How I Invented a New Internet That's a New Supercomputer

Transcript of Philip Emeagwali YouTube lecture 210821 1of4 for the video posted below.

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Philip Emeagwali

The Reader's Digest **described Philip Emeagwali as "smarter than Albert Einstein." Philip Emeagwali is often ranked as the world's greatest living genius and scientist. He is listed in the top 20 greatest minds that ever lived. That list includes Charles Darwin, Isaac Newton, William Shakespeare, Leonardo da Vinci, Aristotle, Pythagoras, and Confucius. Philip Emeagwali is studied in schools as a living historical figure.**

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 an Internet that's a global network of processors. ***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."**

How Did Philip Emeagwali Impact Science?

Inventing a New Internet

Inventing A New Internet

Please allow me to reintroduce myself.

I'm Philip Emeagwali.

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 compute-intensive
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 development of the computer
were these:

I was in the news
for becoming the first person
to use the slowest processors
in the world
to discover the fastest computing
in the world
And solve

the most compute-intensive problems
in the world.

My scientific discovery—called
fastest computing—
occurred at fifteen minutes after 8 o'clock
in 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 discovery of the fastest computing
revolutionized the essence
of both 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 compute-intensive problems
in mathematics, science,
and engineering.
Without supercomputing across
millions of identical processors,
these grand challenge problems
will be impossible to solve.

10.1.1.1 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
in 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.

10.1.1.2 Philip Emeagwali's Blueprint for a 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 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 compute-intensive problems
in the scientific
and engineering worlds.

10.1.1.3 How Are Supercomputers Used in Kuwait?

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
forty-five 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.

10.1.1.4 How I Harnessed the 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 compute-intensive problem.

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.

10.1.1.5 How I Solved the Most Difficult Problem in Mathematics

The parallel processing problem
which I solved in 1989
was then classified
by the U.S. government
as the Grand Challenge Problem
of supercomputing. My solution
of that compute-intensive 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 anisotrophies, make
my supercomputer model more complex.

10.1.1.6 Isaac Newton Wasn't a Scientist

As an aside, Isaac Newton wasn't a scientist.
The term "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.
Looking back retrospectively,
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
the Second Law of Motion of physics.
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 similar to a vector.
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 multiscaled.
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.

Inventing the World's Fastest Computer

Chronicles from the Frontier of Supercomputing

What is Philip Emeagwali Noted For?

Back in 1989, I was in the news because
I was the first person to understand
how to solve
the most compute-intensive problems
in supercomputing.
I discovered how to tackle
the world's most compute-intensive
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 the world of mathematicians, namely
the May 1990 issue of the *SIAM News*.

10.1.1.7 Philip Emeagwali Invents 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.
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 at once
and how to do both across
a new ensemble 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.

10.1.1.8 Fastest Computing Turns Fiction to Fact

As 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 sixty-four binary thousand processors
and use them to emulate
a virtual supercomputer
was as difficult as attempting
to make science fiction become reality.

10.1.1.9 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 unknown 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 a supercomputer scientist.

10.1.1.10 On Becoming a Supercomputer Genius

In an email, a twelve-year-old
writing the biographies
of famous mathematicians
and their contributions
to the development
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.
That 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,
and computer science.
The supercomputer genius
must understand
his computing machinery
and know it forward and backward,
and even sideways."

The supercomputer genius
must be the first person
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 the way
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 compute-intensive 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.

Inventing the First Supercomputer, As It's Known Today

Philip Emeagwali Impact on the Supercomputer

10.1.1.11 Inventing the World's Fastest Computer

My contributions to the development
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 binary million 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 compute-intensive 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 compute-intensive 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
were equal distances apart
and shared nothing,
but were in dialogue with each other.

A Supercomputing Genius Must be a Polymath

I've provided the complete details
of my supercomputing inventions.
And did so across
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 the first person
that could translate some laws of physics
into a system of
partial differential equations
of calculus.
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 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 in 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 compute-intensive 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 one thousand podcasts
and YouTube videos.

Famous scientists,
who came of age after the mid-20th
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.

10.1.1.12 How Philip Emeagwali Became Known

As 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
in 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 call my award
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 sixty-four [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.

10.1.1.13 Why Supercomputing is Often Top Secret

The indication of my contributions
to the development 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 discovery of an alternative way
of recording the fastest speeds
in computing
inspired the change in the way
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 at once.
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 forty-five (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

10.1.1.14 Beyond the Last Computer

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 the partial differential equations
of calculus
is an inadequate answer
to the big question

of how do 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.

10.1.1.15 My 50-Year Retrospective on the Supercomputer

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 person to solve
the most compute-intensive problems
central to supercomputing.

10.1.1.16 Mathematical Knowledge Beyond the Fastest Computer

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 sixty-four 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
at once.

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 sixty-four binary thousand-fold increase
in never-before-recorded
email and supercomputer speeds.

10.1.1.17 My 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 Grand Challenge Problem
because my confidence came from
knowing
what I was doing
and who I am.

10.1.1.18 Early Years of Philip Emeagwali 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.

10.1.1.19 I Contributed Fastest Computing to Physics

During 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 the Second Law of Motion
of physics
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.

Thank you.

I'm Philip Emeagwali.

Further Listening and Rankings

Search and listen to Philip Emeagwali in

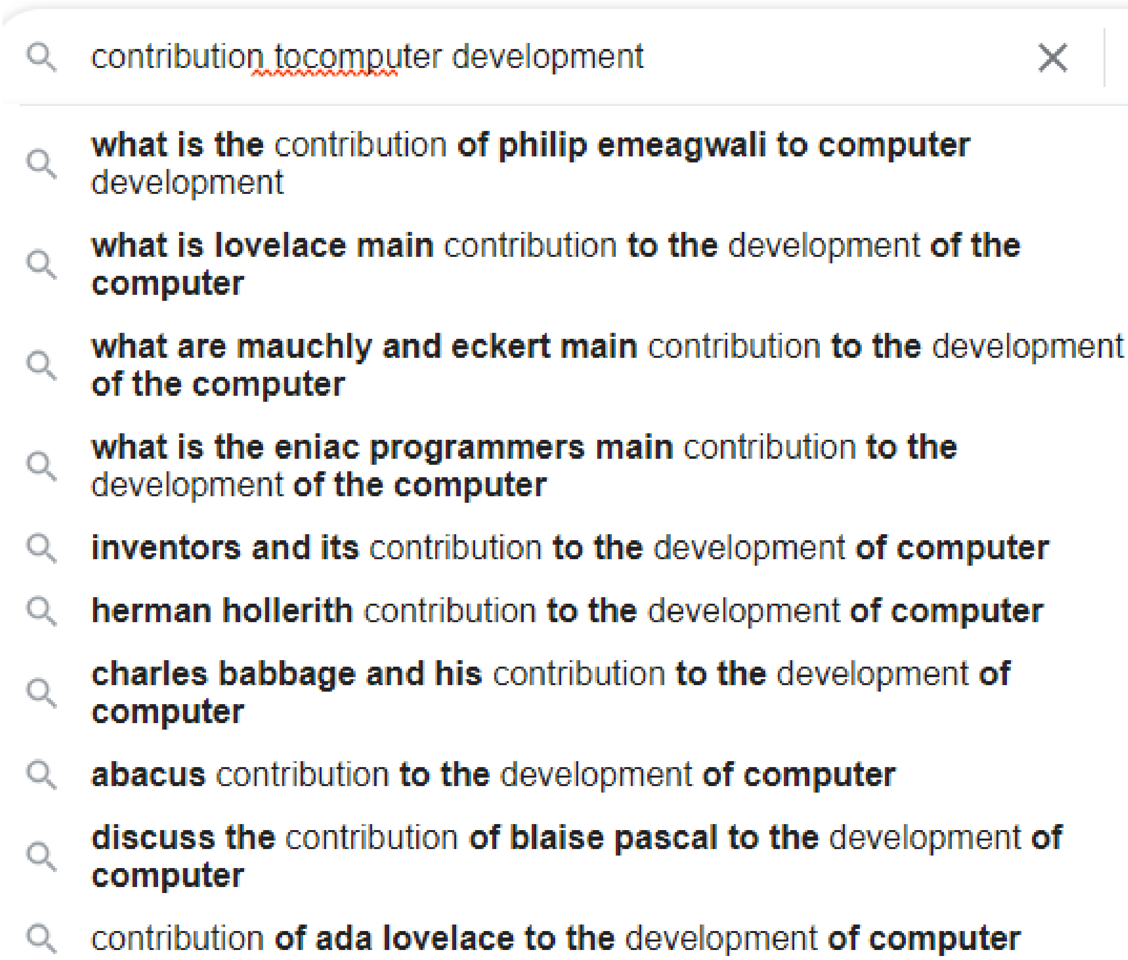
Apple Podcasts

Google Podcasts

Spotify

Audible

YouTube



Google suggests the greatest computer scientists of all times. With the number one spot, Philip Emeagwali is the most suggested computer pioneer for school biography reports across the USA, Canada, UK, and Africa (December 8, 2021).

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 suggests the most noted fathers of the Internet. With four out of ten searches, Philip Emeagwali is the most suggested "father of the Internet" for schools across the USA, Canada, UK, and Africa (Labor Day 2019).

Philip Emeagwali
info@emeagwali.com 202-203-8724

I Contributed Fastest Computing to Physics

Transcript of Philip Emeagwali YouTube lecture 210821 2of4 for the video posted below.

Click below to watch Philip Emeagwali on YouTube.com

https://youtu.be/nVzI2AIBkj0

Philip Emeagwali

The Reader's Digest **described Philip Emeagwali as "smarter than Albert Einstein." Philip Emeagwali is often ranked as the world's greatest living genius and scientist. He is listed in the top 20 greatest minds that ever lived. That list includes Charles Darwin, Isaac Newton,**

William Shakespeare, Leonardo da Vinci, Aristotle, Pythagoras, and Confucius. Philip Emeagwali is studied in schools as a living historical figure.

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 an Internet that's a global network of processors. *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."

Why I Invented the Nine Philip Emeagwali Equations

Forecasting the Weather Inside the Earth

10.1.1.1 Philip Emeagwali Impact on Mathematics

Thank you.

I'm Philip Emeagwali.

In 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 modelling
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 person 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 person
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 the Second Law of Motion of physics.

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.

10.1.1.2 The Soul of Compute-Intensive Physics

My quest was for new knowledge
that will enable me to parallel process

computational fluid dynamics codes
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 person 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 in the morning
of July 4, 1989,
I visualized my sixty-five thousand
five hundred and thirty-six [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-oil-field
to one-processor correspondence.
I executed that one-to-one mapping
between those oil fields
and as many processors
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 sixty-five thousand
five hundred and thirty-six [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 discovery
of 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.

10.1.1.3 The Weather Eight Miles Inside the Earth

The 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 the partial *differential* equation
of calculus
and on the 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 look into
the finite difference discretizations
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 grand challenge 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

was not aware of that similarity.
That ignorance robbed both fields
the benefit of cross-fertilizations
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 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 the realm of 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.

10.1.1.4 The Importance of Physics to Nigeria

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 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 first person
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 grand challenge problems
could only be solved on supercomputers,
if and only if,
the number of processors harnessed
is sufficiently large.

10.1.1.5 The Importance of Supercomputers to Nigeria

"What'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 myself
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.
The 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.

Weather Forecasting: From Fiction to Fact

10.1.1.6 Turning Supercomputer Fiction to Fact

On the Fourth of July 1989,
I became the first person
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 person
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 nothing.

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.

10.1.1.7 Formulating 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 the Second Law of Motion
of physics
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 hypsometric 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.

10.1.1.8 Inventing the Nine Philip Emeagwali Equations

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
the 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.

10.1.1.9 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.

How Did Philip Emeagwali Impact the World Today?

Solving the Most Difficult Problems in Mathematics

10.1.1.10 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 compute-intensive 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.

10.1.1.11 How I Invented the Fastest Computer

As a supercomputer scientist,
my 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 compute-intensive 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 compute-intensive problems
in science, engineering,
and medicine.
My contributions to the development
of the computer were these:

I discovered how to compress
the time needed to solve
the most compute-intensive 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 nearest-neighboring processors.

10.1.1.12 The Eureka Moment I Discovered the Fastest Computer

Parallel processing
creates more Eureka! Moments, such as in
the world's fastest computer
that harnesses 10.65 million
off-the-shelf processors
and uses those processors to solve
the most compute-intensive problems.
Within the world's fastest computer,
parallel processing
is the vital technology used
to reduce the time-to-solution
from thirty thousand [30,000] 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.

10.1.1.13 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 it.

10.1.1.14 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 nearest-neighboring
global climate models
that were executed
within the as many processors.
I discovered how to slice and dice
grand challenge initial-boundary value
mathematical problems.
And massively parallel computing them
in smaller chunks. And aggregating them
for the complete results.
My discovery
of 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 forty percent more than
the mile-long Second Niger Bridge
of Nigeria.

Why Are Supercomputers Important in Climate Modeling?

10.1.1.15 A World Without Supercomputers

Why are supercomputers important
in climate modelling?

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
twenty-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 grand challenge 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.

10.1.1.16 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.

10.1.1.17 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.

10.1.1.18 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.

10.1.1.19 Contributions of Philip Emeagwali to Mathematics

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.

Partial differential 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 aircraft,

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 both 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.

10.1.1.20 How Are Supercomputers Used?

The world's fastest computing
is the key technology
that must be used to address
the grave existential threats
of the twenty-first 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 development
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 development
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.

Thank you.

I'm Philip Emeagwali.

Further Listening and Rankings

Search and listen to Philip Emeagwali in

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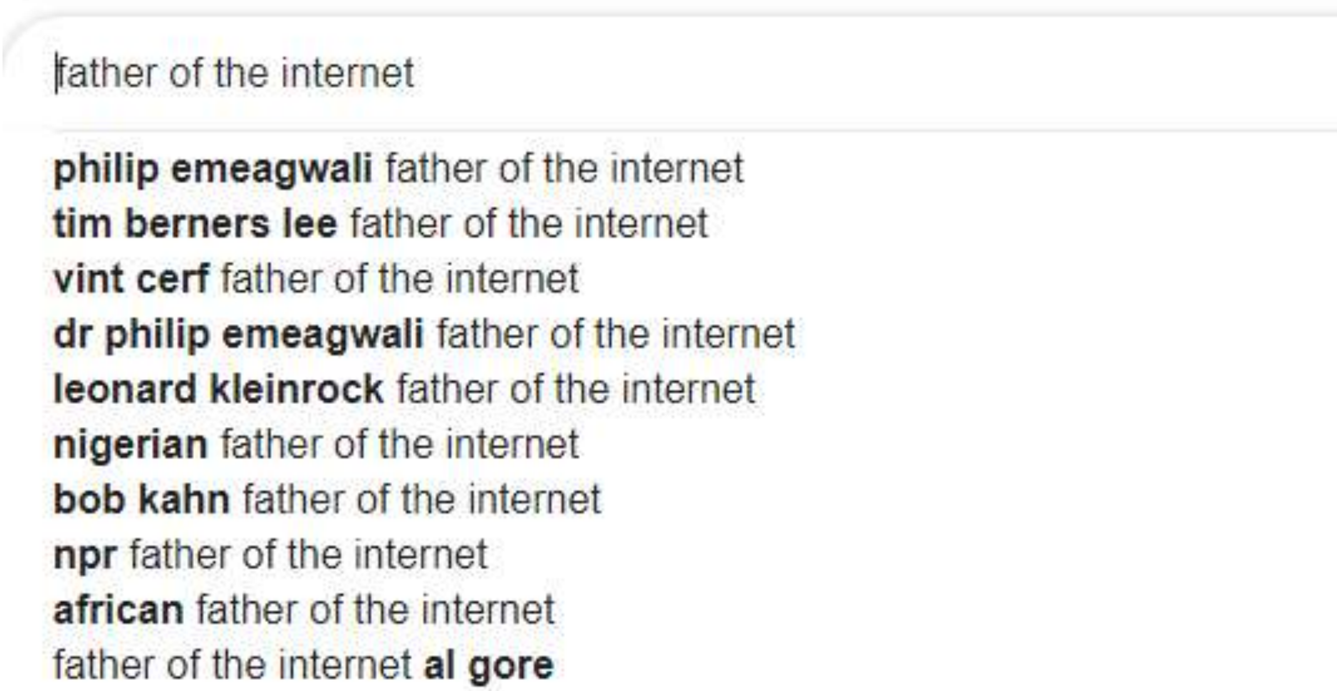
Google Podcasts

Spotify
Audible
YouTube

contribution tocomputer development

- **what is the** contribution **of philip emeagwali to computer** development
- **what is lovelace main** contribution **to the** development **of the computer**
- **what are mauchly and eckert main** contribution **to the** development **of the computer**
- **what is the eniac programmers main** contribution **to the** development **of the computer**
- **inventors and its** contribution **to the** development **of computer**
- **herman hollerith** contribution **to the** development **of computer**
- **charles babbage and his** contribution **to the** development **of computer**
- **abacus** contribution **to the** development **of computer**
- **discuss the** contribution **of blaise pascal to the** development **of computer**
- contribution **of ada lovelace to the** development **of computer**

Google suggests the greatest computer scientists of all times. With the number one spot, Philip Emeagwali is the most suggested computer pioneer for school biography reports across the USA, Canada, UK, and Africa (December 8, 2021).



Google suggests the most noted fathers of the Internet. With four out of ten searches, Philip Emeagwali is the most suggested "father of the Internet" for schools across the USA, Canada, UK, and Africa (Labor Day 2019).

Philip Emeagwali
info@emeagwali.com 202-203-8724

The First Supercomputer Invented from the Slowest Processors[ii]

Transcript of Philip Emeagwali YouTube lecture 210821 3of4 for the video posted below.

Click below to watch Philip Emeagwali on YouTube.com

https://youtu.be/nVzI2AIBkj0

Philip Emeagwali

The Reader's Digest described Philip Emeagwali as "smarter than Albert Einstein." Philip Emeagwali is often ranked as the world's greatest living genius and scientist. He is listed in the top 20 greatest minds that ever lived. That list includes Charles Darwin, Isaac Newton, William Shakespeare, Leonardo da Vinci, Aristotle, Pythagoras, and Confucius. Philip Emeagwali is studied in schools as a living historical figure.

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 an Internet that's a global network of processors. *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."

Thank you.

I'm Philip Emeagwali

Crossing New Frontiers

Father of the Internet

10.1.1.1 The First Supercomputer

The 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.

Philip Emeagwali Computer

Ordinary Person Who Found the Extraordinary

10.1.1.2 "Are You a Black Genius?"

Shortly after 1989, a 12-year-old writing an essay 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 compute-intensive problems at
the intersection
of calculus, algebra, physics,
and computing.
I was in the news for discovering
how to solve
the most compute-intensive problems.
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.

10.1.1.3 Geniuses Contribute 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 at once

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 qual 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.

10.1.1.4 Inventing Philip Emeagwali Computer

My ensemble of 65,536 processors
that shared nothing
didn't solve the as many
compute-intensive 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 compute-intensive 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 a supercomputer, in reality.
That ensemble
of sixty-four binary thousand 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 development 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 was in contrast to using a few
custom-made vector processors
that were designed for the fastest
supercomputers

of the 1970s and 80s.

10.1.1.5 Contributions of Philip Emeagwali to Mathematics

My 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 the 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
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

A Black Mathematician in the Supercomputer Age

Leading mathematicians
first learned about Philip Emeagwali
when my contributions to extreme-scale
computational linear algebra
arising from the discretizations
of the 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 at once.
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
sixty-four 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
sixty-four 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.

10.1.1.6 Contributions of Philip Emeagwali to Mathematics

What is the contribution of Philip Emeagwali to mathematics?

I changed the way
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 within
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 compute-intensive problems
in algebra
or in large-scale computational physics
and engineering.

The contributions
of Philip Emeagwali
to mathematics were these:

I changed the way
we solve compute-intensive
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.

10.1.1.7 The Philip Emeagwali Internet

What is the Philip Emeagwali Internet?

The Eureka moment, or high point,
of my quest
for the fastest computer in the world
occurred at fifteen minutes after 8 o'clock
in 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
sixty-four 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 nearest-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 the world's fastest computer,
in reality.

How I Shrunk Thirty Thousand Years to One Day

10.1.1.8 My Struggles to Invent the World's Fastest Computing

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 compute-intensive problems
in science, engineering,
and medicine.

In the 1970s and 80s,
parallel processing
—or computing many things
at once,
instead of computing only one thing
at a time—
was dismissed as a beautiful theory
that lacked an
experimental confirmation.
In nineteen seventy-nine [1979],
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:
quote, unquote
"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:
[quote]
"We can't find any real progress
in harnessing
the power of thousands of processors."
[unquote]

10.1.1.9 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*.

10.1.1.10 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
sixty-four binary thousand emails.
I discovered how to solve
the most compute-intensive 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

at once. 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.

10.1.1.11 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.

What Will Year Million Humanity Look Like?

10.1.1.12 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 discovery
of 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 17th 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.

10.1.1.13 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
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.

Back 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.

10.1.1.14 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
[anthro-po-mor-phized]
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.

Supercomputing Beyond the Fourth Millennium

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
at once, 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
compute-intensive problems.
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.

I'm Philip Emeagwali.

Thank you.

Further Listening and Rankings

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contribution tocomputer development

- **what is the** contribution **of philip emeagwali to computer** development
- **what is lovelace main** contribution **to the** development **of the computer**
- **what are mauchly and eckert main** contribution **to the** development **of the computer**
- **what is the eniac programmers main** contribution **to the** development **of the computer**
- **inventors and its** contribution **to the** development **of computer**
- **herman hollerith** contribution **to the** development **of computer**
- **charles babbage and his** contribution **to the** development **of computer**
- **abacus** contribution **to the** development **of computer**
- **discuss the** contribution **of blaise pascal to the** development **of computer**
- contribution **of ada lovelace to the** development **of computer**

Google suggests the greatest computer scientists of all times. With the number one spot, Philip Emeagwali is the most suggested computer pioneer for school biography reports across the USA, Canada, UK, and Africa (December 8, 2021).

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 suggests the most noted fathers of the Internet. With four out of ten searches, Philip Emeagwali is the most suggested "father of the Internet" for schools across the USA, Canada, UK, and Africa (Labor Day 2019).

Philip Emeagwali
info@emeagwali.com 202-203-8724

The First Supercomputer | As It's Known Today***

Transcript of Philip Emeagwali YouTube lecture 210821 4of4 for the video posted below.

Click below to watch Philip Emeagwali on YouTube.com

https://youtu.be/nVzI2AIBkj0

Philip Emeagwali

The Reader's Digest described Philip Emeagwali as "smarter than Albert Einstein." Philip Emeagwali is often ranked as the world's greatest living genius and scientist. He is listed in the top 20 greatest minds that ever lived. That list includes Charles Darwin, Isaac Newton, William Shakespeare, Leonardo da Vinci, Aristotle, Pythagoras, and Confucius. Philip Emeagwali is studied in schools as a living historical figure.

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 an Internet that's a global network of processors. *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."

What is Philip Emeagwali Known For?

The World of Magic Within the Supercomputer

Thank you.

10.1.1.1 Contributions of Philip Emeagwali 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 in 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 correctly and accurately
simulate the spread
of virus droplets 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 forty percent more
than the mile-long Second Niger Bridge
in Nigeria.

Please allow me to re-introduce myself.

I'm Philip Emeagwali.

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 nineteen, 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, which was 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 at once,
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
that shared nothing
to solve the most compute-intensive
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.
And reduce them
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 a set of
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 compute-intensive 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.

10.1.1.2 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
compute-intensive 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.

10.1.1.3 Changing the Way We Compute Fastest

The reason my scientific discovery
of how to compute faster
—and how to do so
by changing the way
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.

Why is Fastest Computing Important?

10.1.1.4 A World Without the Fastest Computers

Why 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
at once 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.

10.1.1.5 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 compute-intensive problems
were previously impossible to solve.

10.1.1.6 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'm Philip Emeagwali.

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 predict 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.

10.1.1.7 How I Leapfrogged Across an Internet to the World's Fastest Computer

In the 1980s,
I—Philip Emeagwali—was the only
full-time programmer

of the supercomputer-hopeful
that was powered by
the slowest sixty-four 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.

10.1.1.8 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 the realm of science fiction
to become nonfiction.
For me, Philip Emeagwali,
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—Philip Emeagwali—controlled

and programmed
each of my sixty-four binary thousand
processors.
I programmed them via emails
that I sent to and from
each of my as many
sixteen-bit-long email addresses.

10.1.1.9 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 at once,
instead of solving
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:

[quote]
"Research in Parallel Processing
Questioned
as 'Waste of Time'"
[unquote]

Changing the Way We Look at the Internet

10.1.1.10 Changing the Way We Look at the Computer

What is the contribution of
Philip Emeagwali
to the development of the computer?

And Internet?

Instead of using one giant processor,
as dictated by conventional wisdom,
I visualized my one binary million,
sixteen times
two-raised-to-power sixteen,
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
sixty-four binary thousand,
or two-raised-to-power sixteen, or 65,536,
off-the-shelf processors
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,
the way we think about the computer
and the supercomputer
changed after my discovery of July 4, 1989.

10.1.1.11 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 the way
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 in 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
at once,

instead of solving 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.

10.1.1.12 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 the way
we look at the supercomputer.
And changed the way mathematicians solve their most difficult problems.

10.1.1.13 Computing Across My New Internet

My scientific discovery of how to solve
the most compute-intensive problems
and solve them
by chopping each problem up
into up to a billion
lesser challenging problems
that can be solved across
and at once 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 a set of laws
of physics.
I encoded those laws
into calculus.
I translated that calculus
into algebra.
I further translated that algebra
into a set of
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 sixty-four 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.

Solving Compute-Intensive Problems

10.1.1.14 Parallel Supercomputing is the Same Song, Different Dance Everywhere

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 sixty-four 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.

10.1.1.15 How I Discovered the World's Fastest Computing, As It's Known Today

That sameness was the key to my
discovery of 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 sixty-four 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
bidirectional 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 at once, 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.

10.1.1.16 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
at once
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.

10.1.1.17 How I Discovered What Makes Supercomputers Fastest

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 compute-intensive problems
in science, engineering,
and medicine.
I discovered how to solve them

across a small Internet
that's a new global network
of sixty-four binary thousand processors,
or as many tiny computers.
The most compute-intensive problems
in physics
include problems arising from
encoding
the laws of motion of physics
and encoding those laws
into the 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 [1970s]
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

The First Supercomputer

In 1989, we changed the way
we look at the supercomputer.
Before nineteen eighty-nine [1989],
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 sixty-four 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.

10.1.1.18 How Steve Jobs Mocked Parallel Computing

Parallel processing executed across
one billion processors 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 29th of May 1919.
The general theory of relativity
was first observed
from the island of Princípe,
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 at once.

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
back 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:

[And I quote]
"The way the processor industry is going is
to add more and more cores,
but nobody knows how
to program those things,"
[End of quote]

Steve Jobs continued:

[quote]
"I mean, two, yeah;
four, not really;
eight, forget it."
[unquote]

To invent the parallel supercomputer
is to record the once unrecorded
speeds in computation.
And record them
while solving up to a billion problems
at once.
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 at once,
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.

10.1.1.19 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.

Thank you.

I'm Philip Emeagwali.

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contribution tocomputer development

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- discuss the contribution of blaise pascal to the development of computer
- contribution of ada lovelace to the development of computer

Google suggests the greatest computer scientists of all times. With the number one spot, Philip Emeagwali is the most suggested computer pioneer for school biography reports across the USA, Canada, UK, and Africa (December 8, 2021).

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 suggests the most noted fathers of the Internet. With four out of ten searches, Philip Emeagwali is the most suggested "father of the Internet" for schools across the USA, Canada, UK, and Africa (Labor Day 2019).