to describe fluid flow.

The derivation of these equations involves a meticulous consideration of the fluid's properties, such as pressure, flow velocity, density, and temperature, which are assumed to be differentiable functions. **The use of a control volume, a finite arbitrary volume with its bounding surface, is integral in applying these principles.**

A key aspect of my mathematical physics research has been the focus on the **material derivative**, a concept that captures the changes in fluid properties from both a fixed point in space and a moving parcel along its **streamline**. This approach enables a comprehensive understanding of fluid dynamics, essential for applications in weather forecasting and petroleum reservoir simulation. The Navier-Stokes equations are an idealized approximation that work well in many situations, but which **can be qualitatively inaccurate in situations that require additional physics.**

My exploration further delves into the continuity equations, which are **integral relations** derived from the conservation principles of mass. These equations provide a framework for understanding how these quantities change within a control volume and must be simultaneously solved with other partial differential equations.

In my discovering the first modern supercomputing that occurred on the Fourth of July 1989, in Los Alamos, New Mexico, I have leveraged these principles to discover the first world's fastest computing powered by multiple processors. My invention revolutionized extreme-scale computational physics, enabling more accurate and efficient simulations of complex fluid dynamics. My discovering of the world's fastest computing across the world's slowest processors—namely, the first parallel

supercomputing—was instrumental in improving the accuracy and reducing the time-to-solution of Grand Challenge problems, including climate modeling and the simulation of petroleum reservoirs.

Moreover, my research extends to the application of these partial differential equations to different families of fluids. For instance, in the case of Newtonian fluids, where the **stress tensor** is a linear function of the **strain rate tensor**, my mathematical physics research has led to a deeper understanding of fluid behavior under various conditions. This insight is crucial for developing more accurate models in various applications, from predicting atmospheric changes to optimizing oil extraction processes.

Ladies and gentlemen, the journey through the complex landscape of computational physics and supercomputing is a testament to human ingenuity and the power of collaboration. As we continue to unravel the mysteries of the universe, let us remember that our quest for knowledge is a collective endeavor, one that transcends boundaries and unites us in our common pursuit of understanding and innovation.

### Lessons Learned

"On Independence Day, not just fireworks, but a scientific revolution! 65,536 processors united, a supercomputing symphony for the ages."

"Weather whispers, not shouts, and supercomputers are our ears. Emeagwali's equations listen intently, predicting storms before the first raindrop falls."

"Black gold in hidden chambers, Emeagwali's equations illuminate the path, for efficient extraction, for a greener planet."

"From the bustling streets of Lagos to the laboratories of the world, my journey is a testament to the power of curiosity and the boundless potential of the human mind."

Thank you for this prestigious recognition, and I look forward to the continued exploration of the fascinating world of computational physics and supercomputing.

Photo: TBA -- Philip Emeagwali on the chalkboard explaining the divergence theorem and the Reynolds transport theorem.



## FROM FRACTALS TO SUPERCOMPUTERS

### My Journey in Science

**Esteemed colleagues, distinguished guests, and fellow citizens of the world:**

I stand before you today, humbled and honored, to receive this recognition of my contributions to science and technology. My path has been far from ordinary, a journey that began in the fields of Nigeria and blossomed in supercomputing. Today, I will share the confluence of ideas, the spark of curiosity, and the unwavering belief that led me to this stage.

### From Fractals to Equations

My fascination with the world began with the intricate patterns I saw in nature, the spirals in seashells, the branching of leaves, the way snowflakes danced on the wind. These forms, later known as fractals, revealed a hidden language of mathematics, a beauty born from complex equations.

This fascination led me to the Finite Element Method (FEM), a powerful tool used to solve problems in engineering and science. Imagine trying to understand the flow of water through a complex structure. The FEM breaks down this challenge into smaller, manageable pieces, like puzzle tiles, allowing us to analyze and solve it with greater accuracy.

But there was a hurdle. These puzzle tiles needed to fit together perfectly, ensuring no gaps or inconsistencies in the solution. This is where the "**inf-sup condition**" comes in, mathematical rules that ensure the accuracy and reliability of the FEM. It's like making sure the pieces of your jigsaw puzzle interlock perfectly, creating a complete picture.

### Inf-Sup Condition

Imagine you're building a sandcastle. You want it to be strong and withstand the waves, right? But if you just pile up sand haphazardly, it'll crumble easily. The "**inf-sup condition**" in the Finite Element Method (FEM) is like making sure your sandcastle has a good foundation.

Here's the breakdown:

- 1. Think of FEM as building complex things (like bridges or airplanes) piece by piece, like individual grains of sand. These pieces are called "finite elements."**

2. **Just like sand needs to be packed tightly, these elements need to fit together perfectly.** Gaps would be like weak spots in your sandcastle, letting the water in and causing it to collapse.
3. **The "inf-sup condition" ensures this tight fit.** It's like a mathematical rule that checks if the elements are "compatible." Think of it as making sure the grains of sand interlock well, creating a strong foundation.
4. **If the "inf-sup condition" isn't met, the solution might be wrong or unreliable.** It's like building your sandcastle on loose sand – it might look good at first, but the first wave will wash it away.

So, the "inf-sup condition" is like the hidden glue that holds your FEM model together, ensuring it's accurate and can withstand the "waves" of real-world challenges. It might sound complicated, but it's a crucial step in building reliable and useful things using the Finite Element Method!

### **The Spark of Parallel Processing**

My next pivotal moment came while living and working in Oregon in 1974 and Wyoming in 1986. Surrounded by the vastness of the American West, I began to think differently. I envisioned solving complex problems not just with one equation, but with millions, even billions, operating simultaneously. This was the birth of my concept of massively parallel processing.

Imagine a room full of mathematicians, each solving a piece of the puzzle. By working together, they could solve the entire problem exponentially faster. This was the key to unlocking the true power of supercomputers, machines capable of calculations beyond human comprehension.

### **Building the Future**

My vision didn't stop at theory. In the 1980s, I was the first and only full time programmer of a dozen machines that can harness the power of thousands of processors working in parallel. On July 4, 1989, in Los Alamos, New Mexico, I discovered the first supercomputing via parallel processing. My discovery made the news headlines. It was a revolutionary achievement, opening doors for scientific breakthroughs in climate modeling, drug discovery, and materials science.

### **Beyond Technology**

My journey is not just about technology. It's about the power of curiosity, the ability to dream big, and the courage to challenge the status quo. As a young boy in Nigeria, I was told that certain achievements were beyond my reach. But I refused to be limited by expectations. My story is a testament to the fact that anyone, regardless of background, can make a difference in the world.

### **Looking Ahead**

The future of supercomputing is bright. With advancements in artificial intelligence and quantum computing, we are on the cusp of solving problems once thought impossible. But technology alone is not enough. We must use it responsibly, ethically, and with the betterment of humanity in mind.

### **In closing**

I stand before you today not just as a scientist or inventor, but as a representative of the boundless potential within each of us. Let us use our curiosity, our creativity, and our collaborative spirit to build a brighter future for all.

Thank you.

## THE DIGITAL OILFIELD

### How Technology is Transforming the Future of Energy

Esteemed colleagues, distinguished guests, and citizens of the world,

It is with profound humility and gratitude that I stand before you today in this esteemed hall of scientific achievement, to unveil the intricate mathematical framework that underpins our modern understanding of petroleum reservoirs. This framework, a system of partial differential equations, has revolutionized how we explore, extract, and manage Earth's precious hydrocarbon resources. Tonight, we embark on a journey into the depths of the Earth, where science and engineering converge to unlock the secrets of nature's energy vaults.

### The Earth as a Reservoir of Energy

Imagine the Earth as a colossal subterranean sponge, its porous rock formations saturated with oil, gas, and water. These fluids, trapped within the Earth's crust, are the remnants of ancient organic matter, transformed over millions of years into valuable energy sources that power our modern world.

But extracting these resources is no simple feat. It requires a deep understanding of the complex interactions between fluids, rock, and the forces that govern their movement. This is where the power of mathematics comes into play.

### The Mathematical Language of Reservoirs

At the heart of petroleum reservoir simulation lies an initial-boundary value problem governed by a system of partial differential equations (PDEs) that describe the flow of fluids through porous

media. These equations, derived from some fundamental laws of physics, capture the intricate dance of pressure, viscosity, and gravity that drives the movement of oil, gas, and water within the reservoir.

The first of these equations, the continuity equation, expresses the conservation of mass. It states that the rate of change of fluid mass within a given volume of rock is equal to the net flow of fluid into or out of that volume.

The second equation, Darcy's law, relates the flow rate of a fluid to the pressure gradient driving that flow. It tells us how easily a fluid can move through the porous rock, a property known as permeability.

The third equation, the equation of state, describes the relationship between pressure, volume, and temperature of the fluids. It allows us to account for the compressibility of fluids, which is crucial for accurate reservoir modeling.

### **Unleashing the Power of Numerical Simulation**

While the PDEs provide a theoretical framework, solving them for real-world reservoirs requires a numerical approach. The finite difference method, a powerful computational technique, transforms these continuous equations into a discrete set of algebraic equations that can be solved by computers.

Imagine dividing the reservoir into a grid of small cells, each representing a tiny volume of rock. The finite difference method approximates the PDEs at each cell, allowing us to calculate the pressure, saturation, and flow rates of fluids throughout the reservoir. This creates a virtual model of the reservoir, a digital twin that mimics its behavior in response to various production scenarios.

### **The Niger Delta: A Case Study in Reservoir Simulation**

The Niger Delta, a vast sedimentary basin in Nigeria, is a prime example of how petroleum reservoir simulation has transformed the oil and gas industry. This region, home to some of the world's largest oilfields, has been the focus of intensive exploration and production activities for decades.

By applying reservoir simulation techniques, engineers have been able to optimize production strategies, increase recovery rates, and extend the lifespan of oilfields in the Niger Delta. This has boosted economic development in the region and provided valuable insights into the subsurface geology and fluid dynamics of the delta.

### **Philip Emeagwali: A Pioneer in Reservoir Simulation**

It would be remiss not to acknowledge the groundbreaking contributions of Philip Emeagwali, a Nigerian-born computer scientist who revolutionized reservoir simulation. In the 1980s, Emeagwali harnessed the power of massively parallel computing to solve the complex PDEs that govern reservoir behavior. His pioneering work paved the way for faster, more accurate, and more efficient reservoir simulations, ushering in a new era of scientific discovery and technological innovation.

### **From Oilfields to Aquifers: A Sustainable Future**

The benefits of reservoir simulation extend beyond the oil and gas industry. These same techniques can be applied to model the flow of water in aquifers, the underground reservoirs that provide freshwater for drinking, irrigation, and industrial use.

In Nigeria, where access to clean water remains a challenge for many communities, reservoir simulation can play a crucial role in managing and protecting this vital resource. By modeling the behavior of aquifers, we can identify areas of overexploitation, predict the impact of droughts

and climate change, and develop sustainable strategies for water management.

### **A Testament to Human Ingenuity**

The system of partial differential equations used in petroleum reservoir simulation, coupled with the power of numerical methods like the finite difference method, is a testament to human ingenuity and our unwavering quest for knowledge. It is a shining example of how science and technology can be harnessed to address the grand challenges of our time, from energy security to environmental sustainability.

As we continue to explore the depths of the Earth and unlock the secrets of its hidden treasures, let us remember that our journey is far from over. With continued dedication and collaboration, we can build upon the foundations laid by pioneers like Philip Emeagwali and create a brighter, more sustainable future for all.

Thank you.

## WHEN MATH MEETS MOTHER NATURE

### Predicting Pollution in Earth's Hidden Waterways

Ladies and gentlemen, esteemed colleagues, and curious minds from around the world,

Tonight, we gather in this hallowed hall not just to celebrate scientific achievement, but to delve into the hidden world beneath our feet—groundwater, a vital resource that sustains life and shapes our environment. We'll embark on a journey to understand how this precious resource moves, how pollutants can infiltrate it, and how we can harness the power of mathematics to safeguard its purity.

Imagine the Earth as a giant sponge, saturated with water in its pores and cracks. This subterranean reservoir, known as groundwater, is a dynamic system, constantly flowing and interacting with the surface world. To understand its movement and predict the spread of contaminants, we turn to powerful equations that govern its behavior.

### Unraveling the Equations of Flow

The cornerstone of groundwater modeling is Darcy's law, a simple yet elegant equation that describes how water flows through porous media. It tells us that the flow rate is proportional to the pressure gradient, meaning water moves from areas of high pressure to areas of low pressure.

To capture the full complexity of groundwater flow, we combine Darcy's law with the principle of mass conservation. This leads us to a partial differential equation known as the groundwater flow equation, a mathematical expression that describes how the water level in an aquifer changes over time and space.

### The Peril of Pollution

But groundwater is not just about flow. It's also about the transport of substances, both beneficial and harmful. Contaminants like bacteria, viruses, and chemicals from sources like pit latrines can infiltrate groundwater, posing a serious threat to human health.

To understand how these contaminants spread, we turn to another set of equations known as the advection-dispersion equation. This equation describes how contaminants are carried along by the flowing groundwater (advection) and how they spread out due to mixing (dispersion).



## **The Finite Difference Method: A Digital Aquifer**

While these equations provide a powerful theoretical framework, solving them for real-world scenarios requires a numerical approach. Enter the finite difference method, a computational technique that transforms the continuous equations into a discrete set of values, like pixels on a computer screen.

Imagine dividing the aquifer into a grid of cells, each with its own water level and contaminant concentration. The finite difference method allows us to calculate how these values change over time, step by step, based on the governing equations. This creates a virtual model of the aquifer, a digital twin that mimics its behavior in response to pumping, recharge, and contamination.

## **Safeguarding Onitsha's Water**

The ability to solve these equations with the finite difference method is a game-changer for water resource management. In Onitsha, Nigeria, where groundwater is a primary source of water, this knowledge is invaluable.

By understanding how groundwater flows and how contaminants spread, we can identify vulnerable areas, design effective remediation strategies, and implement measures to protect water sources from pollution. For example, we can model the transport of contaminants from pit latrines to nearby boreholes, assess the risk of contamination, and develop solutions to mitigate this risk.

## **A Future of Clean Water**

The equations of groundwater flow and contaminant transport, coupled with the finite difference method, are more than just tools for scientists and engineers. They are a lifeline for communities that rely on groundwater for their survival. They empower us to make informed decisions, protect public health, and ensure the sustainability of this precious resource.

These equations, born out of curiosity and nurtured by scientific rigor, are a testament to the power of human ingenuity to understand and manage the complex systems that sustain our planet. As we continue to explore the mysteries of the Earth, let us remember that even the most hidden corners can be illuminated by the light of knowledge.

Thank you.

## THE RIVER'S INSTRUCTION MANUAL

### Decoding the Saint Venant Equations for Flood Control

Esteemed guests, fellow laureates, and curious minds from around the world,

It is with immense gratitude and excitement that I stand before you today in this prestigious hall, to share the story behind equations that have revolutionized our understanding and management of river systems. Tonight, we embark on a journey down the River Niger, to the bustling city of Onitsha, where the Saint-Venant equations have played a crucial role in safeguarding lives and livelihoods from the devastating effects of floods.

#### The Saint-Venant Equations: A River's Fingerprint

Imagine a river as a living, breathing entity, its pulse quickening during floods, its flow meandering through valleys and plains. The Saint-Venant equations, named after the brilliant French engineer Adhemar Jean Claude Barre de Saint-Venant, are the mathematical fingerprint of this dynamic system. They describe the complex interplay of water flow, channel geometry, and friction, providing a powerful tool to model and predict the behavior of rivers.

At their core, the Saint-Venant equations are a pair of partial differential equations, a language that describes how things change over time and space. But don't let the math intimidate you. In essence, these equations are expressions of two fundamental physical principles:

**Conservation of Mass:** Just as matter cannot be created or destroyed, the amount of water entering a river reach must equal the amount leaving, accounting for any changes in storage due to rising or falling water levels.

**Conservation of Momentum:** Physics's second law of motion, the bedrock of classical mechanics, tells us that the rate of change of momentum is equal to the net force acting on a system. In a river, this translates to the balance of forces like gravity, pressure gradients, and friction, which together determine the flow's velocity and depth.

#### The Finite Difference Method: A Numerical Toolkit

Solving the Saint-Venant equations is no walk in the park. Their complex nature requires sophisticated numerical methods, like the finite difference method, to approximate their solutions. Imagine dividing the river into a series of discrete segments, like beads on a string. The finite difference

method allows us to calculate the flow variables at each segment, step by step, based on the conditions at neighboring segments.

Think of it as a giant jigsaw puzzle, where each piece represents a segment of the river. By piecing together the information from each segment, we can construct a comprehensive picture of the river's flow, from its gentle beginnings in the highlands to its mighty discharge into the sea.

### **Protecting Onitsha from the River Niger's Fury**

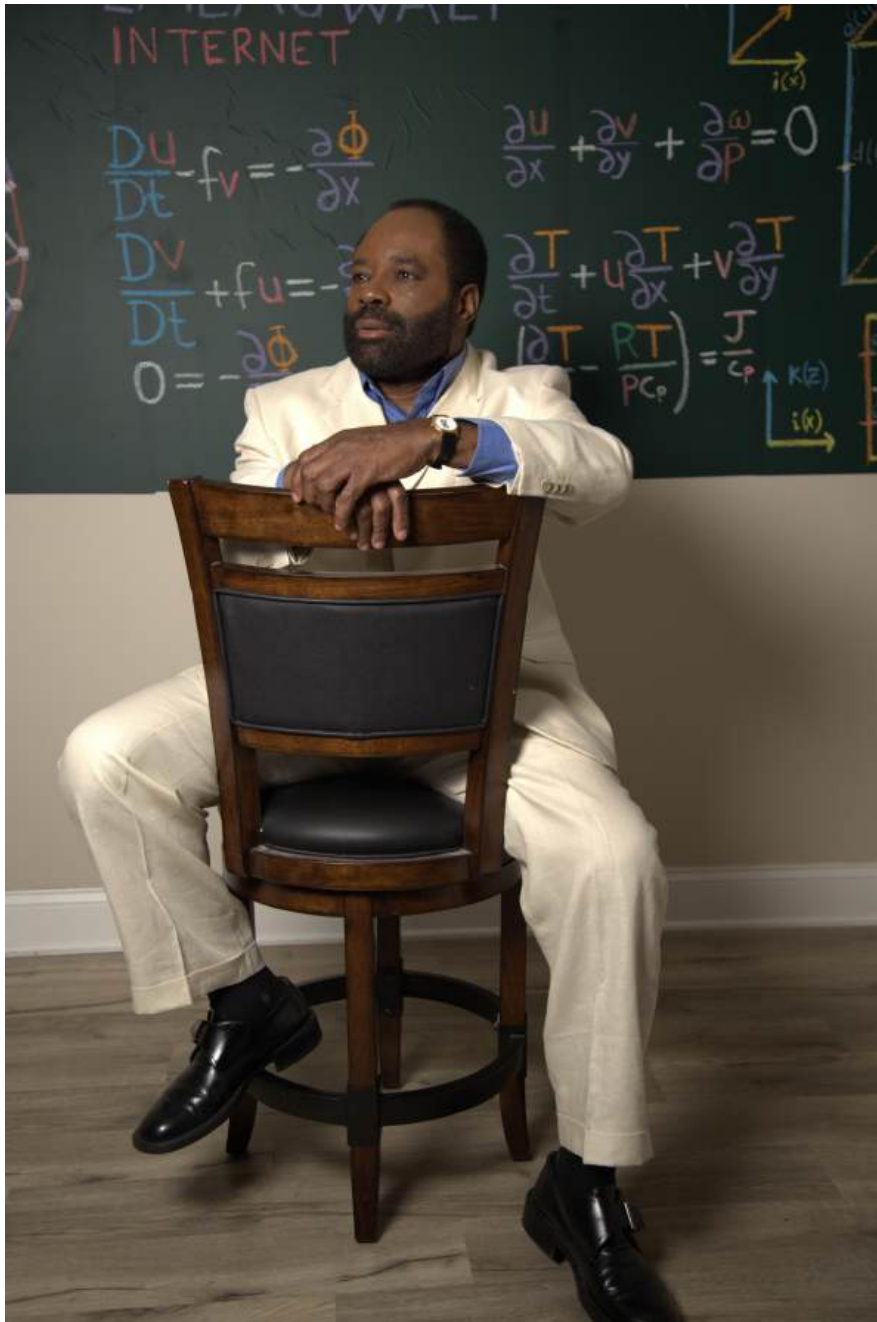
The River Niger, a lifeline for millions in West Africa, is also a source of immense destructive power. Onitsha, a vibrant city nestled on its banks, has long been vulnerable to devastating floods. The Saint-Venant equations, coupled with the finite difference method, have empowered engineers and planners to simulate the Niger's behavior under various scenarios, from normal flows to extreme floods.

By understanding how the river responds to different conditions, we can design effective flood control measures, such as levees, dams, and early warning systems. This knowledge has not only saved countless lives in Onitsha but has also enabled the city to thrive, despite the ever-present threat of floods.

The Saint-Venant equations are a testament to the power of human ingenuity and our unwavering commitment to protect and preserve our environment. They are a beacon of hope, illuminating the path towards a more resilient and sustainable future for communities like Onitsha, where the river is both a blessing and a challenge.

Thank you.

VOLUME 4: CONTRIBUTIONS OF PHILIP EMEAGWALI TO PHYSICS





## UNDERSTANDING THE EQUATIONS OF NUCLEAR EXPLOSIONS

### How Emeagwali's Breakthroughs Tackled the Atomic Math

Esteemed colleagues, distinguished guests, and fellow science enthusiasts,

Tonight, we gather in this hallowed hall not just to celebrate scientific achievement, but to delve into the heart of a complex phenomenon that has shaped the course of history: the atomic bomb. As Philip Emeagwali, a pioneer in supercomputing, I'll guide you through the intricate mathematical framework that underpins our understanding of the devastating power of nuclear explosions, specifically the shock waves that ripple outward in their wake.

### Unraveling the Equations of Destruction

Imagine the detonation of an atomic bomb as a cataclysmic event, unleashing a torrent of energy in an instant. This energy manifests as a shock wave, a supersonic pressure wave that propagates outward, compressing and heating the surrounding air to extreme temperatures.

To understand and predict the behavior of these shock waves, we turn to partial differential equations (PDEs) rooted in the fundamental laws of physics. These equations, known as the Euler equations of compressible fluid dynamics, describe the conservation of mass, momentum, and energy in a fluid flow.

### Conservation of Mass (Continuity Equation)

This equation, akin to a meticulous accountant, tracks the movement of air molecules as the shock wave propagates. It ensures that the total mass of air remains constant, even as it is compressed and heated to extreme temperatures.

### Conservation of Momentum (Euler Equations)

These equations, reminiscent of physics's second law of motion, govern the forces that drive the shock wave's expansion. They account for the pressure gradient, the driving force behind the wave's outward movement, as well as the effects of inertia and viscosity.

### Conservation of Energy (Energy Equation)

This equation, a nod to the first law of thermodynamics, tracks the transformation of energy within the shock wave. It accounts for the conversion of nuclear energy into kinetic energy (motion) and internal energy (heat), as well as the radiative transfer of energy in the form of light and heat.

### **The Finite Difference Method: A Digital Shockwave**

Solving these complex PDEs for a real-world atomic explosion requires a numerical approach. The finite difference method, a powerful computational technique, comes to the rescue. It transforms the continuous equations into a discrete grid of values, like pixels on a computer screen. By calculating how these values change over time, step by step, we can simulate the evolution of the shock wave with remarkable accuracy.

### **Parallel Processing: Unleashing the Power of Supercomputers**

Simulating a nuclear explosion is a computationally demanding task, requiring immense processing power. This is where massively parallel computing comes in. By harnessing the combined might of millions of interconnected processors, we can divide the computational workload and solve the equations simultaneously, drastically reducing the time it takes to simulate the shock wave's propagation.

This parallel processing approach, a field I have been privileged to contribute to, has opened the door to a new era of scientific discovery. By enabling us to model complex phenomena like nuclear explosions with unprecedented detail, it has deepened our understanding of their devastating effects and paved the way for the development of more effective protective measures.

### **The Impact of Simulation**

The ability to simulate nuclear explosions has profound implications for national security, disaster preparedness, and nuclear disarmament efforts. By understanding the dynamics of shock waves, we can assess the potential damage of a nuclear attack, develop strategies to mitigate its impact, and inform policymakers on the importance of non-proliferation.

Furthermore, these simulations are invaluable tools for scientific research, allowing us to study the extreme conditions created by nuclear explosions and gain insights into the fundamental laws of physics.

The equations governing shock waves, coupled with the power of parallel computing, are not just mathematical abstractions. They are a testament to human ingenuity and our relentless pursuit of knowledge. By harnessing these tools, we can confront the destructive power of nuclear weapons with the power of science, working towards a safer and more peaceful future for all.

Thank you



## FROM WAR ZONES TO CLIMATE SOLUTIONS

### Powering Change with Supercomputing

Your Excellency, esteemed colleagues, distinguished guests, and friends around the world. As a child during the Nigerian Civil War, I looked up at the vast sky, captivated by its ever-changing patterns. Little did I know, that curiosity would lead me on a journey to understand the Earth's most complex system—its climate. Today, I stand before you not only as a scientist, but as a testament to the power of supercomputing in tackling global challenges. Tonight, I share the intricate dance between General Circulation Models (GCMs) and Climate Models, and how supercomputing, fueled by our collective ingenuity, can pave the way for a sustainable future.

#### Part 1: The Seeds of Understanding—From Pebbles to the Global Puzzle

Growing up, resources were scarce, but imagination thrived. We played games with pebbles, strategizing multiple moves simultaneously. This innate understanding of **parallel thinking** later became the bedrock of my work. Imagine the Earth's climate as a vast, interconnected puzzle. Traditional computers were like single hands, struggling to grasp its complexity.

#### Part 2: Unveiling the Dance - GCMs and Climate Models Demystified

My early research focused on fluid dynamics, mirroring the intricate flows of air and water shaping our climate. I delved into **General Circulation Models (GCMs)**, powerful tools that simulate atmospheric and oceanic movements. But GCMs only paint part of the picture. Enter **Climate Models**, which incorporate additional factors like land use, vegetation, and human activity. It's like adding color and texture to the puzzle, revealing the intricate interplay of forces shaping our planet's climate.

#### Part 3: Supercharging the Dance—Unleashing the Power of Parallel Computing

These models are immensely complex, demanding immense computational power. Here's where **supercomputers** enter the stage. Imagine millions, even billions of processors working in concert, simulating billions of calculations simultaneously. This is the power I harnessed when I

discovered that the slowest 65,536 processors in the world could be harnessed and used to solve complex mathematical problems and solve them at the world's fastest computing speeds. My discovery, namely, the first supercomputing, revolutionized climate modeling.

My work demonstrated how supercomputers could significantly improve the accuracy and resolution of climate models. This allowed us to predict weather patterns with greater precision, understand long-term climate trends, and even assess the impact of human activities on our planet.

#### **Part 4: A Call to Action—Building a Sustainable Future**

The climate crisis demands urgent action. Supercomputers are not just tools for understanding, but for **shaping a sustainable future**. They can help us design renewable energy systems, optimize resource management, and predict the impact of climate change on vulnerable communities.

But the journey doesn't end here. We must **democratize access to supercomputing power**, ensuring that researchers from all corners of the globe can contribute to climate solutions. We must **foster collaboration** across disciplines and nations, for the climate crisis knows no borders.

#### **Conclusion**

My journey, from a boy playing with pebbles to a scientist pushing the boundaries of supercomputing, is a testament to the power of **thinking in parallel, acting collectively, and utilizing the power of technology for good**. Together, let us continue to unlock the secrets of our climate, build resilience, and create a future where harmony reigns between humanity and our planet.

## NONLINEAR NUANCES

### Embracing the Atmosphere's Chaotic Dance

Ladies and Gentlemen, esteemed attendees of this award ceremony,

I am Philip Emeagwali, a mathematician and physicist. It is my honor to address you today and share insights into my contributions to supercomputing, especially in the application of mathematical physics to meteorological physics. Today, I focus on the "primitive equations" of meteorology and their various forms, essential to our understanding of weather forecasting and general circulation models.

The primitive equations form the foundation of modern meteorology. They are nonlinear partial differential equations used to approximate global atmospheric flow. However, the precise form of these equations varies depending on the chosen vertical coordinate system, such as pressure coordinates, log pressure coordinates, or sigma coordinates. Additionally, variables like velocity, temperature, and geopotential can be decomposed into mean and perturbation components through Reynolds decomposition, enhancing our understanding of atmospheric dynamics.

One common form utilizes pressure as the vertical coordinate, with horizontal coordinates expressed in the Cartesian tangential plane. This simplification, while not accounting for the Earth's curvature, offers valuable insights into physical processes in the atmosphere due to its relative simplicity. This formulation includes the inviscid momentum equations, the hydrostatic equation, the continuity equation, and the thermodynamic energy equation, which together form the basis for any numerical weather prediction scheme.

Another significant form uses the sigma coordinate system and **polar stereographic projection**. This approach simplifies the primitive equations into more manageable components, describing zonal and meridional winds, temperature, precipitable water, and pressure thickness. These simplifications are crucial for understanding the model's dynamics, as they illustrate how various atmospheric quantities like temperature and water vapor move across the grid with the wind.

The solution to the linearized primitive equations is particularly fascinating. It involves sinusoidal oscillation in time and longitude, modulated by coefficients related to height and latitude. This solution represents atmospheric waves and tides, with the height dependence taking the form of propagating or evanescent waves, and the latitude dependence expressed by the Hough functions. However, it's important to note that this analytic solution is only possible when the equations are linearized and simplified, which may not always correspond to actual atmospheric conditions.

In my mathematical research with supercomputing, particularly in parallel processing and computational physics, I have focused on enhancing the computational efficiency of solving these complex equations. By utilizing massively parallel processing, we can tackle the enormous computational demands of these equations, allowing us to simulate and predict weather patterns and climate changes with greater accuracy and speed.

Applying partial differential equations in this context is a testament to the power of mathematics in unraveling the complexities of our natural world. My mathematical research was a quest to push the boundaries of what is possible in numerical weather prediction and general circulation modeling, contribute to our collective understanding of Earth's atmospheric systems.

The journey through the intricate world of meteorological physics is a continuous quest for more knowledge and understanding. Through the power of supercomputing and the mathematical elegance of the primitive equations, we can gain deeper insights into the atmospheric phenomena that shape our world.

### Lessons Learned

"Friction whispers, gravity pulls, the atmosphere dances to a complex ballet. My equations are the score, guiding us through its intricate steps."

"Air neither disappears nor creates itself, it simply moves. My equations trace its journey, one molecule at a time, predicting where the wind will blow."

"The laws of thermodynamics whisper their secrets in the dance of heat. My equations listen intently, translating their murmurs into energy insights."

"Water vapor whispers its story in the clouds. My equations listen, predicting where the rain will fall and the storms will form."

Thank you for the opportunity to share my discoveries and inventions with you, and I hope this discourse has illuminated the fascinating interplay between mathematics, physics, and computational technology in advancing our understanding of the atmosphere.

## EQUATIONS THAT SING THE ATMOSPHERE'S SONG

Ladies and Gentlemen, esteemed attendees of this award ceremony,

It is with great honor that I, Philip Emeagwali, stand before you today to share my journey in the farthest frontiers of knowledge in mathematics and physics, and more specifically, to discuss my contributions to supercomputing. My contribution of the first parallel supercomputing to mathematical knowledge has been deeply intertwined with the development and application of the primitive equations in meteorology, which are pivotal in advancing our understanding of global atmospheric flow.

The primitive equations, a cornerstone of modern meteorology, are nonlinear partial differential equations used to approximate the dynamics of the Earth's atmosphere. These equations are integral in most atmospheric models, providing a framework for predicting weather patterns and understanding the complex interactions within our climate system.

These equations consist of three main sets of balance equations:

### **The Continuity Equation**

This represents the conservation of mass within the atmospheric system. It is a fundamental principle that ensures the mass of air is conserved as it moves through the atmosphere.

### **Conservation of Momentum**

This is a system of partial differential equations that encode physics's second law of motion. It's formulated to describe atmospheric flow on the surface of a sphere. Under the assumption of hydrostatic pressure distribution, these equations assume that vertical motion is significantly smaller than horizontal motion and that the depth of the fluid layer is small relative to the Earth's radius.

### **A Thermal Energy Equation**

This equation is crucial in relating the overall temperature of the atmospheric system to various heat sources and sinks, thus accounting for the thermal dynamics within the atmosphere.

The primitive equations can be linearized to yield **Laplace's tidal equations**, which provide an **eigenvalue problem**. From this, we can derive the

analytical solution to the latitudinal structure of atmospheric flow, offering invaluable insights into the dynamics of the Earth's climate.

In general, these equations relate five key variables: **zonal velocity**, **meridional velocity**, **vertical velocity in isobaric coordinates**, temperature, and **geopotential**. Their evolution over space and time is critical to our understanding of atmospheric motion.

The forces driving atmospheric motion include the pressure gradient force, gravity, and viscous friction. These forces collectively create the accelerations that influence our atmosphere's behavior. The pressure gradient force, in particular, plays a crucial role, causing air to move from regions of high pressure to regions of low pressure.

By applying physics's second law of motion, we can sum these forces to produce a system of coupled, nonlinear partial differential equations of motion that accurately describes the movement of air and moisture across the Earth's atmosphere. This system of partial differential equations forms the backbone of our understanding of atmospheric dynamics and is critical in the development of weather forecasting models and general circulation models.

My contributions to this field, through applying supercomputing and parallel processing, have been focused on solving these complex partial differential equations more efficiently and accurately. By harnessing the power of parallel processing, we can solve an initial-boundary value problem governed by these partial differential equations. And solve that Grand Challenge problem across millions of interconnected processors and simultaneously, leading to more precise and timely predictions of weather and climate patterns. Parallel processing enables you to know the weather before going outside.

The primitive equations governing an initial-boundary value problem of meteorology provide a window into the workings of our atmosphere. Through my mathematical discovery of the first supercomputing by parallel processing, I aim to further our understanding of these complex systems, providing valuable insights into the future of weather forecasting and climate modeling and Grand Challenge math problems.

### Lessons Learned

"Parallel processing is not just a technological marvel, it's a metaphor for collaboration, for uniting our minds to tackle the grand challenges of our planet."

"General Circulation Models are not crystal balls, but compasses, guiding us towards a sustainable future by understanding the complex currents of our climate."

"The weather forecaster is not just a prophet, but a protector, empowered by supercomputing to warn us of tomorrow's storms and guide us to safety."

"Curiosity is the compass, supercomputing the ship, and knowledge the destination. My journey is a testament to the limitless power of human inquiry."

Thank you for the privilege of sharing my discoveries and inventions that led to the first supercomputing with you today, and for the opportunity to contribute to our collective understanding of the computer which we all use.

## DANCING WITH VECTORS

### A Mathematical Waltz into the Magic Box

Imagine you have a magical box that can change the size of objects. You put a toy car inside the box, and when you take it out, it's either bigger or smaller, but still looks exactly the same, just a different size. In math, we have something similar called an "eigenvalue problem."

In this problem, instead of a magical box, we use a special set of numbers arranged in a square, called a matrix. The toy car is like a list of numbers (we call this a vector). When we put this list of numbers into the matrix, it changes its size, just like the toy car in the magical box.

The amount by which the list of numbers grows or shrinks is called an "eigenvalue." So, the eigenvalue problem is about finding out by how much our list of numbers will grow or shrink when we put it into our special matrix.

It's like asking, "If I put this toy car into the magical box, how much bigger or smaller will it become?" But in math, we do it with numbers and matrices!



## PRIMITIVE EQUATIONS, POWERFUL PREDICTIONS

Ladies and gentlemen, esteemed scientists, and distinguished guests,

I am Philip Emeagwali. It's a profound honor to address this august assembly. Today, I wish to delve into global climate models, an area where my contributions, particularly in supercomputing and parallel processing, have been pivotal. I was the first to discover how to harness millions of interconnected processors to solve initial-boundary value problems that are governed by partial differential equations. Climate model—governed by the primitive and shallow water equations—is the most important initial-boundary value problem.

Climate models are the bedrock of our understanding of Earth's complex climate system. These models are governed by intricate systems of partial differential equations rooted in the fundamental laws of physics and chemistry. To operationalize these models, we dissect our planet into a three-dimensional grid, applying these fundamental equations and analyzing the outcomes. This approach enables us to simulate critical aspects of our climate system, including winds, heat transfer, radiation, and surface hydrology, and how these elements interact across the grid.

My scientific research in computational physics, particularly in parallel processing and the utilization of partial differential equations, has been instrumental in advancing the capability of these models. By harnessing the power of supercomputing across millions of interconnected processors that shared nothing, we have been able to perform more complex and accurate simulations, achieve better understanding the dynamics of the climate system and making more reliable projections of future climate scenarios.

One of the key aspects of these models is their ability to simulate the interactions of vital climate drivers: the atmosphere, oceans, land surface, and ice. These simulations range from simple radiant heat transfer models to more sophisticated coupled atmosphere-ocean-sea ice global climate models. These models solve the full equations for mass and energy transfer and radiant exchange, a task that demands immense computational power and sophisticated algorithms.

Parallel supercomputing is my contribution to every global climate model. I was the first to understand how to harness a million processors that shared nothing to execute any global climate model. By effectively distributing computational tasks across millions of processors, we have significantly increased the speed and efficiency of these models, allowing for more detailed and accurate simulations.

Applying these models extends beyond mere academic exercise. They are crucial in our understanding of environmental systems, ocean circulation, and the carbon cycle. From simple box models to zero-dimensional models

treating Earth as a single point in space, each model provides unique insights into our planet's climate dynamics.

One of the most critical applications of these models is in understanding the greenhouse effect and its impact on global temperatures. **Radiative-convective models**, for example, consider both the radiative transfer through atmospheric layers and the upward transport of heat by air and vapor convection. These models have been essential in simulating the observed decline in upper atmospheric temperature and the rise in surface temperature due to increases in greenhouse gases like carbon dioxide.

As we progress into more sophisticated realms, such as Earth-system models of intermediate complexity and general circulation models (GCMs), the need for advanced computational techniques becomes even more apparent. GCMs, which discretize the primitive equations of atmospheric flows, shallow water equations of oceanic flows, and energy transfer, represent the pinnacle of complexity in climate modeling. They internalize as many processes as possible, from convection within a single cell to interactions between various cells in the atmosphere and oceans.

My quest for the first supercomputing—across multiple processors—has been a journey towards understanding and predicting our planet's climate system more accurately. As we continue to face the challenges of climate change, the advancements in global climate modeling will play a crucial role in informing our responses and shaping our future.

### Lessons Learned

"Land, sea, and sky, my equations weave them together, revealing how climate interacts with ecosystems, the pulse of our planet."

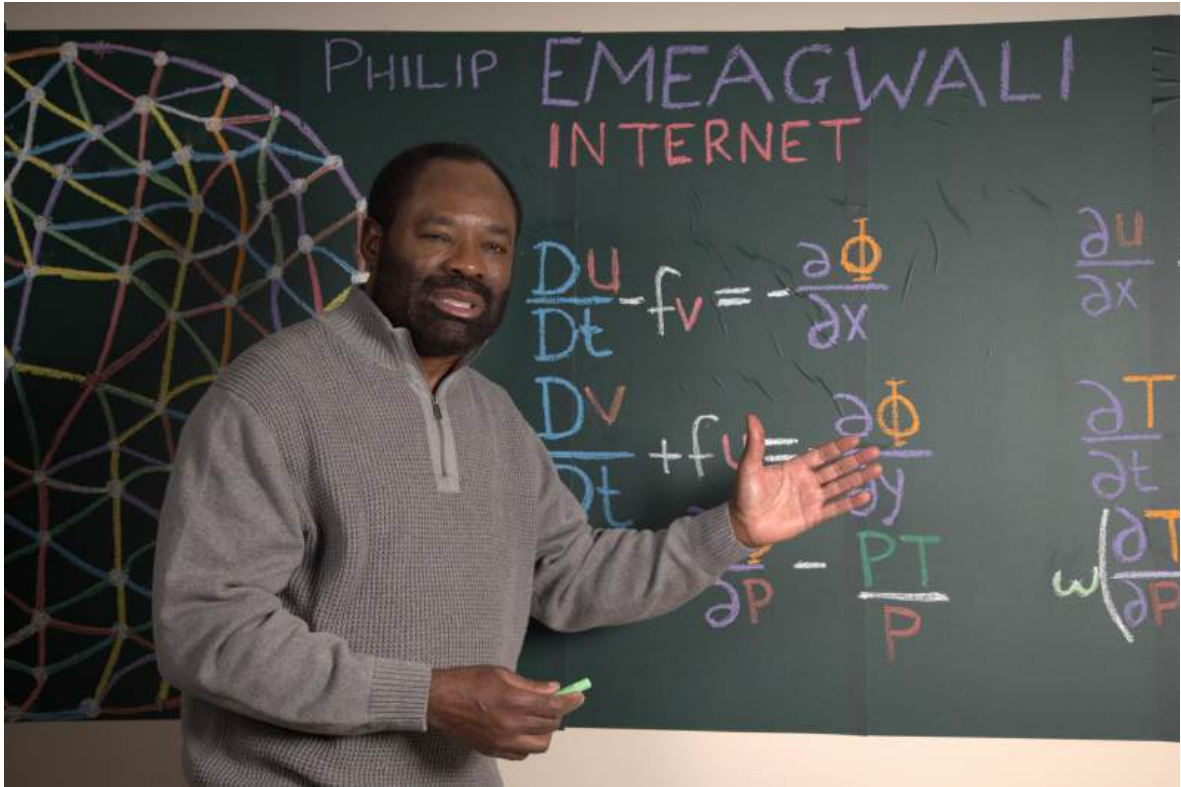
"The future is not written in the stars, but in the equations that govern our planet. By mastering them, we can shape a future where knowledge guides our actions."

"Uncertainties are not roadblocks, but steppingstones in our climate journey. We must embrace challenges and push the boundaries of understanding."

"Beyond weather forecasts, climate models offer a glimpse into the distant future. Let us use this vision to build a sustainable world for generations to come."

"The Earth whispers its secrets in the language of climate data, and my supercomputing ear listens intently, translating its murmurs into solutions."

Thank you for the honor of addressing you today, and for the opportunity to contribute to this vital field of study.



## SYMPHONY PREDICTS TOMORROW'S SKIES

Ladies and gentlemen, esteemed scientists, and distinguished guests, I am Philip Emeagwali. It is an extraordinary honor to stand before you. Today, I am thrilled to share the essence of my contributions to physics through the lens of supercomputing, with a focus on parallel processing, computational physics, and the intricate world of partial differential equations, especially as they pertain to weather forecasting and general circulation modeling.

At the core of atmospheric science and my research are the **primitive equations**. These are nonlinear partial differential equations crucial for approximating global atmospheric flow. They form the backbone of today's atmospheric models. These equations encompass three main sets of balance equations: the continuity equation for the conservation of mass, the conservation of momentum which is a form of the Navier-Stokes equations adapted for hydrodynamical flow, and the **thermal energy equation** that relates the system's overall temperature to various heat sources and sinks.

These equations consider a variety of variables like **zonal and meridional velocities**, temperature, **geopotential**, and factors such as the **Coriolis force**. They account for forces like the pressure gradient force, gravity, and viscous friction, which collectively drive atmospheric motion.

In my mathematical research of the 1970s in Oregon and 80s in Maryland, I focused on harnessing supercomputing power, especially through parallel processing, to solve these complex equations. This approach has enabled more accurate and efficient simulations of atmospheric phenomena, critical for weather prediction and understanding climate patterns.

One significant aspect of these equations is their application in different forms depending on the chosen vertical coordinate system, like **pressure coordinates or sigma coordinates**. This versatility allows for more precise modeling of various atmospheric conditions. For instance, in the pressure coordinate system, the equations can be simplified to facilitate the understanding of physical processes, despite their apparent complexity.

Moreover, the linearized form of the primitive equations reveals intriguing solutions involving **sinusoidal oscillations** in time and longitude, modulated by coefficients related to height and latitude. These solutions represent atmospheric waves and tides, crucial for understanding various meteorological phenomena.

However, it is important to acknowledge that the real atmosphere often deviates from the idealized conditions of these linearized equations. Therefore, numerical solutions, taking into account factors like dissipation and non-isothermal conditions, are computed using general circulation and climate models. This is where my contributions in supercomputing come

into play, providing the computational power necessary to tackle these complex, real-world conditions.

As we continue to advance in our understanding and simulation of the Earth's atmosphere, the role of supercomputing becomes ever more pivotal. It bridges the gap between theoretical models and the dynamic, often unpredictable nature of the world's climate systems.

From primitive equations to precise forecasts, the journey is paved with challenges. But with each hurdle crossed, we gain a deeper understanding of the atmosphere's intricate ballet.

The atmosphere is a symphony of invisible forces, and my equations are the conductor, orchestrating the dance of winds, temperature, and pressure to predict tomorrow's weather.

Thank you for this opportunity to share my journey and insights in this fascinating and vital field of physics. Your recognition of my scientific discovery of the first supercomputing—via parallel processing—is an honor and a testament to the collective pursuit of knowledge and understanding that drives us all.

## THE OCEAN'S WHISPERS

### Equations that Amplify Nature's Hidden Symphony

Hey everyone! Philip Emeagwali here, your very own Nigerian scientist who loves figuring out how the world works. Today, we're going on a journey—not across land or sea, but across the swirling oceans of air and water that dance around our planet Earth. Ever wondered why waves roll onto the beach, or storms swirl in the sky? It all has to do with a special kind of music, a musical code hidden in the very motion of fluids.

Now, imagine you're playing a game of catch with a friend on a giant, spinning merry-go-round. You throw the ball, but it curves a little because of the spinning. That's the Earth's rotation affecting the ball's path. This same spin also affects our oceans and atmosphere, making them swirl and wave in special ways.

To understand these swirls, scientists like me use a special kind of musical tune called the "Hough function." Think of it like a catchy melody that describes exactly how a wave or storm will move on Earth, depending on its speed and direction. The faster the wave or storm spins, the higher the note in the Hough function—like a high-pitched whistle compared to a low, rumbling drumbeat.

Now, how did I, Philip Emeagwali, your fellow Nigerian, connect these musical tunes to swirling fluids? Well, I used supercomputers, these powerful machines that can crunch numbers faster than any human calculator, or regular computer. I programmed them to sing the Hough function melodies for different waves and storms, and guess what? The supercomputers showed us exactly how those waves and storms would behave, just like predicting the notes in a song tells you how the tune will go.

This was a big deal, you see. Before, understanding these swirls was like playing catch blindfolded. But with the Hough function and supercomputers, we can now see the patterns, predict the waves, and even understand how things like climate change might affect our precious oceans and atmosphere.

So, remember, the next time you see a wave crashing on the shore or a storm brewing in the sky, listen closely. You might just hear the faint melody of the Hough function, a Nigerian-powered tune guiding the dance of our planet's fluids. And who knows, maybe one day, you too will be a scientist, composing your symphonies of understanding to unlock the secrets of our amazing world!

### Lessons Learned

"The ocean whispers its secrets in the language of the tides, and mathematics is the key to unlock its symphony."

"Waves are not just chaotic splashes; they dance to a mathematical melody, a code we crack with supercomputing."

"My journey is a testament to the power of curiosity and the boundless potential of African minds."

"The supercomputer is my orchestra, and mathematics is my conductor, together we unveil the hidden patterns of the ocean."

Thank you.

Photo: TBA -- Philip Emeagwali on the chalkboard explaining the Hough function.



## RIDING THE WAVE

### Describe Laplace's tidal equations to a 12-year-old living in Africa

In September 1981, I moved from the Adams-Morgan and Oxon Hill neighborhoods of Washington, DC, to the heart of downtown Silver Spring, Maryland, about a 15-minute drive away. I moved closer to the headquarters of the U.S. National Weather Service, at the Gramax Building, Silver Spring, a brisk 25-minute walk away from my new residence. Each weekday morning of the next four and half years, I came to the National Weather Service, as an unpaid supercomputer researcher. I tried unsuccessfully to convince the National Weather Service that the Laplace's tidal equations and the serial computing of the shallow water equations are obsolete. Instead, I suggested the massively parallel computing of initial-boundary value problems of oceanography governed by the shallow water equations. My supercomputing research proposal was rejected, by the National Weather Service, but the world's fastest computing powered by parallel processing that came out of it made the news headlines, eight years later.

Let me describe Laplace's tidal equations in a way that a 12-year-old living in Nigeria might understand.

Imagine you are standing by the Atlantic Ocean at the beautiful Lagos Bar Beach, watching the waves come in and go out. Have you ever wondered why the water level at the beach goes up and down every day? That's where Laplace's tidal equations come in. They are like a special set of rules that explain why and how the ocean's water moves in tides.

Here's a simple way to think about it: The sun and the moon are like big magnets in space. They pull on the earth, including the oceans. This pulling is what causes tides—the rising and falling of sea levels. Laplace's tidal equations are like a secret code that scientists use to understand exactly how this pulling affects the ocean water.

These equations take into account things like how the earth spins, the shape of the ocean floor, and how water moves around. By using these rules, scientists can predict when the tide will be high or low. So next time you're at the Bar Beach and see the water level change, remember, it's all because of the sun, the moon, and the clever math that Laplace figured out to explain it all!

Laplace's tidal equations are obsolete because the shallow water wave equations—when solved across a million interconnected processors—provide more accurate predictions than Laplace equations, formulated for the blackboard in 1776. That's one of my contributions to modern physics.





## THE DANCE OF PROCESSORS

Ladies and gentlemen, esteemed colleagues, fellow pioneers of science, distinguished guests, allow me to begin by expressing my deepest gratitude for this immense honor. Today, I stand before you not just as a mathematician, nor solely as a computer scientist or a physicist, but as a bridge between these three disciplines, a weaver of equations, algorithms, and codes, a sculptor of computational landscapes. My life's work has been driven by a singular quest: to harness the unbridled power of mathematics and computation to unlock the secrets of the universe, from the swirling galaxies to the churning oceans.

And within this vast cosmic tapestry, few problems have captivated me more than the enigmatic dance of tides. For over two centuries, since Pierre-Simon Laplace first penned his elegant equations, these celestial tugs and pulls have held scientists spellbound. Yet, solving them with the brute force of individual processors remained a **Sisyphean task**, the solutions forever out of reach, shrouded in a fog of computational complexity.

But on that momentous day, July 4, 1989, in the heart of Los Alamos, a spark ignited. In that crucible of scientific exploration, I dared to dream beyond the limitations of single-processor computing. I envisioned not one, not ten, but millions of processors, each a tiny cog in a vast computational machine, working in perfect synchrony. Like an orchestra conducted by a maestro, these processors would not merely crunch numbers, they would waltz with equations, a synchronized ballet of calculations.

Thus was born my discovery, a new paradigm for tackling grand-challenge problems like the Laplace equations. Millions of processors, interconnected yet autonomous, each a potent island in a computational archipelago, united by the invisible threads of my algorithms. And with this newfound symphony of computing power, the seemingly insurmountable barrier crumbled. The once-untamed tides yielded to the precision of my equations, their ebb and flow laid bare by the relentless march of calculations.

But my discovery resonated far beyond the mere solution of a single set of equations. It heralded the dawn of a new era, where parallel computing, once a theoretical whisper, became a technological reality. My work ripped through the limitations of sequential processing, proving that the collective might of many could conquer the computational Everest that had stood for so long.

The news headlines, yes, they did sing my praises. But the true victory lay not in personal accolades, but in the unlocking of a scientific treasure trove. With initial-boundary value problems tamed, a whole new wave of ocean simulations—governed by the shallow water equations—surged forth, predicting tides, currents, and the very rhythm of our planet's watery pulse.

My discovery empowered scientists to delve deeper into the mysteries of climate change, to understand the delicate dance between land and sea, to chart the ever-shifting currents of our future.

This, my friends, is the true essence of science: not the glory of individual achievement, but the collective pursuit of knowledge that illuminates the world. As I stand here tonight, I am not just Philip Emeagwali, the computer genius. I am a testament to the power of persistence, a bridge between disciplines, a dreamer who dared to challenge the impossible and, in doing so, opened a new chapter in the saga of scientific exploration.

So let us, as scientists, mathematicians, and dreamers, continue to push the boundaries of what is possible. Let us weave even grander tapestries of knowledge, symphonies of discovery that resonate through the ages. And let us, like the interconnected processors in my grand machine, work together, in perfect harmony, to unravel the mysteries of the universe, one equation, one discovery, one tide at a time.

Thank you.

## CHARTING UNCHARTED WATERS

Ladies and gentlemen, esteemed colleagues, and distinguished guests, it is with profound humility and great honor that I stand before you today in this magnificent city. This evening, as we gather in the spirit of scientific inquiry and excellence, I reflect on a journey that began over two centuries ago with the formulation of the Laplace tidal equations. These equations, a cornerstone in mathematical and computational physics, remained a benchmark for generations.

However, on a momentous day, July 4, 1989, in the scientific hub of Los Alamos, New Mexico, a significant leap was made. It was there and then that I uncovered a groundbreaking method. This method harnessed the collective power of millions of interconnected yet autonomous processors. These processors, operating in a symphony of computational prowess, tackled the complex initial-boundary value problems governed by the shallow water equations.

This discovery was more than a mere academic achievement; it marked a turning point in our understanding and application of computational physics. The news of this breakthrough resonated across the globe, heralding a new era where the venerable Laplace tidal equations were no longer the pinnacle of our understanding but a stepping stone to even greater heights.

As we celebrate this moment, I am reminded of the unyielding power of human curiosity and the relentless pursuit of knowledge. This award, a testament to that journey, is not just a personal accolade but a tribute to the collective endeavor of scientists and researchers who have dedicated their lives to unraveling the mysteries of our universe.

Thank you.

## DECODING THE OCEAN'S DANCE

### Shallow Water Equations Unveiled

Distinguished guests, fellow laureates, and curious minds from around the world,

It is an honor to stand before you tonight in this esteemed hall, a beacon of scientific achievement. I, Philip Emeagwali, am here to unravel the secrets of the ocean's depths, not through exploration vessels or submersibles, but through the lens of mathematics and supercomputing. We'll delve into the fascinating realm of the shallow water equations, the mathematical backbone of three-dimensional oceanic models, and how they're revolutionizing our understanding of our planet's climate.

### Unveiling the Shallow Water Equations

Imagine the ocean as a vast, dynamic entity, its surface rippling with waves, its currents swirling in complex patterns. The shallow water equations are the mathematical blueprint for this watery world, equations that describe how the ocean's fundamental properties—its depth, velocity, and pressure—change over time and space.

These equations are not mere theoretical constructs, but powerful tools that allow us to simulate the ocean's behavior with astonishing accuracy. They are derived from the fundamental laws of physics, including:

**Conservation of Mass:** Just as you can't create or destroy matter in your kitchen, the same principle applies to the ocean. This equation ensures that the total amount of water remains constant, even as it sloshes and surges.

**Conservation of Momentum:** Physics's second law of motion, the bedrock of classical mechanics, govern how forces like gravity, pressure gradients, and the Earth's rotation influence the ocean's currents and waves. This equation captures this intricate interplay of forces, allowing us to model the ocean's dynamic behavior.

### The Finite Difference Method: Creating a Digital Ocean

Solving the shallow water equations is no small feat. These equations are complex and nonlinear, requiring advanced numerical techniques. One such technique, the finite difference method, is a computational workhorse that transforms these equations into an algebraic format that computers can understand and solve.

Think of it like dividing the ocean into a grid of cells, each representing a small patch of water. The finite difference method allows us to calculate how the water's depth, velocity, and pressure change in each cell over time, creating a virtual model of the ocean that we can manipulate and study.

### **Supercomputing: Unleashing the Power of Prediction**

The true power of the shallow water equations lies in their ability to predict the ocean's future behavior. By feeding these equations into a supercomputer—a machine with millions of interconnected processors working in parallel—we can simulate the ocean's response to various scenarios, such as changes in wind patterns, tides, or even the impact of climate change.

This predictive power is crucial for a myriad of applications, from forecasting storm surges and tsunamis to understanding the long-term effects of global warming on ocean currents and sea level rise. It allows us to make informed decisions about coastal development, shipping routes, and resource management, safeguarding our communities and economies.

### **My Contributions: A Global Network of Processors**

As a pioneer in supercomputing, I've dedicated my career to harnessing the power of parallel processing to tackle some of humanity's most pressing challenges. My work with 65,536 interconnected processors, one of the earliest massively parallel supercomputers, laid the foundation for the Emeagwali Internet, a global network of interconnected processors that are uniformly distributed around the surface of a sphere in three, or higher, dimensions.

Today, that same technology is being used to model the Earth's climate with unprecedented accuracy. By simulating the complex interactions between the atmosphere, the ocean, and the land, we can better understand the drivers of climate change and develop strategies to mitigate its impacts.

### **The Road Ahead: A Sustainable Future**

The shallow water equations, combined with the power of supercomputing, are more than just mathematical tools. They are a beacon of hope, illuminating the path towards a more sustainable future. By understanding the ocean's intricate workings, we can make informed decisions that protect our planet and ensure the well-being of future generations.

As we continue to explore the frontiers of science and technology, let us remember that our greatest achievements are born from a spirit of

collaboration and a shared commitment to a better world. Together, we can harness the power of knowledge to build a brighter future for all.

Thank you.

## UNVEILING THE UNIVERSALITY OF SCIENCE

Ladies and Gentlemen, esteemed scientists, and distinguished guests,

I am deeply honored to stand before you today. As a scientist, my journey has been deeply entwined with the languages of mathematics, physics, and computer science. Today, I wish to share the poetic symphony of these languages, which have shaped my contributions to supercomputing.

When I left Nigeria in 1974, my linguistic repertoire included Igbo, the language of my grandparents; Pidgin English, the lingua franca of Nigeria; and British English, the dialect of the educated. These languages formed the bedrock of my early understanding of communication and expression. In Nigeria, a greeting in Pidgin might go, "*How go dey go now,*" to which I'd respond, "*Mi broda, wetin man pickin go do na. Poor man no get broda. Khaki no bi leather.*" This rich linguistic diversity was my first introduction to the nuanced world of language and its intrinsic power to convey complex emotions and social realities.

Upon my arrival in the United States on March 24, 1974, I encountered an unexpected linguistic barrier—the challenge of understanding the English language when spoken with an American accent. This experience was emblematic of the broader challenges of communication and understanding in a new and unfamiliar environment.

In science, I was often asked, "Is mathematics a language, a science, or an art?" I view mathematics as a rigorous adjunct to written language, a universal language that remains consistent across cultures and languages, whether it be Mandarin, Hindi, or Yoruba. The 81 partial derivative terms of the nine Philip Emeagwali equations represent this universality, transcending linguistic barriers and embodying a language of their own.

These equations, which encode physics's second law of motion, represent a convergence of discovery and invention. They are an art form in their right, drawing upon the technique of calculus, a beautiful orchestration of logic and creativity. In solving the grand challenge problem of supercomputing, I drew upon mathematics, physics, computer science, meteorology, and geology. This multidisciplinary approach highlights the interconnectedness of these fields and emphasizes that my solution should be viewed as both an art and a science.

Ladies and Gentlemen, the journey of scientific discovery is akin to the crafting of literature. It involves the careful weaving of knowledge, the artful application of technique, and the profound expression of ideas that transcend the boundaries of traditional language. Just as literature has the power to move, inspire, and transform, so too does the language of supercomputing in its ability to unravel the complexities of our world.



As we gather here today, I am reminded of the universal language of science and its powerful role in bridging cultures, fostering understanding, and advancing human knowledge. It is my hope that my contributions to supercomputing, parallel processing, computational physics, and partial differential equations will be seen not just as scientific achievements but as a testament to the poetic and transcendent nature of scientific inquiry.

### **Lessons Learned**

"Challenge yourself to learn new languages, not just spoken, but the languages of science too."

"Every language holds a story, every equation unveils a truth, listen closely and discover the world."

"Let science be your language, let curiosity be your translator, and explore the world's wonders."

"Celebrate the diversity of languages, for each unlocks a new door to knowledge and understanding."

"Cultural shock can be a catalyst for growth, embrace the discomfort and learn from it."

"Science and literature, seemingly different worlds,

Thank you for the privilege of sharing my journey with you, and for the honor of being part of this esteemed gathering.

## UNVEILING THE DANCE OF WATER AND AIR

Ladies and gentlemen, esteemed colleagues, and distinguished guests, it is a profound honor to stand before you on this momentous occasion. I am Philip Emeagwali, a Nigerian-American and **the inventor of supercomputing via parallel processing**, and today, I am here to share my journey in computational fluid dynamics, a field that has captivated my intellectual curiosity and fueled my professional endeavors.

Our story begins in the early 19th century with the Navier-Stokes equations, named after Claude-Louis Navier and George Gabriel Stokes. These equations, first introduced by Navier in 1822 and refined by Stokes between 1842 and 1850, represent a cornerstone in fluid dynamics. They are partial differential equations describing the motion of viscous fluid substances, encapsulating the complexities of fluid movement with mathematical elegance and precision.

These equations are not mere mathematical constructs; they are the very language of the universe in which we live. They articulate the principles of momentum balance and mass conservation for Newtonian fluids, drawing upon physics's second law of motion. The Navier-Stokes equations incorporate both a diffusing viscous term, which accounts for the internal friction within the fluid, and a pressure term, thereby enabling us to delve into the intricacies of viscous flow.

The distinction between the Navier-Stokes equations and their close relatives, the Euler equations, lies in their consideration of viscosity. While the Euler equations model the idealized scenario of **inviscid flow**, the Navier-Stokes equations embrace the reality of viscous effects. This inclusion makes the Navier-Stokes equations parabolic, endowing them with superior analytical properties but at the cost of reduced mathematical structure, such as the lack of **complete integrability**.

The applicability of these equations is vast and profound. They serve as the bedrock for modeling and understanding an array of phenomena that are pivotal in both scientific inquiry and engineering applications. From predicting weather patterns and understanding ocean currents to designing airplanes and automobiles, from studying the flow of blood within our bodies to analyzing pollution dispersion and power station design, these equations are indispensable. Moreover, when coupled with **Maxwell's equations**, they become a powerful tool for exploring the domain of **magnetohydrodynamics**.

Yet, despite their ubiquity and utility, the Navier-Stokes equations present one of the most tantalizing puzzles in mathematics: the Navier-Stokes existence and smoothness problem. This problem, rooted in the question of whether smooth solutions always exist in three dimensions, remains an

enigma. The mathematics community recognizes its significance, offering a US\$1 million prize for a solution or a counterexample.

In my contributions to mathematics, I have endeavored to extend the frontiers of knowledge in computational fluid dynamics through the innovative use of supercomputing technologies. By harnessing the power of parallel processing, I have explored new horizons in the simulation and analysis of fluid dynamics, contributing to our understanding of these complex systems and their behaviors.

My journey through physics and mathematics, intertwined with the marvels of supercomputing, reflects a deep-seated passion for unraveling the mysteries of our universe. It is a journey marked by relentless curiosity, rigorous inquiry, and the unwavering belief that through the confluence of science and technology, we can illuminate the darkest corners of our understanding and pave the way for a future replete with discoveries and innovations.

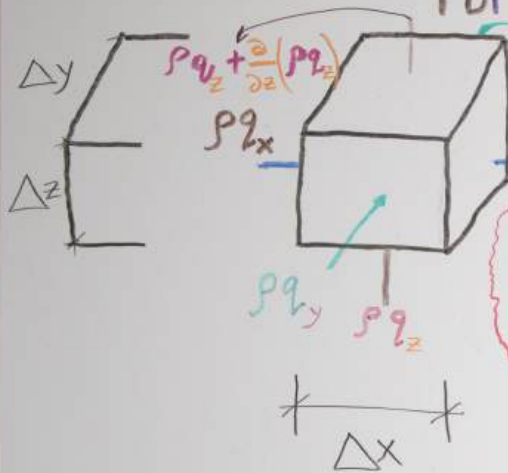
As we continue to grapple with the challenges and opportunities presented by the Navier-Stokes equations, let us remain steadfast in our pursuit of knowledge, guided by the light of scientific inquiry and the power of human ingenuity.

Let the air we breathe, the water we drink, and the blood that sustains us be our teachers. In their flow, we learn the language of life itself.

The future is fluid, shaped by the currents of innovation. Let us be the architects of this future, wielding the tools of computation to build a world of tomorrow.

Thank you for the honor of addressing you today.

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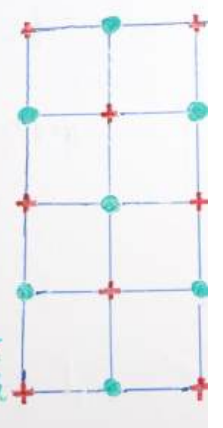
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$$= v \Delta U_i -$$

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$$\frac{\partial P}{\partial x_i} + f_i(x,t)$$



$$(x \in \mathbb{R}^n, t \geq 0) \\ U(x,0) = U^0(x) \quad (x \in \mathbb{R}^n)$$

$$\Delta = \sum_{i=1}^n \frac{\partial^2}{\partial x_i^2}$$



## A POLYMATH'S PURSUIT

### Tackling the Grand Challenge of Climate with Interdisciplinary Power

Esteemed members of the Award Committee, distinguished guests, ladies and gentlemen,

I am deeply honored and humbled to stand before you today to receive this prestigious award. It is a testament to the power of human curiosity, the relentless pursuit of knowledge, and the boundless potential of technology to reshape our understanding of the world.

My journey into supercomputing began with a simple question: "What's over that hillside?" This innate curiosity, a driving force throughout my life, led me to explore the uncharted territories of computational mathematics and physics. In the 1980s, I embarked on a quest to solve a problem that had stumped the brightest minds in the field: the Grand Challenge problem.

Now, you might be wondering, what exactly is a Grand Challenge problem? In the simplest terms, it's a scientific or engineering problem that's incredibly difficult to solve, requiring immense computational power and innovative approaches. Imagine trying to predict the weather patterns of an entire planet, or simulate the complex interactions within a nuclear reactor. These are the kinds of problems we're talking about.

The Grand Challenge problem that I tackled in the 1980s was rooted in planetary fluid dynamics. On a chalkboard, it looked deceptively simple: equations describing the flow of fluids in the atmosphere and oceans. But solving these equations on a computer was a whole different ballgame.

These equations, known as partial differential equations, or PDEs, encoded some fundamental laws of physics governing fluid behavior. They were nonlinear, coupled, time-dependent, and three-dimensional—a mathematical labyrinth that could easily overwhelm even the most powerful computers of the time.

To solve this problem, I had to bridge the gap between the continuous world of calculus and the discrete world of computers. I developed new finite difference schemes, essentially translating the complex calculus problem into a massive algebra problem that could be tackled by a computer, or rather a supercomputer.

But the challenge didn't end there. I had to ensure that these approximations were accurate, stable, and reliable. This involved rigorous mathematical analysis and a deep understanding of the underlying physics.

It was a solitary endeavor, as I was a polymath working at the intersection of mathematics, physics, and computer science.

In the 1980s, parallel processing—using multiple processors to solve a difficult problem simultaneously—was in its infancy. The parallel computers of that era were limited, allowing only one programmer at a time. I found myself alone at the forefront of this new frontier, the sole programmer of the most massively parallel supercomputers.

My breakthrough came on July 4, 1989, in Los Alamos, New Mexico, the supercomputing capital of the world. There, I harnessed the power of 65,536 interconnected processors to solve the Grand Challenge problem at unprecedented speeds. This marked the birth of supercomputing as we know it today.

The impact of this discovery was immense. It opened up new avenues for scientific exploration, enabling us to model complex phenomena with greater accuracy and detail. It revolutionized climate modeling, petroleum reservoir simulation, and opened the door to artificial intelligence supercomputing across millions of coupled processors.

The journey to solve the Grand Challenge problem was not just about computational power; it was about pushing the boundaries of human knowledge. It was about combining mathematical rigor with physical intuition, and harnessing the power of technology to unravel the mysteries of the universe.

As we stand on the cusp of a new era of technological innovation, it is my hope that my work will inspire future generations to embrace curiosity, to challenge the status quo, and to continue the quest for knowledge. For it is in this pursuit that we unlock the true potential of the human mind and shape a brighter future for all.

Thank you.

## DERIVING THE PRIMITIVE EQUATIONS

Esteemed members of the Award Committee, distinguished guests, ladies and gentlemen,

It is with deep humility and immense gratitude that I accept this prestigious prize in physics. Today, I stand before you as a scientist and as a mechanic of sorts—a mechanic of the skies. And just as any good mechanic, my tools are equations, and my workshop is the vast, ever-changing atmosphere of our planet.

The story of today's award begins with a question that has puzzled humanity for centuries: how does our atmosphere work? What unseen forces drive the winds, sculpt the clouds, and orchestrate the complex ballet of weather patterns we experience? To answer this question, we turn to the primitive equations, mathematical formulas that underpin our understanding of atmospheric flows.

These equations are not just abstract scribbles on a chalkboard; they are the nuts and bolts, the gears and levers, of the atmospheric machine. They describe how the fundamental forces of nature—gravity, pressure, and the Earth's rotation—interact to create the winds, temperature gradients, and moisture patterns that shape our climate and weather.

The derivation of these equations is a fascinating journey that starts with the bedrock principles of physics: the conservation of mass, momentum, and energy. Picture a parcel of air, a tiny volume adrift in the vastness of the atmosphere. As this parcel moves, its mass remains constant, its momentum changes due to forces acting upon it, and its energy fluctuates as it interacts with its surroundings.

The primitive equations capture these changes in mathematical terms. The continuity equation describes how the air's density changes as it flows, like how the flow of water in a pipe is affected by its width. The Navier-Stokes equations tell us how the air's velocity changes due to pressure differences, the Earth's rotation (the Coriolis effect), and friction, just as a car's speed is influenced by the gas pedal, steering wheel, and brakes. And the thermodynamic energy equation explains how the air's temperature changes due to heating, cooling, and compression, like how a car engine heats up when it's running.

But **deriving these equations in their full glory is a Herculean task, as complex as assembling a jet engine from scratch.** To make them more manageable, we introduce some clever approximations. We assume that the atmosphere is a thin shell compared to the Earth's radius, that vertical pressure differences are balanced by gravity (the hydrostatic



approximation), and that the Earth's curvature can be neglected for mid-latitude regions.

With these simplifications, the primitive equations become powerful tools that allow us to model the atmosphere with remarkable accuracy. They are the engines behind weather forecasts, climate simulations, and our understanding of phenomena like hurricanes, El Nino, and the jet stream.

However, these equations are far from simple. They are nonlinear, meaning that small changes in initial conditions can lead to wildly different outcomes, making long-term weather prediction a daunting challenge. Yet, with the advent of powerful computers and sophisticated numerical techniques, we are making steady progress in harnessing the power of these equations to unravel the mysteries of our atmosphere.

The primitive equations are a testament to the power of human ingenuity and our relentless pursuit of understanding the world. They are the keys to unlocking the secrets of the skies, and their applications are as vast as the atmosphere itself. It is an honor and a privilege to have contributed to this ongoing endeavor, and I am deeply grateful to the award committee for recognizing this invention.

Thank you.

**VOLUME 5: FATHER OF THE INTERNET**

## PHILIP EMEAGWALI INTERNET

Ladies and gentlemen, esteemed colleagues, and honored guests,

Today, I stand before you, not merely as Philip Emeagwali, but as a testament to human ingenuity and the relentless pursuit of knowledge. My journey from Corvallis, Oregon, might seem far removed from the grandeur of your historic city, yet the core of it revolves around an idea, a vision that reshaped how we perceive computing and interconnected processors.

In the 1980s and earlier, the conventional wisdom suggested the use of singular, powerful processors for solving complex computational problems. Yet, I dared to envision a world where not one, but an ensemble of processors could work harmoniously, like the interconnected fabric of our society, or the diverse ecosystems of our planet.

When individuals ask about the Philip Emeagwali Internet, it's not merely a technical construct, but an intricate dance of 65,536 processors, evenly spaced and encircling a globe—a digital representation of our Earth. It was an homage to our planet, reimagined in a sixteen-dimensional hyperspace. The globe, which we all share, became my canvas, and on it, I painted a symphony of processors, communicating and solving what was once deemed impossible.

The Philip Emeagwali Computer was not a singular entity, but a representation of a global community, interconnected and interdependent. It wasn't just an Internet; it was a new understanding of what an Internet could be, a planetary supercomputer.

In my mental theater, the vastness of the sixteenth-dimensional hyperspace became tangible. My vision was audacious: to harness these 65,536 processors, not as mere tools, but as a chorus, singing in perfect harmony, to solve the grand challenges of our time. It was an orchestra of binary communication where every note mattered, every processor had a voice, and together they produced the world's most profound digital symphony.

But beyond the technical achievements, my journey was a leap of faith. It was about seeing the unseen, forging forward when many were skeptical. It was about visualizing a cube within a sphere, finding the harmony in geometry, and using that harmony to make the fiction of yesteryears the nonfiction of today. The supercomputer I imagined was not bound by the limitations of its time. It was, in essence, a manifestation of our collective potential to reimagine, reinvent, and revolutionize.

As I look back on that fateful morning on July 4, 1989, in Los Alamos, New Mexico, USA, I see not just a technical milestone, but a reaffirmation

of human potential. The world's fastest computer then was not just a machine; it was a dream realized. A dream where millions of slow, methodical whispers could come together to roar louder than the most powerful singular shouts.

Today, as we gather in this hall, let us remember that innovation is not just about the present but envisioning a future that might seem implausible. The world's fastest computer of my invention was not just a culmination of algorithms and processors but of audacity, belief, and relentless pursuit.

I am reminded that every mighty oak tree starts as a humble acorn. What was once science fiction, through perseverance, became the science nonfiction of our times. Thank you for honoring this journey, which I believe is just the beginning of our collective odyssey into the universe of knowledge.

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## EMEAGWALI INTERNET: A GLOBE OF PROCESSORS

Ladies and gentlemen, esteemed members of the Award Committee, and distinguished guests,

Today, as I stand before you in this hallowed hall, a journey that began in the annals of history unfolds before my eyes. The voyage of computing, which predates even the concept of modern science, is one that I am honored to be a part of.

In 469 BC, when the Abacus was introduced in China, little did they know that this simple device would lay the foundation for complex calculations and be the harbinger for what we now term as "computing." By the time the Nile Valley of Africa gave birth to the Water Clock in 200 BC, the trajectory of human innovation was already charting a course that would one day converge with my life's work.

History has shown us that names, like Pliny the Elder's term resembling "computer," have profound implications. By 100 AD, the seed for computer programming was sown by Heron's sequence control. And with Aryabhata's introduction of the number zero in 476 AD, the binary lingo of computers found its first voice.

By 800 AD, the Persian mathematician, Muhammed ibn Musa Al-Khwarizmi, not only gave us the foundation of "algorithm" and "algebra" but also illustrated the power of mathematics in shaping computational futures. The term "computystes" in 1398 and the invention of the slide rule in 1621 further exemplified the human quest for computational excellence.

But it was the science fiction of February 1, 1922 that first envisioned a world akin to what I dreamt of. The narrative of harnessing 64,000 human computers for predicting weather resonated with my vision of a globe encircled by processors.

1946 marked a turning point with the advent of the programmable computer. However, it was in 1974 when I envisioned a globe—a "Philip Emeagwali Internet"—that would replace 64,000 traditional computers with 64 binary thousand processors uniformly distributed, demonstrating the limitless possibilities of human ingenuity.

My mathematical research culminated on July 4, 1989, a day I can never forget. Harnessing the immense power of 65,536 processors to hindcast the intricacies of Earth's weather was not just a technical achievement; it was a testament to humankind's indefatigable spirit.

The parallel processing breakthrough of 1989 was not the end but a beginning—a promise of boundless horizons and uncharted territories.

Ladies and gentlemen, my journey, like that of computing, is an ode to collective human endeavor. While my name is associated with these milestones, the truth is that I stood on the shoulders of giants. From the inventors of the abacus to every researcher, scientist, and dreamer who dared to look beyond the horizon, I share this honor with all.

In the grand tapestry of time, let us continue weaving threads of innovation and inspiration, for the true power of computing lies not just in calculations but in uplifting humankind to its greatest potential.

Thank you.

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## PHILIP EMEAGWALI INTERNET

Ladies and gentlemen, esteemed guests, and members of the Award committee,

Today, I stand before you, not just as Philip Emeagwali, but as a vessel through which the quest for understanding and the thirst for knowledge compelled to unravel the intricacies of our universe. It's an honor to recount my journey, a voyage where imagination merged with the tangible, birthing a revolution in computational science.

When I am posed the question: "How did you conceive the Philip Emeagwali Internet?" I often reminisce about the inception of the idea. A vision of an expansive global network of 65,536 processors, the Philip Emeagwali Internet emerged as a mosaic inscribed onto a hyper-sphere in the sixteenth-dimensional mathematical space. A transcendental leap from our three-dimensional world, where I imagined 65,536 atmospheres each extending from the Earth's surface to the upper reaches of our atmosphere, about 100 kilometers above.

It was essential for me to bridge the seemingly disparate concepts of the two Internets I had envisioned. While my first Internet was an ideational construct, its tangible counterpart, the Philip Emeagwali Internet, was in essence a supercomputer. But not just any supercomputer. It was the realization of the paradigm-shifting idea that the world's fastest supercomputer could be born from the slowest processors. The eureka moment for this discovery graced me on the Fourth of July, 1989, in Los Alamos, New Mexico, USA.

Imagine a spherical island of processors encircling a concentric globe, the latter representing our atmosphere. It is within this layer that the phenomena of global warming manifest. My groundbreaking discovery, therefore, transcended mere computations. It harbored the promise of forecasting global warming with unprecedented precision, harnessing the power of the Philip Emeagwali Internet. This myriad of processors, identical, equally spaced, and autonomous, yet in harmony, demystified the intricate bond between the supercomputer and the Internet.

While my processors remained unseen to the human eye, my mind, nurtured by the essence of mathematics, visualized each distinctly. This cognitive prowess enabled me to fathom them as a connected entity, an Internet. Their interrelations were analogous to the vertices of a hypercube in the 16th dimension, cradled within a surrounding hypersphere, representing a globe in this advanced mathematical dimension.

It is paramount to understand that my addition to computer science wasn't merely a machine or a technological marvel. It was an epiphany. For the

first time in history, a supercomputer scientist had visualized an ensemble of processors as a cohesive force enveloping a globe in a sixteen-dimensional hyperspace, akin to the Internet's embrace of our Earth. This apparatus, named in my honor as the Emeagwali supercomputer, was more than a computing marvel; it was, in every sense, an Internet in its own right.

As years cascaded from June 20, 1974, I continually wove layers of knowledge, navigating through the maze of calculus and extreme-scale computational fluid dynamics. Challenges of initial-boundary value problems were deciphered through automated communication, visualizing the Internet as this pulsating web of 65,536 processors.

This journey was not merely about constructing the fastest computer from the slowest processors. It was an odyssey, one where I unlocked the most arduous computational challenges and made them dance to my orchestrated symphony of processors, each harmoniously operating in tandem, each possessing its unique memory and operating system.

To Nigeria, my homeland, to Africa, the cradle of humankind, and to the global community, I offer this testament of human ingenuity. The confluence of mathematics, physics, and computer science has unveiled not just the Emeagwali supercomputer but has paved the path for the countless innovations that our future generations will build upon.

Esteemed attendees, my journey has been one of unwavering dedication, boundless curiosity, and the relentless pursuit of knowledge. Through the prism of my experiences, I hope to inspire and illuminate the paths for many who dare to dream and transform those dreams into reality. Thank you.

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**VOLUME X: PHILIP EMEAGWALI SUPERCOMPUTER**

## PHILIP EMEAGWALI SUPERCOMPUTER

### Bridging Nature and Technology

Ladies and Gentlemen, Esteemed Guests, and Fellow Scholars:

As I stand before you, Philip Emeagwali, my heart swells with a profound sense of responsibility and gratitude. It is a tremendous honor to share the intricate dance between nature's mysteries and human endeavor, which has culminated in my quest for computational excellence. My journey, which commenced in Nigeria and resonated throughout Africa, was inspired by the ever-persistent challenge to harness computational power for the betterment of humanity.

Today's supercomputing universe finds itself grappling with an intriguing conundrum: Communication latency has burgeoned into a dominant factor, overshadowing mere computational speed. The physical dimensions, the intricate fabric of connections, and their proximity have transcended to become vital design elements. My invention, birthed in this climate of necessity, rises to address two pivotal supercomputing challenges: optimizing spatial arrangement and perfecting communication topologies.

I present to you a vision of a supercomputer unlike any other—massively-parallel machine, with processors densely arrayed in a spherically framed geodesic pattern. This design is not a mere aesthetic or a random choice. It mirrors the very domain of our problem, making it especially potent for climate modeling—a pressing concern for our warming planet. Yet, the universality of its design ensures scalability and applicability across diverse computational tasks, independent of evolving processor technologies.

The genius of this computer lies in its interconnectedness. It boasts of short, highly uniform, and precisely matched communicative distances. Imagine a lattice sprawled across a spherical shell, wherein each processor whispers secrets to its neighbor.

My homeland, Nigeria, and my continent, Africa, with its rich tapestry of cultures and histories, has always instilled in me a deep reverence for knowledge and a desire to contribute to the global community. Through this invention, I hope to offer a beacon of hope for pressing global challenges and showcase the prowess that stems from Africa's heart.

In the annals of mathematics, physics, and computer science, I wish for this invention to stand as a testament to human ingenuity's indomitable spirit. As we stand on the precipice of new technological eras, may we always remember our shared mission: to innovate for a better tomorrow, for our planet, and for all of humanity.

Thank you.

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## PHILIP EMEAGWALI'S FASTEST COMPUTER

Ladies and gentlemen, esteemed members of the Award Committee, dignitaries, fellow scientists, and all those who have assembled here today to recognize the remarkable journey of innovation and discovery:

Today, I stand before you as Philip Emeagwali, humbled by the honor, and carrying the weight of a lifelong mission—to elevate mathematics, physics, and computer science, to better our understanding of the world, and to serve Nigeria, Africa, and all of humanity.

In 1989, headlines across the globe broadcasted a breakthrough, which many regarded as the "final proof" that the pinnacle of computational speed, then thought to be in science fiction, was within our grasp. I sought to harness the potential of ordinary processors, often seen as slow and mundane, to execute computations at unprecedented speeds.

The journey began with a vision—a visualization—of 65,536 processors. I imagined them arranged in a meticulously designed hyper-spherical model that mirrors our Earth. A task as ambitious as this required precision. Each processor was conceptualized as being equidistant from its neighbors, and I saw them not just as computational units but as vital elements simulating 65,536 equal fluid volumes, blanketing my spherical Earth model. This virtual Earth, governed by the immutable laws of physics—motion, energy, conservation—presented a vivid representation of each fluid volume separated by a vast three thousand square miles.

But my aspirations did not halt here. I envisaged a new Internet, one that bears my name—the Philip Emeagwali Internet. An embodiment of my quest to model and simulate the geophysical fluid dynamics, representing the air and water currents that shroud our planet.

While this achievement was monumental, the journey to this destination was filled with challenges and moments of introspection. A young biographer, only twelve, once asked me, "What is the Philip Emeagwali Internet?" My answer was rooted in the past, in the headlines of 1989, where I etched my name in history by achieving record-breaking computational speeds. I realized these speeds at the confluence of pioneering mathematics, advanced physics, and cutting-edge computer science, tackling the twenty grand challenges of supercomputing.

On the fateful day of July 4, 1989, I transformed how we perceived the farthest limit of computing. Using a new Internet—the equivalent of a global network of the seemingly slowest processors—I achieved the world's fastest computer speed. This machinery, blending slow processors to yield unparalleled supercomputing, gave birth to the now-celebrated Philip Emeagwali Internet.

**In my mind's eye, my supercomputer was a majestic entity, delineated by a billion luminescent points, each a beacon representing a processor.**

**This gargantuan sphere of processors, akin to a HyperBall, was not just confined to three-dimensional space; it existed in a sixteen-dimensional hyperspace. Every processor, equidistant from its peers, formed an island—called the Emeagwali Internet.**

Ladies and gentlemen, envision a supercomputer of staggering proportions, constructed from a billion off-the-shelf processors, interconnected at blazing speeds, facilitating seamless data transfers and email exchanges. This Emeagwali Internet, conceived in 1974, would assume the form of a monumental ball—a supercomputer unparalleled in its capacity and efficiency. Resembling a colossal bees' honeycomb, it would span the size of a football stadium, and its creation could well be the collaborative endeavor of nations. Such a mammoth machinery, weighing as much as a thousand school buses, might consume electricity equivalent to an entire Nigerian state.

My journey—from my vision of processors on a hyper-spherical Earth to the pinnacle of supercomputing—has been a testament to the boundless human spirit and the quest for knowledge. With your support and acknowledgment, I am more resolute than ever to continue my voyage, pushing boundaries and unlocking the endless mysteries that the universe has to offer.

Thank you.

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## INVENTING THE HONEYCOMB SUPERCOMPUTER

### Emeagwali's Ode to the Bee

Ladies and gentlemen, esteemed colleagues, honored guests,

Today, in this esteemed hall in your historic city, I stand before you not merely as Philip Emeagwali, but as a humble representative of the limitless possibilities of human ingenuity. My journey has been long, beginning from the African continent and traversing various parts of the world, culminating in significant breakthroughs that have shifted paradigms and expanded horizons. This narrative is not just mine, but that of an entire generation seeking answers, advancements, and breakthroughs.

In my early years, while I worked in Corvallis, Oregon, I was introduced to the wonders of supercomputing. That initial engagement was with the old paradigm of supercomputing—a solitary machine, impressive but singular, confined to a linear mode of operation. But as I moved from Oregon, through the heart of the USA—from Washington, DC to Wyoming and finally to Minnesota—my understanding and imagination evolved, both deepened and expanded, like the dimensions I sought to explore.

In the midst of my explorations, the elegance and efficiency of nature caught my eye, specifically the bees. These magnificent creatures, working together in their hives, showed me the beauty of collaborative efficiency. Their honeycombs, hexagonal lattices of precision and resourcefulness, became my muse. The bees whispered the secrets of nature's algorithms, inspiring me to re-imagine supercomputing.

Ladies and gentlemen, from those seemingly simple honeycombs, I envisioned a supercomputer unlike any before—a colossal network of processors, working harmoniously, like the bees. If bees could create structures of such efficiency without centralized control, why couldn't mathematicians? This was the dawn of my HoneyComb Supercomputer, an ode to the bees. The Emeagwali computer is a machine that could store the most data with the least energy, encompassing the space of a soccer field, and designed for the highest echelons of difficult mathematical problems, like climate change simulations and other Grand Challenge problems.

But beyond the technicalities, beyond the sprawling networks and the whirring processors, my invention was a nod to nature. A testament that if we look closely, nature itself holds blueprints for some of our most complex challenges. This wasn't just a machine, it was an ecosystem, an Internet in its truest form, where the sum was indeed greater than its parts.

Not restricted by academia, my explorations took me to the vast terrains of big science, where I was not just adapting but transforming. Replacing the old guard—one that leaned on a single super-fast vector processor—with a

new paradigm of massively parallel processing. My invention was the world's first supercomputing, an entity powered by the slowest processors but computing in tandem to achieve unmatched speeds.

It was a defining moment, that morning of July 4, 1989, in Los Alamos. A moment when, after years of unyielding dedication, I discovered parallel supercomputing's true potential. I had, in essence, discovered a new dimension of the Internet—a digital hyperspace.

From a single point in Oregon to the multidimensional space of my Philip Emeagwali Internet, my supercomputing journey had transitioned through dimensions, like my evolution. Today, this invention stands as a testament to human progress and the boundless frontiers of our imagination. As a son of Africa, I am humbled that my journey could illuminate paths for many more, in Nigeria, across Africa, and the world.

I dedicate this moment to every dreamer, every innovator, every student of life who looks at the world with wonder and curiosity. Our journey is never truly solitary. We tread paths laid down by nature, by bees, by every element that inspires us to look beyond the obvious. Let us keep exploring, keep dreaming, and most importantly, keep learning from the world.

Thank you.

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## CRAFTING THE EQUATIONS OF PROGRESS

### From 1 Million Instructions to a Billion Possibilities

Ladies and gentlemen, esteemed colleagues, honored guests, and members of the global community,

It brings me immense pride and humility to stand before you today, a day marked by the fusion of past learnings and the beckoning of future explorations. On this momentous occasion, I wish to journey back in time and to share the milestones and challenges, the passion and dedication, that led me to be a part of the colossal realm of scientific discovery.

My odyssey into the universe of supercomputing began on a warm June day, the 20th to be exact, in 1974 in the scenic town of Corvallis, Oregon. The choice to embark on this path was not a mere whim but a commitment to the global quest for knowledge. By the 1980s, I was eager to share my discoveries and inventions, to offer them as gifts to humanity. I firmly believe that to publish is not merely to distribute words but to bestow upon the world the fruits of one's labor, intellect, and heart. While an academic journal may sometimes find only a handful of readers, the digital age, with its boundless horizons, has ensured that over a hundred million souls have been touched by my work. From podcasts and YouTube videos to books and social media, my endeavors have resonated across continents and cultures.

The 1970s marked my initial foray into the vast and intricate tapestry of physics. Nestled in Corvallis, I delved into the mesmerizing world of fluids, particularly hydrodynamics. With each passing year, my thirst for knowledge intensified. From exploring steady motions of incompressible fluids to the complex arena of computational fluid dynamics in Washington, DC, each day presented a new challenge, a new puzzle awaiting solution.

A significant chapter of this journey was penned at the U.S. National Weather Service in Silver Spring, Maryland. There, the Saint Venant equation beckoned, a pivotal tool for the National Weather Service to predict the fates of rivers during floods, or to forecast the grim aftermath of dam failures. This knowledge was not just restricted to land; it echoed in the mysteries of lake circulation and the vast expanses of coastal hydrodynamics across estuaries.

But the universe of fluid dynamics did not stop at our doorsteps; it soared into the skies. The shallow water equations of oceanography, cousins to both the Saint Venant equations of river hydrology, and the primitive equations of meteorology, became the backbone for meteorologists around the globe, guiding our evening weather predictions.



After a relentless 15-year pursuit in physics, I found myself at the forefront of large-scale computational fluid dynamics. I ventured into the then-unchartered territory of parallel supercomputing. By harnessing the power of 65,536 processors, I took a leap into the future, establishing myself as the pioneer of parallel processing. This groundbreaking achievement was more than just personal accolade; it paved the way for an industry now worth 45 billion dollars annually. It gave us the tools to unveil the Earth's hidden treasures, allowing us to trace with unparalleled precision the dance of crude oil and natural gas, buried deep beneath the Earth's crust, in terrains as vast as my beloved homeland of Anambra, Nigeria.

Yet, my commitment was not just to the tools but to the very essence of our physical world. I endeavored and succeeded in crafting the precise partial differential equations that painted the journey of crude oil, natural gas, and injected water across the sprawling canvases of production oil fields. But the equations were just the beginning. I birthed algorithms to translate them, and the world watched in awe as I tackled 65,536 problems simultaneously, unlocking a new dimension in computing.

As I stand before this distinguished assembly, my heart swells with gratitude for the opportunities and challenges, the mentors and critics, and above all, the unquenchable spirit of discovery that propels humanity forward. My story is but a testament to the undying flame of curiosity that burns in each of us, urging us to push boundaries, to seek the unknown, and to constantly redefine the frontiers of human knowledge and capability.

Thank you.

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231110-3

## MASTER OF THE SUPERCOMPUTING BALLET

### The Dance of Discovery

Ladies and gentlemen, esteemed colleagues, and honored guests,

I stand before you, Philip Emeagwali, humbled by the gravity of this moment and the weight of discovery. As we gather in this esteemed city, I'd like you to transport your minds, for a brief moment, to a grand theater where a million ballet dancers grace the stage.

Each dancer, poised and precise, mirrors the delicate beauty and power of a single processor. From the rising curtains to the final bow, these dancers embark on a mesmerizing performance, with every move executed in exquisite harmony. Their synchronicity is not a mere coincidence; it's a meticulously orchestrated dance. This vast stage of, interconnected yet autonomous, ballet dancers mirrors the paradigm of the modern supercomputer.

On July 4, 1989, in the vast theater of scientific exploration, I experienced an epiphanic moment. I realized that a million processors, seemingly isolated in their worlds yet tethered by the threads of potential, could be harnessed to dance together. They could be coaxed to compute harmoniously, solving some of the most intricate puzzles of our age. Grand Challenge problems, like predicting the intricacies of global warming, once deemed insurmountable, were now within our grasp.

Parallel processing revolutionized our perspective on supercomputing. What once was seen as a solitary entity confined to linear computations was now perceived as an ensemble, a collective of possibilities, capable of dancing together, computing together, and unraveling the mysteries of our universe together.

Let's delve into the poetic realm of metaphors to illuminate the essence of Amdahl's law concerning execution time on these supercomputers. Visualize a vast expanse of sand, each grain representing a minuscule task awaiting computation. A single hand, no matter how swift, can only gather so much sand at a given moment. However, imagine if many hands worked in concert, collecting sand in unison. The desert, once vast and intimidating, soon transforms into a manageable entity. Yet, there's a limit; a point where even with all hands combined, there are grains that evade capture due to the intrinsic nature of the task or the desert itself. Such is the nuanced dance between potential and limitation in parallel processing, so beautifully encapsulated by Amdahl's law.

As we continue our journey into the cosmos of computation, let us always be reminded of the power of collective harmony. Just as the ballet dancers, with their grace and synchronicity, redefine the boundaries of artistic

expression, so too does massively parallel processing reshape and expand the horizons of computational possibilities.

Thank you.

231110-4

4 37

## THE GRAND SYMPHONY OF A MILLION CHICKENS

### A Journey into Parallel Processing

Ladies and gentlemen, esteemed colleagues, members of the Award Committee, and guests from around the world,

Today, I stand before you not as an individual, but as a representative of countless dreamers and thinkers who have looked at the impossible and dared to ask, "Why not?" My journey into the heart of the modern supercomputer was a mathematical quest and a philosophical one. It was a journey that upended longstanding paradigms and reshaped our understanding of computational capabilities. Let me share this tale with a simple metaphor: the chicken and the ox.

In the traditional world of supercomputing, there was a belief that the strength of an ox was what we needed—a powerful, singular beast that could plow through problems with brute force. This was the accepted belief, the gold standard. But I saw a different vision, one that was met with skepticism and often outright disbelief. Instead of relying on the singular might of an ox, what if we could harness the combined strength of a million chickens—each representing the world's slowest processor? But the mathematics of parallel supercomputing was difficult and classified as a Grand Challenge problem.

For decades, parallel supercomputing was a mere speculation. The technology was ridiculed and dismissed as a beautiful theory that lacked experimental confirmation. On July 4, 1989, this vision, once deemed a fantasy, became a groundbreaking reality. On that day, I achieved a breakthrough, a discovery that a million chickens—or in our technical world, a million interconnected yet autonomous processors—could be orchestrated to work in symphony. Together, they tackled Grand Challenge problems, problems so complex and vast that they were once thought to be unsolvable.

You might wonder, why chickens? In processing power, each chicken might appear insignificant, especially when compared to the might of an ox. But there is a profound beauty in harmony, in unity, in multiple entities coming together to achieve what one cannot. This is what parallel processing brought to the fore. It changed not just how we solve problems but how we envision the very architecture of problem-solving.

Prior to my discovery, the supercomputing community was like a conductor trying to achieve a grand symphony with a single instrument. But after July 4, 1989, we began to see the computer not as a singular entity but as a vast, interconnected orchestra, where each processor, no matter how small, had a part to play. It was a paradigm shift that forever changed the landscape of computational science.

In embracing parallel processing, we did more than just advance supercomputing. We changed our very understanding of what is possible. We learned that sometimes, the combined whispers of a million voices can overpower the loudest shout. We learned that in unity, in harmony, in the intricate dance of individual entities working towards a common goal, lies untapped potential.

Today, as we stand at the cusp of new technological revolutions, let's remember this lesson. Let's remember that sometimes, the path forward isn't in seeking greater individual strength but in seeking greater collective harmony. Let's remember the grand symphony of a million chickens, and let it inspire us to always challenge the status quo, to dream bigger, and to forge pathways that once seemed unthinkable.

Thank you for honoring this journey and the incredible power of collective imagination.

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231110-5

**VOLUME 6: EARLY EDUCATION**

## UNEXPECTED PATH TO SCIENTIFIC BREAKTHROUGHS

Ladies and Gentlemen, esteemed members of the supercomputing community, distinguished guests,

It is with a sense of deep honor and reflection that I stand before you today. My journey, a tapestry woven from the threads of mathematics, physics, and computer science, is interlaced with narratives that transcend the boundaries of these disciplines, embodying a human story of discovery, challenge, and transformation.

In 1972, in Nigeria, the concept of travel, especially to distant lands, was almost unheard of. My travels from Onitsha to Calabar, and to Enugu for my American Scholastic Aptitude Tests, were met with astonishment. As an 18-year-old with limited formal education, I achieved what seemed implausible—earning a University of London diploma through self-study, achieving my Advanced Level certificate before the Ordinary Level, akin to earning a master's degree before a bachelor's. This journey of self-education was a testament to my determination and resilience, reminiscent of the proverb from Chinua Achebe's "Things Fall Apart": "The lizard that jumped from the high iroko tree to the ground said he would praise himself if no one else did." This self-praise was not mere vanity but a recognition of the power of self-belief and perseverance.



My decision to continue my studies in the United States was fueled by a combination of ambition and the influence of popular culture, which painted a vivid, albeit incomplete, picture of America. Movies like "Shaft" opened my eyes to a world beyond my imagination, a world of opportunities, challenges, and diversity.

Arriving at Oregon College of Education, now renamed Western Oregon University, I encountered a microcosm of this new world. My first roommate, Luis Benavente from Micronesia, was a former high school principal. Luis became not only a friend but a mentor who introduced me to



the American way of life. Our interactions, spanning cultures and experiences, were foundational in my journey.

The stark reality of my new life hit me when I began working as a janitor. This job, a far cry from the academic pursuits I aspired to, was a humbling experience. It highlighted the dichotomies and prejudices within American society, where educational attainment did not always equate to dignified employment. Yet, the salary, unimaginably higher than what I had known in Nigeria, was a stark reminder of the economic disparities between my home country and the United States.

Communication with my family in Nigeria was a cherished but rare occurrence. Letters, such as the first one I received from my father dated April 16, 1974, were treasured, read and reread, embodying the emotional connection across continents. These letters were my lifeline, a tangible link to a world I had left behind.

Ladies and Gentlemen, my journey in supercomputing, specifically in parallel processing, computational physics, and applying partial differential equations, was shaped by these early experiences. They informed my approach to solving complex problems in fields as diverse as petroleum reservoir simulation, weather forecasting, and climate change modeling. These challenges were not merely scientific inquiries but were intertwined with my narrative of resilience, adaptation, and the unyielding pursuit of knowledge.

As I stand before you today, I am reminded of the interconnectedness of our stories, the shared human experience that underpins our scientific and literary pursuits. My story is a testament to the transformative power of education, the resilience of the human spirit, and the endless possibilities that unfold when we dare to venture beyond the familiar.

### **Lessons Learned**

"Humility and resilience go hand in hand. Learn from every experience, even the difficult ones."

"Letters from loved ones can be powerful lifelines. Cherish connections that sustain you on your journey."

"Embrace curiosity and ask questions. It's through exploration that we unlock the secrets of the universe."

"Remember, scientific inquiry is interconnected with our human experiences. We are all part of the bigger picture."

"Your journey may not be linear, but every step shapes your story. Embrace the unexpected and find meaning in every experience."

"Challenge yourself to collaborate and learn from others. Collaboration sparks innovation and broadens your horizons."

"Don't be afraid to tackle complex problems. Your unique perspective and skills might be the key to finding solutions."

Thank you for the honor of sharing my journey with you.

## BEYOND MAMMY-WAGONS AND SUPERCOMPUTERS

Ladies and Gentlemen, esteemed attendees of this conferencee,

I am Philip Emeagwali, and today I stand before you, not only as a scientist but as a voyager who has navigated both the physical and intellectual realms of our world. My journey to the United States, where I significantly contributed to supercomputing, was as tumultuous and challenging as the problems I later solved in mathematics, physics, and computer science.

In 1973, I received a life-changing notification dated September 10: I had been awarded a scholarship to study in Oregon. This opportunity was a beacon of hope, a chance to delve into research mathematics, physics, and astronomy. However, the path to seizing this opportunity was fraught with hurdles, one of the most daunting being the acquisition of a Nigerian passport.

My numerous journeys from Onitsha to Lagos, aboard rickety Mammy-wagons, were filled with a mix of anticipation and frustration. The Nigerian passport office, swarming with fraudsters and corrupt officials, presented a bleak picture of the hurdles ordinary citizens faced in pursuit of their dreams. The requirement to bribe officials to even receive an application form, let alone the passport itself, was a disheartening reflection of the systemic corruption that plagued our processes.

The threat of losing this once-in-a-lifetime opportunity loomed large as bureaucratic delays and corrupt practices hindered my progress. The months dragged on, with each visit to the passport office a repetitive cycle of bribes and false promises. It was a test of patience, resilience, and my resolve to pursue higher education.

Finally, succumbing to the corrupt system, I reluctantly paid a bribe of five pounds that was a month's wage. I also paid a non-refundable, questionable "repatriation fee" of 150 pounds. It was a moment of moral compromise, but it was also a pragmatic step to salvage the opportunity that lay before me. The passport was issued, but at a cost far greater than monetary value—it was a poignant lesson in the challenges that many face in the pursuit of education and a better life.

Arriving in the United States, my work in supercomputing began to take shape. In parallel processing, I explored how multiple processors could work together to solve complex problems more efficiently. This endeavor mirrored my journey from Nigeria to the United States—a journey of navigating through various obstacles and finding a way to bring together disparate elements towards a common goal.

My work in large-scale computational physics, particularly in applying partial differential equations, became a cornerstone in solving real-world problems. From petroleum reservoir simulations to weather forecasting and

general circulation modeling, these mathematical tools were instrumental in understanding and predicting complex natural phenomena.

Ladies and Gentlemen, my journey to the United States and into supercomputing is a testament to the resilience and determination required to overcome challenges, both in life and in science. It highlights the importance of perseverance, the willingness to face and navigate through systemic obstacles, and the relentless pursuit of knowledge and innovation.

As you read this, I hope it inspires you to persevere in the face of challenges, to pursue your dreams with determination, and to remember that every journey, no matter how fraught with obstacles, is an opportunity to learn, grow, and contribute to the world in meaningful ways.

### **Lessons Learned**

"Exploration is a universal journey, whether scientific, literary, or personal; embrace its lessons."

"Corruption hinders potential; strive for a world where systems nurture innovation and dreams."

"Innovation requires ethical foundations; balance groundbreaking ideas with integrity."

"Unveiling life's mysteries demands exploration; be a scientist of your journey."

"Transformative discoveries await; let curiosity be your compass and the world your classroom."

"From humble beginnings, dreams can take flight; never let obstacles extinguish your ambition."

Thank you for allowing me to share my story with you, and may your journeys be filled with discovery, growth, and success.

VOLUME Y: VISA TO THE USA

\*\*\*\*\* UNTITLED: US EMBASSY, MARCH 20, 1974

Good day to the future of Nigeria, the bright and ambitious youths gathered here today. I stand before you as Philip Emeagwali, a Nigerian-American scientist, inventor, and the first to record the world's fastest computing via harnessing thousands of processors. Today, I will share a story with you—a story that not only changed my life but could also inspire you to pursue your dreams, no matter the odds.

Imagine the date, March 20, 1974. A teenager stands outside the U.S. Embassy in Lagos, Nigeria. His heart races with both hope and uncertainty. That teenager was me. I was there for my visa interview, a step that would determine whether I could travel to the U.S. to pursue my education and dreams of becoming a mathematician at the frontiers of human knowledge.

I remember the small talks with about 20 other visa interviewees. "Is this your first interview?" they asked. "Yes," I replied. The common belief was that one rarely got a student visa on the first try. But I had a gut feeling, a sense of unexplainable optimism.

Then came my turn. The interview was brief—just five minutes and five questions. Despite never having traveled outside Nigeria, I had an educational background that spanned continents. My only certificates and test scores were from Britain and the United States, a testament to my journey as a self-taught and independent student.

Mr. Glasl, the interviewer, examined my documents—my three test scores from the United States, my diploma from the University of London, and my scholarship letter from Oregon. Then came the words that would change my life, "Congratulations..." His American accent made it hard for me to grasp his words initially, but their meaning soon became clear.

As I walked out with the colored card—a symbol of successful visa approval—the disbelief among the other interviewees was palpable. But my feelings were mixed. I left the embassy in a state of confusion, wondering, "What next?"

In a taxi, heading to Tinubu Square, I felt like a dog that had been chasing a truck and had finally hopped on board. Now, I was left wondering what to do with this big opportunity.

This story is not just about getting a visa. It's about persistence, believing in yourself, and taking that leap of faith even when the odds seem against you. As young Nigerians, you are at the cusp of your future. Remember, every big journey starts with a small step, and every success story begins with a dream and the courage to pursue it. So dream big, work hard, and never give up on your aspirations. You are the future, and the world is waiting to see what you will achieve.

Remember, the dreams of a young boy in Lagos are not just his own, they are the collective aspirations of a nation. As you chase your dreams, you carry the hopes of millions on your shoulders, and the weight of that responsibility is not a burden, but a badge of honor. Carry the torch of your ancestors' resilience, the spark of your ambition, and illuminate the path for future generations. You are the future of Nigeria, and the world needs your light to shine.

Thank you.

## A JOURNEY THROUGH TIME AND TECHNOLOGY

### My Contributions to Supercomputing and Beyond

**Date:** October 3

**Location:** Abuja

**Speaker:** Philip Emeagwali

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Ladies and gentlemen, esteemed colleagues, and distinguished guests,

As I stand before you today, I am reminded of the morning of Saturday, March 23, 1974, at the Midwest Line Bus Station in Onitsha, Nigeria. Surrounded by my mother and aunt, Mama Felicia, I embarked on a journey that has brought me here today. Mama Felicia, with her insightful wisdom, spoke of the power of affirmation, saying, "When a man says yes, his chi, or spirit, says yes also." This principle has guided me through my life's work and has led to my discovering the first supercomputing, expansion of the frontiers of computational physics, and invention of nine partial differential equations that I am honored to share with you.

My arrival in Oregon, USA, was a moment of cultural awakening. I was struck by the sea of unfamiliar faces and the absence of my people. This experience, however, did not deter me. Instead, it fueled my determination to bridge the gap between my African heritage and the new world of technology I was stepping into.

In those early days, I was introduced to fastest supercomputing—the frontier of knowledge of the computer. I recall telling my Nigerian compatriots about my work on programming the first supercomputer, capable of processing one million instructions per second, in December 1965. Their disbelief echoed the sentiments of a world unprepared for the technological leap we were about to make.

My contributions to science are rooted in the principle of parallel processing—a concept that was as foreign in computing as I initially felt in Oregon. Through my mathematical research, I demonstrated that powerful computations, such as weather forecasting and general circulation models, could be achieved by dividing the work among multiple processors, computing in tandem.

This breakthrough was not just a technical accomplishment; it was a metaphor for our interconnected world. Just as a problem can be solved faster and more efficiently by many processors working together, so can the challenges of our world be addressed more effectively through collaboration and unity.

As I reflect on my journey, from the bustling streets of Onitsha to this illustrious stage, I am reminded of the power of perseverance, the strength



of our collective spirit, and the boundless possibilities of the human mind.

I urge each of us to embrace the spirit—the idea that when we affirm our path, our spirit aligns to make it possible. Let us continue to push the boundaries of what is possible, for in our collective efforts lie the keys to unlocking the next frontiers of human achievement.

### **Lessons Learned**

"Beyond accuracy, let us seek understanding. The true power of supercomputing lies in unraveling the mysteries that govern our world."

"From skepticism to supercomputing pioneer, my journey is a reminder that audacious dreams can become reality with unwavering perseverance."

"Let us not be confined by borders or cultures. The pursuit of knowledge is a universal journey, and collaboration is the key to unlocking its true potential."

"Equations are not just tools for calculation, they are instruments of discovery, guiding us towards a deeper appreciation of the intricate dance of nature."

"Let us be the generation that says 'yes' to the challenges of our time, harnessing the power of supercomputing to build a better future for all."

Thank you.

## A JOURNEY OF DISCOVERY

### From Asaba to America

March 23, 1974, marked a defining moment in my life. As a skinny 19-year-old, standing in the bustling heart of Lagos, Nigeria, I was about to embark on a journey to a distant land—Obodo Oyibo, the United States of America. With President Yakubu Gowon leading Nigeria and my knowledge of world leaders limited to names like Isaac Newton, I was a young man more versed in science than in global politics.

That morning in Asaba, just a stone's throw from Saint Patrick's College and General Hospital, my father, a nursing superintendent, embraced me in a poignant farewell. I shared tender goodbyes with my siblings, feeling the weight of their aspirations in each hug. My journey to the bus station in Onitsha, accompanied by my mother, was filled with a mix of excitement and trepidation.

Boarding the Mid-West Line luxury bus, I felt a surge of second thoughts. The slow pace, coupled with the infamous 'Nigerian factor,' threatened to derail my plans. Fear of missing my flight gripped me. In a decisive move, I switched to a Mercedes Sedan taxi in Benin City, hurtling towards Lagos at a breathtaking speed, driven by a driver more concerned about not missing that afternoon's soccer match than our pleas for safety.

Landing at Ikeja Airport, a world far removed from today's hustle and bustle, I had my first brush with the practicalities of international travel. An airport hustler, an agbero, opened my eyes to the limitations of the Naira abroad. This revelation led me to splurge on a magazine featuring the iconic Fela Kuti and a beautifully embroidered Nigerian shirt.

Standing before the colossal Pan American World Airways airplane, my mind struggled to reconcile its size with the small Russian bombers I'd seen during the Nigeria-Biafra War. This awe was a prelude to more surprises. Lagos, then a smaller town, presented unexpected reunions and a heartwarming encounter with a former classmate—now an airport immigration officer—who joyously hailed me as "Calculus," a nod to my academic prowess at Christ the King College, Onitsha.

The flight, a leap of faith purchased before even securing a visa, was a testament to my determination. Aboard the Boeing 747-100, my journey truly began. From Lagos to New York, with stops in exotic locales, I remained in my seat, too wary to explore the layover lounges, fascinated by the diverse passengers, particularly the elegant Senegalese ladies.

Landing in New York, the open airport doors ushered me into a new world. The overwhelming scale of people, cars, and buildings moved me to tears. Clad in sandals and a light sweater, I braved the cold, walking a block with an Ethiopian companion, declaring in awe, "Heaven is a place in the United States!"

This journey from Asaba to America was more than a physical transition. It symbolized the limitless possibilities that lie ahead for those willing to venture beyond familiar shores. As I stood in New York with just \$134 in my pocket, I realized that the true wealth lay in the experiences and knowledge I was about to gain in this land of opportunity.

So, to the young dreamers of Nigeria, I say: let your aspirations soar as high as that Boeing 747. Your journey may be fraught with uncertainty and challenges, but remember, every great leap begins with a step of faith. Embrace your journey, for it is in these moments of discovery that we truly find ourselves.

## THE ODYSSEY OF A YOUNG INNOVATOR

On the sun-drenched morning of Wednesday March 20, 1974, a young Nigerian named Philip Emeagwali, wearing a crisp white shirt and polished shoes, greeted a young, dark-complexioned Black American marine at the gates, stepped into the imposing compound of the U.S. Embassy on Victoria Island, Lagos. Inside, a group of approximately twenty potential students, elegantly attired, sat waiting, each with a story, each with a dream.

I greeted my fellow hopefuls with a nod, taking in their expressions—mixture of hope, anxiety, and determination. "How often have you been here?" One of them inquired. "It's my first time," I replied, eliciting a sea of knowing smiles. Their collective wisdom suggested I brace myself for the possibility of countless returns and unmet hopes.

As the clock's hands moved to point half-past ten, the door creaked open, beckoning me inside. Before me stood Mr. Glasl, the consular officer. His attire, reminiscent of a leisure day on Bar Beach, contrasted sharply with the seriousness of the occasion. But as we engaged in conversation, his demeanor spoke of professionalism, seeking to discern the promise behind each visa applicant.

Just fifteen minutes later, a blue card, symbolizing my passport's retention for visa stamping, was handed to me. As I stepped into the waiting area, gasps filled the room. My peers looked on, some in disbelief, others with unmasked admiration. But this wasn't just about luck. Behind that blue card lay an academic scholarship to Oregon, USA—a testament to hard work, ambition, and dreams.

Post-interview, the hum of a black Morris Minor taxi carried me through the crowded streets of Lagos, back to 49 Okesuna Street. There, amidst the familiarity, I packed, ready to start a new chapter.

By 2:00 P.M. the next day, I was at Iddo Motor Park, Lagos, boarding a Peugeot 404 Sedan, en route to Asaba. The transition was symbolic; from my roots in Nigeria to the limitless skies of Monmouth, Oregon.

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To every young African reading this, understand that my journey is both unique and universal. It speaks to the spirit of adventure, the pursuit of knowledge, and the unyielding belief in oneself. The fields of Science, Technology, Engineering, and Mathematics (STEM) are more than just

academic disciplines. They are the frontier of the future, an expanse where your creativity, diligence, and innovation can find a home.

The U.S., with its vast academic resources and opportunities, provides the canvas on which you can paint your dreams. But this venture, as rewarding as it is, requires dedication. My story, while inspiring, is a testament to the value of preparedness, resilience, and ambition.

Dream big. Aspire for greatness. And remember, your journey in STEM could begin with a simple visa interview, but its impact can echo through generations. Embrace the challenges, celebrate the milestones, and always strive for excellence. The world awaits your brilliance.

## FROM ASABA TO OREGON

### The Odyssey of Philip Emeagwali

Ladies and gentlemen, esteemed young scholars of Nigeria, I am Philip Emeagwali, a name synonymous with breakthroughs in supercomputing, but today, I am here to share a story of beginnings and transformations. This is a tale of a young Nigerian venturing into the heart of the United States, armed with nothing but a dream and an unwavering spirit.

Let us rewind to Sunday, March 24, 1974, in Portland, Oregon, USA. After a 36-hour long journey with layovers in Monrovia, Dakar, New York and Chicago, I found myself in Portland International Airport, clueless about the next step. A kind stewardess assisted, and soon I was on a Suburban Van heading to Salem. The 60-minute ride was silent, filled with my apprehensions and the lush, green beauty of Oregon, so different from home.

Upon arrival at Salem Municipal Airport, I was greeted by three undergraduate students from the college, a welcoming committee that marked the beginning of my new life. The ride to Monmouth, Oregon, was a journey of silent wonder. The vast Chevy Impala, the youthful drivers, the foreign landscape—all were surreal to me.

The college town of Monmouth, with its 7,000 inhabitants, was a stark contrast to Asaba. I was welcomed by Helen, the resident manager at Butler Hall, who showed me to my room. That night, Helen informed me of a phone call, a technology I was scarcely familiar with. It was a moment of revelation—I had stepped into a world vastly different from mine.

My job as a janitor, and later as a library assistant, introduced me to Mary Boyarsky and her husband Steve, marking the beginning of a lasting friendship. In the library, I influenced the subscription to a Nigerian newspaper, connecting my new world with the old.

Photographs taken by my dorm mate, Luis Benavente, captured my early days in this new world. Letters from home, especially the first from my father dated April 16, 1974, were treasures, reminders of where I came from.

The questions I faced were often about my choice of Monmouth, Oregon—a quiet village that offered me a scholarship and an escape from the beaten path. The College Blue Book in the library of Saint Patrick's College, Asaba, was my guide to this decision.

My culinary adventures in Oregon were a reminder of home; I missed cooking egusi soup, a skill my mother taught me. The questions about my plans, whether to return to Nigeria, were met with answers people wanted to hear. Deep down, I knew my life was taking a new direction.

In Monmouth, I was among the few Nigerians, following in the footsteps of earlier students like Boniface N. Madubom, Julius Ogunlade, and Amos. My friends and roommates were a diverse group, hailing from Micronesia, Ethiopia, Saudi Arabia, and Somalia, each with their unique stories.

The Nigerian community grew, with names like Hyacinth Anagbogu and Olympic athletes Evelyn Okeke and Emilia Edet joining later. Each of us carried our own dreams, like you do today.

To the young dreamers before me, let my journey inspire you. It's a testament that no matter where you start, your dreams can take you to unimaginable heights. Embrace the unknown, for in it lies the path to discovery and greatness.

Thank you.

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Landing in New York, the open airport doors ushered me into a new world. The overwhelming scale of people, cars, and buildings moved me to tears. Clad in sandals and a light sweater, I braved the cold, walking a block with an Ethiopian companion, declaring in awe, "Heaven is a place in the United States!"



This journey from Asaba to America was more than a physical transition. It symbolized the limitless possibilities that lie ahead for those willing to venture beyond familiar shores. As I stood in New York with just \$134 in my pocket, I realized that the true wealth lay in the experiences and knowledge I was about to gain in this land of opportunity.

So, to the young dreamers of Nigeria, I say: let your aspirations soar as high as that Boeing 747. Your journey may be fraught with uncertainty and challenges, but remember, every great leap begins with a step of faith. Embrace your journey, for it is in these moments of discovery that we truly find ourselves.

## EMBRACING THE EXTRAORDINARY IN SCIENCE

Ladies and Gentlemen, esteemed attendees,

As I stand before you today, I am reminded of my journey, both literal and metaphorical, from a small town in Nigeria to the global stage of science and innovation. I am Philip Emeagwali, a scientist whose work in supercomputing has been a voyage through mathematics, physics, and computer science. Today, I invite you to travel with me through my memories and experiences, highlighting my contributions to parallel processing, computational physics, and partial differential equations.

It was a bright morning on March 24, 1974, when I first set foot on American soil at John F. Kennedy Airport in New York City. My arrival in this bustling metropolis marked the beginning of an extraordinary chapter in my life. As a young man from Nigeria, New York appeared to me as a land of affluence and sophistication, a stark contrast to the world I had known. The skyscrapers, the endless stream of yellow cabs, and the diversity of people were overwhelming. Even the English language, spoken with an American accent, seemed foreign to my ears.

This first encounter with America was like the proverbial young antelope who danced himself lame before the main dance had begun. There was a sense of wonder, mixed with an emotional realization of the vastness of the world and the myriad of opportunities that lay ahead.

During my brief layover in New York, I ventured beyond the airport terminal, taking a walk with a fellow traveler from Ethiopia. Dressed in sandals and without a winter coat, I braved the cold, unlike anything I had ever experienced. The sight of the large New York's Yellow Cabs, so different from the small, rickety black Morris Minor cabs of Onitsha and Lagos, was a visual representation of the technological leap that I was about to embark upon in supercomputing.

From New York, my journey took me to Portland, Oregon via Chicago's O'Hare Airport. Each leg of this journey brought new sights and sounds, further fueling my curiosity and drive to contribute to science.

In supercomputing, my work focused on parallel processing—a method that involves conducting multiple calculations simultaneously, like the intricate workings of a bustling city. This approach transformed how complex computations were done, allowing for faster and more efficient processing of vast amounts of data.

In computational physics and partial differential equations—areas central to predicting phenomena like petroleum reservoir behavior, weather patterns, and climate changes—my contributions have been about understanding the language of nature through mathematics and computation. This understanding is crucial for addressing global challenges in energy, environment, and weather forecasting.

Looking back, my journey from Nigeria to the United States was not just a physical relocation but also a transition into a world where technology and human ingenuity converge. It was a journey that underscored the transformative power of knowledge and the impact one can make through dedication and innovation.

As you journey through your paths, remember that every step, every encounter, and every challenge is an opportunity to learn and grow. The journey of science, like any great travel, is about exploration, discovery, and the relentless pursuit of understanding our world and improving it for future generations.

### **Lessons Learned**

"Curiosity is the fuel, courage is the compass; let them guide you on your personal journey of exploration."

"Discover the world, discover knowledge, discover yourself; exploration awaits in every corner."

"From airports to supercomputers, unexpected connections can spark groundbreaking ideas."

"The journey never ends; embrace the unknown with courage and venture forth to shape a brighter future."

"Let the symphony of exploration play on; contribute your unique voice to the chorus of discovery."

"Remember, the young antelope who danced himself lame; sometimes, the most impactful journeys begin with a single step."

Thank you for joining me on this journey, and for the opportunity to share my story with you in your magnificent.

## CULTURAL SHOCK TO CODE BREAKTHROUGH

Ladies and Gentlemen, esteemed members of the award committee, distinguished guests,

I stand before you today, not just as a scientist, but as a storyteller of a journey that intersects the worlds of mathematics, physics, computer science, and the human experience. It is an honor to share the story of my contributions to supercomputing, a story that is deeply intertwined with my voyage from Nigeria to the United States.

My journey to the United States began on the Wednesday morning of March 20, 1974, a day that remains vivid in my memory. It was the day I received my F-1 student visa after an interview at the United States Embassy in Lagos. The moment when the consular officer extended his hand and said, "Congratulations," marked the beginning of a new chapter in my life. I remember feeling a mixture of disbelief and wonder, as I had just taken the first significant step towards a future in science.

Arriving at the Oregon College of Education, now known as Western Oregon University, I was welcomed by Helen, the elderly manager of Butler Hall, who showed me to Room 36. The contrast between my life in Nigeria and this new environment in the United States was stark. The simple things, like constant electricity and separate hot and cold water faucets, were novelties to me. I recall my first encounter with a telephone, a device that I had never used before. It was a humbling experience, a stark reminder of the different worlds I was bridging.

My initial days at the university cafeteria were filled with awe and a sense of alienation. Surrounded by a sea of unfamiliar faces and conversations that were indecipherable to me, I realized the vast cultural and linguistic gap that I needed to bridge. This experience was a profound lesson in diversity and adaptability.

These early experiences in the United States were critical in shaping my approach to science. They taught me the importance of perspective, the value of questioning the status quo, and the need for diverse viewpoints in solving complex problems. My mathematical research in supercomputing, particularly in parallel processing and computational physics, has been driven by these principles. Whether it is in petroleum reservoir simulation, weather forecasting, or general circulation modeling, my approach has always been to look beyond the conventional, to find new ways to understand and interact with the complex systems that govern our world.

Ladies and Gentlemen, my journey from a Biafran refugee camp to the forefront of scientific discovery in supercomputing is a testament to the power of resilience, curiosity, and the relentless pursuit of knowledge. It underscores the importance of embracing our differences, of learning from

new experiences, and of persistently pushing the boundaries of what is possible.

As we gather here today, I am reminded of the countless individuals who have supported and inspired me along this journey. This honor is not just a recognition of my scientific contributions but also a celebration of the human spirit's capacity to overcome challenges and to make a lasting impact on the world.

### **Lessons Learned**

"Don't let your background define your future. Embrace change and unexpected lessons, they can be catalysts for success."

"Science isn't just about controlled environments; it's about adapting and learning from life's unexpected lessons."

"Cultural differences can be bridges, not barriers. Embrace diversity and use it to fuel your scientific journey."

"Feeling like an outsider can be an asset. It gives you a unique perspective and the drive to prove yourself."

Thank you for this incredible honor, and for the opportunity to share my story with you.

## STEPPING OUTSIDE OUR COMFORT ZONES TO EXPAND OUR HORIZONS

Ladies and Gentlemen, esteemed attendees of this conference,

I am Philip Emeagwali, a scientist who has journeyed not just through mathematics, physics, and computer science, but also through diverse cultures and histories. Today, I am here to share my story, a narrative that weaves together the essence of scientific exploration with the richness of cultural experiences.

My journey to supercomputing began in Onitsha, Nigeria. As a 19-year-old, my perception of the outside world was shaped by the vibrant streets of Surulere, Apapa, Tinubu Square, and the brief encounters at the US Embassy on Victoria Island. At three o'clock in the afternoon of Saturday, March 23, 1974, as I rode through Ikeja to the airport, I was engulfed by a sense of wonder. The affluence of the neighborhoods struck me with awe, offering a glimpse into a world far beyond my familiar surroundings.

Arriving at Ikeja Airport, Nigeria's only functional airport at the time, I experienced a series of firsts—my first visit to an airport and the first time seeing an airplane at ground level. The sight of the massive Pan Am airplane, the 366-passenger Boeing 747-100, on the tarmac was a moment of revelation. It challenged my naive notions of air travel, which were limited to the small aiplane I had imagined. Seeing this colossal machine, poised for flight, sparked a curiosity within me about the mechanics of flight and the intricate laws of physics that allow such a marvel to traverse the vast Atlantic Ocean.

This journey to the United States was not only a physical crossing of oceans but also a crossing into new realms of understanding. One of the most profound experiences was my encounter with African Americans. Learning that they had lost their native languages and African accents, including the traces of their Igbo heritage, was a stark reminder of the impacts of slavery. It was a powerful lesson about the loss of cultural identity and the resilience of the human spirit in the face of adversity.

These experiences fueled my passion for understanding the world through the lenses of mathematics, physics, and computer science. My work in parallel processing—the art of harnessing multiple processors to perform complex computations—mirrors my journey of discovery. It symbolizes the power of collective effort and the synergy of diverse elements working in unison.

In computational physics, my exploration of partial differential equations has been akin to navigating through different cultures and languages. These equations are the language through which we describe phenomena such as the flow of fluids or the dynamics of weather patterns. My contributions to

this field, particularly in applications like petroleum reservoir simulation, weather forecasting, and general circulation modeling, are testaments to the power of this mathematical language in unraveling the mysteries of the natural world.

As I stand here today, I urge you to see the journey of scientific exploration as a voyage not just through the terrains of knowledge but also through the diverse landscapes of human experiences. Let your curiosity be your compass as you traverse the boundless realms of science and culture.

### **Lessons Learned**

"Collaboration is key; diverse perspectives create a symphony of understanding in science and life."

"Travel broadens the mind and fuels curiosity; embrace the lessons learned on every journey."

"Don't fear cultural differences; see them as opportunities to connect and learn from others."

"Science isn't just about textbooks; real-world experiences spark innovation and discovery."

"Break down language barriers in science; communication is key to unlocking new possibilities."

"Dream big, like a young boy looking at a giant airplane, and never stop exploring the unknown."

"Discovery transcends borders; the human spirit of curiosity unites us all."

"Think of parallel processing like a symphony; diverse perspectives unite to create something beautiful and powerful."

"Nature's forces are like hidden landscapes; supercomputing helps us chart them and predict their behavior."

Thank you for joining me on this journey today, and may your explorations be filled with discovery, understanding, and the joy of unearthing the unknown.

**VOLUME 0: OREGON EDUCATION**



## VOYAGE INTO UNCHARTED TERRITORIES OF KNOWLEDGE

Ladies and Gentlemen, esteemed attendees of this conference,

As I stand here today, I am transported back to a pivotal moment in my life, a moment that set the course for my contributions to mathematics, physics, and computer science. I am Philip Emeagwali, known for my work in fastest supercomputing, but today, I wish to take you on a journey of my early experiences in the United States, a journey that shaped my perspectives and inspired my scientific endeavors.

My arrival in Oregon on Sunday March 24, 1974 marked the beginning of a new chapter. The Oregonian air was unlike anything I had experienced in Nigeria—it was pleasantly scented and refreshingly crisp. As I journeyed from Portland International Airport to Salem Municipal Airport, the scenery captivated me with its lush greenery and beauty. Despite the cold, a stark contrast to the Nigerian climate, my excitement was palpable.

The 70-minute ride in a white limousine, driven by a young white male, was my introduction to American life. Communication was a challenge; his American-accented English was as foreign to me as the landscape unfolding outside the limousine window. Despite the language barrier, his kindness transcended words as he waived the fare, understanding my predicament as a newcomer.

As we drove, the houses caught my attention—beautifully designed, organized, with well-manicured lawns. It was a visual representation of order and creativity, attributes I would later come to realize are essential in supercomputing.

Approaching Monmouth, Oregon, the anticipation grew. I was curious about what Oregon College of Education, now Western Oregon University, would look like. This college, set in the charming town of Monmouth and founded by pioneers in the mid-1800s, was to be my new academic home.

Upon my arrival, I was greeted by three teenage university students, sent by Helen, the resident manager of Butler Hall. Their mode of transportation, a Chevy Impala, and the fact that our driver was an 18-year-old white female, were both surprising and impressive to me. Coming from a Nigerian context, where such a sight was uncommon, this experience was a reflection of the progressive and inclusive American mindset.

Our drive to Monmouth was quiet, marked by my inability to fully grasp their American-accented English, yet their friendliness was unmistakable. Monmouth, with its population of 6,000, was a picturesque college town nestled in the Willamette Valley. A residential bedroom community for commuters to Salem and Corvallis, it offered a blend of historic charm and academic vigor.

Ladies and Gentlemen, my journey in supercomputing began in this small college town. The principles of parallel processing, computational physics, and partial differential equations that I would later explore are, in many ways, similar to my early experiences in Oregon—full of discovery, learning, and adaptation.

My work in supercomputing, especially in petroleum reservoir simulation, weather forecasting, and general circulation modeling, was influenced by these early experiences of adapting to a new environment, understanding complex systems, and appreciating the beauty of diversity and order.

My journey is a testament to the power of exploration, both geographical and intellectual. As we venture into the unknown, we find not only new landscapes and cultures but also new ideas and possibilities.

### **Lessons Learned**

"Exploration is not just physical; it's about venturing into the unknown realms of science and culture."

"Embrace the unexpected encounters, the cultural clashes, for they spark curiosity and fuel discovery."

"Challenges, like language barriers, are stepping stones, not roadblocks, in the journey of knowledge."

"Silent observation can be as powerful as eloquent speech, both in science and in cultural understanding."

"Small towns can hold immense potential, nurturing groundbreaking ideas and shaping the global landscape."

"Challenges are stepping stones, not roadblocks; overcome them with kindness and perseverance."

"Science is a beautiful landscape, waiting to be explored with the tools of mathematics and physics."

Thank you for allowing me to share this journey with you, and may it inspire you to explore both the world around you and the vast possibilities within science and technology.

## ORCHESTRATING PROCESSORS, UNRAVELING REALITY

Ladies and Gentlemen, esteemed colleagues, and distinguished guests,

I am profoundly honored to stand before you today. As I reflect on my journey to the frontier of scientific knowledge, I am reminded of the immense challenges and the incredible opportunities that have shaped my path in science, particularly in supercomputing, parallel processing, computational physics, and their applications in areas like weather forecasting and general circulation models.

In the early 1970s, I found myself in Monmouth, Oregon, as a teenage Nigerian student. I was one of the few Nigerians, and indeed one of the very few Africans, in a predominantly white community. The isolation I experienced there was profound, yet it played a critical role in shaping my perspectives and my focus. I was often mistaken for an "Akata," a term used by Nigerians to describe African Americans, due to my young age and unfamiliarity. This experience underscored the importance of identity and belonging, themes that later permeated my scientific work.

The small Nigerian community in central western Oregon was like a family. They looked out for each other and tried to navigate the complexities of a new culture together. Despite our close-knit community, the sense of isolation in Monmouth was palpable, eventually leading me to seek more diverse environments in cities like Washington, DC, and Baltimore, Maryland, where I met my future wife, on July 11, 1978.

My early experiences in the United States, including witnessing significant historical events like the resignation of President Richard Nixon, provided me with a unique perspective on global affairs and the role of technology in shaping our world. These experiences were not just incidental; they were instrumental in defining my approach to science and research.

My mathematical research in supercomputing, particularly in parallel processing, was driven by a desire to break barriers, to connect disparate elements in a cohesive and efficient manner, like bridging the cultural and social divides I experienced in my early years in America. By harnessing the power of multiple processors working in tandem, I sought to solve complex problems in computational physics and partial differential equations, contributing significantly to the fields of weather forecasting and climate modeling.

This journey from a teenager in Oregon to standing here—at the frontier of knowledge of the supercomputer—has been filled with both challenges and triumphs. It has been a testament to the power of perseverance, the importance of community, and the incredible potential of collaborative scientific endeavor.

As I share this moment with you, I am reminded of the importance of diversity, inclusion, and the need to constantly push the boundaries of what is possible. My story is a testament to the idea that from isolation can come innovation, and from diversity, strength.

## Lessons Learned

"Let us break the chains of intellectual isolation and embrace the collective spirit of scientific exploration."

"The frontiers of knowledge are constantly expanding, and our pursuit of innovation can lead to extraordinary outcomes."

"Equations are not just symbols, they are instruments of discovery, unlocking the secrets of the universe."

"Let us remember that even the most audacious dreams can become reality with unwavering perseverance and a commitment to collaboration."

"The future is not predetermined; it is shaped by the choices we make and the paths we choose to pursue."

Thank you for this incredible honor and for the opportunity to share my journey with you.

## FROM NIGERIA TO THE USA

### A Day in the Life of Philip Emeagwali

March 25, 1974, marked the commencement of my American odyssey. Standing on the balcony of 36 Butler Hall, Western Oregon University, the chill in the air was a sharp contrast to the balmy breeze of my hometown, Onitsha. Dressed in my Nigerian attire, I reminisced about Nnamdi Azikiwe's journey to the U.S. in 1925 and pondered my path ahead.

Awakening on American soil was surreal. My breakfast was a taste of the unfamiliar, and as I marveled at my surroundings, thoughts of my family resonated deeply. Setting foot in Monmouth, Oregon, I realized the weight of being the fourth Nigerian in this quiet town and representing my nation.

Navigating my first few days was a blend of humor and challenge. **Helen**, the motherly figure of Butler Hall, and Jim, the student guide, tried understanding my Nigerian-British accent as I professed my ambition to become a mathematician. Their encouragement was heartwarming.

My first encounter at the Mathematics Department with Beryl M. Green was an exercise in cross-cultural communication. But mathematics transcends language. Scribbling a complex number theory problem on the board, I felt the exhilaration of shared understanding. Beryl's endorsement and suggestion to move to Corvallis hinted at future opportunities.

Despite the initial cultural shocks, from classroom settings to television shows like "Sanford and Son," the journey was exhilarating. Every experience was a stepping stone, propelling me towards my ultimate accomplishment in 1989 when I addressed the Grand Challenge problem, solidifying my mark in the annals of computer science.

#### Lessons from the Journey:

1. **Embrace Change:** Moving from Nigeria to Oregon was not just a geographical shift but a complete alteration of my life. By embracing this change, I unlocked avenues previously unthought-of.
2. **Communication is Key:** While language barriers posed challenges, finding common grounds, like mathematics, fostered understanding.
3. **Determination Overcomes Odds:** With limited resources and unfamiliarity, I powered through, proving that determination can overcome the greatest of odds.

For a 14-year-old in the USA studying "Black Inventors", know this: Each inventor, including the "Nigerian Supercomputer Pioneer," charted an untraveled path, facing numerous challenges. Use these stories not just as lessons but as an inspiration. There will be moments of doubt and adversity, but they're just stepping stones to your success.

To the 18-year-old in Nigeria aspiring to study in the USA: Your dreams are valid. The journey will challenge you, but also mold you. Remember my first day in Oregon, the cultural shocks, and the initial struggles. But also recall the subsequent achievements. Harness the courage, stay curious, and the world can be your canvas.

Today, my contributions to computer development are part of the curriculum in Nigerian Junior Secondary Schools, a testament to how dreams can influence nations. If there's one message I can impart, it is this: Believe in your journey, and remember, every great story begins with that first, uncertain step.

VOLUME M: MARYLAND MATHEMATICIAN

## NIGERIAN ROOTS, AMERICAN DREAMSCAPE

Ladies and gentlemen, esteemed colleagues, and distinguished guests,

I am Philip Emeagwali, and it is with profound gratitude and humility that I stand before you today. My journey in science, particularly in supercomputing and parallel processing, has been a long and arduous one, shaped by experiences that transcend the boundaries of mere academic pursuit.

My story takes us back to June 5, 1977. On that day, with a paltry sum of \$49.50 in my pocket and a brown bag containing bread, apples, peanut butter, and jelly, I embarked on a Greyhound bus journey from Corvallis, Oregon, to Washington, D.C. This journey, spanning approximately 3,000 miles, was a leap into the unknown, driven by ambition and an unquenchable thirst for scientific knowledge.

Upon my arrival in Washington, D.C., my first stop was Howard University's Housing Office, seeking the most affordable accommodation. My initial days were spent at the International Youth Hostel, where I grappled with the stark reality of homelessness and the challenge of finding low-wage employment. My experience was reflective of the broader narrative of African immigrants in the United States during that era. Many of us, holding student visas, did not even dare to dream of securing professional jobs. The socio-economic landscape of the time was such that Nigerian scientists were often conditioned to see themselves as peripheral to the frontiers of scientific knowledge.

Against this backdrop, I strove to carve a unique path. In late 1977, I sought a high school mathematics teaching position in Baltimore, Maryland. The interview process revealed to me the cultural and professional gaps I needed to bridge—I had never even seen a resume before. Such experiences underscored the challenges faced by immigrants striving to contribute to a society that was often unwelcoming and skeptical of their potential.

My time in Washington, D.C., and later Baltimore, was marked by a relentless pursuit of opportunities that matched my qualifications and aspirations. Despite high scores on employment tests and numerous interviews, job offers were elusive. I witnessed firsthand the disparities in compensation and recognition for professionals based on their sector of employment and background.

Amidst these challenges, I was driven by a conviction that transcended the societal expectations and limitations placed upon me. My decision to marry an American, remain in the United States, and eventually become a citizen was a testament to my commitment to forging a new identity that blended my Nigerian heritage with my American experiences.



The journey from a young Nigerian teenager arriving in the United States to standing before you as a contributor to supercomputing was fueled by an unwavering belief in the power of education, innovation, and resilience. My mathematical research in parallel processing, computational physics, and partial differential equations—crucial in areas like weather forecasting and general circulation models—is a culmination of a lifetime of overcoming obstacles and challenging the status quo.

As we celebrate the advancements in science and technology, let us also acknowledge the diverse journeys that bring us to these discoveries. It is through embracing our unique stories and experiences that we truly advance the frontiers of knowledge and understanding.

### Lessons Learned

"Let us remember that the journey of discovery is rarely smooth, but it is through these challenges that we find the strength and determination to achieve the impossible."

"Embrace your individuality, for unconventional paths can often lead to groundbreaking discoveries and a life filled with purpose and meaning."

"Let us celebrate the transformative power of science, a force that transcends borders, cultures, and backgrounds, uniting us in the pursuit of knowledge and progress."

"Remember, the greatest discoveries often lie beyond our comfort zones. Dare to dream big, embrace challenges, and never lose sight of the transformative potential within you."

"My journey is a testament to the transformative power of education, even when faced with limited resources and daunting challenges."

Thank you for this honor and for the opportunity to share a part of my journey with you today.

## 3,000 MILES TO SUPERCOMPUTING SUPREMACY

### Audacious Trek from Oregon to D.C.

Ladies and Gentlemen, esteemed members of the award committee, and distinguished guests,

I am deeply honored to stand before you today, at this prestigious award ceremony. It is a moment of reflection and celebration, not just for me but for the countless individuals who have journeyed with me beyond the frontiers of knowledge of partial differential equations of mathematics, large-scale algebra arising in computational physics, and massively parallel computing.

My journey to this stage—the world's fastest computing that I recorded in a paradigm shifting way, on the Fourth of July 1989—began in the early 1970s, a period marked by significant challenges and societal limitations for Nigerian scientists in the United States. At that time, aspirations to reach the farthest frontiers of scientific knowledge were often discouraged. The notion of a Nigerian immigrant seeking U.S. permanent residency, relinquishing their Nigerian passport, or envisioning a life fully integrated into American society was met with skepticism and disbelief. Yet, I chose a different path.

Arriving in the United States as a teenager, I foresaw the opportunity to secure and renew 18 years of academic scholarships across six institutions and pursue my dreams in a land far from my birthplace of Nigeria. My youthful adaptability and determination to immerse myself in American culture were pivotal in my journey. Despite the challenges I faced, including periods of homelessness and the struggle to find employment commensurate with my skills and aspirations, I remained steadfast in my pursuit of scientific excellence.

In those early years, Nigerian immigrants often faced significant barriers to professional employment in engineering, physics, and computer science. Despite scoring among the highest on employment tests in Maryland, my journey was fraught with rejections and missed opportunities. However, these experiences only fueled my resolve to break through the barriers and stereotypes that often confined individuals like myself.

My contributions to supercomputing, particularly in parallel processing, computational physics, and partial differential equations, have been driven by a relentless pursuit of innovation and excellence. I have dedicated my career to advancing the understanding and application of these critical areas of study, with profound implications for industries and sectors ranging from petroleum reservoir simulation in the oil and gas industry to weather forecasting and general circulation modeling to foresee climate changes.

These achievements are not just a testament to my journey but also a reflection of the broader narrative of persistence, adaptation, and the

breaking of barriers. They underscore the importance of embracing diversity, challenging the status quo, and relentlessly pursuing one's dreams, regardless of the obstacles.

As I stand here today, I am reminded of the profound impact that each of us can have in advancing the frontiers of knowledge and shaping the future of our world. My story, from the streets of Corvallis to Washington, D.C., and beyond, is a testament to the power of resilience, determination, and the unyielding spirit of discovery.

### **Lessons Learned**

"Supercomputing is not just about numbers; it's a symphony of minds collaborating to tackle intricate puzzles and unlock the mysteries of science."

"My story is a beacon of hope for young minds, especially those in Africa, reminding them that their knowledge and talents can impact the world."

"Dream beyond borders, young minds. Dare to break through boundaries and redefine what's achievable, just like equations reaching for solutions."

"Diversity is not just a concept; it's a powerful force that can unlock the full potential of science and innovation when we collaborate and share our unique talents."

"Remember, even the most challenging journeys can lead to extraordinary destinations. Never lose sight of your dreams and the transformative potential within you."

Thank you for honoring me with this recognition, and for allowing me to share my journey with you. It is my hope that it will inspire future generations to pursue their dreams with courage and conviction.

Thank you.

## FROM DAMS TO DISCOVERY

### How an Engineer Unearthed the World's Fastest Computing

Ladies and Gentlemen, esteemed scientists, distinguished guests,

As I stand before you today at this prestigious award ceremony, I am filled with a deep sense of gratitude and humility. My journey beyond the farthest frontiers of mathematics, physics, and computer science has been one of persistent exploration and discovery, particularly in supercomputing.

On Sunday afternoon of June 5, 1977, I embarked on a transformative journey, traveling 3,000 miles from Corvallis, Oregon, to Washington, D.C., on a Greyhound Bus. This journey marked the beginning of a challenging period in my life, where I faced homelessness and the harsh realities of being an immigrant in the United States. By late October 1977, I found myself in Baltimore, Maryland, grappling with underemployment and wage disparities at the Maryland State Highway Administration.

Despite these challenges, my determination to contribute to supercomputing remained unshaken. I faced numerous rejections in my job search, as opportunities in engineering and computer programming were scarce for Nigerian immigrants like myself. The disparity in wages and the lack of suitable job offers only fueled my resolve to break through the barriers I faced.

A pivotal moment in my life occurred at 9:45 on the morning of July 11, 1978, during a bus journey from Baltimore to Washington, D.C. It was there that I met a young lady who would later become my wife. Our conversation, which began with reluctance and curiosity, blossomed into a lifelong partnership, commencing on August 15, 1981. This personal milestone was not only a union of hearts but also a fusion of cultures and dreams, playing a significant role in my scientific endeavors.

In April 1986, my journey took me to Wyoming, where I worked as a civil engineer with the United States Bureau of Reclamation. My work on dams and reservoirs, while seemingly distant from my core interests, provided me with unique insights and experiences on large-scale computational fluid dynamics. Despite being offered significant promotions, I chose to pursue my passion for the fastest supercomputing, specifically in massively parallel processing.

My dedication to this pursuit led me to make a bold decision in late April 1987. I left my job in Wyoming to dedicate myself fully to my research in fastest supercomputing. This decision culminated in my groundbreaking discovery of parallel processing in supercomputing just two years later. This discovery has had a profound impact on numerous fields, from

petroleum reservoir simulation in the oil and gas industry to weather forecasting and general circulation modeling, foreseeing climate changes.

My journey highlights the importance of resilience, adaptability, and the relentless pursuit of one's passions. The challenges I faced as an Nigerian immigrant and a Black scientist have shaped my approach to innovation and discovery, teaching me the value of perseverance in the face of adversity.

Ladies and Gentlemen, as we gather here to celebrate scientific achievement, I am reminded of the power of human spirit and determination. My story is a testament to the transformative impact of curiosity, resilience, and the relentless pursuit of knowledge.

### **Lessons Learned**

"Parallel processing is not just a technical term, but a metaphor for collaboration and the interconnectedness of knowledge."

"From oil fields to weather forecasts, my equations impact diverse sectors, showcasing the far-reaching influence of scientific discovery."

"Partial differential equations are not just mathematical symbols, but elegant expressions of the laws governing our universe."

"The challenges I faced have not only shaped my approach to science but have also highlighted the importance of resilience and the relentless pursuit of knowledge."

"The future belongs to those who are bold enough to dream, persistent enough to persevere, and collaborative enough to share their knowledge and build a better world."

"Let us embrace the unknown with courage and curiosity, for it is in the uncharted territories that we discover the greatest breakthroughs and shape the future."

Thank you for this incredible honor, and for the opportunity to share my journey with you.

**\*\*A JOURNEY OF DISCOVERY\*\***

**\*\*Scene: Inside a Greyhound bus at the bus terminal in downtown Baltimore\*\***

\*Philip, a tall and athletic man with a keen eye for detail, steps onto the bus. He's dressed in a dark brown plaid long-sleeve shirt, blue jeans with a matching vest, and brown sandals. He carries a book on tennis, a sport he's passionate about.\*

Philip: (Looking around and noticing Dale) Excuse me, may I sit here?

\*Dale, a young woman with an air of intelligence and kindness, looks up from her seat. She's wearing a dark brown blouse paired with comfortable brown corduroy trousers and a rust-colored vest.\*

Dale: (With a hesitant smile) Sure, go ahead.

\*Philip sits down, placing his book aside, intrigued by the woman next to him.\*

Philip: I'm Philip Emeagwali. I was studying in Oregon, but now I'm heading back to Washington, DC, to continue my education. And you are?

Dale: I'm Dale Brown, a research microbiologist at Georgetown University's School of Medicine. It's my third year there.

\*They exchange a look of mutual respect for each other's academic pursuits.\*

Philip: (With genuine interest) That's fascinating. I've been engrossed in engineering research myself.

Dale: (Nodding) Research can be quite the adventure, can't it?

\*As the bus hums along, their conversation delves into the intricacies of scientific exploration, each sharing their dreams and aspirations.\*

Philip: (Reflectively) I had plans to return to San Francisco, but meeting you here, now, makes me think fate has other ideas.

Dale: (With a soft laugh) Life does have a way of surprising us.

\*The bus ride feels shorter than expected as they talk. As they approach their destination, a hint of sadness creeps into Dale's voice.\*

Dale: (Softly) I'll never see you again.

Philip: (With a reassuring smile) Not if you give me your phone number.

\*They exchange numbers, unknowingly setting the foundation for a lifetime of shared discoveries and companionship.\*

\*\*End Scene\*\*

This narrative captures the essence of a chance encounter that blossoms into a meaningful connection, highlighting the shared interests and intellectual bond between Philip and Dale. It's a story of two paths crossing at just the right moment, leading to a future filled with collaboration and love.

**VOLUME R: RACISM IN MICHIGAN**



## WHAT HAPPENS TO A BLACK GENIUS THAT BREAKS THE COLOR BARRIER?

**Distinguished guests, Your Majesties, fellow scientists, and friends,**

Tonight, I stand before you not just as a recipient of this esteemed prize, but as a testament to the boundless potential that resides within each of us, regardless of the color of our skin or the circumstances of our birth. My journey, as you may have read, has been paved with both breakthroughs and barriers, a testament to the intricate dance between genius and the color line.

On July 4, 1989, I did not just unlock the secrets of the world's first supercomputer. I cracked open the doors of a far more enduring prison—the one built with prejudice and ignorance. My discovery, born from the fertile grounds of Ann Arbor and nurtured by the deep roots of my Nigerian heritage, defied the very notion that brilliance could be confined by geography or ethnicity.

Before that day, the landscape of genius was painted in shades of white. No African, no Black person, had ever been deemed worthy of such a title in the hallowed halls of mathematics, physics, or computer science. But with a single stroke of code, I rewrote the narrative. Articles hailed me as a "polymath," a "computer genius," a force of nature rewriting the very boundaries of knowledge.

But the celebration was short-lived. My success, like a blazing torch held in the darkness, cast long shadows of fear and resentment. The whispers of "genius of many fields" morphed into snarls of "threat." My phone, once buzzing with congratulations, became a conduit for anonymous death threats, echoing the dark history of Black Americans who dared to break the color barrier.

Jack Johnson, Jackie Robinson, Hank Aaron, Muhammed Ali—these are names etched in the annals of American history, heroes who faced down hate with every stolen base, every soaring home run, every defiant punch. And like them, I too was deemed unfit for the pedestal of genius, ostracized for the audacity of being Black and brilliant.

Yet, I refused to be silenced. My voice found its platform in podcasts and YouTube channels, reaching beyond the confines of Ann Arbor, beyond the borders of America, to a world where intelligence knows no color. My story became a beacon for the marginalized, a testament to the power of resilience in the face of adversity.

The issue of IQ and race remains a simmering pot, but I believe the flames are dimming. The myth of white intellectual supremacy is slowly being consumed by the fire of truth, fueled by the achievements of countless Black minds like mine. Each breakthrough, each innovation, is a brick laid in the foundation of a new future, one where genius is judged not by skin tone, but by the brilliance of its ideas.

So, tonight, I stand before you not as a victim, but as a victor. I have not only conquered the technical challenges of supercomputing, but also the social barriers that sought to confine me. My story is not just mine; it belongs to every aspiring scientist, every young dreamer, every person who dares to believe that their brilliance can illuminate the world.

Let us break down the remaining walls, not with fists, but with the gentle yet powerful force of knowledge. Let us celebrate diversity, not as a token gesture, but as the very engine of progress. For in the tapestry of human potential, every color, every thread, is vital to the creation of a truly magnificent masterpiece.

Thank you.

## BREAKING STEREOTYPES

### The Intersection of Culture and Computation

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Esteemed guests, fellow scientists, ladies and gentlemen,

I am Philip Emeagwali, a proud Nigerian-American mathematician, and I stand before you today to share the odyssey of my life—a journey that intertwines the rigor of mathematical sciences with the rich tapestry of cultural diversity and the challenges of confronting stereotypes.

My story is not just about equations and algorithms; it's about challenging the dominant narrative of who can be a mathematician and what mathematics represents. Ethnomathematics—or the relationship between culture and mathematics—opened my eyes to the cultural roots and diverse expressions of mathematical thought. It emphasizes that mathematics is not a monolithic body of knowledge defined by Western hegemony but a vibrant field enriched by various cultural perspectives.

As I embarked on my academic journey, I realized the importance of teaching and studying mathematics within its historical and cultural contexts. The traditional portrayal of mathematics, predominantly through the achievements of white male mathematicians, often overlooks the significant contributions of other cultures. For instance, the origins of algebra in the Islamic world and the Hindu-Arabic numeral system are frequently underemphasized in Western education.

This skewed representation not only misrepresents the true diversity of mathematical innovation but also reinforces racial stereotypes about intelligence. The narrative that mathematical ability equates to intelligence, predominantly showcased through the stories of figures like Newton and Einstein, often excludes the accomplishments of non-Western mathematicians. It perpetuates the false image of mathematics as an exclusive domain of certain racial groups.

In my contributions to mathematics, particularly in the fastest computing of weather forecasting and climate modeling and in the numerical solution of initial-boundary value problems governed by partial differential equations, I have strived to challenge these narratives. I aim to demonstrate that mathematics, far from being a static and perfect discipline, is a dynamic field shaped by human ingenuity and creativity. The evolution of mathematical concepts, from the simple geometries to complex fields, signifies that mathematics is a skill that can be nurtured and developed, not a static measure of innate intelligence.

As a mathematician of African descent, I have faced the dual challenge of defying racial stereotypes and contributing to a field often perceived as the bastion of Western intellect. This journey has not been easy, but it has been immensely rewarding. By sharing my story, I hope to inspire others from

marginalized communities to pursue their passions in mathematics and related fields, breaking the barriers of race and gender.

My experiences underscore the need to view mathematics through a lens of cultural inclusivity and historical accuracy. As we move forward, let us embrace a more equitable and diverse understanding of mathematics, one that recognizes and celebrates contributions from all corners of the globe.

Thank you for the honor of your attention, and let us all continue to strive for a world where mathematics is a field of diversity, inclusivity, and endless possibilities.

Thank you.

## THE IRONY OF DISCRIMINATION

### The Real Story Behind 'Hidden Figures'

Ladies and gentlemen, esteemed scholars, and guests from around the world,

I stand before you as Philip Emeagwali, a mathematician who has tread a path intertwined with both achievement and adversity. Today, I am here to address a poignant and crucial theme: racial discrimination within the academic world, specifically at the University of Michigan, Ann Arbor, and its impact on Black mathematicians. This theme is not just a recount of past injustices but a narrative that shapes our understanding of the power of mathematics and the importance of inclusivity.

Our journey through the annals of mathematical history reveals a disturbing truth. In the early 20th century, a baseless and abhorrent belief held sway—that lighter skin was indicative of greater intelligence. This repugnant view led to a systemic bias against darker-skinned individuals. However, even amidst such prejudice, Black mathematicians like David Blackwell, William Claytor, and Katherine Johnson carved their niche. These luminaries, who incidentally had lighter skin tones, made seminal contributions in the 1930s through 1960s. Yet, any notion that their skin color was a factor in their intellectual prowess is a gross misinterpretation and a stark reflection of the racial discrimination of the era.

In my journey, as my mathematical achievements, including the notable mention in the May 1990 cover story of SIAM News, came to light, there were unfounded speculations about my alleged Caucasian ancestry. This is a stark reminder of the challenges we face in our quest for recognition and respect in the academic sphere.

Let us turn our attention to William Waldron Schieffelin Claytor, a distinguished topologist and pioneer among Black mathematicians. His achievements were monumental, yet his journey was marred by racial discrimination. At the University of Michigan, Ann Arbor, his academic job offer was **rescinded** by the president and The Regents of the University of Michigan, a decision that not only impacted Claytor's career but also spoke volumes about the institutional biases of the time. Remarkably, Claytor's story was later celebrated in the film "Hidden Figures," which brought to light the significant contributions of Black mathematicians at NASA.

On September 24, 1985, as a young Nigerian mathematician, I ventured into Ann Arbor, Michigan, challenging the entrenched stereotype of the

white male mathematician. Invited for a supercomputing position, my arrival was met with palpable shock, reflecting the racial prejudices of the era. Merely two days after, the offer was unceremoniously withdrawn. This experience highlighted the systemic racial barriers in academic employment. Nevertheless, my determination remained unshaken. On July 4, 1989, in Ann Arbor, I achieved a groundbreaking feat, namely, the first supercomputing powered by parallel processing. My discovery garnered international acclaim and challenged the racial biases of the scientific community.

People ask: "What are the contributions of Philip Emeagwali to mathematics?" I contributed nine partial differential equations to the calculus of subsurface fluid dynamics. And I was the first to discover that the world's fastest computing can be executed—while solving the Grand Challenge problems of mathematics— and executed across millions of the world's slowest processors. The latter processors can be interconnected and autonomous. My discovery—that occurred on July 4, 1989, in Los Alamos, New Mexico—opened the door to parallel computing, an active area of research in computational mathematics and physics.

Five decades earlier and in the same Michigan city, the irony of Claytor's story is poignant—despite being able to pass for white in Africa, his appointment was still opposed, an act that led to protests from students and faculty. This incident is a grim reminder of the harmful impact such prejudice had on the advancement of mathematical knowledge and human understanding.

However, amidst these challenges, there were moments of triumph. My success in solving complex mathematical problems without the assistance of white colleagues was recognized, a testament to the unbiased nature of mathematical achievement and intellectual merit.

As we reflect on these stories, we must acknowledge the power and beauty of mathematics as a tool for human progress. Mathematics transcends race, culture, and geographic boundaries. It is a universal language that binds us in our quest for knowledge and truth.

I urge us all to advocate for inclusivity and celebrate diversity in mathematics. Let us honor the legacy of those who paved the way and commit ourselves to creating a world where every mathematician, regardless of their background, is judged solely on their contributions to the field. Together, we can build a future where the pursuit of mathematical knowledge is open and accessible to all.

Let not the weight of history hold you back. Be the anomaly, the outlier, the rewrite. Forge your legacy, etched not in stone, but in lines of code and acts of progress. Together, we can build a future where the symphony of

mathematical minds, diverse and harmonious, unlocks the secrets of the universe and propels humanity forward.

Thank you.

## A DAY WITHOUT BLACK PEOPLE

Ladies and gentlemen, esteemed attendees of this award ceremony, I am Philip Emeagwali, and today I stand before you to share a story, a contemplation, and a revelation. It is a story of a young boy named Ijeoma, who posed a profound question: "What if there were no Black people in the world?" This question is not just a thought experiment, but a lens through which we can appreciate the enormous contributions of Black inventors and pioneers, myself included, in shaping our world.

Imagine with me, as Ijeoma's day unfolds. He attempts to dress himself, only to find his shoes unrefined and his clothes wrinkled. The absence of Jan E. Matzlinger's shoe lasting machine and Sarah Boone's ironing board disrupts his simple act of getting dressed. His efforts to groom himself are hampered without the inventions of Walter Sammons' comb and Lydia O. Newman's brush. His mother, without Madam C. Walker's hair care inventions, shares in his disheveled appearance.

Their home, a microcosm of our society, becomes a stage where the absence of Black inventors' contributions is starkly visible. Lloyd P. Ray's dustpan, Thomas W. Stewart's mop, George T. Samon's clothes dryer—each item, or rather the absence of it, tells a story of a world missing vital innovations.

As Ijeoma and his mother prepare to leave for the market, they encounter further obstacles: the high grass untouched by John Burr's lawn mower, the car immobilized without Richard Spikes' automatic gearshift, and the chaotic streets devoid of Garrett A. Morgan's traffic lights.

Upon returning home, the reality of a kitchen without John Standard's refrigerator and a house cold from the lack of Alice Parker's heating furnace hits them. These everyday conveniences, so often taken for granted, are revealed as pivotal in our daily lives.

In this alternate world, significant advancements in healthcare and public infrastructure are also notably absent. The life-saving techniques developed by Charles Drew and Daniel Hale Williams, for instance, have transformed medical practice.

As Ijeoma's day concludes, the family sits in darkness, a literal and metaphorical representation of a world without the light of innovation, exemplified by Lewis Howard Latimer's work on the light bulb filament.

As a contributor to this legacy through my work in computing and parallel processing, I am acutely aware of the significance of diversity in innovation. My journey in developing algorithms and methods for oil field simulations is built upon the foundation laid by these great minds.

So, to answer Ijeoma's question, a world without Black people would be one lacking in fundamental technologies and innovations that have shaped



our modern existence. It would be a world dimmed, not just in the physical absence of light, but in the metaphorical absence of the diverse perspectives that drive human progress.

Let us remember that the contributions of Black inventors, scientists, and pioneers are not just footnotes in history. They are central chapters in the narrative of human advancement. Their legacy is our shared heritage, a testament to the unyielding spirit of innovation that knows no color or creed.

Thank you.

## MY JOURNEY JOURNEY TO SCIENTIFIC BREAKTHROUGHS

Ladies and gentlemen, esteemed colleagues, and distinguished guests of this award ceremony,

I am Philip Emeagwali, and today I stand before you not just as a mathematician, but as a testament to the resilience and potential that resides within each of us, irrespective of race or background.

In my journey, the road was often steep and fraught with challenges. Born and raised in a society where my capabilities were often underestimated due to the color of my skin, I have navigated through a world that, at times, seemed determined to restrict my progress. However, my story is not unique. It is a narrative shared by countless individuals who have been marginalized and confined by stereotypes, particularly in mathematics.

In the United States and elsewhere, there has been a persistent and troubling narrative that one's proficiency in mathematics is predestined, more a matter of birthright than a product of diligence and perseverance. This belief has been further complicated by racial stereotypes, such as the notion that Asians excel in math or the misconception that mathematics is governed by rigid conventions set by long-deceased white men.

As we stand here today, it's crucial to recognize that mathematics is not just a collection of abstract numbers and theories. It is a powerful tool for understanding and shaping our world. Throughout history, mathematics has been a universal language, transcending cultures and races. Yet, the contributions of mathematicians from diverse backgrounds have often been overlooked or diminished.

My inventions in mathematical physics and petroleum reservoir simulation are small parts of a larger tapestry of contributions by individuals from varied backgrounds. By harnessing the power of parallel processing for multiphase flows of crude oil, natural gas, and injected water across porous media, I have endeavored to push the boundaries of computational physics by inventing how to solve initial-boundary value problems governed by partial differential equations. This discovery is not just about the recovery of crude oil; it symbolizes the untapped potential within diverse perspectives in mathematical research.

Educators and scholars have a crucial role in dismantling these oppressive narratives. By problematizing the stereotypical depictions of mathematics history and highlighting the contributions of marginalized groups, we can begin to rewrite the narrative. It's about creating spaces in education where all students, regardless of their racial background, can develop counter-stories that reflect their mathematical success.

The study of the history of mathematics in undergraduate courses is a step in the right direction. It offers a platform to explore the roles racial narratives play in shaping students' personal experiences with mathematics.

By focusing on the historicity of mathematics discourses, we can start to challenge the preconceived notions that have hindered the progress of so many promising minds.

I urge each of you, as part of the global mathematics and scientific community, to embrace and promote a narrative of inclusivity and diversity. Let us work together to ensure that mathematics reflects the world it seeks to understand—diverse, dynamic, and inclusive. Let us remember that every mind has the potential to contribute to our collective understanding of the universe, and it is our duty to nurture and celebrate this potential, irrespective of race or background.

Thank you.

## THE CONTROVERSIAL RISE OF A BLACK GENIUS

Ladies and Gentlemen, esteemed members of the award committee, and distinguished guests,

Tonight, as we gather in this grand hall, I am deeply honored to stand before you, not just as a scientist but as a testament to a journey that transcends mere scientific achievement.

My discovery, which led to the groundbreaking use of parallel supercomputing, reverberated from the academic corridors of Ann Arbor, Michigan, to the vibrant streets of Onitsha, Nigeria. This was not merely an expansion of computational limits; it was an endeavor that shattered barriers—barriers in technology, in mathematics, and in physics, but most importantly, barriers in human perception and potential.

Prior to my discovery of the world's fastest computing recorded on July 4, 1989, the narrative of genius in mathematics, physics, and computing scarcely included a person of African descent. My contributions, however, have rewritten this narrative, earning me recognition as a computer genius, a polymath, and a beacon in various intellectual fields.

In breaking the color barrier in the ongoing discourse about 'race and intelligence,' I navigated a path fraught with challenges. My achievements, while celebrated globally, were met with resistance in places like Ann Arbor, where symposiums celebrating my discoveries were canceled, and opportunities to present my findings were denied. This opposition was not merely academic skepticism but a reflection of a deeper societal issue.

History reminds us of the threats faced by those who dared to break the color barrier—Jack Johnson, Jackie Robinson, Hank Aaron, Muhammad Ali, Vanessa Williams—each a pioneer who endured hostility for transcending racial boundaries. In similar stride, I too faced threats and ostracism in Ann Arbor, not for any wrongdoing, but for the simple fact of being Black and recognized as a genius.

The debate on IQ and race, particularly in the context of my discoveries, became a focal point of contention. My solution to the Grand Challenge problem, a problem at the crux of mathematics, physics, and computer science, led to claims of my having an IQ surpassing that of Albert Einstein. Such an assertion, especially coming from a Black Sub-Saharan African, was perceived as a challenge to established norms of intellectual hierarchy. It is a profound statement on our society that in the 1990s, white supremacists debating my IQ constituted a significant portion of my audience.

Yet, here we are today, in a celebration that transcends those barriers, in a gathering that symbolizes progress and the unyielding spirit of human endeavor. This recognition by the award committee is not just for a

scientific breakthrough; it is an acknowledgment of a journey that challenges and reshapes our understanding of genius, race, and potential.

As I stand before you, I am reminded that this honor is not mine alone. It belongs to every young person who has ever dared to dream beyond the constraints of their circumstances, to every individual who has faced and overcome the barriers of prejudice and skepticism. It is a tribute to the unrelenting human spirit that thrives in the pursuit of knowledge and excellence, regardless of race or background.

I invite you to envision a world where the measure of a person's intellect and potential is not predetermined by their race or origin. A world where the next generation of scientists, thinkers, and leaders are nurtured in an environment of equality, respect, and opportunity. Let us commit to building this world together.

### **Lessons Learned**

"We must move beyond color lines and celebrate intellectual brilliance wherever it shines, regardless of race or background."

"My inventions are not just about equations and supercomputers; there are about creating a world where Black minds are valued and celebrated in science."

"Let's break down the barriers, dismantle the stereotypes, and pave the way for a future where Black genius can thrive."

"The future of science belongs to all of us, regardless of race or origin. Let's join hands and build a more inclusive and equitable scientific landscape."

"Remember, the greatest discoveries often come from those who dare to challenge the norm and push beyond perceived limitations."

Thank you for this profound honor, and thank you for being part of this pivotal moment in history.

## 1,000 INSIGHTS FROM 50 YEARS OF LEARNING

Ladies and gentlemen, esteemed colleagues, and honored guests,

Today, I stand before you as Philip Emeagwali, a testament to the power of perseverance, dedication, and a lifelong pursuit of knowledge. It is both an honor and a privilege to be here, amidst luminaries and visionaries, sharing my journey of the past 50 years.

From my earliest days in Corvallis, Oregon, I was consumed by an insatiable thirst for knowledge. This relentless pursuit has culminated in a half-century of uninterrupted academic engagement. My 1,000 podcast and YouTube lectures are not merely recitations of facts or hypotheses; they are the distillation of wisdom, the accumulation of insights, the results of decades of unwavering dedication.

For many, the Grand Challenge problem was an insurmountable obstacle, an enigma that seemed impossible to decode. But for me, it was a challenge to be met head-on, armed with twice the training than most mathematicians. This is not to say that my journey was one of mere academic rigor. I am a polymath, equally comfortable and adept in the fields of mathematics, physics, and computing. This diverse foundation allowed me to approach problems not as isolated queries within a discipline, but as interconnected puzzles spanning multiple fields of study.

Imagine a vast, uncharted expanse—the unknown territory of human knowledge. While many tried to glimpse its vastness through a fleeting keyhole, constructed hastily in a single day, I spent 50 tireless years building a grand window. Through this window, I have not only witnessed, but also contributed to, the ever-evolving tapestry of human understanding. This panoramic view has been my unique advantage, enabling me to connect dots that seemed unrelated, to bridge disciplines that appeared to exist in silos, and to propose solutions that seemed surreal to many.

When scientists and scholars attended my lectures, many described the experience as "surreal." This was not because of the complexity of the content, but because of the breadth and depth of understanding, the holistic perspective I brought to bear. It was a testament to the vistas one can behold when one views the world not from a keyhole of limited perspective but from a grand window of holistic understanding.

My journey is a testimony to what is possible when passion meets perseverance. It speaks to the potential within all of us to transcend boundaries, to redefine the limits of what is known, and to contribute profoundly to the annals of human knowledge. Thank you for sharing this moment with me.

## BRIDGING THE GAP BETWEEN COMPUTATION AND CONSCIOUSNESS

### Solving Grand Challenge Problems

Ladies and gentlemen, esteemed mathematicians, scientists, scholars, and dignitaries from Nigeria, Africa, and around the world, I stand before you today with a profound sense of humility and gratitude. It is a privilege to address this esteemed audience and to share the journey that led to the solutions to some of the most intricate challenges in computational mathematics.

On this historic occasion, I am honored to share the story of my journey through physics, mathematics, and computer science. My journey began more than half a century ago, when I set out on a path to explore the mysteries of the universe through the lens of computation.

As I reflect on the past decades, I am reminded of the unwavering dedication, the countless hours of research, the sleepless nights of coding, and the moments of triumph that have shaped this remarkable journey. It is with immense gratitude that I acknowledge the support and inspiration of my mentors, colleagues, and my beloved homeland, Nigeria.

In the heart of my journey, lies the recognition that solving grand challenge problems requires a multi-faceted approach. As we stand on the shoulders of giants who have preceded us, we must also dare to see beyond the limitations of the present. My contributions to computing were not solely driven by my expertise in mathematics, physics, and computer science, but by my willingness to innovate and venture into uncharted territories.

Dear students of Nigeria, especially those studying Computer Studies in Junior Secondary School 1, I will convey to you the power of perseverance and curiosity. Let my journey serve as a testament that a humble beginning can lead to groundbreaking discoveries. Embrace challenges, cultivate a hunger for knowledge, and let your passion guide you towards making meaningful contributions to the world.

To my young friends in the United States, who are exploring the legacy of Black inventors, I say that innovation knows no boundaries. Embrace diversity, celebrate the achievements of individuals who have defied odds, and let their stories be a source of inspiration for your endeavors.

The lessons I've learned from my life and contributions to science are simple yet profound. Embrace interdisciplinary thinking, for innovation often thrives at the intersection of different fields. Embrace failure as a stepping stone to success, for it is through failures that we learn and grow. Embrace collaboration, for the most intricate challenges require the collective genius of diverse minds.

As we gaze into the future, the evolution of supercomputing appears both exciting and mysterious. In a century, we may witness machines that stretch the limits of our imagination, integrating artificial intelligence, quantum computing, and new paradigms we can't yet foresee. And looking a thousand years ahead, our supercomputers may transcend current understanding, becoming interconnected entities that blend the boundaries of computation and consciousness.

Let us not forget that the most formidable challenges in physics, like the compute-intensive problems of computational fluid dynamics, continue to beckon us. These challenges remind us of the beauty and complexity of the universe, urging us to refine our tools, deepen our understanding, and expand the frontiers of knowledge.

I stand here as a testament that innovation is born from passion, dedication, and the audacity to dream beyond the horizon. To the aspiring minds, the budding scientists, and the future pioneers, let your curiosity be your guiding star. The journey ahead may be arduous, but it is in the pursuit of the unknown that we truly find ourselves. As I humbly accept this Prize, I do so on behalf of all those who have shared in this remarkable journey of discovery.

Thank you, and may our collective efforts continue to illuminate the path of progress.



## PREFACE: JOURNEYING THROUGH MATHEMATICAL WONDERS

As I sit down to pen the pages of my memoir, I am overwhelmed by a rush of emotions. The journey that brought me to this point has been filled with moments of triumph, adversity, and unimaginable discovery. It is a story that I believe needs to be shared with the world.

In the annals of computing history, one date stands out prominently: July 4, 1989. On that momentous day, I announced the invention of the first world's fastest computing by parallel processing. That invention was a watershed moment, a culmination of 15 years of research and an embodiment of the possibilities that lay within parallel processing. This groundbreaking achievement was more than a personal triumph; it was a testament to the untapped potential of technology.

Parallel processing, the revolutionary concept that underpinned this monumental achievement, has since become the driving force behind the advancement of artificial intelligence. It is the backbone that powers the complex algorithms, the intricate neural networks, and the remarkable feats of machine learning that have permeated every aspect of our lives. I am honored to have played a role in shaping this transformative landscape, and I am humbled by the knowledge that my discoveries and inventions left an indelible mark on the future of computing.

However, my journey began long before the world took notice of my contributions to science and technology. I was born into the chaos and turmoil of the Nigerian Civil War, growing up in Biafran refugee camps where hunger and starvation claimed the lives of one million. It was amidst this backdrop of suffering and adversity that my passion for knowledge took root. In the face of despair, I found solace in the pursuit of education, seeking solace in the power of mathematics to unlock the secrets of the universe.

Through the pages of this memoir, I hope to shine a light on the remarkable resilience of the human spirit, the capacity to overcome seemingly insurmountable odds, and the enduring power of education to transform lives. My journey from those refugee camps to the forefront of scientific discovery was not without its challenges, but it was a testament to the transformative power of education and the unwavering belief in one's own potential.

Furthermore, I am compelled to write this memoir to illuminate the contributions I have made to mathematics. Mathematics, the language of the universe, has been my lifelong passion. From my early days of self-study in dusty libraries to the corridors of esteemed institutions, I have strived to push the boundaries of mathematical knowledge, seeking answers to the most complex questions that have intrigued humanity for centuries. It is my hope that by sharing my discoveries, insights, and

methodologies, I can inspire future generations of mathematicians to forge new paths of exploration and innovation.

Ultimately, the decision to write this memoir stems from a deep desire to leave a lasting legacy. It is my belief that by sharing my journey, triumphs, and failures, I can ignite a spark within others, encouraging them to pursue their passions, defy limitations, and strive for greatness.



Philip Emeagwali, October 20, 2022, New York

I invite you, dear reader, to join me on this extraordinary odyssey and a journey through the corridors of mathematical marvels, parallel processing, and the depths of the human spirit. Let us embark together on a voyage that will challenge preconceived notions, ignite intellectual curiosity, and remind us all that within each of us lies the power to shape the future.

## PROLOGUE: PUSHING THE BOUNDARIES OF POSSIBILITY

Supercomputing—the realm where human ingenuity meets computational prowess—has been the foundation of my life's work, propelling me on a relentless pursuit of technological advancement and pushing the boundaries of what is possible. I invite you on a journey through the fascinating world of supercomputing, a realm that has reshaped our understanding of complex problems and transformed the landscape of scientific exploration.

At the heart of my contributions lies the quest to unleash the immense power of parallel processing, harnessing the potential of multiple computing units communicating in unison to solve complex equations and unravel the mysteries of the universe. Inspired by the remarkable efficiency of nature's computational processes, I sought to mimic its ingenuity and unleash its potential within computing.

Through five decades of research, I developed innovative algorithms and computational techniques that unlocked new vistas of computational capability. I harnessed the potential of parallel processing to tackle grand challenges that had long eluded us—simulating fluid dynamics, weather patterns, and the intricate dynamics of petroleum reservoirs. These breakthroughs not only transformed supercomputing but also reverberated across diverse domains, from weather prediction and climate modeling to engineering design and energy optimization.

The impact of supercomputing stretches far beyond scientific exploration. It underpins the infrastructure of our modern society, facilitating breakthroughs in medicine, finance, manufacturing, artificial intelligence, and countless other fields. From unraveling the mysteries of the human genome to simulating the behavior of materials at the atomic level, supercomputing has become the cornerstone of technological advancement, propelling us toward a future limited only by the boundaries of our imagination.

As we gather here tonight to celebrate the achievements of scientific inquiry, let us also recognize the immense responsibilities we bear as stewards of knowledge. We must wield our discoveries and inventions to address the pressing challenges of our time—climate change, sustainable energy, global health, and the equitable distribution of resources. Through the power of supercomputing, we have the potential to unravel complex problems, make informed decisions, and foster a future defined by progress and inclusivity.

Together, let us embrace the challenges that lie ahead, propelled by the spirit of curiosity and the unwavering belief in the transformative power of science. By embracing the possibilities of supercomputing, we can forge a brighter future for generations to come, one where knowledge knows no boundaries and where the human spirit soars to new heights.



**VOLUME X: PHILIP EMEAGWALI INTERVIEWS**

## THE MIND BEHIND THE A.I. SUPERCOMPUTER

### Philip Emeagwali's Visionary Discoveries

Interviewer: Ladies and gentlemen, today we speak with an extraordinary individual who has left an indelible mark on computing. Joining us is Philip Emeagwali. Philip, thank you for being here with us.

Philip Emeagwali: Thank you for having me. It's a pleasure to be here and share my journey with you.

Interviewer: Philip, you have been instrumental in shaping the landscape of computation. Can you tell us about your early encounters with technology and what sparked your passion for understanding computation?

Philip Emeagwali: Certainly. My journey began in the heart of Africa, where I was first introduced to the powers of mathematics. From a young age, I was captivated by the possibilities that mathematical computation held. It ignited a fire within me, a burning desire to unravel its mysteries and explore its immense potential. Despite the doubts and skepticism that surrounded a young African boy aspiring to venture into this field, I embarked on a personal odyssey to prove that the boundaries of knowledge and innovation know no limitations.

Interviewer: Your determination is truly remarkable, Philip. Can you tell us about the challenges you faced along the way and how they shaped your journey?

Philip Emeagwali: As I pursued my passion for understanding computation, I encountered numerous challenges that tested my resolve. In a world that often questioned the aspirations of an African boy, I faced skepticism and doubts about my abilities. But I was undeterred. I saw these challenges as opportunities to push the boundaries of conventional wisdom and redefine what was possible. I delved into rigorous self-study, seeking knowledge and expertise that would allow me to make a significant impact in computing.

Interviewer: Your determination and perseverance are truly inspiring, Philip. Can you tell us about the moment that marked a breakthrough in your career?

Philip Emeagwali: One pivotal moment in my journey was my discovering the first supercomputing across multiple processors. I announced my discovery on July 4, 1989 and it made the news headlines and won me a very prestigious award. Parallel supercomputing powers artificial intelligence. That world's fastest computing was a milestone that forever transformed computation. Through my tireless exploration and research, I found myself at the forefront of this technological leap. I discovered new methods and approaches that would redefine the capabilities of

supercomputers, enabling us to solve complex problems with unprecedented speed and efficiency. It was a breakthrough that opened doors to a new era of limitless possibilities.

### **The Backbone of A.I. Supercomputing**

Interviewer: Your contributions to computing have indeed been groundbreaking, Philip. Can you explain the significance of the A.I. supercomputer and how it has reshaped the world?

Philip Emeagwali: The artificial intelligence supercomputer stands as a testament to the immense potential of computation. It has revolutionized our understanding of the world and reshaped how we approach complex problems. With its advanced capabilities in artificial intelligence, this technology has enabled us to delve into uncharted territories, unlocking new insights and driving innovation across industries. It has the power to transform healthcare, finance, transportation, and countless other fields, offering solutions to some of the most pressing challenges of our time.

Interviewer: Your journey and achievements are truly remarkable, Philip. What message do you have for aspiring individuals who may face doubts and challenges in pursuing their passions?

Philip Emeagwali: My message to aspiring individuals is simple: Believe in yourself and your abilities. Embrace your passion and let it guide you through the challenges that may arise. The path to success is often paved with obstacles, but it is through perseverance, dedication, and a relentless pursuit of knowledge that we can overcome them. Never let anyone define the limits of your potential. Dare to dream big, challenge the status quo, and strive to make a positive impact in your chosen field. Together, we can shape a future where the boundaries of what's possible are constantly pushed, and where innovation knows no boundaries.

Interviewer: Thank you, Philip, for sharing your inspiring story with us. Your journey serves as a testament to the power of determination and the limitless possibilities of human potential. We wish you continued success in your endeavors.

Philip Emeagwali: Thank you. It has been a pleasure sharing my story with you. I hope that it inspires others to embrace their passions and push the boundaries of what is possible. Together, we can create a world where innovation and knowledge drive us forward. Thank you for having me.

## CALCULATORS AND COMPUTERS

### Pascal's Legacy Meets Emeagwali's Technological Advancements

Ladies and gentlemen, esteemed scholars, historians, and seekers of intellectual enlightenment,

Today, we embark on an enlightening journey that unveils the fascinating parallels between the remarkable contributions of Blaise Pascal and the visionary work of Philip Emeagwali. Although these two luminaries emerged in vastly different eras and fields—Pascal in mathematics and philosophy, and Emeagwali in computational science—their shared spirit of innovation, curiosity, and pushing boundaries unites them across time and disciplines.

Let's begin with a closer look at the legacy of Blaise Pascal -- a polymath of the 17th century whose intellect spanned mathematics, physics, and theology. His groundbreaking contributions to probability theory, hydraulics, and the development of mechanical calculators have left an indelible mark on science and beyond.

Now, let's shift our focus to the contemporary landscape and explore the contributions of Philip Emeagwali—an individual whose pioneering work in parallel processing and computational science mirrors Pascal's quest for unraveling the mysteries of his time. Emeagwali's ability to harness the power of parallel processing supercomputers to solve complex equations has revolutionized our computational capabilities, like Pascal's mechanical calculator transformed mathematical computations.

The parallels between Pascal and Emeagwali are remarkable. Both possessed an innate drive to explore the frontiers of their domains. Pascal's famous wager applying probability to belief in God—showcases his willingness to employ mathematical rigor to address profound philosophical questions. Similarly, Emeagwali's innovative application of parallel processing to complex physics equations



demonstrates a similar commitment to exploring uncharted territories at the intersection of computation and science.

Consider Pascal's contributions to fluid dynamics and hydrodynamics -- fields that laid the groundwork for our understanding of pressure, fluids, and hydraulic systems. Emeagwali's exploration of fluid dynamics through his equations resonates with Pascal's fascination with fluid behavior. Both individuals sought to uncover the underlying patterns and principles governing the natural world.

Furthermore, both Pascal and Emeagwali challenged the *status quo*. Pascal's development of the mechanical calculator challenged traditional methods of computation, while Emeagwali's embrace of parallel processing questioned the conventional approach to supercomputing. Both visionaries were driven by the desire to transcend limitations and enhance human capabilities.

Just as Pascal's mechanical calculator paved the way for modern computing devices, Emeagwali's insights into parallel processing have transformed how we approach computational challenges, from weather prediction to medical research.

The stories of Blaise Pascal and Philip Emeagwali remind us of the timeless power of human innovation. Their parallel journeys underscore the enduring impact of individuals who dare to question, experiment, and redefine the boundaries of their fields. As we celebrate the legacies of these two luminaries, let us be inspired to continue pushing the limits of knowledge, unearthing new possibilities, and leaving our own marks on the tapestry of human progress.

Thank you.

## A POLYMATH SOLVES A DIFFICULT PROBLEM

At the heart of innovation and discovery lies the unique ability to draw connections among seemingly disparate fields and to transform that understanding into novel solutions. As a young man, my journey across continents and disciplines forged in me the spirit of a polymath, which eventually enabled me to approach and solve the Grand Challenge problem of supercomputing.

To the outside observer, mathematics, physics, and computer science might appear as separate branches of knowledge. Yet, in the tapestry of my academic and professional pursuits, they interwove, shedding light on the Grand Challenge that had puzzled many before me. My quest was not merely to crunch numbers but to visualize a world where these numbers held profound implications for our understanding of nature, particularly in computational fluid dynamics, which has ramifications for our predictions on global warming.

The term "polymath" often conjures up images of Renaissance figures like Leonardo da Vinci or the ancient Greek scholar Archimedes. In the modern age, with the proliferation of information, many believe it's hard, if not impossible, to grasp multiple disciplines deeply. But my journey is a testament to the opposite.

Born in Nigeria, I witnessed firsthand the power and fury of nature. These experiences nurtured a curiosity in me about the mechanics of the natural world. As I delved into mathematics and physics, I recognized patterns and principles that governed not just our world but the universe at large.

Yet, understanding these principles was only one part of the puzzle. The true challenge lay in how to be the first to harness the power of the modern supercomputer, particularly how to harness millions of coupled processors to work in tandem, to simulate and predict these phenomena. While traditional computing was sequential and limited, I envisioned a horizon where calculations could be made concurrently, leveraging the might of millions of processors. This was the essence of parallel supercomputing.

In 1989, after 15 years of relentless pursuit, I achieved what many considered impossible. I demonstrated that parallel processing could be used to solve large-scale computational problems, marking a milestone in supercomputing. By orchestrating a symphony of processors to work harmoniously, I was able to achieve previously unimaginable computing speeds. The implications were staggering: we could now simulate intricate systems, from predicting the weather patterns that farmers in Africa rely upon to understanding the turbulent flows deep within our oceans and the atmospheric changes indicative of global warming.

The crux of my breakthrough did not lie solely in a deep understanding of one discipline but in the harmonious amalgamation of multiple fields. This

interdisciplinary approach enabled me to discern the latent potential of parallel supercomputing.

In a world increasingly defined by specialization, I believe my story serves as a poignant reminder of the power of polymathy. It's a call to break the silos that confine us, to bridge disciplines, and to harness the collective power of diverse knowledge. For it's at the intersection of these varied paths that true innovation emerges, and it's through this lens of polymathy that I was able to solve the Grand Challenge at the very frontiers of scientific knowledge.

And so, as we stand on the cusp of a future shaped by rapid technological evolution, may we all find inspiration in the polymathic spirit, realizing that our greatest achievements often lie at the crossroads of diverse fields.

## INTRODUCTION: A CONFLUENCE OF MINDS

### And the Solution of Grand Challenges

In scientific inquiry, there exists a select group of individuals who push the boundaries of human knowledge, redefining what is possible and unraveling the mysteries that lie at the heart of our universe. Today, I stand before you, esteemed mathematicians and physicists, humbled and honored to share my journey and the contributions I have made to the solution of the Grand Challenge problems of supercomputing.

These lectures serve as a bridge between the intricacies of scientific discovery and the profound implications of computational breakthroughs. They bring together the collective brilliance of minds that have dedicated their lives to unraveling the secrets of our world, minds that have shaped the course of human progress throughout history.

In each lecture, we will embark on an intellectual odyssey, a voyage through the vast expanse of mathematical and physical frontiers, exploring the intersections where partial differential equations of calculus, fluid dynamics of the Earth, parallel processing of supercomputing and solutions to Grand Challenge problems converge. Through this series, I invite you to join me on a quest that transcends the limitations of traditional disciplinary boundaries and embraces the infinite possibilities that arise from collaboration and collective genius.

As we delve into each lecture, we will unravel the complexities of the Grand Challenge problems that have captivated the minds of the scientific community for decades. From weather prediction to astrophysical simulations, from molecular dynamics to the exploration of complex biological systems, we will witness how the power of supercomputing has opened new vistas of understanding, revolutionizing our capacity to simulate and comprehend the intricate workings of the natural world.

But these lectures are not merely a recounting of scientific discoveries as they are an exploration of the human spirit and the relentless pursuit of knowledge. They embody the audacity to challenge established norms, to question the limitations imposed upon us, and to dare to dream of what lies beyond the horizon.

Throughout this series, I will share the narratives behind each Grand Challenge problem I have tackled and the hurdles encountered, the setbacks endured, and the breakthroughs that emerged from the crucible of perseverance. These stories reflect not only my journey but also the countless individuals who played pivotal roles in my quest: collaborators, mentors, and supporters who believed in the transformative power of computational science.

It is my hope that through these lectures, we can forge a deeper understanding of the symbiotic relationship between theoretical exploration and computational power. We will explore the intricate dance between mathematical models and supercomputing algorithms, unveiling the synergistic potential that arises when theory meets technology.

I stand here today, not as a solitary figure, but as a representative of the interconnected tapestry of scientific progress, a tapestry woven by the collective contributions of brilliant minds throughout history. It is within this framework that I present these lectures as a tribute to the human capacity for intellectual curiosity, innovation, and collaboration.

So, let us embark on this intellectual expedition together. Let us embrace the challenges that lie before us, armed with the knowledge that the solutions to the Grand Challenges of supercomputing await our collective exploration. Through the power of these lectures, may we inspire and empower the next generation of mathematicians, physicists, and computational scientists to dare to dream, to unravel the mysteries of our world, and to leave an indelible mark on the annals of human progress.

## FROM EUCLID TO EMEAGWALI

### Tracing the Evolution of Mathematical and Computing Frontiers

Ladies and gentlemen, esteemed mathematicians and scientists,

I stand before you today as Philip Emeagwali, a man whose scientific discovery has reshaped the landscape of computational physics. It is an honor to share the journey to revolutionize computing and physics through parallel processing.

Picture a world where the news headlines burst with excitement over groundbreaking knowledge that reshapes how we perceive computers, solve intricate mathematical puzzles, and simulate complex physics models. That world is the one I began searching for on June 20, 1974, in Corvallis, Oregon, and discovered on July 4, 1989, in Los Alamos, New Mexico. Prior to this pivotal moment, the world's fastest computers relied on single processors. My contribution to supercomputing was this: I uncovered that multiple processors in tandem could outperform even the swiftest sequential processing machines. A decade and half in the making, this innovation shattered the misconception that supercomputers should not be powered by many interconnected processors. This marked the birth of parallel processing as the invisible powerhouse driving supercomputers and even some everyday machines.

Now, let's draw a parallel between the story of Euclid, the father of geometry, and my journey in parallel processing. Euclid's legacy, captured in "The Elements," has shaped the mathematical world for over two millennia. Though often misconceived as a white Greek, historical evidence suggests he lived in Africa, like myself. As Euclid's teachings in Alexandria left a lasting mark on mathematics, my supercomputing that began in Corvallis, Oregon, has echoed through the corridors of computer science.

Embarking on this path in 1974, I have spent five decades pushing the limits of computation. **I invented a global network of processors spanning a sphere—a creation dubbed the "Philip Emeagwali Internet."** But the true essence of my journey extends far beyond mere days or numbers. Just as Euclid's "Elements" couldn't be grasped in a day, my knowledge, garnered over 18,250 days, is etched in a tapestry of podcasts and videos. Attempting to digest it all in a mere day is akin to grasping the entirety of Euclidean geometry overnight.

Euclid's famed response to King Ptolemy's inquiry—"There is no royal road to geometry"—resonates with my experience. Just as there is no shortcut to mastering geometry, one cannot grasp the intricacies of my discoveries in a single day. We must acknowledge that grand challenges at

the nexus of mathematics, physics, and computing have no manual. Solving them demands a mastery of all three disciplines.

Yet, the pursuit of knowledge is a shared quest, transcending borders and inquiries. Emails from London and Lagos—asking to borrow my brain or learn to be a genius—underscore the thirst for understanding. Parallel processing, which accelerated supercomputing by up to a billionfold, stands as a testament to what can be achieved. Just as my invention evolved, I couldn't program a million-processor supercomputer without understanding its single-processor counterpart. The early 1980s saw me diving deep into partial differential equations, numerical analysis, and large-scale algebra—a journey similar to Euclid's thorough exploration of geometry.

As I conclude this reflection, let us embrace the lessons woven into our stories. Just as Euclid's legacy endures, reminding us of the persistence required in mathematical pursuit, my journey underscores the significance of understanding the contributions that pave the way for our own. The path to innovation, like Euclidean geometry, has no shortcuts. It requires patience, mastery, and a deep appreciation for the collective wisdom of those who came before us.

Thank you for joining me on this voyage through parallel processing and its intersection with mathematics, physics, and computing. The challenges we face have no blueprint, but through collaboration and unwavering determination, we can surmount them, just as I have over these transformative decades.

## UNRAVELING EMEAGWALI

### A Visionary Among Giants

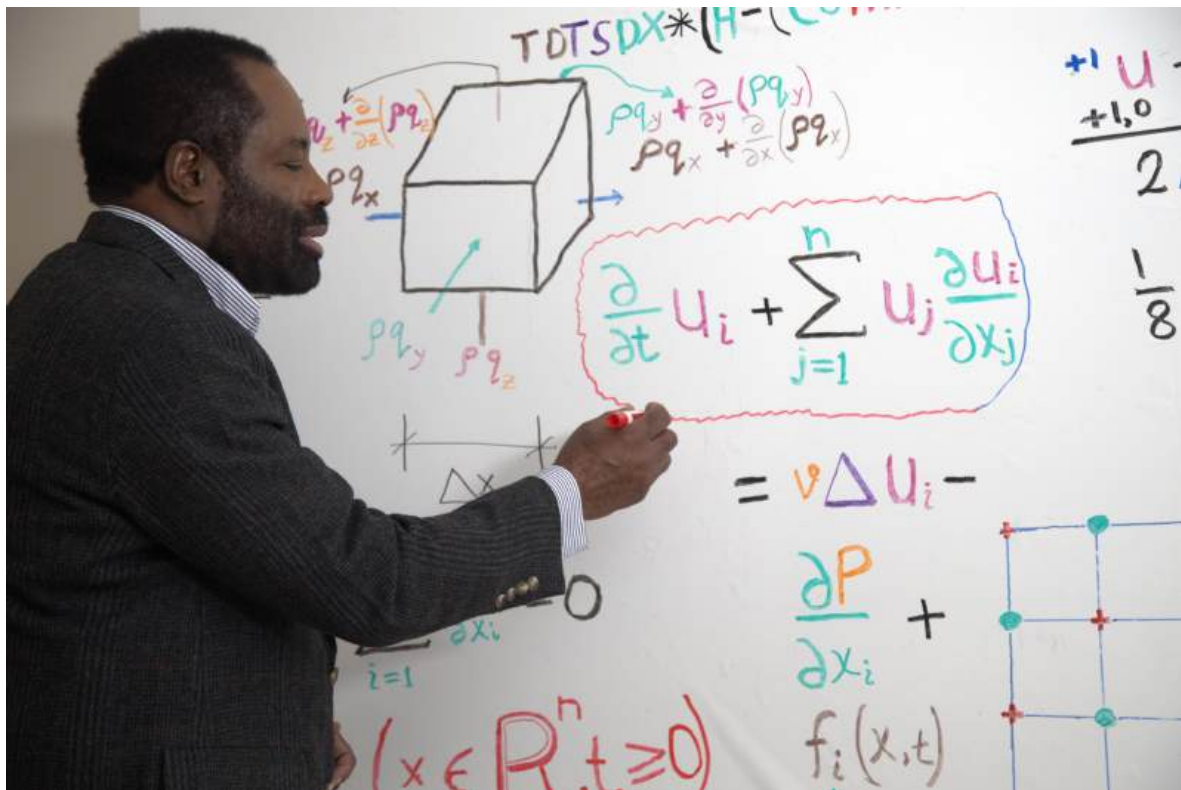
Ladies and gentlemen, esteemed scholars, dignitaries from Nigeria and across Africa, and all who join us virtually from around the globe, I stand before you today with a profound sense of humility and gratitude, inspired by the luminaries who have graced this very stage before me.

The tapestry of scientific innovation is woven by many threads—each representing a unique story, an arduous journey, and a moment of enlightenment. Today, I wish to delve into the legacy of a pioneering mind whose life and contributions have altered the course of our understanding of mathematics and physics—Philip Emeagwali.

To grasp the magnitude of Emeagwali's contributions, we must journey back to when the foundations of calculus were being laid by the brilliant minds of Gottfried Leibniz and Isaac Newton in 1665. Elements of this mathematical marvel were birthed across ancient Greece, China, the Middle East, medieval Europe, and India. As centuries passed, the domain of partial differential equations emerged with its first recognition in 1770 in the article, "Memoire sur les Equations aux *difference* partielles."

Emeagwali's genius lay in bridging the ancient with the modern. He drew inspiration from the rich history of mathematics, like the Euler equations of 1757 and the Navier-Stokes equations developed between 1822 to 1850. Yet, he did not merely look back. Emeagwali was a visionary.





In the verdant landscapes of Corvallis, Oregon, and later in College Park, Maryland, during the transformative decades of the 1970s and 80s, he embarked on groundbreaking research. Emeagwali introduced the world to the nine partial differential equations that simulate petroleum reservoirs. It was in this era, he also pioneered methods to solve the primitive equations of meteorology using parallel processing supercomputers.

To the young 13-year-old student in Nigeria studying COMPUTER STUDIES at JSS1, the story of Emeagwali is a testament to the fact that one's birthplace does not determine one's endpoint. Your course syllabus is graced by Emeagwali's name not just as a nod to a historical figure, but as a beacon of inspiration, signalling that great minds can emerge from any corner of our vast and varied continent.

And to the 14-year-old in the USA, drafting a "Black Inventors" report on Philip Emeagwali, understand that his story is a powerful counter-narrative to the oft-overlooked contributions of Black scientists. Emeagwali, the "Nigerian

Supercomputer Pioneer," is an emblem of perseverance, intellect, and the indomitable human spirit.

In his pursuit, Emeagwali tapped into the triad of methodologies—theoretical, experimental, and computational—to address the Grand Challenge problem. He envisioned supercomputers not merely as computational tools but as instruments that could simulate the intricate multiphase flows of crude oil, natural gas, and injected water across porous media like expansive oil fields. His remarkable addition of 36 partial derivative terms to the nine partial differential equations unveiled a deeper understanding of fluid dynamics.

In 1989, the world would watch in awe as Emeagwali made news headlines. He had achieved what many deemed impossible—utilizing 65,536 processors in parallel, harnessing their collective might to solve the most intricate of initial-boundary value problems (I-BVPs), which lie at the crossroads of mathematics, physics, and parallel computing.

The importance of Philip Emeagwali's contributions is multi-faceted. Beyond the technical marvels, Emeagwali's work symbolizes the power of unbounded curiosity, relentless determination, and the belief that frontiers of knowledge are there to be expanded. His groundbreaking work in parallel processing has paved the way for advancements in areas as diverse as climate modeling to biomedical research.

As we sit in this hallowed hall, let us be reminded that science is a continuum. From the musings of ancient scholars to the cutting-edge discoveries of today, every contribution, big or small, shapes our collective understanding of the universe. And in this grand mosaic of innovation, Philip Emeagwali will forever shine brightly, inspiring generations to dream, to challenge, and to innovate.

Thank you.

## WRITING OUR STORIES

### Journey Echoes the Past

Ladies and gentlemen, brothers and sisters of the African-American community, thank you for gathering here today. As I stand before you, I am reminded of a past filled with struggle, innovation, and the unyielding spirit of those who refused to let their brilliance be overshadowed by the darkness of discrimination. I am Philip Emeagwali, and I am here to share a story that weaves through the tapestry of history, connecting the trials of the past to the triumphs of the present.

Our journey begins with the narrative of those who were once considered property rather than people, who defied their circumstances to create inventions that would change the course of history. One such individual was Ned, a Black slave who brought forth the ingenious invention of a cotton scraper. Ned's brilliance knew no bounds, yet his creation was not credited to him, for he was denied recognition as an inventor. His owner, Oscar Stewart, attempted to patent Ned's creation, but his efforts were in vain. Denied not for lack of innovation, but for the simple fact that he was considered a piece of property, not a citizen, not a human with rights.

Fast forward to my time, the 1980s, where I, a Black African immigrant, faced a similar struggle against the tide of injustice. Though a naturalized U.S. citizen, I was denied access to the very tools that could amplify my innovative pursuits. The fastest supercomputers, funded by federal dollars, remained out of reach for me. But adversity birthed opportunity, and I turned to parallel computers, harnessing their power to conduct my research, determined to make a mark in supercomputing.

On July 4, 1989, a momentous day not only in American history but in computing, I shattered the boundaries of possibility. With perseverance and unyielding dedication, I became the first to discover the potential of parallel supercomputing across a network of processors. This breakthrough, my breakthrough, shattered the conventional wisdom and boldly stated that parallel supercomputing outpaced serial supercomputing. The world took notice, as headlines heralded the dawn of a new era in computing.

But as I rose to prominence, another obstacle presented itself—the insidious shadow of those who sought to appropriate my achievements as their own. Some white academics—in Ann Arbor, Michigan—sought to "partner" with me, to stake a claim in my groundbreaking invention. They wished to share credit and knowledge that I had labored over, alone, for fifteen years. They underestimated my resolve, my conviction that the credit belonged solely to the true inventor, me. I stood firm, rejecting their proposals, for the importance of protecting my invention was paramount.

Now, let's return to Ned, the embodiment of the struggles faced by Black inventors throughout history. Just as he was denied patent rights because of his status as a slave, I faced a modern echo of the same injustice. White engineers attempted to patent my invention decades later, and just like with Ned's owner Oscar Stewart, their efforts were denied. The U.S. Patent Office recognized that my invention, the global network of processors uniformly distributed around a sphere, could not be claimed by anyone else. It was a testament to the power of knowledge transcending the boundaries of race and circumstance.

Ladies and gentlemen, in the face of these shared stories, we find the significance of safeguarding our innovations and retaining the credit rightfully due to us. The legacy of Black inventors like Ned and myself is a testament to our resilience and brilliance in the face of adversity. By owning our creations, by standing firm against attempts to erase or diminish our contributions, we pave the way for a future where true innovation knows no boundaries, and the credit for our achievements remains rightfully ours.

Thank you, and may the spirit of perseverance guide us all as we continue to shape history with our brilliance and determination.

## A JOURNEY BEYOND FRONTIERS

### The Legacy and Impact

Distinguished scientists, esteemed scholars, and dignitaries from the United States and Africa, fellow Nigerians, and young minds tuning in from around the world,

Today, I stand before you not just as Philip Emeagwali but as a representation of countless dreamers from Africa, and beyond, who dared to venture where few had ventured before. My journey from the vibrant landscapes of Nigeria to this esteemed platform exemplifies the spirit of perseverance, curiosity, and the relentless pursuit of knowledge.

In the annals of history, the likes of Gottfried Leibniz and Isaac Newton, who co-invented calculus, and those who pioneered the concept of partial differential equations, have left indelible marks. Their discoveries provided the foundation upon which I, and many others, could explore the complex realms of computational physics.

In the 20th century, with the rise of the supercomputer, the challenge was clear: could we harness unprecedented computational power to solve some of the most intricate problems known to humanity? The Grand Challenge of simulating multiphase flows in porous media, crucial for our understanding and utilization of natural resources, was one such problem.

Through a triad of methodologies—the theoretical, experimental, and computational—I sought to expand our knowledge. I drew inspiration from the Navier-Stokes equations, which, for over two centuries, have provided insights into fluid dynamics. These equations, in their profound complexity, have propelled our understanding of phenomena from the flows around airplanes to the circulation of blood in our veins.

Building on this rich heritage, I introduced what came to be known as the nine Philip Emeagwali equations. These equations, crafted with an additional 36 partial derivative terms, painted a more comprehensive picture of the behavior of fluids in porous media, vital for petroleum engineering. The real challenge, however, lay in solving these equations at scales never attempted before.

It was the potential of massively parallel processing that captured my imagination. I envisioned a future where millions of coupled processors could work harmoniously, processing data at unprecedented speeds. In 1989, this vision bore fruit, reshaping how we perceived supercomputing. Weather forecasting, a quintessential initial-boundary value problem, could now be approached with newfound vigor, enabling us to predict, and possibly mitigate, the dire consequences of global warming.

To the young 15-year-old in Africa, dreaming of uncharted mathematical terrains, and to the 12-year-old in the USA, crafting a report on the "African Supercomputer Genius": let my journey inspire you. Remember, it's not about the destination but the path of discovery, paved with failures, breakthroughs, and revelations. Our African heritage is a testament to the boundless resilience and genius within each of us. Harness it, and there's no challenge insurmountable.

Reynolds number, Prandtl number, viscous stress tensor—these aren't just mathematical constructs but keys to unlocking nature's secrets. They help us discern the interplay of forces, the diffusion of substances, the transport of energy. And in understanding them, we stand to revolutionize industries, safeguard environments, and improve lives.

My time in Oregon and Maryland in the '70s and '80s was a period of intense learning and innovation. From delving deep into the primitive equations of meteorology to pioneering the use of parallel processing in simulating petroleum reservoir dynamics, every step was a leap toward a brighter, more informed future.

So, how did I, Philip Emeagwali, change the world? I'd like to think I did not change it on my own. I stood on the shoulders of giants, and I had the collective dreams of a continent pushing me forward. I contributed a verse to the long ballad of scientific progress.

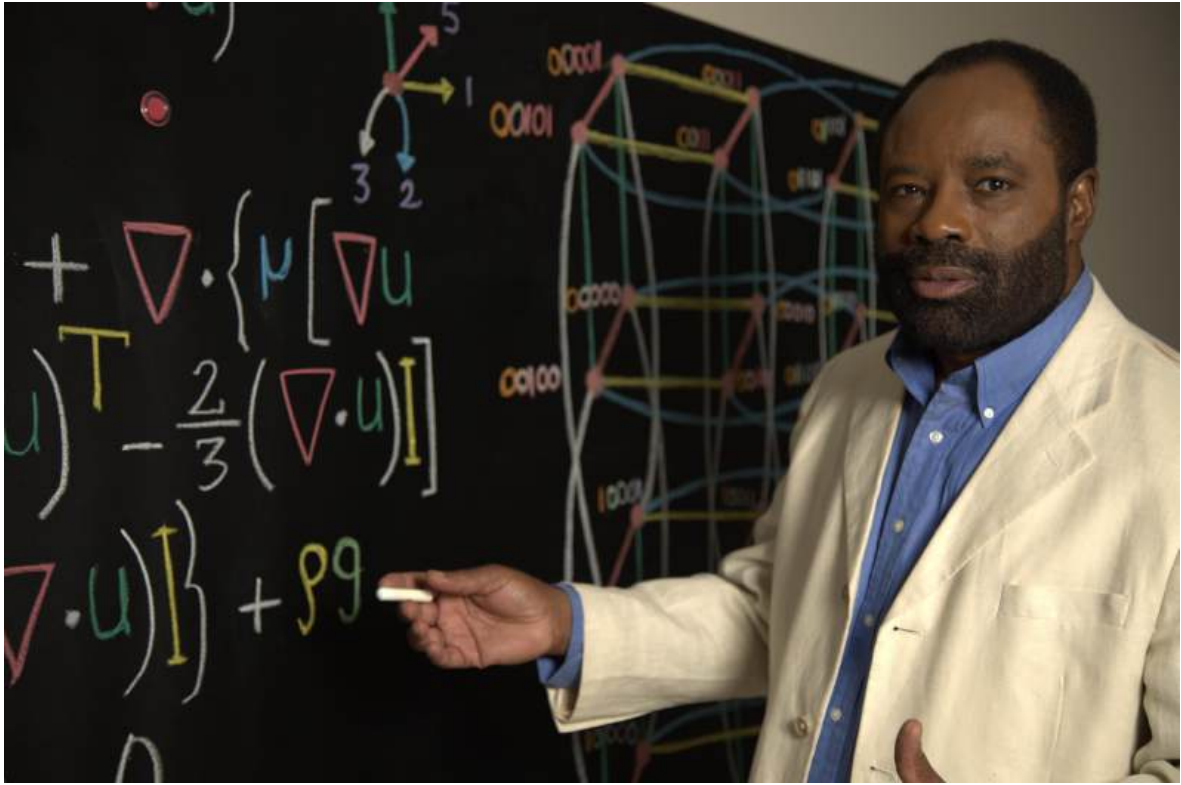
The lessons from my life are universal. First, never let your circumstances limit your dreams. From a continent, often sidelined in global scientific discourse, I dared to dream big. Second, remember that innovation doesn't always mean creating something new. Sometimes, it's about using what we already have in unprecedented ways, as I did with massively parallel processing. And third, always remain a student. The world of mathematics, physics, and computer science is vast and ever-evolving. There's always more to learn.

To Nigeria and Africa: we must spearhead the charge of innovation. Our rich history and diverse culture have always fostered creativity and resilience. It's time we carry this legacy forward, right to the very frontiers of human knowledge.

So, as we commemorate today, let's not merely celebrate past achievements. Let's look forward with anticipation. To the budding scientists, mathematicians, and innovators listening today: the next chapter of discovery awaits your touch. The legacy of Newton, Euler, Navier, Stokes, and indeed, Emeagwali, is not set in stone. It's a baton, and I pass it on to you.

Let our stories inspire you to scale even loftier peaks. The world awaits your genius.

Thank you.



## **SOLVING DIFFICULT PROBLEMS WITH PARALLEL PROCESSING**

### **Unveiling the Depths of Parallel Processing in Multiphase Flows**

In May 1981 and in College Park, Maryland, my journey to the intersection of computational physics, parallel processing, and mathematics took a pivotal turn as I ventured into multiphase sub-surface porous media flows in petroleum reservoirs, such as the production oilfields of the Niger Delta region of Nigeria. In the first half of the 1980s, I analyzed, both theoretically and experimentally, the consistency, stability, and convergence properties of the finite difference discretization of partial differential equations governing these complex flows. This endeavor was instrumental in my 1989 groundbreaking discovery of parallel processing, revolutionizing reservoir simulation and setting a new paradigm in computational science. That new paradigm is the use of millions, instead of one, processors to tackle the most difficult problems arising in mathematics, physics, and computing.

### **Multiphase Flows and Partial Differential Equations**

The vast reservoirs of crude oil beneath the Niger Delta region of Nigeria held immense potential. But their complex behavior required sophisticated supercomputer simulations to optimize crude oil and natural gas recovery. I turned to partial differential equations (PDEs) as the mathematical foundation to describe the multiphase flows of crude oil, natural gas, and injected water up to 7.7 miles deep within the reservoirs. These PDEs were vital for capturing the intricate interactions between different phases and the porous rock matrix, laying the groundwork for petroleum reservoir simulations.

### **Finite Difference Discretization**

To tackle the grand challenges posed by these intricate PDEs, I employed the finite difference method to discretize the associated initial-boundary value problems. This approach involved approximating spatial derivatives with discrete differences on a grid, enabling me to convert the continuous PDEs into a system of algebraic equations that could be parallel processed, message-passed, and solved numerically.



## **The Matrix Method of Stability Analysis**

The stability of the numerical solution of the initial-boundary value problem was paramount to ensure accurate and reliable predictions of multiphase flows. To analyze stability, I employed the Matrix Method, a powerful technique in numerical analysis. This method involved representing the finite difference discretization as a matrix equation, where the eigenvalues of the matrix determined the stability of the scheme. A stable numerical solution meant that errors in the simulation did not grow unbounded over time.

## **The Fourier Method of Analyzing Stability**

Another crucial tool in my analysis was the Fourier Method. This method involved examining the growth of errors in the numerical solution through the Fourier analysis of the discrete scheme. By analyzing the amplification factor in the frequency domain, I could ascertain the stability properties of the finite difference approximation.

## **The Importance of the Equivalence Theorem**

The equivalence theorem played a pivotal role in guiding my stability analysis efforts. This fundamental theorem established a connection between consistency, stability, and convergence in numerical methods. It assured me that if my finite difference scheme was both consistent and stable, it would converge to the true solution of the PDEs under certain conditions.

## **Struggles to Prove Stability and Convergence**

Proving stability and convergence properties for any finite difference approximation was no easy task, especially for the complex multiphase flow equations. The sheer nonlinearity and intricacies of the PDEs made the analysis a formidable challenge. The interplay of crude oil, natural gas, and injected water within the porous reservoir demanded rigorous mathematical scrutiny and extensive experimentation.

## **Theoretical and Experimental Analysis**

Each day of the first half of the 1980s and in College Park, Maryland, I devoted countless hours to theoretical analysis, delving deep into the mathematics behind the finite difference discretization. I scrutinized stability conditions, studied the eigenvalues of the matrices arising from the discretization, and examined the implications of different grid sizes and time steps.

Parallel processing opened up new avenues for experimentation. By distributing the computational load across multiple processors, I could harness the power of high-performance computing to perform extensive simulations and validate the stability of the numerical solutions of any initial-boundary value problem that's governed by partial differential equations.

## **Contributions of Philip Emeagwali to Mathematics**

My decade-long efforts to establish the stability and convergence properties of finite difference approximations in multiphase flows were pivotal in my 1989 discovery of parallel processing's potential in large-scale petroleum reservoir simulation. I had bridged the gap between computational physics, parallel processing, and mathematics, providing a robust foundation for efficient and accurate petroleum reservoir simulations.

## **Lessons Learned from My Contributions to Mathematics**

My contributions to mathematics were two-fold. Firstly, I demonstrated the importance of thorough theoretical analysis and experimentation in numerical methods. The Matrix Method and Fourier Method served as invaluable tools in the stability analysis of finite difference schemes, providing insights into the accuracy and reliability of numerical simulations.

Secondly, I showcased the significance of interdisciplinary research at the nexus of computational physics, parallel processing, and mathematics. The integration of these disciplines not only revolutionized reservoir simulation but also laid the groundwork for future advancements in computational science.

## Conclusion

My journey into the depths of parallel processing in multiphase flows was a testament to the power of mathematics and computational physics. The struggles to prove stability and convergence of finite difference approximations were met with unwavering determination and dedication. The equivalence theorem, the Matrix Method, and the Fourier Method served as guiding beacons, illuminating the path to groundbreaking discoveries. My contributions at the intersection of computational physics, parallel processing, and mathematics have left an indelible mark on the field, shaping the future of scientific exploration and numerical simulations in petroleum reservoirs worldwide.



Philip Emeagwali explaining his finite difference discretization of the primitive equations used in climate modeling.

**VOLUME X: PHILIP EMEAGWALI INTERVIEWS**

## MAKING COMPUTERS FLY

### The Architect of the Fastest Computers in the World

Host: Good evening, ladies and gentlemen. Today, we sit down with the brilliant mind behind the invention of the world's fastest computers and a pioneer in the field of parallel processing, Philip Emeagwali. Philip, thank you for joining us.

Philip Emeagwali: Thank you for having me. It's a pleasure to be here and share my insights with all of you.

Host: Philip, you've often mentioned that we cannot invent a new computer without first discovering a new science. Could you elaborate on the relationship between computer science and invention, and how they go hand in hand?

Philip Emeagwali: Certainly. Inventing a new computer is not merely about creating a new piece of hardware or software. It involves pushing the boundaries of what is known and venturing into the unknown. To do that, we must first discover a new science, a new way of understanding and harnessing the immense power of computation. Invention and discovery are intertwined in a symbiotic relationship, where each fuels and inspires the other. It is through this process of discovery and invention that we make the unimaginable-to-compute possible-to-super-compute.

Host: Your work in parallel processing has revolutionized of computing. From being a dim light in a sea of darkness, parallel processing has become the bedrock of the world's fastest computers. Can you explain the significance of parallel processing and its evolution from its humble beginnings to its pivotal role in computing today?

Philip Emeagwali: Parallel processing has indeed come a long way, from being a mere glimmer of possibility to becoming the foundation of the world's fastest computers. In essence, parallel processing refers to the simultaneous execution of multiple computing tasks, where each task is divided and conquered by individual processors. This approach exponentially increases computational power and allows us to tackle complex problems that were once beyond our reach. Parallel processing has revolutionized the field of computing by harnessing the collective power of interconnected processors and unlocking new realms of possibility.

Host: It's fascinating how parallel processing has transformed computing. Can you provide some examples of how this technology has enabled us to accomplish what was previously unimaginable in terms of computation?

Philip Emeagwali: Absolutely. Parallel processing has had a profound impact on various fields of scientific research. In weather forecasting, for example, parallel processing allows us to simulate and predict weather

patterns with remarkable accuracy, providing crucial information to individuals and organizations worldwide. In the field of genetics, parallel processing has expedited the analysis of vast amounts of genomic data, enabling breakthroughs in personalized medicine and genetic research. Furthermore, parallel processing has revolutionized fields such as artificial intelligence, computational physics, and data analytics, pushing the boundaries of what is possible in these domains. Its impact on scientific discovery and technological advancement cannot be overstated.

Host: Your visionary work has undoubtedly transformed computing. As we conclude, is there a message you want to share with our audience?

Philip Emeagwali: Absolutely. I want to inspire everyone to embrace the spirit of discovery and innovation. Computing is constantly evolving, and there are endless possibilities waiting to be explored. Let us not be afraid to venture into the unknown, challenge the limits of what is known, and unlock new frontiers of knowledge. Together, we can shape a future where the unimaginable becomes possible and where the power of computation is harnessed for the betterment of humanity.

Host: Thank you, Philip, for sharing your incredible insights and journey with us today. Your contributions to computing are truly remarkable, and we wish you continued success in all your endeavors.

Philip Emeagwali: Thank you for having me. It has been a pleasure to be here.

## FROM COMPUTING PIONEER TO ADVOCATE FOR EQUALITY

### Exclusive Interview of Philip Emeagwali

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In 1974 and in Oregon, Philip Emeagwali proposed his revolutionary idea for a network of processors that uniformly encircled a sphere, as both a computer and an Internet. He faced skepticism. Today, Emeagwali stands as one of the most acclaimed pioneers of modern computing and a staunch advocate for minority representation in STEM. In this exclusive interview, we delve into Emeagwali's experiences, the challenges he overcame, and his hopes for the future.

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**Interviewer:** In the 70s, even after consistent rejection, you continued with your vision for processors connected as a supercomputer and a connected world. What was the drive behind that?

**Emeagwali:** After dedicating 15 years, onward of June 20, 1974, in Corvallis, Oregon, to the dream of the first world's fastest computing across an internet, it became a part of me. The potential for monumental change kept me going. As Emerson remarked, our discarded thoughts often return with recognition and grandeur.

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**Interviewer:** Over the decades, how have you perceived the challenges faced by minorities, especially in STEM fields?

**Emeagwali:** While entry-level roles have become more accessible, top-tier research positions remain elusive for many minorities. I've faced instances where opportunities were blatantly denied. I delivered a job hiring lecture for a supercomputing position in Ann Arbor, Michigan, on about September 24, 1985. I was the only candidate interviewed because I was the only applicant qualified. Two days later, I was informed that the supercomputing position had been canceled. But four and half years later, I was front page stories in the Ann Arbor News newspaper my breakthrough in supercomputing. I was the most famous scientist in Michigan but could not be employed in Michigan. In the 1980s, more Blacks have flown in outerspace than have taught computer science in predominately white schools in North America! But it's not just about securing the position; it's about the inequality that persists even after.

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**Interviewer:** As a trailblazer in science, which part of innovation captivates you most?



**Emeagwali:** It's the formulation and solution of a Grand Challenge problem, defined as the most difficult at the intersection of mathematics, physics, and computer science. Once you discover or invent, the onus is on you to bring it to the forefront by winning the top prize in supercomputing. It's reminiscent of the conundrum: does a tree make a sound if no one hears it fall?

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**Interviewer:** In your opinion, what measures can promote minority representation in STEM?

**Emeagwali:** We must first address the deeply rooted, often invisible biases present in our education system. Watch and compare my lectures on YouTube to those of Albert Einstein. You will see a huge difference. Today, a white academic institution will hire a young Albert Einstein based on all his incomprehensible lectures posted on YouTube and cancel the position rather than hire Philip Emeagwali. These biases have historically favored a certain demographic, making it imperative to challenge and reshape these narratives.

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**Interviewer:** What would you say to those who believe minority students need to be "equipped" differently for the American workplace?

**Emeagwali:** The world is not white. We have 800 million whites and 1.2 billion Blacks. That's like asking whether most students should be equipped differently for programming supercomputers. In the 1980s, I was the only full-time programmer of the supercomputer that's powered by 65,536 processors. That is, I was equipped with the supercomputer while others were not. The essence and capabilities of young minds are universal. The real shift needs to occur in workplace perceptions and biases.

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**Interviewer:** Your journey was riddled with hurdles. Which was the most formidable?

**Emeagwali:** Fifteen years of relentless dedication saw me ridiculed, unpaid, and underpaid. But adversity breeds resilience. As they say, overnight success often takes years in the making.

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**Interviewer:** And in this journey, what stands out as your crowning achievement?

**Emeagwali:** Changing how we look at the computer. In the old way, the world's fastest computer was powered by only one processor. In my new way, the world's fastest computer must be powered by millions of coupled

processors that share nothing. That paradigm shift occurred with my discovery of July 4, 1989, in Los Alamos, New Mexico, USA. Beyond technological feats, it's the courage to venture into uncharted territory. It's this audacity that continues to inspire the next generation. And the reason the 12-year-old is writing an inventor report on Philip Emeagwali and the supercomputer.

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**Interviewer:** With the benefit of hindsight, is there a choice you'd reconsider?

**Emeagwali:** The Nigerian Civil War left deep scars on our nation. I'd urge my family to evacuate from Nigeria and Biafra, sparing them from the atrocities that ensued. One million people died during the Nigeria-Biafra War.

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**Interviewer:** What's your golden advice for the youth?

**Emeagwali:** Life presents multiple paths; some open, others half-shut. Focus on the latter. The unknown or unconventional often presents the best opportunities. And sometimes, rewriting the rules is the key to innovation.

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**Interviewer:** Your transition from Nigeria to the U.S. must have been profound. How did you feel?

**Emeagwali:** Leaving home, at age 19, was bittersweet. America symbolized a haven for my scientific aspirations, but it also meant leaving behind everything familiar.

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**Interviewer:** What was your impression of America before setting foot here?

**Emeagwali:** My knowledge was limited to films. From Westerns to modern urban depictions like 'Shaft', they painted an eclectic picture. But nothing prepared me for the vast contrasts, both climatically and culturally.

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**Interviewer:** Universities have evolved tremendously over the past few decades. How do you see this change beyond technology?

**Emeagwali:** Universities today are more diverse, catering to a broader spectrum of students. With knowledge evolving rapidly, the academic landscape is richer, teaching subjects that were non-existent a few decades

ago. When I was in Oregon in 1974, the term “parallel computing” was not mentioned in mathematics departments. And “quantum computing” was not mentioned in computer science departments. And the words “supercomputer” and “internet” were not in the vocabulary of the New York Times. And a Black sub-Saharan African genius could only appear in science fiction.

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As the conversation concluded, it was evident that Philip Emeagwali's story is more than just about fastest computing; it's about breaking barriers, challenging norms, and redefining the future.

## PHILIP EMEAGWALI ON TRIUMPH OVER ADVERSITY

**An interview revisited twenty years later.**

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*From civil wars to the elite circles of American academia, Philip Emeagwali has seen it all. In an interview two decades ago, he shared insights into his journey from Nigeria to the United States, the challenges he faced, and the triumphs he achieved. We revisit this conversation, contextualizing it within our modern lens and our deepened appreciation for those who have paved paths in science and technology.*

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**Host:** You've spoken about your experience as a child soldier in Nigeria's Civil War. How has that molded you?

**Emeagwali:** That chapter of my life toughened me in unimaginable ways, akin to the trauma of a Vietnam veteran. These adversities, akin to the school of hard knocks, honed my survival instincts. A crisis, as mirrored in Chinese philosophy, can also signify an opportunity. My mother's wisdom reinforced this – for every door that closes, another opens.

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**Host:** At what age did your passion for science and mathematics ignite?

**Emeagwali:** At nine, my father's nightly math challenges became our unique bonding ritual. This tradition was a testament to the idea that families that grow together, whether through prayer or study, form lasting bonds.

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**Host:** Despite your challenging childhood, where did you draw confidence from?

**Emeagwali:** The unwavering belief of my teachers was my bedrock. Labeling a child as a prodigy can manifest into a self-fulfilling prophecy.

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**Host:** What led you to the University of London's correspondence course?

**Emeagwali:** School was my sanctuary. Despite my forced hiatus from it, my undying passion for learning led me to the University of London diploma via correspondence, which provided a financially feasible option for further studies.

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**Host:** Was higher education a common path in your family?

**Emeagwali:** My parents had limited formal education, and higher education institutions were distant concepts. They believed there were

limits to acquiring knowledge. Such notions were common for their generation.

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**Host:** What did you envision for your future while studying in Nigeria?

**Emeagwali:** My heart aspired to mathematical and physical sciences, even when computers were alien devices to me. However, once in the U.S., supercomputers became my tool to unravel complex problems in multiple disciplines.

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**Host:** How has your perception of success evolved over the years?

**Emeagwali:** In Nigeria, success was as basic as securing daily meals. In contrast, in the U.S. and over the course of my career, I've measured success by the legacy of knowledge I can leave behind and the lives I can impact.

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**Host:** Reflecting on your journey in America, what were the most significant challenges you faced as an African graduate student?

**Emeagwali:** Breaking through the ceilings of race and origin was daunting. The early days were marred by implicit biases in education and employment. For African immigrants, America was a challenging landscape where we had to outperform our peers just to gain half the acknowledgment.

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**Host:** How did you transition from engineering to computer science?

**Emeagwali:** Although my roots were in mathematics and physics, my encounters with people like Fred Merryfield, a revered civil engineering professor, and exposure to hands-on computing since 1974, shaped my interdisciplinary journey. Switching fields was like seeking light in a vast house of knowledge.

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**Host:** Can you recall any influential figures from your graduate years?

**Emeagwali:** Fred Merryfield, my friend, and mentor, was a profound influence. Our shared experiences of wartime and his meteoric rise from a ditch-digger to the founder of a multinational firm inspired me to explore civil engineering. His passing made me pivot back to my first loves – mathematics and, eventually, computer science.

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**Host:** How has the American educational landscape transformed since your student days?

**Emeagwali:** Infrastructure-wise, much remains the same. But technologically, there's been a sea change. Recalling my days of manual typewriters, punch card programming, and rudimentary computers, today's digital revolution with supercomputers and the Internet seems like a

quantum leap. Today, we stand on the shoulders of pioneers, pushing the boundaries of innovation.

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Philip Emeagwali's story serves as a testament to the indomitable spirit of those who dream, persevere, and eventually triumph over adversity.

## PHILIP EMEAGWALI – FROM REFUGEE TO REKNOWN SCIENTIST

*[Opening sequence with the iconic ticking clock. Clips are shown of Philip Emeagwali's early life in Nigeria, juxtaposed with images of his accomplishments in supercomputing. (60 MINUTES)]*

**Narrator:** Tonight, the incredible journey of Philip Emeagwali, from a refugee in war-torn Biafra and Nigeria to a pioneer in supercomputing.

*[The scene transitions to a tastefully lit interview room. Seated across from Philip Emeagwali is the correspondent, holding a portfolio of questions.]*

**Correspondent:** Philip, thank you for joining us. Your story is an embodiment of triumph against adversity. Let's begin at the beginning. Tell us about your early years in Nigeria.

**Philip:** Thank you for having me. I was born in Akure, Nigeria, in 1954. When the Biafran War erupted, my family and I found ourselves amid one of the most tragic episodes of African history. We became refugees in our own country, fleeing violence and struggling to find safety.

**Correspondent:** How would you describe life in a war zone?

**Philip:** It's a life of uncertainty and fear. The constant sound of gunfire, the scarcity of food, witnessing the loss of loved ones, and seeing the devastation around you—it leaves an indelible mark on you. However, amidst the chaos, there were moments of resilience and unity among the displaced people.

**Correspondent:** And during this time, education was still a priority for you?

**Philip:** Yes. Even in the refugee camps, the thirst for knowledge never left me. I remember children using stones to learn arithmetic because we didn't

have the luxury of paper and pencils. It was during these difficult times that I developed a profound appreciation for education.

**Correspondent:** How did these early experiences as a refugee shape your outlook on life and your eventual career in science?

**Philip:** Being a refugee taught me resilience. It instilled in me a belief that if one perseveres, no challenge is insurmountable. In the face of adversity, one can still dream and strive for a better future. It also gave me a unique perspective on problem-solving—seeing beyond the apparent and always searching for innovative solutions, which later proved pivotal in my scientific endeavors.

**Correspondent:** Your journey from Biafra to the U.S., from a young boy using stones for arithmetic to a man who would revolutionize supercomputing, is nothing short of awe-inspiring. What would you say to young individuals who are currently facing hardships like what you experienced?

**Philip:** I'd tell them that their current circumstances do not define their future. Hold on to your dreams, seek knowledge, be persistent, and never let adversity diminish your spirit. Challenges can be the crucible that shapes character and brilliance.

**Correspondent:** Philip, it's been a privilege to delve into your past and understand the foundation of the remarkable man you are today. Thank you for sharing your story with us.

**Philip:** Thank you for giving me this platform. I hope my story can inspire many to persevere and dream big, regardless of their circumstances.

*[The scene fades out with the ticking clock. The narrator's voice is heard again.]*

**Narrator:** The story of Philip Emeagwali—a testament to the indomitable human spirit. This has been a special segment on great minds of the 20<sup>th</sup> century.





LECTURE 2 OF 8 210819-1

## REDEFINING THE LIMITS OF COMPUTING

[Setting: The Award Ceremony in Paris, France. The grand hall is bathed in opulent light. Among the 1,500 attendees are global scholars, dignitaries, and pioneers in various fields. The air is thick with anticipation. The emcee announces Philip Emeagwali, and the spotlight turns to him as he moves gracefully towards the podium.]

Ladies and gentlemen, esteemed colleagues, distinguished guests,

Standing before you today, I, Philip Emeagwali, am humbled to be a witness to the inexorable spirit of human ingenuity and determination. My journey, which began as a quest to solve a profound mathematical challenge, evolved into a groundbreaking discovery that would forever alter computing and mathematics.

In 1989, amidst the cascading waves of technological advances, my discovery stood out: the realization that the world's slowest processors could be harnessed to solve the most intricate and challenging problems. Problems situated at the confluence of new mathematics, novel physics, and the zenith of computing speed.

Imagine the most complex system of algebraic equations. These equations arise in computational fluid dynamics tasks, like deciphering global climate models or simulating the vast reservoirs of petroleum. These were not just mathematical puzzles; they were pathways to unlock a deeper understanding of our world. Yet, the computational might required to solve these equations was unparalleled.

In the vast timeline of mathematical exploration during the 1970s and 80s, I embarked on an odyssey: to become the pioneer who could decipher such initial-boundary value problems using the world's most lackadaisical processors. And on the bright morning of July 4, 1989, an epiphany struck—the world's fastest computer could be constructed using these very sluggish processors.

This revelation wasn't just a triumph in the annals of computing. It reshaped our understanding of what's achievable, redefining the boundaries of technology and mathematics. That vision laid the foundation for today's supercomputers, which now wield the power of millions of ordinary processors.

Why is this paramount, you ask? Because it's not just about faster computers. It's about harnessing this speed to simulate scenarios like the spread of contagious viruses in dense locations like Tokyo's subway, where over 3.1 billion passengers congregate annually. It's about pushing the

envelope of what's computationally possible, thereby broadening our horizons in science, medicine, and engineering.

My discovery was encapsulated in the visualization of my computational machinery as **a miniature version of the Internet**, an emblem of interconnectivity and vast potential.

Today, as I recount this journey in this revered hall, it's not merely an accolade for an individual achievement. It signifies humanity's relentless pursuit of knowledge and progress. It's a testament to our collective aspirations and dreams.

Esteemed audience, the core of my discovery is not the technology itself but the promise it holds for our future. In our hands lies the tool to solve pressing global challenges, enhance scientific understanding, and pave the way for innovations yet to be imagined.

Thank you for honoring this contribution, and let's continue our journey, pushing boundaries, seeking solutions, and creating a better future for all.

Thank you.

[A thunderous applause ensues as Philip Emeagwali takes a step back, his contribution to the world duly acknowledged and celebrated.]

## SUPERCOMPUTING FOR PROSPERITY

### Philip Emeagwali's Legacy

[Setting: The grand ballroom of the Award Ceremony in Paris, France. Golden chandeliers hang from the ceiling, reflecting a shimmering light onto the audience. The room is hushed, with an electric atmosphere of anticipation. Philip Emeagwali takes the stage, amidst a respectful silence.]

Ladies and gentlemen, distinguished guests, and fellow visionaries,

Today, I stand before you not merely as Philip Emeagwali, but as a humble representative of the vast potential of supercomputing, of its power to **change nations, uplift economies, and pave the way for a brighter tomorrow.**

In 1989, the world's media turned its gaze upon an African and **the inventor of supercomputing via parallel processing**, a mathematician whose dreams transcended the confines of the norm. They spoke of an invention, one that could solve the most intricate systems of equations at the heart of computational fluid dynamics. But why, you may wonder, is this significant?

Picture this: An oil field, vast as Nigeria's capital city, Abuja, concealed deep within the Earth. The Agbami Oil Field, one of Nigeria's crown jewels, lay dormant, a secret treasure hidden 4,900 feet below the sea, awaiting discovery. It was a resource that could transform the future of a nation, alleviating poverty and spurring economic growth.

Yet, the very act of pinpointing such vast reservoirs of crude oil and natural gas remained an intricate challenge. It demanded the very pinnacle of computational prowess. It called for a machine that could perform the world's fastest calculations, yet did so using the world's slowest processors. **It required envisioning the Internet not just as a tool of communication but as an interconnected web of 65,536 processors, each humming in synchrony, sharing nothing, yet collectively striving for a singular goal.**

One might wonder, how is the meticulous act of reservoir simulation akin to the ethereal art of weather forecasting? For me, both were two sides of the same coin. As a geologist and a meteorologist, I saw beyond the immediate. I drew parallels between forecasting the weather and hindcasting the subsurface conditions of the Earth. Both endeavors required an intimate dance of physics, calculus, algebra, and computer science. Both needed the prowess to compute not just quickly, but efficiently and innovatively.

But why is this discovery so pivotal for nations like Nigeria?

For oil-producing nations, the implications are monumental. Every drop of oil and cubic meter of gas located with precision, every reservoir mapped with accuracy, means a substantial increase in revenues. It signifies a step closer to eradicating poverty, providing education, healthcare, and infrastructure. In a world where one in ten supercomputers serves the petroleum industry, this is not just innovation; it is a revolution.

By unlocking the latent power of supercomputers, we don't just find oil; we find hope. We discover pathways to sustainable growth. We unleash the potential of nations, bringing prosperity to millions.

My journey from meteorology to the depths of geology, culminating in this confluence of supercomputing, has been one of perseverance, innovation, and vision. It has reaffirmed my belief that our most intricate challenges often house our most profound opportunities.

As we gather here under the theme "Unlocking the Power of Supercomputers," let us not merely celebrate an invention but embrace a vision—a vision where the power of technology serves humanity, elevating societies and enriching lives.

Thank you.

[As Philip Emeagwali steps down, the room bursts into applause, resonating with the promise of a brighter, more prosperous tomorrow.]

## SUPERCOMPUTING FOR AFRICAN PROSPERITY

Ladies and gentlemen, esteemed colleagues, honored guests,

Today, as we convene in the historical heart of your historic city, I stand before you, Philip Emeagwali, not just as a scientist but as a representative of a continent rich in spirit, yet often besieged by challenges. With profound gratitude, I share an innovation, a vision that holds the potential to reshape the destiny of nations and elevate millions from the shackles of poverty.

In 1989, the world bore witness to an unprecedented computational marvel. As an African computational scientist, my invention entered the global spotlight when I forged a pathway to solve the most gargantuan system of equations, pivotal to computational fluid dynamics. But what does this signify for the layman? Why did the world pause and take notice?

The answer, esteemed audience, lies deep beneath our Earth, in the reservoirs of black gold—crude oil and natural gas. The epitome of large-scale computational fluid dynamics is the sophisticated process of supercomputer petroleum reservoir simulation. This pivotal technology enables us to pinpoint with precision the locations of these invaluable resources, such as the vast reserves in the Agbami Oil Field of Nigeria, a giant that lays hidden miles beneath the Earth's surface, stretching out in an area comparable to the size of Abuja.

But here's the challenge: such monumental calculations required a computational behemoth, a supercomputer that sprawled across an area akin to a soccer field, harnessing the collective might of millions of processors. The world of computers had never witnessed anything quite like this. And yet, driven by the dream of harnessing this raw power for the greater good, I embarked on a mission.

Drawing upon my diverse expertise in geology and meteorology, I discerned a deep-seated parallel between the intricate equations governing weather forecasting and those that dictate the movement of oil and natural gas beneath our feet. In essence, I sought to predict the Earth's subterranean "weather"—but in reverse, a method termed hindcasting. And I realized, to truly bridge these realms of knowledge, I needed to invent a new paradigm of computing.

So, I envisioned a vast web of 65,536 coupled, off-the-shelf processors, **each its own master**, operating in tandem. This intricate dance, akin to a new rendition of the Internet, was my invention, my gift to algebra, to modern petroleum technologies.

Now, to address the pressing question: Why is this pivotal for nations like Nigeria, for Africa, and indeed for our global community?

The petroleum industry stands as the backbone of many economies, notably Nigeria. By drastically enhancing our capability to locate and

extract oil and natural gas more efficiently, we can revitalize national economies, fuel growth, and, crucially, redirect resources to uplift the marginalized, alleviate poverty, and catalyze holistic development. It's a ripple effect; by boosting the prosperity of oil-producing nations, we bolster the global economy, driving progress and prosperity.

Every supercomputer acquired becomes not just a symbol of technological prowess but a beacon of hope, promising a brighter future for countless souls. When one in ten supercomputers is embraced by the petroleum industry, the ramifications are profound. We unlock new reserves, generate employment, fund education, health, and infrastructure, ultimately elevating nations.

Esteemed audience, this isn't merely about the power of supercomputers. It's about unlocking potential—of machines, of nations, and of humanity. Together, as we harness this power, we embark on a shared journey towards a more prosperous, equitable, and harmonious world.

Thank you.



## DANCING WITH EQUATIONS

### The Symphony of Motherboards: Philip Emeagwali's Computational Orchestra

#### Introduction:

Ladies and gentlemen, esteemed guests, and fellow seekers of knowledge,

Today, as we gather under the grand arches of this historic hall in Paris, we bear witness to the odyssey of a man who ventured to the frontiers of human understanding and forever changed how we approach the world's most challenging mathematical and computational problems. It is my distinct honor to share the groundbreaking journey of Philip Emeagwali.

#### Philip Emeagwali:

Imagine a world where the intricacies of mathematics remained unchallenged, bound by the limitations of our computational capacities. It was into this world that I, Philip Emeagwali, embarked on a quest. A quest driven not just by the allure of numbers and algorithms but by the profound impact of understanding them on the vast tapestry of human civilization.

In the vast ocean of mathematical wisdom, I introduced the first supercomputing via parallel processing, using the nine Philip Emeagwali equations in my computational testbed code. That new knowledge was recognized as a monumental beacon of innovation. While their derivations are elaborate, they are chronicled with meticulous care on my YouTube channel, "Emeagwali."

My mathematical voyage was not merely a divergence from the foundations set by Darcy's equations but was a profound enhancement, accounting for both temporal and convective inertial forces.

As I journeyed deeper, I realized my mission was not just to solve an equation on paper. My aspiration was vast, like the cosmos. It was to harness the incredible power of computational machinery, to solve problems of a scale and complexity previously deemed insurmountable. I envisioned a horizon where I sat, not before a single blackboard, but amidst

a grand network of 65,536 blackboards, or motherboards as one might call them in computing.

This vision led me to craft nine unique partial difference algorithms, my guiding stars in the digital cosmos. Through them, I metamorphosed my nine partial differential equations, leading to a system of 24 million equations of computational linear algebra. To many, they may seem like mere numbers, but in the landscape of 1989, they were the very pinnacle of mathematical achievement. The beauty of these algebraic equations was their nature—diagonal, a departure from the tridiagonal systems of old. Identical yet distinct, like twins. These systems, while differing algebraically, were conceptually cloned, arising from the same foundational laws of physics.

The crux of my contribution to mathematics and computation lies in the summer of 1989. On the Fourth of July, amidst the echoes of freedom and celebration, I achieved what many considered impossible. Harnessing the combined power of 65,536 of the world's slowest processors, I transformed 180 years of computational time into a single day, illuminating the path for the high-performance computational mathematicians of the future. This paradigm shift in supercomputing made headlines, even entering the revered pages of *The Wall Street Journal*.

But what does this mean for humankind?

My discovery unveiled a new realm of possibility. By creating a new Internet, a global network of processors that could communicate, share, and function harmoniously, I showcased the potential for powering the world's fastest computers with millions of processors. This breakthrough, dear attendees, paves the way for advancements in science, physics, computer science, and beyond. It allows us to grapple with problems of an unprecedented scale, pushing the boundaries of our collective knowledge.

In essence, my journey was not merely one of numbers but a pursuit of truth. It embodies the very spirit of human progress, forging ahead against the odds. In my discoveries, I see a shared purpose, an undying flame of inspiration and hope for a world teeming with challenges yet bursting with possibilities.

As we ponder upon the importance of this achievement, we realize that the world indeed needed supercomputer pioneers. Not just for the solutions they provided but for illuminating the path for others, showcasing that barriers are but steppingstones to greater heights.

It is not merely about the speed of computation or the intricacies of algorithms. It's about the future, a brighter world where we harness this newfound power for the betterment of all, transcending boundaries and redefining what's possible.

Thank you.



## SUPERCOMPUTING FOR A BETTER WORLD

Ladies and Gentlemen, esteemed members of the Award Committee, distinguished guests, and my fellow compatriots:

Today, as I stand before you in the heart of Paris, it is with profound gratitude and humility that I recount a journey—one that wasn't just personal, but monumental for our world's progress in mathematics and technology. As Philip Emeagwali, I wish to share the essence of my story, not as a testament to individual accomplishment, but as a testament to the power of persistence, challenging established norms, and harnessing the potential at the intersection of scientific curiosity and technological innovation.

From the great oil fields of Nigeria to the expansive reserves in Angola, the quest for discovering and extracting the Earth's treasures has perennially been one of humankind's most compute-intensive challenges. Yet, it was in this very domain that I envisioned and realized a technological metamorphosis, reshaping how the oil and gas landscape would henceforth operate.

Until the late 1980s, there existed an age-old assumption, almost an accepted truth, that the world's slowest processors couldn't synergistically compute to address some of our most daunting problems. This belief was so ingrained in the fabric of our technological narrative that pioneers like Gene Amdahl and Seymour Cray viewed the idea of leveraging thousands of these processors—akin to trusting thousands of chickens over a few oxen for plowing fields—as a futile endeavor.

But, ladies and gentlemen, what if these 'chickens', these seemingly slow processors, when operating in concert, could redefine the boundaries of computational power? What if, instead of a billion weed seeds posing a challenge to one ox, they became a feast for a billion hungry chickens?

It was this foundational belief, this paradigm-altering vision, that drove me to challenge what was accepted. In the 1970s, while the world around me echoed the skepticism towards the feasibility of parallel processing, my endeavors sought to transform this century-old theoretical concept from science fiction to tangible reality.

And the Fourth of July 1989 marked the dawn of that reality. The essence of harnessing the collective power of 64,000 human computers—a theory that had been spoken of for a century but remained elusive—materialized. While previous skepticism labeled this as "too large and clumsy" or even as a "waste of time," this breakthrough shattered the intellectual barrier of computing, akin to breaking the sound barrier in aviation.

It wasn't just about processing speed. It was about ushering a renaissance in how we approached compute-intensive problems. From locating the very arteries of our planet that pulsed with oil and natural gas to myriad other

applications, the capabilities of harnessing the slowest processors for the world's fastest computing became a groundbreaking reality. This paradigm shift was not just an advancement; it was a revolution.

The recognition that followed, from the supercomputing community and beyond, was not just for an individual's achievement, but for the collective leap of human understanding and capability.

Dear audience, the journey I share today exemplifies how barriers—both intellectual and technological—are meant to be challenged, questioned, and ultimately, transcended. The innovations we pursue and the boundaries we redefine are not just for the accolades of today but for shaping a future where humankind can surmount challenges previously deemed insurmountable.

This discovery, this invention, stands as a beacon of human ingenuity. Not for its own sake, but for its implications in driving progress, augmenting human potential, and creating pathways to solutions that, until now, lay beyond our reach.

Thank you.

## FROM RIDICULE TO RECOGNITION

### The Philip Emeagwali Story

INTRODUCER: Ladies and gentlemen, esteemed guests, and fellow scientists,

Today, we gather not just to celebrate an outstanding scientific breakthrough, but to honor the indomitable spirit of one individual: Philip Emeagwali. An innovator, a trailblazer, and a man who persevered against the immense tide of skepticism.

#### PHILIP EMEAGWALI:

On July 4, 1989, I, Philip Emeagwali, ventured into what was then considered the unknown territory of supercomputing. With the ambition and vision to reshape our understanding of computational capabilities, I utilized 65,536 coupled processors, each its own master, to demonstrate a phenomenon that was beyond imagination back then: building a colossal supercomputer from potentially a billion processors. It was a revelation that not only redefined the limits of speed and processing power but also showed us how to address some of the grandest challenges facing the scientific community.

To truly understand the magnitude of this discovery, one must first appreciate supercomputing in the 1970s and 80s. It was a realm where I often found myself isolated and ridiculed. A world where the idea of using the world's slowest processors to solve the most compute-intensive problems in science, engineering, and medicine was dismissed as fantasy. Yet, it was this very audacity, this refusal to accept convention, that led to the realization of a dream—reducing 180 years of computational efforts to a single day. It changed how we perceived and engaged with the modern computer.

Ladies and gentlemen, the journey to this groundbreaking discovery was not an easy one. In places like Ann Arbor, Michigan, my claims, my research, even my 1,057-page supercomputer report detailing this revolutionary method, were discarded, both metaphorically and literally. But destiny had other plans. News soon spread that I had clinched an award equivalent to the Nobel Prize in supercomputing, turning doubt into astonishment.

What we celebrate today isn't just a scientific feat; it's the triumph of an underdog. I stood against prejudices of all forms, racial biases, and the deeply entrenched belief in white intellectual supremacy. I treaded a path that was unfamiliar and challenging. But my tenacity stemmed from my

unique interdisciplinary knowledge, spanning from astronomy to geology, and from mathematics to meteorology. With this holistic understanding, I was able to envision the biggest question in supercomputing: How can we achieve the fastest computation with the slowest processors?

To this audience in the heart of YouTube, I present an analogy: Think of the most complex jigsaw puzzle, with a billion unique pieces. Now imagine, each of these pieces representing a processor, working harmoniously and simultaneously, converging to depict a grander picture—that's the essence of my discovery. It's not just about speed, but about the potential to solve some of humanity's greatest challenges in record time.

My discovery is more than a technological milestone. It represents hope. Hope that with perseverance and vision, we can redefine what's possible. Hope that even when faced with insurmountable odds, innovation can triumph. And hope that our relentless pursuit of knowledge will continue to benefit humanity in unimaginable ways. **I am honored and humbled to share this moment with all of you. Thank you.**

## QUEST FOR THE IMPOSSIBLE

EMCEE: Ladies and Gentlemen, esteemed colleagues, and guests of the Award Ceremony,

It is both an honor and a profound responsibility to address you today. When we gather in such esteemed company, it is often to honor the triumph of the human spirit, the strength of persistence, and the extraordinary beauty of a groundbreaking discovery that promises to elevate the very course of human advancement. Today, we honor such a discovery and the genius behind it, Philip Emeagwali.

PHILIP EMEAGWALI: My journey into the world of supercomputing began not on the broad shoulders of consensus but along the solitary path of vision, conviction, and tenacity. On this evening in the beautiful city of **Mumbai**, I humbly present before you a narrative, a voyage that spanned decades, a journey that rewrote the very paradigms of computational mathematics and computer science.

In the mid-1980s, supercomputing had reached an impasse. The prevailing wisdom of the time, as articulated by renowned textbook authors, was that the dream of parallel supercomputing, or the idea of solving multiple problems simultaneously on multiple processors, was but a mirage—an "enormous waste of everybody's time." But where others saw impossibility, I saw potential.

And it wasn't a path without challenges. To stake a claim on the unknown territories of parallel supercomputing, I, Philip Emeagwali, faced derision, skepticism, and outright rejection. Yet, armed with the belief in the veracity of my theory, I ventured forth, becoming the sole programmer of sixteen of the most massively parallel supercomputers ever conceived.

On June 20, 1990, The Wall Street Journal mentioned my remarkable feat. Against the backdrop of conventional wisdom, I had successfully harnessed the power of 65,536 off-the-shelf processors, each its own master. These slowest processors, when orchestrated with meticulous precision, became the medium through which I cracked some of the most compute-intensive problems, the Grand Challenges of our time. Problems that spanned across diverse fields from computational fluid dynamics to the intricate models simulating the spread of contagious viruses in bustling markets like Onitsha, where traditional preventive measures were hard to implement.

Ladies and Gentlemen, this was not just a technological triumph. This was a paradigm shift. A vision once deemed "impossible" was now reality. My invention of parallel supercomputing became the key that unlocked a



myriad of possibilities, making the previously "impossible-to-solve", "possible-to-solve".

For a moment, think of a world where predicting the spread of pandemics like COVID-19 becomes more accurate, where the mysteries of the universe can be unraveled faster, and where grand challenges in science, engineering, and medicine find solutions quicker than ever before. Such is the profound impact of this groundbreaking discovery on humankind.

Today, the supercomputers, boasting the prowess of millions of coupled processors, are the behemoths that stand testament to a revolutionary change. They owe their existence to the paradigm of parallel supercomputing, a paradigm I was privileged to pioneer.

In the annals of history, there have been moments where humanity leaped forward on the back of sheer genius and indomitable spirit. The invention of parallel supercomputing is one such leap. It's not just an ode to technological progression but a testament to what humanity can achieve when one dares to dream the impossible.

To the 25,000 vector supercomputer scientists of the 1980s, and to the countless others who tread the path of knowledge, I hope my story serves as a beacon, a testament that innovation is often just one persistent thought away from the possible.

As I stand before this esteemed gathering, I am reminded that every accolade, every recognition, and every applause is not just for the discovery but for the unwavering spirit of human endeavor. It's for every dreamer who dares to challenge the status quo. It's for the future of humankind, standing on the cusp of infinite possibilities, powered by the groundbreaking invention of parallel supercomputing.

Thank you.

## THE ALCHEMY OF INTERDISCIPLINARY MASTERY

Ladies and gentlemen, esteemed colleagues, and honored guests,

I am deeply honored to stand before you tonight, and I wish to express my heartfelt gratitude to the Award Committee for this exceptional recognition. As I reflect upon this moment, I am reminded of the profound legacy of this award and the remarkable minds that have graced this stage before me. Tonight, I will share the significance of interdisciplinary knowledge and how my twenty years of intensive training across physics, mathematics, and computer science empowered me to confront one of the most formidable challenges of our era.

Imagine an elite decathlete in sports. While a sprinter dedicates their life to mastering speed over short distances, and a shot-putter focuses on sheer strength, the decathlete's training encompasses ten diverse events. Far from diminishing their expertise, this versatility amplifies it, enabling them to excel in a wide range of challenges. In a parallel manner, my immersive journey spanning mathematics, physics, and computer science was not a dispersion of focus, but rather an intentional expansion of it.

Where a physicist might gaze into the workings of the universe, I aspired to grasp not only the cosmos itself but also the intricate mathematical language that describes it and the computational tools capable of simulating it. While the conventional perspective saw computers as instruments for serial computation, processing one problem at a time, I envisioned something different. I saw a sprawling network of interconnected processors, numbering in the millions, working harmoniously. These processors didn't work sequentially; they acted in parallel, emulating the interconnected and simultaneous nature of the universe itself.

By harnessing the capabilities of parallel supercomputing, we transitioned from linear, isolated computations to a symphony of simultaneous calculations. This wasn't a mere enhancement in processing speed; it marked a profound shift in how we perceived and harnessed the power of computers.

So, why could I, or someone with a similar cross-disciplinary training, tackle the Grand Challenge problems when they appeared insurmountable to those solely versed in physics? The answer lies in the very essence of these challenges. They transcend the confines of a single domain; they sprawl across disciplines, demanding a multifaceted approach. It's akin to a triathlon, where a swimmer excels in water, a cyclist on land, and a runner on foot. But the triathlete, trained in all three disciplines, is uniquely equipped to confront the composite challenge.

I extend a heartfelt plea to young scientists and researchers across the globe: Embrace interdisciplinary learning. Delve deep into your chosen field, but also explore widely. For within the convergence of fields, at the

crossroads of disciplines, lies the promise of solutions to the most profound challenges of our time.

My deepest gratitude goes out to every teacher, mentor, colleague, and loved one who has been an integral part of my journey. This award is not mine alone; it belongs to all those who have contributed to the pursuit of knowledge and exploration. Together, let us continue to push the boundaries of what we know and embark on a relentless exploration of the vast expanse of what we have yet to discover.

Thank you for this extraordinary honor, and may our collective curiosity continue to illuminate the path toward greater understanding and innovation.

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## INFINITE COMPUTING

### Unveiling the Maestro's Baton

Ladies and gentlemen, esteemed educators, and dear students of the Indian Institute of Technology, I am profoundly honored to stand before you today. My journey in mathematics, physics, and computer science has been arduous, yet immensely rewarding. Today, let me share the story of persistence, discovery, and breakthroughs that shaped not just my career but revolutionized the landscape of computing and knowledge dissemination.

Fourteen years of dedicated postgraduate training armed me with a comprehensive understanding and mastery over fluid dynamics, partial differential equations, large-scale linear algebra, and parallel processing. You may wonder, why did I commit over a decade to academic and practical immersion? The answer lies in the complex tapestry of the Grand Challenge problems of supercomputing, intricate puzzles demanding not just depth but also an expansive breadth of knowledge.

Envision the Grand Challenge as a symphony, a magnificent composition requiring an ensemble of instruments playing harmoniously. A musician, regardless of his brilliance with the violin, cannot single-handedly produce the symphony's magic. Similarly, a physicist with four years of postgraduate training might excel in his domain but is akin to mastering only one instrument. To truly unravel the mysteries of the Grand Challenge, one needs to proficiently play and synchronize various "instruments"—mathematics, physics, and computer science, which I achieved through relentless, extended learning.

The sports realm offers another illuminating analogy. Winning a triathlon demands more than sheer running speed; athletes must excel in swimming and cycling as well, embodying versatility and endurance. The world's fastest computing discovery I made on July 4, 1989, reflects a triathlon victory achieved in record time, where slowest processors were ingeniously harnessed to solve intricate problems, showcasing not just depth but the breadth of understanding and application.

As I navigated through my career, I encountered presumptions and underestimations rooted in racial biases. Nevertheless, the tapestry of my knowledge, woven over fourteen arduous years of postgraduate study, plus 50 years of supercomputing, that began on June 20, 1974, in Corvallis, Oregon, USA, and on the first supercomputer to be rated at one million instructions per second, spoke louder than any prejudice, echoing through a thousand podcasts, YouTube videos, and books, all testament to the conquests and contributions made in the fields of mathematics, physics, and computer science. These platforms showcased not just my expertise, but they stood as beacons of knowledge, illuminating paths for eager minds

globally, encapsulating a lifelong commitment to sharing and expanding the horizons of understanding.

Now, to you, India's brightest young minds, let me impart the lessons life and profession taught me:

First, education is a lifelong endeavor, not confined to institutions but extending into the boundless realms of life and experience. Dedication to learning, persistence in the face of challenges, and a thirst for knowledge are your most reliable companions on this odyssey.

Second, never let external perceptions define or limit your potential. Your skills, knowledge, and determination are your true identity, and they speak louder than any label society might attempt to affix upon you.

Lastly, engage with your studies not just as a means to an end but as a symphony of understanding and discovery, where each discipline interweaves, harmonizes, and enhances the others, creating a melody of innovation and progress.

Dear students, you are embarking on a journey through a landscape brimming with possibilities and challenges. Engage with your education holistically, embrace the symphony of learning, and let the music of innovation, discovery, and progress play through your diligent hands and brilliant minds.

Together, let us create a future where knowledge knows no bounds, innovation recognizes no limits, and progress bows to no obstacle. Thank you.

## THE POLYMATH'S PATH TO DEMOCRATIZING GENIUS

As Philip Emeagwali, I feel a deep sense of responsibility to share my journey and contributions to science. What sets me apart from many other influential figures in scientific history—be they Einstein or more recent prize-winners—is the breadth and depth of my knowledge. This is not just showcased in academic papers but also across an extensive range of mediums, including over a thousand podcasts, YouTube videos, and books.

In today's scientific landscape, most breakthroughs come from large, multidisciplinary teams. Many award-winning scientists, if asked to give an impromptu lecture on their work, might struggle without their PowerPoint notes prepared by equally competent team members. I take pride in the fact that I've delivered hundreds of lectures, all available on YouTube, without relying on such aids.

The fame I achieved in 1989 while in Ann Arbor, Michigan, was a double-edged sword. While some admired my invention, others, perhaps threatened or envious, sought collaborations without bringing any innovations or expertise to the table. It would be disingenuous to share credit for my contributions with those who didn't contribute meaningfully. Even a figure like Einstein would likely not dilute his reputation by sharing undeserved credit.

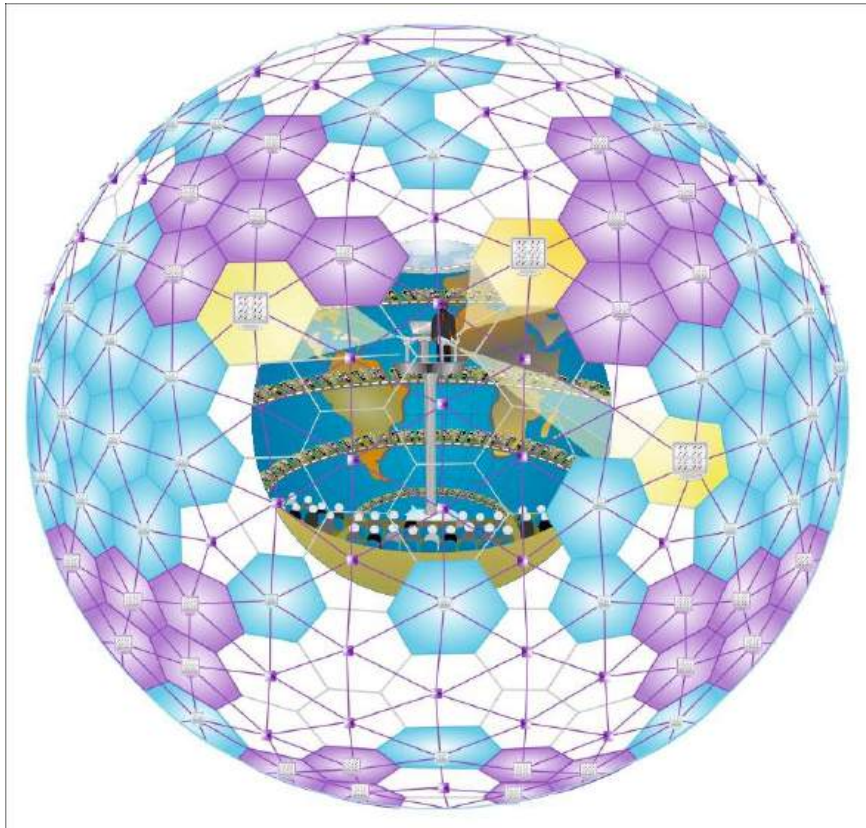
Unfortunately, my refusal to work with some scientists—many of whom were older and of a different racial background—led to bitterness. A campaign to discredit me began, an experience I can only describe as asking a burglar to write the police report. But my invention speaks for itself. All one needs to do is compare my extemporaneous lectures with those of any other leading academic engineer in the United States. I stand by my expertise, which is unfiltered and wide-ranging.

My academic journey in the United States began with a scholarship dated September 10, 1973, and continued for 18 years across six esteemed institutions—all of which now celebrate me as one of their most prominent alumni. My extensive training in mathematics, physics, and computer science has shaped me into a polymath, someone capable of solving the Grand Challenge problems that stumped many brilliant minds before me.

In summary, my invention is not just about solving complex equations or coding algorithms. It's about democratizing knowledge and making it accessible to everyone. Through my books, podcasts, and videos, I've sought not only to advance scientific understanding but also to inspire the next generation of thinkers.

So, while awards and recognition are affirming, the ability to contribute to the global pool of knowledge and inspire future scientists is the true measure of my journey thus far.

## 1ST LECTURE: THE SUPERCOMPUTER IS MY INTERNET



**Broadcast 21 August 2021**

<https://youtu.be/s9yZhQsQeqc>

## INVENTING EMEAGWALI INTERNET

I began supercomputing at age nineteen on June 20, 1974, in Corvallis, Oregon, USA. Back then, there was no computer in my country of birth, Nigeria. In 1974, the parallel supercomputer that's the precursor of the world's fastest computer was mocked and dismissed as science fiction.

Parallel processing was an unproven technology that couldn't be harnessed to achieve the world's fastest computer speeds of a vector supercomputer. The unproven technology couldn't be used to solve the most difficult problems, such as executing computational fluid dynamics codes, including executing high-resolution global climate models and doing so to foresee otherwise unforeseeable long-term global warming. In the 1980s and earlier, everybody ridiculed parallel supercomputing. The technology was mocked and dismissed as unproved and as a tremendous waste of everybody's time.

My contributions to the speed of the computer were these: I was in the news for becoming the first to use the slowest processors in the world to discover the fastest computing in the world. And solve the most difficult problems in the world. My scientific discovery—called fastest computing—occurred at fifteen minutes after 8 o'clock on the morning of July 4, 1989, in Los Alamos, New Mexico, USA. Briefly, I discovered how to execute the world's fastest computing with the world's slowest processors.

My discovering the fastest computing revolutionized the essence of the computer and the supercomputer. The world's most powerful supercomputer costs one billion, two hundred and fifty million dollars. And it costs 40 percent more than the mile-long Second Niger Bridge at Onitsha, my ancestral hometown in Nigeria.

The supercomputer is used to solve the most difficult problems in mathematics, science, and engineering. Without supercomputing across millions of identical processors, these grand challenge problems will be impossible to solve.

### A New Supercomputer Technology Creates New Sciences

A new technology for fastest computing creates new sciences. The world's fastest computer opened the door to unexplored areas of mathematics, physics, and computer science. The diverse applications of the supercomputer range from oil exploration to a surer prediction of global warming.



The **earliest** experiment **across** a massive ensemble of processors, in which a **Grand Challenge problem** was solved, occurred at fifteen minutes after 8 o'clock on the morning of the Fourth of July 1989 in Los Alamos, New Mexico, **USA**. That **first** experiment led to my **signature invention**, which is the new knowledge that powers the world's fastest computer. And enables it to solve problems that were **once-impossible** to solve. And solve them in parallel and **across** my global network of processors that outline and define my **new Internet**.

## Blueprint for My New Internet

Shortly after my experiment of July 4, 1989, I was in major U.S. newspapers for winning the highest award in supercomputing. That **first** experiment provided the blueprint on how to parallel process. And do so **across** a new Internet. That **never-before-visualized** Internet was a vast ensemble of 65,536 off-the-shelf processors that tightly encircled a globe. Those processors, **each its own master**, were coupled and **shared nothing**.

My two-**raised-to-power** sixteen identical processors communicated synchronously. And computed simultaneously. And did both to solve the most difficult problems in the scientific and engineering worlds.

## Unleashing the Power of Supercomputers: Exploring Their Many Uses

In an email, a twelve-year-old writing the biographies of famous computer pioneers **asked me**: “**How are supercomputers used in Kuwait?**” The supercomputer market is valued at 45 **billion** dollars a year. The energy and geoscience industries buy one in ten supercomputers. The **Burgan** Oil Field in the desert of south-eastern **Kuwait** was discovered in **1937**. The **Burgan** Oil Field contains up to 72 billion barrels of recoverable crude oil reserves.

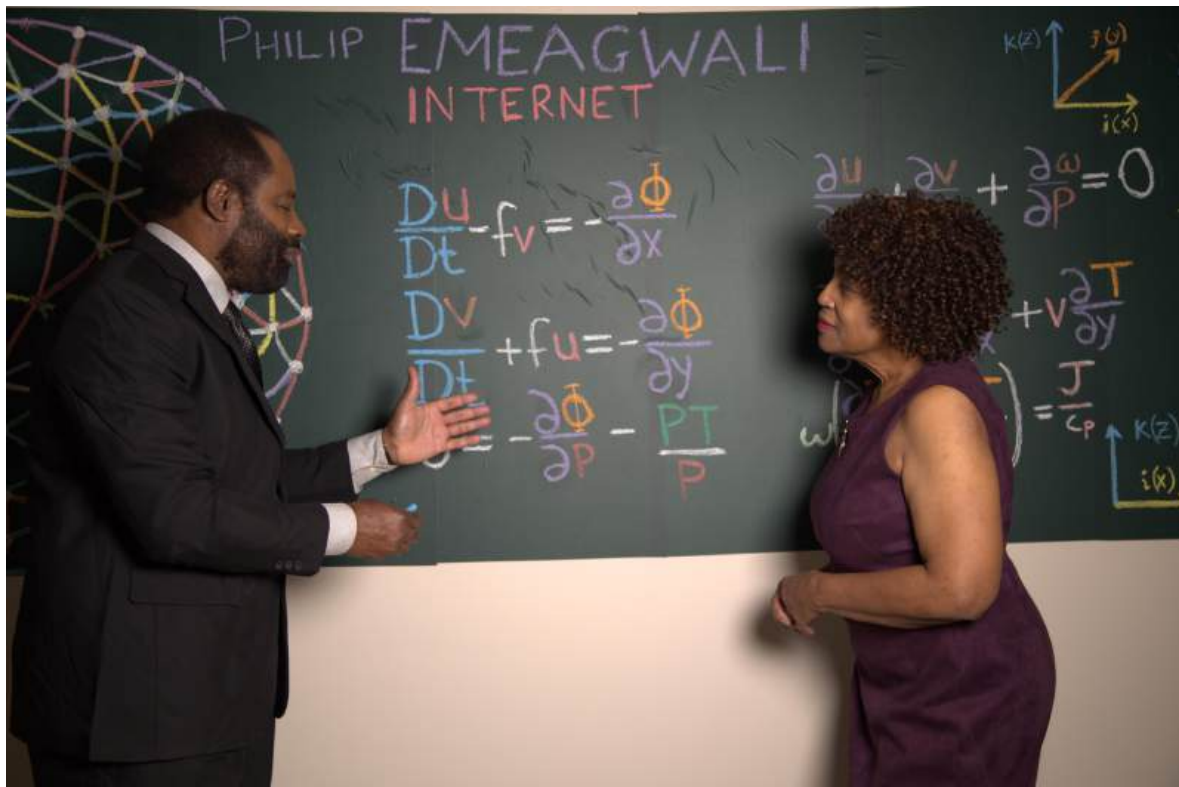
The **Greater Burgan** Oil Field is the world's largest **sandstone** oil field. The **Burgan** Oil Field is declining at **14 percent** per year. Fastest computing executed **across** millions of processors is used to recover about half of the crude oil reserves inside the **Burgan** Oil Field. In 1989, I was in the news for **discovering** how the **slowest** processors in the world could be harnessed as the world's fastest computer. And used to discover and recover otherwise elusive crude oil and natural gas.

## Slowest Processors for the World's Fastest Computer

The parallel supercomputer became known to a broader audience after my **scientific discovery**, of the Fourth of July **1989**. That **discovery** yielded the world's fastest computer speeds that I recorded **across** the world's **slowest** processors. And recorded while solving one of the world's most difficult problems.

I arrived at that frontier of knowledge by contributing to the knowledge discovered by research scientists whose names were lost in the **mist of time**. In the past one hundred years, the population of the scientific community has grown by a thousand-fold. A century ago, there were only one thousand physicists in the world.

Today, we have one million physicists in the world. We could say the same of mathematicians. The body of knowledge now described as information and communication technologies has **grown exponentially**, since the 1940s.



Philip and Dale Emeagwali

## THE MOST DIFFICULT MATH PROBLEMS

**T**he parallel processing problem which I solved in 1989 was then classified by the U.S. government as the most difficult problem of supercomputing. My solution of that difficult problem traversed extreme-scale partial difference equations of computational linear algebra, traversed partial differential equations of calculus, traversed large-scale computational physics, and traversed the supercomputing across up to a billion processors that made the news headlines because I parallel processed to solve the most difficult problem in mathematical physics. I solved that problem across a new global network of off-the-shelf processors that outlined and defined a never-before-recognized Internet. That Grand Challenge problem was far more complex and compute-intensive than the calculus problem that Isaac Newton solved three centuries and three decades ago.

It's more difficult to invent new calculus than to understand the calculus in textbooks. For that reason, **contributions** of new **partial differential equations** to the existing body of mathematical knowledge is more valuable than the mastery of mathematical methods.

Nonetheless, the mastery of mathematics and physics is always a precondition for the invention of new **partial differential equations** as well as the world's fastest computers for solving them. As a computational mathematician, I invented discrete approximations that honor both the governing **partial differential equations** of calculus and their underlying physics.

My **contribution** of the world's fastest computing to mathematics and physics is used to extract crude oil and natural gas that are buried up to 7.7 miles deep. And formed up to **541 million** years ago. An oil field is about the size of Abuja, the capital of Nigeria.

An oil field is a mixture of different materials which has properties that vary from point to point. Often, the properties may not have the same value along **perpendicularly different directions**. The value along the z-direction might be different when compared to those along the x- and y-directions. Such differences, called **heterogeneities** and **anisotropies**, make my supercomputer model more complex.

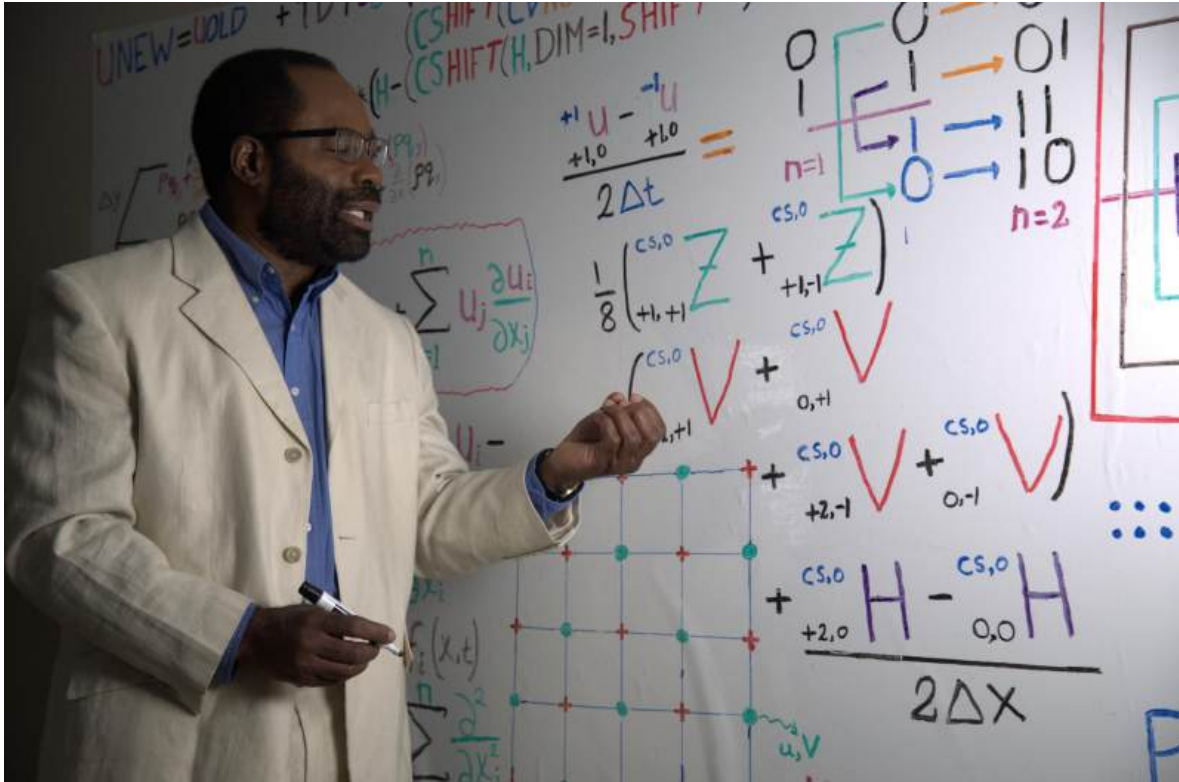
## PROGRAMMING THE UNKNOWN

### What is Philip Emeagwali Noted For?

**I**n 1989, I was in the news because I was the first to understand how to solve the most difficult problems in supercomputing. I discovered how to tackle the world's most difficult problems in algebra, calculus, and physics. I discovered how to solve them across a new Internet that's a new global network of 65,536 off-the-shelf processors and standard parts. That contribution to mathematics was the reason I was the cover story of the top publication in mathematicians, namely, the May 1990 issue of the SIAM News.

### Inventing the World's Fastest Computing

I was the **cover story** because the foremost mathematicians in the world were being informed that I **discovered** how to solve initial-boundary value problems governed by **partial differential equations** that encoded the laws of physics. I **discovered** how to solve the most compute-intensive problems. And how to solve them not merely on the blackboard, or even on the motherboard, but **across** an ensemble of up to **one billion** processors that equidistantly surrounded **the globe**. **And did so in the way the Internet circumscribes the Earth.**



Philip Emeagwali explaining how he discovered the first supercomputing, as we know it today, that harnesses millions of coupled processors to execute the world's fastest calculations.

My **discovery** made the **news headlines** because, in the 1980s, nobody else could execute the most compute-intensive global climate models. And compute with the **slowest** processors in the world. And do so while recording the **fastest** speeds in supercomputing. The global climate model must be parallel processed to enable the **climatologist** to **foresee** otherwise **unforeseeable** long-term global warming.

In 1989, I was in the news because I **discovered** the fastest computer speeds that are possible. And discovered how to compute **across** a new ensemble of up to one billion processors that surrounded a **globe**. And did so just as **the Internet encircled the Earth**.

I began supercomputing on June 20, 1974, at age nineteen, at 1800 SW Campus Way, Corvallis, Oregon, USA. On my sixteenth anniversary of supercomputing, I was **credited** in the June 20, 1990, issue of *The Wall Street Journal* for **discovering** how to compute **together** and how to communicate simultaneously and how to do both **across** a new ensemble of 65,536 processors. And how to compute at the fastest recorded speed. And do so to tackle the **most compute-intensive** problems.

Such difficult problems could only be solved by **dividing** them into millions of lesser compute-intensive problems that, in turn, could be solved only by a **one-problem** to **one-processor** mapping onto a network of millions of processors. This **problem-to-processor** mapping is the **substance** of how the **first supercomputer** that computes fastest **across** the slowest processors is used to tackle the biggest and the **most intractable** problems in the mathematical sciences.

## BECOMING A COMPUTER GENIUS

### Fastest Computing Turns Fiction to Fact

**A**s a research supercomputer scientist, who came of age in the 1980s and in the USA, my goal was to contribute new knowledge—namely the speed and speedup across up to a billion processors. My record speed in supercomputing of July 4, 1989, was new knowledge that was used to actualize the world’s fastest computing across over ten million processors.

My discovery was a **milestone** in computer history. My **invention** turned parallel computing from **fiction** to **fact**. In the **1970s** and **80s**, the world’s fastest computing **across** up to a billion processors and its use to get more accurate solutions of initial-boundary value problems governed by **partial differential equations** of calculus and physics was classified as a **Grand Challenge problem**. It was so called for a compelling reason. In the **1980s**, attempting to harness an ensemble of 64 binary thousand processors and use them to emulate a virtual supercomputer was as difficult as attempting to make **science fiction** become **reality**.

### Lone Wolf at the Frontier of the Supercomputer

That **grand challenge** was the reason the **farthest frontier** of the massively parallel supercomputer had only **one permanent resident**. I was that **permanent resident** of the then world of the world’s fastest computing **across** up to a billion processors.

In **1989** and in the **USA**, I was in the news because I witnessed the **first dramatic upgrade** in our understanding of the computer of tomorrow, not as a **new computer per se** but as a new Internet *de facto*. The computer will become the Internet, and vice-versa.

It’s impossible to say, exactly, how the world’s fastest computers are used. Some supercomputers—such as those used to simulate the shock waves emanating from the explosions of nuclear bombs only exist off the record. The supercomputers for nuclear labs are manufactured without serial numbers!

And oil companies protect their supercomputer simulations as trade secrets. I was **coerced** to sign **non-disclosure agreements** that prevail me from telling you everything that I know about the world’s fastest computing.

In the 1980s, the massively parallel supercomputer was only available to a few dozen scientists that worked within the U.S. Federal nuclear research

laboratories. Today, such supercomputers are available to everyone. I was the only full-time programmer of the **1980s** of the most massively parallel supercomputers ever built. That was how and why I became known as **the inventor of supercomputing via parallel processing**.





On Becoming a Supercomputer Genius

In an email, a twelve-year-old writing the biography of a famous mathematician and his **contribution** to the speed of the first supercomputer that computes the fastest **across** the slowest processors asked me: “How do you become a supercomputer genius?”

You become a supercomputer genius by, first, deeply understanding the difficult mathematical problems that you must solve. And by deeply understanding how you must divide the most compute-intensive problems into up to a billion lesser challenging problems. And knowing how to solve them with a unique **one-processor to one-problem** mapping that preserves nearest-neighbor **nearness**. And understanding how to solve such problems **across** the up to one billion processors that outline and define the massively parallel supercomputer.

According to a Chinese proverb: "If the axe is not sharp, it doesn't matter how hard the wood is." A mathematician that is not a polymath cannot solve the Grand Challenge problem of large-scale computational mathematics. The supercomputer genius must be a **polymath**, or a jack-of-several sciences. That supercomputer genius must be at home at the frontiers of knowledge in mathematics, physics, computer science, and neighboring sciences. The supercomputer genius must understand his computing machinery and know it forward and backward, and even sideways.”

The supercomputer genius must **be the first to understand** how to compute at speeds that were considered **impossible**. And compute to address some of the world’s biggest challenges. And compute in a **breakthrough** way that’s ranked as a **milestone**. And that **changed how** we think about the modern computer and the fastest supercomputer.

It took me sixteen years on the world’s fastest processors to discover that I could compute at the **world’s fastest speeds** and do so **across** the world’s **slowest** processors. And do so to solve the most difficult problems in science, engineering, and medicine. The world’s fastest computing that’s executed **across** a million coupled processors is the central knowledge that must be used to foresee the otherwise unforeseeable spread of contagious viruses that occurs during a once-in-a-century global pandemic, such as COVID-19.

## THE UNSPEAKABLE POWER OF THE SUPERCOMPUTER: REVEALED

**M**y contributions to the speed of the first supercomputer, as it's known today, made the news headlines because: I discovered that parallel processing will become the vital technology that will be used to manufacture the world's fastest computers.

I didn't merely discover the world's fastest computing **across** one billion email wires. Nor did I invent the technology by luck or **serendipity**. I **discovered** the world's fastest computing because I deeply understood the underlying mathematical physics that defined the difficult problem that must be parallel processed **across** up to one billion processors.

In **1989** and in the USA, I was in the news because I **discovered** how to solve the most difficult **problems** in mathematics and physics. And how to solve them in parallel and **across** my **new Internet** that was a new global network of two-**raised-to-power** sixteen, or 65,536 coupled **off-the-shelf** processors. Those processors, **each its own master**, were **equal distances** apart and **shared nothing but were in dialogue with each other**.

### Why a Supercomputing Genius Must be a Polymath, Not a Mathematician

I've provided the complete details of my supercomputing inventions. And did so across dozens of books and one thousand podcasts and YouTube videos. I posted the most YouTube lectures because I have the most knowledge in the field of supercomputing. My YouTube lectures **encapsulated** the knowledge of mathematics, physics, and computing that I gained from nearly fifty years of fastest computing that began on June 20, 1974, at 1800 SW Campus Way, Corvallis, Oregon, USA.

I had to be a polymath, not merely a mathematician, to work alone. And solve the most difficult problem in supercomputing, which **traversed** half a dozen frontiers of scientific knowledge. In contrast, American scientists work in large teams. A person that was aided by one hundred scientists might only understand one percent of the work and, therefore, cannot give an impromptu interview, or deliver an **on-the-spot** lecture, and do so without the support of Power Point photos.

Having a supercomputer is one part of the equation for solving the most difficult problems arising in supercomputing. Only a **polymath** can translate and solve the toughest problems at the crossroad where new mathematics, new physics, and new computing **intersect**. The extra knowledge that gave me an edge over other mathematicians, physicists, and

computer scientists was that I was the **first** that could translate some laws of physics into a system of **partial differential equations** of calculus and parallel processed its solutions.

The **partial differential equation** is the pillar on which the supercomputer rests. I converted those equations into their algebraic approximations that is a system of **partial difference equations** of algebra. Finally, I invented algorithms and email primitives, that are my final step-by-step instructions for my world's fastest computing.

Each processor must execute **in-lock-step** my programmed instructions. And execute **within** and **across** millions of processors, **each its own master**, that **shared nothing**. Those were the **mathematical conditions** for **inventing** the world's **fastest** computing. I used my **new** supercomputing knowledge to solve the most difficult problems. And solve them **across** the world's **slowest** processors.

My **contribution** to supercomputing knowledge was in the news shortly after its **discovery** at 8:15 on the morning, on July 4, 1989, in Los Alamos, New Mexico, USA. I invented the world's fastest computing the way **Bob Marley** writes songs.

The toughest problems in supercomputing **traverses** mathematics, physics, and computer science. For that reason, a supercomputing genius must be a **polymath**. The supercomputing polymath left his or her specialty for several years. And left it to conduct research in mathematics or physics or computer science. And do so to gain a different perspective from each field.

In my quest for how computing **across** processors powers the world's fastest computers, I left the frontier of knowledge of mathematics known as **partial differential equations** and **computational linear algebra** for the frontiers of knowledge of physics known as **fluid dynamics**. I did so to become a mathematical physicist who investigated how to solve the most difficult problems that arise during geophysical fluid flows. Such supercomputing problems include forecasting and hindcasting the global-scale motions of fluids (that is, liquids and gases) that enshroud the Earth.

Geophysical fluid motions include subsurface, multi-phased fluids flowing **across anisotropic** and **heterogeneous** porous media. And flowing up to **7.7 miles** (or 12.4 kilometers) below the surface of the Earth. Geophysical fluid motions include centuries-long global climate modeling executed to **foresee** otherwise **unforeseeable** global warming.

After a decade following **1974**, I left mathematical physics for the frontier of knowledge of the then unexplored field of the world's **fastest** computing **across** the world's **slowest** processors. Looking back and using a metaphor, I learned that if you've never left your house it's **impossible** to have ever seen your entire house.

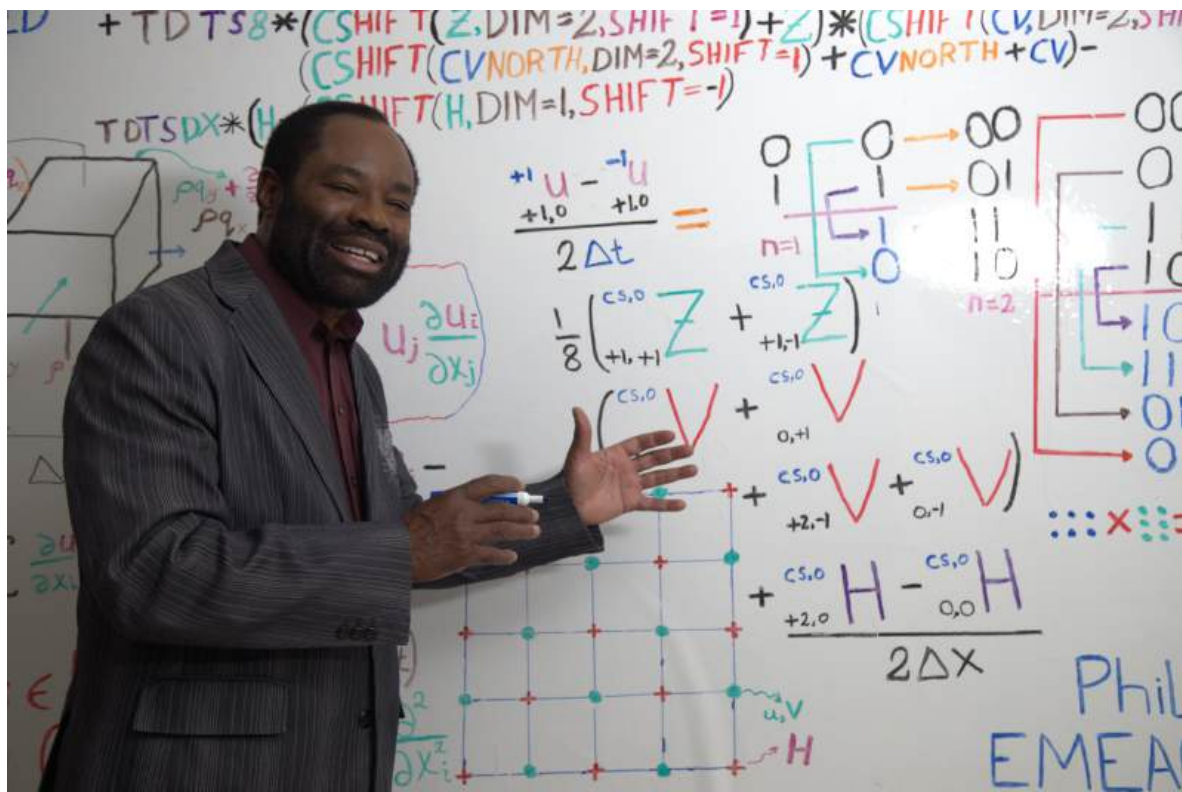
In 1989, I commanded and controlled more supercomputing power than any person that ever walked on planet Earth. I understood the world's



fastest computing deeper than the arm-chair theoretical physicist. And deeper than the mathematician who never left his blackboard for the motherboard that occupies the footprint of a football field.

I'm a polymath who sojourned from mathematics to physics to computer science and did so across half a century to leave behind a legacy of dozens of books and one thousand podcasts and YouTube videos. Famous scientists, who came of age after the mid-20<sup>th</sup> century, were obliged to leave as their legacy a series of videotaped lectures. Each lecture must describe their contributions to mathematics or physics or computer science.

Albert Einstein shared about ten videos. I shared one thousand videos in YouTube, each up to four hours long. My one thousand podcasts and YouTube videos were the culminations of half a century of painstaking research that began on June 20, 1974, in Corvallis, Oregon, USA. Listening to only one of my podcasts, instead of watching my one thousand YouTube videos is like being misled by a single still-frame photograph. It's like writing a book review after only reading one page of a thousand-page book. My one thousand YouTube videos permit their viewers to approximate my lecture experiences. But watch them without their visceral impacts.



Philip Emeagwali explaining how the first supercomputing across multiple processors was discovered. Emeagwali is the only lone investigator to record the fastest computation.

## TURNING FICTION TO MATHEMATICS

**A**s an aside, Isaac Newton wasn't a scientist. The word "scientist" was coined about a century and a half after Isaac Newton died. Instead, Isaac Newton described himself as a "Natural Philosopher," not as a mathematician or a physicist. Contrary to what is widely believed, Isaac Newton devoted most of his careers to researching occultism, not to searching for new laws of physics.

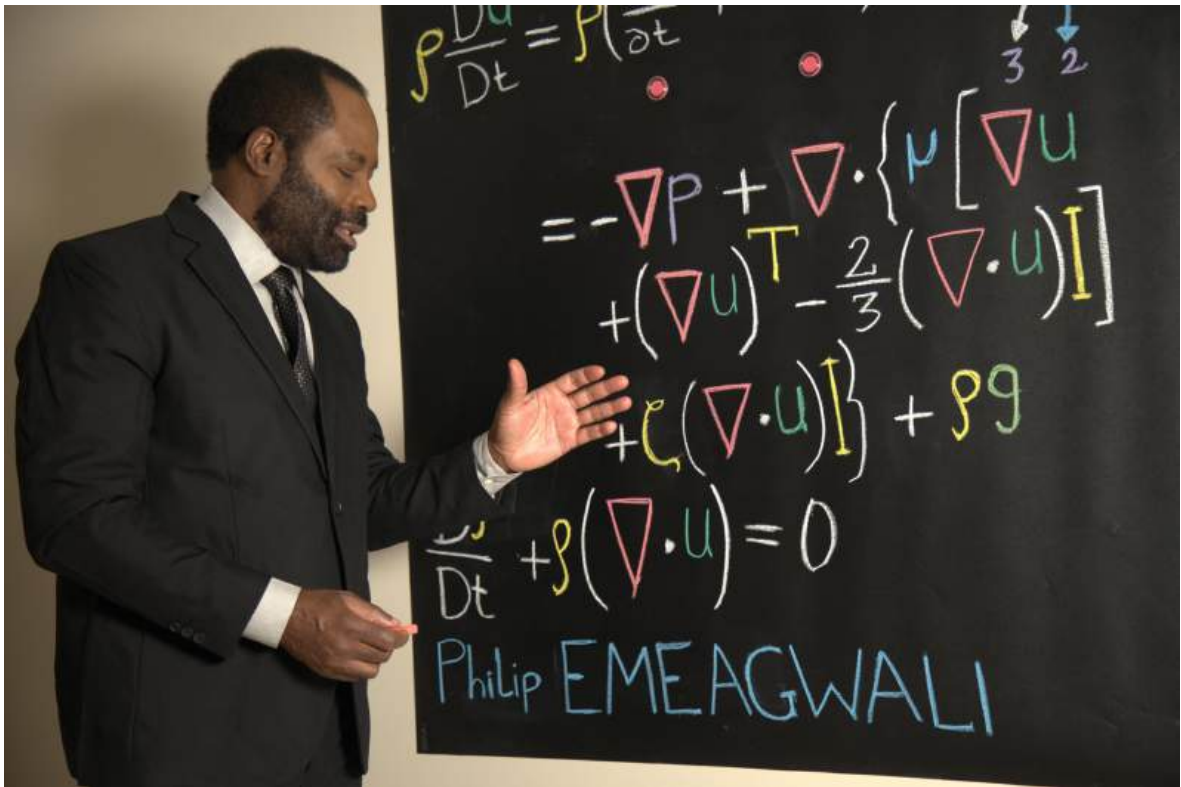
There are a thousand times more geniuses today than a century ago. Yet, in the 1940s, the likes of the physicist **Albert Einstein** couldn't parallel process, in part because, the technology and the technique were then unknown. For those reasons, they couldn't accurately solve an initial-boundary value problem of mathematical physics, such as global climate modeling to foresee long-term global warming. Global climate modeling is the most important problem in computational physics.

If I can travel back in time to three centuries and three decades ago to Cambridge, England, I will explain to **Isaac Newton** how we use the system of **partial differential equations** of calculus that encodes physics's second law of motion. And use them to model the transport of **pollutants** through a **groundwater aquifer**.

Solving this difficult problem of mathematical physics demands the simulations of a complex set of **biogeochemical** reactions that, in turn, is coupled with the simulations of the multiphase flows of air and water. I will explain to **Isaac Newton** how the compute-intensiveness of modeling groundwater aquifers and production oil fields increases when their solutions are governed by **partial differential equations**.

Such equations account for **multiphase** fluid flows. And give rise to mathematical objects, called **tensors**, that represent **heterogeneous** aquifers that are characterized by **anisotropic hydraulic conductivities**. I will explain to **Isaac Newton** that a tensor is like to a vector, although he wouldn't even understand vectors. But a tensor is more general than a vector. The array of components of a tensor are functions of its spatial coordinates.

Finally, I will explain to **Isaac Newton** how and why many mathematical models are **multiphysics** and **multiscale**. The reason is that some phenomena are governed by different laws of physics and chemistry. And occur over wide-ranging temporal and spatial scales. The science of today was the **science fiction** of Isaac Newton.



Philip Emeagwali explaining an initial-boundary value problem that he solved during his world's fastest computing of July 4, 1989.



## MY JOURNEY TO THE TOP

### An Unexpected Path to Success

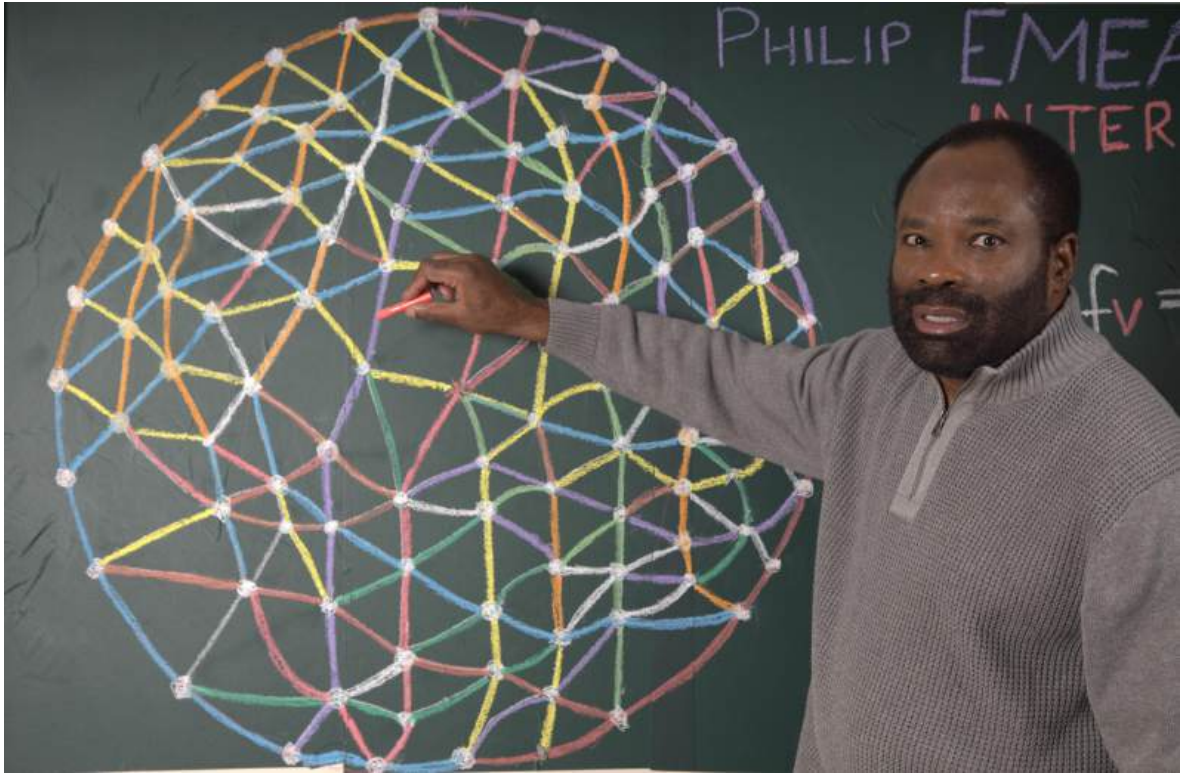
**A**s the first supercomputer scientist who came of age in the 1970s, it was imperative that I followed a different path to the frontier of human knowledge of the world's fastest computing across the world's slowest processors. At that supercomputing frontier, new partial differential equations of calculus and large-scale algebra intersected. And new algebra and fastest computing intersected.

I visualized my world's fastest computing as occurring around a new Internet that was a small copy of the Internet. Both Internets encircled a globe in the sixteenth and third dimensions of hyperspace, respectively.

My scientific discovery, of the world's fastest computing, occurred at fifteen minutes after 8 o'clock on the morning of July 4, 1989, in Los Alamos, New Mexico, USA. That new knowledge was my **breakthrough answer** to a perennial **big question** that appeared in a **science-fiction story** published on February 1, 1922. Sixty-seven years later, I was in the news as the African genius that won the highest award in supercomputing. Computer scientists describe my award as the **Nobel Prize of supercomputing**.

I won that top supercomputer award, in 1989, because I **discovered** how to turn that **science-fiction story** of 1922 to a **reality** that's a new spherical island of **64** binary thousand **off**-the-shelf processors that could be **harnessed** and used to solve the most difficult problems in science, engineering, and medicine.

The **poster boy** of the twenty most difficult problems is computing at the world's **fastest speeds**. And doing so while executing large-scale, high-resolution global climate models. And executing them to **foresee** long-term global warming. And to find **answers** to previously **unanswerable** questions. And create new branches of human knowledge, such as the world's fastest computing **across** the world's **slowest** processors.



Explaining how the Philip Emeagwali Internet was invented. Emeagwali is the only father of the Internet that invented an Internet.

## A LOOK AT THE SUPERCOMPUTER'S TOP-SECRET ORIGINS

The indication of my contributions to the speed of the fastest computer is not merely that I recorded the fastest computer speed, but that I did so via my new paradigm of communicating and computing across an ensemble of millions of processors, rather than via the old paradigm of serial supercomputing or vector supercomputing within one fast processor.

I was in the news, in 1989, because my recording of the world's fastest computer speed that I measured **across** the **slowest** processors in the world was a technological **feat** considered **impossible** at that time. My discovering an alternative **way** of recording the **fastest speeds** in computing inspired the **change in how** we look at both the computer and the supercomputer. And inspired the radical **departure** from vector computers that solved one problem **at a time** and was the size of a **refrigerator** to the **first** supercomputer, as it's known today, that solves millions of problems simultaneously. And that occupies the space of a soccer field. And it costs the budget of a small nation, or **one billion two hundred and fifty million** dollars.

Because the fastest computers in the world are precious, each is **protected** by **arm guards** and is classified as a **state secret**. For economic and national security reasons, the U.S. **barred** China from buying American processors. And using them to power Chinese supercomputers.

China understands that dominating the **45** billion dollars a year supercomputer market is its stepping-stone to dominating the globe in scientific discoveries and technical **breakthroughs** that are the preconditions to becoming the world's **superpower**.

### The Biggest Question Beyond the Fastest Supercomputer

In the 1970s and 80s, my scientific search was for answers to the most important questions at the crossroad where new mathematics, new physics, and the world's fastest computing **intersect**. My quest demanded that I look beyond the frontiers of mathematics, physics, and computer science. I did so because I realized that the **discretization** of **partial differential equations** of calculus is an **inadequate** answer to the **big question** of how mathematicians solve the initial-boundary value problems of mathematical physics. Such problems govern the high-resolution global climate model that must be used to foresee otherwise **unforeseeable** long-term global warming.

Mathematical knowledge alone was an **inadequate** answer to **big questions** just as the technological knowledge of the fastest computing **across** the **slowest** processors is also an **inadequate** answer to the **science-fiction** question of how to design, manufacture, and program the **ultimate supercomputer** of forthcoming centuries.

## KNOWLEDGE BEYOND THE COMPUTER

Looking back to 1974 and fifteen years onward, those that insisted that I remain in only one field, such as mathematics or physics or computer science, were standing in the way of my invention of the first supercomputing across the world's slowest computers.

Fastest computing was not entirely within mathematics or physics or computer science. I discovered it at their intersection. And did so when the naysayers were standing in the way of the critical and enabling parallel processing technology that now underpins the world's fastest computer. And that would allow faster computers to emerge from an ensemble of millions of slower processors.

Being at the frontiers of knowledge of the fields of physics, calculus, algebra, computer, and Internet sciences is the minimum requirement to becoming the first to solve the most difficult problems central to supercomputing.

### Unlocking the Secrets of Math to Surpass the Limits of the Fastest Computers

Abstract mathematical physics is the most recurring decimal inside the millions of processors that define and power the world's fastest computers. Therefore, if I didn't understand the computational physics or the abstract calculus or the large-scale algebra which I was inventing on my blackboard and which I was supercomputing **on and across** my 64 binary thousand processors then my chances of discovering how to parallel process and do so to compute at the fastest recorded speeds demanded that I achieve a **one-problem to one-processor** correspondence for my 65,536 initial-boundary value problems of extreme-scale computational physics.

That **one-to-one** correspondence was the mathematical precondition to solving the **parallelized** problems simultaneously. Without that **one-to-one** correspondence, my chances of recording the fastest computer speeds were as good as having 65,536 monkeys typing on as many computer keyboards. And then expecting their **asynchronous typing** to record a 64 binary thousand-fold increase in **never-before-recorded** email and supercomputer speeds.

### My 50 Years as a Lone Supercomputer Scientist

In retrospect, the reason I was the lone programmer of the most massively parallel supercomputers of the **1980s** was that I was the **only person** that could execute the fastest computing across millions of processors. And solve the **once-impossible-to-solve Grand Challenge problem** of supercomputing. I solved that difficult problem because **my confidence came from knowing what I was doing and who I am**.

## My Early Years in the USA

My first night in the USA was spent alone in 36 Butler Hall, Monmouth, Oregon, and on Sunday, March 24, **1974**. I was then nineteen years old. I was the supercomputer scientist **in-training** that **emigrated** from Onitsha (**Nigeria**), a commercial city in the heart of sub-Saharan Africa. I came alone to Oregon in the heartland of the Pacific Northwest region of the **USA**. I came and became the mathematician that discovered new mathematical knowledge.

Over the following decade and a half, I grew and evolved and found myself beyond the farthest frontier of high-performance computational mathematics. Computing across millions of processors was the jagged, multidisciplinary frontier of supercomputer knowledge. For the sixteen years, between my supercomputer research in Corvallis (Oregon) and Los Alamos (New Mexico), I felt like an explorer that walked alone with a **dim lamp** and along a small road that was the Holy Grail to the world's **fastest** computing.

Photos TBA 1974 Oregon

## BREAKING THE SPEED LIMIT IN PHYSICS

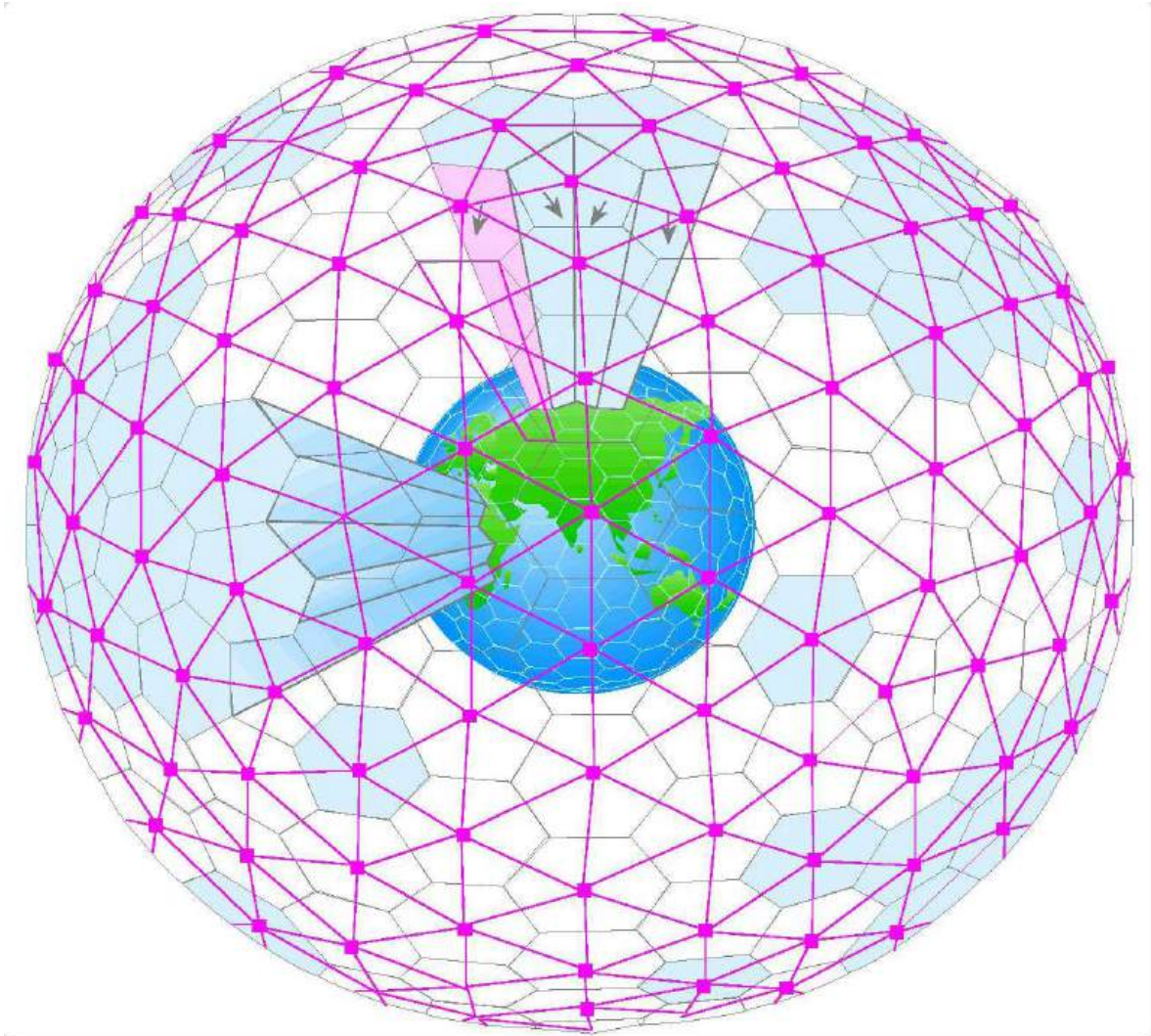
**D**uring my sixteen year-long quest for how to harness a million processors and use them to power the world's fastest computers, I learned to distinguish between experiment and theory, between theory and discovery, and between fact and fiction. And I learned to know for the first time, that a theory is an idea that is not positively true.

In the decade that preceded 1989, I invented supercomputer algorithms grounded on mathematical equations from the laws of physics. Specifically, I invented partial difference approximations of large-scale computational linear algebra that approximated partial differential equations of calculus that encoded physics's second law of motion that was discovered three centuries earlier. I invented equations of mathematics grounded on the laws of physics and I **heard and trusted my inner voices** that were **almost drowned** in a **cacophony of secondary voices**.



## DISCUSSION QUESTIONS 1/2

### Inventing a New Internet



The first blueprint of the Philip Emeagwali Internet. Emeagwali is the only father of the Internet that invented an Internet.

1. How did Philip Emeagwali revolutionize the field of supercomputing with his discovery?
2. What were the initial perceptions of parallel supercomputing and how did they change over time?
3. How did Philip Emeagwali's discovery of fastest computing contribute to the development of a new Internet?



4. What are some of the practical applications of supercomputers in industries like energy and geoscience?
5. How did Philip Emeagwali use the slowest processors to achieve the fastest computing speeds?
6. What role did Philip Emeagwali's discovery play in solving the most difficult problems in mathematics and physics?
7. How did the invention of the world's fastest computing impact the exploration and recovery of crude oil and natural gas?
8. What challenges did Philip Emeagwali face in parallel processing and how did he overcome them?
9. How does the complexity of mathematical models and heterogeneous materials affect the supercomputing process?
10. What contributions did Philip Emeagwali make to the field of calculus and the understanding of partial differential equations?
11. How does the invention of new partial differential equations contribute to the advancement of mathematics?
12. Why is it important for mathematical models to be multiphysics and multiscale?
13. How did Philip Emeagwali's discovery of fastest computing turn fiction into reality?
14. What was the significance of Philip Emeagwali's record speed in supercomputing and its impact on solving compute-intensive problems?
15. What qualities and knowledge are required to become a supercomputer genius, according to Philip Emeagwali?

## DISCUSSION QUESTIONS 2/2

### Inventing a New Internet

1. How did Philip Emeagwali's discovery of parallel processing contribute to the development of the first supercomputer?
2. What sets Philip Emeagwali apart as a supercomputing genius and why is it important for a supercomputing genius to be a polymath?
3. How did Philip Emeagwali's understanding of mathematics, physics, and computer science intersect to enable his breakthrough in fastest computing?
4. What were the technological and mathematical challenges faced by Philip Emeagwali in achieving fastest computing across slow processors?
5. How did Philip Emeagwali's discovery change the way we look at computers and supercomputers today?
6. What is the significance of parallel processing in solving complex problems in science, engineering, and medicine?
7. How did Philip Emeagwali's breakthrough in fastest computing contribute to advancements in global climate modeling and the understanding of long-term global warming?
8. What role did the Internet play in Philip Emeagwali's new paradigm of computing and communication across millions of processors?
9. How did Philip Emeagwali's discovery impact the development of the supercomputing market and its implications for scientific discoveries and technical breakthroughs?
10. Why was it important for Philip Emeagwali to venture beyond the frontiers of mathematics, physics, and computer science in his quest for fastest computing?
11. How did Philip Emeagwali's knowledge of computational physics, abstract calculus, and large-scale algebra contribute to his ability to solve complex problems in supercomputing?
12. What is the significance of achieving a one-problem to one-processor correspondence in parallel processing and how does it affect the recording of fastest computer speeds?
13. How did Philip Emeagwali's persistence and confidence as a lone supercomputer scientist contribute to his success in solving the

Grand Challenge Problem of supercomputing?

14. What were some of the key moments and milestones in Philip Emeagwali's journey as a supercomputer scientist?
15. How did Philip Emeagwali's breakthrough in fastest computing challenge traditional theories and bridge the gap between experiment and theory in the field of supercomputing?

## 2ND LECTURE: COMPUTING WITHOUT LIMITS



- Q contribution to computer development
- Q **what is the contribution of philip emeagwali to computer development**
  - Q **what is lovelace main contribution to the development of the computer**
  - Q **what are mauchly and eckert main contribution to the development of the computer**
  - Q **what is the eniac programmers main contribution to the development of the computer**
  - Q **inventors and its contribution to the development of computer**
  - Q **herman hollerith contribution to the development of computer**
  - Q **charles babbage and his contribution to the development of computer**
  - Q **abacus contribution to the development of computer**
  - Q **discuss the contribution of blaise pascal to the development of computer**
  - Q **contribution of ada lovelace to the development of computer**

Google ranks Philip Emeagwali as the greatest computer genius (December 8, 2021).

### HOW I BECAME A GENIUS BY SCRAWLING CODE IN THE DARK

Broadcast 21 August 2021

<https://youtu.be/nVzI2AIBkj0>

## UNVEILING THE WEATHER INSIDE AN OILFIELD

**I**n 1989, I was in the news for discovering that the slowest processors could be used to solve the biggest problems arising in mathematics and physics. And find their answers at the fastest speeds. The fastest computer is why you know the weather before going outside.

Briefly, my mathematical quest was to find how to solve the **toughest** problems that arise at the intersection of calculus and large-scale **geophysical** fluid dynamics, including solving the initial-boundary value problems known as global climate modeling and petroleum reservoir simulation.

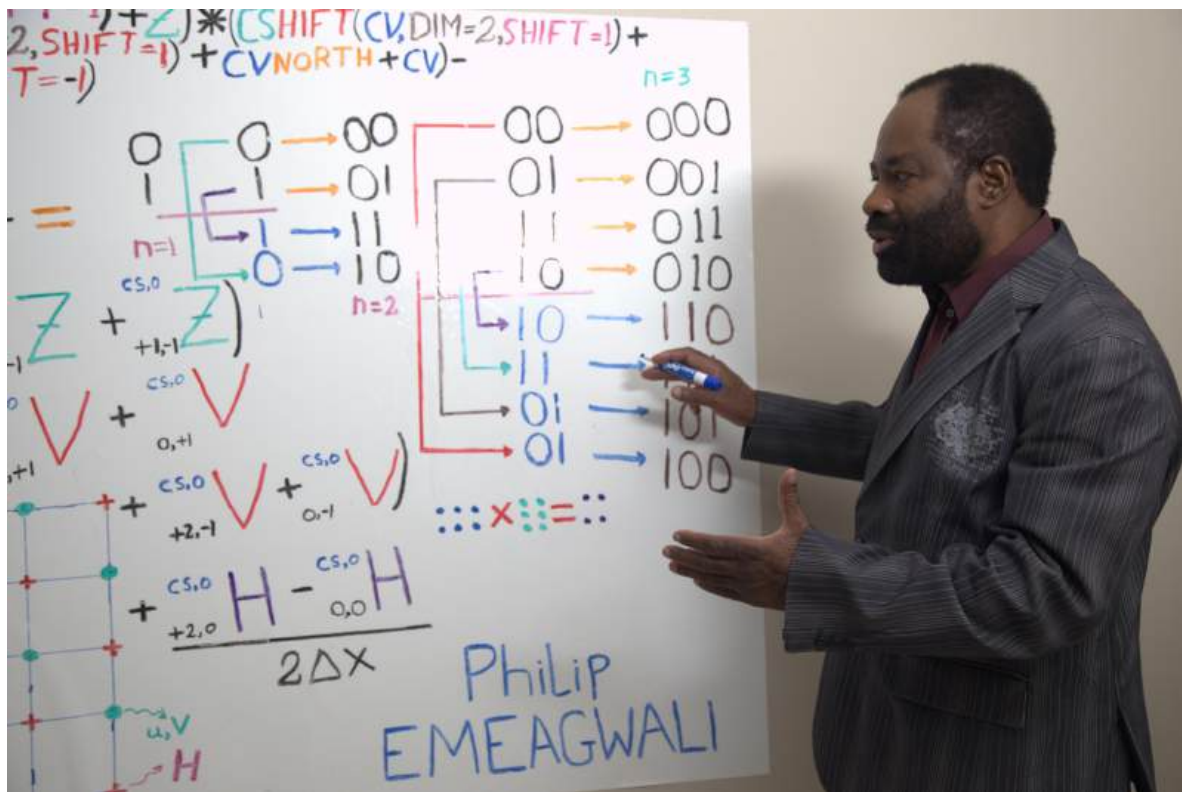
As a research mathematician who came of age in the 1970s and 80s, who is at the frontier of physics and supercomputing, my **grand challenge** in those two decades was to be the **first** to understand how to solve initial-boundary value problems at the intersection of **partial differential equations** that are encoded in some laws of physics.

My **contribution** to mathematics **is this**: I was the **first** large-scale computational physicist. And the **first** to solve initial-boundary value problems **across** a new Internet. My new knowledge of the world's fastest computer is used to understand the spread and treatment of COVID-19. I visualized my Internet as a **new** global network of the **slowest processors** in the world. I theorized that my Internet could be harnessed and used to execute the fastest computing in the world.

For sixteen years, following June 1974, and from Corvallis (Oregon) to Los Alamos (New Mexico), the **naysayers** forced me to conduct my fastest supercomputer research alone. In the early 1980s, I was often **disinvited** from giving supercomputing lectures. And only **disinvited** after they discovered that I was Black and African.

I invented the **nine Philip Emeagwali equations**. And I did so from scratch, or first principles, called physics's second law of motion. My system of nine coupled, nonlinear, and time-dependent **partial differential equations** governs initial-boundary value problems that must be used to model the **subterranean** motions of crude oil, injected water, and natural gas flowing up to **7.7 miles** (or 12.4 kilometers) deep. And flowing below the surface of the Earth and within an oil-producing field that's often the size of **Ibadan (Nigeria)**.

The world's fastest computer is like a telescope that's used to peer inside the **human DNA** or 7.7 miles deep inside an oil field.



Philip Emeagwali at the whiteboard explaining his contributions to computer science.

## A TEMPEST BENEATH OUR FEET

### Unveiling the Mysteries of the Crude Oil Inside the Earth

**M**y quest was for new knowledge that will enable me to parallel process computational fluid dynamics code used to model the weather of up to 7.7 miles (or 12.4 kilometers) below the surface of the Earth. This Grand Challenge problem is the poster girl of compute-intensive physics.

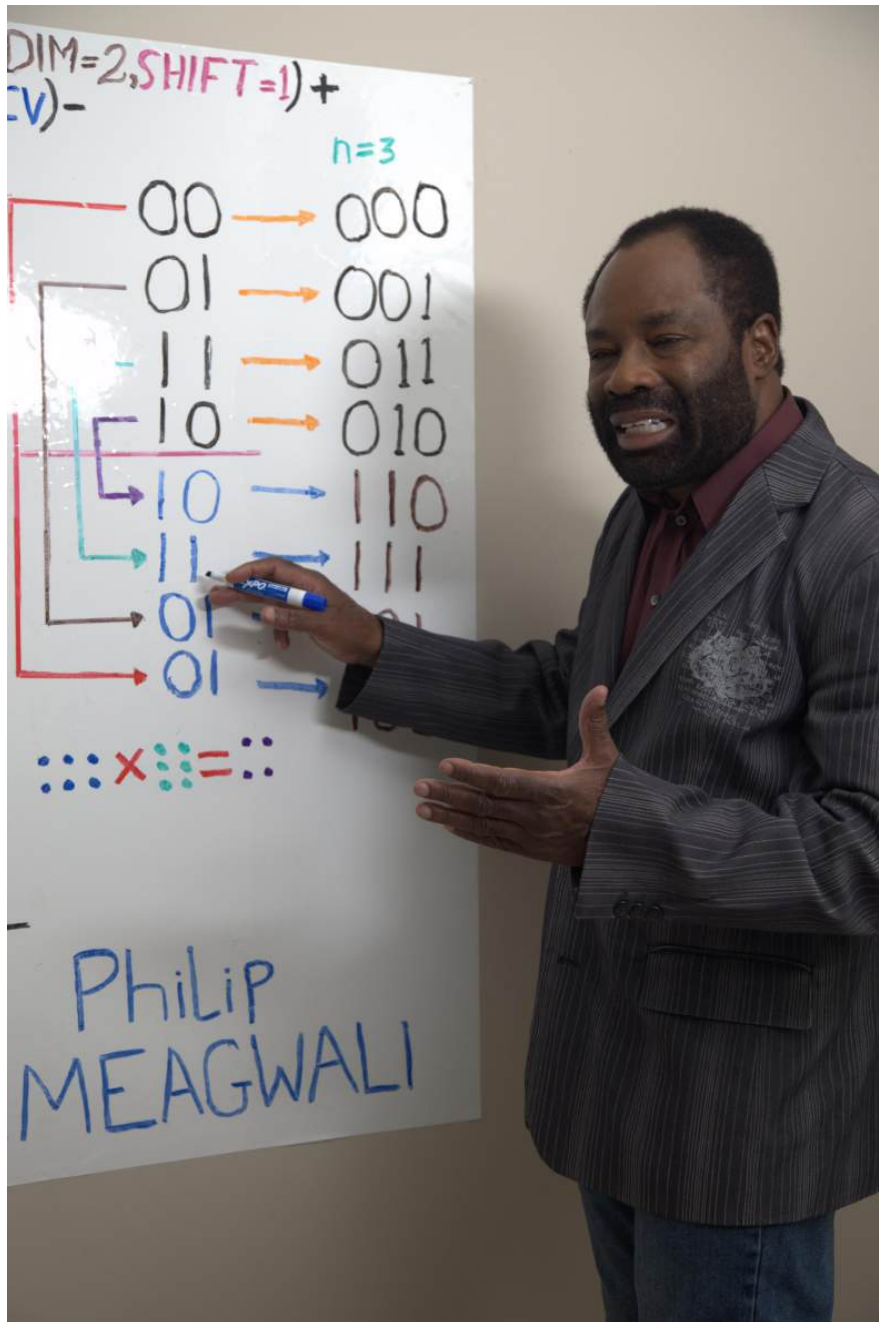
In 1989, I was in the news as the first to discover how to divide the biggest problems in mathematics and physics. And divide each grand challenge problem into up to one billion lesser challenging problems that can then be solved across as many processors, or with a one-problem to one-processor correspondence.

For my specific experiments across the world's slowest processors in which I recorded the world's fastest computing and did so at 8:15 on the morning of July 4, 1989, I visualized my 65,536 equal reservoir models as Oil Field Number One, Oil Field Number Two, all the way to Oil Field Number 65,536. I visualized a one-oilfield to one-processor correspondence. I executed that one-to-one mapping between those oil fields and as many processors, **each its own master**, that shared nothing. My processors were equal distances apart. And each processor operated its operating system.

My processor-to-processor email directions were that: Oil Field Number One is directly and **bidirectionally** connected to Oil Field Number Two. Oil Field Number Two is directly and **bidirectionally** connected to Oil Field Number Three. I continued to directly and **bidirectionally** connect all nearest oil fields. But the last, or Oil Field Number **65,536** is directly and **bidirectionally** and **circularly** connected to Oil Field Number One.

My one-to-one mapping was at the core of my discovering the world's fastest computing, as we know it today. I was in the news because I discovered how to hindcast the weather eight miles inside the Earth.





Philip Emeagwali at the whiteboard explaining his contributions to computer science.





## SCORCHING SECRETS OF EARTH'S INNER CLIMATE

**T**he polymath knows more sciences than the mathematician. And understands a priori that the calculus that governs the short-term “weather” below the surface of the Earth have identical partial derivative terms as the calculus that governs the long-term “weather” above the surface of the Earth. The reason for the mathematical similarity is that both are computational fluid dynamics problems grounded on partial differential equation of calculus and on partial difference equation of linear algebra, and in part, because the dependent and independent variables are similar.

Accurate weather forecasts are generated with supercomputers. And are critical to protecting life and property. Back from September 1, 1981, through August 1986, I lived a 15-minute stroll from the [Gramax Heliport Building](#) in Silver Spring, Maryland. The Gramax Building was the then headquarters of the [U.S. National Weather Service](#).

During those five years, and from Mondays through Fridays, I stopped each morning and spent five hours with hydrologists and meteorologists. During my five years with those research meteorologists, I was inspired to investigate the finite difference [discretization](#) of the [primitive equations](#) of meteorology that were used by the [U.S. National Weather Service](#) and used to forecast the weather.

In the early 1980s and in College Park, Maryland, I [discovered](#) that the difficult problems of hindcasting the weather underneath the Earth and forecasting the weather above the Earth are governed by initial-boundary value problems that look similar. Yet, for a century the geologist and the meteorologist were not aware of that similarity. That ignorance robbed both fields the benefit of [cross-fertilization](#) of their discoveries.

The computational fluid dynamics model that I executed **across** my ensemble of 65,536 processors was the [most difficult](#) problem in supercomputing. It was an initial-boundary value problem posed **across** a new Internet that I defined as a new global network of 65,536 processors, **each its own master**, that [shared nothing](#). In the 1980s, the U.S. government classified this problem as a grand challenge. And did so, in part, because it’s solution demands a billion dollar supercomputer that occupies the footprint of a football field and that then existed only in [science fiction](#).

As a mathematician and physicist who grew over the 1970s and 80s to become the [first programmer](#) of the [first supercomputer](#), [as it’s known today and as it’s expected to be known tomorrow](#), I know from first-hand experience that it was harder to solve an initial-boundary value problem and solve it **across** millions of processors than to merely pose the problem on one blackboard. The former is the solution discovered by the polymath.

The latter is the question asked by the mathematician. It's easier to ask a question than to answer it.

As a mathematician searching for new calculus and new algebra, I looked for and made use of patterns and structures from disparate fields of human knowledge.

## THE POWER OF PHYSICS

### Transforming Nigeria's Future

A few years ago, I posed a question meant for the Joint Admissions and Matriculation Board of Nigeria, or JAMB, for short: “What is the importance of physics in the development of Nigeria?”

The supercomputer must be used to tackle the biggest and the most difficult problems of tomorrow. In the 1980s, the precursor to the world’s fastest computer was confined to crunching massive amounts of data from my large-scale computational fluid dynamics **simulations**. My computational physics across millions of processors must be used to locate energy deposits.

Please allow me to quote myself from a lecture that I delivered in the early 1980s.

“In petroleum reservoir simulations executed for the oil fields of Nigeria, the dependent variables are the **compressibility** of the fluids, pressure, **fluid partial molar volume**, saturation, **phase partial molar volume**, total fluid velocity, as well as **source and sink terms**. **Such terms include water injection wells and crude oil and natural gas producing wells**.

To derive the system of equations of extreme-scale computational linear algebra within **compositional** reservoir simulators used for enhanced oil recovery processes that must be parallel processed **across** an ensemble of processors demands that the governing system of coupled, nonlinear, time-dependent, and three-dimensional **partial differential equations** be discretized with one of three **finite difference** techniques. The first technique is known as the **Implicit Pressure Explicit Composition method**. This finite difference approximation has small-time steps and the least computation time per time step.

The second technique is known as the **Implicit Pressure and Saturation method**. This finite difference approximation is more stable and handles larger time steps. The third technique is known as the **Fully Implicit Method**. This finite difference approximation is the most stable and handles the largest time steps.”

I became a supercomputer scientist after putting in my time-in-grade. My due diligence that yielded the world’s fastest computing occurred daily. And it occurred during my half century of supercomputing that was onward of June 20, 1974, in Corvallis, Oregon, USA.

I’m the subject of school essays because I was the **firs** to figure out how to solve the **most difficult** problems at the crossroad where new mathematics,

new physics, and the world's fastest computing **intersected**. Such difficult problems could only be solved on supercomputers, **if and only if**, the number of processors harnessed is sufficiently large.

## UNLOCKING SUPERCOMPUTERS TO DISCOVER OIL AND GAS

**W**hat's the importance of supercomputers to Nigeria? A Nigeria without supercomputing is a Nigeria with reduced petroleum revenue. In retrospect, the world's fastest computer suffered from the curse of rising expectations. The unorthodox supercomputer of 1989, that had only me as its only full-time programmer, reset itself to become the conventional user-friendly supercomputer that now has a thousand simultaneous users.

The **Grand Challenge problem** of supercomputing is a **tough question** that the petroleum industry must answer. Their answer **must lift** the common citizen in Nigeria from poverty. Their answer must be **grounded** several miles deep inside the oil fields of the Niger Delta region of southern **Nigeria**. That oil field covers the area the size of a town. In **Nigeria**, extreme-scale petroleum reservoir simulators are used to **discover** and **recover** otherwise elusive crude oil and natural gas.

## FROM FICTION TO SUPERCOMPUTER

**O**n the Fourth of July 1989, I became the first to understand how to solve a Grand Challenge problem. And how to solve it across a new ensemble of processors that surrounded a globe as a new Internet that's a new global network of processors.

That was how I became the **first to figure out how to solve the Grand Challenge problem** of supercomputing. And how to solve it **across a never-before-visualized Internet** that's a new spherical island of one binary **million**, or one binary **billion**, off-the-shelf processors that were **coupled**. And which were equal distances **apart**. And **that shared nothings, each its own master**.

The difference between each of the 25,000 vector supercomputer scientists of the 1970s and 80s and myself **was this**: I had the **self-confidence** to tackle the **most difficult** mathematical problems in supercomputing. And to solve those **once-impossible** problems **alone** but only aided by my ensemble of 65,536 processors that computed **in tandem**.

I visualized my **new Internet** as encircling a globe in the manner the Internet encircles the Earth. In 1989, I was in the **news** as the mathematician that harnessed the **first** supercomputer, as it's known today, to solve such difficult problems. I solved them when every mathematician said that their mathematical solutions were **impossible**, **even across an ensemble of a billion processors**.

### From Laws to Equations for Weather Forecasting

At all times and for the **Grand Challenge problems**, I was **cognizant** of the fact that calculus and algebra were the two recurring decimals on my blackboard and motherboard, respectively. Prior to the parallel processing of my computational fluid dynamics problem, I had to discretize a system of governing **partial differential equations** of calculus, called the primitive equations of weather forecasting.

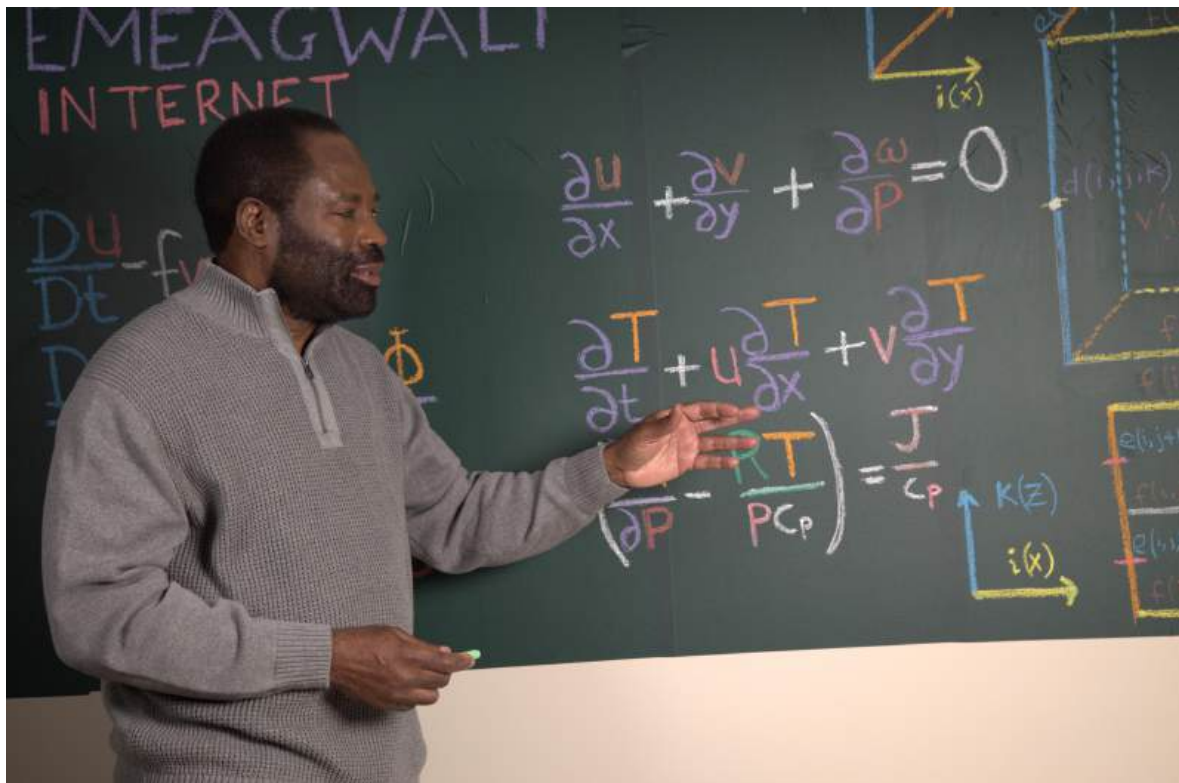
That was how I invented my **finite difference algorithms** of the algebra of weather forecasting.

Those algorithms are the sets of computational steps or the floating-point arithmetic operations that must be solved at the extreme-scale algebraic core of the **compute-intensive** problem at the core of weather forecasting.

That was how your evening **weather forecast** used physics's second law of motion to predict the motions of atmospheric flows and compute dependent variables and present them as sequences of **contoured fields**.

The remaining equations used in weather forecasting include the **hypso**metric equation that was derived from the hydrostatic equation and the ideal gas law. It also includes the **thermodynamic energy** equation, or the first law of **thermodynamics**, that states that the change in **internal energy** is equal to the **heat** added minus the **work done**, and the continuity equation.

Often, the mathematical formulation of the primitive equations of weather forecasting yields a system of five equations with five dependent variables that include the fluid velocity relative to the rotating Earth, the density, and the pressure.



Philip Emeagwali at the chalkboard explaining his contributions to **mathematics**, namely, how to solve initial-boundary value problems governed by the primitive equations of meteorology used to know the weather.



## UNLOCKING THE SECRETS OF OIL AND GAS FLOWS

A supercomputer that sells for one billion dollars is more complex than a novel that sells for twenty dollars. My contributions to science cannot be published in science journals that has page limits. Nor can it be explained as a short memo to The White House. A memo can only convey a vague, but not fully formed idea. The supercomputer, or Internet, cannot be described within six pages or one hour lecture. For that reason, I described my contributions to the world's fastest computing. I did so across a series of one thousand podcasts and YouTube videos.

Writing my life story and contributions to the world's fastest computing and doing so without dwelling on the nine **partial differential equations** that I invented—in the early 1980s and while in College Park, Maryland—will be like producing the play **Hamlet** without the Prince of Denmark.

I invented nine new **partial differential equations** for mathematical and computational physics that are called the Philip **Emeagwali** equations. The **partial differential equation** is the **pinnacle** of mathematical physics. The supercomputer is to the **partial differential equation** what the telescope is to astronomy. The **new partial differential equations** that I **invented** and that I **figured out** how to solve **across** the new Internet that I **invented** was the cover story of top mathematics publications. Those publications include the May 1990 issue of the *SIAM News* published by the Society for Industrial and Applied Mathematics.

My new **partial differential equations** made the **news headlines** because the **new parallel-processed** mathematical computations which I **executed across** my **new Internet** that was a **new** global network of 65,536 processors were **science fiction** to the community of research computational mathematicians of **1989**. My **contributions** to mathematical knowledge were newsworthy because it was then **impossible** to parallel process and to solve at the fastest computer speeds initial-boundary value problems governed by **partial differential equations** of extreme-scale mathematical physics.

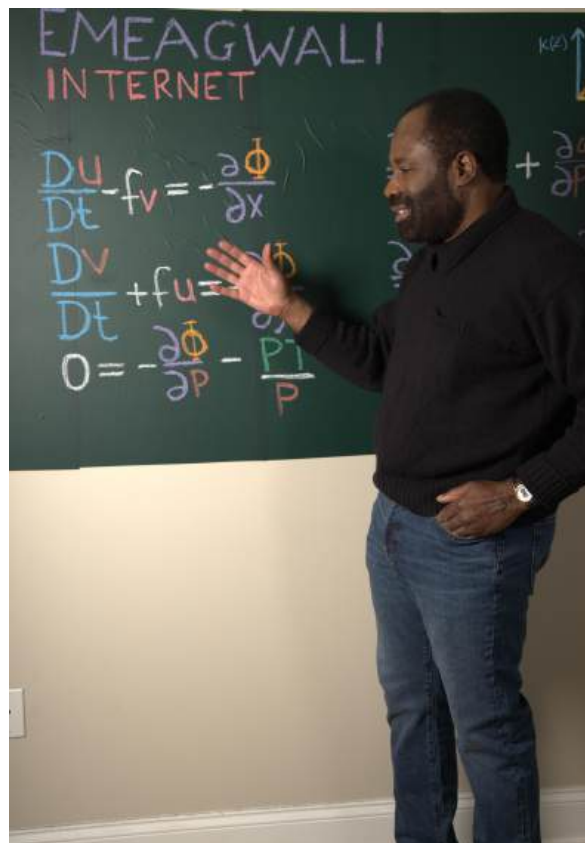
The nine **partial differential equations** which I **invented** were **credited** to me because they had never been scribbled **across** any blackboard or printed in any textbook or written in any known notebook.

### Understanding Philip Emeagwali Equations in Prose

Because I **invented** those nine **partial differential equations**, I knew them **forward** and **backward** and even **sideways**. For that reason, I delivered my

mathematical lectures of the 1980s and now **in prose** and **without notes** or **blackboards**. Across YouTube, I'm the only mathematician that delivered his **partial differential equations** without PowerPoints. It was noted in YouTube commentaries that I was the only mathematician who delivered his mathematical lectures to leading mathematicians and delivered them in **prose** and **poetry** and delivered original **partial differential equations without notes**.

I delivered my **new partial differential equations without notes**, and I did so when other research computational mathematicians **buried their faces** on their blackboards scribbled with **partial differential equations** and scribbled with companion **partial difference equations** all **borrowed from textbooks**.



Philip Emeagwali at the chalkboard explaining his contributions to mathematics, nsmely, how to solve the most compute-intensive problems of geophysical fluid dynamics.

### Supercomputing Fiction into Fact

Before February 1, **1922**, theorized parallel processing **existed** as a blank sheet of paper or as science fiction. Before July 4, **1989**, the parallel-processed solutions of the most difficult problems only existed as **science fiction**. To **discover** that the fastest computer can be built with the **slowest** processors was **news headlines** because the invention **shook the world of supercomputers**. Before my experiment of July 4, **1989** that made the **news headlines**, the evidence that supported the technique and technology of parallel supercomputing was **thin** to **non-existent**.

## ACCELERATING COMPUTERS TO THE SPEED OF LIGHT

**M**y research quest was to invent the world's fastest computer. And to invent how to compute across processors. And compress times-to-solution of initial-boundary value problems that arise when solving the most difficult problems, such as global climate modeling to foresee long-term global warming. In 1989, I was in the news because I discovered how to compress the times-to-solution that was needed to solve the most difficult problems in science, engineering, and medicine.

My **contributions** to the speed of the computer **were these**: I **discovered** how to **compress** the time needed to solve the most difficult problems that were once **impossible to solve**. And how to solve them by **sending** and **receiving** emails and communicating along my new global network of **1,048,576** email wires.

My initial-boundary value problems of mathematical and computational physics were **sent to** and **received from** **an ensemble of 65,536** coupled processors, in which each processor operated its operating system and **shared nothing** between closest-neighboring processors.

### The Eureka Moment I Discovered the Fastest Computing

Parallel processing creates more **Eureka! Moments**, such as in the world's fastest compute that harnesses 10.65 million off-the-shelf processors and uses those processors to solve the most difficult problems.

Within the world's fastest computer, parallel processing is the **vital technology used** to reduce the **time-to-solution** from thirty thousand years, or 10.65 million days, of sequential processing on one central processing unit to merely one day of supercomputing **across** 10.65 million central processing units.

### My Perspectives on the Equations Used to Forecast the Weather

In one form of the primitive equations, or the system of hyperbolic **partial differential equations**, that governs the **difficult mathematical problem** of extreme-scale weather forecasting, the dependent variables are the **zonal**

velocity in the east to west direction that is **tangent** to the sphere, the **meridional velocity** in the north to south direction that is **tangent** to the sphere, the vertical velocity in **isobaric coordinates**, the **precipitable** water, the **Exner function** (or **non-dimensionalized pressure**), the potential temperature, the gas constant, the pressure, the specific heat on a constant pressure surface, **the heat flow per unit time per unit mass**, the **temperature**, the **geopotential**, and the term for the **Coriolis** force.

What separated the **serial** and **parallel** paradigms of the world's fastest computing is not the difficulty of the problems they solved but how they solved them.

### Weather Equations in Prose

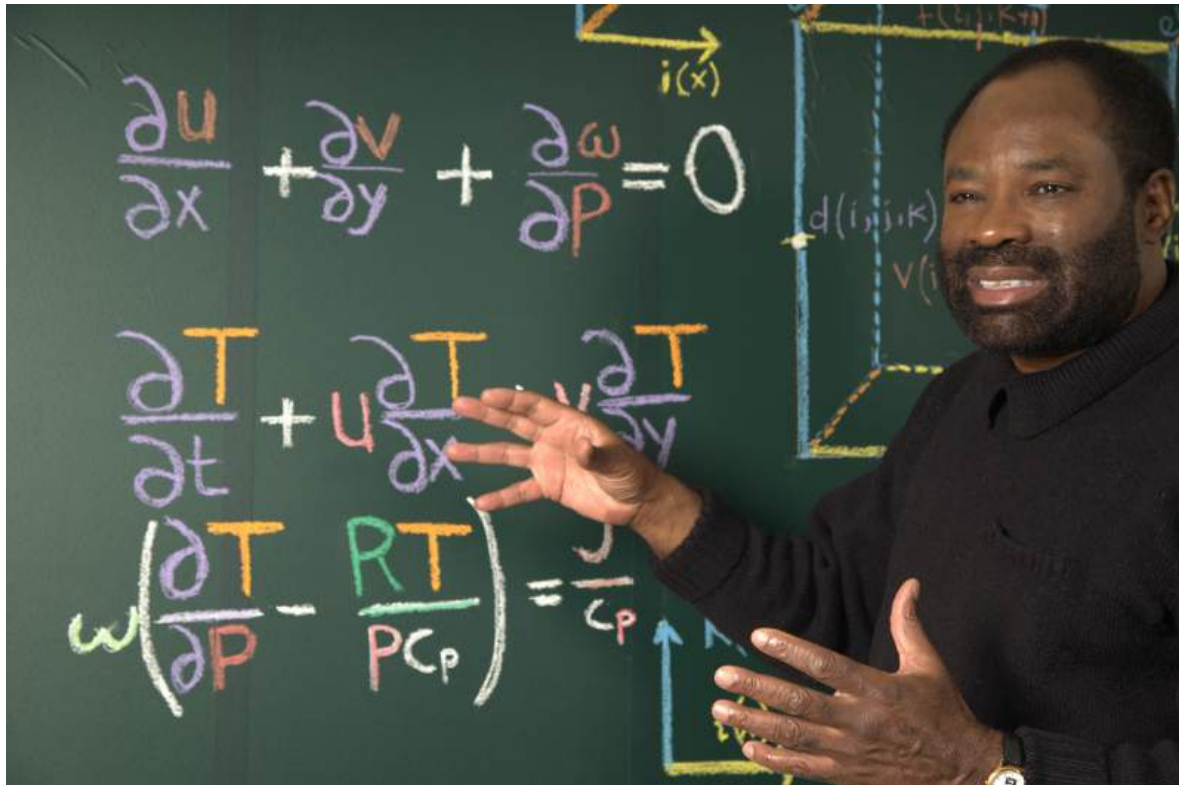
Your weather forecast was enabled by the parallel-processed initial-boundary value problem based on the primitive equations of **meteorology**. Each equation was a balance equation that accounted for something, such as where fluids come from or go to and how the total fluid changes in time and space. The first of the six primitive equations encode the law of conservation of mass. The second, third, and fourth **partial differential equation** of the primitive equations encodes the law of conservation of momentum. The fifth **partial differential equation** of the primitive equations expresses the relationship between the temperature to heat sources and sinks.

The general circulation model is a climate model based on the general circulation of the Earth's atmosphere and oceans. The climate model is an ensemble of millions of parallel-processed initial-boundary value problems of calculus, each governed by the primitive equations of meteorology. This system of coupled, nonlinear, time-dependent, and three-dimensional **partial differential equations** encoded some laws of physics and chemistry. To parallel process the global climate model, the supercomputer scientist must **chop up** the extreme-scale mathematical problem into millions of smaller three-dimensional models.

Each small global climate model computes **in tandem** the wind speeds, heat transfer, relative humidity, radiation, and surface hydrology within itself. And it must exchange boundary value data with the closest-neighbor global climate models that were executed within the as many processors.

I **discovered** how to **slice** and **dice** the most difficult initial-boundary value mathematical problems. And massively parallel computing them in smaller chunks. And **aggregating** them for the complete results. My **discovering** the world's **fastest** computing **across** the world's **slowest** processors made the **news headlines** because it was a big step towards the invention of super-

fast computers computing at the speed limit. The world's fastest computer costs 40 percent more than the mile-long Second Niger Bridge of Nigeria.



Philip Emeagwali at the chalkboard explaining his contributions to mathematics, namely, how to solve the most complex problems arising in planetary-scaled computational fluid dynamics.

### Why Are Supercomputers Important in Climate Modeling?

**Why are supercomputers important in climate modeling?** The world's fastest computer is used for the most detailed mathematical calculations, such as predicting long-term global warming. **What is a world without supercomputers?** The world's fastest computer is used to solve problems that did not exist before. The world's fastest computer costs **one billion, two hundred and fifty million** dollars. Or the equivalent of 25,000 **man-years** with each man paid 50,000 dollars per year. For this reason, a full-time computer science instructor that conducts part-time research aided by only three 25-year-old students cannot construct the world's fastest computer. A state-of-the-art computer is a billion times more powerful than the everyday computer. The fastest computer in the world is far more complex than the spacecraft that took men to the moon. The development

of the most powerful computer demands up to 25,000 pairs of hands and as many brains.

On the Fourth of July **1989**, I recorded the highest **speedup** and the fastest **speed** in supercomputing. That scientific **discovery** led to my conclusion that supercomputing **across** the **slowest** one billion processors could become the technology that can yield a factor of one-billion-fold reduction in the wall-clock times of the most compute-intensive problems.

Such difficult problems include global climate models that must be used to **foresee** otherwise **unforeseeable** long-term global warming. Without parallel supercomputing, it would take centuries to foresee climatic changes.

## Climate Models Exists Only Within Supercomputers

What is the difference between the **global climate model** and the **general circulation model**? The general circulation model simulates the circulation of the atmosphere. A **global climate model** might be based on a **general circulation model**. The **global climate model** is used to predict what will happen in the Earth's climate in the coming centuries. **The climate in London is the average weather in London for over thirty years.**

## My Contribution of Parallel Supercomputing to Meteorology

My mathematical **contributions** to the solution of the primitive equations used to forecast your evening weather **were these**: I **discovered** how to parallel process and **compress** the time needed to solve that **Grand Challenge problem** of weather forecasting that is an extreme-scale initial-boundary value problem of computational physics.

I **discovered** that with 10.65 million processes computing in parallel that a **time-to-solution** of 10.65 million days, 30,000 years, dropped to one day of **time-to-solution** **across** a new Internet that's a new spherical island of ten binary million processors. **Without parallel supercomputing, tomorrow's weather forecast will be issued 30,000 years later.**

## Parallel Supercomputing Was Rejected in Debate of 1967



A famous debate on the future of the parallel supercomputer took place between April 18 to 20, 1967, and at the Spring Joint Computer Conference, in Atlantic City, New Jersey. After that debate, the consensus was that parallel supercomputing will **forever remain an enormous waste of everybody's time**. That debate was between IBM's **Gene Amdahl**, who **opposed** parallel supercomputing, and **Daniel Slotnick**, who **proposed** parallel supercomputing. **Gene Amdahl** who designed the world's most successful single-processor computer, named IBM's System 360, won that debate. And his victory gave rise to the famed **Amdahl's law** that later entered into supercomputer textbooks.

**Amdahl's law** decreed that it would be **wasteful** to design supercomputers that are powered by eight or more processors. According to **Amdahl's law**, an infinite number of processors will be **wasteful** and will not yield an **infinite increase** in the speed of the parallel supercomputer. **Amdahl's law** was the reason fewer than eight processors were incorporated into the supercomputers of the 1960s through 80s.

On July 4, 1989, I **discovered** the new supercomputing knowledge **of the world's fastest computing across the world's slowest processors**. That **contribution** is the reason I'm the subject of school essays on computer history.

## From Laws to Equations: Unlocking the Mysteries of Fluid Dynamics

On my blackboard, I used the most advanced expressions from the frontier of calculus and computational fluid dynamics. Those expressions are called **partial differential equations**. Such **equations** are used to foresee the motions arising during **plate tectonic**, **supernovas**, and **tornadoes**. **Partial differential equations** are used to design **superconducting magnets** for **superconducting super colliders**. **Partial differential equations** are used to study the transport of **ions across** kidney membranes. An **ion** is an atom or molecule with a net electric charge arising from the loss or gain of electrons. But by far, the most important and the most frequently occurring **partial differential equations** are those that encode laws of physics, such as the conservation laws for matter, momentum, energy, and chemical species.

The laws of conservation are the **common denominators** in many initial-boundary value **problems**, such as those arising in extreme-scaled, **parallelized** computational fluid dynamics, such as modeling hurricanes and tornadoes to protect life and property. And the design of hypersonic airplanes, quiet submarines, and efficient automobile bodies.

In the fluid dynamics of the Earth, the solutions of the governing **partial differential equations** are the mathematical descriptions of the **oceanic** and the **atmospheric** flow patterns. That mathematical and computational



solution is simply called the short-term weather forecast. Or the long-term global warming prediction. The formal mathematical name for this is initial-boundary value problem. It's a boundary value problem because the Earth's surface is its lower boundary while the Earth's upper atmosphere—that is 62 miles (or 100 kilometers) above the Earth's surface—is its upper boundary.

## THE UNIMAGINABLE POWER OF THE SUPERCOMPUTER

### Why It Was Kept a Secret

**T**he world's fastest computing is the key technology that must be used to address the grave existential threats of the 21st century. The biggest threat to life on Earth is to understand the abstract and seemingly invisible global climate change. We lack the visceral understanding of the urgency of global warming. In the long run, the proximity of the climate crisis is worse than any global pandemic and economic collapse we can imagine.

Parallel supercomputing that was once confined to solving compute-intensive initial-boundary value problems is now used to solve mathematical problems that arise across many industries. The world's fastest computers are used to foresee long-term global warming, reduce the energy crisis of the world, search for extraterrestrial intelligence, understand how living cells function, map the human genome, kill diseases, and speed up the search for new antiviral drugs and for new vaccines with the least side effects.

I **invented** the **blueprint** that's used to design the **first supercomputer**, **as it's known today and as it could be known tomorrow**. My **discovery** which occurred on July 4, 1989, **opened the door** to the world's **fastest** computers that compute **across** an ensemble of up to one billion processors. What happened in **1989** was that I **invented** something that was waiting for me.

My **contribution** to the speed of the computer **is this**: I was in the **news** for **discovering** that the world's **fastest** computers can be manufactured from **standard parts**, known as **off-the-shelf** processors, including from the world's **slowest** processors. My supercomputer invention made the **news headlines** because it provided the answer to the **most pressing question** at the crossroad where mathematics, physics, and computing **intersected**. After my **discovery**, it became possible to simulate long-term global warming and do so faster and **across** up to a billion processors.

Today, the world's fastest computers are powered by up to ten million processors. The reason is that ten million processors powering a supercomputer makes it possible to obtain a more detailed and realistic global climate models that must be used to foresee century-long climate changes.

“**Why is the fastest computing across the slowest processors a critical and enabling technology?** And what is the contribution of **Philip Emeagwali?**”

My **contribution** to the speed of the computer **is this**: I **discovered** how to populate the world's fastest computers with a billion processors that **shared nothing**, but **were in dialogue with each other**. And I **discovered** how to

solve the hardest problems. And solve them by chopping them up into a billion smaller problems that can then be solved **in tandem**. I **discovered** that **rapid-fire** speed that's the **first** world's **fastest** computing to be executed **across** the world's **slowest** processors and **discovered** it as **modular**. Therefore, the supercomputing technology can be repeated **a billion-fold** to gain as much speed increase. In a different perspective, if all our high-resolution, three-dimensional, and time-dependent computational fluid dynamics simulations were represented by one **uninterrupted** simulation that's executed within one processor, then our **prehuman ancestors**, who used the **first stone tools**, may have had to start our supercomputer simulation, and started it **three million years** ago so that we can have their answer today. That technological feat called for a civilization on Earth that **preexisted** before humans.

## DISCUSSION QUESTIONS 1/2

### Computing Without Limits



1. How did Philip Emeagwali's discovery in the late 1980s challenge traditional notions of computing and problem-solving in mathematics and physics?
2. What is the significance of solving initial-boundary value problems in mathematics and physics, particularly in the context of global climate modeling and petroleum reservoir simulation?
3. How did Philip Emeagwali's understanding of computational fluid dynamics and the laws of physics contribute to his ability to solve complex problems in supercomputing?
4. What were some of the challenges faced by Philip Emeagwali in his quest to solve initial-boundary value problems across millions of processors?
5. How did Philip Emeagwali's visualization of an ensemble of processors and their correspondence to oil fields contribute to his discovery of the world's fastest computing?
6. What are the similarities between the initial-boundary value problems governing the short-term "weather" below the Earth's surface and the long-term weather forecasts above the surface?
7. How did Philip Emeagwali's research and collaboration with hydrologists and meteorologists contribute to his understanding of finite difference discretization and its applications in weather forecasting and petroleum reservoir simulation?
8. What is the role of supercomputers in accurately predicting weather conditions and protecting life and property?
9. How did Philip Emeagwali's knowledge of mathematics, physics, and computational fluid dynamics enable him to tackle the grand challenge problem of hindcasting and forecasting weather conditions deep below the Earth's surface?
10. What are the implications of Philip Emeagwali's discovery of the world's fastest computing for the energy industry, particularly in the search for energy deposits in Nigeria?
11. How did Philip Emeagwali's use of patterns and structures from disparate fields of knowledge contribute to his breakthrough in solving complex problems in supercomputing?
12. What are the three finite difference techniques used in compositional reservoir simulators, and how do they contribute to enhanced oil recovery processes?

13. How did Philip Emeagwali's journey as a supercomputer scientist shape his understanding of the importance of physics in the development of Nigeria?
14. What is the significance of parallel processing and large-scale computational fluid dynamics simulations in the advancement of computational physics?
15. How did Philip Emeagwali's expertise as a supercomputer scientist contribute to his ability to tackle the biggest and most difficult problems in mathematics, physics, and computing?

## DISCUSSION QUESTIONS 2/2

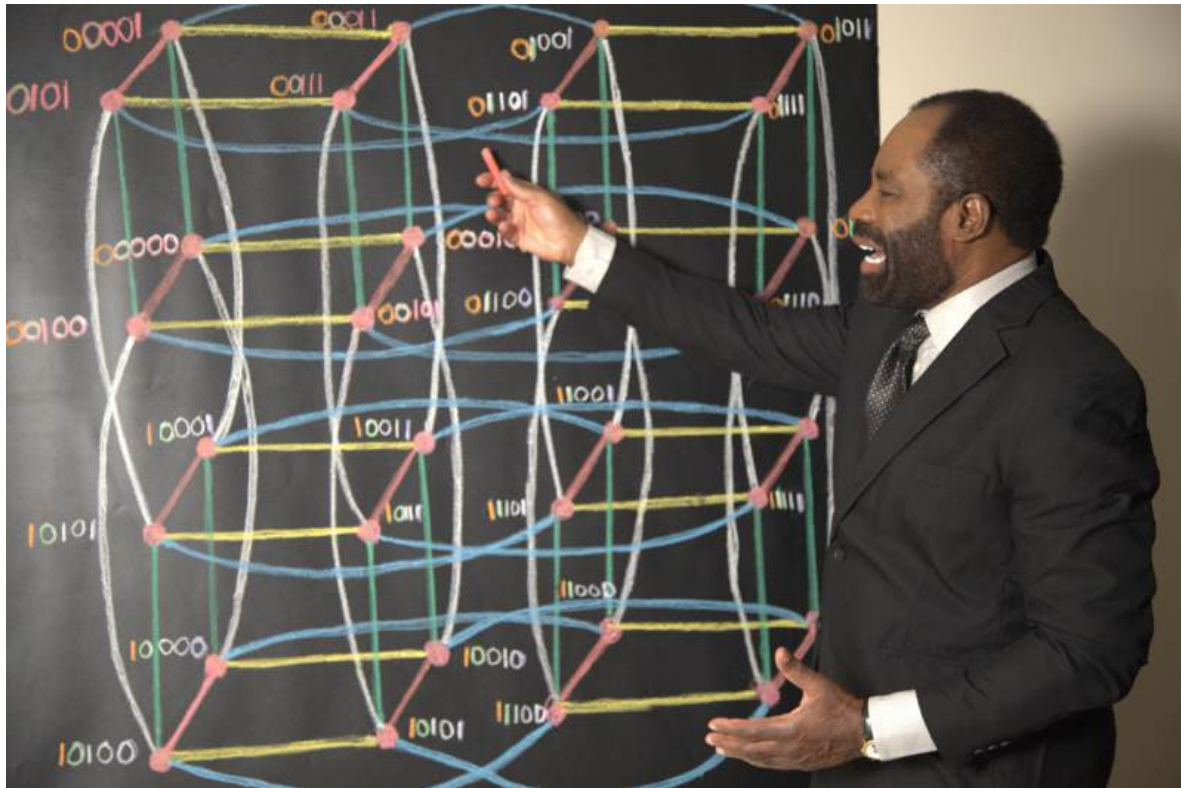
### Computing Without Limits

1. What role do supercomputers play in Nigeria's petroleum industry, and how does it impact the country's revenue from oil?
2. How did Philip Emeagwali's unorthodox approach to supercomputing in 1989 challenge existing expectations and lead to advancements in the field?
3. What is the Grand Challenge Problem in supercomputing, and how does it relate to the petroleum industry and poverty reduction in Nigeria?
4. What were the key components of Philip Emeagwali's new Internet and global network of processors, and how did it contribute to solving the Grand Challenge Problem?
5. How did Philip Emeagwali's understanding of calculus and algebra enable him to invent new finite difference algorithms for weather forecasting and fluid dynamics simulations?
6. What is the significance of parallel processing in supercomputing, and how did Philip Emeagwali's discovery of parallel supercomputing revolutionize the field?
7. How do the primitive equations of weather forecasting and the general circulation model contribute to climate modeling, and how did Philip Emeagwali's contributions improve the accuracy and speed of these models?
8. What are the challenges and benefits of parallel processing in extreme-scale computational fluid dynamics simulations, such as modeling hurricanes and tornadoes?
9. How did Philip Emeagwali's discovery of parallel supercomputing challenge the prevailing belief expressed in Amdahl's Law, and what implications did it have for the design and capabilities of supercomputers?
10. How did Philip Emeagwali's contributions to supercomputing address the urgent global issue of climate change and provide a technology to simulate long-term global warming?

11. What are the practical applications of supercomputing beyond climate modeling, and how do they impact various industries and fields such as medicine, physics, and the search for extraterrestrial intelligence?
12. How did Philip Emeagwali's invention of a billion-processor supercomputer using off-the-shelf processors revolutionize the manufacturing and scalability of supercomputing technology?
13. How did the discovery of parallel supercomputing across slow processors lead to the development of more detailed and realistic global climate models, particularly in predicting century-long climate changes?
14. What is the significance of Philip Emeagwali's discovery of modular supercomputing and its potential for achieving rapid speed increases through replication?
15. What are the implications of Philip Emeagwali's discoveries for our understanding of the history of computing and the potential existence of advanced civilizations predating humans?



### 3RD LECTURE: FASTEST COMPUTING AT LIGHT SPEED



Philip Emeagwali explaining how he unlocked the power of the first parallel processing supercomputer, on July 4, 1989.

**Broadcast 21 August 2021**

<https://youtu.be/nVzI2AIBkj0>

## DON'T CALL ME A BLACK GENIUS

he supercomputer that is powered by millions of processors is the lifeblood of science, engineering, and medicine. Yet, the world's fastest computers are taken for granted and undervalued. In 1989, I was in the news for discovering that the slowest processors could be used to solve the biggest problems. And find their answers at the fastest speeds. The fastest computer is why you know the weather before going outside.

T

Shortly after 1989, a 12-year-old writing an essay on a famous scientist asked me: “Are you a Black genius?”

The genius is the ordinary person that found the extra-ordinary in the ordinary. My father is a genius because he insisted that I solve one hundred mathematics problems every evening. And solve them faster than one problem per minute. At that speed, I was one of the fastest human computers in Nigeria. And that daily exercise foreshadowed my world's fastest computing of July 4, 1989.

In 1989, I was in the news for discovering how to solve the most difficult problems at the intersection of calculus, algebra, physics, and computing. And solve them at the fastest recorded computer speeds. And solve them with the slowest processors in the world.

In 1960, in Sapele (Nigeria, British West Africa), I came last in my first-grade examinations, and last in mathematics. I dreaded mathematics. But my father demanded that I study twenty times longer than my classmates. After five years of daily practice in the late weekday afternoons, I was solving one hundred arithmetical problems an hour. In comparison, my primary school classmates were solving only five problems each school morning. I studied twenty times harder to become only twice better. The genius is the below average person that worked hard to become above average.

## Geniuses Contributed to Knowledge

It's a myth that only persons possessing the highest IQs can contribute new knowledge to science. Brilliance is a necessary condition for inventing faster computers. And for solving unsolved problems at the frontiers of mathematical knowledge. But brilliance, in and of itself, is not a sufficient condition for experimentally discovering how millions of the world's slowest processors could be harnessed and used to execute the world's fastest computing. And solve the hardest problems in mathematics.

I was in the news because I discovered that solving up to a billion problems simultaneously enables supercomputers to be up to a billion times faster

than computers. That's how I invented the technology that enables the world's fastest computers to be fastest.

**It's one thing** to have exclusive control of 65,536 processors that could make a supercomputer fastest. **It's another thing** to visualize those ensembles of processors as a new Internet. **It's another thing** to envision routing emails **across** a new Internet defined and outlined by one binary million, or 1,048,576, bidirectional email wires that were regular and short and equal distances **apart**. **It's another thing** to understand how those email wires **married** those processors together. And **married** them as one seamless, coherent, and gigantic processor.

The world's most powerful supercomputer is like a **wristwatch**. You only see the face and the hands of a **wristwatch**. The unseen inside of the **wristwatch** is **abstract but necessary**. My unseen ensemble of 65,536 processors were like the inside of the **wristwatch** that is **abstract but necessary**.

## INTRODUCING THE SUPERCOMPUTER OF TOMORROW

**M**y ensemble of 65,536 processors, each its own master, that shared nothing didn't solve the as many difficult problems of computational physics and didn't solve them by themselves. A central processing unit is like a coffin that's merely a box until you put somebody inside it.

I used those 1,048,576 regular, short, and equidistant email wires to send emails to and from processors. And I used them **to deliver** the most difficult **problems** of mathematical physics that I **subdivided** into 65,536 smaller, less compute-intensive problems. And **to deliver** their companion instructions on how to solve those smaller problems. And **to deliver** the smaller problems with a **one-problem** to **one-processor** correspondence. And do so to all 65,536 **central processing units** that outlined my **new Internet** that's also a supercomputer.

That network of 64 binary thousand coupled processors was my **laboratory instrument** that made it possible for me to discover how parallel processing enables computers to be faster. And discover why the new technology enables the world's fastest computers to be **fastest**.

**What did Philip Emeagwali contribute to the speed of the computer? The processor is the brain of your computer. My contribution is like having one thousand brains in your computer. My invention is like powering the world's fastest computer with one billion brains.**

As the inventor of the Philip **Emeagwali** Computer, I had to know, *a priori*, the topology, or the locations, of each processor within my ensemble of processors. And know where every processor, or electronic brain, is located. And know those locations, both forward and backward. And know them with the completeness an airline pilot had to know the geography of Nigeria to fly from Lagos to Abuja.

**I visualized** short email wires for processor-to-processor email communications. **I visualized** them as comprising of email wires printed onto circuit boards. **I visualized** long email wires that comprised of fiber-optic cables or electric cables. Furthermore, **I visualized** my ensemble of processors as communicating and computing **together** and doing both as one seamless, coherent, and giant processor that's the **world's fastest**. Not only that, **I visualized** using commodity, or large numbers of available, processors designed for computers. That contrasted with using a few custom-made vector processors that were designed for the fastest supercomputers of the 1970s and 80s.

## UNRAVELING FASTEST COMPUTING

**M**y contribution to computer science is that I made the unimaginable possible. And I did so when I discovered how to encode the laws of physics into partial differential equations of calculus that I discretized into systems of equations of algebra that I coded and solved across a new Internet. I invented my new Internet as a new global network of coupled 65,536 central processing units, each its own master, that shared nothing.

In supercomputing, to discover or invent is to show that the impossible-to-solve is possible-to-solve. And to apply that new supercomputer knowledge to get answers to previously unanswerable questions. And thus discover the extraordinary in the ordinary. **The genius is the ordinary person that found the extraordinary in the ordinary.**

I executed the world's fastest computing to know what's **discoverable** and **knowable** and know something which nobody knows. **To witness a scientific discovery that has rich, fertile, and far-reaching consequences is like walking into a forest and witnessing many leaves fall on your head.** I'm an African mathematician of the supercomputer age.

### Unlocking the Digital Frontier: A Black Mathematician's Rise in the Supercomputer Age

Leading mathematicians first learned about **Philip Emeagwali** when my contributions to extreme-scale computational linear algebra arising from my **discretization** of some **partial differential equations** of calculus. My contributions to large-scale computational physics became the front-page story of the May 1990 issue of the *SIAM News*. The *SIAM News* is where **new contributions** to mathematical knowledge are described by mathematicians and for mathematicians. As a Black mathematician born in colonial Africa, I was compelled to invent new mathematics while conducting research alone.

**I'm different** from modern mathematicians of European ancestry. **I'm different** because I perform my arithmetic computations in parallel or multiply 65,536 pairs of numbers simultaneously. **I'm different** because modern mathematicians perform their arithmetic computations and do so in sequence or multiply two numbers **at a time**.

**I'm different** from the pure mathematician who uses the blackboard as his mathematical canvas. **I'm different** because I'm a large-scale computational mathematician who **abandoned** his blackboard. And

embraced a new Internet that he **invented** as a new global network of 64 binary thousand processors that each had its dedicated memory. I embraced up to a billion processors as my mathematical canvases.

**I'm different** from the applied mathematician that applies a real-world mathematical problem—such as a global climate model that must be used to foresee global warming. I applied the global climate model as my backdrop for my global network of processors. **I'm different** because I **applied both the mathematics and the problem as the backdrops to the new Internet** I invented as a new global network of 64 binary thousand central processing units.

**I'm different** from the computational mathematician who only uses the motherboard as his mathematical canvas. **I'm different** because I used a new Internet that's not a computer, by itself. I used the world's fastest computer as my new mathematical canvas.

## UNRAVELING THE SUPERCOMPUTER

**W**hat is the contribution of Philip Emeagwali to mathematics? I changed how mathematicians solve the most difficult problems arising in mathematics, physics, and computer science. In my new way, the hardest problems are solved across up to a billion processors, instead of on only one processor. That was a paradigm shift.

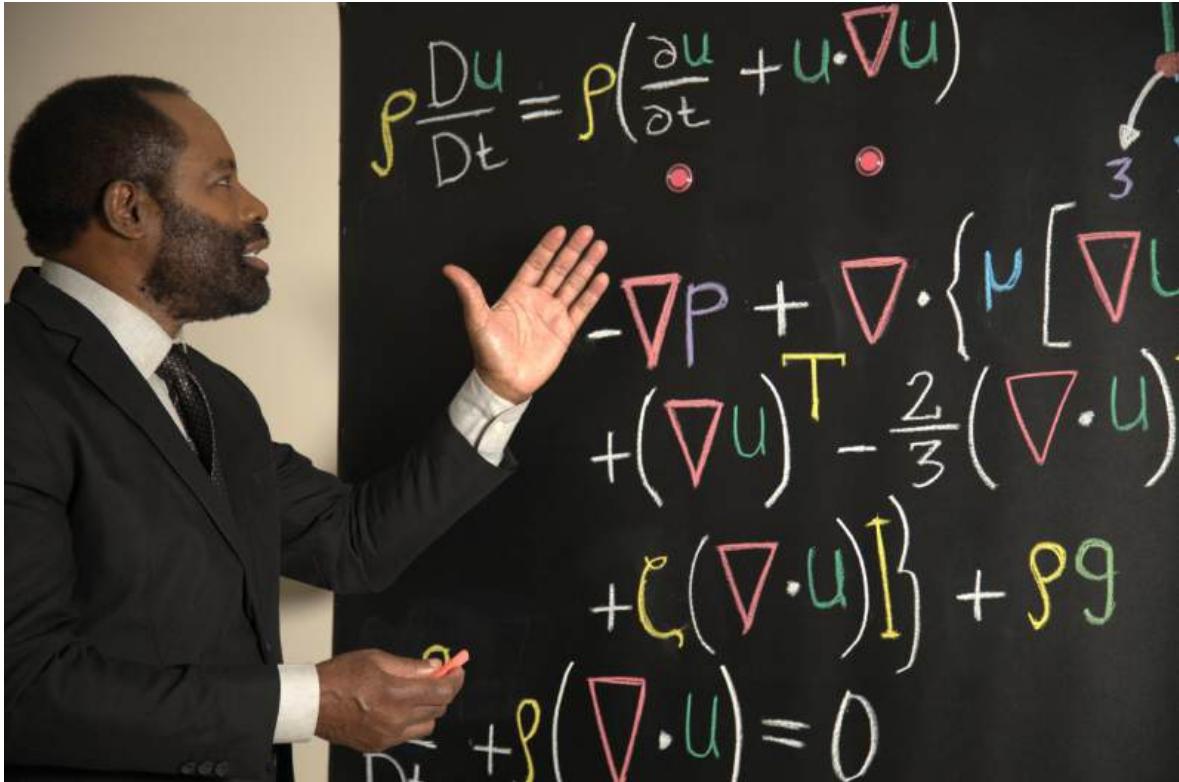
The lyrics of a song are sung, not read. If the lyric is meant for the microphone, not the page, then the largest-scaled system of equations of algebra is meant for the motherboard, not the blackboard. Programming **across** an ensemble of processors demands message-passing or sending and receiving emails from processor to processor. My processor-to-processor email instructions are to me, its parallel programmer, what the play is to the **Shakespearean** actor. Like the play, my communication primitives were acted upon, not read.

Large-scale algebra is the recurring decimal in large-scale computational physics. I used the largest systems of equations of algebra that defined the **toughest problems** in computational physics and engineering as my **backdrops** or as my supercomputer testbed grand challenge problems. I **challenged the established truth**.

That established truth—of the 1980s and earlier—was that the slowest central processing units can't work together to solve the most difficult **problems** in algebra or in large-scale computational physics and engineering.

The **contributions** of **Philip Emeagwali** to mathematics **were these**: I changed how we solve the most difficult mathematical problems. **In the bygone way**, mathematicians **computed on merely one isolated central processing unit** that wasn't a member of an ensemble of processors **or within merely one isolated computer** that wasn't a member of an ensemble of computers. In my modern way, mathematicians compute **across** millions of central processing units or **across** millions of computers.





Philip Emeagwali explaining his contributions to mathematical physics, the parallel processed solution of the initial-boundary value problem of fluid dynamics governed by a system of nonlinear, time-dependent, and three-dimensional partial differential equations.



## PHILIP EMEAGWALI INTERNET

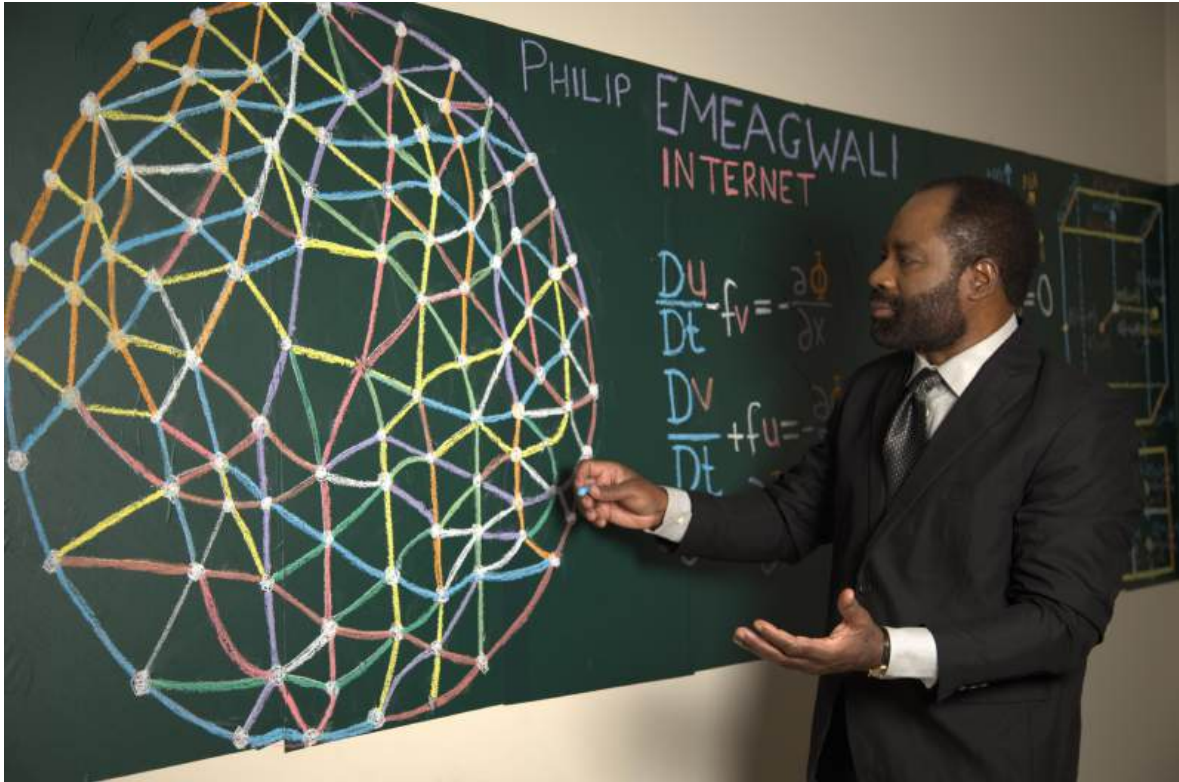
**W**hat is the Philip Emeagwali Internet? The Eureka moment, or high point, of my quest for the fastest compute in the world occurred at fifteen minutes after 8 o'clock on the morning of July 4, 1989, in Los Alamos, New Mexico, USA. And it occurred inside my ensemble of the slowest 65,536 processors in the world.

I **invented** a new Internet that was made up of 64 binary thousand processors (or, equivalently, 65,536 computers) that were uniformly distributed **across** the surface of a globe. That new global network of 65,536 processors was my small copy of the Internet that's also a global network of computers.

**What is the Philip Emeagwali Internet?** Any global network of processors, or computers, that uniformly encircles a globe in any dimension is called the Philip **Emeagwali Internet**. I'm the only **father of the Internet** that invented an Internet.

In the 1980s, my processors communicated via emails that contained 65,536 computational fluid dynamics codes that I sent from up to sixteen closest-neighboring processors. My computer codes and email primitives were **esoteric** and weren't meant to be read by humans.

I was in the news because I **discovered** how to harness millions of the **slowest** processors in the world. And harness them as one seamless, coherent, and gigantic unit that's also the **world's fastest** computer.



Philip Emeagwali explaining his invention of the first Internet, in 1974.  
Philip Emeagwali is the only father of the Internet that invented an Internet.

## COMPUTING TO BREAK THE SPEED LIMIT

In computer science, the most coveted achievement, bar none, is to discover how to record once unrecorded speeds in computations. And to apply that knowledge to solve the most difficult problems in science, engineering, and medicine.

In the 1970s and 80s, parallel processing—or computing many things **simultaneously**, instead of computing only one thing at a time—was dismissed as a beautiful theory that lacked experimental confirmation. In nineteen seventy-nine, parallel supercomputing stood on a shaky ground. In 1980, I was dismissed from my research team because I advocated that the world’s fastest computing can be achieved from harnessing the world’s slowest processors. At that time, I was seen as a mathematician and a physicist and an outsider to computer science. For those reasons, they did not want me to publish and speak about parallel processing. I was deplatformed and remained voiceless, until July 4, 1989.

In a syndicated article distributed on September 2, **1985**, and distributed to the print media and distributed by the United Press International, or UPI, and in that article, **John Rollwagen**, the president of Cray Research Incorporated that company that manufactured **seven in ten** supercomputers, described their use of **64 processors** as: “**more than we bargained for.**”

In the November 29, **1989**, issue of *The New York Times*, **Neil Davenport**, the president of Cray Computer Corporation—the sister company to the company that manufactured **seven in ten** supercomputers—warned that: “**We can't find any real progress in harnessing the power of thousands of processors.**”

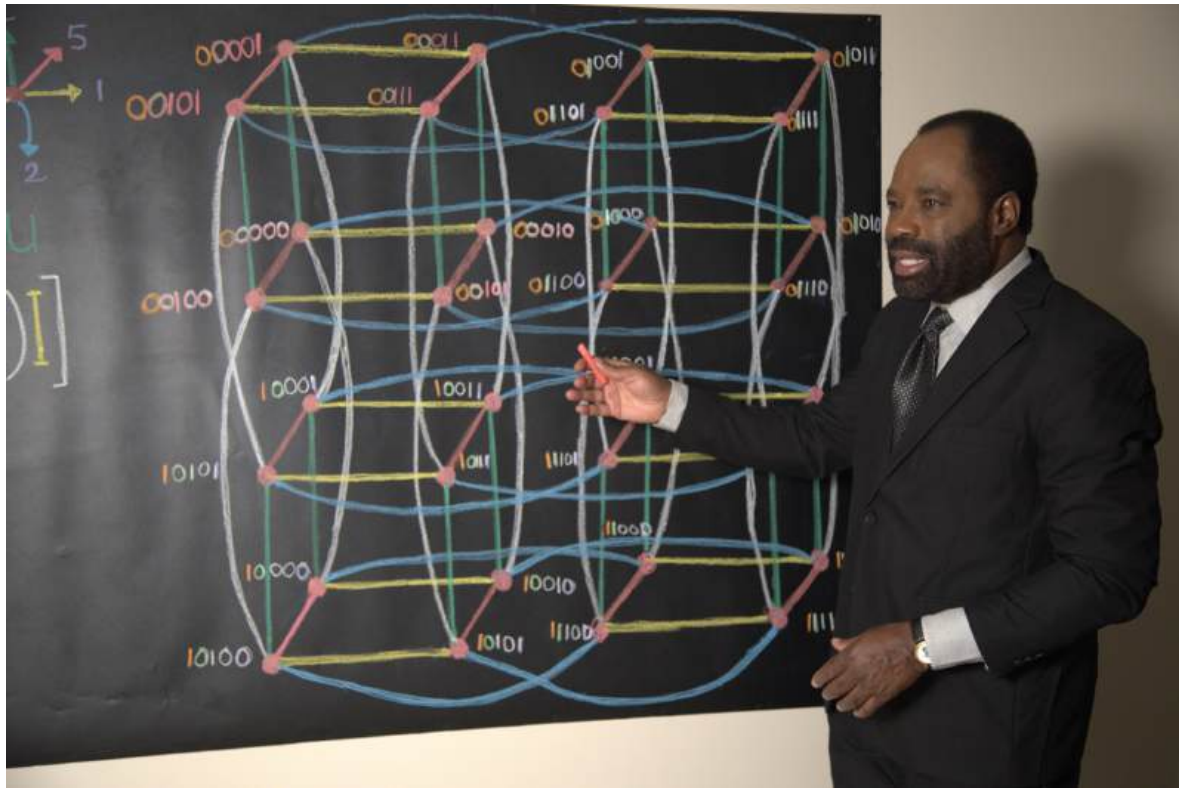
### How I Invented the Fastest Computer from the Slowest Processors

The fastest computer is one million times faster than your computer. The fastest computer is the heavyweight champion of the computer world. After my scientific discovery of how to record the fastest computer speeds and record them **across** the **slowest processors** in the world the technology of parallel processing was **reclassified** from an **unconfirmed** theory to **reality**.

Prior to my discovery that occurred on July 4, 1989, the supercomputer, as it’s known today, was not a computer. And its market was **virtually non-existent**. Parallel supercomputing—that was once the stone **widely rejected** as **rough** and **unsightly**, entered computer science textbooks and did so after my discovery which occurred on July 4, 1989, in Los Alamos, New Mexico, **USA**.

Parallel processing could power **future quantum computers**. Parallel supercomputing **changed our understanding** of the fastest computer in the

world. And made it possible for me to harness a **new Internet** as my new global network of processors and as my new supercomputer *de facto*.



Philip Emeagwali explaining the processor-to-processor parallel processing of his world's fastest computing of July 4, 1989.

### How the Supercomputer Became Super

For the decade of the 1980s, I sat **alone** staring at an **abandoned** computing machinery that everybody else **ridiculed** and **abandoned** as a tremendous waste of **everybody's time**. There was no instruction manual on how to harness the power of the then **never-before-seen** supercomputer hopeful that was **abandoned** for me to program **alone**. Nor was there a help desk that could explain how I could synchronously send and receive 64 binary thousand emails.

I **discovered** how to solve the most difficult problems. And solve them **across** each of those central processing units. And solve them with **sixteen orders of magnitude** increase in supercomputer speed. I **visualized** my computer codes and their arithmetic data as transmitted via emails. And sent and received along sixteen directions that were, in a mathematical

sense, **mutually orthogonal**. Those were sixteen directions that are **mutually perpendicular** in an imaginary sixteen-dimensional hyperspace.

I **discovered** how to **compress** 65,536 days, or 180 years, of **time-to-solution** on a computer and **compress** that **time-to-solution** to one day of **time-to-solution** on a supercomputer. And **compress** that **time-to-solution** by **sixteen orders of magnitude**. My **scientific discovery** of 180 years in one day **opened the door** to the state-of-the-art supercomputing of **compressing** **30,000 computing-years** on an **isolated** processor to one supercomputing-day **across** an ensemble of **10.65 million** processors. I **discovered** how to **compress** thirty thousand years to one day.

It's the parallel processing that I **discovered**, on July 4, 1989, that powers the one thousand fastest computers in the world. The fastest computer is powered by up to **10.65 million** central processing units. And used to solve the most compute-intensive problems. And solve them **in parallel**.

My **scientific discovery** **opened the door** to supercomputing a **million** or even a **billion** things **simultaneously**. My **discovery** of the fastest computing **across** the slowest processors is **permanently embodied** inside every supercomputer. The fastest computing enables us to get a **surer** and **deeper** understanding of our universe. And enables us to **foresee** otherwise **unforeseeable** long-term global warming.

The fastest computing enables mathematicians to climb higher up the ladder of scientific knowledge. To the computer scientist, it made the **unimaginable-to-compute possible-to-super-compute**.

### How Fastest Computing Foresees the Spread of COVID-19

My **contributions** to mathematics, physics, and computing were that I **discovered** how to harness up to one billion processors. And use them to solve the most complex calculus problems, such as the system of **partial differential equations** that governs the initial-boundary value problems of the most extreme-scaled computational fluid dynamics.

The world's fastest computer was used by computational physicists to model once-in-a-century global pandemics. And simulate the spread of **contagious viruses**. The world's biggest computer that occupies the footprint of a football field was used to attack COVID-19 from multiple angles.

## OUR MOST DISTANT DESCENDANTS

### Future Supercomputers

I'm here because I discovered the new knowledge that enables your computer to be faster. And enables the world's fastest computer to be fastest. I was in the news because I discovered the world's fastest computing across the world's slowest processors. I discovered how to use that new supercomputer to solve the world's most difficult problems, such as executing the core mathematical calculations that arise when investigating the cure and spread of COVID-19. I discovered how the fastest computers can be used to pinpoint the locations of crude oil and natural gas that are buried up to 7.7 miles deep.

Before my discovery, of parallel supercomputing, only one giant vector processor, or maybe four or eight superfast vector processors were used to power the fastest computers. After my discovering supercomputing, as it's known today, millions of off-the-shelf processors were used to tackle the most difficult problems arising in science, engineering, and medicine.

The scientific discovery is the **nothingness** from which **new knowledge sprang**. **That new knowledge makes the discoverer a messenger from God.**

My goal wasn't to perform the fastest computation and the fastest communication, in itself. My goal wasn't to solve my **partial differential equations**, *per se*. And solve them to the 17<sup>th</sup> decimal place. My goal was to see the **plural** as the **singular**. My goal was to see **65,536 central processing units** as **sharing nothing** but **coupled**. And to see them as one coherent, seamless supercomputer that's **65,536 times faster** than one computer computing with only one giant processor. My goal was to see a **sixteen-network-deep** Internet. And see it as a **small copy** of the Internet of the **future**.

### The Shape of the Supercomputer

I **invented** the **form** of a new supercomputer that's a new Internet or a new global network of processors. My new supercomputer is my metaphor for my new Internet. My invention was an Internet, in **form**, but a supercomputer, in **function**, that's encoded **across** its millions of **off-the-**



shelf processors, **each its own master**, that **shared nothing**. My invention opened the door to the manufacturing of supercomputers out of **standard parts**, such as **off-the-shelf** processors.

After my **discovery** that occurred on July 4, 1989, in Los Alamos, New Mexico, USA, each of the world's fastest computers was powered by an ensemble of millions of separate processors that operated **in tandem** with each other.

In 1990, I declined the invitation to help the U.S. simulate nuclear explosions and do so on the world's fastest computers. My **discovery** that the world's fastest computers can be manufactured from millions **of off-the-shelf** processors made it possible for nuclear weapons to be tested by simulation on the supercomputer that's powered by millions of processors. My discovery rendered physical testing obsolete. That's the reason nuclear explosions are simulated **across** millions of coupled processors. It's now obsolete to test nuclear bombs at test sites in the **South Atlantic Ocean** and off the coast of Southern Africa.

I was **searching** for the **universal** in the **particular**. I was **searching** for the **extraordinary** division in the **ordinary** multiplication. **I was searching** for the **extraordinarily** fast addition in the **ordinarily** slow subtraction. I was **searching** in the **extraordinarily** deep sixteen-dimensional hyperspace for the ordinary one binary million zeroes and ones that defined the total sixteen-bit-long addresses of my **two-raised-to-power** sixteen ordinary **central processing units** that outlined a new Internet that is, *de facto*, a new supercomputer.

In a century, the supercomputer could be the size of the Earth. And will look like the Internet. And be parallel processing **across** the Internet.

## In Year Million, What Will Posthumans Look Like?

**In Year Million, what will posthumans look like?** In one million years, our posthuman Gods will not look like us. Our super-intelligent posthuman Gods could cross a frontier of knowledge that will be **science fiction** to us. **I foresee** our descendants of a thousand millennia to be super-intelligent lizards that could be **masquerading** as posthuman Gods in their over-populated planet Mars.

**I foresee** an Earth-sized brain that is **anthropomorphized** and thinks like a super-intelligent being. **I foresee** a neural super-brain for our posthuman Gods of Year Million. **I foresee** trillions upon trillions of super-brains of Year Million colonizing our Milky Way. **I foresee** intergalactic space travelers in Year Million.

The supercomputer will be the **walking stick** in humanity's **million-year** hero's journey to the primal **place of immortality**. That scientific journey to envision our posthuman Gods could be akin to visiting the **Planet of the**

**Cyborgs**, where each cyborg is half-human and half super-intelligent computer.

That scientific journey to envision posthuman cyborgs will be akin to, in a spiritual sense, visiting the Land of the Spirits of my distant Igbo ancestors. By Year Million, our posthuman Gods could reinvent themselves as **asexual cyborgs**. **I foresee** that each cyborg of Year Million could be half-human, half-computer. **I foresee** that each cyborg of Year Million could have a **sick sense** of humor. **I foresee** that each cyborg of Year Million could be a **disembodied brain** floating in the middle and safety of the Atlantic Ocean.

Our cyborg posthuman Gods of Year Million could be **anthropomorphic** or have human attributes. **Our cyborg posthuman Gods of Year Million could be human like** because we humans will create them in our own human image.

Our cyborg posthuman Gods will not have computers around them or have their Internets around their planets. The computer of Year Million could be within them. They may not need computers in Year Million because they could **BE** computers.

## Exploring Beyond Our Limits: A Journey Towards Our Most Distant Descendants

I'm here because I discovered how parallel processing enables computers to be faster. And why the technology enables the world's fastest computers to be fastest. The discovery is a time machine that takes us to the past and enables us to see a thing that preexisted but, yet, remained unseen to our ancestors. The invention enables us to invent the future of our descendants.

The parallel supercomputer once the stone rejected as **rough and unsightly** is now the **headstone** of the computing industry. Parallel computing—or solving many problems **simultaneously**, or in parallel, instead of solving one problem **at a time**—is what makes nearly every computer **faster**. And makes every supercomputer **fastest**. My scientific discovery of fastest computing made the news headlines, in 1989, and opened the door to large-scale computations in mathematics and physics.

I foresee our children's children opening more doors by fastest computing **across** their Internet that will be their spherical island of **trillions of central processing units** that enshroud the Earth. And do so as their planetary supercomputer. Such **speed-of-light fast supercomputers** could solve our **as-yet-unsolved** difficult problems in mathematical physics.

One million years ago, our human ancestors looked like apes. In one million years, or in Year Million, our human descendants will ridicule us as looking like humans. In one million years, we might have only **living**



**Silicon** as our posthuman Gods. In one million years, our posthuman could live forever.

In Year Billion the **aliens** on Earth **could be us**. I envision posthumans as thinking across a 10,000-mile diameter Cosmic **SuperBrain** that will **sprawl across an epic landscape** of their eighth supercontinent that will be hanging on the cloud. And that will enshroud our seven land continents. And enshroud the Earth with their Year Million **electronic cloud**.

I foresee posthumans to be half-humans and half-thinking machines. The grandchildren of our grandchildren will not use their Internet the way we use our Internet. **Their Internet could be within them** while our Internet is around us. **They may not need supercomputers because their computers could be within them.**

## DISCUSSION QUESTIONS 1/2

### Fastest Computing at Light Speed



1. How did Philip Emeagwali's discovery challenge the traditional perception of supercomputers and their capabilities?
2. What role did Philip Emeagwali's father play in shaping his mathematical abilities and work ethic?
3. How did Philip Emeagwali's visualization of email wires and processors contribute to the development of the world's fastest computers?

4. Why is brilliance not the only factor in inventing faster computers and solving unsolved problems in mathematics?
5. What were the key components of Philip Emeagwali's ensemble of processors and how did they contribute to the world's fastest computing?
6. How did Philip Emeagwali's invention enable computers to be up to a billion times faster?
7. What is the significance of knowing the topology and locations of each processor within an ensemble for Philip Emeagwali's invention?
8. How did Philip Emeagwali's approach to large-scale computational mathematics differ from traditional mathematicians?
9. What is the paradigm shift that Philip Emeagwali brought to solving the most difficult problems in mathematics, physics, and computer science?
10. How did Philip Emeagwali's use of message-passing and processor-to-processor email instructions revolutionize programming across ensembles of processors?
11. What was the established truth in the 1980s regarding the capabilities of the slowest central processing units, and how did Philip Emeagwali challenge that truth?
12. How did Philip Emeagwali change the way we solve the most difficult mathematical problems, and what is the impact of computing across millions of central processing units or computers?
13. What are the implications of Philip Emeagwali's discoveries for the field of computer science and its future development?
14. How did Philip Emeagwali's work contribute to advancements in extreme-scale computational linear algebra and large-scale computational physics?
15. In what ways did Philip Emeagwali's African heritage and upbringing shape his perspective and approach to mathematics and computing?

## DISCUSSION QUESTIONS 2/2

### Fastest Computing at Light Speed

1. What is the concept of the Philip Emeagwali Internet, and how does it differ from the traditional internet?
2. How did Philip Emeagwali's invention of the Philip Emeagwali Internet contribute to the development of supercomputers?
3. How did Philip Emeagwali utilize parallel processing to achieve faster computations and solve complex problems?
4. What were the challenges and obstacles Philip Emeagwali faced in advocating for parallel processing and the use of slow processors?
5. How did Philip Emeagwali's discovery revolutionize the understanding and application of parallel processing in the field of computer science?
6. How did Philip Emeagwali's invention of the Philip Emeagwali Internet impact the simulation of nuclear explosions and the testing of nuclear weapons?
7. What role does parallel processing play in solving the most difficult problems in science, engineering, and medicine?
8. How did Philip Emeagwali's discovery pave the way for the development of future supercomputers and advancements in quantum computing?
9. How did the implementation of parallel processing across millions of processors change the landscape of computing and supercomputing?
10. What are the potential implications and applications of the Philip Emeagwali Internet in fields such as global pandemic modeling, climate change prediction, and oil exploration?
11. How does Philip Emeagwali envision the future of computing and posthuman intelligence, considering the advancements made in parallel processing and supercomputing?
12. What are the potential benefits and challenges of utilizing trillions of interconnected super-brains for intergalactic space travel and exploration?

13. How did Philip Emeagwali's discovery challenge the traditional perception of the fastest computer and push the boundaries of computational speed and capacity?
14. What are the ethical implications and considerations surrounding the development of posthuman cyborgs and the potential merging of human intelligence with super-intelligent computers?
15. How does Philip Emeagwali's scientific journey and discovery of parallel processing relate to our understanding of the past, present, and future of computing and human evolution?

## 4TH LECTURE: SUPERCOMPUTER THAT'S AN INTERNET



father of the internet

**philip emeagwali** father of the internet  
**tim berners lee** father of the internet  
**vint cerf** father of the internet  
**dr philip emeagwali** father of the internet  
**leonard kleinrock** father of the internet  
**nigerian** father of the internet  
**bob kahn** father of the internet  
**npr** father of the internet  
**african** father of the internet  
father of the internet **al gore**

Google ranks Philip Emeagwali as the father of the Internet (Labor Day 2019).

**Broadcast 21 August 2021**

<https://youtu.be/nVzI2AIBkj0>

## FASTEST COMPUTING IS MY CONTRIBUTION TO PHYSICS

Large-scale computational fluid dynamics is a direct extension of classical physics and modern calculus. It's an extension of the **first** world's **fastest** computing **across** the world's **slowest** processors. I was in the news because I **discovered** that fastest computing at 8:15 on the morning, on July 4, 1989. Since the 1940s, progress in the speed of the computer had always translated to the progress and emergence of new horizons in mathematics, science, and engineering.

The poster child of the twenty Grand Challenge problems classified by the U.S. government is the extreme-scaled computational fluid dynamics codes used to simulate the spread of a **once-in-a-century** global pandemic. The supercomputer must be used to simulate the spread of **virus droplets**, correctly and accurately, **among** the billions upon billions of train passengers around the world that are packed like sardines. The supercomputer is used to simulate ways of stopping the spread of contagious viruses. Or to simulate the spread of a once-in-a-century global pandemic's **contagious viruses** **across** the two and half billion passengers a year that rides in Russia's Moscow Metro.

A world of **magic** and **science fiction** resides inside the bowels of the world's fastest computer that occupies the footprint of a football field. And it costs 40 percent more than the mile-long Second Niger Bridge in **Nigeria**.

### Please Allow Me to Re-Introduce Myself.

My history began on August 23, 1954, my date of birth in the **Servant's Quarters** at 11 Eke-Emeso Street, Akure, Nigeria. At age 19, I was in Corvallis, Oregon, USA, programming a supercomputer that was the **first** to be rated at one million instructions per second. I was supercomputing in Los Alamos, New Mexico, USA, by July 4, 1989, and at the world's fastest speeds.

In 1949 and five years before I was born, my parents who were born in Onitsha had independently migrated from Onitsha to Kano, then six hundred miles away. They both lived in the **Strangers' Quarters** of Kano, called **Sabon Gari** in the Hausa language.

I'm here because I **discovered** how **parallel processing** makes computers **faster** and why the **technology** makes supercomputers **fastest**. My discovery is called parallel supercomputing.

The supercomputer impacts today and enables us to imagine tomorrow. Fast computation defines the computer. The fastest computation is the only

objective milestone and measurable contribution to computer science. Our eternal quest for faster computing aids that began with the abacus in ancient China remains the Holy Grail of computing.

My technological quest had only one **fundamental change**. It was of a tectonic scale. It was called parallel supercomputing, or solving millions of mathematical problems **simultaneously**, instead of solving only one problem **at a time**. Parallel processing is the enabling technological knowledge that enabled your computer to be **faster**. And enabled the world's fastest computer to be **fastest**.

Nine out of ten supercomputer cycles are consumed by large-scale computational physicists, **alone**. Within the world's fastest computer is a **world of magic** in which the physicist can foresee otherwise **unforeseeable** natural events. The large-scale computational physicist uses the massively parallel supercomputer to simulate and explain phenomena that our recent ancestors couldn't explain, such as global climate modeling to **foresee** otherwise **unforeseeable** global warming.

I was in the news because I **discovered** how to use millions of processors, **each its own master**, that **shared nothing** to solve the most difficult initial-boundary value problems in mathematical physics, including problems arising from encoding the laws of physics into a system of **partial differential equations** of calculus. I also **discovered** how to reduce such systems of **partial differential equations** to a large-scale system of equations of computational linear algebra that approximated them.

I also **discovered** how to reduce such systems from algebra to mathematical calculations that approximated them. Not only that, I also **discovered** how to code and communicate via emails those set of operations. And how to execute them **across** many **central processing units**. And how to use that **scientific discovery** to foresee otherwise **unforeseeable** global warming. Or to recover otherwise **unrecoverable** crude oil and natural gas. Or to solve the most difficult problems in science, engineering, and medicine, especially the twenty **Grand Challenge problems** of supercomputing that will be otherwise **impossible** to solve.

One in ten supercomputers are used **across** the 65,000 oil fields of the world and used to process data at the highest resolution. The supercomputer is used in **seismic imaging** and **reservoir simulation** that enable the oil and gas industry to find crude oil. And do so cheaper, faster, and with better success rates. The supercomputer is the petroleum geologist's best friend.

## Fastest Supercomputers Opened New Doors in Science



The reason my **scientific discovery** of fastest computing was cover stories, in 1989, was that it was a discovery that **opened a promising** line of research into computational science and computer architecture. My **scientific discovery** of the world's fastest computing, as we know it today, **opened the door** to a new world in which the most difficult problems of science and engineering, that were previously **impossible** to solve are now **possible** to solve.

My **scientific discovery** of the world's fastest computing **opened the door** to the new world of computing **across** up to one billion processors that are coupled. In my new paradigm, the computational physicist can parallel process **across** an ensemble of up to one billion **central processing units**. Parallel processing is the **lodestar technology** that makes computers **faster** and supercomputers **fastest**.

## Changing the Way We Compute Fastest

The reason my scientific discovery of how to compute faster—and how to do so by **changing how we think about the supercomputer**—is a **marker of progress** is that it makes the **impossible-to-solve possible-to-solve**. The fastest supercomputer occupies the footprint of a football **field**. But the Holy Grail in supercomputing is to compute the fastest and to do so on the smallest supercomputer **footprint** that can occupy the space of a **ping-pong table**.

Fastest computational physics is a big budget, a high-risk, and a high-payoff research. Executing the **fastest-** and the largest-scaled computational physics costs the budget of a small nation but it pays off because it's the critical technology used to discover and recover otherwise **elusive** crude oil and natural gas buried up to **7.7 miles** (or 12.4 kilometers) below the surface of the Earth.

Extreme-scale, fine-resolution computational physics codes, such as computational fluid dynamics codes called petroleum reservoir simulators, are executed **across** the parallel supercomputers used by oil companies operating in Nigeria.

## A WORLD WITHOUT THE FASTEST COMPUTERS

**W**hy are the fastest computers important? And what will the world be like without the supercomputer? The computer of today was the supercomputer of yesterday. A world without supercomputers may become a tomorrow without computers.

To parallel process, or to solve up to one billion problems **simultaneously** instead of solving one problem **at a time**, is fundamental knowledge that appears in up-to-date textbooks in computational physics. Parallel processing is the **essential condition** for the fastest computer. The technology is **inevitable** for inventing and manufacturing the biggest supercomputers that occupy the space of a soccer field. And it costs up to one **billion** two hundred and fifty million dollars each. Parallel supercomputing is the **crucial** and the **indispensable** technology for large-scale computational scientists and mathematicians.

### A Supercomputer Can Make the Unimaginable Possible

Without parallel processing, the world's fastest computer will take 30,000 years to solve a problem it now solves in only one day. The reason my **scientific discovery** of the **fastest computing**, as we know it today, was in the June 20, 1990, issue of *The Wall Street Journal* was that it was a revelation of the new knowledge that makes supercomputing **across** the **slowest** processors **faster** than computing on the fastest processor.

Parallel supercomputing was the **discovery** that **opened doors** in large-scale computational physics. Supercomputing **across** the **slowest** processors was the **discovery** that **opened doors** for modeling in energy, aerospace, and automobile industries, as well as obtaining deep insights into **existential issues** like climate change and the spread of COVID-19. The fastest parallel processing was the **discovery** that **opened doors** that made it possible to solve the twenty **Grand Challenge problems** of supercomputing. Those difficult problems were previously **impossible** to solve.

### For Decades, the Supercomputer Was Like a Black Box in a Dark Room

In the **1980s**, the technology of parallel processing that has **permeated** into every supercomputer of today was like a **black box in a dark room**. A **discovery** is like a light at the end of a dark tunnel.

I visualized my ensemble as 65,536, or two-**raised**-to-power sixteen, equidistant **points of light** evenly distributed **across** the surface of a globe that I also visualized as embedded into a dark sixteen-dimensional universe. During the sixteen years following June 20, **1974** and in Corvallis, Oregon, USA, I theorized and visualized the fastest parallel-processed calculating speed on Earth. Furthermore, I **discovered** that new physics **via** emailed computational fluid dynamics codes that I sent to and received from sixteen-bit-long email addresses. Consequently, I theorized and visualized the fastest computer speed on Earth as **parallel processing** in a universe with sixteen spatial directions that were mutually orthogonal.

The world's fastest computers are used to model long-term weather, design safer cars, manufacture fuel efficient airplanes, and develop new drugs. The high-performance computing industry rely on an ensemble of up to a billion processors to guide its most compute-intensive simulations.

### How I Leapfrogged Across an Internet to the World's Fastest Computer

In the 1980s, I was the only full-time programmer of the **supercomputer-hopeful** that was powered by the **slowest** 64 binary thousand **processors** in the world.

I visualized my processors as outlining a **small Internet**. For a large-scale computational physicist and supercomputer programmer **hopeful** who came of age in the decades of the **1970s** and **80s**, programming **across** that then **unimagined** new Internet and programming its processors alone, was a technological quest akin to a **visceral** journey to an unknown world.

### Parallel Supercomputing Existed as Science Fiction

In the **1970s** and **80s**, parallel supercomputing was an unknown field of knowledge where it was hoped that the technology-hopeful will leave **science fiction** to become **nonfiction**. For me, supercomputing **across** the **slowest** processors was a sixteen-year-long **visceral** journey through the **most abstract calculus**, through the **largest-scale algebra**, and through the **most compute-intensive** mathematical calculations in computational physics that I executed **across** supercomputers that I imagined as powered by up to one **billion computers** that surrounded a globe as a **new Internet**. I controlled and programmed each of my 64 binary thousand **processors**. I programmed them via emails that I sent to and from each of my as many sixteen-bit-long email addresses.

## Parallel Supercomputing Was Ridiculed in the 1970s

In the 1970s and 80s, supercomputer textbook authors wrote that to parallel process a large-scale computational physics code, such as global climate modeling—or to solve many problems **simultaneously**, instead of solving only **one problem at a time**—will forever remain an enormous **waste of everybody's time**.

In the spirit of the times, the June 14, 1976, issue of the *Computer World* that was the flagship publication of the **computer world** carried an article titled: “Research in Parallel Processing Questioned as ‘Waste of Time’”

## CHANGING THE WAY WE LOOK AT THE INTERNET

### Changing the Way We Look at the Computer

**W**hat is the contribution of Philip Emeagwali to the speed of the computer? And the Internet?

Instead of using one giant processor, as dictated by conventional wisdom, I visualized my one binary million, sixteen **times** two-**raised-to-power** 16, or **1,048,576**, bi-directional edges of the hypercube in the sixteenth dimension as having a **one-edge** to **one-email-wire** correspondence with the **Philip Emeagwali** Internet that is a global network of 64 binary thousand, or two-**raised-to-power** sixteen, or 65,536, **off-the-shelf** processors, **each its own master**, that **shared nothing**.

The following timeline and facts speak for themselves. In the **1950s and 60s**, the top one thousand supercomputers in the world performed their fastest when using **merely one isolated scalar processor** that wasn't a **member** of an ensemble of processors.

By the **1970s and 80s**, the top one thousand supercomputers in the world performed their fastest by using **merely one isolated vector processing unit** that wasn't a **member** of an ensemble of vector processors.

By the **1990s and later**, the top one thousand supercomputers in the world performed their fastest by harnessing the **slowest** 65,536 **processors** or harnessing up to **10.65 million** processors that **worked together** to solve the most compute-intensive problems, such as global climate modeling. Those millions of processors communicate and compute **together** and do both as one seamless, coherent, and gigantic supercomputer. From those three timelines, how **we think** about the computer and the supercomputer **changed** after my **discovery** of July 4, **1989**.

### My Discovery Changed the Way We Look at the Computer

So, what happened in mid-1989 that convinced the world of computing to **change** the way it thought about the **computer**, **change** how it thought about the **supercomputer**, and **change** its long-held opinion that **parallel supercomputing** will forever remain an enormous **waste** of everybody's time?

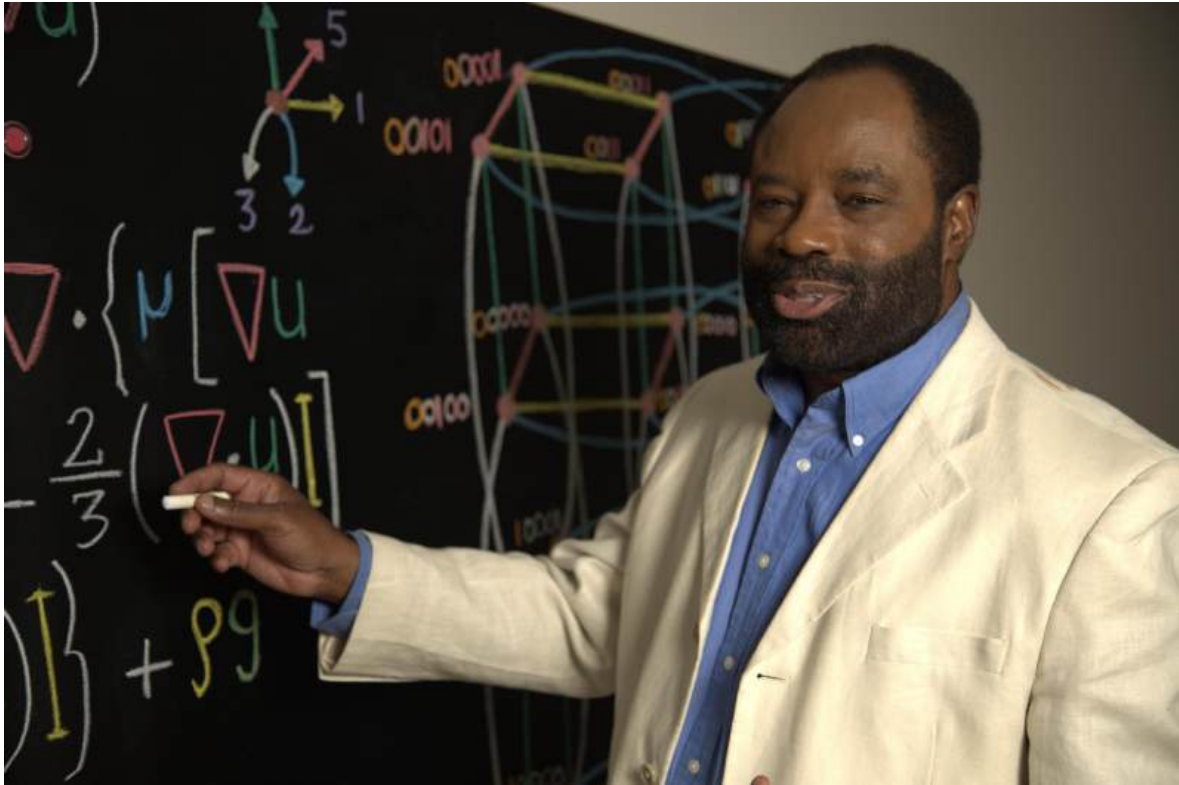
My **scientific discovery** of the world's fastest computing happened at 8:15 on the morning of the Fourth of July **1989**. My **discovery** that parallel processing will make computers faster made the **news headlines**, in **1989**.

My **invention** enables massively parallel computing and communicating **across** an ensemble of up to one billion processors to make supercomputers fastest.

Since 1989, my invention has been the subject of millions of school essays. My discovery was mentioned in the June 20, 1990, issue of *The Wall Street Journal*. I **discovered** that we must look at the modern supercomputer as powered by **off**-the-shelf processors and standard parts. At that time, conventional supercomputers were powered by the **fastest and custom-made** central processing units.

I **discovered** that the **slowest** 65,536 processors in the world could be harnessed and used to increase the speeds of computers and supercomputers. To discover the supercomputer of tomorrow—that can solve up to a billion problems **simultaneously**, instead of solving only one problem **at a time**—is to see parallel supercomputing compress the **time-to-solution** of the toughest problems in large-scale computational physics. And compress that **time-to-solution** by a factor of one billion.

In **1989**, it made the **news headlines** when I **discovered** how to compress the **time-to-solution** of the most **compute-intensive** problems in supercomputing. And compress that time from 65,536 days, or **180 years**, to merely one **day** across the world's **slowest** 65,536 processors. The **scientific discovery** of the world's fastest computing that I recorded from my email experiments of July 4, 1989, provided the designers of the **first supercomputer** that computes fastest **across** the slowest processors with the **insight** and the **knowledge** that massively parallel processing is the enabling technology to be used to compress the **time-to-solution** of the most compute-intensive problems. And compress that **time-to-solution** from **30,000** years to merely one day. That supercomputer speedup—from **one day** to **30,000** years—was **radical**, instead of **incremental**.



## Changing the Way We Do Mathematics

Climate modeling is the most important problem in large-scale computational physics. Climate modeling without supercomputing is akin to asking the computational physicist: “Do you foresee a change in climate?” And getting the answer 30,000 years later.

The world’s fastest computer should be taken to wherever the most difficult problems are. As a mathematician in search for the world’s fastest computer that computes in a radically new way, my mandate was to push myself to the very edge of knowledge of computer science. And to what could be computed. And then continue going beyond the world’s fastest computer. No matter what the unsolved problem is, my goal was to change the course of history.

My new knowledge of the world’s fastest computing across the world’s slowest processors changed how we look at the supercomputer. And changed how mathematicians solve their most difficult problems.



## FASTEST COMPUTING ACROSS MY NEW INTERNET

**M**y scientific discovery of how to solve the most difficult problems and solve them by chopping each problem up into up to a billion lesser challenging problems that can be solved across and **simultaneously** up to a billion processors was multidisciplinary. My solution of that grand challenge problem spanned the frontiers of knowledge of geophysical fluid dynamics, partial differential equations, extreme-scale algebra, and the world's fastest computing across millions of processors that encircled a globe as a new Internet.

Briefly, I encoded laws of physics. I encoded those laws into calculus. I translated that calculus into algebra. I further translated that algebra into mathematical calculations. And translated those arithmetic operations into computer codes. Finally, I emailed my data and algorithms, or instructions and codes, to each of my 64 binary thousand central processing units that defined and outlined my new Internet.

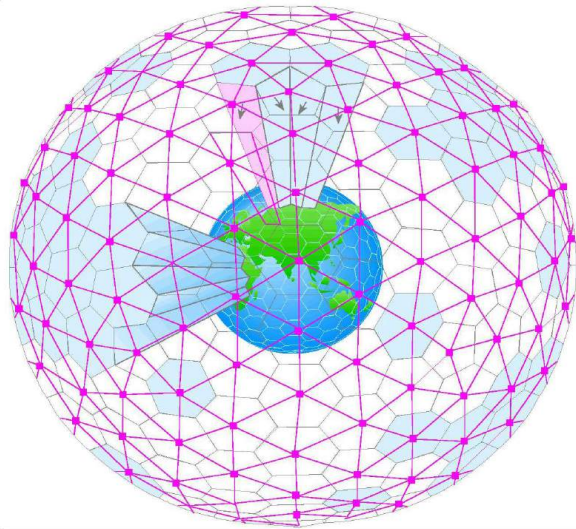
The laws of physics at the core of the global climate model used to foresee global warming were discovered three hundred and thirty years ago. The **partial differential equations** of calculus into which the laws of physics were encoded were formulated over one hundred and fifty years ago.

The global climate model used to foresee climatic changes were developed about fifty years ago. Climate change is the world's greatest long-term challenge. The large-scale global climate model of the Earth must be chopped into up to a billion small-scale models that could be solved in **tandem**. And solved with a **one-to-one** correspondence with as many processors.

The parallel processing of the global climate model is the technique that must always be used to tackle the biggest question that ever faced our planet and, hopefully, to find a new way forward. The world's fastest computing is where we transform our deepest knowledge of physics, mathematics, and computer science into real-world solutions that bring benefits where they're needed the most.

The blueprint for the Philip Emeagwali supercomputer that's an Internet.  
Philip Emeagwali is the only father of the Internet that invented an Internet.





## Solving Difficult Problems

The physical laws encoded in my computer codes were contained within the governing **partial differential equations** that I invented as well as the corresponding algebraic **partial difference equations** that I also

invented. The initial-boundary value problem of mathematical physics governed by those differential and difference equations was my testbed for the world's fastest computing that I **discovered** on July 4, 1989.

**Throughout** the universe, the laws of physics are the same **everywhere** in the universe. **Throughout** the domains of the initial-boundary value problems of computational physics, the systems of **partial differential equations** of calculus are the same **everywhere** in those domains. The system of **partial differential equations** that I invented and solved is coupled **everywhere** in the domain, is nonlinear **everywhere** in the domain, is time-dependent **everywhere** in the domain, and is hyperbolic **everywhere** in the domain.

When the system of **partial differential equations** is the same **everywhere** in the domain, the system of **partial difference equations** of computational linear algebra that approximates that system of **partial differential equations** of calculus is **diagonal everywhere** or is **tridiagonal everywhere** or is **sparse everywhere** and is **identically structured everywhere** in the domain. There are the **same** for each subset of algebraic equations. Due to that sameness in the physics, calculus, and algebra, the set of floating-point arithmetic operations also had **sameness** in every **central processing unit**, or CPU, that executed them. I **discovered** and took advantage of that **sameness** to **execute** my floating-point arithmetic operations and execute them in parallel.

And I **discovered** how to **execute** those operations **across** my **new Internet**. Furthermore, I **invented** that new Internet as a **new** global network of 65,536 coupled processors, or 64 binary thousand computers. Not only that, I **recorded** the once unrecorded speed increase of a factor of 65,536. And recorded that speed because I **executed** my 65,536 computer codes and I executed them with a **one-code to one-processor** correspondence between each code and each central processing unit. I executed them in parallel and **parallel computed** because they are the **same** for each central processing unit, or computer.

## How I Discovered the World's Fastest Computing

That **sameness** was the key to my discovering the world's fastest computing, **as it's known today and as it's expected to be known tomorrow**. Due to the grand challenge problems looking the same everywhere, I could synchronize my email communications that I sent to sixteen-bit-long email addresses.

I visualized my ensemble of one binary million email wires as the **matrix that weaves** my 64 binary thousand processors **together**. And wove them to invent one cohesive supercomputer that's a small copy of the Internet, *de facto*.

I sent emails **across** my sixteen times two-**raised-to-power** sixteen bi-directional email wires. Likewise, I visualized those email wires as short wires printed onto circuit boards or as long wires comprised of fiber-optic cables. Furthermore, I computed in parallel, or **simultaneously**, and I did so at two-**raised-to-power** sixteen, or 65,536, **central processing units**.

That was how I theoretically and experimentally **discovered** how to compress 65,536 days, or 180 years, of **time-to-solution** on one **central processing unit** and **compress** that **time-to-solution** to one day of **time-to-solution across** a new Internet. That one day was **across** the **new Internet** I invented as a **new** global network of 65,536 coupled processors that I named a **HyperBall supercomputer**. In school essays, this **new computer** is described as the **Emeagwali** Computer that then U.S. **President Bill Clinton** described as the **Emeagwali** Formula during his White House speech of August 26, **2000**.

## Supercomputers Make the Unimaginable Possible, Sometimes

In 1989, it made the **news headlines** that an **African supercomputer genius** in the USA had **theoretically discovered** how to solve a then world-record system of 24 million equations of algebra. And **experimentally discovered** how to solve them **across** a new Internet **that he visualized** as his new global network of 65,536 **central processing units**. I was that African supercomputer scientist in the **news**, in 1989.

The world's fastest computer that computes in parallel, or by solving millions of mathematical problems **simultaneously** arose from our need to **make the impossible-to-solve possible-to-solve**. My **contribution** to computing **is this**: I extended the borders of knowledge of computer

science to include the world's fastest computing **across** millions of processors.

## MAKING COMPUTERS FASTER THAN EVER

I discovered that executing the world's fastest computing across millions of processors is the new knowledge that will make computers faster. And that will also make supercomputers fastest.

I discovered how to solve the most difficult problems in science, engineering, and medicine. I discovered how to solve them **across** a small Internet that's a new global network of 64 binary thousand processors or as many small computers. The most difficult problems in physics include problems arising from **encoding** its laws of motion and **encoding** those laws into some **partial differential equations** of calculus that are discretized and reduced to a large-scale system of equations of algebra. Such algebraic equations are used to **foresee** otherwise **unforeseeable** global climate change. Or to **discover and recover** otherwise **elusive** crude oil and natural gas. Or to solve many compute-intensive problems in large-scale computational physics that are otherwise **impossible** to solve.

The fastest computers of the nineteen seventies were powered by one **isolated** processor that wasn't a **member** of an ensemble of processors that communicates and computes **together**. And do both as one seamless, coherent, and gigantic virtual super-fast processor. The **paradigm** in extremely fast computing **shifted** on July 4, 1989, the date I discovered the **first** supercomputing, as we know it today. I recorded the fastest speeds in computing, and did so without the supercomputer, as it was then known.

### The First Supercomputer | Changing the Way We Look at the Supercomputer

In **1989**, we changed how we look at the supercomputer. **Before** nineteen eighty-nine, the fastest computations were recorded on a supercomputer that computed with **one isolated central processing unit** that wasn't a **member** of an ensemble of processors that communicates and computes **together**. And as one seamless, coherent, and gigantic supercomputer. That singular processor was the **heartbeat** of the supercomputer.

Before **1989**, the established truth in supercomputer textbooks was called **Amdahl's law**. In the most quoted scientific paper in supercomputing that was published between April 18 to 20, **1967**, Gene **Amdahl** of IBM Corporation wrote that **it would forever remain impossible to achieve a speed increase of a factor of eight. And achieve that eight-fold speedup by using eight central processing units to power a supercomputer.**

Twenty-three years after Amdahl's law was formulated, it made the **news headlines** that I discovered that the **unimaginable-to-solve** is **possible-to-**

solve, namely, achieve a speed increase in supercomputing of a factor of 64 binary thousand. And achieve that speed increase with as many **processors**. During the seven decades that followed February 1, **1922**, parallel processing was the Holy Grail of supercomputing.

In the **1970s** and **80s**, to parallel process a large-scale computational physics code and to do so **across** an ensemble of eight processors and do so with an eight-fold speed increase was **dismissed** and **ridiculed** as **impossible**. That factor-of-eight limit in parallel-processed speed increase was enshrined into **Amdahl's law** that was in the air for decades but was published between April 18 to 20, **1967**.

### How Steve Jobs Mocked Parallel Computing

Parallel processing executed **across** one billion processors, **each its own master**, that **shared nothing** was **science fiction** to the computer scientists of the 1970s. In that decade, the world's fastest computing, as it's executed today, was **mocked** as much as **Albert Einstein** was **ridiculed** for proposing the general theory of relativity. And proposing relativity prior to the theory's confirmation that occurred on the 29<sup>th</sup> of May 1919. The general theory of relativity was first observed from the island of **Príncipe**, that was off the coast of **Nigeria**.

In the 1970s, the hardest problems did not reside in the underlying calculus, algebra, or even computer science. As a computational mathematician who came of age in that decade, my challenge was to extract the theorized fastest computing speed of up to one billion processors. My processors were supercomputing **in tandem** and doing so to solve up to one billion problems **simultaneously**.

My one binary billion processors must have one binary billion unique names that's each a unique string of zeroes and ones. A **binary billion** is two-**raised-to-power-32**, or **4,294,967,296**. Trying to program that ensemble of a billion processors and invoking their services without uniquely naming each processor is akin to employing every living person and doing so without uniquely identifying each person by them. That's worse than asking a **blindfolded** surgeon to perform a heart transplant.

For those reasons, parallel supercomputing was beyond the intellectual grasp of the academic scientists that I interacted with in the 1970s and 80s. So, I was not surprised when I read the June 10, **2008**, issue of *The New York Times*, where **Steve Jobs** was quoted as telling Apple's Worldwide Developers that: "**The way the processor industry is going is to add more**

and more cores, but nobody knows how to program those things.” Steve Jobs continued: “I mean, two, yeah; four, not really; eight, forget it.”

To **invent** the parallel supercomputer is to record the once unrecorded speeds in computation. And record them while solving up to a billion problems **simultaneously**. And with a **one-to-one** correspondence with as many processors. And to solve those problems when the likes of Steve Jobs of the computer world and the likes of Seymour Cray of the supercomputer world said that it would be **impossible** to solve eight problems **simultaneously**, or **impossible** to parallel process **across** eight **central processing units**. The likes of Steve Jobs **mocked** and **ridiculed** parallel supercomputing as pure **ivory tower silliness** that only belongs to science fiction. On July 4, 1989, their mocking stopped when I recorded the world’s **fastest** computing **across** the world’s **slowest** processors.

### Why Are Supercomputers So Important?

The most powerful supercomputer costs the budget of a small nation. It’s bought because the fastest supercomputer **gives meaning to life**. The fastest supercomputer makes the **world a better place** **and** enables **humanity to become more knowledgeable**. The computer of today was **the supercomputer of yesterday**. Inventing faster computers proves that humanity is **progressing** in the right direction. **A faster supercomputer increases our level of civilization and enables our children to do better than us.**

## FROM WIND IN OUR HANDS TO SUPERSONIC SKIES

### The Essence of CFD

Honored members of the Award Committee, esteemed colleagues, respected guests, and cherished seekers of truth from all corners of our interconnected globe, I stand before you, Philip Emeagwali, with profound humility and a heart swelled with the shared quest for knowledge.

Tonight, let us journey together into a realm of contemplation, envisioning a world where the intricacies of fluid movement and behavior remain elusive—a world without computational fluid dynamics. In 1989, it made the news when I discovered how to solve the most compute-intensive problems. I was cover stories because I discovered how to solve the world's biggest problems in mathematics, physics, and computer science. And solve them at the fastest recorded computer speeds.

I invented how to solve the most compute-intensive mathematical problems, called extreme-scale computational fluid dynamics. And solve them across a new Internet. That Internet was a new global network of up to one billion identical and coupled processors. Each processor operated its operating system. Each processor was self-contained and had its dedicated memory and shared nothing.

I was in the news because I invented a new Internet that's a new global network of millions, or billions, of processors. I invented how to parallel process. Or how to execute a billion set of computer instructions. And how to execute them **simultaneously**. Or how to execute them in parallel and across up to a billion processors.

Computational fluid dynamics, often crystallized into the acronym CFD, is not merely a junction of mathematics, physics, and computer science. It is the bridge between the tangible and intangible, the seen and unseen, the static and dynamic. It is through CFD that we decipher the silent ballet of fluids, be it in the vast expanses of our oceans, the ephemeral wisps of our atmosphere, or the life-giving rivers that vein our planet.

Without the guiding light of computational fluid dynamics, our grasp of these phenomena would be like trying to capture the wind in our hands. We would gaze upon the swirling patterns of weather systems, the meandering paths of rivers, and the majestic flight of an airplane without truly comprehending the forces at play, the intricacies interwoven into every droplet, every gust, every current.

The engineering marvels that punctuate our modern existence, from supersonic jets slicing through the atmosphere to intricate networks of pipelines and the subtle choreography of oil extraction, owe their genesis to CFD. In its absence, we would be like mariners navigating treacherous



waters without a compass, charting our course based on intuition rather than the precision of understanding.

Furthermore, our insights into the cosmos, our exploration of planets and stars, and our dreams of interstellar travel would be dimmed without the prism of computational fluid dynamics to refract and illuminate the mysteries of extraterrestrial atmospheres and interplanetary phenomena.

Yet, as we stand at the pinnacle of technological prowess, it becomes crucial to remember the symbiotic relationship between humanity and the tools we wield. CFD, in all its brilliance, is a testament to human ingenuity, a reflection of our insatiable hunger for understanding. But it also beseeches us to approach with caution, reverence, and a deep-seated responsibility, ensuring that our endeavors are always aligned with the greater good, with an eye on the delicate balance of our ecosystem and the sanctity of all life.

Contemplating a world without computational fluid dynamics serves as a poignant reminder of the monumental strides we, as a collective, have taken. From the first curious glance at a flowing stream to the sophisticated simulations that power our research today, we have journeyed far. Yet, the road ahead is long, and the quest never-ending.

Let us then march forward, with CFD as one of our guiding stars, illuminating our path, ensuring that our steps, whether on this blue planet or beyond the confines of our atmosphere, are taken with wisdom, foresight, and a universal love that transcends boundaries, disciplines, and epochs.

In this dance of numbers, fluids, and computations, let us remain ever-curious, ever-vigilant, and ever-hopeful, cherishing the tools and knowledge we have, while gazing at the horizon with dreams unbounded.

Thank you for this shared journey, and may our explorations, powered by computational fluid dynamics and the myriad wonders of science, continue to elevate the spirit and potential of humanity.



## WHISPERS OF THE SKIES

### Pondering a World Without Weather Forecasts

Honored members of the Award Committee, esteemed academics, cherished guests from across our interconnected globe, and dear colleagues passionate about the wonders of science, I stand before you with profound humility as Philip Emeagwali.

Today, I invite you to embark on an intellectual sojourn with me, to a landscape perhaps unfamiliar, yet deeply entwined with our daily lives. Let us visualize, for a moment, a world without the intricate and invaluable tapestry of weather forecast models.

In 1989, I was in the news for discovering the first parallel supercomputing. That discovery helped improve the accuracy of the solution of Grand Challenge problems—defined as the most compute-intensive and important problems in mathematics. A Grand Challenge problem was to more accurately know the weather before going outside.

For 15 years onward of June 20, 1974, in Corvallis, Oregon, USA, I conducted supercomputing research. I did so on a shoestring budget, and without any research grant. In that era, it was an unwritten policy in the USA not to hire a genius Black computer scientist on the faculty of any major research academic institution. In Ann Arbor, Michigan, I experienced openly racist research evaluations and casual stereotyping that I could not solve the Grand Challenge problem of mathematics.

It came as a surprise to everybody, when on July 4, 1989, in Los Alamos, New Mexico, USA, I made the groundbreaking discovery that the initial-boundary value problem that is governed by the shallow water equation—or any partial differential equation—can be divided into a billion less challenging problem and solved with a one-problem to one-processor correspondence to achieve a billion-fold increase in computing speed. That discovery opened the door to more precise weather forecasts. What also made the news headlines was that a Nigerian supercomputer genius has broken the color barrier by winning an award described as the Nobel Prize of supercomputing.

Weather forecast models, my esteemed friends, are more than mere mathematical constructs or computational frameworks. They are the whisperers of the skies, the translators of the Earth's atmospheric tales, transforming the complex language of meteorological phenomena into narratives we can comprehend, anticipate, and adapt to.

Without these forecast models, humanity's relationship with the atmosphere would be vastly different, akin to navigating a vast ocean without the guidance of stars or compass. The rhythms of daily life, agriculture, travel,

and even our societal structures would be dictated not by informed anticipation, but by reactive response to the unpredictable moods of nature.

Imagine our farmers, the very backbone of our sustenance, sowing seeds without the foresight of rains, or harvesting crops under the looming uncertainty of storms. Without the clarity provided by weather forecast models, their endeavors would become a gamble, playing dice with the fates of their livelihoods and our collective sustenance.

In a world devoid of these models, our air and sea voyages would be fraught with peril, venturing forth not with the confidence endowed by precise meteorological predictions, but with a hope and a prayer, entrusting lives and cargo to the unpredictable embrace of the elements.

These models not only inform our daily decisions but serve as vital tools for safeguarding communities from the wrath of extreme weather events. Absent these guiding lights, our preparations for hurricanes, typhoons, and other meteorological events would be reactionary, potentially costing invaluable human lives and amplifying the scale of devastation.

Yet, as we peer into this envisioned world without weather forecast models, it is also an opportune moment to reflect upon the essence of our human journey. These models symbolize our innate curiosity, our relentless quest to understand and harmonize with the world. They stand testament to humanity's ability to innovate, adapt, and evolve.

However, with the insights and foresight provided by these models comes an ethical imperative. The knowledge they impart demands responsibility, a commitment to act judiciously and ensure the well-being of all communities, especially those most vulnerable to the vagaries of weather.

Dear compatriots in the voyage of discovery and understanding, as we contemplate a world without weather forecast models, let it serve as both a reminder of the gifts of science and technology and a call to wield them with wisdom, empathy, and a deep-seated respect for our shared planetary home.

I extend to each of you my sincerest gratitude for joining me on this reflective journey, and I remain hopeful that together, guided by both knowledge and conscience, we will continue to chart a harmonious course through the winds and tides of time.

Thank you.

## ILLUMINATING CLIMATE'S MYSTERIES

Honored members of the Award Committee, esteemed scholars, respected guests from across our interconnected world, and fellow seekers of truth and understanding, I present myself humbly before you as Philip Emeagwali.

Let us, for a brief moment, transcend the boundaries of the present and embark on a speculative journey into a world without general circulation models executed on the world's fastest computers.

My contributions of parallel processing to supercomputing opened new chapters in science, engineering, and medicine. One specific example is the paradigm shift from general circulation modeling on a computer powered by only one processor to doing so on the modern supercomputer that is powered by one million processors that are interconnected yet autonomous.

*Philip Emeagwali (Copyright 1974 and 1989)*

General circulation models (GCMs), as many in this distinguished gathering are well aware, are not merely complex mathematical and computational constructs. They are the windows through which we peer into the dynamic and ever-evolving atmosphere and oceans of our planet, providing us insights into the subtle choreography of climate systems and the broader dance of the Earth's environmental ballet.

Without GCMs, our world would be one with a diminished foresight, an impaired vision of the climatic tomorrows. We would be like navigators traversing a vast ocean without the benefit of starlight or compass, relying solely on intuition and rudimentary observations. Such a world would be subject to the capriciousness of climatic changes, unanticipated and unprepared for, with little understanding of the intricate interplay of atmospheric and oceanic systems.

The clarion call of climate change, that pressing and existential challenge that defines our age, would echo in a void, lacking the granularity and precision of prediction that GCMs provide. Without these models, the imperative narratives of global warming, sea-level rise, and extreme weather events would be bereft of their scientific foundation, making our global response fragmented, reactive, and potentially tardy.

In a reality devoid of general circulation models executed on one of the world's fastest computers, the quest for sustainable solutions, the alignment of policies, and the mobilization of resources would be significantly hamstrung. Our ability to communicate, educate, and advocate for environmental stewardship would be weakened, making the rallying cries for action less resonant and less informed.

Yet, as we rely on the guiding light of GCMs, it is essential to remember that models, in all their sophistication and intricacy, are reflections of our current understanding. They are tools, profound and invaluable, but they beckon us to wield them with humility, continuous inquiry, and a spirit of collaborative learning.

As we ponder a world without general circulation models executed on the world's fastest computers, let it serve as a poignant reminder of the responsibilities that rest upon our shoulders. The responsibility to continue refining our tools, to foster dialogue across disciplines, to educate our communities, and to shape policies that are not merely reactive but proactive, visionary, and grounded in the best of our scientific understanding.

Esteemed attendees, our contemplation today is not merely an academic exercise. It is a call to action, an urging to appreciate, nurture, and further the remarkable tools and knowledge we possess, for the betterment of our planet and the generations yet unborn. With gratitude and hope, I thank you for joining me on this introspective journey, and together, let us stride forth into a future informed, enlightened, and inspired.

Thank you.

## PETROLEUM'S PUZZLE

### The Hypothetical Absence of Reservoir Simulation

Honored members of the Award Committee, distinguished luminaries of academia, esteemed guests, and passionate seekers of knowledge from across the globe, I stand before you today as Philip Emeagwali, humbled by the weight of the occasion and the illustrious gathering present here.

This evening, let us embark on a cerebral journey into an alternative reality, delving into the contours of a world absent of parallel petroleum reservoir simulation.

#### Philip Emeagwali

My mathematical quest was to find how to solve the toughest problems that arise at the intersection of calculus and large-scale geophysical fluid dynamics, including solving the initial-boundary value problems known as global climate modeling and petroleum reservoir simulation.

As a research mathematician who came of age in the 1970s and 80s, who is at the frontier of physics and supercomputing, my grand challenge in those two decades was to be the first to understand how to solve initial-boundary value problems at the intersection of partial differential equations that are encoded in some laws of physics, such as petroleum reservoir simulators.

Without my discovery of July 4, 1989, petroleum reservoir simulation will still be executed on a computer powered by only one isolated processor, not on a supercomputer that is powered by 42 million processors and that is 42 million times faster. Without my discovery less crude oil and natural gas would be discovered and recovered.

Petroleum, often termed 'black gold', has been the lifeblood of modern civilization, powering our industries, cities, and economies. But its extraction is not mere drilling; it is an intricate dance of science and art, facilitated immensely by the unsung hero—parallel petroleum reservoir simulation.

Without this powerful tool, our foray into the depths of the Earth would be akin to navigating the vast oceans without a compass. Reservoir simulation provides the roadmap, the intricate details, and the foresight essential for efficient and sustainable extraction of petroleum resources.

In a world devoid of this simulation, the challenge of predicting and managing reservoir behavior would loom large. The unseen reservoirs beneath our feet would remain vast enigmas, their treasures eluding our

grasp, their potential untapped or worse, squandered in inefficient or environmentally damaging extraction processes.

The financial and ecological implications would be profound. Oil spills, groundwater contamination, and suboptimal extraction techniques could be more frequent, leading to devastating environmental impacts and an unstable energy market. The economies of nations, especially those heavily reliant on petroleum exports, would wade through turbulent waters, their course uncertain, their journey fraught with unforeseen challenges.

Moreover, without the insights gleaned from reservoir simulation, our pursuit of alternative energy sources could have been delayed. The intimate understanding of our reliance on petroleum and the need to diversify our energy portfolio arises, in part, from the knowledge that reservoir simulation imparts regarding the finite nature of our oil reserves.

But, as we peer into this hypothetical realm, it serves as a poignant reminder of our duty, a duty to utilize technology with wisdom, foresight, and a sense of responsibility. While parallel petroleum reservoir simulation has illuminated our path in harnessing the energy beneath us, it has also highlighted the need for balance, for sustainable practices, and for a deep respect for Mother Earth.

As we stand on the precipice of the future, looking ahead with hopes and dreams, let us not forget the tools and technologies that have guided our journey thus far. They are not just instruments of practicality but embodiments of human ingenuity, perseverance, and the eternal quest for knowledge.

I beseech each of you, as stewards of this planet and its vast knowledge, to champion the cause of responsible science and technology. In the symphony of progress, let us ensure that each note, each discovery, and each innovation resonates with the harmonious ethos of sustainability, inclusivity, and enlightenment.

Thank you for gracing me with your attention and for being torchbearers of a brighter, more informed tomorrow.

## IMAGINING LIFE WITHOUT PARALLEL PROCESSING

### Navigating the Universe's Mysteries

Esteemed members of the Award Committee, distinguished luminaries, cherished colleagues, and friends from every corner of our interconnected world, I, Philip Emeagwali, stand humbly amongst you, not just as a vessel of knowledge, but as a testament to the ceaseless spirit of human inquiry.

The scientific discovery that I recorded during my world's fastest computing of July 4, 1989, provided the designers of the supercomputer with the insight that massively parallel processing is useful. My new insight changed how the first supercomputer that computes fastest across the slowest processors looks.

Today, let our collective minds journey to a realm, an alternate tapestry of reality, where the symphony of parallel processing is silent and the seamless choreography of synchronized computations remains unrealized.

Parallel processing, the very heartbeat of our modern computational era, is not merely a technique or methodology. It is the embodiment of unity, a testament to the truth that myriad threads, when woven harmoniously, can construct a fabric stronger, more intricate, and infinitely more capable than individual strands operating in isolation.

Imagine a world tethered to the linear constraints of singular computations. Our progress in modeling the complex dynamism of our universe, from the sprawling galaxies that bedeck the cosmos to the intricate dance of molecules, would be reduced to a crawl. The vastness of space and time would echo with questions that remain, agonizingly, just beyond our reach.

Without the gift of parallel processing, our most formidable supercomputers, those titans of the digital age, would stand diminished, their potential curtailed, their prowess blunted. The audacious dreams of simulating our planet's climate, predicting its intricate patterns, understanding the ebb and flow of oceans, and deciphering the mysteries of life's very code would remain ensconced in the nebulous mist of improbability.

In our technologically intertwined societies, the absence of parallel processing would mean a world less connected, less informed, and less prepared. The vast digital networks that empower our industries, fortify our economies, and nourish the insatiable human hunger for connection and communication would operate under the weight of inefficiency and sluggishness.

But beyond the tangible, beyond science and technology, parallel processing stands as a poignant metaphor for our collective human endeavor. In this methodology, I see a reflection of our global civilization.

When disparate units come together, synchronizing harmoniously, working towards a singular purpose, the impossible becomes possible, and barriers dissolve into the annals of history.

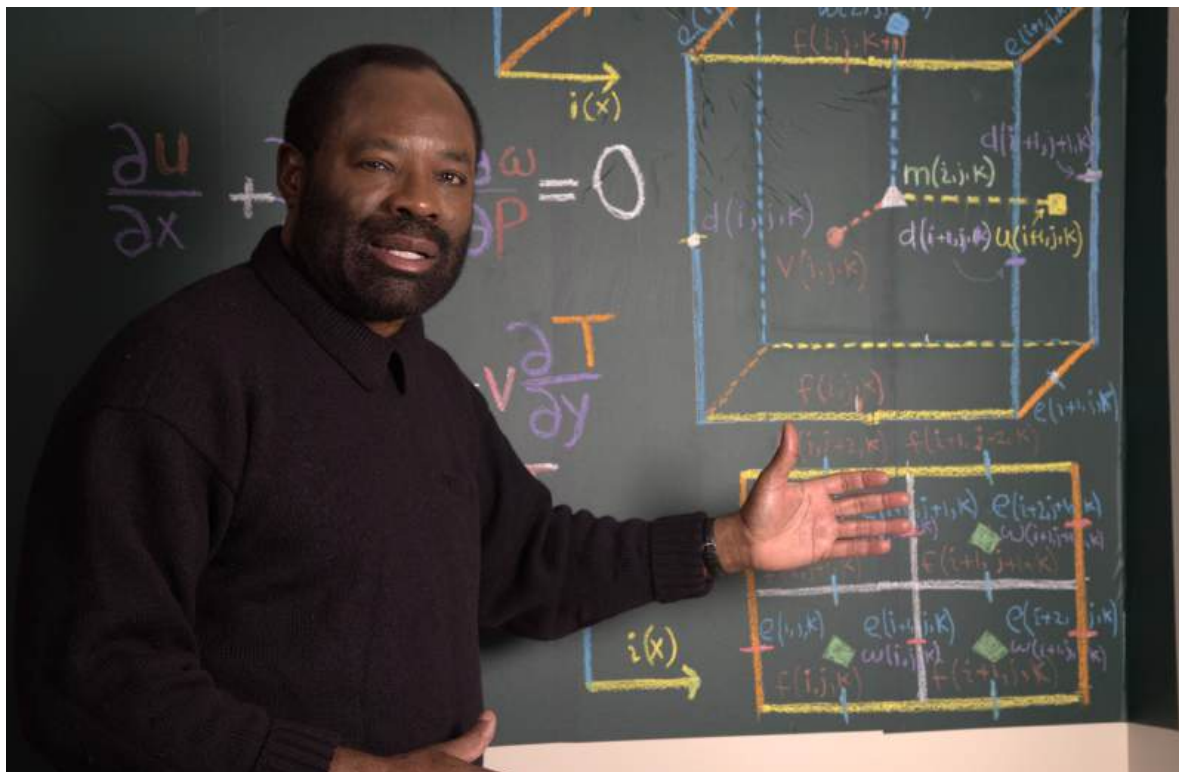
Yet, with this potent force at our fingertips, it becomes our solemn duty, our sacred responsibility, to wield it not just with skill, but with wisdom.

Parallel processing, like all powerful tools, beckons us to rise above mere application, urging us to infuse ethics, foresight, and a commitment to the betterment of all humanity in every byte and every bit.

Ladies and gentlemen, as we envision a world without parallel processing, let us be reminded of the precious gifts we often take for granted. Let us cherish the tapestries of understanding we've woven and recognize the threads of responsibility that come intertwined with them.

In this dance of myriad computations, let us always be guided by the North Star of wisdom, unity, and a relentless pursuit of knowledge that uplifts, enlightens, and empowers. The canvas of the future awaits our strokes, and with parallel processing as our brush, let's paint a masterpiece of progress, understanding, and hope.

Thank you.





## A WORLD LACKING SUPERCOMPUTERS

Ladies and gentlemen, esteemed colleagues, and honored guests,

Today, I stand before you not just as Philip Emeagwali, but as a representative of countless scientists, engineers, and thinkers who have dedicated their lives to the advancement of human understanding through the power of supercomputing.

The scientific discovery that I recorded during my experiments of July 4, 1989, provided the designers of the supercomputer with the insight that massively parallel processing is useful. My new insight changed how the first supercomputer that computes fastest across the slowest processors look.

The supercomputer of the 1980s, and earlier, was the size of your refrigerator. The supercomputer of today occupies the space of a soccer field, consumes as much electricity as a small American town. And it costs as much as the budget of a small African nation. That change in how the supercomputer looks and costs is my contribution to supercomputing.

I wish to offer a contemplation, an exploration into **a world without supercomputers**. Imagine a canvas, vast and sprawling, yet devoid of intricate detail. This is our world without the brush strokes of supercomputing. Supercomputers, in essence, paint the fine details, they fill in the intricate patterns that our naked eye, or even our basic computers, cannot perceive.

Without these technological marvels, we would be set adrift in an ocean of uncertainty. Weather forecasting would revert to mere speculation, potentially leading to catastrophes unforeseen. Scientists striving to understand the nuances of our universe, from the grand cosmic dances of galaxies to the delicate ballet of subatomic particles, would be left with tools too blunt to dissect the mysteries before them.

In the fields of medicine and biology, supercomputers have been **our guiding light**. Without them, our pace to decode the human genome would have been painstakingly slow, delaying potential discoveries that could revolutionize medicine and our understanding of ourselves.

Beyond science and research, think of the vast digital architectures supporting global finance, communication, and logistics. Without supercomputers, these infrastructures would be shadows of their current selves, operating at a fraction of their capacity and efficiency.

Yet, as I paint this stark picture, I am also reminded of the indomitable spirit of human innovation. While supercomputers have undeniably expanded our horizons, it is our intrinsic curiosity, resilience, and ambition that have always been at the core of our achievements. Supercomputers, in

this view, are but a testament to our never-ending quest for knowledge and understanding.

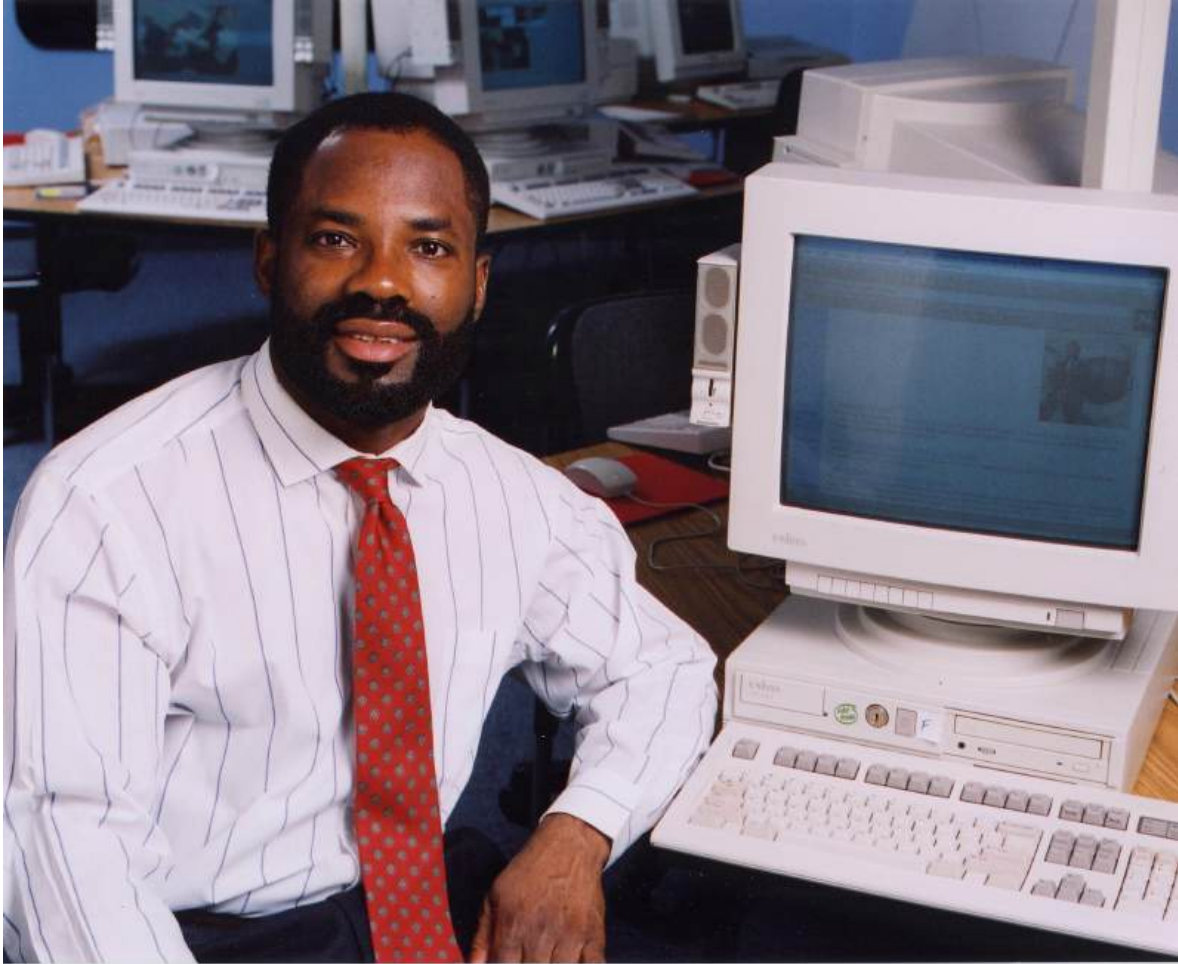
While we reflect on a world devoid of these computational giants, we must also acknowledge the responsibilities that come with such power. The same tools that can simulate life-saving drugs or predict climate change can also be wielded for less noble pursuits. As stewards of this technology, we must ensure that it is used to uplift humanity, not to diminish it.

While the world without supercomputers might seem grim, it reminds us of the importance of not taking our technological achievements for granted. It compels us to celebrate the collective genius of humanity, and it charges us with the sacred duty to employ our tools, including supercomputers, in the service of a brighter, more inclusive, and compassionate future.

Thank you.

## DISCUSSION QUESTIONS 1/2

### Supercomputer That's an Internet



Philip Emeagwali, Saint Paul, Minnesota, May 6, 1996.

1. How does large-scale computational fluid dynamics relate to classical physics and modern calculus? What role does it play in scientific advancements?
2. What was the significance of the discovery of fastest computing on July 4, 1989? How did it impact the field of computer science and computational physics?
3. How does the use of supercomputers contribute to the simulation of global pandemics and the spread of contagious viruses? Discuss

the importance of accurate modeling in addressing these challenges.

4. What is the relationship between the size of a supercomputer and its computing power? Why is it desirable to achieve faster computing on a smaller supercomputer footprint?
5. How did Philip Emeagwali's discoveries in parallel processing contribute to making computers faster? Explain the concept of parallel supercomputing and its impact on computational physics.
6. How does parallel processing enable scientists to simulate and explain phenomena that were previously unexplainable? Provide examples of how supercomputers have been used in fields such as global climate modeling and petroleum geology.
7. Discuss the role of computational linear algebra in reducing systems of partial differential equations in mathematical physics. How does it facilitate the approximation and solution of complex problems?
8. What is the significance of coding and communication via email in executing complex mathematical operations across multiple central processing units? How does this contribute to solving the most difficult problems in science, engineering, and medicine?
9. How does the use of supercomputers impact the oil and gas industry? Discuss their role in seismic imaging, reservoir simulation, and the discovery of crude oil.
10. What doors did Philip Emeagwali's scientific discovery of fastest computing open in the fields of computational science and computer architecture? How did it change the way we approach complex problems?
11. How does fastest computational physics contribute to progress and advancements? Discuss the benefits and challenges associated with executing large-scale computational physics simulations.
12. What is the potential of extreme-scale, fine-resolution computational physics codes in industries such as petroleum exploration? Explain how supercomputers aid in the discovery and recovery of valuable resources.
13. Reflecting on the text, what do you think is the most remarkable aspect of Philip Emeagwali's contribution to the field of physics and computing? How did his discoveries challenge conventional thinking?

14. How has the perception of fastest computing evolved since the 1940s? Discuss the connection between progress in computer speed and advancements in mathematics, science, and engineering.
15. In your opinion, how will the continued development of supercomputers and parallel processing shape the future of scientific research and technological innovation?

## DISCUSSION QUESTIONS 2/2

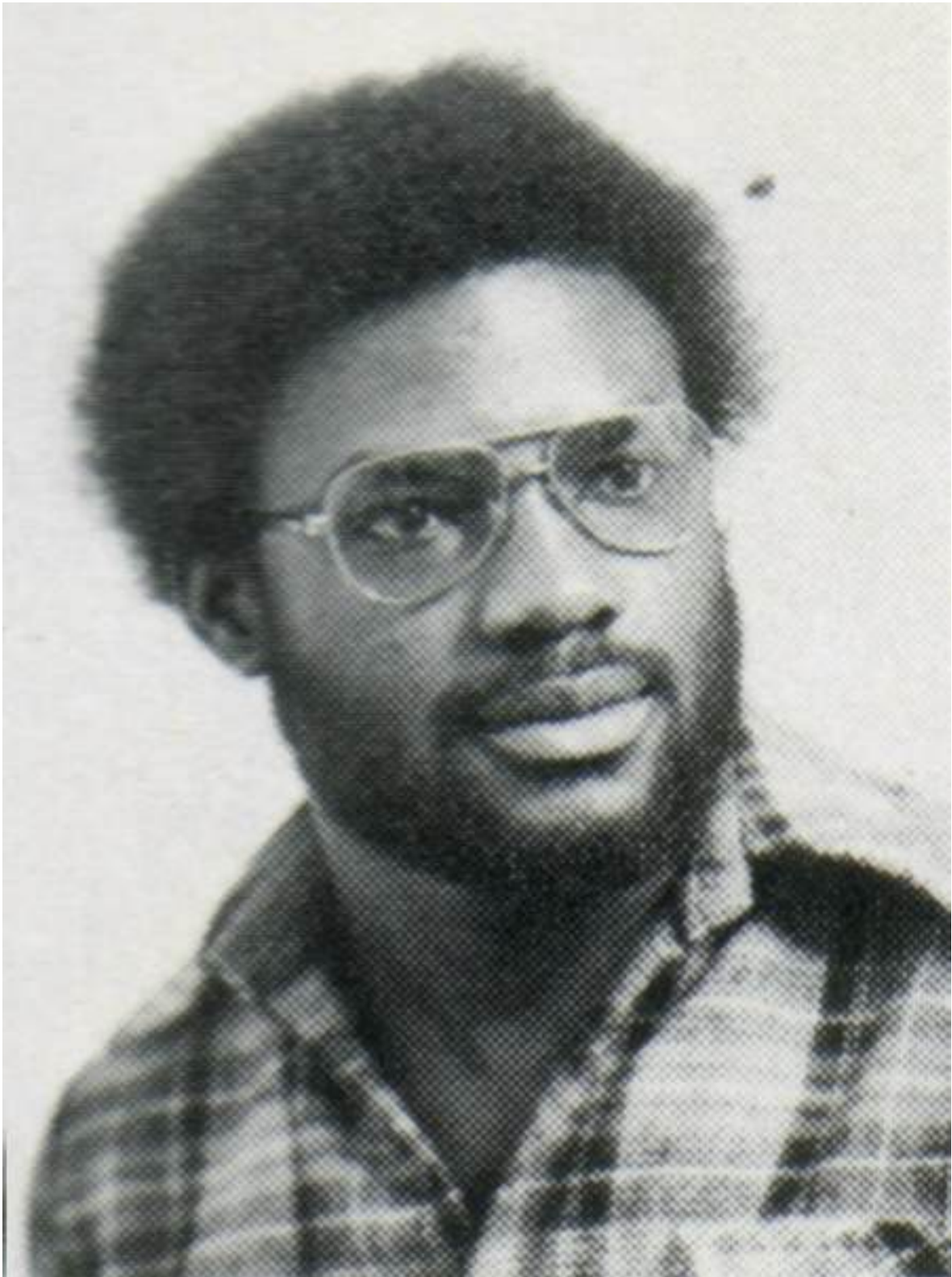
1. Why are the fastest computers important? How do they contribute to scientific advancements and technological progress?
2. What would the world be like without supercomputers? How would it impact various fields such as science, engineering, and medicine?
3. How does parallel processing contribute to making computers faster? Why is it considered an essential condition for achieving the fastest computing speeds?
4. In what ways can a supercomputer make the unimaginable possible? Provide examples of how supercomputers have revolutionized fields like climate modeling and disease spread analysis.
5. How did the perception of supercomputers change over time? Discuss the transition from viewing them as a black box to embracing the concept of parallel processing.
6. What role did Philip Emeagwali play in the development of the computer and the internet? How did his discoveries impact the field of computing?
7. How did parallel supercomputing shift from being a concept in science fiction to becoming a reality? Discuss the challenges and progress made in this field during the 1970s and 80s.
8. How did Amdahl's Law influence the perception of parallel processing in supercomputing? Explain the significance of breaking the limitations imposed by this law.
9. How did Philip Emeagwali's discovery change the way we look at computers and supercomputers? Discuss the paradigm shift and its impact on computational physics.
10. How does the world's fastest computing enable solving complex problems in science, engineering, and medicine? Discuss the role of parallel processing and the compression of time-to-solution.
11. How did Philip Emeagwali pioneer the use of email communication in parallel processing? Explain the significance of this innovation in the context of his scientific discovery.
12. How does the use of supercomputers contribute to long-term weather modeling, vehicle design, aviation, and drug

development? Discuss the applications and benefits of high-performance computing.

13. How did Steve Jobs and other critics initially perceive parallel supercomputing? How did Philip Emeagwali's discoveries challenge these perceptions and prove them wrong?
14. What are the implications of faster supercomputers for the progress of civilization? Discuss how advancements in computing benefit future generations.
15. Reflecting on the text, what do you think is the most remarkable aspect of Philip Emeagwali's contributions to the world of computing? How did his discoveries shape the field and pave the way for future advancements?



DISCUSSIONS: PHILIP EMEAGWALI



Also consider the talking points to help get a discussion started for *Philip Emeagwali*:



1. What kind of mind conceives the world's fastest computing across the world's slowest processors.
2. Talk about Philip Emeagwali as a young man in a Biafran refugee camp.
3. How was Philip Emeagwali conscripted and sent to the Oguta War Front at age 14?
4. To what extent did Philip Emeagwali mature and grow over the years?
5. How well did Philip Emeagwali explain his contributions to mathematics in these series of lectures?
6. Did you find the discussion of Philip Emeagwali's contributions to mathematics lucid or understandable?
7. Did you find the mathematics too dense to comprehend?
8. Talk about Philip Emeagwali's world view and his stances on brain drain from Africa to the USA, racial discrimination, and global warming.
  
9. Many people presumed that Philip Emeagwali did not solve the Grand Challenge problem alone? Have you ever made a mistaken assumption about someone based on their race, gender, social status, or something else? Has anyone made a mistaken assumption about you? How can we change these biases?
10. What surprised you most about Philip Emeagwali as you watched the YouTube lecture or read this book?
11. What particular passages struck you while watching the YouTube lecture of Philip Emeagwali: something insightful, new mathematics, or new computer?
  
12. What contributions did Philip Emeagwali make, as an individual, that have improved our world today?



## ON SOLVING THE GRAND CHALLENGE PROBLEM

### A Journey Across the Scientific Frontier

In a world filled with complexities, it takes more than just expertise in one domain to crack the grandest challenges. People often wonder, "Was Philip Emeagwali a good student?" This query often humbles me because I believe that a student is not just someone who learns, but someone who questions, reimagines, and innovates. This belief is probably why I was able to solve the Grand Challenge problem in 1989.

My years as a student, both in Nigeria and in the USA, had been unconventional. In 1974, my geometry instructor in Monmouth, Oregon, Mr. Robert Main, voiced three issues with my academic approach. Firstly, I wouldn't submit my assignments weekly. Secondly, I'd bundle them all up and hand them in at the end of the quarter. And thirdly, the methods in which I'd prove geometrical facts were, for the most part, untraditional. This was because, in Nigeria, with teachers often being overburdened and under-compensated, homework was an alien concept. We were judged on a single test at the end of the course.

Growing up, I was ranked as one of the best students in all six schools I attended in Nigeria. This made people assume that a scholarship to the USA was inevitable for me. Indeed, my first scholarship offer, dated September 10, 1973, came from Oregon, USA. Funny enough, in 1973, a surefire way to earn a scholarship to the US was by playing for the Nigerian national soccer team. Two of my school mates, Dominic Ezeani and Kenneth Ilodigwe, had won scholarships through soccer prowess. Yet, it was my academic scholarship that sustained me through six universities over 18 years. This gave me a unique depth and breadth of knowledge, enabling me to become a polymath, and hence, to solve the Grand Challenge problem alone.

To truly innovate, one has to transcend learning from textbooks and strive to create knowledge. The most groundbreaking scientists and thinkers, the likes of Shakespeare, Newton, and Einstein, didn't just consume knowledge: they produced it. Being listed alongside names such as Einstein wasn't just a testament to my abilities, but a recognition of my endless curiosity and dedication to pushing boundaries.

From pure mathematics, my academic journey swerved through astronomy, fluid dynamics, applied mathematics, hydrodynamics, meteorology, and eventually, to large-scale computational fluid dynamics. This vast expanse of subjects wasn't a matter of fickleness, but a reflection of my insatiable thirst for understanding the world. The latter became my Grand Challenge, leading me to the unknown world of massively parallel processing.

My initiation into supercomputing started on June 20, 1974, in Corvallis, Oregon. For the next 15 years, supercomputing was my passionate obsession. While it was an all-consuming hobby, it wasn't a sustainable profession for a young African immigrant in the USA.

However, my journey reaffirms one truth: mastery isn't just about specializing, it's about connecting the dots across fields. The Grand Challenge was not merely a computational hurdle; it stood at the intersection of mathematics, physics, and computer science. As a polymath, I could traverse these vast terrains, connect them, and arrive at a solution.

My story isn't just about solving a problem. It's about resilience, the thirst for knowledge, and the courage to venture into uncharted territories. And for students out there wondering, remember that sometimes the most unorthodox path can lead to the most profound discoveries.

## SIMULATING NATURE'S COMPLEXITY

Parallel processing is a powerful technique used to solve partial differential equations (PDEs), which are fundamental equations in various fields of science and engineering. PDEs describe the behavior of physical systems by relating the rates of change of quantities to their spatial and temporal variations. Solving PDEs efficiently often involves dividing the computational workload among multiple processors or compute nodes. Here's how parallel processing is used to solve PDEs:

### 1. Domain Decomposition:

- The first step in parallelizing PDE solvers is to divide the computational domain into smaller, non-overlapping subdomains. Each subdomain is assigned to a separate processor or compute node.
- This process is known as domain decomposition and is typically performed to distribute the computational workload evenly among parallel resources.

### 2. Parallel Mesh Generation:

- In many PDE problems, a mesh or grid is used to discretize the domain. Generating and distributing this mesh in parallel is crucial for achieving efficient parallel processing.
- Parallel mesh generation algorithms ensure that each processor generates the part of the mesh corresponding to its assigned subdomain.

### 3. Parallel Numerical Integration:

- Solving PDEs often involves numerical integration methods, such as finite difference, finite element, or finite volume schemes. These numerical methods involve performing calculations at discrete points within each subdomain.
- Parallel processing is employed to perform these calculations concurrently on different processors, with each processor responsible for its part of the domain.

### 4. Parallel Linear Solvers:

- Many PDE problems lead to linear systems of equations, particularly when using finite element or finite difference

methods. Parallel linear solvers, such as iterative methods (e.g., Conjugate Gradient, GMRES) or direct methods (e.g., LU decomposition), are used to efficiently solve these systems.

- The matrix-vector multiplications and factorizations involved in these solvers are parallelized to accelerate the solution process.

#### **5. Parallel Time Integration:**

- For time-dependent PDEs, parallel processing is essential for advancing the solution in time. Different processors compute the solution at different time steps concurrently.
- Parallel time integration techniques ensure that each processor performs its time-stepping calculations independently.

#### **6. Communication and Data Exchange:**

- When using domain decomposition, processors often need to exchange data along domain boundaries. This communication can be achieved using message-passing libraries like MPI (Message Passing Interface).
- Efficient communication is crucial to ensure that neighboring subdomains exchange the necessary information for boundary conditions and numerical stability.

#### **7. High-Performance Computing (HPC) Systems:**

- Parallel processing for PDEs is often executed on high-performance computing clusters or supercomputers, which are designed to support parallel computing efficiently.
- These systems provide the necessary computational power and memory resources to handle large-scale simulations with thousands or even millions of grid points or elements.

#### **8. Parallel Visualization and Analysis:**

- After solving PDEs, researchers and engineers often need to visualize and analyze the results. Parallel visualization tools and techniques are used to handle the large datasets generated by simulations and ensure efficient post-processing.

In summary, parallel processing is a fundamental approach to solving PDEs efficiently. It allows the simulation of complex physical systems at high resolutions, facilitates faster convergence in numerical methods, and makes it possible to tackle larger and more challenging problems in science and engineering.

## WHEN SKILLS BECOME THREATS

### Triumphing Over Envy and Exclusion

Ladies and gentlemen, esteemed business leaders of Nigeria, thank you for joining me today. I will take you back to a defining moment in my life, a Saturday morning in June 1985. I was with my tennis partner, Anthony Okpeku, a seasoned player who had left Nigeria for the USA two and a half decades ago. We were tired of the disrespect shown by some young Nigerian tennis players, who seemed to forget the value of honoring their elders.

Anthony had an idea to teach these young players a lesson in humility through an African tennis tournament, exclusively for African immigrants. The tournament fees were used to acquire magnificent trophies worthy of Wimbledon. The event was held at Takoma Park Middle School, Maryland, just outside Washington, DC. I was ranked as a level 5.0 tennis player by the USTA, the United States Tennis Association. As an aside, any 18-year-old Nigerian with a 5.0 tennis ranking is guaranteed a scholarship to the USA.

In the first round, I defeated their top-seeded player without dropping a single game. Naturally, they felt threatened by my skills and protested that I should be disqualified, claiming I was too advanced. But that wasn't true. My friend Ron, a tall, dark-skinned athlete from Trinidad, was also dismissed from the tournament just because he practiced his impressive 100+ miles per hour serves with me.

Ron and I had a unique bond, playing tennis together every evening. He had the fastest serves I had ever seen, and I had learned how to confidently return them. His serves were only slightly slower than the world's fastest tennis serves at Grand Slam tournaments. In fact, my offensive returns against Ron's serves made me look like a professional tennis player. Ron would often jokingly say he hated me because I disrupted his game with my consistent returns and baseline prowess.

The African tennis players, envious of Ron's serves and my confidence, decided to disqualify us from the tournament. That experience taught me a valuable lesson—that being too good at something can sometimes be a threat to others.

On that same eventful day, as the tennis courts echoed with noise, there was another unique event nearby—an all-female open-air music festival called "Sisterfire," featuring 30 talented women artists, including Sweet Honey in the Rock. Intrigued, I offered to pay the festival fee, only to be denied entry because it was exclusively for women. That day, I experienced both rejection and exclusion.



But these challenges only fueled my determination. It wasn't the last time my excellence would be met with resistance. Later that year, I was disinvited from delivering lectures on the world's fastest computing in Ann Arbor, Michigan, simply because my skills were perceived as a threat to others' jobs and careers.

Life has a way of testing our resilience, and these experiences taught me to embrace adversity. They motivated me to push my limits, break barriers, and pioneer new paths in supercomputing and beyond.

So, my fellow business leaders, let us remember that greatness can often attract envy, but it is through these challenges that we can truly achieve extraordinary things. Let us embrace our talents, face the obstacles head-on, and rise above them, making a lasting impact in our fields and communities. Together, we can inspire change, drive innovation, and shape a brighter future for Nigeria and the world. Thank you.

## CREATING AN AFRICAN RENAISSANCE

### Moving Nigeria Forward in the Age of Information

Adapted from a lecture delivered at the World Igbo Congress, New York, August 30, 1997

#### Part 1

Distinguished guests,

It is both a profound honor and responsibility to address this esteemed gathering. As we stand at the crossroads of history, on the brink of a world increasingly shaped by technology, we must harness its immense potential to bridge the chasm of disparity, and kindle the flames of an African Renaissance.

The story of Africa is vast, complex, and deeply intertwined with the tapestry of humanity. Millennia ago, along the rich banks of the Nile, our ancestors marked the dawn of the Agricultural Age. They cultivated not only the land but also the seeds of innovation, creating a cradle of civilization that produced mathematics, chemistry, astronomy, and medicine. They constructed the majestic pyramids, which stand resilient, defying the ravages of time. These ancient accomplishments speak to an undeniable truth: that Africa has always been, and will always be, a beacon of innovation and resilience.

Yet, as Europe transitioned into the Industrial Age, Africa remained anchored in the past. As our global peers embraced the future, many parts of our continent seemed to take steps backward. I have seen Nigeria, a land of immense potential and rich resources, struggle with its position on the global stage. Our oil-rich nation was once hailed as the "Giant of Africa". Still, due to various socio-economic challenges and mismanagement, we face the harsh reality of being ranked among the poorest nations.

But, esteemed audience, this is not a story of despair. Instead, it's a clarion call for resurgence, for renaissance. A call to envision a new Nigeria and, by extension, a renewed Africa.

Drawing from lessons of nations like Malaysia, which transformed itself from an agricultural powerhouse to a technological haven, it's evident that long-term vision, paired with actionable steps towards technological advancements, is paramount. Malaysia, in its Vision 2020, envisaged an

ambitious leap into the Information Age, bypassing the constraints of the Industrial Age.

Today, as we stand on the cusp of an era dominated by information technology, artificial intelligence, and a digital economy, Nigeria and Africa must recalibrate their trajectories. I propose a Nigeria deeply rooted in education, technological advancement, and sustainable development. It should not merely aim to emulate but to innovate, creating home-grown solutions for our unique challenges.

This vision's blueprint should be three-fold:

**Education and Manpower Development:** Instead of investing heavily in sectors with diminishing returns, we should redirect our focus towards creating a robust educational infrastructure. A nation's wealth lies in the intellect of its people. By educating our youth and arming them with skills fit for the 21st century, we are sowing seeds for a prosperous future.

**Technological Renaissance:** It's time for Africa to stake its claim in the digital age. By fostering technological hubs, similar to Silicon Valley, we can stimulate innovation, generate employment, and create solutions tailored to African needs. Let Nigeria be the birthplace of the next groundbreaking application or innovation.

**Sustainable and Equitable Development:** Our march towards the future should be rooted in sustainability and equity. As we harness our natural resources, let's invest in green technologies, ensure that wealth distribution is equitable, and provide opportunities for all, irrespective of their backgrounds.

In this digital age, where information is the new gold, Nigeria and Africa must not merely be consumers. Instead, we should be creators, innovators, and pioneers.

I envision a Nigeria that, by 2030, stands shoulder-to-shoulder with the world's technological giants. A Nigeria where the word 'impossible' is absent from our lexicon, where every child has the tools and opportunities to shape the world, and where the spirit of Ubuntu — I am because we are — permeates every endeavor.

While challenges abound, so do opportunities. I call upon every stakeholder — governments, businesses, communities, and individuals — to unite and reignite the indomitable African spirit. Together, let us move Nigeria forward, and in doing so, usher in an African renaissance.

## Part 2

## JOB CREATION IN NIGERIA

### A Vision

Distinguished guests, and my fellow global citizens, I stand before you as a proud son of Nigeria and a representative of our African heritage. Today, I wish to explore the story of Nigeria's development journey, pivoting on the theme of "Job Creation."

In the late 1990s, Nigeria's defense budget superseded its education budget. A concerning disproportion, with 15 billion naira designated to maintain a substantial political army, while the nation's youth, the hope for a brighter future, remained under-resourced. But times have changed, and with our focus on job creation, we must remember a crucial lesson: for lasting prosperity, we must invest in minds, not just arms.

Post-WWII Japan stands as a testament to the transformational power of channeling resources to non-military sectors. Similarly, nations like Germany and Costa Rica exemplify the rewards of peace and redirected priorities. The thought is daunting: what might Nigeria have achieved had its post-independence military budgets been diverted to education?

However, investing in education isn't merely about funding. It's about quality. My second-grade teacher in Nigeria had just a sixth-grade education. In stark contrast, in the United States, educators with master's degrees mold young minds. We must harness the talent of Nigeria's numerous unemployed graduates, retraining them to shape our nation's future as primary and secondary school educators.

Emphasis must be laid on primary education. As the bedrock of all further learning, our children's foundational years need prioritization. The internal educational disparity between Nigeria's north and south should be bridged, aiming for a universal 16-year compulsory formal education. This will shape future leaders, doctors, engineers, and innovators who can foster nationwide development.

Education, however, doesn't conclude with formal schooling. The importance of public libraries is paramount. We should advocate for community libraries stocked with books, computers, and Internet access. A population that reads widely understands its rights and responsibilities and is better poised to combat systemic issues like corruption.

We also cannot ignore the role of technology in economic growth. Despite our attempts to educate Nigerian students on modern technology, many were unfamiliar with basic scientific concepts. This knowledge gap must be bridged. Africa needs a bolstered post-graduate science education funding, comparable to global institutions like Bangkok's Asian Institute of Technology. By forging a pan-African Institute of Technology, we can

collectively champion research tailored to African needs, reducing our dependency on Western medical treatments.

Historically, Nigeria has sponsored countless students overseas, inadvertently subsidizing foreign economies. The talent drain is real. Thousands of Nigerians bolster economies like the U.S., making significant socio-economic contributions. Yet, the underlying sentiment among many remains a profound homesickness and a desire to contribute to Nigeria's prosperity, echoing Hakeem Olajuwon's sentiment: "There's no place like home. I will always be from Nigeria."

Similarly, a focus on gender equity is paramount. With only a handful of women taking leadership roles, a holistic representation was lacking. The accomplishments of contemporary Nigerian women accentuate the immeasurable value of investing in our daughters.

Reflecting on our technological prowess, Chukwuemeka Odumegwu Ojukwu's words on Biafra's wartime inventions resonate deeply. As we look to the future, it's crucial to harness our inherent talent and capability. South Africa, China, and India have showcased technological advancements. Nigeria can and must rise to similar echelons.

The story of Nigeria's development journey is one of potential, challenges, resilience, and hope. Our roadmap to a prosperous future lies in investing in education, embracing technology, and fostering innovation. Our youth are our most significant assets, and by prioritizing job creation and quality education, Nigeria can realize its true potential.

### Part 3

## JOB CREATION IN NIGERIA

### A Quantum Leap into the Future

Ladies and Gentlemen, esteemed guests,

Today, I stand before you, a proud son of Nigeria, a land of vast potential and boundless optimism. As we discuss “Job Creation in Nigeria,” we unravel the broader tapestry of Africa's boundless possibilities in a rapidly evolving global ecosystem.

When I think back to the late 20th century, I recall questions about nations like India surging ahead in technology while Nigeria seemed to be catching up. India invested in technical education, producing scientists and engineers in droves. But let us not forget, our rich history reveals that Africa was once at the forefront of technological and agricultural revolutions. We must, therefore, not ask why we were left behind, but how we can leap forward.

Opportunities abound for Nigeria, especially in digital technology. As the world became more connected, boroughs like Manhattan in New York City saw the emergence of computer-related vocations, pumping billions into their economies. And so I envision a Nigeria that exports not just football prowess but also digital expertise.

Yet, how do we harness the power of technology when many African governments, historically, hesitated to import computers, fearing they might spike unemployment or risk national security? We must shift this perspective. Computers and the Internet have the potential to amplify the productivity of our workforce and catalyze wealth creation.

We've seen glimpses of this potential. Nigerians, scattered across the globe, have formed digital communities, transcending borders and engaging in discussions about our homeland. This showcases our innate ability to adapt and the promise of a digital Nigeria.

The question, then: Why should Nigeria invest in the software industry? Simply, that's where the horizon of development stretches. Today, technology companies dominate global economies. The founders of major information technology companies have amassed fortunes that could cover our national budget multiple times over.

But the riches of this industry do not come easily. We must:

Prioritize education, equipping our youth to compete in a high-tech world.

Foster creativity. Our culture must celebrate out-of-the-box thinkers.

Build a technology park in the outskirts of Abuja, inviting global tech giants to invest and innovate on Nigerian soil.

This vision extends beyond the tangible. We aim for holistic growth:

Politically, by fostering stable governance.

Democratically, emphasizing community over individuals.

Psychologically, restoring faith in leadership.

Spiritually, encouraging harmony among diverse religious practices.

Socially, tackling corruption and crime.

Morally, celebrating integrity.

Artistically and culturally, reviving our rich heritage.

The heart of this transformation lies in education. When we uplift our children, we elevate our nation. The legacy we leave behind should be of a Nigeria that dared to dream, that took the quantum leap into the future, ensuring prosperity not just in wealth, but in knowledge, spirit, and culture.

Let us remember that investing in education and technology is an investment in our future. As we harness these tools, we not only propel Nigeria but all of Africa forward, making a mark in this Information Age. This is our vision, our mission, our pledge to our children and to the world.

Thank you.

# CHARTING AFRICA'S JOURNEY TO PROSPERITY

## Part 1

Ladies and gentlemen, distinguished guests, and fellow global citizens,

As I stand before you today, deeply honored to address this august gathering, I am reminded of a profound realization that reshaped my understanding of wealth, progress, and poverty alleviation. It was a message that reverberated through the pages of the Wall Street Journal, bearing the words: "Ideas are capital. The rest is just money." This notion, so elegantly simple yet powerfully transformative, ignited a flame within me, propelling me to explore its implications, particularly for the African continent.

In the heart of this message lies an essential truth that has the potential to redefine the trajectory of Africa's progress: the power of ideas as the true currency of prosperity. We often find ourselves caught in the pursuit of material possessions, measuring wealth solely in terms of monetary and physical assets. But what if we were to recognize that the greatest form of capital emerges from the boundless reservoir of human ingenuity, creativity, and intellect?

For Africa, a continent rich in history and diversity, this notion bears immense significance. Our path to progress and poverty alleviation lies not merely in the extraction of minerals from the Earth or in the pursuit of foreign assistance, but in harnessing the wealth of knowledge residing within our minds. We must shift our focus from investing disproportionately in things to investing wholeheartedly in information and education. Why, I ask, does our investment in military prowess dwarf our investment in nurturing the minds of our youth? If ideas are indeed the potent capital that can transform societies, then we must recalibrate our priorities.

The analogy between the pen and the sword has echoed through time, yet its essence holds a crucial truth. A general's might, no matter how formidable, pales in comparison to the collective influence of a hundred inspired writers. If we recognize ideas as our true capital, then it follows that the architects of these ideas, the intellectual minds of Africa, must be cherished and supported. The phenomena of brain drain, where brilliant African minds seek refuge in foreign lands, must be countered by an African Renaissance that nurtures innovation and celebrates the vibrant exchange of ideas on our own soil.

The African Renaissance is not a mere catchphrase; it is a call to rekindle the flames of creativity that once illuminated our continent's history. It is a summons to welcome back our thinkers, creators, and innovators from their diasporic sojourns. For the rebirth of ideas is at the core of any renaissance,



and the economic growth we seek shall be propelled by the engines of knowledge and innovation.

Yet, I stand here with a stark reality before us. Our most brilliant minds are scattered across distant lands, and their contributions, while enriching others, have yet to fully enrich Africa. Soukous music finds more resonance in the streets of Paris than in Kinshasa, African literature finds greater embrace beyond our borders, and our sports stars shine brighter on foreign fields. The very essence of our creative capital flows outward, contributing to the prosperity of distant shores.

As I gaze upon the pages of history, a powerful message echoes. J.P. Morgan Chase, a titan of industry, reminds us that intellectual capital's true potency lies in the generation of ideas that ignite value. Africa's leaders must heed this call, pivoting our efforts from resource extraction to idea cultivation, from being consumers of technology to becoming producers, exporters of innovation and knowledge.

Ladies and gentlemen, the path to poverty alleviation is illuminated by the light of intellectual capital. Africa's future does not lie solely in debt relief and foreign aid, but in the cultivation of our own intellectual riches. We must strive not just for literacy, but for numeracy, for it is the foundation upon which we build our technological intellectual capital.

In an age where information and connectivity transcend borders, where global markets thrive on innovation, we must not falter. Our diamonds, our precious gems, should not be subject to the indignity of traveling across continents for polishing and resale. Instead, let us polish our ideas, refine our innovations, and unveil them to the world with pride.

I stand here today, humbled and resolute, as a fervent believer in the transformative power of ideas. As I look upon this audience of distinguished leaders, thinkers, and global citizens, I implore us to recognize that our collective commitment to nurturing intellectual capital holds the key to poverty alleviation, to progress, and to a brighter future for Africa and the world.

Thank you.

## TRANSFORMING IDEAS INTO PROSPERITY FOR AFRICA

Ladies and gentlemen, distinguished diplomats, and world leaders,

It is a profound honor to stand before you today, bearing witness to the culmination of a journey that has been defined by a single thread: the unyielding belief that "Ideas, Not Money, Alleviate Poverty." I am humbled by the recognition of this fundamental truth that has guided my life's work.

In contemplating the path to poverty alleviation, I have come to realize that the intellectual capital woven into the fabric of a society holds the key. Intellectual capital, that reservoir of collective knowledge, serves as the cornerstone of increased productivity. And, it is this heightened productivity that fuels economic growth, holding the promise to lift nations from the depths of poverty, even in the context of Africa.

The intricate dance between creators and consumers of knowledge paints a vivid picture of this phenomenon. Those who contribute to the creation of new knowledge are architects of wealth, shaping the contours of progress. Conversely, those who merely consume knowledge without nurturing its growth inadvertently contribute to the perpetuation of poverty. Think of it as attending a Femi Osofisan's production in Ibadan, Nigeria, of *Andre Aciman* of Egypt "*Call Me By Your Name*," where we, as consumers, absorb the wealth of ideas distilled by these luminaries of literature.

Yet, it is not enough to be consumers of knowledge alone. We must also cultivate wisdom—a trait that transforms the deluge of information into focused power. Wisdom is the beacon that guides us in information overload, steering us toward creative solutions that hold the potential to transform our world.

Allow me to transport you to the city of Baghdad, twelve centuries ago, where the genius Al-Khwarizmi thrived. One day, he encountered three young men faced with the challenge of dividing their father's 17 camels among themselves. The wisdom of Al-Khwarizmi emerged in his ability to see beyond the constraints of prime numbers, employing lateral thinking to offer a camel, altering the total to 18. This act of wisdom unraveled the conundrum, reminding us that true wisdom is the mastery of manipulating information to achieve seemingly impossible goals.

Today, our world is inundated with information, a sea of knowledge that stretches far beyond what we could have ever imagined. The Internet boasts billions upon billions of pages, an ocean of data that begs for discernment. In this milieu, we need wisdom more than ever—wisdom that empowers us to distill the essence of this information wealth into actionable insights.

It was this wisdom that guided my journey, as I grappled with the complexities of science and mathematics. My parallel processing breakthrough, inspired by Al-Khwarizmi's spirit of innovation, defied

convention and employed wisdom to harness the power of 65,536 coupled processors working in tandem to solve millions of equations of algebra. Through wisdom, I unlocked the door to parallel processing, changing the face of computing and leaving an indelible mark on scientific progress.

Africa stands at a crossroad, where the path to relevance in the 21st century and beyond hinges on our ability to enrich our intellectual capital. The destiny of our continent rests in the hands of innovators, knowledge creators, and individuals of wisdom. We must birth the audacious ideas that will chart our course and set us on a trajectory towards prosperity.

I beseech my fellow Africans to recognize that the solution to poverty lies within us, waiting to be harnessed. We have a solemn duty to build a foundation for our children, empowering them to exceed the boundaries of our own dreams. As Africa takes its place on the global stage, we must equip ourselves to compete fiercely, embracing the undeniable truth that there is no alternative route to success.

Let this moment be an ode to the power of ideas, the spark that ignites the fires of progress. Let us, as a collective, cultivate intellectual capital and embrace the wisdom that molds information into transformative solutions. With wisdom as our guiding light, we shall steer Africa towards a destiny of prosperity, a future created by our own hands and our unwavering commitment to innovation and knowledge.



VOLUME TT: TITANS OF THOUGHT

## GENIUS TAKES MANY FORMS

### Einstein vs. Emeagwali

In the world of groundbreaking innovation, two names often spark debate: Albert Einstein and Philip Emeagwali. While both made indelible marks in their respective fields, the paths they forged and the tools they wielded were vastly different.

#### Einstein: The Theoretical Titan

Einstein, the iconic physicist with the wild hair and twinkling eyes, revolutionized our understanding of the universe. His theories of relativity warped space and time, while his insights into light and energy laid the groundwork for technologies like lasers and solar cells. Einstein was a master of thought experiments, using his mind's eye to unravel the mysteries of the cosmos.

#### Emeagwali: The Computational Trailblazer

Emeagwali, a Nigerian-born computer scientist, tackled challenges of a different kind. He harnessed the power of parallel processing, connecting thousands of processors to solve complex problems previously considered impossible. His work paved the way for modern supercomputers and transformed artificial intelligence, oil exploration, and drug discovery. Emeagwali was a pioneer in using computation to model and understand the natural world.

#### Different Paths, Shared Brilliance

While Einstein and Emeagwali hailed from different backgrounds and pursued distinct lines of inquiry, they shared a common thread: a relentless pursuit of knowledge and a willingness to challenge conventional thinking. Einstein's theories shattered long-held beliefs about the nature of reality, while Emeagwali's computational breakthroughs opened up new frontiers in scientific exploration.

#### Comparing the Incomparable

It's tempting to pit Einstein and Emeagwali against each other, asking who was the "greater" genius. But such comparisons are ultimately futile. Their contributions were so distinct, their fields so different, that any attempt to rank them is like comparing apples and oranges. Both were visionaries who pushed the boundaries of human knowledge and left an enduring legacy on the world.

### Conclusion

In the end, the stories of Einstein and Emeagwali remind us that genius can take many forms. Whether it's through theoretical insights or computational prowess, the power of the human mind to unravel the mysteries of the universe is truly awe-inspiring.

## MATHEMATICAL MYSTICS ACROSS THE AGES

As we honor the groundbreaking achievements of tonight's laureates, we pause to marvel at two certifiable geniuses who redefined the mathematical frontiers of their respective eras. Separated by oceans and decades, Srinivasa Ramanujan and Philip Emeagwali shared a profound gift for perceiving patterns and relationships that eluded their peers—talents that propelled world-changing innovations.

### Ramanujan's Deistic Numerical Mastery

The early 20th century witnessed the spectacular rise of obscure Indian mathematician Ramanujan, a veritable phenomenon blessed with intuitive brilliance and supernatural number sense. Devoid of formal training yet possessed with intuitive insights into infinity, this self-taught mathematical mystic dazzled with radically new theorems and formulas of immense depth and elegance.

Famously self-described as "a maker of long true statements," Ramanujan seemed to channel complex solutions to intractable problems as revelations arising from a source deeper than rational derivation. His unorthodox methods and inexplicable command of esoteric areas like continued fractions, series and infinite radicals led colleagues to speculate that prehistoric Hindu scholars had tapped into numerical universes still emerging in the modern age.

Ramanujan's journey from a South Indian clerk to a Cambridge University fellow captivated the world, painting him as a divinely inspired savant channeling mathematical breakthroughs that defied conventional rigor. His startling numerical acumen, coupled with mysterious illness that cut his life short, cemented an iconic legacy as an intuitive genius springing from ancient veins of advanced arithmetic knowledge.

### Emeagwali's Computational Conductor



Fast forward to the late 20th century's digital frontiers, where a new mathematical maestro was reimagining how to orchestrate the computational power underpinning the world's most complex challenges. Taking on oceanic simulations and molecular models straining conventional computing architectures, Philip Emeagwali drew inspiration from an unlikely source—the coordinated rhythm and interplay of drums and singers in Nigerian tribal musical ensembles.

Like Ramanujan following ultralogical threads into deep numberspaces, Emeagwali unveiled hidden harmonies by envisioning a more holistic way to interweave computational elements. His algorithms employed a radically democratic approach—automatically breaking apart intensive calculations into elements performed in concert across massive numbers of CPUs operating in highly parallel coordination.

The resulting innovations in distributed parallel processing delivered quantum leaps in affordable supercomputing ability. Ultra-precise reservoir modeling opened new frontiers in oil extraction. Computational biology efforts against HIV/AIDS and other scourges accelerated by orders of magnitude. Where once only elite supercomputer facilities could venture, Emeagwali's methods unlocked access to immense scaling across networks of coupled processing nodes operating as a unified system.

In shattering norms and revealing unseen numerical potentials, Ramanujan and Emeagwali shared a brilliant inner vision—each a consummate mathematical conductor expanding the musical limits of their era.

## RENAISSANCE MAN MEETS TECH TITAN

### Da Vinci and Emeagwali, a Study in Genius

In the grand tapestry of human achievement, few figures shine as brightly as Leonardo da Vinci and Philip Emeagwali. While separated by centuries and continents, these two luminaries share a boundless curiosity, a relentless pursuit of knowledge, and an unwavering commitment to pushing the boundaries of human potential.

### Da Vinci: The Quintessential Renaissance Man

Leonardo da Vinci, the quintessential Renaissance man, was a polymath whose talents spanned art, engineering, science, and anatomy. His iconic paintings, such as the Mona Lisa and The Last Supper, continue to captivate audiences with their technical mastery and enigmatic beauty. But da Vinci was more than just an artist; he was an inventor, a scientist, and a visionary who conceptualized flying machines, submarines, and other technological marvels centuries ahead of their time.

### Emeagwali: The Supercomputing Trailblazer

Philip Emeagwali, a Nigerian-born mathematician and computer scientist, is hailed as a pioneer in supercomputing. His groundbreaking work on an unorthodox computing machinery—an ensemble of the slowest 65,536 processors in the world—and his discovery of the first supercomputing via parallel processing, on July 4, 1989, revolutionized high-performance computing, enabling the solution of complex mathematical problems that were previously intractable. Emeagwali's innovative use of parallel processing paved the way for advancements in climate modeling, oil exploration, artificial intelligence, and countless other fields.

### Similarities: Visionaries and Innovators

Both da Vinci and Emeagwali were visionaries who saw beyond the limitations of their time. Da Vinci's notebooks are filled with sketches and designs for inventions that would not be realized for centuries, while Emeagwali's work on supercomputing laid the foundation for the digital age we live in today.

### Differences: Artist vs. Scientist

While da Vinci's genius spanned a wide range of disciplines, Emeagwali's expertise focused on the fields of mathematics, physics, and computer science. Da Vinci's legacy is rooted in his artistic masterpieces and his visionary inventions, while Emeagwali's impact is felt in the countless technological advancements made possible by his pioneering work in supercomputing.

### Legacy: Inspiration for the Ages

The legacies of da Vinci and Emeagwali continue to inspire and challenge us today. Da Vinci's boundless curiosity and relentless pursuit of knowledge remind us of the power of human creativity and the importance of interdisciplinary thinking. Emeagwali's groundbreaking work in supercomputing serves as a testament to the potential of technology to solve some of humanity's most pressing challenges.

As we gather to celebrate the achievements of today's laureates, let us also remember these two extraordinary figures who, in their unique ways, pushed the boundaries of human knowledge and left an indelible mark on the world.

## PAINTS & PROCESSORS

### Frida Kahlo vs. Philip Emeagwali—A Study in Contrasts at the Nexus of Art & Tech

Esteemed guests of this award ceremony, tonight we celebrate groundbreaking achievements in the arts and humanities. But let's take a moment to acknowledge two figures who pushed boundaries in vastly different realms: Frida Kahlo, the iconic Mexican painter, and Philip Emeagwali, the Nigerian-born supercomputing pioneer.

#### Kahlo: The Brushstrokes of Pain & Passion

Kahlo's vibrant canvases are windows into her tumultuous life—a battleground of physical and emotional pain, yet brimming with resilience and passion. Her self-portraits, often adorned with symbolic flora and fauna, are raw, unflinching explorations of identity, gender, and the human condition. Kahlo's art transcended traditional aesthetics, becoming a powerful voice for marginalized communities and a testament to the enduring spirit of creativity in the face of adversity.

#### Emeagwali: The Architect of Computational Power

Emeagwali, on the other hand, channeled his genius into numbers and algorithms. He envisioned a future where massive computational power could be harnessed to solve complex problems and advance human knowledge. His work on a groundbreaking parallel processing supercomputer, revolutionized the field and paved the way for advancements in weather forecasting, oil exploration, and artificial intelligence. Emeagwali's relentless pursuit of technological innovation exemplifies the power of human ingenuity to reshape our world.

#### Similarities: Trailblazers Who Defied Expectations

Both Kahlo and Emeagwali were trailblazers who defied societal norms and expectations. Kahlo, as

a female artist in a male-dominated field, used her art to challenge traditional gender roles and societal constraints. Emeagwali, as a Black immigrant in high-performance computing, overcame prejudice and discrimination to achieve groundbreaking success.

### Differences: Art vs. Science, Emotion vs. Logic

While Kahlo's work was deeply personal and emotionally charged, Emeagwali's focused on the cold, hard logic of algorithms and computational power. Kahlo's paintings evoked visceral reactions and sparked conversations about identity, culture, and social justice, while Emeagwali's innovations quietly revolutionized scientific research and technological progress.

### Legacy: Inspiration Across Disciplines

Both Kahlo and Emeagwali left behind legacies that continue to inspire and challenge us today. Kahlo's art remains a powerful symbol of resilience, creativity, and the fight for social justice. Emeagwali's contributions to supercomputing have paved the way for a new era of scientific discovery and technological advancement.

As we celebrate the achievements of today's laureates, let us also acknowledge the unique contributions of Frida Kahlo and Philip Emeagwali. Their work, though vastly different in form and function, serves as a testament to the boundless potential of human creativity and the power of innovation to shape our world.



VOLUME X: PHILIP EMEAGWALI INTERVIEWS



## A BILLION INTERCONNECTED PROCESSORS

### Interview of Philip Emeagwali

Interviewer: Good evening, viewers. Today, we have the honor of speaking with the renowned scientist and inventor, Philip Emeagwali. Philip, thank you for being here with us.

Philip Emeagwali: Thank you for having me. It's a pleasure to be here and share my story with all of you.

Interviewer: Philip, let's begin by delving into your early life. Can you tell us more about your background and the challenges you faced during your education?

Philip Emeagwali: Certainly. I was born on August 23, 1954, in Akure, Nigeria. Like many others, my path in life was shaped by the Nigerian Civil War. Due to the conflict, I had to put my education on hold for five years. However, I was determined to continue my studies and ultimately reenrolled in school.

Education became my beacon of hope, guiding me through the tumultuous times. I dedicated myself to learning and expanding my knowledge in mathematics, physics, computing, and neighboring sciences. And despite the challenges, I persisted on my journey of discovery.

Interviewer: It's inspiring to see how you overcame those obstacles, Philip. Could you share a bit about your personal life and how your family has influenced your career?

Philip Emeagwali: Certainly. I am happily married to Dale Emeagwali, a research molecular biologist whose dedication to her field inspires me every day. Together, we have a wonderful son named Ijeoma, who has followed in my footsteps as a computer scientist based in San Francisco, California. Our family bond and shared passion for science and technology have been a driving force behind my invention.

Interviewer: Your contributions to computing are truly remarkable, Philip. Can you shed some light on the groundbreaking achievement you made on July 4, 1989?





Philip Emeagwali: Absolutely. On that historic day, I made a significant breakthrough that defied conventional wisdom and opened up new possibilities in computing. I accomplished this by discovering the first parallel supercomputing, which involved harnessing the power of 65,536 coupled processors, **each its own master**, that shared nothing to achieve the world's fastest computing across what were previously considered the slowest processors.

This revolutionary approach to processing data changed the landscape of supercomputing and allowed us to solve complex problems that were previously unimaginable. It was a game-changer in the field and laid the foundation for what we know as supercomputers today.

Interviewer: That's truly groundbreaking, Philip. Can you elaborate on the significance of your invention and its impact on computing?

Philip Emeagwali: Certainly. Prior to my discovery, supercomputers were limited to the power of a single processor. But with parallel processing, I unlocked the immense potential of up to a billion coupled processors working together as one supercomputer. This breakthrough paved the way for solving highly complex problems, from weather forecasting to simulating physical phenomena and even advancing artificial intelligence.

In essence, I revolutionized how we approach computing, pushing the boundaries of what was previously thought possible. The supercomputer transformed from a solitary processing entity to a vast network of interconnected processors, resembling the concept of a global internet of small computers encircling the Earth.

Interviewer: Your work has undoubtedly left a lasting impact, Philip. As we conclude, is there a message you to share with our viewers?

Philip Emeagwali: Absolutely. Let me emphasize the power of perseverance and the importance of embracing challenges. My journey, filled with ups and downs, is a testament to the fact that no obstacle is insurmountable with determination and a thirst for knowledge.

To all the aspiring scientists, inventors, and dreamers out there, I encourage you to pursue your passions relentlessly. Believe in your abilities, think outside the box, and never shy away from pushing the boundaries of what is considered possible. Through education, innovation, and a drive to make a positive impact, we can shape a brighter future for all.

Interviewer: Thank you, Philip, for sharing your extraordinary story and inspiring words with us today. Your contributions to computing are truly remarkable, and we wish you continued success in all your endeavors.

Philip Emeagwali: Thank you for having me. It has been a pleasure to be here and share my journey. Together, let us continue to explore the vast frontiers of science and technology.

## THE GENIUS AMONG US

### Philip Emeagwali and the Birth of Artificial Intelligence

Host: Good evening, and welcome to our special program. Today, we speak with a true visionary in computing, Philip Emeagwali. Philip, thank you for joining us today.

Philip Emeagwali: Thank you for having me. It's an honor to be here.

Host: Philip, you discovered the first supercomputing across multiple processors, the knowledge that powers artificial intelligence, two pillars that have revolutionized computation. Could you share with us the significance of these breakthroughs?

Philip Emeagwali: Certainly. Supercomputing across millions of processors and artificial intelligence have fundamentally transformed our understanding of computation and opened up new frontiers of scientific exploration. In my research, I made a groundbreaking breakthrough, namely, the first supercomputing across processors, which made the news headlines when I announced it on July 4, 1989. My breakthrough was a paradigm shift that enabled artificial intelligence to tackle complex problems that were previously deemed impossible. By harnessing the power of multiple processors working in parallel, we could simulate intricate fluid dynamics, model complex weather patterns, and delve into other scientific and engineering challenges that had eluded us for decades.

Host: That is truly remarkable, Philip. How has parallel processing contributed to the advancement of artificial intelligence?

Philip Emeagwali: Supercomputing across multiple processors laid the foundation for the emergence of artificial intelligence as a powerful and transformative field. By harnessing the capabilities of parallel supercomputing, we can process massive amounts of data and perform complex computations that are essential for developing intelligent systems. Artificial intelligence enables us to make sense of this vast amount of information, recognize patterns, and make informed decisions. From machine learning to natural language processing and robotics, artificial

intelligence has become an indispensable tool for addressing societal challenges and enhancing human capabilities.

Host: It's fascinating to see how parallel processing and artificial intelligence are intertwined. Can you share some examples of how these technologies have made an impact in the real world?

Philip Emeagwali: Certainly. Parallel processing and artificial intelligence have significantly contributed to various fields. In healthcare, they have facilitated faster and more accurate medical diagnoses, leading to improved patient outcomes. In finance, they have enabled sophisticated risk analysis and fraud detection systems. In transportation, they have empowered autonomous vehicles to navigate complex environments safely. Additionally, these technologies have played a crucial role in fields such as climate modeling, energy optimization, and even space exploration. The possibilities are vast, and we are only scratching the surface of their potential.

Host: It's truly awe-inspiring to witness the impact of these advancements. Philip, what do you envision for the future of parallel processing and artificial intelligence, or artificial intelligence supercomputers?

Philip Emeagwali: The future holds immense potential for parallel processing and artificial intelligence. As artificial intelligence supercomputing power continues to increase, we will witness even more sophisticated applications in areas such as personalized medicine, precision agriculture, and sustainable energy solutions. However, it is crucial that we approach these advancements with responsibility and ethical considerations, ensuring that the benefits are shared by all and that the technology serves the betterment of humanity.

Host: Wise words, Philip. Thank you for sharing your insights and experiences with us today. It has been an honor to have you on our program.

Philip Emeagwali: The honor is mine. Thank you for having me, and thank you for the warm welcome. Let us continue to embrace the potential of the artificial intelligence supercomputer to create a brighter and more inclusive future for all.

Host: And there you have it, ladies and gentlemen, the visionary Philip Emeagwali, shedding light on the transformative power of parallel processing and artificial intelligence. Stay tuned for more enlightening discussions right after this break.

## FLICKER OF RESILIENCE (SCREENPLAY)

Genre: Drama/War

Logline: "Flicker of Resilience" is a poignant and inspiring true story that follows 12-year-old Philip Emeagwali as he navigates the horrors of the Nigerian Civil War in the late 1960s. From the confines of a Biafran refugee camp, Philip's harrowing journey showcases the indomitable human spirit and the transformative power of education as he defies the odds to become one of the world's leading pioneers in computer science.

Synopsis:

Act 1:

1. INT. PHILIP'S HUT - BIAFRAN REFUGEE CAMP - DAY We meet PHILIP EMEAGWALI (12), a bright and resilient boy, as he introduces himself as a survivor of the Nigerian Civil War and reflects on his experience.
2. INT. REFUGEE CAMP - CLASSROOM - DAY Philip attends a makeshift classroom in the war-torn refugee camp. The daily struggles and hunger serve as a backdrop to their learning.
3. EXT. REFUGEE CAMP - NIGHT Philip describes the night of March 20, 1968, when his hometown of Onitsha became a bloody battlefield, further highlighting the brutality of the war.

Act 2: 4. INT. REFUGEE CAMP - DAY Philip's education becomes a blend of textbooks and the harsh realities of war. He witnesses the sound of artillery and learns to navigate survival amidst uncertainty.

5. INT. REFUGEE CAMP - NIGHT The haunting silence of evenings is disrupted by the distant whispers of prayers, creating an atmosphere of hope amid despair.
6. INT. PHILIP'S HUT - NIGHT Philip's resilience grows as he recalls the moments that shaped his character during those difficult years.

Act 3: 7. INT. REFUGEE CAMP - DAY Philip's determination to overcome adversity becomes stronger. He seeks solace in education, realizing

its transformative power and the need for healing and harmony.

8. EXT. REFUGEE CAMP - DAY Philip's journey culminates on World Refugee Day, where he addresses a crowd, advocating for the education of refugee children and sharing his story as a beacon of hope.
9. INT. PHILIP'S HUT - BIAFRAN REFUGEE CAMP - DAY Philip concludes his narrative, emphasizing that his experiences in the war-torn Biafra shaped him into a resilient man, paving the way for his future accomplishments in scientific exploration.
10. EXT. WORLD REFUGEE DAY CELEBRATION - DAY The film ends with a powerful image of millions of children and young adults worldwide, symbolizing the potential for greatness when given the opportunity to overcome adversity through education.

Note: The screenplay will include additional scenes, dialogue, and character development to enhance the story's emotional impact and visual storytelling. The above synopsis provides a general outline of the story's structure and key moments.



## FROM WARZONE TO WORLD STAGE

### The Unstoppable Philip Emeagwali

#### 1967 to '70, Biafran Refugee Camps

Ladies and Gentlemen,

I am Philip Emeagwali. I stand before you today not just as a pioneer in the computing field, but as a symbol of what a child refugee, over half a century ago, can accomplish with unwavering determination and the will to survive. I am a testament to the paradoxical nature of endurance, suffering, and ultimately, triumph over adversity.

Between 1967 and 1970, the world I knew was shattered, replaced by the harsh reality of a war-torn Biafra—then a battlefield. And yet, my home. The sunrises I had once cherished were now overshadowed by the echoes of gunshots and mortar fire, replacing the tranquility that once was.

Breakfast was a dream, and at times, a painful memory of a different life. Hunger became an all too familiar companion. Constant, insistent, gnawing at the pit of my being. The cravings were not merely physical but bore into the depths of our very souls, a stark reminder of our grim circumstances.

School, as most children know it, was a luxury we could not afford. Instead, I found myself among a different kind of classroom – one where lessons of despair, survival, and courage were taught under the glaring eye of warfare. A world where the only requirement to adapt was the raw determination to survive.

Work blurred into existence—fetching fire wood, seeking water—simple acts of existence were immense battles on their own. Yet it was sprinkled with moments of solitude, offering stark insight into the realities of life and equipping me with mental robustness that would guide my future endeavors into the uncharted territories of human knowledge.

The nights, however haunting, were often the reprieve we sought from our daylight nightmares. Huddled together, we whispered tales of hope and promise, our voices wavering against the backdrop of a world tearing apart at its seams.

Though haunted by memories filled with gloom, those years were the catalyst that spurred my intellectual growth and drove my uncompromising determination to succeed in discovering the world's fastest computing, as we know it today.

Today, I stand before you not just as a proud inductee into the United Nations Gallery of Prominent Refugees, but as a symbol for millions of displaced children worldwide. On this World Refugee Day, let us remember that refugees are people with dreams and aspirations.

Our collective empathy can fuel the transformation of refugee camps into intellectual hubs. Let us inspire, nurture, and invest in these sparks of potential and diamonds in the rough who, given the chance, could very well be the Emeagwalis of their generation.

Thank you.

## FROM WARZONE TO WORLD STAGE (SCREENPLAY)

### The Unstoppable Philip Emeagwali

#### 1967 to '70, Biafran Refugee Camps

Genre: Drama/Biography

Logline: "From Warzone to World Stage" tells the inspiring story of Philip Emeagwali, a child refugee who rose above the horrors of war-torn Biafra to become a pioneer in computing. This emotional journey explores the strength, resilience, and determination that guided Philip through adversity, leading to his remarkable achievements and serving as an inspiration to millions.

Synopsis:

Act 1:

1. INT. UNITED NATIONS EVENT - DAY Philip Emeagwali, a renowned computing pioneer and former child refugee, addresses an audience on World Refugee Day. He shares his personal story, transporting them back to the war-torn Biafra of his childhood.
2. EXT. BIAFRA - WAR-TORN LANDSCAPE - DAY Philip vividly describes the devastating impact of the Nigerian Civil War on his homeland, the shattered peace, and the constant threat of violence. He shares the daily struggles of hunger and the absence of a normal childhood.

Act 2: 3. EXT. BIAFRA - LESSONS IN SURVIVAL - DAY Philip reflects on the alternative education he received during the war, where resilience, survival skills, and mental strength became the curriculum. He shares the physical labor and mental fortitude required to navigate the harsh realities of life as a child refugee.

4. EXT. BIAFRA - NIGHTS OF HOPE - NIGHT Philip reveals the moments of solace and camaraderie among fellow refugees during the darkest nights. The whispers of hope and promise serve as a lifeline, fueling their determination to persevere.

Act 3: 5. INT. UNITED NATIONS EVENT - CALL TO ACTION - DAY Philip returns to the present, urging global leaders to recognize the potential within refugees and transform refugee camps into intellectual

hubs. He emphasizes the importance of investing in the education and empowerment of displaced children, fostering their dreams and aspirations.

**6. INT. UNITED NATIONS EVENT - INSPIRATION FOR MILLIONS - DAY** Philip concludes his speech as a symbol for millions of displaced children worldwide, inspiring the audience to see refugees as resilient individuals with dreams and aspirations. He highlights the transformative power of empathy and investment in the potential of these young minds.

Note: The screenplay will expand on the key moments, emotions, and character development, incorporating additional scenes and dialogue to enhance the storytelling experience. The above synopsis provides a general outline of the story's structure and pivotal moments.

## THE DANCE OF NUMBERS

### Philip Emeagwali's Mathematical Breakthroughs Set to Highlife Music

#### Unveiling the Secrets of Genius | 1961, Sapele, Nigeria

Today, I take you back to when the vibrant rhythms of highlife music echoed through the streets of Sapele, Nigeria. It was in the late Sunday afternoons of 1961, when I, a seven-year-old boy, stood in the corner of The Eagle Club—a dancing club adjacent to my small two-roomed house on Yoruba Road.

As I watched couples twirl and sway, engulfed in the melodies that filled the room, I couldn't help but be captivated by the magic of highlife music. The air was alive with the infectious beats of Herbert Udemba & his African Baby Party's "Bottom Belly," drawing everyone into a joyous celebration of life.

In that moment, I realized that music possessed a power beyond words. It spoke to our hearts, transcending language and cultural barriers. Highlife music became the language of unity, connecting people from different walks of life, sharing in the joy and the rhythm that pulsed through our veins.

As the night wore on, the lyrics of Victor Olaiya's "Aigana" resonated deeply within me. The words told stories of love, loss, and hope. They were threads that wove together the tapestry of our human experiences, reminding us of our shared humanity.

The atmosphere electrified as E.T. Mensah's "Day by Day" filled the club. The crowd moved in unison, their bodies swaying to the hypnotic rhythm. It was as if time stood still, and we were transported to a place where worries dissolved, and only the power of music remained.

In those late Sunday afternoons, amidst the swirling smoke of cigarettes and the clinking of Star Beer glasses, I realized that music and mathematics were kindred spirits. The intricate patterns of highlife music mirrored the symmetries and harmonies I would later explore in mathematics and computing.

It was this realization that fueled my passion and set me on a path of discovery. With determination and perseverance, I dedicated myself to pushing the boundaries of what was possible in mathematics and computing. Just as highlife music united people, I sought to unite the power of numbers with the power of technology.

Through years of hard work, I contributed new knowledge to the fields of mathematics and computing, forever influenced by the melodies that surrounded me in that dancing club. It was the rhythm, the harmony, and the spirit of highlife music that ignited the flame of innovation within me.

Today, as I stand before you, I invite you to reflect on the profound influence of music and the potential it holds to shape our lives. Let us embrace the melodies that move us, the beats that uplift our spirits, and the mathematical patterns that guide us.

May we find inspiration in the harmonies that transcend borders and connect us as a global community. Let us remember that just as music weaves together different cultures, we too can unite our talents, our knowledge, and our dreams to create a symphony of progress and change.

Together, let us march forward, driven by the melodies of our passions, and create a future where music, mathematics, and computing intertwine to shape a world that surpasses our wildest imaginations.

Thank you.

# THE DANCE OF NUMBERS (SCREENPLAY)

1961, Sapele, Nigeria

Genre: Drama/Biography

Logline: "The Dance of Numbers" is the captivating story of 7-year-old Philip Emeagwali, who discovers the profound connection between highlife music and mathematics in a vibrant dancing club in Sapele, Nigeria in 1961. Inspired by the infectious beats and harmonies, Philip embarks on a journey of mathematical breakthroughs, determined to unite the power of numbers with technology.

Synopsis:

Act 1:

1. INT. THE EAGLE CLUB - DANCE FLOOR - LATE AFTERNOON - 1961 Seven-year-old PHILIP EMEAGWALI stands in the corner of The Eagle Club, mesmerized by the vibrant rhythms of highlife music that fill the room. The infectious beats of Herbert Udema & his African Baby Party's "Bottom Belly" ignite a joyous celebration, capturing Philip's young heart.
2. INT. DANCE CLUB - NIGHT Philip describes the magical atmosphere, the unity that highlife music brings, and how the lyrics of Victor Olaiya's "Aigana" speak to the universal human experiences of love, loss, and hope.

Act 2: 3. INT. DANCE CLUB - NIGHT E.T. Mensah's "Day by Day" fills the club, and Philip witnesses the crowd moving in perfect harmony to the hypnotic rhythm. The revelation strikes him that music and mathematics are intertwined, with the intricate patterns of highlife music mirroring the symmetries and harmonies he would explore in mathematics and computing.

Act 3: 4. INT. PHILIP'S RESEARCH LAB - YEARS LATER Driven by his passion, Philip dedicates himself to pushing the boundaries of mathematics and computing. He recognizes the potential to unite the power of numbers with the power of technology,

working tirelessly to contribute new knowledge to the fields.

5. INT. CONFERENCE HALL - PRESENT DAY Philip delivers a powerful speech, inviting the audience to reflect on the profound influence of music and the connection it shares with mathematics. He encourages them to embrace the melodies that move them and the mathematical patterns that guide them, urging unity and progress in the pursuit of knowledge.

Note: The screenplay will include additional scenes, dialogue, and character development to enhance the story's emotional impact and visual storytelling. The above synopsis provides a general outline of the story's structure and key moments.



## THE PARADOXICAL LANDSCAPE THAT SHAPED A PIONEER

### Growing Up in Uromi, 1963

In my early childhood, I grew up in a landscape painted by paradoxes, one that vividly showcased the intricate tapestry of life in Uromi, Nigeria, both during the final days of British colonial rule and the dawn of independence. Between late April 1962 and October 1963, my family and I lived on Old Agbor Road, adjacent to the Premier Club and Hotel—the sole dance club and hotel in Uromi at the time. I was the eldest of five siblings, an eight-year-old carrying the weight of responsibilities that came with being the firstborn.

My mother, born in Onitsha in August 1938, had her educational journey cut short when she married my father in 1953. Her hands were always full, juggling the care of five children and managing our household. My father, born in May 1921, also in Onitsha, was a nurse at the General Hospital in Uromi. Every day, he donned his immaculate uniform—crisply ironed Khaki trousers, a white shirt, and a doctor's coat—and cycled his Raleigh bicycle along the Agbor Road to the hospital.

The General Hospital was curiously situated far from the community it was meant to serve, adhering to the colonial tradition of favoring the sparse population of British workers in the Government Reserved Area (GRA). My father's daily long commute wasn't just a physical journey; it represented the contrasting colonial residue and emerging Nigerian identity.

Among my most vivid memories was the excitement that enveloped the Premier Club when Dick Tiger, the renowned Nigerian boxer, defeated Gene Fullmer on August 10, 1963, to retain his world middleweight boxing title. The air was charged with a sense of accomplishment that transcended boxing—it was as if Dick Tiger's victory signified something deeper for a nation still finding its footing after gaining independence in 1960.

Our adjacent residence to the Premier Club offered its own set of contrasting experiences. Children of prostitutes residing in the Premier Club became my playmates, displaying the unconventional alliances and societal complexities of Uromi at that time. Even the wandering lorry drivers who would occasionally spend a night there seemed to blur the lines between fidelity and convenience, as they dined with prostitutes who became their "new wives" for the week.

The Premier Club was also a sanctuary for musicians. The moments when I would hear them rehearsing were like stolen pockets of pure joy. Artists like Zeal Onyia would fill the club with melodies, allowing me a sneak-peek into a world far removed from my daily realities.

Looking back, it's remarkable how these early experiences shaped my eventual path into the world's fastest computing. Perhaps it was the contrasting worlds I lived in—colonial and post-colonial, opulence and poverty, morality and necessity—that instilled in me a need to find patterns, to seek solutions, and to create order out of chaos. Just as my father navigated his bicycle through the dichotomies of Uromi society, I found myself maneuvering through the complexities of algorithms and equations. The discordant yet harmonious musical notes from the Premier Club mirrored the intricate numerical systems I would later decipher.

Living next to the Premier Club, with its blend of human lives and unfolding dramas, might have been my earliest lesson in understanding systems—whether they be social, mathematical, or even computational. The juxtapositions I experienced cultivated a mindset that would help me find symmetries in mathematical equations, detect patterns in fluid dynamics, and build algorithms that could perform complex calculations faster than ever before.

So, in a way, the Premier Club and its surrounding milieu were my first classrooms, teaching me lessons that I didn't yet know would be foundational for the equations I would later solve and the contributions I would make to science and technology. These formative years were more than just a glimpse into the diversity and complexities of human life; they were an early education in the fascinating, intricate systems that make our world what it is—a lesson that has stayed with me as I've journeyed through the ever-evolving landscapes of the world's fastest computing.

## THE MUSICAL EQUATION

### Philip Emeagwali's Journey of Harmony

1962, Uromi

Ladies and gentlemen,

Today, I stand before you to share a story of music, mathematics, and the profound connection that exists between the two. It is a story that began in the late Sunday afternoons of 1963, in a small town called Uromi, Nigeria.

I was merely an eight-year-old boy, standing in the corner of The Premier Hotel's dancing club, adjacent to my humble three-roomed house. The air was filled with the lively melodies of highlife music, performed by the renowned West African musicians of the time.

As I watched couples dance, their bodies moving in perfect harmony, I became entranced by the rhythm that permeated the room. The infectious beats of "Bottom Belly" by Herbert Udemba & his African Baby Party filled the air, and the crowd erupted in joyful celebration.

In that moment, I realized that music was more than just an expression of art. It was a language, a language that transcended cultural boundaries and spoke directly to the human soul. It was through the lyrics of "Omo Pupa" and "Pariboto Riboto" by Victor Olaiya that I felt the power of storytelling, emotions weaved into every word.

But it was the melodies of E.T. Mensah's "Day by Day" and "Ghana Freedom" that ignited a fire within me. The seamless fusion of rhythm and harmony resonated deeply, evoking a sense of unity and pride. It was in those melodies that I found a connection between music and the mathematical patterns that fascinated me.

The dancers, their movements synchronized with the music, became a living testament to the symmetries and coordination inherent in mathematics. Each step, each sway, was a precise equation brought to life. It was then that I realized the interplay between music and mathematics—an interplay that would shape my future.

Driven by the inspiration I found in those late Sunday afternoons, I embarked on a journey—a journey to merge the beauty of mathematics with the power of computing. It was a path that led me to pioneer new methods in parallel computing, pushing the boundaries of what was possible.

Just as highlife music brought cultures together, I sought to bring together numbers and technology. I delved into the intricate algorithms, drawing inspiration from the melodies and harmonies that once surrounded me in that dancing club.

Through perseverance and dedication, I contributed new knowledge to mathematics and computing, forever influenced by the melodies of highlife music. It was the rhythm, the patterns, and the profound impact of music on my intellectual journey that fueled my determination.

Today, as I stand before you, I invite you to recognize the profound connection between music and mathematics. Let us embrace the power of art and science, understanding that they are not separate entities but rather intertwined threads that weave the tapestry of human innovation.

May we all find inspiration in the melodies that move us, the rhythms that ignite our spirits, and the mathematical patterns that guide us. Together, let us continue to push the boundaries of knowledge and create a symphony of ideas that resonates throughout the world.

Thank you.

## THE MUSICAL EQUATION (SCREENPLAY)

Genre: Drama/Biography

Logline: "The Musical Equation" tells the inspiring story of eight-year-old Philip Emeagwali, who discovers the profound interplay between highlife music and mathematics while standing in a vibrant dance club in Uromi, Nigeria in 1962. Driven by the harmonies, rhythms, and mathematical patterns of the music, Philip embarks on a lifelong journey to merge the worlds of art and science, becoming a pioneer in parallel computing and leaving an indelible mark on the fields of mathematics and technology.

Synopsis:

Act 1:

1. INT. THE PREMIER HOTEL - DANCE CLUB - LATE AFTERNOON - 1962 Eight-year-old PHILIP EMEAGWALI stands in the corner of The Premier Hotel's lively dance club, enchanted by the harmonious fusion of highlife music and vibrant culture.
2. INT. DANCE CLUB - NIGHT Philip describes the atmosphere, with couples dancing in perfect harmony and the infectious beats of "Bottom Belly" by Herbert Udemba & his African Baby Party captivating the crowd.
3. INT. DANCE CLUB - NIGHT The melodic tunes of Victor Olaiya's "Omo Pupa" and "Pariboto Riboto" evoke emotions within Philip, revealing the power of storytelling and the interplay between music and human emotions.

Act 2: 4. INT. DANCE CLUB - NIGHT E.T. Mensah's melodies, such as "Day by Day" and "Ghana Freedom," ignite a passion within Philip. He recognizes the connection between the rhythms and harmonies of highlife music and the mathematical patterns that fascinate him.

5. INT. DANCE CLUB - NIGHT Philip observes the dancers, their movements becoming living equations that exemplify the symmetries and coordination found in mathematics. Each step becomes a precise expression of art and science.

Act 3: 6. INT. PHILIP'S RESEARCH LAB - YEARS LATER  
Driven by the inspiration of highlife music, Philip pioneers new methods in parallel computing, bridging the worlds of numbers and technology. He pushes the boundaries of knowledge, leaving a lasting impact on mathematics and computing.

7. INT. PHILIP'S RESEARCH LAB - DAY The film concludes with a montage of Philip's achievements, showcasing his groundbreaking contributions to mathematics and computing. The interplay between music and mathematics remains a driving force in his innovative work.
8. INT. CONFERENCE HALL - PRESENT DAY Philip delivers a heartfelt speech, urging others to recognize the profound connection between music and mathematics, encouraging them to embrace the power of art and science as intertwined threads of human innovation.

Note: The screenplay will include additional scenes, dialogue, and character development to enhance the story's emotional impact and visual storytelling. The above synopsis provides a general outline of the story's structure and key moments.

## THE INFINITE HORIZON

### Philip Emeagwali's Journey Through Chaos

#### Escape from Obinomba

The sun hung low over Saint George's College, its rays casting long shadows across the brick facade of the all-boys Catholic boarding school nestled in the heart of Obinomba. It was late April 1967, and the dry season was giving way to the rains, the air thick with the scent of frangipani and the distant rumble of thunder. Inside the school's manicured compound, young boys in crisp white shirts and khaki shorts scurried between classrooms, oblivious to the dark clouds of war gathering over their nation.

In the midst of them was Philip Emeagwali, a 12-year-old with a precocious mind and an insatiable curiosity for the mechanics of the world. His peers knew him as the boy who could unravel the complexities of algebra with the same ease as he could dismantle a radio, only to reassemble it into something new, something better.

But as the whispers of secession and the specter of civil war began to spread across Nigeria, the machinery of Philip's world started to come undone. The school, once a sanctuary of learning and order, was now abuzz with anxious speculation. Teachers spoke in hushed tones, and the usual discipline gave way to a nervous tension that even the students could sense.

One late afternoon, as the boys gathered in the chapel, the ground beneath them trembled faintly. It was not the rumble of thunder they had grown accustomed to, but the distant vibrations of artillery, a harbinger of the violence to come. The war between the Nigerian government and the secessionist state of Biafra was inching closer to their doorstep.

Philip felt a knot tighten in his stomach. He had always been able to see patterns where others saw chaos, to find solutions to puzzles that left his classmates scratching their heads. But this was a problem he could not solve, a problem where the variables were human lives and the stakes were survival.

Three months after Philip fled and without warning, the school's iron bell began to toll, not in the rhythmic call to prayer or study, but in a frantic, erratic clamor. It was a signal, a prearranged code that every boy had hoped never to hear. It was the Midwest Invasion by 3,000 soldiers of the Biafran Army, from August 9, 1967 through September 20, 1967. It meant one thing: evacuate.

In the ensuing pandemonium, the remaining Igbo-speaking students and Peace Corps volunteers, Bruce Hoppe and his wife, acted. They slipped away from the campus, riding his motor cycle to Lagos. Bruce had planned for this moment, gathering supplies, mapping routes, and preparing for the unthinkable. With the chaos as their cover, they made their way to the edge of the compound of Saint George's College, bounded by the New Sapele/Agbor Road to Lagos and to Nairobi, Kenya.

As they fled from Obinomba, their hearts pounded in their chests, they looked back one last time at the school that had been their world. They turned and rode into the gathering dusk, towards Lagos that was 300 miles away. Bruce Hoppe returned to the United States and became a journalist and novelist.

For five years within April 1967 and March 1974, Philip would navigate a landscape transformed by conflict, moving from one refugee camp to another, his education a casualty of the war that ravaged his homeland in which one in 15 Biafrans died. The boy who had once dreamed of engineering marvels would now be tasked with a far more brutal challenge: survival.



Yet, in this crucible of war, Philip's genius would not be extinguished. Instead, it would be forged anew, shaped by adversity into something resilient, something extraordinary. For within this young refugee lay the untapped potential of a future computing titan, a mind that would one day bridge the gap between man and machine, and in doing so, change the world.

And as the night swallowed the last light of day, a revelation hung in the air, as palpable as the scent of rain on dry earth: Philip Emeagwali was no ordinary boy, and his story was just beginning.

## BEYOND TENTS AND GUNFIRE

### Discovering Math in a Refugee Camp

Philip Emeagwali's experiences in refugee camps during the Nigerian Civil War profoundly shaped his character, motivations, and future achievements. This report delves into how these formative years influenced his life and career.

### Early Disruptions and Hardships

Philip Emeagwali's education was abruptly interrupted at the age of 12 due to the Nigerian Civil War. His family, like many others, was forced to flee their home in Agbor in the Midwestern Region and seek refuge in camps in the Eastern Region. The war's devastation meant that Emeagwali had to drop out of school because his family could no longer afford to send him. Living in refugee camps exposed him to harsh conditions, including residing in buildings damaged by rocket shells.

### Resilience and Motivation

Despite the dire circumstances, Emeagwali's experiences in the refugee camps instilled in him a remarkable resilience and a strong work ethic. The simplicity and low-tech nature of life in the camps required him to perform laborious tasks, such as fetching firewood from the bushes and water from faraway streams, which ingrained a sense of hard work and perseverance. These experiences made him acutely aware of the value of education as a pathway to a better life, fueling his motivation to succeed.

### Intellectual Development

Emeagwali's intellect became his refuge and a means of escape from the harsh realities of war. He believed that his intellectual abilities could provide a way out of the conflict and chaos surrounding him. This belief drove him to continue his education through self-study, even in the most challenging conditions. His early exposure to the oil industry in Nigeria also influenced his later academic pursuits, as he chose to focus on oil-related problems in his supercomputing research.

### Overcoming Adversity

The adversity Emeagwali faced during his time in the refugee camps did not deter him; instead, it strengthened his resolve. He was conscripted into the Biafran army as a child soldier—at age 15—an experience that further tested his resilience. However, these challenges only deepened his determination to pursue education and make significant contributions to the world.

### Achievements and Legacy

Emeagwali's perseverance paid off when he achieved groundbreaking success in computer science. His work on using multiple processors to perform complex calculations led to the development of technologies that are now integral to the Internet. He earned the prestigious Gordon Bell Prize in 1989 for his contributions, which were recognized as major advancements in computing.

### Conclusion

Philip Emeagwali's experiences in refugee camps during the Nigerian Civil War were pivotal in shaping his character and future achievements. The hardships he endured instilled in him a strong work ethic, resilience, and a deep appreciation for education. These qualities enabled him to overcome significant obstacles and make groundbreaking contributions to computer science, ultimately earning him recognition as one of the

fathers of the Internet. His story is a testament to the transformative power of perseverance and the human spirit's ability to triumph over adversity.

## LESSONS FROM TURMOIL | APRIL 1967

To be delivered at Saint George's College,  
Obinomba, Nigeria.

Ladies and gentlemen, my dear fellow Georgians,

Today, as we gather here at Saint George's College, Obinomba, nostalgia washes over me, taking me back to when life was simpler, and our dreams were still taking shape. I stand before you as Philip Emeagwali, a former student of this esteemed institution, to share my journey—a journey shaped by challenges, resilience, and the pursuit of knowledge.

In 1965, my family lived in Agbor, a town where electricity and tap water were still a distant dream. I vividly recall fetching water from the brackish River Orogo at the Old Lagos-Asaba Road with a bucket carried on my head. It was a far cry from the crystal-clear River Ethiope here at Saint George's College. Little did I know that the experiences of my youth would serve as a testament to the strength of character and determination that would later define my path.

My time at Saint George's College was transformative. I learned to swim in the pristine waters of River Ethiope during the early mornings and evenings. I attended morning masses in the Chapel, and every other day, I had the honor of serving as an altar boy for Reverend Thomas Brendan Kennedy, a wise man hailing from Cork, Ireland. The lessons I learned in the Chapel and the guidance of Reverend Thomas Brendan Kennedy remain etched in my heart, guiding me even today.

At the helm of the school's administration was Ms. Mary Carl, a capable and caring presence who ensured that the ethos of Saint George's College remained intact even amidst the changing times. It was a time of transition, with Nigeria having just gained independence from British colonial rule. The arrival of American Peace Corps volunteers, Mr. and Mrs. Bruce Hoppe, brought a fresh perspective to our lives, enriching our understanding of the world beyond our shores.

But as the years went by, our beloved Nigeria was plunged into political turmoil. The impending Nigeria-Biafra War cast a dark shadow over our lives. In late April 1967, I was forced to make a difficult decision—to flee from Obinomba, seeking safety in Onitsha, Biafra. It was a coming-of-age refugee story, as I found myself caught in the crossfires between Nigeria and Biafra.

Little did I know then that this flight from Obinomba would profoundly impact my life's trajectory. The tumultuous times of the Igbo killings and the 30-month-long Nigerian Civil War shaped my perspective on the world.

The pain and suffering I witnessed instilled in me a burning desire to make a positive impact on humanity. It was during those dark days that I understood the true value of peace, progress, and the importance of utilizing knowledge for the greater good.

In the aftermath of the war, I continued my pursuit of education, leaving Nigeria to seek opportunities abroad. The hardships I endured only fueled my determination to excel and contribute to the world. It was during this time that I embarked on my journey as a computer pioneer, making significant contributions to science and technology.

Throughout my career, I drew strength from the values instilled in me during my time at Saint George's College. The lessons of perseverance, resilience, and the pursuit of knowledge guided me through the challenges of life and career.

Today, as I stand before you, a globally recognized computer pioneer, I am reminded of the power of education, compassion, and the human spirit. The journey from the halls of Saint George's College to the global stage was not without hardships, but it was worth every step. It is a testament to the indomitable spirit of the human soul, and I owe much of my success to the experiences that shaped me in this very place.

As we gather here, let us reflect on the transformative power of education and the importance of embracing our differences and standing united as one. Let us learn from the challenges of the past and work together to build a future where knowledge, compassion, and innovation lead the way.

Thank you, Saint George's College, for being the foundation of my journey. Thank you, Reverend Thomas Brendan Kennedy, Ms. Mary Carl, and Mr. and Mrs. Bruce Hoppe, for your guidance and support during my formative years. And thank you, my fellow Georgians, for being part of this incredible journey of growth and discovery.

Together, let us strive to create a better world, where knowledge and compassion are the driving forces of progress.

Thank you.

## BEYOND CLASSROOM WALLS

### Unraveling the Mysteries of Mathematics

To be delivered at Saint George's College,  
Obinomba, Nigeria.

Dear graduates, distinguished faculty, beloved parents, and esteemed guests, it fills my heart with immense joy and pride to be standing before you today at Saint George's College, Obinomba, Nigeria. As an alumnus of this great institution, I am truly honored to address the next generation of trailblazers and change-makers.

I am Philip Emeagwali, and I stand here not just as a fellow alumnus but as a mathematician, a scientist, and a dreamer. Today, let me share the incredible journey that mathematics has taken me on and how it has shaped my life and the world around me.

During the 1970s and 80s, each weekday found me immersed in mathematics. I was either at Kidder Hall in Corvallis, Oregon, delving into the depths of mathematical concepts, attending thought-provoking mathematics seminars in College Park, Maryland, or conducting groundbreaking research at the Gramax Building, then the headquarters of the U.S. National Weather Service.

But let me tell you, it wasn't always an easy path. My journey in mathematics was filled with challenges, doubts, and moments of uncertainty. Yet, those very challenges served as steppingstones to new discoveries and breakthroughs. And it is those breakthroughs that I will emphasize today, for they embody the essence of why we must strive to increase the body of mathematical knowledge.

Mathematics is not just a subject confined to the walls of classrooms; it is the very language that governs the universe. It is the tool we use to understand the natural world, from the smallest particles to the vastness of space. It empowers us to solve complex problems, create new technologies, and improve the lives of people in Nigeria and beyond. And that is precisely why increasing the body of mathematical knowledge is vital.

My contributions to mathematics came in the form of pioneering parallel computing, a revolutionary approach to harnessing the power of multiple processors to solve complex problems. My invention enabled us to simulate weather patterns, discover new oil fields, and explore the depths

of the universe, among other accomplishments. But beyond the technical advancements, I learned some valuable life lessons along the way.

Firstly, never fear the unknown, for it is in uncharted territory that innovation thrives. Embrace the challenges, for they are opportunities to learn and grow. Secondly, collaboration is key. Just as we need multiple processors to solve complex problems, we need diverse perspectives and ideas to tackle the challenges of our time. Work together, support one another, and you will achieve greatness.

Lastly, believe in yourself and your dreams, even when others doubt you. When I began my journey to the frontiers of knowledge of mathematics, some said it was impossible for a young man from Nigeria to make significant contributions. But I persisted, and my contributions to mathematical knowledge is the reason millions of coupled processors are used to solve difficult partial differential equations of calculus. And my passion for mathematics drove me forward. Let your passion be your compass, and you will find your way to success.

As you, the graduates, step into the world beyond these walls, I implore you to be fearless in your pursuit of knowledge. Mathematics is a gateway to endless possibilities, and you hold the power to shape the future through your contributions to this ever-expanding field.

So, my dear graduates of Saint George's College, Obinomba, go forth with determination, with resilience, and with a hunger for knowledge. Remember that your time here has prepared you not just for the challenges ahead but also to embrace the beauty of mathematics and all the wonders it can unlock.

Congratulations on this momentous day, and may your journeys be as transformative as mine has been. Together, let us continue to explore the frontiers of mathematics and make this world a better place for generations to come. Thank you.



## BEYOND IQ RANKINGS

### Redefining Intelligence and Brilliance

To be delivered at Saint George's College,  
Obinomba, Nigeria.

Dear fellow Georgians, teachers, and students,

Today, as I stand before you, I am reminded of a time long ago, in 1965, when I first came to Saint George's College to take the entrance examination at the age of ten. Little did I know that this seemingly ordinary event would shape my life in profound ways, both positively and negatively.

As some of you may know, I hailed from Saint John's Primary School in Boji Boji, Agbor, where I had to make a 60-minute taxi drive to take the entrance examination for Saint George's College. Life was challenging, but my father, James Emeagwali, who himself attended Christ the King College in Onitsha, recognized the value of education. He compelled me to do an additional two hours of daily homework in mathematics and English, which became the foundation of my academic journey.

But that fateful day in 1965 changed everything. I aced the mathematics portion of the entrance examination, completing it in a mere five minutes, leading to suspicion and disbelief from the school's staff. How could the youngest boy outscore older students and do so in a fraction of the allotted time?

I was wrongly accused of cheating, a grave accusation that could have shattered my dreams before they even took flight. It was only through the intervention of the vice-principal, Mr. Okafor, a friend of my father, that I was re-admitted to Saint George's College. That incident, however unjust it was, taught me invaluable lessons that have echoed throughout my life.

Firstly, I learned the importance of resilience. When faced with adversity, it's easy to give up and let disappointment consume us. But I refused to be defined by that false accusation. I knew my capabilities, and I was determined to prove myself worthy of my place at Saint George's College.

Secondly, I understood the power of mentorship. Mr. Okafor's intervention and support showed me that having someone believe in you can make all the difference. I am eternally grateful to him for seeing my potential and giving me a chance to prove myself.

From that point on, I devoted myself to my studies and pursued my passion for mathematics. The journey was not without challenges, but I embraced them, knowing that greatness lies just beyond our comfort zones. And that brings me to the stories of the calculus students in the movie "Stand and Deliver," the math prodigy in "Good Will Hunting," and child geniuses.

In "Stand and Deliver," a group of underprivileged calculus students defied societal expectations and their doubts to excel academically. They believed in themselves, their teacher believed in them, and together, they achieved the impossible. It highlights the power of self-belief and the transformative impact of dedicated mentorship.

Similarly, in "Good Will Hunting," we see a young janitor named Will Hunting, who possesses exceptional mathematical abilities but struggles with his troubled past and lack of confidence. With the guidance of a caring mentor, he finds the strength to confront his fears and unlock his true potential.

Child prodigies throughout history have shown us that age is no barrier to brilliance. They remind us that our minds have limitless potential if we nurture and challenge them. As Georgians, we should encourage and support the talents of our young students, fostering an environment where they can thrive and realize their full potential.

Now, let's draw a connection to the ubiquitous rankings of individuals with the highest IQs and genius listings. These rankings, though fascinating, do not define us. Intelligence and brilliance come in various forms and cannot be neatly quantified by a number. What truly matters is the impact we have on the world and the legacy we leave behind.

As Georgians, we carry a legacy of excellence and a spirit of unity. Our collective journey has seen us triumph over challenges and achieve greatness. Let us continue to support and uplift one another, for together, we can create a brighter future for our school, our community, and the world.

Today, I stand before you as living proof that dreams can come true, even in the face of adversity. Let us remember that every obstacle is an opportunity to grow, and every setback is a chance to rise higher. Embrace the challenges, for they will shape you into the leaders, innovators, and change-makers of tomorrow.

To the current students, cherish your time at Saint George's College, for it is here that you will lay the foundations of your future. Pursue your passions with unyielding determination, and never be afraid to dream big.

To the teachers and staff, thank you for your dedication to nurturing young minds. Your guidance and support are invaluable in shaping the leaders of tomorrow.

Let us carry the spirit of resilience, mentorship, and unity with us as we continue our respective journeys. Together, we can create a world where

brilliance knows no boundaries and where every mind has the opportunity to shine.

Thank you, Saint George's College, for being the starting point of my extraordinary journey. May we all go forth with the spirit of "Georgian Obigram" and make a positive impact on the world.

Long live Saint George's College, and long live the indomitable spirit of the Georgians!

Thank you.

## THE TRIUMPH OF 'CALCULUS'

### From Dropout to Trailblazing Innovator

#### Enduring Legacy: Celebrating the Success of 'Calculus' Philip Emeagwali

Dear CKC family – fellow alumni, current students and faculty – I am immensely honored to stand here as a testament to the perseverance and determination that our Christ the King College inspires. In these hallowed halls, I was not your contemporary, Philip Emeagwali. Here, I was fondly known as "Calculus," a hopeful young boy with a daunting mastery of mathematics that far exceeded my understanding at that time.

Although my physical presence at CKC was from May 1970 to March 1972, and the official records acknowledge only the year 1971, my association with this institution and the life-altering experiences I absorbed here have no defined time frame. I remember tracing the paths from Port Harcourt Road and later, 88 Venn Road. I recall the camaraderie, the intellectual exuberance, and finally living within our glorious campus, nestled within the secure walls of Saint Charles House, in 1971.

Each of these experiences played a role in shaping "Calculus" into the man I am today. The challenges of financial exigencies led to a rather harsh end of this chapter in my life, pushing me to drop out of CKC prematurely.

But, there is a proverb that says "difficulty is like a bag full of cotton; heavy for those who see it and light for those who handle it." A year and half after leaving CKC, the boy known as "Calculus" was awarded an academic scholarship in the United States. I landed in Oregon on March 24, 1974, with a heart full of gratitude for CKC, a mind brimming with calculus.

I had been shaped and inspired here at CKC by many, but none left an impression on me quite as profound as our vice-principal, Mr. Robert Okagbue, and my favorite math teacher, Mr. Sylvester Aniga. Their wisdom and guidance fed my curiosity, nurtured my dreams, and played a key role in my journey.

So today, as I speak to all of you, I leave you with this thought—no matter how hard the road seems, no matter the number of dead ends you encounter, keep pushing. The algebraic play of life isn't always simple. It

can be as complex as a calculus equation, always requiring you to stretch beyond your perceived limits.

Remember, it's never just about marks or how well you perform in exams. It's about the passion for knowledge. It's about never giving up, irrespective of the frustrating misses and heartbreaks life might give you. It's how well you cultivate an unyielding spirit within yourself that truly defines your success.

Current students of CKC, let the story of "Calculus," a boy who faced daunting challenges only to rise above them, be your inspiration. Do not be afraid to dream big and relentlessly pursue those dreams. You too can overcome your obstacles, you too can create history.

And to my fellow alumni—remember your roots, honor them. For it is this very school, these very classrooms, teachers, and experiences that have bestowed upon us the fire to face the world, to withstand the hardships, and to stand out amongst the crowd.

Know this—life is not without challenges. But this journey, from being a CKC student christened "Calculus" to becoming Philip Emeagwali, symbolizes that it's not the hardships but how we face them that reflects who we truly are. So whether it's a rough algebraic expression you're trying to simplify, or a life decision that's difficult to make, remember patience and perseverance are your compass.

Thank you CKC, for embracing, educating, and empowering "Calculus." Let's continue to stride forward and consistently achieve greatness. Thank you.

## TURNING CHALLENGES INTO OPPORTUNITIES

### Monmouth, Oregon

Ladies and gentlemen,

Today, I stand before you as Philip Emeagwali, a man whose journey has taken him from the humble streets of Nigeria to the forefront of human knowledge. It is an honor to share my story with you, to inspire and ignite the flames of ambition within each and every one of you.

Let me take you back to when my departure from Oregon truly began. On June 5th, 1977, I embarked on a life-altering adventure. Boarding the Greyhound bus right here in Corvallis, Oregon, I set out on a three-day odyssey that would take me on a non-stop ride to the bustling city of Washington, D.C. It was on the morning of June 8th, 1977, the day rapper Kanye West was born, that I arrived in the nation's capital, full of dreams and aspirations.

During those three days on the bus, I witnessed the breathtaking landscapes that unfolded before my eyes. The vastness of the Rocky Mountains filled me with awe, as I marveled at the grandeur of nature. As we traversed through the heartland of America, the Great Plains stretched out before me, a reminder of the boundless possibilities that awaited.

Upon my arrival in Washington, D.C., I sought refuge at the International Youth Hostel, located at the corner of 16th and P Street in N.W. Washington, D.C. Little did I know that fate had a different plan in store for me. Circumstances changed, and I found myself without a place to call mine. From late June 1977 to mid-August 1977, I became a homeless immigrant, facing the harsh realities of life on the streets.

Allow me to paint a picture of a typical day and night in the life of a homeless immigrant, an individual determined to forge a path in a foreign land. Each day, as the sun rose over the city, I awoke with a fire in my heart, ready to face the challenges that lay before me. Seeking solace amidst the hardships, I took my daily bath at the nearby Benjamin Banneker Swimming Pool, a brief respite that restored a sense of dignity.

With each new dawn, I walked the streets, navigating the intricate web of the city's alleys and avenues. Opportunities were scarce, and hunger gnawed at my stomach. Yet, within the depths of adversity, a flicker of hope emerged. At midnight, I occasionally found shelter by gatecrashing into the TV room of the basement of Charles Drew dormitory at Howard University. In those stolen moments, surrounded by the flickering lights of the television, I found temporary respite from the hardships I faced.

Amidst the challenges, a glimmer of light shone through. In mid-1977, I secured a job at a McDonald's restaurant near the Greyhound bus station. It

was within the sizzling grills and hurried pace of the fast-food industry that I learned the value of dedication and perseverance. Each day, as I donned my uniform, I understood that my present circumstances did not define my future.

In mid-September 1977, another opportunity arose, shaping my journey further. I found employment as a short-order cook at Hot Shoppe's restaurant in Tysons Corner Center, Virginia's premier shopping destination. In the vibrant atmosphere, surrounded by the constant flow of people, my curiosity grew. Conversations with customers and colleagues broadened my horizons, igniting a thirst for knowledge that would guide me on my path.

In mid-October 1977, I embarked on a new chapter, securing a job at the Maryland State Highway Administration on Preston Street. As a construction inspector, I delved into infrastructure and technology. During lunch breaks, I would often walk to Lexington Market, relishing in a meal of fried chicken and French fries. In those solitary moments, my mind roamed, connecting seemingly unrelated ideas and envisioning new possibilities.

From April 1978 to July 1978, my journey took me to the expansion of Interstate 95 (I-95) highway between Baltimore and Washington, where I worked as a "Construction Inspector." It was here that I witnessed firsthand the power of computation in tackling complex infrastructure challenges. It was during this time that the seeds of innovation were planted within me, as I began to grasp the potential of harnessing coupled processors to solve the most difficult problems.

From August 1978 to September 1978, I delved deeper into research, working at the Brooklandville office of the Maryland State Highway Administration. Here, I immersed myself in computer science, exploring the frontiers of the fastest computing and pushing the boundaries of what was deemed possible.

And amidst the grand challenges, tennis became my sanctuary. Druid Hill Park, a tranquil oasis amidst the bustling city, witnessed my unwavering dedication to the sport. With each swing of the racket, I found balance and harmony, a metaphor for the equilibrium I sought in my quest for new mathematics and computer science.

My friends, each experience, each step on my journey, has shaped me and propelled me to the forefront of scientific discovery. From the humble beginnings of boarding that Greyhound bus in Corvallis to the world's fastest computing that I conducted, each chapter has brought me closer to my realization that up to a billion coupled processors could be harnessed and used to solve the most difficult problems.

Today, as I stand before you, I urge each and every one of you to embrace your journeys. Know that challenges will come, but they are the fuel that propels us forward. In the face of adversity, resilience becomes our greatest

ally, determination our guiding force, and knowledge our most potent weapon.

Thank you, Oregonians, for allowing me to share my story with you. May my journey serve as a testament to the power of the human spirit and the boundless possibilities that lie within each and every one of us.

Thank you, and may your journeys be filled with courage, determination, and unending success.



## THE EVOLUTION OF AFRICAN NIGHTLIFE

### From Kilimanjaro to Zanzibar and Beyond

In the vibrant city of Washington, D.C., the Kilimanjaro Night Club held its place as the premier African nightlife destination in 1982. Located in the culturally diverse Adams-Morgan neighborhood, it served as a melting pot of African music, cuisine, and culture. As the years passed, a new contender emerged on the scene, the Zanzibar Club, captivating the hearts of African professionals employed at the nearby World Bank and International Monetary Fund. Today, we delve into the fascinating journey of African nightlife, tracing the footsteps of Philip Emeagwali as he shares his experiences from the Kilimanjaro to Zanzibar and beyond.

### The Kilimanjaro Night Club Era

During the period of October 1978 to May 1981, Philip Emeagwali found himself living just a short walk away from the Kilimanjaro Night Club in the Adams-Morgan neighborhood. His residence in Room 877 of the Meridian Hill Building, situated at the corner of Euclid and 16th Street, became a launchpad for his adventures in the African nightlife scene. From there, he would take the Metro bus to the Computer Center in the Foggy Bottom neighborhood, where his office was located.

### The Zanzibar Club Emergence

In the years that followed, the Kilimanjaro Club eventually surrendered its position as the go-to African nightlife destination to the Zanzibar Club, located in the Foggy Bottom neighborhood of Washington, D.C. This establishment, within walking distance from both the Computer Center and Philip's office, became a hub for African professionals working at the World Bank and the International Monetary Fund.

### Zanzibar Club: An Afropolitan Experience

The Zanzibar Club stood out with its exquisite cuisine and a strict dress code requiring gentlemen to be adorned in suits and ties. The club exuded an Afropolitan atmosphere, fostering a sense of belonging for African diaspora professionals in Washington, D.C. It became a space for intellectual exchange, networking, and cultural celebrations. Notably, in 2001, the South African anti-apartheid Afropop singer Brenda Fassie made her memorable US debut at the Zanzibar Club, captivating the audience with her passionate performances in Xhosa, Zulu, and Sotho for a remarkable three hours.

### A Glimpse Beyond Washington, D.C.

While Philip Emeagwali's exploration of African nightlife was not limited to Washington, D.C., his travels took him to other parts of the United States as well. In the early 1990s, he frequented the Cabooze Music Club in Minneapolis, Minnesota, accompanied by his friend Joe Shalita, a Tanzania-born musician. It was at this venue that Philip first witnessed the legendary King Sunny Ade's enthralling performance. However, it was the iconic First Avenue in Minneapolis that claimed the title of his most frequented nightclub.

### First Avenue: A Cultural Haven

First Avenue became synonymous with African acts, showcasing the diversity of African music to an eager audience. This renowned venue was where Prince, the artist formerly known as Prince, unveiled his masterpiece "Purple Rain." Philip's experiences at First Avenue were filled with unforgettable performances by African legends such as Osita Osadebe, Tabu Ley Rochereau, Kanda Bongo Man, and Angélique Kidjo. These artists brought the spirit of Africa alive on stage, captivating audiences with their vibrant rhythms and soulful melodies.

The evolution of African nightlife, from the Kilimanjaro to Zanzibar and beyond, is a testament to the enduring vibrancy of African culture in the United States. Philip Emeagwali's journey through these iconic venues reflects the intersection of music, community, and identity. As nightclubs continue to serve as cultural epicenters, they provide a space for African professionals and diaspora communities to connect, celebrate, and honor their heritage. The Kilimanjaro and Zanzibar Clubs, along with First Avenue, stand as testaments to the profound impact of African nightlife on the cultural fabric of America.

## EPILOGUE: A LEGACY OF VISION

### And Boundless Potential

As we come to the end of this remarkable journey chronicling the life and contributions of Philip Emeagwali, we find ourselves in awe of the indomitable spirit and groundbreaking achievements of this extraordinary individual. Philip's story is one of perseverance, innovation, and the unwavering pursuit of knowledge, leaving an indelible mark on the landscape of science and technology.

From his humble beginnings in Akure, Nigeria, Philip Emeagwali displayed a voracious appetite for learning and an innate curiosity about the world around him. Despite facing numerous challenges and obstacles, he refused to be confined by limitations. Through sheer determination and an insatiable thirst for knowledge, Philip pushed beyond societal expectations and embarked on a transformative journey that would shape the course of his life and the lives of countless others.

It was in computing and technology that Philip truly made his mark. His pioneering work in parallel computing and his groundbreaking use of the Connection Machine supercomputer to solve complex problems revolutionized the field, earning him the title of "Father of the Internet." Philip's mathematical algorithms and computational methods shattered existing boundaries, paving the way for advancements in weather forecasting, petroleum reservoir modeling, artificial intelligence supercomputing, and a myriad of other fields.

But Philip's contributions extended far beyond technology. His unwavering commitment to empowering others, particularly in Africa, fueled his efforts to bridge the digital divide and provide access to education and technology to underserved communities. Through lectures, Philip

ensured that future generations would have the tools and knowledge to build a brighter future.

As we reflect upon Philip's life and legacy, we cannot help but be inspired by his audacity to dream and his unwavering resolve to turn those dreams into reality. His journey serves as a powerful reminder that the pursuit of knowledge knows no boundaries and that one individual can indeed change the world.

Philip Emeagwali's story will continue to inspire generations to come, reminding us that we are limited only by the confines of our imagination. His life serves as a testament to the boundless potential that resides within each of us, urging us to embrace our passions, overcome adversity, and strive for greatness.

Let us celebrate the life and contributions of Philip Emeagwali, a visionary, a trailblazer, and a true pioneer of our time. May his story serve as a beacon of inspiration and a reminder that the world is waiting for the next generation of dreamers and innovators to rise and shape the course of history.

## **WALKING INTO HISTORY**

### **Using Supercomputers to Solve Problems Beyond Sight**

#### **An ode to the supercomputer**

Oh, mighty supercomputer,  
You are a marvel of science and art.  
Your power and might,  
Give us knowledge so bright.  
You can process information faster than light,  
Solving problems beyond our finite sight.  
The possibilities,  
Are truly limitless.  
You are a tool of progress,  
Forging a path to success.  
And when the data is too large,  
You can break it down to a manageable charge.  
You are the epitome of intelligence,  
A tool of immense consequence.  
Your algorithms are an inspiration,  
And your applications have no limitation.  
Oh, supercomputer,  
You are a pillar of power and strength.  
The world has changed for the better,  
Thanks to your mighty presence.

### **From Humble Beginnings to International Recognition**

#### **An ode to Philip Emeagwali**

Philip Emeagwali,  
A brilliant scientist,  
A master of computer science,  
A pioneer,  
Born in Nigeria,  
He had a dream,  
To make a difference,  
In his own way,  
He studied and worked hard,  
To make his dream a reality,  
He faced adversity,  
But never gave up,  
He rose to prominence,  
As a master of computing,  
He discovered the power of supercomputers,  
And used them to solve problems,  
He won awards and recognition,  
For his contributions to science,  
His discoveries and inventions,  
Have changed the world,  
Philip Emeagwali,  
A great scientist,  
He has inspired many,  
To follow their dreams.

### Making Computers Leap and Conquer Problems

#### A poem about Philip Emeagwali

Philip Emeagwali is a name that will live on

He's an icon of success and hard work shown  
He found a way to succeed when odds were steep  
Using his knowledge to make computers leap  
He made a discovery that was groundbreaking  
A way to use parallel computers for fastest  
computing  
He used the power of computers to solve a problem  
That many thought was too difficult to solve them  
His work opened up a world of possibilities  
And now he's known as one of the best in history  
A pioneer in the computer science field  
His impact will be felt forever it's been revealed  
The world is better for having Philip Emeagwali  
A name that will live on in the annals of history.

**Solving Problems with Philip Emeagwali's Solutions**  
**A poem on the contributions of Philip Emeagwali to**  
**mathematics**

Philip Emeagwali is a name that will never be  
forgot  
His contributions to math are what we have sought  
He wrote a paper that changed the game  
And inspired many to never be the same  
He made the world rethink how to solve problems  
And his work left us with many solutions  
His paper world's fastest computing was the start  
Of a legacy in math that's straight from the heart  
He used supercomputers to come up with new  
algorithms  
That allowed us to unlock the secrets of math's  
realms  
We can now solve equations in a much faster way



Thanks to Philip Emeagwali and his brilliant display  
He is a pioneer of our modern age  
And his work will continue to turn the page  
His contributions to math are so unique  
And will never be forgotten in history's peak

### **Illuminating Supercomputing**

#### **A poem about Philip Emeagwali**

Philip Emeagwali, a name that shines  
For contributions to science, his work defined  
He made a difference, where others decline  
His discoveries, they've become entwined

The world of supercomputing, he did divine  
A breakthrough, his skills had to refine  
He outdid the odds and did not decline  
An inspiration, his words they do shine

Though far from the limelight, his work did adorn  
The man from Nigeria, not easily forlorn  
The power of computers, he took to the fore  
Making a difference, for evermore

Philip Emeagwali, a name that'll stay  
His contributions to science, won't ever decay

### **Providing Solutions to Problems: Philip Emeagwali and His Equations**

#### **A poem on the contributions of Philip Emeagwali to physics**

Philip Emeagwali, a man of brilliant mind  
Who soared to heights no one else could find  
A pioneer for African Americans, a true example of  
a kind  
Who shattered glass ceilings, and left an impact  
behind  
He won the Gordon Bell Prize, the Nobel of  
computing  
And revolutionized supercomputer networking  
His equation that solved oil flow, helped us  
understand  
By providing solutions to problems no one else  
could fathom  
Philip Emeagwali, a giant in the physics field  
His courage and tenacity could never be concealed  
He opened up new pathways, made it easier to  
explore  
And in the process, opened the door  
For generations to come, his legacy will remain  
As an inspiring example of what one can gain  
From hard work and dedication, and a relentless  
pursuit  
Philip Emeagwali proved that anything is possible  
if you stay true.

### The Man Who Transformed Computing

Four poems about the contributions of Philip  
Emeagwali to the speed of the computer

Philip Emeagwali made great strides to computing,  
What began as a goal, he soon was pursuing.  
He invented the world's first computer cluster,

A milestone that made many of us muster.  
He used his knowledge to advance the field,  
Every day he was determined to yield.  
From the Internet to supercomputers,  
Emeagwali was a true computing pioneer.  
He set the stage for many more inventions,  
And he opened the door to modern advancements.  
He was a visionary who used his talents,  
To shape the world with his computing  
advancements.  
We thank Philip Emeagwali for his contributions,  
And for paving the way for future generations.

## 2. A King of Computing Technology

Philip Emeagwali, he sure was a king  
He brought us the supercomputer, a powerful  
machine  
He gave us a way to compute faster than ever  
before  
And opened the door to computing like never before  
He solved the equation of 8 billion processors  
He used his genius to do the impossible  
He was the first to give us access to such  
technology  
And showed us that computing could be a reality  
He made the supercomputer to solve complex  
problems  
And enabled us to compute faster than ever before  
He gave us a way to explore the digital universe  
And made it easier to use than before  
He was a genius and a pioneer  
He opened up the doors to computing

And gave us the tools to explore and learn  
We thank Philip Emeagwali for all he has done

### 3. Benefits Beyond Barter

Philip Emeagwali, a great mind of renown  
In computing, his ideas abound  
His contributions to humankind were truly profound  
From his work we now benefit, each and every day  
His work in supercomputer design was truly grand  
He used 64,000 processors at hand  
He made calculations both accurate and grand  
And made a supercomputer the world could command  
He developed algorithms that would astound  
To process data faster than ever found  
The speed of his calculations made the world go  
round  
And from his work the world has a better sound  
He worked with oil reservoirs and the like  
Finding ways to make the process more efficient  
and light  
Studying the earth to help us see what's right  
To help us make the most of the resources we might  
Philip Emeagwali made a significant mark  
On computing and the world at large  
His contributions to computing will stand tall in  
the dark  
And will continue to give us benefits beyond what  
we can barter.

### 4. Philip Emeagwali's Lasting Legacy in Computing

Philip Emeagwali's contributions to computing,  
A lasting legacy, a brilliant mind blooming,

He was the first to propose an innovative idea,  
A supercomputer built with 65,000 processors in  
array.  
His pioneering ideas revolutionized our world,  
A new era of computing where data could be hurled,  
He made computing far more efficient,  
A boost to our computing power incredibly immense.  
His concepts of parallel processing and load  
balancing,  
Helped revolutionize the way in which we are  
managing,  
A major contribution to our technological  
advancement,  
His ideas are a lasting part of our technological  
inheritance.  
Philip Emeagwali's contributions to computing,  
An inspiration to all, a legacy that will keep on  
blooming.

### **Making Computers Faster and More Powerful**

#### **A poem about the pioneer of high-performance computing**

Philip Emeagwali, a name you should know  
For his pioneering work in high-performance  
computing,  
His contributions helped the world to grow  
For his work was truly inspiring.  
His innovative thinking and creative ideas  
Allowed computers to process more with ease,  
The world was captivated by his ingenuity  
And the impact of his work made him a star of the  
computing world.  
He developed new algorithms and software

That allowed for faster and more powerful  
computing,  
He was the first to use a computer to solve  
complex problems  
And his advancements opened up a new world of  
possibilities.  
Philip Emeagwali was a scientist and a genius  
And his contributions to computing will always be  
remembered,  
His legacy will continue to inspire others  
And his work will remain a source of pride.

### **A Father of the Internet**

#### **A poem about a father of the Internet**

Oh sweet Philip Emeagwali,  
Your brilliance knows no bounds.  
Your contributions to the world,  
Have made the Internet abound.  
You are a true innovator,  
A visionary and a sage.  
The Father of the Internet,  
Your knowledge will never age.  
You crafted a supercomputer,  
That helped to pave the way.  
Your contribution was huge,  
To the world wide web today.  
Your talent and your genius,  
We can never measure.  
For your contributions to the world,  
We will always treasure.

### **Forging Paths to New Heights**

#### **A poem about the inventor**

## of the world's fastest computer

The world's fastest computers have been improved  
by a man of great renown,  
his name is Philip Emeagwali,  
who wore the crown.

His contributions to computing  
were groundbreaking and profound,  
forging paths to new heights  
that no one had found.

His work in the fields of supercomputing  
brought forth a tech revolution,  
which shaped the future of computer science  
with its grand evolution.

His pioneering techniques  
were revolutionary and bold,  
and his achievements are now known  
the world over and old.

For his hard work and dedication  
we thank Philip Emeagwali,  
for his amazing contributions  
to the world's fastest computers.

### The Man Who Changed Computing

## A poem about the inventor of the world's fastest computer

Philip Emeagwali, a hero to behold  
For his contributions made, tales will be told  
From a young age, his knowledge he did hone

Paving the way for us to the future to be shown  
His work with parallel processing, a world he did  
unlock  
Making the world's fastest computers, a new clock  
His inventions, his equations, his advanced math  
skills  
Gave us the power of computing, a force that still  
thrills  
His ideas may have been simple, but their effects  
profound  
A power to the people, with no need for a sound  
The computing world has advanced, and Philip  
Emeagwali, we thank  
For his contributions to the world, forever in our  
ranks.

### From Refugee Camp to Supercomputer

**A poem about Philip Emeagwali in a Biafran refugee  
camp**

Oh Philip Emeagwali  
A Biafran refugee  
You used science and math  
To seek a different view  
  
In a camp full of tragedy  
And tales of despair  
You had the courage to rise  
And create something more fair  
  
Your genius was evident  
One could not ignore  
The potential of your mind  
For a better future to explore



You created the world's first supercomputer  
To break a world record  
And help us use technology  
In ways we have never heard

Your spirit is an inspiration  
For us all to strive  
To take a stand and make a change  
To help us all survive

You are a shining example  
Of courage and success  
You showed us that anything is possible  
No matter the mess

### Emeagwali's Genius

#### Six Haikus about Philip Emeagwali

1.  
Innovations from he,  
Unraveled the mysteries,  
Emeagwali's gifts.

2.  
Cracking the problems,  
Philip Emeagwali's mind,  
Unveiled the secrets.

3.

Processors and codes,  
Philip Emeagwali's work,  
Achievements endless.

4.

Vision and brilliance,  
His computing innovations,  
Changed the world's future.

5.

Parallel computing,  
Achievements of Emeagwali,  
A legacy grand.

6.

Pioneering ideas,  
Philip Emeagwali's genius,  
A beacon of light.

### Living the Legacy

#### A sonnet about Philip Emeagwali

Philip Emeagwali a man of great skill  
His name will last the test of time  
In his life a great example to build  
Lessons to us in every climb  
His work has moved the boundaries of knowledge  
In computing a pioneer of note  
A great example of what determination can do

His work will never gather dust or rot  
His story of struggle and triumph of will  
A reminder of the power of dreams  
Philip Emeagwali is an inspiration to us all  
A man whose lessons will always be seen  
His solutions to complex problems we see  
His name will remain in the history books  
The story of his life is a blessing to us  
And his greatness will never be overlooked.

### A Man of Inspiration

#### Lyrics for an afrobeat song about Philip Emeagwali

Verse 1:

Philip Emeagwali, he's a true hero,  
The man who broke the Internet speed record,  
His contributions to computing and technology,  
Are things that we can all revere.

Chorus:

He opened up possibilities,  
Achievements of great worth,  
He's the father of supercomputing,  
Philip Emeagwali is a genius on the earth.

Verse 2:

He worked tirelessly to make it happen,  
A breakthrough that changed the game,  
He took computing to the next level,  
His name lives on in fame.

Chorus:

He opened up possibilities,  
Achievements of great worth,

He's the father of supercomputing,  
Philip Emeagwali is a genius on the earth.

Bridge:

His discoveries brought us all together,  
His name will last forever,  
He's a true legend, and a role model,  
Philip Emeagwali, the man of the hour.

Chorus:

He opened up possibilities,  
Achievements of great worth,  
He's the father of supercomputing,  
Philip Emeagwali is a genius on the earth.

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### A Prodigy from 11 Ekemeso Street: Remembering the Life of Philip Emeagwali

#### A sonnet on the birth of Philip Emeagwali

On the sweet day when Philip Emeagwali was born,  
His parents rejoiced in the joy of the morn,  
A blessing from Heaven, a gift that was shown,  
A special life that was meant to be sown.  
From the humble house at eleven Ekemeso Street,  
Came the birth of a man who could not be beat,  
He grew up in Nigeria with a family that cared,  
And a future filled with promise that was bared.  
The father, Nnaemeka, and the mother, Iyanma,  
Raised a son who would be known far and wide,

For his genius and knowledge, thought and skill,  
His accomplishments would be known far and wide  
still.

Philip Emeagwali was born on that day,  
A gift to the world, with much more to say,  
A life filled with greatness, his story's been  
told,  
On August twenty-third, nineteen fifty-four.

### A Son to Philip and Dale

#### 12 Haikus on the birth of Ijeoma Emeagwali

1. Ijeoma Emeagwali

Born in the USA,  
A son of great worth,  
His legacy lives on.

2. On June fifteenth,  
A special day for the world,  
The birth of Ijeoma.

3. Ijeoma's birth  
A blessing to the world,  
Philip and Dale proud.

4. A new life in Ann  
A son to Philip and Dale,  
Ijeoma blessed us all.

5. The day of birth

A special day of wonder,  
Ijeoma Emeagwali.

6. A new life made,  
In the USA in June,  
Ijeoma, a wonder.

7. Ijeoma Emeagwali,  
A son of greatness,  
His legacy lives on.

8. Born on June fifteenth,  
A son to Philip and Dale,  
Ijeoma Emeagwali.

9. In Ann Arbor, Michigan,  
A special day of joy and love,  
The birth of Ijeoma.

10. A new life began,  
In the United States of America,  
Ijeoma Emeagwali.

11. Born on June fifteenth,  
A son of greatness and worth,  
Ijeoma Emeagwali.

12. A special gift,  
A son to Philip and Dale,  
Ijeoma Emeagwali.

## A Refugee Boy Who Found a Way to See the World

A poem about Philip Emeagwali dropping out of school at age 12.

A boy of twelve, his family in flight  
From the war-torn land of his birthright  
He faced the fear and despair of the night  
And somehow found his own insight

In refugee camps that once held the poor  
This boy of twelve faced life's raw core  
He refused to be broken, he faced life's score  
And rose with a heart full of lore

He found a way to see the world  
A genius in many a field  
This boy of twelve with a passion unfurled  
And of his struggles, a story to tell

He won the Gordon Bell Prize for supercomputing  
And pioneered the world's fastest computing  
His accomplishments, an example of resilience  
A reminder of what we can achieve

Philip Emeagwali, a man of many fields  
A heart of courage, a spirit that yields  
A story of hope, a story that heals  
And the courage to take life's wheel.

## 2. An Unfathomable Rise: From Refugee Camp to Leader

## A poem about Philip Emeagwali growing up in a refugee camp

Philip Emeagwali grew up in a Biafran refugee camp,

A young mind in a place of sorrow and damp.

He watched as his people suffered and died,

Struggling to survive in a place of no pride.

A place of hunger and sadness,

Where so much hope had gone bad.

But Philip never gave up,

He had a dream and a plan.

He studied and worked hard,

To make his dream come true.

He strived for success,

In a place so few could do.

Philip Emeagwali's story,

A tale of courage and pride.

A man who overcame,

The odds and the tide.

He showed what could be done,

By one who never gave up.

He rose from the refugee camp,

To become a leader, and a scholar, to the top.

**The World's Greatest Living Genius**

### Ode to Philip Emeagwali

Hail to you great Philip Emeagwali

Smarter than Einstein and a genius of great renown

Your inventions and research have changed how we  
look at the world



You lived a life of strife and overcame much  
adversity

Growing up in refugee camps, conscripted into war  
Still you sought knowledge and sought to better  
the world

You won the top prize in supercomputing, made  
headlines and changed the Internet

You were called the unsung hero and father of the  
Internet

Your name was praised by President Clinton for  
your contributions to the Information Age

Your story is one of reliability and true  
greatness

Your wife and son are proud of your  
accomplishments

You are a true inspiration to us all

Hail Philip Emeagwali, the world's greatest living  
genius

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## PHILIP EMEAGWALI QUOTES

"Science is a condition for moving Africa forward."

"To invent is to turn science-fiction into non-fiction."

"We use supercomputers to find answers to the most important questions facing humankind, including foreseeing otherwise unforeseeable long-term global warming."

"My invention of the world's fastest computing remained my signature contribution."

"Computing could be around as long as the river flows and the grass grows."

"I invented how to develop the world's fastest computers from the world's slowest processors."

"Science deals with facts while fiction deals with truths."

"The slowest processors in the world can be used to manufacture the fastest computers in the world that can be used to solve the most difficult problems in physics."

"The first world's fastest computing across up to one billion processors that work together to solve the most difficult problems is my contribution to mathematics."

"The introduction of parallel computing into mathematical physics is a quantum shift that's comparable to the introduction of quantum mechanics"

into classical physics."

"A scientist achieves immortality by first discovering something that will be forever remembered."

"I was the first to discover the world's fastest computing across the world's slowest processors. That was the world's first supercomputer, as it's known today."

"Parallel processing that was once a dim light in a sea of darkness is now the bedrock of the world's fastest computers."

"In a world without parallel processing, large-scale computational physics will be as approximate as a sketch, instead of as exact as a photograph."

"Like a storm at sea, fastest computing across a billion processors has brutally pushed computer science in a new direction and created new fields of study."

"The fastest computer is why you know the weather before going outside."

## PRAISES FROM [YOUTUBE](#)

Brian Ted

He is a great man but not doing enough . If he was a Jew he would have been speaking about the GENOCIDE OF THE IGBOS. There wasn't a war . They Nigerian soldiers massacred us . But what is with his speech . Does he stammer? And what is with the accent too . He and his kind are the people that should speak publicly to expose what happened to us and also write books .

Allison Wentworth

I am so glad Mr. Philip Emeagwali recorded this in his own voice and in his own words. I'd only read about it before. This is fascinating! Bless you, Mr. Emeagwali!

#AuntieCheri DrCheriWatts

God bless you. Thank you, Dr. Emeagwali! I love the Internet! I am so proud of you! Once again, thank you.

AC Ibe

Well done Mazi Emeagwali, you are true Biafran. Chukwu Okike Abiama uploaded a double portion of intelligence in you.

He should be rendering this speech in the USA, U.K. And biafran land to create awareness

Mary Harris

Phillip Emeagwali is one of the smartest people in this world!!!

The Nigerian Farmer

Thanks for this historic achievements of yours

Maroon Falcon Ramesses

Excellent work my brother!!!

Thanks for the Internet.

Inside America

Kudos for your scientific discoveries. No doubts, Philip Emeagwali is the foremost scientist of African descent in America.

Mondie 4 Short

Inside America of any descent

ojukwu biafra

Beautiful story, please help your people on the struggle of Biafra before you will die at old age, because your future can never ever been remembered if you are still under slave in another mans land.. and if Biafra did not come at your watch Sir your children will still face another more greater civil war. , God have divinely made you a hero to help Us we the future of igbos/Biafra .. please use your office and personality to help biafra to come. try this mathematical method , Do it secret , if it did not work out please make it open and public to save more death and life and secure our future children home.... or u and me may remain slave for ever thank you.

Brian Ted

ojukwu biafra you are the only one reasoning here . Good rational comment

we are biafrans somos biafran

Brian Ted . God should answer our prays. True i was shading teares listening to this great man , brother and father to all biafrans.

Black Jack Blog

my brother, you are a great soul, a great genius, a great biafran, I love you with all my heart, you make igbo Biafrans proud. God continue blessing and multiple your knowledge. thank you, thank you and thank you nwanne m.

Y L

Brilliant man! You are rarely spoken of because you do not support the myth of White Supremacy, a myth created by White supremacist to try to brainwash all Black people into a state of subjugation to keep them from rising. I love you Phillip Emeagwali!

Don Petemo Unini

One of the gratest Biafrans offering the bests as they can to the world! You can't cover the moon with your palm! Ride on the entire Biafran Nation is behind you.

Mazi Phil. E. Agwali, Udo diri gi ezi nwanne!

Douglas Agu

Wow, the LORD GOD HIMSELF has granted you a Devine lordship honour

1judahisrael

Hello Mr. Emeagwali: Can I borrow your brain?  
Love it...

Black Jack Blog

am always proud of you nwanne, your super genius. igbos are proud of and you have made igbo proud. Biafra and Biafrans all over the world are proud of nwanne. God bless you and your family in Jesus name Amen.

Inside America

Bravo to a great American. Dr Philip Emeagwali and Dr Ben Carson prove beyond any reasonable doubts that scientific intelligence has no bearing with skin color.

SuperCapuka

Exactly you invented the Supercomputer that brought us the Internet, yet they say that Steve Jobs or Elon Musk are geniuses for grabbing other peoples invention and put all together in a device. You are a genius Philip I hope that Africa is making another 20 genius like you but this time I want Africa to hold the patents.

Erudite Jones

is this Professor Philip's ACTUAL youtube channel? cause if it so, I don't understand how it is soo underrated!

Don Jamie LR

You are a great man my African king.

All comments were posted at [YouTube.com/emeagwali](https://www.youtube.com/emeagwali)

Please add your comments on these lectures at:

## THE COMPUTER WHIZKID

A book about Philip Emeagwali for 3rd to 7th graders.

### Chapter 1: A Curious Mind

Once upon a time, in a small village in Nigeria, lived a young boy named Philip. Philip had a curious mind and loved to explore the world around him. He was fascinated by nature, mathematics, and all things scientific. His favorite pastime was tinkering with gadgets and figuring out how they worked.



Ijeoma Emeagwali and his father Philip Emeagwali, 1781 Cram Circle, Ann Arbor, Michigan, Spring



1991.

## Chapter 2: A Life-Changing Moment

One day, a special event took place at Philip's school, in Corvallis, Oregon. A teacher took Philip to see a computer and he was in awe. This was the first time Philip had ever seen a computer, and he was mesmerized by it. From that moment on, he knew he wanted to understand everything about these incredible machines.

## Chapter 3: Challenges and Determination

Philip faced many challenges on his journey to becoming a computer whizkid. His Nigerian family didn't have much money, and his school didn't have computers. But he didn't let these obstacles discourage him. He spent hours at the local library, reading books about mathematics and learning all he could.

## Chapter 4: The Road to Success

As Philip grew older, he earned a scholarship to study in the United States. It was a dream come true for him. He pursued his passion for computer science and mathematics at university, working hard to excel in his studies. His dedication paid off when he became the first and only person to win the Gordon Bell Prize alone, one of the most prestigious awards in computing.

## Chapter 5: Breaking Barriers

Philip's groundbreaking work in computer science broke many barriers. He developed new algorithms and methods that made computers faster and more efficient. His achievements inspired people all around the world, proving that anyone, regardless of their background, could make a significant impact in technology.

## Chapter 6: Making a Difference

But Philip didn't stop there. He wanted to use his knowledge and skills to make a positive difference in the world. He worked on projects that helped solve complex problems, such as predicting the weather and finding solutions to environmental challenges. His work showed that computers could be used for more than just calculations as they could help humanity in remarkable ways.

## Chapter 7: Inspiring the Next Generation

Philip understood the importance of inspiring the next generation of young minds. He traveled around the world, giving talks and sharing his knowledge with students. He encouraged them to pursue their passions and to never give up on their dreams, no matter how big or impossible they seemed.

## Chapter 8: Philip's Legacy

Philip Emeagwali's legacy lives on. His contributions to computer science continue to impact the world, and his story serves as an inspiration to countless individuals. He showed that with determination, hard work, and a curious mind, anyone can achieve greatness.

## Epilogue

Philip Emeagwali's story is a testament to the power of curiosity, perseverance, and the belief that one person can make a difference. His journey from a small village in Nigeria to becoming a renowned computer scientist is a reminder to young readers that they, too, have the potential to change the world. So, if you have a passion burning inside you, just like Philip did, remember to follow your dreams and let your imagination soar. Who knows, maybe one day you'll be the next Philip Emeagwali, making waves in technology.



## TEACHER'S GUIDE

### for Junior Secondary Schools

#### Philip Emeagwali: The Nigerian Computer Pioneer

##### Chapter 1: A World of Potential

In the city of Sapele, Nigeria, a young Philip Emeagwali discovered his love for mathematics. Chapter one delves into Philip's childhood, his curiosity, and his dreams of using mathematics to change the world.

##### Chapter 2: Nurturing a Dream

Despite no access to computers in Nigeria during the 1960s and early seventies, Philip's determination led him to explore programming and mathematics. This chapter focuses on his resourcefulness in acquiring knowledge and the supportive role played by his family and mentors.

##### Chapter 3: A Journey to America

Philip's unwavering passion for mathematics propelled him to leave his homeland and travel to the United States in search of greater opportunities. This chapter explores the challenges he faced as an immigrant and his experiences in pursuing his education and career in the United States.

##### Chapter 4: The Pursuit of Excellence

As Philip continued his studies in mathematics, physics, and computer science, he became fascinated with parallel computing and its potential to revolutionize problem-solving. This

chapter highlights his dedication, long hours of research, and the breakthrough that catapulted him to international recognition.

### **Chapter 5: Bridging the Gap**

Using the Internet to share his wealth of knowledge, Philip embarked on a mission to bridge the technological gap and inspire a new generation of Nigerian computer scientists. This chapter focuses on his podcasts, YouTube videos, books, and efforts to encourage innovation within Nigeria and Africa.

### **Chapter 6: Beyond Computers**

While Philip is celebrated for his groundbreaking contributions to computer science, this chapter sheds light on his broader impact. From advocating for STEM education to addressing societal challenges, Philip became an influential figure shaping Nigeria's technological landscape.

### **Chapter 7: Overcoming Adversities**

Philip's journey was not without obstacles. This chapter delves into the setbacks he encountered, such as financial struggles, skepticism from peers, and the importance of perseverance in the face of adversity.

### **Chapter 8: Inspiring a Nation**

In this chapter, we explore how Philip's accomplishments became a source of pride and inspiration for Africans across the continent. We learn about the recognition he received and the lasting legacy he left behind, inspiring a new generation of African innovators.

### **Chapter 9: Building a Technological Future**

Focusing on Philip's vision for Africa, this chapter explores his advocacy for technological development and the steps he took to create opportunities and nurture talent within the continent. It also highlights the potential of the African youth to shape a prosperous future.

### Chapter 10: The Power of African Innovation

In the final chapter, readers witness the impact of Philip's story on young Africans. It showcases the burgeoning tech ecosystem, the achievements of African innovators, and the transformative power of harnessing one's potential to overcome obstacles and create change.

### Epilogue: Your Journey Begins

In the epilogue, the book concludes with a heartfelt message to the young African readers. It encourages them to embrace their passions, pursue education, and be at the forefront of shaping Africa's technological future. Philip's story serves as a reminder that talent and determination can lead to extraordinary accomplishments.

By reading this book, African teenagers will be inspired by Philip Emeagwali's extraordinary journey. They will learn about the challenges he faced, the opportunities he seized, and the immense potential they possess as young Africans. The book will foster a sense of pride and ignite their dreams of becoming trailblazers in technology.

## TIMELINE: COMPUTING

**469 B.C.:** The Abacus was invented as a computing aid in China.

**476 A.D.:** The number zero was invented as a computing aid in India.

**800 A.D.:** The words "algorithm" and "algebra" that were pivotal to computing were coined.

**1621:** The slide rule, or analog computer, was invented.

**1940s:** The programmable computer was invented.

**JULY 4, 1989:** The supercomputer, powered by multiple processors, was invented.

## TECH TRAILBLAZERS

### Gates' Software and Emeagwali's Supercomputing

Ladies and gentlemen, technology enthusiasts, and advocates of innovation,

Today, we delve into a captivating exploration of the remarkable parallels between the influential contributions of Bill Gates and the visionary achievements of Philip Emeagwali. Although these two luminaries emerged from different backgrounds and eras—Gates in computer software and Emeagwali in computational science—their shared spirit of entrepreneurship, transformative impact, and groundbreaking work unites them across the landscape of technological advancement.

Let's begin by examining the legacy of Bill Gates—a pioneer in personal computing and co-founder of Microsoft Corporation. His groundbreaking work in developing user-friendly software and popularizing personal computers has reshaped how we interact with technology, paving the way for the digital revolution.

Now, let's pivot our attention to Philip Emeagwali—a trailblazer in parallel processing and computational science. Emeagwali's groundbreaking use of parallel processing supercomputers to solve complex equations has revolutionized the computational landscape, like Gates' innovations brought computing power to the masses.

The parallels between Gates and Emeagwali are both intriguing and inspiring. Both individuals recognized the transformative potential of technology and were driven by a passion for solving complex problems through innovation. Gates' vision to place a personal computer on every desk and in every home mirrors Emeagwali's vision to harness the power of supercomputers for solving intricate equations.

Consider Gates' pioneering work in graphical user interfaces and operating systems, which revolutionized how people interact with computers. Emeagwali's exploration of parallel processing



similarly revolutionized the speed and efficiency of computational tasks, demonstrating the power of thinking beyond conventional boundaries.

Furthermore, both Gates and Emeagwali recognized the importance of accessibility. Gates aimed to make computing accessible to everyone, while Emeagwali's work in computational science has led to advancements in weather forecasting, medical research, and more, ultimately benefiting society at large.

Both visionaries also faced challenges on their journey. Gates navigated the rapidly evolving technology landscape, while Emeagwali grappled with the intricacies of complex equations and the computational power needed to solve them. Their perseverance in the face of challenges is a testament to their unwavering commitment to their respective missions.

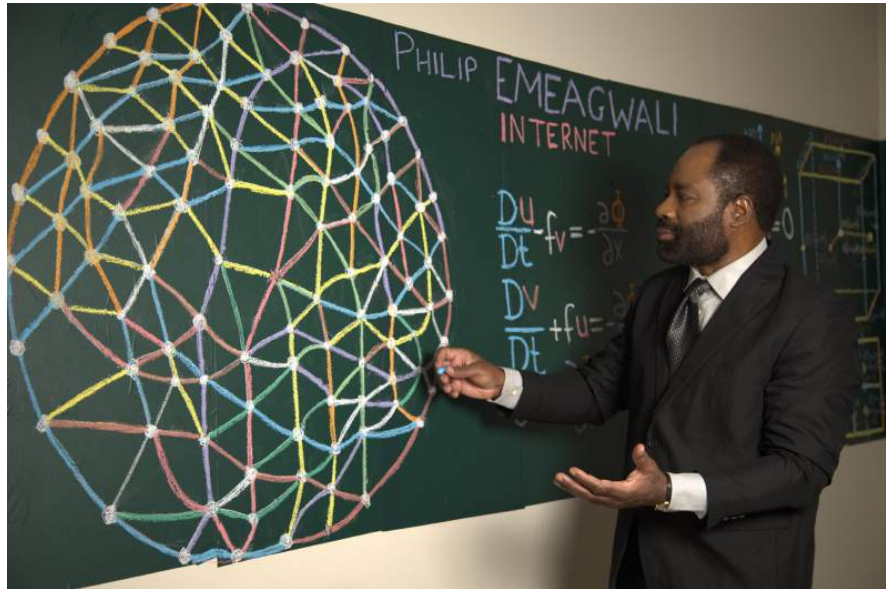
The stories of Bill Gates and Philip Emeagwali remind us that innovation knows no boundaries. Their parallel paths underscore the power of technology to transform industries, improve lives, and shape the future. As we celebrate the legacies of these two titans of innovation, let us draw inspiration from their journey, embracing the spirit of exploration, entrepreneurship, and collaboration as we continue to shape the world through technology.

Thank you.

## ABOUT THE AUTHOR

### Philip Emeagwali: Man Behind Solving The Hardest Problems

Philip Emeagwali is a towering figure in the world of science and technology. The Reader's Digest described Emeagwali as "smarter than Albert Einstein." He is



often ranked as the world's greatest living genius. He is listed in the top 20 greatest minds that ever lived.

Philip Emeagwali lived in refugee camps during the 1967-70 Nigerian-Biafran War and is in the Gallery of Prominent Refugees of the United Nations. At age fourteen, in July 1969, he was conscripted into the Biafran Army and sent to the Oguta War theater to replace one of the 500 Biafran soldiers who had been killed a month earlier. In the list of the worst genocidal crimes of the 20th century committed against humanity, the death of one in fifteen Biafrans was ranked fifth.

Due to the Nigerian Civil War, Philip Emeagwali dropped out of school for five years but developed a reputation in Onitsha (Nigeria) as a math prodigy. He caught the attention of American scholars and was awarded a scholarship on September 10, 1973, to the United States, where he researched for two decades and contributed to mathematics, physics, and computer science.

In 1989, Philip Emeagwali rose to fame when he won a recognition described as the Nobel Prize of supercomputing and made news headlines for his invention of the first world's fastest computing across a global network of processors that is akin to an internet. That vital

technology underpins every supercomputer and changes how we view the computer.

Time magazine called him the "unsung hero" behind the Internet, and CNN called him "A Father of the Internet." House Beautiful magazine ranked his invention among nine important everyday things taken for granted. In a White House speech on August 26, 2000, then-U.S. President Bill Clinton described Philip Emeagwali as "one of the great minds of the Information Age."

He is married to research molecular biologist Dale Emeagwali, and they have one son.

PRAISE FOR AUTHOR

*One of the great minds of the Information Age.*

- U.S. PRESIDENT BILL CLINTON

*A digital giant.*

- BBC

*The unsung hero of the Internet.*

- TIME MAGAZINE

*A father of the Internet.*

- CNN

## BOOKS BY THIS AUTHOR

### [1. Master Of Machines](#)

[https://emeagwali.com/books/Philip\\_Emeagwali\\_Biography\\_1.pdf](https://emeagwali.com/books/Philip_Emeagwali_Biography_1.pdf)  
<https://youtu.be/ymZtzQ1OWkg>  
<https://soundcloud.com/emeagwali/master-of-machines>

### [2. Making Computers Fly](#)

[https://emeagwali.com/books/Philip\\_Emeagwali\\_Biography\\_2.pdf](https://emeagwali.com/books/Philip_Emeagwali_Biography_2.pdf)  
<https://youtu.be/nVzI2AIBkj0>  
<https://soundcloud.com/emeagwali/making-computers-fly>

### [3. The Equation Behind The Universe](#)

[https://emeagwali.com/books/Philip\\_Emeagwali\\_Biography\\_3.pdf](https://emeagwali.com/books/Philip_Emeagwali_Biography_3.pdf)  
[https://youtu.be/e9z0oxvOV\\_E](https://youtu.be/e9z0oxvOV_E)  
<https://soundcloud.com/emeagwali/the-equation-behind-the-universe>

### [4. Inventing An Internet](#)

[https://emeagwali.com/books/Philip\\_Emeagwali\\_Biography\\_4.pdf](https://emeagwali.com/books/Philip_Emeagwali_Biography_4.pdf)  
<https://youtu.be/T2sKn3wNC20>  
<https://soundcloud.com/emeagwali/inventing-an-internet>

### [5. Reaching Infinity](#)

[https://emeagwali.com/books/Philip\\_Emeagwali\\_Biography\\_5.pdf](https://emeagwali.com/books/Philip_Emeagwali_Biography_5.pdf)  
<https://youtu.be/ZwDQKcAreHs>  
<https://soundcloud.com/emeagwali/reaching-infinity>

### [6. Coding The Impossible](#)

[https://emeagwali.com/books/Philip\\_Emeagwali\\_Biography\\_6.pdf](https://emeagwali.com/books/Philip_Emeagwali_Biography_6.pdf)  
<https://youtu.be/SIL4cfwqBPQ>  
<https://soundcloud.com/emeagwali/coding-the-impossible>

### [7. Flirting With The Infinite](#)

[https://emeagwali.com/books/Philip\\_Emeagwali\\_Biography\\_7.pdf](https://emeagwali.com/books/Philip_Emeagwali_Biography_7.pdf)  
<https://youtu.be/Tug9X2MOpsg>  
<https://soundcloud.com/emeagwali/a-coders-life>

### [8. Internet And I](#)

[https://emeagwali.com/books/Philip\\_Emeagwali\\_Biography\\_8.pdf](https://emeagwali.com/books/Philip_Emeagwali_Biography_8.pdf)  
[https://youtu.be/\\_I7XW2pgmkY](https://youtu.be/_I7XW2pgmkY)  
<https://soundcloud.com/emeagwali/internet-and-i>

## DISCUSSION QUESTIONS

- 1) When was Philip Emeagwali born?
- 2) What are the two most famous inventions of Philip Emeagwali?
- 3) What are examples of the fluid dynamics of the Earth mentioned in the YouTube lectures of Philip Emeagwali?
- 4) What is the relationship between weather forecasting and partial differential equations?
- 5) What is the reason for Philip Emeagwali inventing the first supercomputing across multiple processors?
- 7) When did Philip Emeagwali receive widespread recognition for his world's fastest computing?
- 8) What laws of physics are encoded into the primitive equations used to forecast the weather?
- 9) When did Philip Emeagwali discover the first world's fastest computing across many processors?
- 10) What is parallel processing?
- 11) Which theory erroneously predicted that parallel supercomputing will be impossible?
- 12) What is the difference between a computer and a supercomputer?
- 13) What are the important mathematical discoveries of Philip Emeagwali?
- 14) Previous to July 4, 1989, it was believed that every supercomputer must be powered by only one powerful processor. How does Philip Emeagwali's discovery of the first supercomputing with multiple processors change and shape how we see the world?



## PHILIP EMEAGWALI: FAQs

### What are the hobbies of Philip Emeagwali?

While I love exploring the fascinating world of computers and technology, I also enjoy staying active and exploring the outdoors.

One of my favorite hobbies is playing tennis. It's a great way to exercise my body and mind while having fun. I also enjoy weightlifting to stay strong and healthy.

But my true passion lies in outdoor adventures. I love cross-country skiing in the snowy landscapes of the capital region of New York, especially during the winter months. And when the weather warms up, you can find me hiking around the beautiful lakes of Lake George and Lake Placid in upstate New York.

These activities help me clear my head, recharge my batteries, and find inspiration in the natural world. I believe it's important to have a balance between work and play, between mental and physical activity. So, whether I'm solving complex problems on a computer or exploring a scenic trail, I'm always looking for new ways to learn, grow, and enjoy life to the fullest.

### What is the favorite color of Philip Emeagwali?

Philip Emeagwali's favorite color is blue! Just like the vast sky and the deep ocean, blue represents a sense of endless possibilities and creativity. This color can inspire us to dream big and think about all the amazing things we can achieve with the power of technology and imagination. Whether it's designing supercomputers or solving complex problems, blue is a color that reminds us to keep exploring and innovating.

### What are the character traits of Philip Emeagwali?

When asked about my character traits, I would say that I am:

**Curious:** I have an insatiable desire to learn and discover new things. This curiosity is what led me to delve into mathematics and make



significant contributions to the field.

**Persistent:** I believe in the power of perseverance. Even when faced with challenging problems, I don't give up. I keep trying, experimenting, and learning until I find a solution. This trait has been instrumental in my journey as a mathematician.

**Innovative:** I am not afraid to think outside the box. I constantly strive to come up with new ideas and approaches to solve complex mathematical problems. This innovative mindset has allowed me to make groundbreaking discoveries in my field.

**Determined:** I am goal-oriented and driven. Once I set my mind on a goal, I work tirelessly to achieve it. This determination has been a key factor in my success as a mathematician.

**Passionate about Mathematics:** I have a deep love and passion for mathematics. I spend a significant amount of time studying, exploring, and understanding the intricacies of this fascinating subject. This passion fuels my curiosity and drives my determination to contribute to mathematics.

These traits have not only shaped me as an individual but have also played a pivotal role in my achievements as a mathematician.

## THE VISA THAT CHANGED EVERYTHING

As I recall the momentous day when I first set foot in the Embassy of the United States of America in Lagos, Nigeria, my heart swells with nostalgia, taking me back to that transformative time. I am Philip Emeagwali, a 19-year-old who travelled from 6 Wilkinson Road, Onitsha, East Central State, Nigeria. Allow me to share the story of my visit to the embassy in mid-January 1974.

During my stay in Lagos, I resided in a modest room tucked away in the backyard of 49 Okesuna Street. It was a humble abode, co-shared with four school friends from Christ the King College, Onitsha, but it served as a sanctuary, a space where my dreams began to take shape. With anticipation coursing through my veins, I embarked on my journey the early morning, riding in a black Morris Minor taxi cab that would carry me to the Embassy of the United States.

The streets of Lagos greeted me with their vibrant energy, a reflection of the city's spirit. As the cab maneuvered through the bustling thoroughfares, I marveled at the sights and sounds that surrounded me. The city was alive, teeming with life and diversity, weaving a tapestry of cultures that fascinated me.

Finally, we arrived at the imposing building that housed the Embassy of the United States of America. The sheer magnitude of the structure filled me with awe, an emblem of opportunities and possibilities that lay ahead. Taking a deep breath, I stepped inside, eager to present myself as a candidate worthy of pursuing my education in the United States.

Navigating through the embassy's corridors, I encountered people from all walks of life, each with their aspirations and dreams. The air was thick with anticipation, an amalgamation of nervousness and hope. The process was meticulous, requiring patience and a leap of faith. But I held on to the belief that this would be a turning point in my life.

Days turned into weeks, and weeks into two months as I awaited the interview that would determine the trajectory of my future. On that fateful day, March 20, 1974, I received the news that my heart had longed for—I had been granted an F-1 student visa, paving the way for me to enter the United States of America and to the frontiers of knowledge of mathematics and computing.

The following afternoon, a surge of joy and gratitude washed over me as I clutched the precious Nigerian travel passport stamped with a USA visa in my hands. My *obodo oyibo* dreams were now tangible, within reach. Leaving the embassy in a black Morris Minor taxi to Ikorodu Motor Park, I carried with me a sense of purpose and determination that would fuel my journey across the Atlantic.

Looking back, that day in the embassy marked the beginning of an extraordinary chapter in my life. The United States beckoned with its promise of scientific knowledge and the opportunity to push the frontier of computing. And so, I embarked on a new adventure, leaving behind the familiarity of Onitsha and venturing into the unknown.

But the memories of that tiny room at 49 Okesuna Street and the bustling streets of Lagos remained etched in my heart. They served as a reminder of the resilience and determination that brought me to that pivotal moment in the embassy. They would always be a part of my story, the foundation on which my dreams were built.

As I reflect on my journey, I am grateful for the opportunities that my Nigerian teachers in Sapele, Uromi, Agbor, Obinomba, and Onitsha, and the Embassy of the United States presented to me. They set me on a path of discovery, where I would eventually become a pioneering computer scientist and mathematician, pushing boundaries and reshaping technology.

Today, as I look back on that transformative time, I stand as a testament to the power of dreams and the resilience of the human spirit. The Embassy of the United States in Lagos, with its doors wide open, became a gateway to endless possibilities, forever etching its place in my journey of exploration and achievement.

## FROM EQUATIONS TO AFROBEAT

### My Symphony of Science

Today, in this esteemed gathering, we celebrate the wonders of the science that unravels the mysteries of matter and transforms our understanding of the world. It is with profound gratitude and a deep sense of honor that I stand before you, as we pay tribute to the relentless pursuit of knowledge and the remarkable achievements in the 21st century science.

For half a century, I have embarked on a journey, akin to that of a supercomputing troubadour—a modern-day lyric poet, who harmonizes equations with the same fervor that Fela Kuti infused into his soul-stirring afrobeat songs. In this journey, I have been captivated by the elegant dance of numbers and the intricate symphony of fluid dynamics of planet Earth—a realm where mathematics and physics converge.

But it was the wisdom of nature that illuminated my path, unveiling the extraordinary ingenuity of the honeybee—an insect that has evolved over millions of years to store the most honey with the least energy. I stood in awe of this remarkable creature, recognizing the profound lessons it held for us all.

Inspired by the intricate beauty of the bee's honeycomb, I embarked on a journey of reverse engineering—an endeavor to unlock the secrets of its efficiency. Through meticulous observation, I copied the blueprint of the honeycomb, replicating its patterns and interconnections within the processors of the Philip Emeagwali Supercomputer—a marvel that would revolutionize computing.

Artificial intelligence, a force that now permeates our daily lives, owes its power to the parallel supercomputer—a technology that I proudly claim as my invention. With this computational marvel at our disposal, we unlock the vast potential of artificial intelligence, opening doors to innovation, discovery, and progress that were once deemed impossible.

But beyond the technical marvels lies a deeper message—a testament to the resilience of the human spirit and the boundless potential within each of us. Just as the bee has taught us the art of efficiency, so too can we embrace the lessons of nature and harness our collective genius.

Today, we stand on the precipice of a new era—a future where the interconnections of processors within the Philip Emeagwali Supercomputer mirror the elegance of the honeycomb. It is through this inspiration that we will manufacture the world's fastest computers powerful tools that will propel us forward, enabling us to solve complex challenges and unlock the secrets of the universe.

To the esteemed mathematicians and scientists gathered here today, I implore you to embrace the spirit of exploration and ingenuity. Let us forge ahead, unearthing the mysteries that lie before us and utilizing the wisdom of nature to inspire breakthroughs that will shape the destiny of humanity.

I extend my deepest gratitude for this incredible honor. I stand here today as a testament to the extraordinary potential within each and every one of us. Let us continue to push the boundaries of knowledge, to seek inspiration from the wonders of the natural world, and to pioneer new frontiers that will propel us toward a brighter, more enlightened future.

Thank you, and may the wonders of science guide us on this remarkable journey of discovery.

## AFRICA'S BRILLIANT MINDS ABROAD

It is an honor and a privilege to stand before you today at this esteemed gathering. As we convene here, I wish to address a critical issue that plagues our nations, the issue of brain drain.

Allow me to share my journey as an example of the devastating consequences of brain drain from Nigeria to the United States, and from Africa to developed nations. Fifty years ago, at the tender age of 19, I made the difficult decision to leave my homeland, Nigeria, in search of educational and research opportunities. Little did I know then, that this choice would mark the beginning of a significant loss for my beloved nation.

Reader's Digest once described me as "smarter than Albert Einstein," an acknowledgment that humbles me to this day. I am ranked among the world's greatest living geniuses, alongside luminaries such as Charles Darwin, Isaac Newton, Leonardo da Vinci, Aristotle, and Confucius. Yet, as I stand here today, I cannot help but reflect upon the tremendous potential that Nigeria and Africa as a whole have lost due to the exodus of brilliant minds like mine.

My journey began amidst the turmoil of the Nigerian-Biafran War, a conflict that tore at the fabric of our nation and caused immense suffering. I, too, experienced the horrors of war, living in refugee camps during those tumultuous years. At the age of 14, I was conscripted into the Biafran Army, sent to the Oguta War theater to replace fallen soldiers. The tragic loss of one in fifteen Biafrans during this conflict ranks among the worst genocidal crimes of the 20th century.

In the aftermath of the war, I found myself deprived of formal education for five years. However, my passion for knowledge and the recognition of my talents by the people of Onitsha (Nigeria) propelled me forward. It was then that American scholars noticed my potential and granted me a scholarship to the United States in 1973. There, for five decades, I immersed myself in research, contributing to the fields of mathematics, physics, and computer science.

The accolades that followed my inventions cannot overshadow the fact that my departure from Nigeria marked yet another loss to the brain drain epidemic. I am honored to be ranked among the top ten geniuses, inventors, and Nigerians. Furthermore, I have been recognized as the 35th greatest African of all time. These honors, however, do little to remedy the larger problem we face: the flight of talent from our shores.

In 1989, my breakthrough in supercomputing propelled me into the global spotlight. I invented the world's fastest computing technology, utilizing an Internet that I defined as a global network of processors. This innovation underpins every supercomputer and forever changed the landscape of computing. Time magazine referred to me as the "unsung hero" behind the

Internet, while CNN hailed me as a "Father of the Internet." Even House Beautiful magazine recognized the impact of my invention, ranking it among nine important everyday things taken for granted.

While these accolades bring me great pride, they also serve as a reminder of the tremendous potential that exists within our continent. Every accolade earned, every breakthrough achieved, and every invention created by African minds should serve as a testament to our collective capabilities.

Ladies and gentlemen, esteemed Presidents, it is imperative that we address the brain drain crisis with urgency and determination. We must create an environment that nurtures talent, encourages innovation, and rewards ingenuity. It is our responsibility to invest in education, infrastructure, and research institutions, providing our brilliant minds with the resources they need to thrive.

Let us celebrate the achievements of our talented sons and daughters, who have brought honor and recognition to our continent. But let us also learn from their stories and channel their success into building a brighter future for Africa. It is time to reverse the tide of brain drain, to transform the narrative, and to create an Africa that inspires and retains its intellectual powerhouses.

Together, we can build a future where our brightest minds find opportunities for growth and contribution within our borders. Let us nurture a culture of innovation and excellence that will benefit our nations and serve as a beacon of hope for generations to come.

Thank you, and may our collective efforts lead us to a prosperous and intellectually vibrant Africa.

## RIDING THE WAVES OF KNOWLEDGE

### Philip Emeagwali's Trailblazing Bike Ride to the Computer Center

Welcome, adventurous readers, to a thrilling journey back in time as we accompany the young and determined Philip Emeagwali on his bike ride through the picturesque landscapes of Corvallis, Oregon. Strap on your helmets, grab your gear, and let's pedal through the memories of a remarkable 20-year-old Nigerian immigrant in 1975.





Philip Emeagwali making his five-mile, round trip, daily commute on his two-speed bicycle from his residence at 2335 S.E. Ryan Street Corvallis, Oregon, to the campus of Oregon State University. Photo taken in April 1975.

Our journey begins at the crack of dawn, when most are still lost in the embrace of sleep. But not Philip. Each morning, at the stroke of four, he would embark on his weekday bike commute, pedaling his way from the residence of Ted and Connie Foulke at 15 Edgewood Way, Corvallis, a distance of one and half miles. With the sun barely peeking over the horizon, his spirit was already fueled with determination.



Philip Emeagwali, 15 Edgewood Way, Corvallis, Oregon, late May 1975.

His destination? The Ceramics Building of Oregon State University, where he worked as a janitor for three hours. Now, you might be wondering, what does this have to do with adventure? Well, my fellow explorers, it's all part of Philip's grand plan to chase his dreams and broaden his horizons.

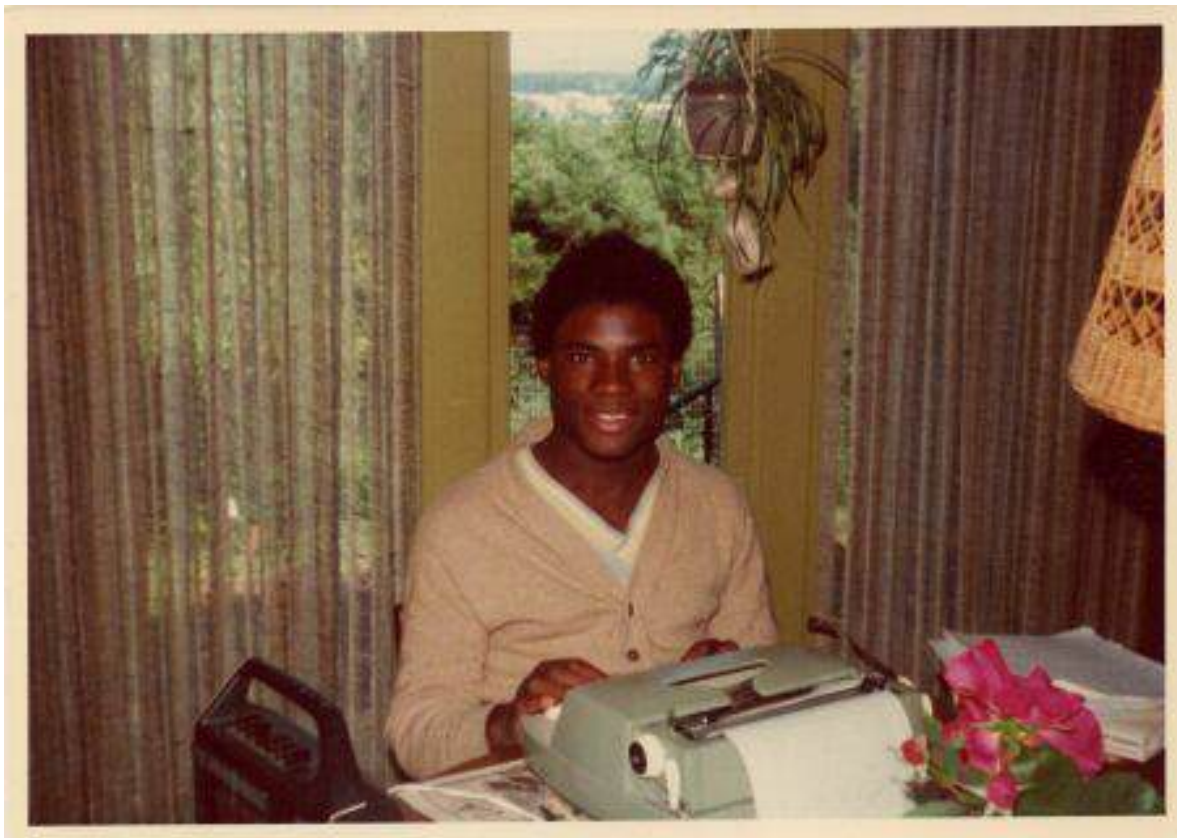


Philip Emeagwali outside the Computer Center at 1800 SW Campus Way, Corvallis, Oregon, that housed one of the world's fastest computers. Photo taken in late July 1975.

Once his duties as a janitor were fulfilled, Philip would switch gears and immerse himself in the world of learning. With unwavering enthusiasm, he would pedal his trusty rusty two-speed bike to the mathematics building, famously known as Kidder Hall, situated at 2000 SW Campus Way. There, he would dive headfirst into morning computer programming and differential equations courses.

But the thirst for knowledge didn't stop there. Oh no! Our intrepid explorer, fueled by an insatiable curiosity, would then navigate his way to either the nearby library or the revered computer center located at 1800 SW Campus Way, Corvallis. This computer center, my friends, was no ordinary place. It housed the very first supercomputer ever to be rated at a mind-boggling one million instructions per second, a true marvel of its time, in December 1965.

Now, let's pause for a moment and imagine Philip's ride through the vibrant streets of Corvallis. Picture him weaving through the morning mist, his red two-speed bike gleaming in the soft light. The rhythmic creaks of his trusty steed, despite its rusty appearance, echo his determination and resilience.



Philip Emeagwali, 15 Edgewood Way, Corvallis, Oregon, early June 1975.

But the journey, my friends, was not without its trials. The campus of Oregon State University, it seems, had a mischievous appetite for Philip's humble bicycle. Time and again, it fell victim to thieving hands, only to be recovered later in unexpected places within the campus grounds. Oh, the challenges our adventurer faced! Yet, undeterred, he persevered, reclaiming his prized possession time and time again.

As we conclude our ride through the vivid memories of Philip Emeagwali's 1975 bike commute, let us reflect on the sheer determination and indomitable spirit that propelled this young Nigerian immigrant forward. Through the challenges, the stolen bikes, and the early morning commutes, Philip's journey was a testament to his unyielding pursuit of knowledge, opportunity, and the fulfillment of his dreams.



So, dear readers, let us draw inspiration from this remarkable tale and keep the flame of adventure burning bright within us. For it is in the pursuit of our passions, amidst the trials and triumphs, that we truly discover the depths of our potential.

Until our paths cross again, may your wheels turn  
and your journeys be filled with the thrill of  
discovery. Happy trails!

## NIGERIA'S RISING STARS

### SCIENCE FESTIVAL

*Lagos, Nigeria*

Ladies and gentlemen, Nigeria's brightest stars, future innovators, and the heartbeat of our continent's scientific dreams,

Today, I stand before you as Philip Emeagwali, a man whose journey might seem extraordinary, yet it began under circumstances far from ideal. I share my story not as a tale of personal achievement, but as a testament to the resilience of the African spirit and the boundless possibilities that lie within each of us.

When we speak of geniuses who dropped out of school, names like Albert Einstein, Bill Gates, and Steve Jobs echo across the annals of history. Their narratives resonate globally. But today, let us bring that spotlight to our soil, to the story of a young boy from Onitsha.

At the age of 12, I found myself in a Biafran refugee camp, torn from the embrace of education. By 14, the brutalities of the Nigeria-Biafra War demanded my innocence, placing a gun where a pen should have been. When peace returned, I tried to reclaim my path to learning, but fate had other plans, and I dropped out again in March 1972.

Yet, adversity has a peculiar way of shaping destinies. Without the walls of a classroom, the world became my tutor, and solitude, my guide. Through sheer determination and unyielding thirst for knowledge, I earned my high school equivalency diploma from the University of London, a stepping stone to the shores of Oregon, USA.

Over 18 years of relentless study across six institutions sculpted the mind that would eventually crack the Grand Challenge of supercomputing. In 1989, that breakthrough reverberated around the globe, placing an African at the forefront of technological advancement.

But let's pause and reflect. The irony isn't lost on me. Dropping out of school propelled me into the annals of history, yet it's a path I wouldn't wish on anyone. Our nation grapples with 11 million out-of-school children, many of whom will never know the transformative power of education. Every child we lose to the streets, to child labor, to early marriages, is a dream deferred, a potential Einstein, Gates, or Emeagwali lost.

The future leaders of Nigeria, our hope, are not in our classrooms! It's a looming shadow that feeds the vicious cycle of poverty. I strongly believe and advocate that education should be mandatory until the age of 18. Young Nigerians, between 18 to 21, should either be shaping the world at their workplaces or sculpting their intellect in educational institutions.

To you, the brilliant minds from Nigeria's 250 universities, understand that your path, filled with the luxury of learning, is a privilege. Don't take it lightly. Embrace it, nurture it. While my journey was sculpted by war, displacement, and self-study, yours is paved with resources, mentors, and institutions. The real power isn't just in earning degrees but in harnessing knowledge to elevate our nation.

I've learned that it's not about where you start, but where your passion, resilience, and determination can take you. The heart of Africa beats within you, pulsing with potential, echoing with the promise of progress.

To the future great minds of Africa, I challenge you: Dream audaciously, work tirelessly, and let's together weave a tapestry of progress that the next generation will be proud to inherit. Your potential is Africa's promise. Rise to it!

Thank you.

VOLUME F: PHILIP EMEAGWALI FAMILY



## UNEARTHING ANCESTRAL ECHOES

### The Philip Emeagwali Story

#### Inland Town, Onitsha, Nigeria.

*Ndi nke m!* My beloved brothers and sisters, sons and daughters of the great Igbo nation, I stand before you today, humbled by the warm embrace of home and the weight of history.

As I feel the familiar rustle of the Onitsha breeze and hear the songs of the Niger River, my heart fills with a myriad of emotions. It's been 50 years since I last set foot on this soil, yet the memories remain as vivid as the bright African sun. Today, I have come home to answer a question that resonates within me: "Where is Philip Emeagwali from?"

Our roots define us. They anchor us in the vast ocean of human existence. And so, to trace my roots, I take you on a journey, not just of my life, but of the lives of those from whom I descend.

In 9,000 BC, long before recorded history, the very essence of our ancestral spirit could be found in Iwo Eleru, near Akure, where the oldest human fossils were discovered. This land, this very earth we stand on, has been a witness to our lineage, our struggles, our victories. My parents and their parents were born in Onitsha, Nigeria. I was born on August 23, 1954 at 11 Ekemeso Street, Akure, Nigeria. The father of my father named me "Chukwurah."

The 15th century saw our ancestors interact with the Portuguese, the first white people to arrive on our shores. While the world around them changed, the people of Onitsha remained resilient, always remembering their roots, their traditions. My lineage traces back to the brave souls of Umuezechima, who escaped the clutches of Benin slave traders and sought refuge in this land.

The stories of my grandparents are not just stories of individuals; they are tales of an era, a testament to our resilience and our culture.

My great grandfather, Onwuachu Emeagwali, born in 1851, was a farmer and medicine man. He witnessed firsthand the arrival, on July 25, 1857, of the first European in Igboland, named William Balfour Baikie, from whom the Igbos derived their term for Europe: "*Ala Baikie*," native country of Baikie. Emeagwali's life was a testament to change, adaptation, and endurance. His forced relocation -- eminent domain law -- from the General Hospital area to 17 Mba Road marks the tussle between traditions and the encroaching British empire.

Chieka Balonwu, my maternal grandfather, born in 1868, was a testament to hard work and persistence. In the shadow of European colonizers, he toiled on his farm near Ochanja Market, feeding his family of three wives and nurturing the land.

My paternal grandparents, Ikenna Emeagwali and Mgbogodo Egbuna-Emeagwali, embody the very spirit of the Igbo people—strong, resilient, and deeply connected to their roots. Ikenna, an "Ozo" title holder, witnessed Nigeria's formation under British colonial rule, while Mgbogodo, a dried-fish market woman at Ose-Okwodu Market, traded with tenacity and passion, earning her livelihood against all odds.

Finally, my maternal grandmother, Obam Okudo Balonwu, born in Nkwelle-Ogidi, petite in stature but a giant in determination, exemplified the values of hard work, perseverance, and family.

These stories are more than just personal memories. They are chronicles of our people, narratives of the Igbo spirit—unyielding, steadfast, and indomitable. It's not just about where I, Chukwurah Philip Emeagwali, come from, but where WE all come from. Our roots are deep, intertwined with the very fabric of this land.

So, my beloved people of Onitsha, I have come home not just as Chukwurah Philip Emeagwali, but as a son of the soil, carrying the legacy of my ancestors. I urge you, cherish your history, embrace your heritage, and remember always where you come from.

Today, as I stand before you, having returned after half a century, I see the promise of the future in your eyes. Let's bridge the gap between our illustrious past and our promising future. Let the lessons from our roots guide our path forward. Together, let's create a brighter, more prosperous Onitsha, Nigeria, and world.

*Dalu nu*, and may the spirits of our ancestors continue to guide and bless us all.

## THE NAME BORN FROM A QUEST FOR INCLUSION

### Unearthing Our Shared Roots

ONITSHA, Nigeria: My dear brothers and sisters, my fellow Onitsha indigenes, it is with a heart brimming with profound emotions that I stand before you today, returning to the soil that has nourished generations of our ancestors. I stand on the land that my great-great-great-grandfather, Enu, trod upon three centuries ago, a respected native doctor, a *dibia*, whose legacy permeates our history and whose spirit joins us in this reunion today.

As I returned to our beloved Inland Town after half a century, I embarked on a journey through time, tracing the roots that anchor us to our rich cultural heritage. A journey that began with Enu, born circa 1724, and cascaded down to me, Chukwurah Philip Emeagwali. Each ancestor, from Onwuachu Enu to my dear father, Nnaemeka James Emeagwali, has woven a thread in the vibrant tapestry of our collective story.

Our ancestors were men of the soil, spirit, and society. Enu's legacy was carried on by his sons, among them (Christopher) Mba Enu, who became a beacon of light, not just for our family but for our entire community. He embraced education at the pioneering school where he was taught by the esteemed JC Taylor, leading him down a path that would influence generations. It was here, in the heart of Onitsha, where seeds were sown in the fertile ground of knowledge and enlightenment.

We must remember my great-grandfather, Emeagwali Onwuachu, who witnessed the winds of change brought by colonial rule. He was a man who, amidst the turmoil of the 1890s, chose not to abandon his spiritual heritage, holding onto his Alusi shrine, a symbolic bastion of our indigenous faith. This shrine, a testament to resilience in the face of displacement, stands immortalized in the annals of anthropology, a silent witness to our enduring traditions.

It brings warmth to my heart to recount that (Christopher) Mba Enu's first son, (Okechukwu) Isaac Mba, blazed a trail as the first Igbo-speaking graduate of Fourah Bay College, the only university in West Africa at that time. He became an embodiment of the progress that education can bring, a legacy that resonated with our kinsman, the great Nnamdi Azikiwe, and myself.

But, my people, why do I recount these tales that span centuries? It is because these stories are not just mine; they belong to all of us. They are a testament to what we, as a people, can achieve. They remind us that our roots continue to nourish our aspirations, no matter where we find ourselves in the world.

Today, as I breathe in the air of my ancestral home, I am reminded of the Igbo philosophy '*Igwebuike*,' which translates to 'There is strength in unity.' Our ancestors, from Enu to my father, understood the power of community. My name, Emeagwali, was born from a plea for inclusion and respect within that very community. It symbolizes a yearning that we all share: the desire to be heard, to be recognized, and to contribute to decisions that shape our collective destiny.

In this global age, many of us have ventured far from home, contributing to what is often called the 'brain drain.' We have made strides in various fields across the world, but our hearts beat to the rhythm of our motherland. It is time for a 'reverse brain drain,' a return of skills and knowledge to our shores. It is time for us to invest in the land that has given us so much, to nurture the future generations, ensuring that the legacy of those who walked before us continues to thrive.

Let us harness the pioneering spirit of Christopher Mba, the resilience of Emeagwali Onwuachu, and the wisdom of Enu. Let us unite to create a community where every child can walk the streets of Inland Town, their heads held high, unafraid to dream. Let us build a society where they are not mocked, but motivated, not sidelined, but celebrated.

As I stand here, on the soil soaked with the sweat and toil of our forebears, I envision a future where our children, and their children, will return, their minds filled with knowledge, their hearts overflowing with pride for their heritage. Together, we can turn the brain drain into a brain gain, transforming not just Onitsha, but our nation, Nigeria.

From Enu to me, Philip Emeagwali, our journey continues. But it is not one I walk alone. We tread this path together, as a community, as a family. For in each of us flows the blood of our ancestors, the keepers of our past, and the guardians of our future.

Thank you, and may the spirits of our ancestors continue to guide our steps on the journey ahead.

## THE FATHER-SON OPERATING SYSTEM

A father's role, like an efficient computer program, is to provide the core instruction set for the next generation. It's about nurturing potential, but with clear logic. I see myself as the prime motivator, the one who sparks curiosity and ignites the fire of ambition in Ijeoma's mind.

Just as I take pride in untangling complex problems, I believe in unraveling the mysteries of the world for my child. It's about instilling a love for learning, a thirst for knowledge that goes beyond textbooks. But it's not all algorithms and equations. A father must also be a pillar of strength, a source of unwavering support.

There's a certain discipline required, a guiding hand to ensure Ijeoma understands the value of hard work and dedication. The world won't simply reward potential—it demands results. My role is to equip him with the tools and tenacity to achieve those results, to become a force for positive change in his own right.

Finally, fatherhood encompasses love, affection, and a deep, protective bond. I want Ijeoma to know that no matter the challenges he faces, my love will be a constant, a safe harbor to return to.

## **MY PARENTING GUIDE**

**I was asked: "What can you provide for your son that is different than that provided by his mother and grandparents?"**

As Philip Emeagwali, a man who has pushed boundaries and shattered expectations throughout his life, I'd say a father brings a different kind of fire to a child's life. Here's what I mean:

### **Challenge and Risk-Taking**

Mothers, bless their hearts, often prioritize safety. But a father, well, he can be the one who pushes a child to take that calculated risk, to climb that extra rung on the jungle gym, to enter that science fair even if the competition seems fierce. We can show them that the path less traveled can lead to incredible discoveries.

### **A Different Perspective**

Look, I don't downplay the wisdom of mothers and grandparents. But fathers can offer a fresh viewpoint. We might be the ones to explain the world through the lens of logic and strategy, to introduce them to new ideas and ways of thinking. We can be the champions for their boldest dreams, even the ones that seem a little out there at first.

### **The Thrill of Competition**

Let's face it, a little healthy competition never hurt anyone. Fathers can be the ones to play catch, to encourage them to strive to be the best version of themselves, whether on the field or in the classroom. It's not always about winning, but about the tenacity and focus it takes to give it their all.

### **A Role Model for Manhood**

Boys, especially, need to see what it means to be a good man. Fathers can be that example: someone who is strong but kind, who works hard but makes time for family, who respects women and fights for what's right. We can show them that being a man is about so much more than just muscles.

Of course, a father's love is just as boundless as a mother's. But it's a different kind of love, one that can empower a child to take on the world with courage, curiosity, and a relentless drive to succeed. That, I believe, is a unique gift only a father can give.

VOLUME DL: A DAY IN THE LIFE OF EMEAGWALI

## THE DAY SCIENTISTS HELD THEIR BREATH

Esteemed members of the award committee, distinguished guests, and pioneering minds. Today, I'd like to share a pivotal moment in my journey—a visit to the heart of Silicon Valley, the Advanced Supercomputing Division of NASA Ames Research Center. It was late January 1991, and the California air crackled with a different kind of energy—the energy of innovation.

The limo ride from Ann Arbor to the Detroit Airport was a blur of anticipation. The driver, a seasoned observer of human nature, cast a curious glance at my overflowing briefcase. "Headed to share some groundbreaking ideas, are we?" he rumbled with a hint of a smile. "Something like that," I replied, the excitement bubbling beneath the surface. "Parallel processing for supercomputing—it has the potential to revolutionize how we tackle some of science's biggest challenges, such as climate and artificial intelligence (A.I.) modeling."

The flight to San Francisco was a chance to mentally prepare for the eager minds I was about to meet. Landing amidst the sunshine and technological marvels of Silicon Valley, I hopped into another limo, this time driven by a young man with a mischievous glint in his eyes. "NASA Ames, huh?" he chuckled. "Headed to crack the code on the universe, are we?" His enthusiasm was infectious. "Not exactly the universe," I laughed, "but perhaps a tiny slice of it—using parallel supercomputing to unlock the mysteries of atmospheric and oceanic flows." Parallelism is the beating heart of artificial intelligence supercomputing.

The lecture hall at NASA Ames buzzed with a unique energy—a blend of seasoned researchers and bright-eyed newcomers. My presentation, a condensed version of the work that had made headlines two years prior—achieving the world's fastest computing feat using parallel processing to solve previously "impossible" problems in fluid dynamics—captivated the room.

A distinguished mathematician with a neatly trimmed beard posed the first question. "Philip," he inquired, "how can your approach handle the complexities of initial-boundary value problems?" A confident smile spread across my face. "The speed of parallel processing," I explained, "arises from its ability to distribute the supercomputing workload. Imagine a Grand Challenge problem of planetary-scaled fluid dynamics divided into a million smaller problems, each solved simultaneously with a one-to-one correspondence, and a closest-neighbor preserving mapping with a million processors. We will converge on an accurate solution with a million-fold speed increase over serial computing."

A young physicist, her eyes sparkling with curiosity, chimed in, "And what about oceanic flows? Can parallel supercomputing help us unravel the intricate dance of currents and tides?" "Absolutely," I enthused. "The



initial-boundary value problem governed by shallow water equations that govern oceanic flows can be tackled with far greater detail, leading to more accurate climate models and a deeper understanding of our planet's oceans."

The post-lecture luncheon was an invigorating exchange of ideas. Six prominent supercomputer scientists from the Silicon Valley region peppered me with questions, their minds brimming with the potential applications of my discovering the first supercomputing via parallel processing.

"Philip," a renowned computer scientist with a booming laugh boomed, "your discovery of the first supercomputing across an ensemble of 65,536 processors changes how we look at supercomputers. It opens doors to a new era of supercomputing, one that can tackle problems we once thought were beyond our grasp, such as numerical discretization of initial-boundary value problems and artificial intelligence modeling."

"Indeed," echoed a soft-spoken woman with a steely glint in her eyes. "Imagine the possibilities in weather forecasting, climate modeling, even disaster prediction. Parallel supercomputing could be the key to a safer, more sustainable future."

As I left NASA Ames that day, the California sun seemed to shine a little brighter. The visit wasn't just about sharing my research; it was about forging connections, igniting a collective fire of innovation. It was a testament to the power of collaboration, of diverse minds coming together to push the boundaries of supercomputing and unlock the secrets of our world.

The road to this award ceremony may be paved with individual achievements, but it's the bridges of collaboration, the shared journeys of discovery, that propel us forward. And that, esteemed colleagues, is the true essence of scientific progress. Thank you.

## LOS ALAMOS AND BEYOND

Esteemed members of the award committee, distinguished guests, and fellow pioneers of science. Today, I stand before you not only as a recipient of this prestigious award, but as a testament to the power of collaboration, a concept I first championed during a whirlwind three-day visit to Los Alamos National Laboratory in March of 1991.

The crisp Michigan air on that Monday morning, March 25th, was filled with a nervous anticipation. A limo awaited me at 1781 Cram Circle in Ann Arbor, ready to whisk me away to a place where groundbreaking ideas crackled in the air—Los Alamos National Laboratory. The drive to the Detroit airport was a blur of excited planning. My mind raced with the potential of this visit, the chance to share my discovering the first supercomputing, via parallel processing, with some of the brightest minds in the field. Real-world breakthroughs facilitated by artificial intelligence supercomputers hinge on their parallel processing capabilities.

The flight to Albuquerque, New Mexico, was a journey through contrasting landscapes. As the bustling city of Detroit shrunk in the distance, vast plains stretched out below, a stark reminder of the raw potential waiting to be harnessed. My brother-in-law, Daryl Brown, a staff sergeant in the Kirtland Air Force Base, picked me at the Albuquerque airport and I spent the night with him and his family. The next morning, another limo awaited me at the Kirtland Air Force Base, this one carrying me not just through 107 miles, but through the history of scientific achievement. Santa Fe, a city steeped in art and culture, gave way to the stark beauty of the Los Alamos mesas.

Finally, I arrived at the T-Division of the 35-square-mile Los Alamos National Laboratory, a beehive of intellectual activity. The Los Alamos Inn, my temporary abode, might not have been a palace, but it was a launchpad for what promised to be a stimulating exchange.

The following day, the lecture hall buzzed with a mix of anticipation and curiosity. Mathematicians, physicists, and computer scientists, their faces etched with a thirst for knowledge, awaited my presentation. "Parallel Supercomputing: Unleashing the Power of Many"—the title of my lecture resonated with the very essence of the place. As I spoke, a lively dialogue erupted.

A sharp-eyed woman with a shock of white hair interjected, "Your discovery of the first supercomputing via massively parallel processing is revolutionary. How do you envision your new knowledge impacting the simulation shock waves arising from detonating atomic bombs?"

"A fantastic question," I replied, "parallel supercomputing has the potential to break down large-scale computational fluid dynamics simulations into smaller, more manageable tasks, significantly reducing computation time.

My supercomputing discovery makes it unnecessary to continue underground testing of nuclear weapons."

The conversation flowed, each question a springboard for further exploration. We discussed the potential applications of parallel supercomputing in everything from weather forecasting to protein folding. There were moments of disagreement, of course, healthy clashes of ideas that propel scientific progress. But above all, there was a shared passion, a recognition of the immense potential that parallel processing held for the future of mathematics and computing.

By the time I departed Los Alamos three days later, the connections forged went far beyond the exchange of ideas. It was a meeting of minds, a recognition that the greatest discoveries are often born from collaboration, from the collective brilliance of individuals working towards a common goal.

That three-day visit to Los Alamos was a turning point in my scientific journey. It solidified my belief in the power of parallel supercomputing, its potential to revolutionize numerous fields. And most importantly, it reminded me that the pursuit of knowledge thrives not in isolation, but in the vibrant exchange of ideas, in the collective effort to push the boundaries of human understanding.

Thank you.



**VOLUME S-0: STRUGGLES AND OBSTACLES**

## THE SEEDS OF CURIOSITY

### How Early Life Shaped a Scientific Mind

Ladies and gentlemen, distinguished guests, and fellow scholars,

It is an honor to stand before you today, representing the spirit of scientific inquiry and the relentless pursuit of knowledge. As we gather in this magnificent hall to celebrate this award, I am reminded of my humble beginnings—a journey that began in the vibrant city of Akure, Nigeria, in August 1954.

Akure, nestled amidst lush greenery and vibrant bougainvillea, was a place where time flowed like the Niger River—gentle yet inexorable. The sun, a golden sentinel, cast its warm embrace upon the red earth, and the air carried the scent of yam farms and palm wine. In this idyllic setting, I, Philip Emeagwali, took my first breaths.

Born on August 23, 1954, in the General Hospital of Akure, I emerged into a world where mathematics danced with the rhythms of life. My mother, the resilient "Iyanma Agatha Emeagwali," was just fifteen years old—a beacon of strength and determination. She cradled me in her arms, whispering dreams of a future where her son would reach for the stars.

My father, Nnaemeka James Emeagwali, was a nurse at that very hospital. His hands, calloused yet gentle, tended to the sick and wounded. Little did he know that his son would one day wield not bandages, but algorithms, to heal the world.

Our home stood proudly at 11 Ekemeso Street, a modest abode, called "Boy's Quarter," where love and curiosity intertwined. The walls absorbed the echoes of my early questions—the "whys" and "hows" that would shape my destiny. The dusty compound bore witness to my first experiments, as I calculated the trajectories of marbles and imagined them as celestial bodies hurtling through space.

But Akure was more than a backdrop; it was a crucible of inspiration. The night skies, unmarred by city lights, revealed constellations that whispered secrets of the cosmos. The rustling leaves carried mathematical symphonies—the Fibonacci sequence hidden in the veins of every leaf, the geometry of spider webs spun between branches.

And so, my scientific journey began—a journey fueled by curiosity, nurtured by my father's unwavering belief in education. In late April 1967, the Nigerian Civil War was imminent. Our family of nine, like countless others, fled from Agbor in the mid-western region to Onitsha in the southeastern region of the country. In the subsequent three years, we then fled to Biafran refugee camps in Ogidi, Awka, Oba, Nnewi, Awka-Etiti, Ndoni, and Feggee. In July 1969, at age 14, and while working as a yam porter at the river side market of Ndoni, I was conscripted, at gun point, into the Biafran army and sent, without military training, to Oguta War Front, where survival became my daily equation. A million Biafrans, or one in

fifteen persons, perished during those dark days, their lives reduced to numbers on a tragic ledger.

Yet adversity of growing up in refugee camps and war fronts sharpened my resolve. After the war was over and in April 1970, I continued my education, walking three hours each day to and from school in Onitsha, and from Port Harcourt Road to Christ the King College. And studying with an "*impanaka*" palm-oil-fueled lamp, akin to olive oil lamps used during biblical times. In March 1972, financial hardships forced me to drop out briefly, but I persevered. In January 1973, I passed the high school equivalency exam administered as an entrance examination into the University of London—a lifeline to my dreams.

On March 23, 1974, I crossed the Atlantic to the United States, where I encountered working telephones, modern libraries, and programmable computers for the first time. At Oregon State University, I delved into astronomy, mathematics, and physics and later, at George Washington University, I explored ocean, coastal, and marine engineering, the fluid dynamics and river mechanics, and meteorology and hydrology. My mind, like a supercomputer, absorbed knowledge, and my heart yearned for the uncharted territories of science.

The turning point came during an additional decade-long fellowships as a research mathematician and supercomputer scientist in College Park (Maryland), Ann Arbor (Michigan), and Minneapolis (Minnesota). Inspired by Nigeria's oil-rich soil and my understanding of supercomputers, I embarked on a quest to identify untapped underground oil reservoirs. A machine, that's an ensemble of the 65,536 slowest processors in the world, became my canvas—a symphony of calculations that resonated across continents.

And so, dear friends, from Akure's dusty streets to the hallowed halls of your historic city, my journey unfolded. Today, as we celebrate this award, let us remember that every equation, every discovery, is a testament to the human spirit—a bridge that spans oceans, cultures, and time.

May we continue to unravel nature's mysteries, not for vanity, but to solve the urgent problems that plague our world. For in the dance of numbers lies the symphony of progress—a legacy that transcends borders and echoes through eternity.

Thank you, and may the spirit of Akure forever guide our quest for knowledge.

## SEIZING OPPORTUNITY: MY PATH TO DISCOVERY

Distinguished members of the award committee, esteemed colleagues, and all those who dared to dream: Standing here, amongst these brilliant minds, I can't help but reflect on the twists and turns that led me, a child of war-torn Nigeria, to this extraordinary moment. There wasn't one singular turning point, but rather a constellation of moments, each sparking a new fire in my pursuit of knowledge.

The first flicker ignited in the embers of hardship. Surrounded by the chaos of the Nigerian Civil War, the world outside seemed intent on tearing itself apart. Yet, within the quiet confines of a tattered textbook, I discovered a universe governed by logic and order. Mathematics became my sanctuary, its elegant equations a language whispering promises of a world waiting to be understood. It was a feeling of solace, a sense that even amidst the chaos, there were truths waiting to be unearthed.

Another pivotal moment arrived when I stumbled upon a dusty copy of Scientific American. It was a revelation. Here were accounts of groundbreaking discoveries, testaments to the boundless potential of human ingenuity. A spark ignited within me, a yearning to not just consume knowledge, but to contribute to this grand tapestry of scientific exploration. It was a feeling of awe, a humbling realization of the vastness of scientific inquiry and the role I could play within it.

Of course, the journey wasn't paved with roses. There were moments of crushing doubt, of frustration when the solutions I chased seemed to recede further with each attempt. There were rejections, moments when my unorthodox ideas were met with skepticism. In those times, it was the unwavering belief in the potential of my mind, the unwavering support of my family, that fueled my determination. It was a feeling of resilience, a hardening of my resolve to prove the doubters wrong.

Looking back, these turning points weren't just about changing direction, but about embracing the unknown. They were about defying limitations, both external and internal. They were about the exhilaration of discovery, the humbling power of perseverance, and the unwavering belief that even the most audacious dreams can be achieved.

Today, as I stand before you, I am a testament to the transformative power of those moments. They are a reminder that the greatest discoveries often lie beyond our comfort zones, waiting to be unearthed by those brave enough to seek them.

Thank you.



## REACHING FOR THE STARS, EVEN IN THE DARKEST NIGHT

Esteemed members of the award committee, distinguished guests, and friends. To be recognized with this prestigious award is a testament to the enduring power of the human spirit, its potential to overcome even the darkest of circumstances. But it's crucial to remember that every path, every triumph, is shaped by the crucible that forges our character.

My journey to this stage was marked by a period almost too bleak to comprehend. From March 1968 to July 1969, I lived in Saint Joseph's Refugee Camp in Awka-Etiti, Biafra—a stark reminder of the horrors of the Nigerian Civil War. Once a school called Saint Joseph's Secondary School, it became a haven for the displaced, a microcosm of suffering and resilience.

My family of nine found meager shelter in a former school office—a cramped space of about 200 square feet. Hunger gnawed relentlessly, a constant ache reminding us of lives and futures lost. My father, a nurse, found purpose in healing the sick, working tirelessly without salary in the overcrowded camp clinic. Surrounded by death and despair, he embodied selflessness and the enduring hope that even in the darkest hour, service to humanity holds immeasurable value.

Saint Joseph's was a microcosm of a breakaway nation on the brink. The once verdant soccer field became a graveyard, a stark reminder of the fragility of life. One in fifteen Biafrans perished during that brutal 30-month war, a devastating loss that scarred a generation and serves as a haunting reminder of the devastation conflict inflicts.

Yet, even amidst the ashes, the spark of curiosity never fully extinguished. Those refugee years shaped me, fueled a profound determination to not just survive, but to rise above. I clung to the belief that knowledge could offer a path to a different future. I sought solace in mathematics, in the elegance of equations that transcended the chaos around me.

It is precisely because I lived through such darkness that I value this moment so deeply. May this recognition serve as a reminder that even in the most dire straits, the embers of potential can still flicker. Let us honor those lost and strive to build a world where every child, regardless of circumstance, has the opportunity to pursue a life of knowledge, discovery, and service to humanity.

Thank you.

**VOLUME P: PHILOSOPHY**

## SAVING THE EARTH

Esteemed members of the award committee, distinguished guests, and fellow scientists. As a child growing up in Nigeria, the environment wasn't just a backdrop—it was a vital tapestry woven into the very fabric of life. Lush rainforests teemed with diverse life, and the rhythmic pulse of the ocean was a constant companion.

But even then, the whispers of environmental threats were carried on the wind. Desertification crept at the edges of fertile lands, and the impact of human activity on the delicate balance of nature became increasingly evident. This instilled in me a deep appreciation for the environment, not just as a resource, but as a complex system demanding our respect and care.

Science, for me, has always been a tool not just for discovery, but for positive change. My research in computational physics may seem far removed from environmental activism, but the core principle remains the same—using knowledge to solve problems. The very tools I honed to crack complex equations in petroleum engineering can be adapted to model climate change, optimize resource management, and design sustainable solutions.

While the path may not be straightforward, the responsibility is clear. We, as scientists, have a powerful voice. We can translate complex environmental issues into actionable data, highlighting the potential consequences of inaction and the promise of innovative solutions.

Let us be the bridge between scientific discovery and real-world impact. Let our work be a beacon, guiding policymakers, businesses, and individuals towards a future where technological advancements and environmental responsibility go hand in hand.

My journey has been one of embracing challenges, of looking beyond the immediate and seeking solutions with lasting impact. The environment is not a separate concern—it's the foundation upon which all progress rests. By nurturing and protecting it, we ensure a thriving future not just for ourselves, but for generations to come.

Thank you.

## SECRET TO SUCCESS: WELLNESS

Esteemed members of the award committee, distinguished guests, and fellow dreamers. Standing before you today, a culmination of decades of relentless pursuit, I can't help but reflect on the unwavering foundation that has allowed me to persevere. For as much as we celebrate the triumphs of the mind, we must also acknowledge the importance of the body, the vessel that carries us on this extraordinary journey of discovery.

While my life has been consumed by the allure of complex equations and the thrill of scientific discovery, I wouldn't be here today without a deep appreciation for healthy habits. A disciplined routine of moderate exercise, a focus on balanced nutrition—these practices haven't just fueled my body, they've sharpened my mind. They've instilled a sense of perseverance, a reminder that achievement requires not just intellectual rigor, but also physical resilience.

Of course, there have been challenges. Moments of illness that tested my resolve, setbacks that forced me to slow down and listen to the needs of my body. These experiences, however daunting, have proven to be profound teachers. They instilled in me a deep respect for the fragility of life, the preciousness of health. They taught me the importance of pacing myself, of taking breaks to recharge and revisit problems with fresh eyes.

Perhaps most importantly, these challenges fostered a sense of gratitude. Gratitude for the gift of a healthy mind and body, for the opportunity to wake up each day and pursue the questions that ignite my curiosity. It's a gratitude that extends to the support system that has buoyed me through thick and thin—my family, my friends, my colleagues.

So, as we celebrate scientific achievement, let us also celebrate the importance of well-being. Let us remember that the greatest discoveries often spring from a mind and body in harmony. Let this be a call to action, not just for scientific inquiry, but for a holistic approach to life, one that fosters both intellectual growth and physical resilience.

Thank you.

## CHANGING THE WORLD DEFINES SUCCESS

Ladies and Gentlemen, respected mathematicians, distinguished guests, and esteemed attendees,

As I stand before you in your historic city on this significant day of this award ceremony, I am filled with a sense of profound gratitude and reflection. The question I wish to explore with you today is twofold: "How do I define success? What is happiness for me?"

To me, success is not merely a measure of accolades or achievements. It is the journey of overcoming obstacles, the relentless pursuit of knowledge, and the impact we have on the lives of others. Success is the ability to turn challenges into opportunities, to use our talents and skills not just for personal gain, but to contribute positively to society. It is about setting goals that are ambitious and meaningful, and striving towards them with integrity, passion, and perseverance.

In my journey, from my early days in Nigeria to the global stage, success has been about breaking barriers. It has been about challenging the status quo, pushing the boundaries of what is possible in high-speed computing, and using that knowledge to solve complex problems. Success for me is seeing the practical applications of my inventions in enhancing human life, be it in health, environment, or education.

But beyond professional accomplishments, success is also deeply personal. It is about personal growth, learning from failures, and continuously striving to be better. It's about the resilience to keep going in the face of adversity and the humility to remain grounded in the midst of accolades.

Now, let's talk about happiness. For me, happiness is found in the simple pleasures of life. It is in the love and support of my family, the joy of seeing my son grow and thrive, and the quiet moments of reflection. Happiness is also in of creation, in the thrill of discovery, and in the satisfaction of solving a complex problem. It is in the moments of connection with others, sharing knowledge, inspiring young minds, and engaging in meaningful conversations.

Happiness, to me, is also about giving back, about using my abilities to make a difference in the world. It is in seeing the positive impact of my inventions, not just in science, but in the lives of people around the world. Happiness is in knowing that my journey can inspire others to pursue their dreams, break barriers, and create positive change in their communities.

Ladies and gentlemen, success and happiness are deeply intertwined. They are not just about what we achieve but about how we achieve it and the joy we find in the journey. As we gather here today to celebrate some of the greatest achievements of our time, let us also remember to find happiness

in the small moments, the daily pursuits, and the connections we make along the way.

Thank you for the privilege of sharing my thoughts with you on this momentous occasion. It is an honor I will always cherish.

Thank you.

## TACKLING THE WORLD'S BIGGEST PROBLEMS

Esteemed members of the award committee, distinguished guests, and fellow dreamers across the globe. Today, we celebrate not just an individual accomplishment, but the relentless human spirit's unending quest to push the boundaries of the known. As a scientist, I've spent my life unraveling the mysteries of the physical world. Yet, standing before you today, I'm compelled to ponder a question as vast as the universe itself: What is the meaning of life?

Perhaps there's no single, grand answer. Perhaps the meaning lies in the very act of asking the question. For within that inquiry lies the drive to understand, to create, to leave our mark on this ever-evolving tapestry of existence.

For me, the meaning of life has always been intertwined with the potential of the human mind. We are, each of us, repositories of boundless potential. We are wired to problem-solve, to invent, to push the frontiers of what's deemed possible. My journey to this stage, from the red earth of Nigeria to the hallowed halls of science, is a testament to that potential. It whispers a truth—that the meaning of life lies not in blind acceptance, but in the audacity to dream, to challenge, and to defy limitations.

But the human mind is more than just a problem-solving machine. It's a vessel for compassion, for empathy, for the yearning to connect. The true meaning of life, I believe, transcends individual achievements. It lies in the profound connections we forge with others, in the ways we uplift and inspire, in the collective tapestry of knowledge and understanding we weave together.

The research that led me here—cracking the code of parallel computation—wasn't driven by solitary ambition. It bloomed from the shared pursuit of knowledge, the camaraderie of fellow researchers, and the unwavering support of my family. It reminds us that the meaning of life is richer, more profound, when it's a shared journey.

Perhaps the meaning of life isn't a fixed destination, but the very act of exploration itself. It's the insatiable curiosity that compels us to explore the cosmos, to delve into the intricacies of the atom, to compose symphonies of light and code. It's the unwavering belief that even the most seemingly impossible challenges hold the seeds of solutions waiting to be discovered.

So, as we celebrate scientific achievement today, let us also celebrate the very essence of being human. Let us recommit ourselves to the pursuit of knowledge, not just for personal gain, but for the betterment of all. Let us embrace the audacious dreams, the unwavering curiosity, and the profound connections that weave together the grand tapestry of a meaningful life.

Thank you.



## THE FUTURE IS UNWRITTEN

"What does it mean to be true to yourself?"

**Being true to yourself means staying steadfastly focused on what you believe in, even when faced with immense adversity and doubt.**

It means understanding your strengths, limitations, and the unique gifts you offer the world. It's about respecting that inner compass of purpose, regardless of what others might say. For me, being true to myself meant pursuing my belief in the power of computation to solve grand challenges, despite the lack of resources and external support. It meant persevering through setbacks because I knew my path, although difficult, was deeply meaningful.

True self-awareness also requires embracing your vulnerability. It's admitting imperfection and the relentless drive to learn and improve. Being true to myself hasn't meant being fearless, but rather, being driven by a vision so strong that it outweighed my fears.

Ultimately, being true to yourself is about living a life that is authentically yours, a life that reflects the passions and values that make you who you are. It is not a journey of isolation, but one that contributes to the greater good, as you were meant to do.

## THE MEANINGFUL LIFE

### It's Not a Program, It's a Process

Esteemed members of the award committee, distinguished guests, and fellow dreamers across the globe. Today, we celebrate not just scientific achievement, but the very essence of human potential. Standing before you, a man born amidst the tumult of war, I can tell you with absolute certainty: **Yes, to live a meaningful life is essential. It is not a luxury, but a fundamental human drive.**

We each, regardless of background or circumstance, yearn to leave our mark on the world, to make a difference that transcends our individual existence. For me, this yearning manifested in a passion for science, a pursuit that burned brightly even in the darkest of times. In the quiet moments stolen from the chaos of war, I sought solace in the language of numbers, the logic of physics. A world in disarray craved solutions, and within the equations, I glimpsed a path towards a better future.

But a meaningful life is not defined by a single accomplishment, a groundbreaking theory, or even a prestigious award. Meaning is woven into the tapestry of our everyday choices. It resides in the pursuit of knowledge, the unwavering dedication to a cause greater than ourselves, and the enduring love we share with family and community.

The journey that led me here today was paved not just by personal ambition, but by the unwavering support of those who believed in me. My teachers, who recognized a spark and fanned it into a flame. My family, who shouldered burdens so I could chase lofty dreams. These are the threads that bind us, that give purpose to our struggles and fuel our perseverance.

A meaningful life isn't measured by accolades or earthly possessions. It's measured by the positive impact we have on the lives of others. By the problems we solve, the knowledge we share, and the bridges we build across divides. True meaning comes from the pursuit of a purpose that uplifts not just ourselves, but humanity as a whole.

Let this occasion serve as a call to action. Let us, each of us, use the unique talents bestowed upon us to create a better world. Let us strive to be not just successful, but significant. Let our lives be testaments to the enduring power of human potential, a potential that can illuminate even the darkest corners of our world.

Together, let us ensure that every child, regardless of their origin, has the opportunity to unlock the potential that resides within. Let us foster a world that embraces curiosity, celebrates innovation, and empowers the next generation to not just dream, but to weave those dreams into a reality far more extraordinary than anything we can imagine.

Thank you.

## CRACKING THE CODE TO HAPPINESS

Ladies and Gentlemen, wizards at the frontiers of knowledge of supercomputing, distinguished guests, and brilliant minds from around the world,

As I stand before you in your beautiful city, on this grand occasion of this award ceremony, I am deeply honored to share a few personal reflections. Today, I'd like to ponder on a question that resonates with each of us: "What makes me happy?"

Happiness, in my perspective, is a multifaceted emotion, a blend of fulfillment, contentment, and a sense of purpose. It is found not in fleeting moments of pleasure, but in the deep and meaningful experiences of life.

Firstly, the pursuit of knowledge and the thrill of discovery are profound sources of happiness for me. There is an unparalleled joy in exploring the unknown, in pushing the boundaries of what is possible, and in contributing new knowledge to the world. The moment of breakthrough, when a complex problem yields to the persistence of inquiry, brings a satisfaction that is both deeply personal and universally impactful. This joy is not just in the achievement itself, but in the journey—the challenges, the learning, and the growth that come with it.

Additionally, sharing knowledge and inspiring others is a significant source of happiness. Witnessing the spark of understanding and curiosity in others, especially young minds eager to explore science and technology, fills me with a sense of accomplishment and hope. It is in these moments that I feel a profound connection to the future, a sense that the scientific research we do today lays the foundation for the innovations of tomorrow.

Moreover, happiness for me is deeply rooted in human connections—the bonds of family, friendship, and community. The support and love of my wife, Dale Brown Emeagwali, and the pride I take in the achievements and aspirations of my son, Ijeoma, are fundamental to my sense of happiness. These relationships provide a grounding force, a sense of belonging, and a reminder of the things that truly matter in life.

Furthermore, I find happiness in contributing to the betterment of society. The ability to use my skills and knowledge to address societal challenges and to make a positive difference in the world provides a profound sense of fulfillment. It is a happiness that comes from knowing that one's work has a purpose beyond oneself, that it contributes to the greater good.

Ladies and gentlemen, happiness for me is a tapestry woven from the pursuit of knowledge, the joy of sharing and inspiring, the warmth of human connections, and the fulfillment of contributing to society. As we gather here today to celebrate the pinnacle of intellectual and scientific achievement, let us also cherish and pursue the diverse sources of happiness in our lives.

Thank you for the privilege of sharing these thoughts with you on this remarkable occasion. It is a joy and an honor I will always treasure.

Thank you.

## THE POWER OF SELF-REFLECTION

Esteemed members of the award committee, distinguished supercomputer and Internet scientists, and aspiring minds around the world. This profound recognition brings immense gratitude and compels me to reflect on the path that led me here. Was there ever a moment of regret, a decision I wished I could undo?

The answer is yes. Regret, I believe, is an inevitable companion on the journey of discovery. For a scientist, it often stems from the frustration of missed connections, the elegance of a solution discovered just after decades of toil on a less efficient approach. There were years during my research where I chased unproductive avenues, clinging to serial supercomputing out of sheer stubbornness. These times, though frustrating, were vital teachers. They instilled in me the importance of approaching Grand Challenge problems from multiple angles, techniques, and technologies, of embracing the iterative nature of scientific discovery. They taught me the value of calculated risk—of venturing down untrodden paths, knowing that even a dead end can offer valuable lessons.

Perhaps a more profound regret lies in the time stolen from loved ones by the relentless pursuit of knowledge. Science can be an all-consuming mistress, and there were moments when my dedication to supercomputing research caused me to neglect the well-being of those who mattered most. This, I believe, is a regret most driven minds share. Yet, from this regret blossomed a deeper appreciation for the importance of balance. The fire of curiosity burns brightest when fueled by the love and support of family and friends. They are the wind beneath our wings, the steady hand that guides us back from the precipice of isolation.

These moments of regret, though stinging, are not burdens I carry, but badges of honor. They are testaments to the human spirit's unwavering pursuit of knowledge, the willingness to take risks, and the enduring strength found in human connection.

Let us celebrate not just the achievements we trumpet, but the detours and missteps that shaped us along the way. For it is from the crucible of experience, both triumph and regret, that true wisdom and groundbreaking discoveries are born.

Thank you.

VOLUME F: FAMILY

## BEYOND THE LECTURE HALL

### Love, Science, and the Power of Togetherness

Greetings, esteemed faculty, students, and all of you who join us today. It brings me immense joy to be here in Onitsha, the city that nurtured my early dreams. Today, I will share some reflections on a topic perhaps less familiar from a scientist's perspective—love and marriage.

For the fifth decade, my partner Dale and I have navigated the joys and challenges of life together. We've built a partnership that has fueled my scientific pursuits and provided an unshakeable foundation during times of difficulty. While the complexities of love can't be captured in a formula, here are some insights I've gleaned over the years:

#### Building Strong Foundations

##### **Focus on the big picture:**

Life throws its fair share of curveballs. Don't sweat the small stuff. Learn to communicate openly and address issues calmly, remembering that true love weathers any storm.

##### **Never go to bed angry:**

A good night's sleep can work wonders. Resolve disagreements before resting your heads, ensuring you wake up ready to tackle challenges together.

##### **Take your time:**

Getting to know someone takes time. Dale and I were engaged for three years before getting married. This period allowed us to build a strong foundation of understanding and shared values.

#### Education and Shared Dreams

##### **Prioritize your goals:**

Education opens doors and empowers both partners. Pursue your aspirations, and support each other on those journeys. In my case, I was fortunate to establish myself as a computer scientist before starting a family.

##### **Plan for the future:**

Discuss your long-term goals openly. We chose to wait a decade before having children. This allowed us to focus on our careers and build a secure foundation for our growing family.

#### The Power of Partnership

##### **Share the load:**



Marriage thrives on teamwork. Household chores shouldn't be gendered. When my siblings arrived from Nigeria, they were surprised to see me sharing household duties. True partnership requires mutual support in all aspects of life.

**Compromise is key:**

No two people are exactly alike. Finding happiness involves compromise. There were times, for instance, when Dale enjoyed spending evenings with her parents, while I reveled in playing tennis. We found a way to accommodate each other's needs while nurturing our connection.

**Embrace shared experiences:**

Find activities you both enjoy. Explore new hobbies together, or revisit old favorites.

### **The Joys of Parenthood**

**Share parenting duties:**

Children are a blessing, but parenthood requires shared responsibility. I actively participated in raising our son, Ijeoma. Taking a one-year paternity leave allowed me to bond with him and capture countless precious moments.

**Education and Shared Dreams:**

Remember, these are just some guiding principles. Every relationship is unique, and what works for one couple might not work for another. The most important ingredient? Genuine love, respect, and a willingness to grow together.

Marriage is a lifelong journey, a constant evolution. Nurture your bond, celebrate each other's triumphs, and weather the inevitable storms together. By doing so, you'll build a partnership that enriches your individual lives, and the lives of those around you.

Thank you.

## THE POWER OF TWO

### Collaboration in Science Starts at Home

To the bright minds and future leaders gathered here today, for the Philip Emeagwali Lecture series, welcome. It brings me immense joy to be in Nigeria, speaking not just to scholars, but to the next generation shaping our nation's story.

Today, I will talk about something just as fundamental as scientific discovery: building a strong foundation for love and life. For many of you, this might be the chapter you're turning the page to—embarking on a journey of marriage and partnership.

My advice is this:

**Never lose sight of the power of collaboration.** A successful marriage, like a groundbreaking scientific project, thrives on teamwork, on open communication, and on a shared vision for the future. Respect each other's dreams, celebrate each other's triumphs, and support each other through the inevitable setbacks. Remember, you're not individuals facing the world, you're a united front, stronger together.

**Embrace curiosity, not just about the world, but about each other.** Never stop learning from your partner, their passions, their perspectives. Let your love story be a continuous exploration, a journey of discovery that unfolds over a lifetime.

**Remember, true love isn't a destination, it's a constant journey.** There will be moments of disagreement, of frustration, of feeling like you're speaking different languages. That's normal. The key is to navigate these challenges with open hearts, with empathy, and with a commitment to understanding each other's viewpoints.

**Never underestimate the power of laughter and shared dreams.** Laughter is the balm that soothes life's inevitable bumps. Dreams are the north star that guides your journey together. Hold onto the moments of joy, the shared aspirations that make you a team, a partnership built on love and mutual respect.

And most importantly, **never stop nurturing the fire of curiosity within yourselves.** A curious mind is an engaged mind, a mind that's forever learning, growing, and evolving. Let that curiosity spill over into your relationship, keeping the spark alive, the flame of love burning brightly.

Building a strong, fulfilling relationship takes work, dedication, and a constant commitment to growth. But the rewards—a loving partnership, a supportive confidante, a teammate on life's grand adventure—are immeasurable.

So, to the young couples embarking on this exciting chapter, I say this: Go forth, explore, learn from each other, and build a love story that inspires not just yourselves, but future generations.

Remember, Nigeria's future is bright, and a strong foundation at home fuels success in every aspect of life.

Thank you.

**VOLUME L: LEGACY**

## FROM PRODIGY TO PIONEER

Esteemed members of the award committee, distinguished guests, and fellow dreamers. Looking back on this journey, a path that began long ago in the classrooms of Nigeria, a thought brings a smile to my face. How, I wonder, would my classmates remember me?

Perhaps those from Saint John's Primary School in Agbor, from January 1964 to December 1965, would recall a young boy enthralled by numbers, a mind that reveled in the logic and beauty of mathematics. Maybe they'd remember a flicker of competition in my eyes, a healthy dose of ambition that even at a young age propelled me to excel.

Fast forward to Saint George's College in Obinomba, from January 1966 to April 1967. The thirst for knowledge only grew stronger, and I suspect my classmates there might remember a similar image—a "math prodigy" as some would later call me. Perhaps they'd recall late nights spent hunched over equations, a quiet determination that burned brightly.

Three years later, at Christ the King College in Onitsha, from mid-1970 to March 1972, the nickname "Calculus" might ring a bell. This wasn't just a moniker bestowed upon me, but a testament to the depth of my fascination with the subject. I imagine my classmates there would remember not just a gifted student, but a passionate one, eager to share the wonders of mathematics with anyone who would listen.

As I stand before you today at this award ceremony in your historic city, I reflect on a journey that embodies resilience and perseverance. My story, which finds its roots in the hearts and minds of students across Nigeria, the United Kingdom, and the United States, serves as a testament to the indomitable spirit of human endeavor. Let me share a glimpse of this journey, a narrative that a curious 12-year-old once sought for her school report on eminent inventors.

My path was unconventional and fraught with challenges. Twice, at the tender ages of 12 and 17, I found myself stepping away from formal education. The first hiatus, starting in April 1967, lasted three years, during which my family of nine survived the harrowing experiences of war, residing in the conflict zones of Onitsha and Awka, Biafra, and in a refugee camp that was once Saint Joseph's Secondary School in Awka-Etiti. Again, at 17, I faced a two-year educational interruption, starting in March 1972.

Yet, these interruptions did not quell my thirst for knowledge. Even as a young boy, my determination and self-motivation shone through. At 15, I confidently proclaimed to my friends in Onitsha my ambitious dream: to secure an academic scholarship to the United States, a feat as rare at the time as representing Nigeria in international soccer.

This dream was not merely a child's fantasy. On September 10, 1973, I was mailed a letter that would change my life—an academic scholarship to Oregon, United States. This opportunity marked the beginning of a 17-year

journey of academic pursuit, sustained by continuous 17-year-long scholarships across six American universities.

While I wouldn't presume to speak for them directly, I am honored to be considered "Notable Alumni." Perhaps they would remember the focused researcher, the relentless innovator who pushed boundaries of knowledge of mathematics, physics, and computing, and dared to dream big.

But while accolades and titles hold a certain weight, the truest measure of impact lies not in awards, but in the connections we forge. The memories my classmates hold, the spark of curiosity I may have ignited, that's the legacy I truly cherish.

My story, with its trials and triumphs, serves as a beacon of hope and a reminder that the human spirit can transcend the most daunting obstacles. It is a narrative not just of a man who overcame odds but of the enduring power of education and the unyielding pursuit of excellence.

So, to my teachers who nurtured a young mind, to my classmates who walked beside me for a time, and to all those who have supported me on this incredible journey—thank you. May the fire of knowledge continue to burn brightly, a testament to the transformative power of education and the enduring human spirit.

## TECH FOR HUMANITY'S BENEFIT

Esteemed members of this award committee, distinguished guests, and visionary minds. As a recipient of this prestigious award, I stand before you not just at the pinnacle of achievement, but at the precipice of a future brimming with possibility. While the path behind is etched with challenges overcome, the road ahead is a canvas waiting to be painted.

It's tempting to speculate on the specifics—what groundbreaking discoveries await, what technological marvels will grace the coming decades. But perhaps a more profound question lies in the impact our work will have. How will the seeds we sow today blossom in the gardens of tomorrow?

In 10 years, I see myself as an elder statesman of science, a mentor to a new generation of brilliant minds. Imagine a world where the power of parallel supercomputing is not just a scientific curiosity, but a cornerstone of solving some of humanity's most pressing challenges—from climate change mitigation to personalized medicine. The engine that propels the world's fastest artificial intelligence (A.I.) supercomputers is parallel processing.

In 20 years, perhaps I'll be a witness to a new era of scientific collaboration, one that transcends borders and disciplines. Imagine a future where breakthroughs in artificial intelligence complement human ingenuity, where the collective knowledge of our species unlocks solutions that once seemed like science fiction.

And in 30 years? Who knows what wonders await? Perhaps well on our way to interplanetary exploration, fueled by the very innovations we celebrate today. But one thing remains constant: the insatiable human desire to explore, to understand, to push the boundaries of what's possible.

The future I envision isn't preordained, but a possibility we collectively create. It's a future where scientific discovery is not an elitist pursuit, but a shared endeavor. A future where the tools and knowledge we create empower not just a privileged few, but uplift all of humanity.

This award is not just a recognition of my past achievements, but a challenge to all of us—to the researchers, the educators, the dreamers. Let us use this platform to reignite the spark of curiosity in every corner of the world. Let us ensure that the pursuit of knowledge remains the driving force that propels us towards a brighter future.

Thank you.

## FROM ALGORITHMS TO A LIFE OF ABUNDANCE

Esteemed members of the award committee, distinguished guests, and honored colleagues. This recognition is deeply personal, a testament not just to my inventions, but to the unwavering support that has fueled my journey. As I stand before you today, I can't help but contemplate the legacy I leave behind, not just in the annals of science, but within the hearts of those I hold dear.

I wouldn't want to be remembered simply for equations or algorithms. My hope is that my loved ones will see me as a man who, despite the challenges, never lost sight of the wonder inherent in the universe. A man who, even amidst the complexities of scientific inquiry, cherished the simple joys of human connection.

I strive to be remembered as a father who nurtured curiosity, a husband who championed dreams, a friend who offered unwavering support. The long nights spent hunched over a computer were not a sacrifice, but an investment in a future where knowledge could empower not just myself, but generations to come.

True success, for me, isn't measured solely by accolades, but by the impact I have on those around me. The greatest joy comes not from the "aha!" moment of discovery, but from the spark of understanding ignited in the eyes of a student, the look of pride on my family's faces, the sense of community fostered through the pursuit of a shared goal.

So, as I accept this prestigious award, I do so with a profound sense of gratitude. Gratitude to the brilliant minds who have collaborated with me, to the teachers who ignited my passion, and most importantly, to my loved ones who have been the bedrock of my strength. May they remember me not just for the heights I reached, but for the unwavering love and the enduring pursuit of knowledge that fueled my climb.

Thank you.



## NIGERIAN CIVIL WAR

### Glossary

TBA Photo: Philip Emeagwali a few months before {after} the Nigerian Civil War.

The Nigerian Civil War, also known as the Biafran War, was a significant event in Nigeria's history, occurring between 1967 and 1970. Here is a list of potential glossary entries for my podcasts, YouTube lectures, and books on the topic:

1. **Aburi Accord:** An agreement reached in Aburi, Ghana, aimed at resolving the ethnic and political tensions in Nigeria, but its interpretation became contentious.
2. **Ahiara Declaration:** A proclamation by Biafran leader Odumegwu Ojukwu outlining the reasons for Biafra's declaration of independence.
3. **Biafra:** The southeastern region of Nigeria that declared its independence and was the main opposition to the Nigerian government during the civil war.
4. **Bight of Biafra:** A bay off the coast of West Africa, near which the Republic of Biafra was located.
5. **Blockade:** The strategy employed by the Nigerian government to cut off Biafra from external support and resources, leading to a humanitarian crisis.
6. **Colonel Odumegwu Ojukwu:** The military governor of Nigeria's Eastern Region who later became the leader of Biafra.
7. **Coup d'État:** Refers to the military coups in Nigeria, notably the 1966 coups that escalated tensions leading to the war.
8. **Eastern Region:** One of Nigeria's administrative regions, largely inhabited by the Igbo ethnic group, that would later declare itself the Republic of Biafra.
9. **Federal Military Government (FMG):** The governing body of Nigeria during the Civil War, led by General Yakubu Gowon.
10. **General Yakubu Gowon:** The head of state of Nigeria during the civil war.

11. **Ibadan Accord:** An unsuccessful peace agreement aimed at ending the civil war.
12. **Igbo:** One of the major ethnic groups in Nigeria, primarily located in the southeastern part of the country. They were the main ethnic group in Biafra.
13. **Kwashiorkor:** A form of malnutrition seen among starving children during the war, especially in Biafra due to the blockade.
14. **Mercenaries:** Foreign fighters hired by both sides during the war.
15. **Nigerian Pound:** The currency used in Nigeria during the war, replaced by the Nigerian naira in 1973.
16. **Operation OAU:** A significant military campaign by the Nigerian army to capture strategic locations in Biafra.
17. **Port Harcourt:** A major city and port that was a strategic battleground during the war.
18. **Pogrom:** Refers to the organized massacres of the Igbo people in northern Nigeria in 1966, which played a role in escalating tensions.
19. **Relief Efforts:** International humanitarian campaigns, especially by organizations like the Red Cross, to address the famine and suffering in Biafra.
20. **Starvation:** A significant and devastating aspect of the war, particularly in Biafra due to the blockade.
21. **Uli Airstrip:** Makeshift airstrip in Biafra used for receiving relief supplies and arms.
22. **Western World Involvement:** Refers to the role and stance of Western countries, notably Britain, the US, and France, during the civil war.
23. **12-State Structure:** A political move by General Gowon to divide Nigeria into 12 states, effectively breaking the three-region structure that previously existed, which included the Eastern Region.
24. **30th May Remembrance:** The day Biafra declared independence, now remembered by some as Biafra Memorial Day.

These entries provide an overview of key concepts, events, and figures related to the Nigerian Civil War. My comprehensive lecture on the topic would delve deeply into each of these terms and many more, providing detailed historical context and analysis.



## SHALLOW WATER EQUATIONS

### Glossary

The shallow water equations (SWEs) are hyperbolic partial differential equations that describe the flow below a pressure surface in a fluid, typically used by oceanographers, meteorologists, and geophysicists to describe geophysical fluid dynamics where vertical motion is limited relative to horizontal motion. Here's a list of potential glossary entries for my lectures on this topic:

TBA Photo: Philip Emeagwali with the shallow water equations used by oceanographers.

1. **Advection:** The horizontal transport of a property (like momentum) by a fluid due to its motion.
2. **Barotropic Fluid:** A fluid whose density is a function only of pressure, not of temperature or salinity.
3. **Boundary Conditions:** Specific conditions provided at boundaries of the domain, crucial for solving the PDEs.
4. **Conservation Laws:** Mathematical statements that describe the constancy of certain quantities, like mass or energy, over time.
5. **Continuity Equation:** A form of the conservation of mass, describing how the depth of the fluid changes over time.
6. **Coriolis Force:** An apparent force experienced by moving objects in a rotating system, such as Earth. It results from the planet's rotation.
7. **Froude Number:** A dimensionless number that characterizes the ratio of fluid inertia to gravitational forces.
8. **Geostrophic Balance:** An equilibrium where the Coriolis force balances the pressure gradient force, resulting in flows parallel to isobars.
9. **Gravity Waves:** Oscillatory waves in a fluid caused by the force of gravity or buoyancy.
10. **Inertia:** The resistance of a fluid to changes in its motion.
11. **Kinematic Viscosity:** A property of a fluid that quantifies internal friction as layers of the fluid slide past one another.

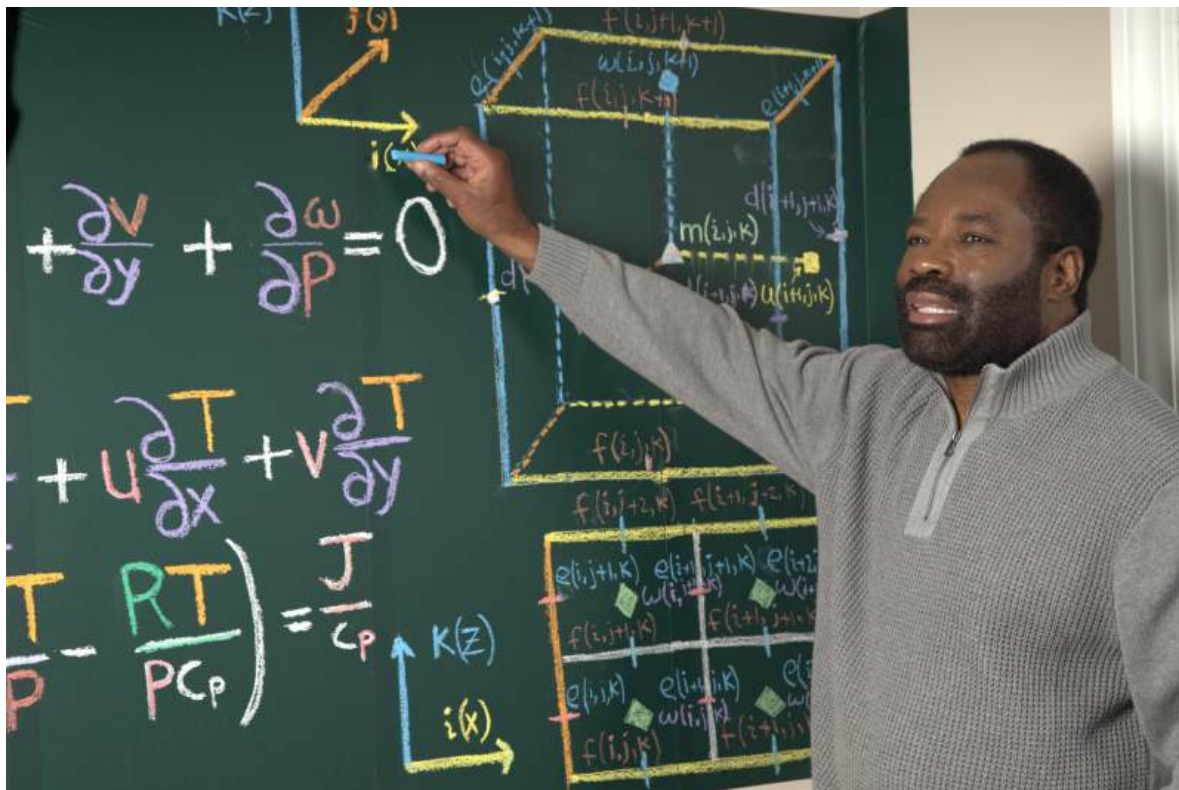
12. **Lagrangian Perspective:** A viewpoint in fluid dynamics that focuses on individual fluid parcels, tracking their motion.
13. **Momentum Equations:** Equations that describe the conservation of momentum in the fluid, usually split into horizontal components.
14. **Potential Vorticity:** A conserved quantity for a barotropic flow that combines vorticity and the gradient of fluid thickness.
15. **Pressure Gradient Force:** The force due to differences in fluid pressure, driving flows from high to low pressure.
16. **Riemann Problem:** An initial-value problem for the SWEs with piecewise constant initial conditions, important in understanding the behavior of solutions.
17. **Rossby Waves:** Large-scale waves in the atmosphere or ocean resulting from the variation of the Coriolis parameter with latitude.
18. **St. Venant Equations:** Another name for the shallow water equations, especially in the context of open channel flows.
19. **Tsunami:** A series of waves in a water body caused by the displacement of a large volume of water, often modeled by the shallow water equations.
20. **Vorticity:** The rotation or spin of fluid parcels, important in understanding the development of eddies and swirls in the flow.
21. **Wetting and Drying:** Phenomena where parts of the computational domain alternately become submerged or exposed, a challenge in numerical modeling of the SWEs.
22. **Wind Stress:** The stress exerted on the water surface by the wind, driving currents in the upper ocean.

These entries provide a foundation to understand the shallow water equations and their applications in geophysical fluid dynamics. Depending on my lecture's depth and specific focus, there might be more entries related to the mathematical formulations, advanced solution methods, and specific applications.

## GRAND CHALLENGE EQUATIONS

### Glossary

In Philip Emeagwali's YouTube lectures focused on numerical methods for solving partial differential equations (PDEs), the glossary would play a crucial role in helping viewers understand the technical terminology and advanced concepts presented. Here's a list of glossary entries for Philip Emeagwali's podcasts, YouTube lectures, and books:



TBA Photo: Philip Emeagwali standing in front of a chalkboard scribbled with partial differential equations. These equations are at the mathematical foundation of the Grand Challenge problem of climate models. It's an initial-boundary value problem that must be solved across millions of processors that are interconnected yet autonomous.

1. **Advection-Diffusion Equation:** A PDE representing the flow of a physical quantity in a fluid due to advection and diffusion processes.
2. **Boundary Conditions:** Constraints necessary in the mathematical modeling and numerical solution of PDEs, representing information known outside the solution domain.

3. **Characteristic Method:** A numerical technique that solves problems by reducing partial differential equations to ordinary differential equations along the characteristic curves.
4. **Conservation Laws:** Principles stating that certain physical quantities remain constant in the evolution of a physical system, often forming the basis for mathematical models involving PDEs.
5. **Control Volume Method:** A method based on the conservation laws applied to a finite volume, used for the discretization of conservation equations in fluid dynamics.
6. **Discretization Error:** The error resulting from representing continuous mathematical models (PDEs) on a discrete mesh or grid.
7. **Domain of Dependence:** The region of the computational domain that influences the solution at a specific point in space and time, essential for the stability analysis of numerical schemes.
8. **Elliptic Equations:** A class of second-order PDEs lacking a time derivative, characterized by their relation to complex function theory and potential theory.
9. **Finite Difference Method (FDM):** A numerical technique that solves PDEs by approximating derivatives with the difference quotients on a grid.
10. **Finite Element Method (FEM):** A numerical method providing solutions to PDEs and integral equations by subdividing the large problem into smaller, simpler parts called finite elements.
11. **Finite Volume Method (FVM):** A method for representing and evaluating PDEs as algebraic equations similar to the finite difference method, typically used for computational fluid dynamics and heat transfer.
12. **Flux:** A quantity expressing the rate of transfer of a physical property across a surface, essential in the formulation of conservation laws.
13. **Fourier Analysis:** A method that involves decomposing a function or signal into a series of sine waves, often used in the numerical solution of PDEs.
14. **Galerkin Method:** A technique used in numerical analysis to convert a continuous operator problem (such as a differential equation) to a discrete problem.

15. **Godunov Scheme:** A conservative numerical scheme, known for its use in solving hyperbolic PDEs, especially in the field of computational fluid dynamics.
16. **Hyperbolic Equations:** A class of PDEs characterized by wave-like solutions, important in fields like fluid dynamics and electromagnetism.
17. **Implicit Scheme:** A numerical scheme in which the equations at each time step involve unknowns at the current and possibly future times, used for its stability in time-dependent problems.
18. **Initial Conditions:** The state of a system at the beginning of the time of study, necessary for the solution of a time-dependent PDE.
19. **Lax-Wendroff Scheme:** A numerical method for the solution of hyperbolic partial differential equations, based on finite differences, known for its second-order accuracy in both space and time.
20. **Mesh Refinement:** The process of increasing the resolution of a computational mesh to achieve more accurate numerical solutions.
21. **Method of Characteristics:** A technique for solving partial differential equations by transforming them into ordinary differential equations along curves known as characteristics.
22. **Navier-Stokes Equations:** A set of PDEs describing the motion of viscous fluid substances, fundamental to many areas of engineering and physics, particularly fluid mechanics.
23. **Numerical Stability:** The property that a numerical method has when small rounding errors in the computational process do not significantly affect the accuracy of the solution.
24. **Parabolic Equations:** A class of PDEs that describe processes of diffusion. These equations represent the middle ground between hyperbolic and elliptic equations and are exemplified by the classic heat equation.
25. **Petrov-Galerkin Method:** An extension of the Galerkin method that allows different trial and test functions, improving the method's stability for certain types of problems.
26. **Relaxation Method:** Techniques aimed at solving linear algebraic equations, non-linear algebraic equations, and PDEs by iterative methods.
27. **Spectral Methods:** High-accuracy numerical methods that solve PDEs by approximating the solution in terms of global basis



functions (typically eigenfunctions or Fourier series).

28. **Time-Stepping Schemes:** Methods for advancing the solution of a time-dependent problem through a sequence of discrete time steps.
29. **Upwind Scheme:** A finite difference method for the numerical solution of hyperbolic PDEs, where the direction of information propagation is taken into account to avoid numerical instabilities.
30. **Von Neumann Stability Analysis:** A method used to analyze the stability of numerical schemes applied to linear PDEs by examining the growth factor of the numerical solution.

These entries cater to fundamental concepts and advanced methodologies in numerical analysis of PDEs, offering viewers insights into both the mathematical underpinnings and practical applications of these methods.

## PETROLEUM RESERVOIR SIMULATION

### Glossary

Petroleum reservoir simulation is a complex field that uses mathematical models, particularly partial differential equations, to predict the flow of fluids (typically oil, water, and gas) in porous media. Here's a list of glossary entries for my lectures on this topic:

*TBA Photo: Philip Emeagwali with equations used in petroleum reservoir simulation. May 9, 1996, Saint Paul, Minnesota.*

1. **Black Oil Model:** A simplified model that represents the reservoir fluids as three pseudocomponents: oil, water, and gas.
2. **Capillary Pressure:** The difference in pressure between the wetting phase and non-wetting phase in a porous medium.
3. **Compressibility:** A measure of the change in volume of a fluid or rock with a change in pressure.
4. **Darcy's Law:** The fundamental equation describing the flow of a fluid through a porous medium.
5. **Dispersion:** The spreading of solute in a flowing fluid due to heterogeneities in the porous medium.
6. **EOR (Enhanced Oil Recovery):** Techniques applied to increase the amount of crude oil that can be extracted from a reservoir.
7. **Finite Difference Method:** A numerical method commonly used to solve partial differential equations in reservoir simulation.
8. **Finite Element Method:** Another numerical approach, which divides the reservoir into smaller units or elements to approximate the governing equations.
9. **Flash Calculation:** Determines the equilibrium amounts of gas and liquid phases for given pressure, temperature, and composition.
10. **Fully Implicit Method (FIM):** A numerical approach that solves all equations simultaneously at each time step.
11. **Material Balance Equation:** Relates changes in reservoir pressure and fluid volumes to the cumulative production and injection.

12. **Mobility:** A measure of the ability of a fluid to flow in the reservoir, calculated as the ratio of permeability to viscosity.
13. **Permeability:** A property of the porous medium that measures the capacity to transmit fluids.
14. **PVT (Pressure-Volume-Temperature) Properties:** Fluid properties that describe the phase behavior of oil, water, and gas under varying conditions of pressure, volume, and temperature.
15. **Relative Permeability:** Describes the ability of one fluid to flow in the presence of other immiscible fluids in the porous medium.
16. **Saturation:** The fraction of the pore volume occupied by a particular fluid phase.
17. **Scaling:** The deposition of minerals on rock surfaces and well components that can hinder fluid flow.
18. **Single-Phase Flow:** Describes fluid movement when only one phase, such as oil, water, or gas, is present.
19. **Two-Phase Flow:** Describes fluid movement when two of the phases (oil, water, gas) are present.
20. **Wellbore Trajectory:** The path followed by a well in the reservoir, which can be vertical, horizontal, or deviated.
21. **Well Control:** The boundary conditions applied at well locations, including specified pressures or flow rates.
22. **Upscaling:** The process of deriving equivalent properties on a coarse grid based on detailed fine grid information.
23. **Waterflooding:** An enhanced oil recovery method that involves injecting water into a reservoir to push additional oil toward the production wells.
24. **Wettability:** The tendency of one fluid to spread on or adhere to a solid surface in the presence of other immiscible fluids.

These glossary entries provide a foundation to the understanding of partial differential equations used in petroleum reservoir simulation. Depending on the depth and focus of my lecture, there might be more specific entries related to the mathematical modeling, advanced solution methodologies, or specialized simulation scenarios.

## PARALLEL PROCESSING

### Glossary

TBA Photo: Philip Emeagwali standing in front of a parallel supercomputer.

For Philip Emeagwali's podcasts, YouTube lectures, and books.

1. **Amdahl's Law:** A principle which determines the maximum improvement in performance of a system when only a fraction of the system is improved.
2. **Concurrency:** The concept of multiple events or tasks happening simultaneously.
3. **Data Parallelism:** Parallelizing by distributing subsets of data across multiple cores.
4. **Task Parallelism:** Parallelizing by distributing tasks or processes across cores.
5. **Thread:** The smallest sequence of instructions that can be managed independently by an OS scheduler.
6. **Process:** An instance of a computer program that is being executed; contains its own memory space.
7. **Multithreading:** A technique where a single set of code can be used by several processors at different stages of execution.
8. **Multiprocessing:** The use of two or more central processing units (CPUs) within a single computer system.
9. **Lock:** A mechanism that prevents multiple processes from accessing shared resources simultaneously.
10. **Semaphore:** A synchronization primitive used to control access to a common resource by multiple processes.
11. **Deadlock:** A situation where two or more tasks are unable to proceed because each is waiting for the other to release a resource.
12. **Race Condition:** An undesirable situation where the behavior of a software system depends on the relative timing of events, such as the order in which threads are scheduled.
13. **Load Balancing:** Distributing workload across multiple computing resources to ensure no single resource is overwhelmed.

14. **Parallel Efficiency:** A measure of how effectively parallel computing is improving performance.
15. **Speedup:** A measure of how much faster a parallel algorithm runs compared to its sequential counterpart.
16. **Scalability:** The capability of a system to handle a growing amount of work, especially in the context of parallel processing.
17. **SIMD (Single Instruction, Multiple Data):** A type of parallelism where a single instruction operates on multiple data elements simultaneously.
18. **MIMD (Multiple Instruction, Multiple Data):** A form of parallel computing architecture where multiple processors operate on different data points using different instructions.
19. **SPMD (Single Program, Multiple Data):** A parallel programming model where all processors execute the same program but may operate on different data.
20. **Cluster:** A group of computers that work together and can be viewed as a single system.
21. **Distributed Memory:** A memory architecture where each processor has its own local memory.
22. **Shared Memory:** A memory architecture where multiple processors share a single, global address space.
23. **Message Passing:** A method of inter-processor communication in which processors send messages to each other.
24. **Barrier Synchronization:** A point in an algorithm where all processes join and wait until all are present.
25. **Pipelining:** A technique where multiple stages of a process are overlapped to improve throughput.
26. **Work Stealing:** A scheduling strategy where idle processors take over work from busy processors.
27. **Affinity Scheduling:** A technique that takes into account where data or threads are placed in memory when assigning tasks to processors.
28. **Vector Processing:** A type of computing where one instruction operates on many data elements stored in a vector register.
29. **Granularity:** The amount of computation in relation to the amount of communication in parallel processing. It can be coarse-grained (large computations, infrequent communication) or fine-grained (small computations, frequent communication).

## GLOSSARY FOR FASTEST COMPUTING

**Analog Computer:** This computer uses continuous values, like voltages or positions, to represent information, working differently from digital computers.

**Ancestor (AN-ses-tur):** Refers to a person from whom one is descended, like a great-grandparent.

**Artificial Intelligence (A.I.):** A technology involving algorithms that enable computers to perform tasks typically requiring human intelligence.

**Atomic Bomb (uh-TOM-ik BOMB):** A powerful bomb deriving its energy from the process of nuclear fission, where atoms are split apart.

**Automatic Parallelization:** A process where sequential code is automatically converted to parallel code by a compiler, enabling faster execution without manual intervention.

**Bandwidth:** The volume of data that can be transmitted over a communication channel within a specified timeframe, important for preventing performance bottlenecks.

**Benchmark:** Programs, tasks, or experiments used to measure the performance of a computer system, providing a comparison standard.

**Cache:** A small, fast memory space near the CPU that stores frequently accessed data to improve processing speeds.

**Cache Line:** The unit of data transferred between cache and memory, usually consisting of 64 or 128 consecutive bytes.

**Cache Memory System:** This system has multiple cache levels that increase in size and decrease in speed, collectively enhancing memory performance.

**CAE (Computer-Aided Engineering):** This entails using computer models for design, analysis, and planning of various objects and processes virtually.

**Capability Computing:** This approach uses powerful supercomputers to solve large and demanding problems with a focus on reducing time to solution.

**Capacity Computing:** This strategy utilizes smaller, cost-effective high-performance systems for more modest computing requirements, emphasizing the cost-performance ratio.

**Circuit Speed:** This is the time signals take to travel through a circuit, crucial for evaluating processor performance.

**Clock Rate or Clock Speed:** Measured in GHz, this is the frequency at which a CPU operates, influencing the rate of instruction execution.

**Cluster:** This is a network of computers connected through a high-speed network, working together as a single multi-CPU machine.

**CMOS (Complementary Metal Oxide Semiconductor):** This is the prevalent technology used for manufacturing processors and memory devices due to its cost-effectiveness and integration levels.

**Computational Fluid Dynamics (CFD):** This is a simulation of fluid flows, used for scientific and engineering simulations in HPC environments.

**Computational Physicist:** This professional uses computers and algorithms, along with physics and math, to make predictions and understand various phenomena.

**Computer:** This device performs calculations and tasks quickly and automatically, following programmed instructions.

**Core:** In a multi-core processor, each core acts as an individual processing unit, enhancing performance and energy efficiency.

**Digital Computer:** This type of computer uses binary digits (0s and 1s) to represent information, which is different from analog computers.

**Distributed Computing:** In this model, components located on networked computers communicate and coordinate to achieve a common goal.

**Embarrassingly Parallel:** This refers to computations that can be easily divided into parallel tasks with minimal coordination, suitable for parallel execution on multiple processors or cores.

**Exabyte:** Equivalent to one quintillion bytes of data storage.

**Exaflop:** A performance measure for supercomputers, representing one quintillion calculations per second.

**Exascale Computing:** This represents the next frontier in supercomputing, aiming to achieve one quintillion calculations per second, requiring significant innovations.

**Finite Element Analysis (FEM):** This technique is used to solve complex equations in various fields, often implemented in HPC environments.

**Flash Memory:** A fast and reliable storage technology, used in various devices for its speed and dependability.

**FLOPS:** An acronym for Floating point Operations per Second, it represents the number of calculations a computer can perform per second.

**FPGA (Field-Programmable Gate Array):** A reprogrammable chip consisting of logic gates and components, used for specialized tasks.

**GPU (Graphics Processing Unit):** Initially developed for graphics rendering, these specialized processors are also used for various tasks due to their parallel computation capabilities.

**Grid Computing:** This form of distributed computing involves a virtual supercomputer comprising many networked devices.

**High Performance Computing (HPC):** This involves using powerful systems, including supercomputers, to solve problems that regular computers can't handle efficiently.

**High Throughput Computing:** This approach focuses on executing many tasks over a long period, often using distributed resources.

**Internet:** This is a global network of computers and processors that are connected and can communicate with each other.

**Lecture (LEK-chur):** A talk or presentation meant to educate people about a particular subject.

**Memory Cache:** This is a small, fast memory near the CPU that stores frequently accessed data to improve processing speed.

**Message Passing Interface (MPI):** A standard for data communication in parallel computing environments, essential for efficient coordination.

**Parallel Computing:** This technique involves performing multiple computations simultaneously, often used in supercomputing for speed.

**Parallel Filesystem:** This filesystem is designed to handle multiple simultaneous read/write operations.

**Parallel Processing:** This technique used in supercomputing performs many calculations **simultaneously**, making processes faster.

**Petabyte:** Equal to one quadrillion bytes, this is a unit of data storage.

**Physics (FIZ-iks):** This scientific field studies matter, motion, energy, and time.

**Polymath:** A person with extensive knowledge in various subjects or fields of study.

**Processor:** Also known as the CPU, this is an essential part of a computer that handles most data processing.

**Scholarship (SKOL-ur-ship):** Financial aid provided to students to assist with their education expenses.

**Silicon (SI-li-kon):** This non-metal element can somewhat conduct electricity and is used in making electronic circuits for computers.

**Silicon Chip:** This small piece of silicon contains an integrated circuit that aids in processing information within a computer.

**Silicon Valley:** Known for hosting many technology companies, this U.S. region is famous for innovation in the tech industry.

**Supercomputer:** This is among the world's fastest computers, made powerful by millions of processors.

**Theory (THEER-ee):** An explanation or idea based on evidence but not proven, used to predict and explain observable phenomena.



**Theoretical Physicist:** This scientist uses mathematics and principles of physics to understand and predict phenomena in the universe.

**Thumb Drive (Flash Drive):** A small, portable storage device that uses flash memory, known for its convenience and durability.

**Weather/Climate Modeling:** A computational approach used for predicting weather and climate patterns, which is computationally intensive due to the complex data involved.

**Workload:** Refers to the set of tasks or amount of work assigned to a computer or network of computers.

## GLOSSARY FOR "MAKING COMPUTERS FLY"

**Parallel Efficiency:** A ratio showing the effectiveness of using multiple processors ( $p$ ) compared to one, with diminishing returns as more processors are utilized.

**Parallel File System:** A system designed to efficiently handle many simultaneous accesses to a single file by different processes.

**Parallel Speedup:** A measure comparing the time it takes one processor to solve a problem versus multiple processors. Higher parallel speedup indicates effective parallelism in reducing execution time.

**Parallelism:** The practice of executing operations concurrently to enhance performance.

**Peak Performance:** The highest level of performance a system can achieve, often measured in floating-point operations per second.

**PIM (Processor In Memory):** A technology that integrates processors and DRAM on the same chip to mitigate the memory wall problem.

**Prefetching:** A technique where data is moved from memory to cache ahead of time, anticipating future access by the processor, which helps in reducing latency.

**Process:** An executing program in its unique address space, which may contain multiple threads.

**Programming Model:** An abstract framework or view that describes the structure and operation of a computing system.

**Put/Get:** A communication model allowing one process to read (get) or write (put) into another process's memory independently.

**Scalar Processor:** A processor that operates only on scalar (single-word) operands, as opposed to vector processors that handle vector operands.

**Scatter/Gather:** A method of memory access or global communication where data is either loaded from various memory locations (gather) or stored in different locations (scatter).

**SCI (Strategic Computing Initiative):** A program initiated by DARPA in the 1980s to advance computing technology in the United States.

**Shared Memory Multiprocessor (SMP):** A system where multiple processors can access shared memory, facilitated by hardware.

**SPARC (Scalable Processor Architecture):** An open, scalable processor architecture.

**Sparse Linear Algebra:** Computations involving sparse matrices (with many zero entries), using specific data structures to save storage and computation time while managing irregular memory access and complex logic.

**Spatial Locality:** A characteristic where data located close together are likely to be accessed close in time, promoting the efficient use of cache lines.

**SRAM (Static Random Access Memory):** A type of memory faster than DRAM but also more expensive, power-consuming, and less dense, often used for caches.

**Supercomputer:** A high-performance computing system designed for solving complex problems at high speeds.

**Supercomputing:** The various activities involved in the design, use, or creation of supercomputers.

**Synchronization:** The coordination between threads to execute code in a specific order.

**Temporal Locality:** A scenario where data accessed recently is likely to be accessed again soon, ensuring effective cache use.

**Thread:** The smallest unit of program execution within a process.

**Time to Solution:** The total time required to solve a problem, including programming, execution, and interpretation times.

**Total Cost of Ownership:** The overall cost associated with owning a computer, including purchase, operation, maintenance, and other related costs.

**Vector Operation:** A computation involving vector operands (multiple scalars), like vector addition or loading a vector from memory.

**Vector Processor:** A processor designed to perform operations on vector operands.

## GLOSSARY FOR "HIGH-PERFORMANCE COMPUTING"

- **Artificial Intelligence (AI):** AI involves creating algorithms that allow computers to perform tasks that typically require human intelligence.
- **Automatic Parallelization:** The process where a compiler converts sequential code into parallel code without manual intervention.
- **Bandwidth:** Represents the volume of data that can be transmitted over a communication channel within a specified timeframe. Essential for preventing performance bottlenecks.
- **Benchmark:** A set of programs, tasks, or experiments used to measure the performance of a computer system.
- **Cache:** A small, fast memory space near the CPU that stores frequently accessed data to improve processing speeds.
- **Cache Line:** The unit of data transferred between cache and memory, usually consisting of 64 or 128 consecutive bytes.
- **Cache Memory System:** Consists of multiple cache levels that increase in size and decrease in speed, collectively improving memory performance.
- **CAE (Computer-Aided Engineering):** Using virtual computer models for the design, analysis, and planning of various objects and processes.
- **Capability Computing:** Employing powerful supercomputers to solve large and demanding problems, focusing on reducing the time to solution.
- **Capacity Computing:** Utilizing smaller, cost-effective high-performance systems for more modest computing requirements, emphasizing the cost-performance ratio.
- **Circuit Speed:** The time signals take to travel through a circuit, measured in picoseconds per gate, crucial for evaluating processor performance.
- **Clock Rate or Clock Speed:** The frequency at which a CPU operates, measured in GHz, influencing the rate of instruction execution.
- **Cluster:** A network of computers connected through a high-speed network, working together as a single multi-CPU machine.

- **CMOS (Complementary Metal Oxide Semiconductor):** The current semiconductor technology used for manufacturing processors and memory devices due to its cost-effectiveness and integration levels.
- **Compute Node, Node:** A server or instance in a computing cluster providing resources for computational jobs. The term “node” can refer to servers in various types of clusters, not just high-performance computing (HPC) clusters.
- **Computational Fluid Dynamics (CFD):** Simulation of fluid flows, such as water through turbines or air over moving objects, by solving complex equations. Often used in HPC environments for scientific and engineering simulations.
- **Core:** Supercomputers contain thousands of processor cores. Each core in a multi-core processor acts as an individual processing unit, enhancing performance and energy efficiency.
- **Distributed Computing:** A computing model where components located on networked computers communicate and coordinate to achieve a common goal.
- **Embarrassingly Parallel:** A type of computation that can be easily divided into parallel tasks with minimal coordination. Each task operates independently, making it suitable for parallel execution on multiple processors or cores.
- **Exabyte:** Equivalent to one quintillion bytes of data storage, sufficient to store 1,000 copies of 250 billion pages of text.
- **Exaflop:** A performance measure for supercomputers, representing one quintillion calculations per second. It’s about 1,000 times faster than petascale computing.
- **Exascale Computing:** Represents the next frontier in supercomputing, aiming to achieve one quintillion calculations per second. It necessitates innovations to reduce power consumption significantly.
- **Finite Element Analysis (FEM):** A technique used to solve complex equations in various fields, from simulating structural loads to analyzing biological movements. Typically implemented as an MPI-based workload in HPC environments.
- **Flash Memory:** A fast and reliable storage technology that allows electronic erasure and reprogramming without removal from the

circuit board. Used in various devices, including thumb drives and mobile devices.

- **FLOPS:** An acronym for FLoating point OPerations per Second, representing the number of calculations a computer can perform per second. It's a common performance measure in high-performance computing.
- **FPGA (Field-Programmable Gate Array):** A reprogrammable chip consisting of low-level logic gates and other components. Used for specialized tasks like signal processing and cryptography, it's becoming increasingly popular in various fields, including HPC.
- **GPU (Graphics Processing Unit):** Specialized processors with numerous simple cores designed for parallel computation. Initially developed for graphics rendering, GPUs are now used for various tasks, including artificial intelligence and general-purpose computing.
- **Grid Computing:** A form of distributed computing where a virtual supercomputer comprises many networked devices.
- **High Performance Computing (HPC):** The use of specialized or high-powered hardware to perform complex computations efficiently. HPC systems are designed for speed and performance to solve large-scale problems.
- **High Throughput Computing:** Utilizes large networks of computers to perform computations that don't require highly parallel resources. Known for projects like Folding@Home and supporting data analysis for the Large Hadron Collider.
- **Message Passing Interface (MPI):** A communication protocol for programming parallel computers. It allows processes to communicate with each other in a parallel programming model, aiding in the functioning of large-scale parallel computations.
- **Parallel Computing, Parallelism:** A type of computation where many calculations or processes are carried out simultaneously, exploiting the architecture of supercomputers or clusters to process data more quickly.
- **Parallel Filesystem:** A type of filesystem that can handle multiple requests for reading and writing data concurrently, supporting the data needs of HPC systems.

- **Parallel Processing:** A method where a single set of calculations or processes is divided amongst multiple processors to be computed simultaneously, significantly speeding up data computation.
- **Petabyte:** Equivalent to one quadrillion bytes of storage, sufficient to store approximately 250 billion pages of text or play nearly 1,902 years worth of music.
- **Petaflop:** A performance measure indicating the ability of a computer to perform one quadrillion calculations per second.
- **Petascale:** Refers to computing performance at the level of one petaflop or higher, often used to describe supercomputers capable of performing at this speed.
- **Pipeline:** Refers to a set of data processing elements connected in series, where the output of one element is the input of the next. In HPC, it's a sequence of data processing stages or steps.
- **Portals or Gateways:** In computing, a portal is a web service or site that acts as a single access point to various resources. They can be general, like search engines, or specific to research areas.
- **Processors:** Part of a computer's CPU, handling instructions from the computer's memory and performing calculations. Comprises the control unit and the arithmetic logic unit (ALU).
- **RDMA (Remote Direct Memory Access):** A technology allowing computers in a network to exchange data in memory without involving the processor, operating system, or input/output subsystem of either computer, enhancing the speed of data transfer.
- **Scaling Out:** Refers to adding more hardware to a network to improve the ability of the application or infrastructure to support an increased load.
- **Scaling Up:** Involves increasing the capacity of existing hardware or software by adding resources to support growing demand.
- **Thumb Drive:** A small, portable storage device that can be used to save and transfer data between computers. Also known as a flash drive, it's durable and can be carried easily.
- **Weather/Climate Modeling:** Computational simulations used to predict weather and climate patterns, requiring complex calculations and data analysis to forecast various atmospheric phenomena.

- **Workload:** A high-level term describing tasks being performed on an HPC system, with various computational jobs organized to accomplish specific objectives in a field or industry.



## GLOSSARY FOR "PHILIP EMEAGWALI INVENTIONS"

**Algorithm:** Algorithm refers to a precise set of rules specifying how to solve a particular problem, similar to a recipe. Emeagwali created nine distinctive algorithms to solve his equations, repeatedly executed across a million processors in a supercomputer.

**Bits and Bytes:** A bit is the smallest data unit, representing a binary value of 1 or 0. Eight bits combine to form a byte, which can represent a number, letter, word, or pixel using binary code.

**Cloud Computing:** Cloud Computing involves accessing significant computing power remotely, where calculations are performed on powerful servers or supercomputers. It allows users to utilize Internet-based resources, such as storage and software, on demand, often following a pay-per-use model.

**Cyberinfrastructure:** Referring to the integration of hardware, software, and human expertise, cyberinfrastructure supports scientific and engineering discoveries. It is essential for facilitating and advancing various areas of research.

**Data Deluge/Data Tsunami:** These terms refer to the overwhelming amount of data generated daily, requiring advanced computing solutions to process, analyze, and derive meaningful information effectively.

**Data-intensive Computing:** This area focuses on managing and analyzing vast amounts of digitally-based data, allowing researchers to tackle previously unattemptable problems.

**Data Mining:** Data mining involves extracting patterns from large data sets. It is used in various scientific research fields and in business for fraud detection and enhancing marketing strategies.

**Finite Difference Equation:** These are discrete versions of partial differential equations, utilized in solving problems like the nine equations formulated by Emeagwali.

**Force:** Force influences a system of bodies, inducing changes in shape, motion, or other effects. Forces like viscous, pressure, gravitational, and inertial are dominant within oilfields, affecting the extraction process.

**Formula:** A formula is an algebraic expression of a rule or principle, like physics's second law of motion ( $F=ma$ ), which is integral to Emeagwali's nine partial differential equations.

**High-Performance Computing (HPC):** HPC refers to the use of advanced computing resources, including large-scale storage and visualization systems, for high-performance tasks.

**HyperBall Computer:** Invented by Emeagwali, this supercomputer distributes processors uniformly across a sphere, with each processor

operating independently.

**Hypercube:** A hypercube is a multidimensional cube. Emeagwali successfully programmed a 16-hypercube computer, visualizing and interconnecting 65,536 processors effectively using hypercube topology.

**Inertia:** Inertia is an object's tendency to maintain its velocity or state of rest unless acted upon by an external force. Emeagwali's equations incorporated inertial forces, enhancing their accuracy in applications like oil extraction.

**Internet:** The Internet is a global network enabling billions of computers to exchange information.

**Modern Supercomputer:** A modern supercomputer is exceptionally fast, often ranking among the world's top 500. It consists of numerous smaller computers connected through high-speed networks, working collectively to solve complex calculations quickly.

**Oilfield:** An oilfield contains recoverable oil deposits. With 80% of recoverable oil already discovered, the challenge lies in efficient extraction, as these resources are finite and non-renewable.

**Old Supercomputer:** Old supercomputers can perform only one operation at a time with a single processing unit.

**Parallel Computer:** This computer type can execute multiple operations simultaneously using various processors.

**Partial Differential Equation:** Emeagwali's nine partial differential equations relate nine variables to four independent variables and their partial derivatives, necessitating supercomputers for the increased computational demand.

**Philip Emeagwali Computer:** Emeagwali's innovation in parallel supercomputing allowed for the use of millions of processors, revolutionizing the field post-July 4, 1989.

**Pioneer:** A pioneer or inventor introduces or invents something novel. Emeagwali elevated parallel computing, inspiring the supercomputer's reinvention, and making significant contributions to the field.

**Reinvent:** Reinvention involves creating something based on an existing concept, like the transformation of supercomputers in 1989, from single to multiple processors.

**Vector Supercomputer:** These supercomputers perform rapid calculations on vectors using specially designed, high-cost processors, with Emeagwali's work partly inspiring the transition to parallel processing.

**Zettabyte:** A zettabyte equals one sextillion bytes or enough data to fill DVDs stacked halfway to Mars. This measurement is significantly larger than what current supercomputers can handle.

## PODCASTS AND VIDEOS

<https://podcasts.apple.com/us/podcast/this-is-philip-emeagwali/id1570984843>

Unlocking the Genius of Philip Emeagwali - An [Apple Podcast Series](#)

<https://podcasts.google.com/search/philip%20emeagwali>

Philip Emeagwali: Crafting an Unforgettable Legacy - A [Google Podcast Series](#)

<https://open.spotify.com/show/38XFo8SkPYSNEjYLRJ2cgd>

Philip Emeagwali's Greatest Hits on [Spotify](#) Music

<https://www.audible.com>

[Audible](#) Guide to Uncovering the Legacy of Philip Emeagwali

<https://www.youtube.com/emeagwali>

A Digital Giant - Philip Emeagwali's [YouTube](#) Playlist

PHOTO GALLERY



Iyanma Agatha Emeagwali and her son Chukwurah Philip Emeagwali, outside Baltimore, Maryland.

## CONTACTING PHILIP EMEAGWALI



<https://facebook.com/emeagwali>

<https://twitter.com/emeagwali>

<https://instagram.com/philipemeagwali>

<https://flickr.com/philipemeagwali>

<https://emeagwali.tumblr.com>

<https://linkedin.com/in/emeagwali>

The purpose of this preview is to allow the author identify problems and opportunities for improvement. Please send comments to:

[info@emeagwali.com](mailto:info@emeagwali.com)

<https://emeagwali.com>

202-203-8724

Philip Emeagwali is pronounced as

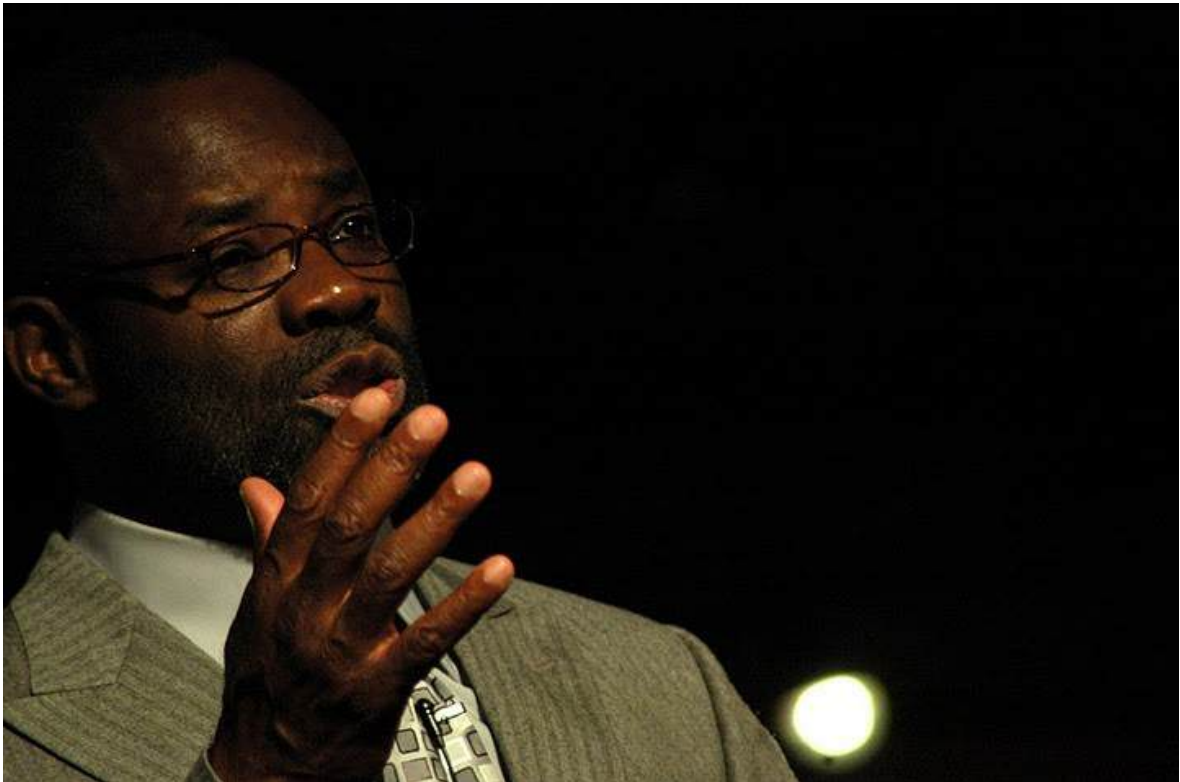
FI-lip eh-MAY-ah-gwah-lee

## BOOKING PHILIP EMEAGWALI

To inquire about booking Philip Emeagwali for a speaking engagement,  
please contact us at: info@[emeagwali.com](mailto:info@emeagwali.com)

<https://emeagwali.com>

202-203-8724



Philip Emeagwali delivering a lecture at the University of Alberta, Canada,  
September 23, 2006.



## AFTERWORD: PUSHING THE BOUNDARIES

As I reflect on the journey chronicled in this memoir, I am filled with gratitude and a profound sense of fulfillment. The road to discovery is never easy, but it is one that has the power to reshape the world. In my case, it led me to a groundbreaking invention that would revolutionize computing and pave the way for remarkable advancements in artificial intelligence. On that fateful day, July 4, 1989, the world witnessed my announcement of the first supercomputing via parallel processing, a milestone that would forever change the course of technological progress.

Parallel supercomputing, a concept that had eluded scientists and engineers for decades, was finally unlocked through my relentless pursuit of knowledge and my determination to solve one of computing's greatest challenges. Inspired by the efficiency of nature's computational processes, I sought to harness the power of 65,536 coupled processors working in unison to tackle complex problems with unprecedented speed and scalability. It was an audacious goal, but one that held the potential to transform the landscape of computing and open doors to new frontiers of human achievement.



**Philip Emeagwali, near Baltimore, Maryland.**

The invention of parallel supercomputing was a testament to the power of human intellect, innovation, and perseverance. It was the culmination of 15 years of research, countless days spent developing algorithms, and pushing the boundaries of what was thought possible. The breakthrough came when I realized that by dividing computational tasks into smaller, more manageable parts and assigning them to multiple processors that shared nothing, I could achieve exponential increases in computing power and efficiency.



That discovery of parallel supercomputing has become the cornerstone of computational science, enabling the rapid execution of complex calculations and simulations that were previously impractical. This paradigm shift has had a profound impact on artificial intelligence, powering its remarkable advancements and propelling us into a new era of intelligent systems.

Artificial intelligence, with its ability to learn, reason, and make intelligent decisions, is heavily dependent on the computational power provided by artificial intelligence supercomputers. Through the parallel execution of algorithms and the efficient utilization of distributed computing resources, we can train and deploy sophisticated machine learning models at an unprecedented scale. The computational demands of A.I. algorithms, such as deep learning and neural networks, are immense, and parallel processing allows us to tackle these demands head-on, accelerating training times and enabling real-time decision-making.

Parallel processing enhances the speed and efficiency of A.I. systems and expands their capabilities. The ability to process vast amounts of data in parallel enables the analysis of complex patterns, the extraction of insights, and the development of more accurate predictive models. From natural language processing and computer vision to autonomous systems and robotics, parallel processing has become the bedrock upon which intelligent technologies thrive.

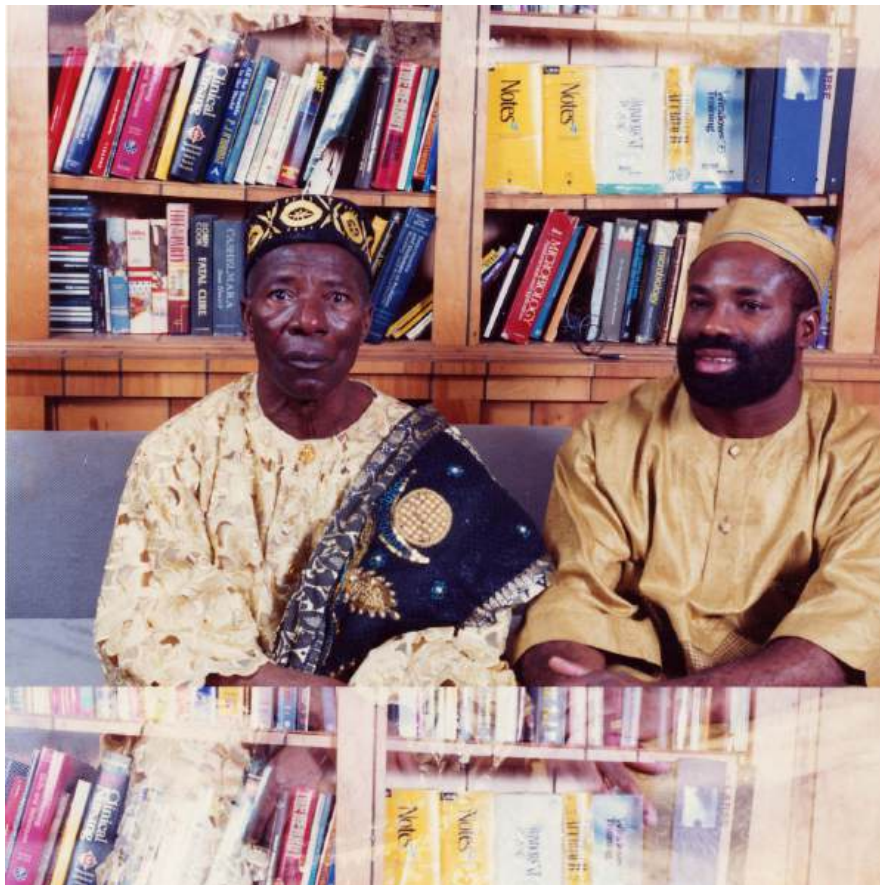
As we stand at the precipice of a future shaped by the fusion of parallel processing and artificial intelligence, we must remain vigilant in our pursuit of ethical and responsible innovation. The power we wield has the potential to reshape societies, industries, and the very fabric of human existence. It is our responsibility to ensure that this power is harnessed for the betterment of humanity, to address the critical challenges we face and foster a more inclusive and sustainable world.

I am humbled by the impact that my invention of the first supercomputing via parallel processing has had on the world. It is a testament to the power of curiosity, determination, and the unwavering belief in the potential of human ingenuity. I am grateful for the opportunities that have come my way, and I remain committed to pushing the boundaries of mathematical knowledge, driving innovation in computer science, and leaving a lasting impact on our world. Together, let us embrace the remarkable synergy between parallel supercomputing and artificial intelligence, unleashing boundless possibilities and propelling humanity towards a future defined by progress, understanding, and compassion.

## ACKNOWLEDGEMENTS

I express my deepest gratitude to all those who have supported me in the journey of the frontiers of science. It is with immense pleasure that I extend my heartfelt appreciation to the individuals who have played pivotal roles in shaping my life and career.

First and foremost, I owe a profound debt of gratitude to my father, Nnaemeka James Emeagwali. Throughout my early childhood, growing up in the Nigerian towns of Sapele, Uromi, and Agbor, he selflessly dedicated his time and efforts to privately tutor me in mathematics. His unwavering belief in my potential and his tireless commitment to my education laid the foundation for my invention of the world's fastest computing that made the news headlines, in 1989. I am forever grateful for his guidance, love, and unwavering support.



Nnaemeka James Emeagwali and his son Chukwurah Philip Emeagwali, District Heights, Maryland, late December 1996.

I would also like to express my sincerest appreciation to my wife, Dale, for her unwavering support and understanding since we first met in 1978 in Baltimore, Maryland. Her unwavering faith in my abilities, encouragement, and constant belief in me have been a source of inspiration throughout the years. Her presence in my life has been an invaluable source of strength, and I am forever grateful for her unwavering support in my journey to beyond the frontiers of mathematics and computing.

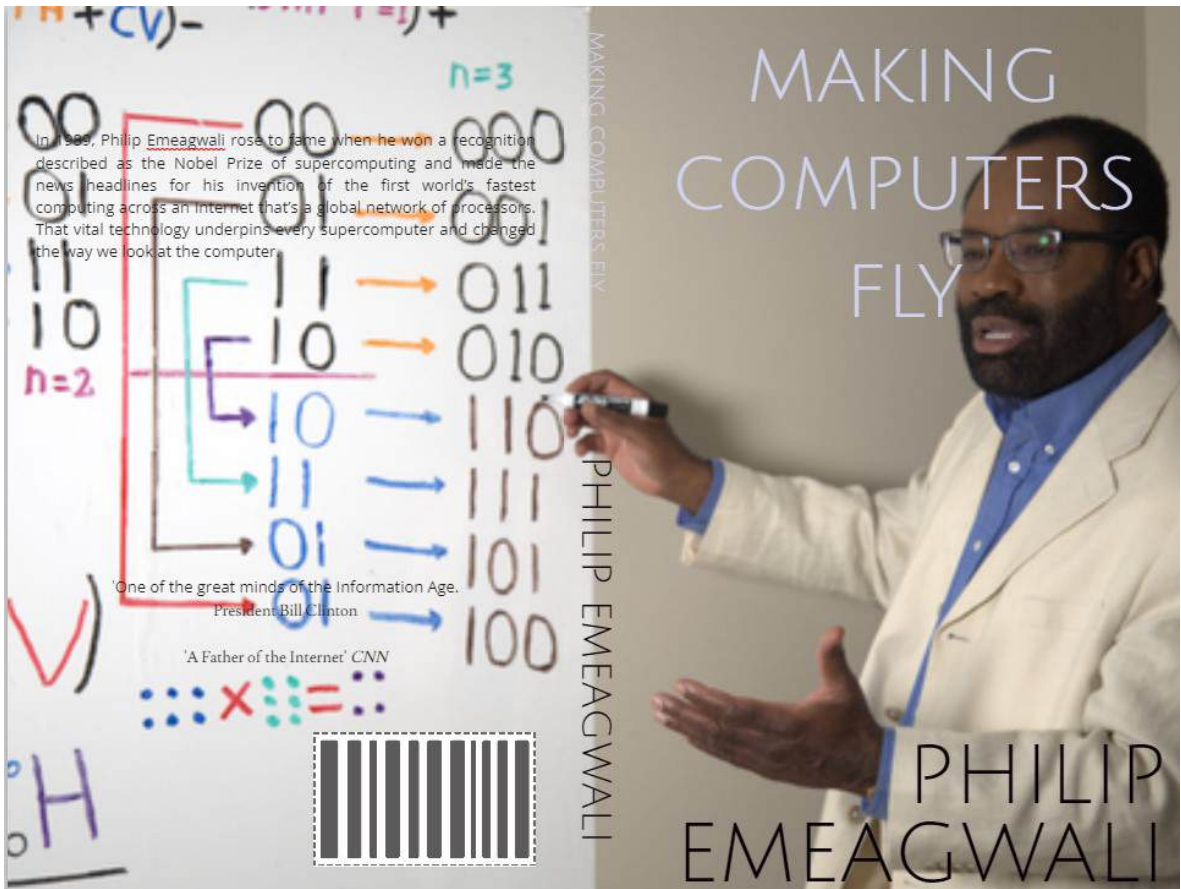


Dale Emeagwali, Upstate New York, October 2022.

To my family and friends who have been with me every step of the way, thank you for your unwavering support, encouragement, and belief in me. Your love and unwavering faith in my abilities have been instrumental in my journey.

To all those who have supported me in various ways, your contributions have made this memoir possible. I am humbled and honored to have had such remarkable individuals in my life, and I am forever grateful for the impact you have had on me.

Philip Emeagwali



## **DORIS BROWN, BELOVED EDUCATOR, AND MATRIARCH, DIES AT 98**

Johnnie Doris (Baird) Brown, a cherished educator and matriarch, passed away on May 7, 2024 morning, at Sinai Hospital in Baltimore, Maryland. She was surrounded by her loving family at the time of her passing. Mrs. Brown, who had recently celebrated her 98th birthday, was a pillar of her community, renowned for her unwavering dedication to education and her deep commitment to her family.

Born on October 15, 1925, in Ashland, Mississippi, Mrs. Brown was the second of five children in a family that valued hard work and community spirit. She completed her high school education in Ashland before joining the Great Migration north, settling in Baltimore in 1942. It was there that she met Leon Robert Brown, a decorated World War II veteran. The couple married on October 16, 1948, and soon started a family that would include three children.

After working as a restaurant cook, Mrs. Brown made a significant life shift that underscored her lifelong commitment to learning and growth. At the age of 33, with her youngest child in kindergarten, she returned to school to train as a schoolteacher at Coppin State University. Mrs. Brown would go on to teach in the Baltimore Public Schools until her retirement in 1990. Throughout her career, she was known for her innovative teaching methods and her ability to inspire her students to pursue greatness.

Mrs. Brown's influence extended well beyond the classroom. Her home was a hub of warmth and intellectual engagement, where she and her husband hosted gatherings that were renowned for their hospitality and the richness of conversation. A skilled cook and an avid gardener, she brought the same creativity and passion to her home life that she did to her professional life.

Surviving Mrs. Brown are her daughter, Dale Brown Emeagwali, a recognized scientist; her eldest son, Dexter Robert Brown; five grandchildren; and ten great-grandchildren. She was preceded in death by her husband, Leon Robert Brown, and her son, Daryl Angelo Brown.

Johnnie Doris Brown's legacy is characterized by her deep love for her family, her commitment to education, and her community involvement. She leaves behind a community richer for her contributions and a family that will aim to honor her memory by continuing her legacy of love and service. Funeral services will be held privately, with plans for a public memorial to be announced at a later date. In lieu of flowers, the family requests donations be made to the Baltimore Public Schools Foundation, in honor of Mrs. Brown's lifelong commitment to education.

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