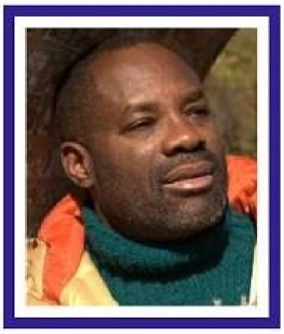
30 How I Invented a New Supercomputer



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30.1.1 Who's Philip Emeagwali, the Discoverer of Parallel Processing?

30.2 Philip Emeagwali Computer

30.2.1 Philip Emeagwali Supercomputer

I began programming the sequential processing supercomputer on June 20, 1974 and at age nineteen.

Back then, to program the
parallel processing supercomputer
and to do so for the first time
was like asking a man who had never
climbed a mountain
to begin by climbing Mount Everest.
In 1974, parallel processing
was scorned and ridiculed as a
wonderfully useless
and vacuous gimmick.
In 1974, parallel processing
was mocked
as a beautiful theory
that lacked experimental confirmation.
After my experimental discovery
of parallel processing
that occurred on the Fourth of July 1989,
the parallel processed
supercomputer technology
became a time-tested truth
that has been re-confirmed **across**
the frontiers of extreme-scale
computational physics, **across**

the frontiers of large-scale
algebraic computations,
and **across**
the frontiers of the toughest
initial-boundary value problems
that arises in modern calculus
that are, for example,
at the mathematical core
of the general circulation modeling
that must be used
to foresee otherwise unforeseeable
global warming.
The Earth's atmosphere doesn't fit into a lab,
or into one computer.
For that reason, I invented
how to fit—in a digital sense—the
Earth's planetary-sized atmosphere
into a room-sized supercomputer
that is not a computer *per se*
but that is a new internet *de facto*.
My new internet
is powered by my ensemble of
65,536 commonly-available processors.

Each processor
operated its own operating system.
Each processor
had its own dedicated memory
that shared nothing with
other processors.

30.2.2 Supercomputing at Mathematics Congress

I'm **Philip Emeagwali**,
the extreme-scaled
computational mathematician
who became known
for inventing
how to solve the most
computation-intensive problems
arising in calculus and algebra
and arithmetic.
I mathematically invented
how to solve the toughest problems
arising in extreme-scaled
computational physics
and how to solve them **across**

my new internet
that is my new global network of
64 binary thousand tightly-coupled,
commodity-off-the-shelf processors
that are identical
and that are equal distances
apart.
Yet, I cannot fully describe
the **Philip Emeagwali**'s Equations,
namely, the nine
partial **differential** equations
of the modern calculus
and the companion and approximating
nine partial **difference** equations
of extreme-scale algebra
that took me sixteen years
to discover and invent.
I cannot fully describe
the **Philip Emeagwali**'s equations
within sixty minutes.
For this reason,
I've posted online
tens of thousands of pages

on how I discovered and invented
the **Philip Emeagwali**’s equations.
I’ve posted online
more than a hundred audiotaped
and videotaped lectures
in which I described
my contributions to human knowledge,
namely, new physics, new calculus,
new algebra,
a never-before-seen computer,
a never-before-seen supercomputer,
and a never-before-seen internet.
I’ve posted my lectures
on my website **emeagwali** dot com.
I also shared
the **abstract** and the **invisible**
parts of my mathematical invention
and I shared them
with research mathematicians.
I delivered an invited lecture
on my contributions to mathematics
and I delivered that lecture
at the largest

international mathematics congress, 1248
called ICIAM ’91,
that’s held once every four years.
My ICIAM ’91 lecture was at 11 a.m.
Monday July 8, 1991,
in the Dover Room
of the Washington Sheraton Hotel
in Washington in the District of Columbia,
United States.
Because I had become known
to the research mathematics community,
I was invited
to deliver that lecture
and invited by a society of societies,
named the International Council
on Industrial and Applied Mathematics.
The council on mathematics
asked me to speak at
one of the ICIAM ’91 symposia
of the International Congress of
Industrial and Applied Mathematics.
The research mathematicians
at that mathematics symposium

was a gathering of the Who’s Whos
in the world of mathematics.
Most research mathematicians
in that world’s largest
mathematics conference
were at home with
using the partial differential equations
of the modern calculus
and using those abstract equations
to symbolically encode
and to solve
the most extreme-scaled problems
arising in computational physics.
Such massively parallel processed
supercomputer problems
include the excruciatingly-detailed
general circulation modelling
of the air and the water
that enshroud planet Earth
and executing such models to foresee
otherwise unforeseeable global warming.
Such massively parallel processed
supercomputer problems

include the high-resolution
petroleum reservoir simulation
that is executed
to recover otherwise unrecoverable
crude oil and natural gas.
The massively parallel processing
supercomputer
that I experimentally discovered
on the Fourth of July 1989
is used to discover and recover
otherwise elusive crude oil and natural gas
that are buried a mile-deep
inside the Niger-Delta oilfields
of southeastern Nigeria.

Please allow me to quote myself
from that lecture of July 8, 1991
that I gave to the international congress
of mathematicians.

[quote]
“Under the laws of physics
is the partial differential equations

of calculus. 1251
Under the calculus
is the system of equations
of algebra.
Under the algebra
is a set of floating-point
arithmetical operations.
Electronically and automatically executing
the floating-point arithmetical operations
is a new internet
that’s a new global network of
processors.
Connecting to each processor
is an ensemble of sixteen pairs of
bi-directional email wires.
Controlling that new internet
—as a cohesive whole unit
that’s a new massively parallel processing
supercomputer
that’s comprised of
two-raised-to-power sixteen
processors
that are married together

by sixteen **times** 1252
two-raised-to-power sixteen
email wires—
is the supercomputer wizard.
I—**Philip Emeagwali**—was that
supercomputer scientist
that was logged on alone
to the only system powered by
two-raised-to-power sixteen,
or 65,536, processors.
I discovered that
a grand challenge problem
in extreme-scale computational physics
could be divided into
65,536 challenging problems
that I solved
in each of my 65,536
tightly-coupled processors
and solved at the speed of
forty-seven thousand
three hundred and three [47,303]
calculations per second
per processor.

The total speed
of my massively parallel processing
supercomputer
was the world's fastest computation."
[end of quote]

30.2.3 Changing the Way We Look at the Computer

It's often said that
necessity is the mother of invention.
The progress of the field of
extreme-scale computational physics
has been a sequence of interplays
between the computer
and the field of mathematical physics.
The fastest sequential processing
supercomputers
of the mid 1940s
inspired the development
of algorithms that are used to solve
the largest possible system
of equations of algebra,

such as the diagonal system of equations
of algebra
that arises from **explicit**
finite **difference** approximations
of the primitive equations of meteorology
that is behind all
massively parallel processed
supercomputer-generated weather forecast
in your television evening news.
The reason my invention
of the massively parallel processing
supercomputer
was reported in newspapers
and in the June 20, 1990 issue
of *The Wall Street Journal*
was that it was a
technological breakthrough.
It made the news headlines that
an African supercomputer wizard
in the United States
had figured out
how to harness a new internet
that is a new global network of

64 binary thousand
commodity-off-the-shelf processors.
Each processor
operated its own operating system.
And each processor
had its own dedicated memory
that shared nothing with each other.
I figured out
how and why that new internet
is an instrument of extreme-scale
computational physics
and how to use that new internet
to compute faster than
any sequential or vector processing
supercomputer
that computed
with the fastest custom processor.
My technological breakthrough
that occurred on the Fourth of July 1989
opened the path
to the field of massively parallel processing
that was previously dismissed
as a huge waste of everybody's time.

30.2.4 The Chinese Are Coming

China is exploiting the rich
and fertile consequences
from my invention
of the massively parallel processing
supercomputer
that was the **precursor**
to the modern supercomputer.
China now has the world's fastest
supercomputer.
The fastest supercomputer assembled
in China
by a team of one thousand
three hundred [1,300]
Chinese engineers and scientists
is massively parallel processing **across**
ten million
six hundred and forty-nine thousand
six hundred [10,649,600]
commodity-off-the-shelf processors.
Chinese supercomputer scientists

divided their grand challenge problems
in extreme-scale computational physics
and did so to enable them to solve,
in parallel, ten million
six hundred and forty-nine thousand
six hundred [10,649,600] smaller problems.
China's use of ten million
six hundred and forty-nine thousand
six hundred [10,649,600]
commonly available processors
vindicated my programming of
64 binary thousand
commodity-off-the-shelf processors.
Massively parallel processing **across**
one billion processors
could be extended to the
as-yet-unsolved billion problems
of extreme-scale computational physics.

30.2.5 Vision of the First Supercomputer Scientist

For a wider and a more diverse perspective,
we need to see
the massively parallel processing
supercomputer
that is the **precursor**
to the modern supercomputer
and see the technology
through the eyes of its first
lone wolf programmer,
and not always see the technology
through the eyes
of a person that merely studied
the massively parallel processing
supercomputer
and studied the technology
from the supercomputer textbook authors
that, in turn, first learned
how to program the modern supercomputer
and learned it
from the first person
that programmed it.

I—**Philip Emeagwali**—was that first
parallel processing supercomputer scientist
that was the first
to experimentally program
the most massively parallel processing
supercomputers
of the 1980s
and that was ever built.
I visualized my massively
parallel processing supercomputer
differently from other vector processing
supercomputer scientists.
I visualized my massively
parallel processing supercomputer
as a new internet
that is a new global network of
65,536 commodity-off-the-shelf processors.
I theorized my massively
parallel processing supercomputer
as my new internet
that is a small copy of the Internet.
That new internet
was a small copy

of a never-before-understood Internet, 1260
that had only 65,536 processors
around a room-sized globe
instead of billions of computers
around a planetary-sized globe.
According to a nineteen eighty-nine [1989]
survey,
there were twenty-five thousand [25,000]
vector processing supercomputer scientists
in that year.
Those twenty-five thousand
supercomputer scientists
considered the **precursor**
to the modern supercomputer
to be a **waste of time** of their time.
For that reason, I was the only
supercomputer scientist
that was logged on fulltime and 24/7
on the most massively parallel processing
supercomputer
ever built.
In 1989, I was in the news because
I invented

how to use the precursor
to the modern
massively parallel processing
supercomputer
and how to use that technology
to solve the most
computation-intensive problems
that arises
in extreme-scale computational physics.

30.2.6 Diary of the First Supercomputer Wizard

I am the first person
to be referred to
as a parallel processing
supercomputer scientist.
I began supercomputing
by programming the first supercomputer
that was rated
at the then unheard of speed of
one million instructions per second.
I began programming

that first supercomputer
on June 20, 1974 at age nineteen
at 1800 SW Campus Way,
Corvallis, Oregon, United States.
As a nineteen year old
that was programming
that first supercomputer,
I felt like a small boy
that was challenged
to climb the Iroko tree
and to climb it with his bare hands.
The Iroko tree
is one of the tallest trees in Africa.
It's not on all days
that we are able to climb the Iroko tree.
For that reason,
when I climbed the Iroko tree
of supercomputing,
I climbed down with all the firewood
or the new knowledge,
that I will need
to invent a new supercomputer.
I did so because

I might never get a second chance
to climb the Iroko tree.
Asking a person to become
the first programmer
of the first massively parallel processing
supercomputer
was like asking a man
who had never climbed a mountain
to climb Mount Everest.
Because it was considered impossible
to program the first
massively parallel processing supercomputer
nobody took me seriously
in my attempt
to climb the Mount Everest
of the world of supercomputers.
In the 1980s, I was logged on alone
on the only system in the world
powered by an ensemble of 65,536
commodity-off-the-shelf processors.
In that frontier of knowledge
of the massively parallel processing
supercomputer

of 1989
there was a digital divide
that is a gulf between
white supercomputer scientists
who had ready access
to vector processing supercomputers
but avoided
the parallel processing supercomputer
and wouldn’t touch it with a ten-foot pole,
and the lone wolf black
massively parallel processing
supercomputer scientist.
After it was discovered
that I was black and African,
I was banned from programming
vector processing supercomputers
and restricted to programming
massively parallel processing
supercomputers.
Back in the 1970s and ‘80s,
restricting a programmer
to only programming
the massively parallel processing

supercomputer
was like giving him a death sentence
and was perceived as a career killer.
I was forced to program
the massively parallel processing
supercomputer
and to do so alone.
That act of racism
created a digital divide with a twist:
namely, one black supercomputer scientist
and no white supercomputer scientist
at the farthest frontier of supercomputing
and 25,000 nearly all-white
supercomputer scientists
hugging the soon to be obsolete,
conventional vector processing
supercomputer.
In the 1980s, I was logged on alone
on the most massively parallel processing
supercomputers
ever built.
I was the lone wolf supercomputer scientist
for two reasons.

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First, black supercomputer scientists
were socially isolated.
For that reason,
black vector processing
supercomputer scientists
tend to program supercomputers **alone**.
For that reason, I didn't know
any other black supercomputer scientist
while I was supercomputing
in 1974
in Corvallis (Oregon, United States)
or supercomputing in the mid-1980s
in Cambridge (Massachusetts, United States)
or supercomputing in the late 1980s
in Los Alamos (New Mexico, United States).
I knew from the unanimous rejections
that I received
from white supercomputing teams
that a black supercomputer scientist
will most likely be programming
supercomputers alone
and will most likely be supercomputing
as an outsider

to supercomputer laboratories
in the United States.
As an outsider,
each black supercomputer scientist
is most likely to think
outside the box,
and outside conventional supercomputers
and inside unorthodox supercomputers.
For his or her outside-the-box thinking,
the black supercomputer wizard
is fearless and raw
and brings a diversity of ideas
to the massively parallel processing
supercomputer
that's missing in all-white
scientific supercomputer teams.
As a lone wolf,
that black supercomputer scientist
must be a renaissance person
that is a jack-of-several-sciences
that is simultaneously at home
in mathematics, physics,
and the new supercomputer science.

I will guess that, in 1989, that about 25
of the 25,000 supercomputer scientists
in the world
were black Americans
and that five were black
sub-Saharan Africans.
Furthermore, as one in a thousand,
black supercomputer scientists
of the 1970s and ‘80s
were scattered and didn’t know each other.
As I got known in the 1990s,
I heard from a few
black supercomputer scientists.
Each black supercomputer scientist
re-confirmed my theory
that he worked as a lone wolf.

30.2.7 How I Invented a New Supercomputer

As the first black person
to win the top prize in supercomputing,
I was **devoured** like a lamb

and my garments were soiled
in mockery.
The goal of white hate groups
was to wreck my image
and to disrepute my reputation
as the only supercomputer scientist
that is the subject of school reports
and that is honoured on postage stamps.
Back in the 1980s,
all massively parallel processing
supercomputers
were in experimental laboratories,
such as the United States
National Laboratories
that were tasked
to invent
how to use the massively parallel processing
supercomputer
and how to use that then
unproven technology
to simulate the shock waves
that arises from exploding nuclear bombs.
The goal of simulations of nuclear explosions

was to enable the United States
to evade the spirit
of the Comprehensive
Nuclear Test Ban Treaty
that bans all nuclear tests.
That expanded treaty, originated as
the Limited Nuclear Test Ban Treaty
that was signed on August 5, 1963
and signed by the United States,
Soviet Union, and Great Britain.
Fast forward three decades
from my experimental discovery
of the parallel processing supercomputer
that occurred on the Fourth of July 1989,
50 percent of the modern supercomputer
that has high core counts
are in industries,
such as the petroleum industry
where they were used to discover
and recover
otherwise elusive crude oil and natural gas.
The massively parallel processing
supercomputer

is used in the production oilfields
of the Niger-Delta region
of south-eastern Nigeria.
The massively parallel processing
supercomputer
is used to foresee otherwise unforeseeable
global warming.
For the record,
the modern supercomputer
was not recognized as a supercomputer
until I—**Philip Emeagwali**—
invented the technology
as a massively
parallel processing supercomputer.
I invented
the precursor to the modern supercomputer
in Los Alamos, New Mexico, United States
and I discovered the technology
at 8:15 in the morning
of Tuesday the Fourth of July 1989.
My invention
of the modern supercomputer
was recorded in the June 20, 1990 issue

of *The Wall Street Journal*. 1272
My invention
of the modern supercomputer
was recorded again
by then **President** Bill Clinton
in his White House speech
of August 26, 2000.
Prior to my experimental discovery
of parallel processing,
no ensemble of processors
was rated as a supercomputer.
Due to that performance failure,
the parallel processing technology
was scorned
as a huge waste of everybody's time.
My contribution
to the development of the computer
is the new knowledge
that is the experimental discovery
of how to massively parallel process
and how to reduce the **time-to-solution**
needed to solve the toughest problems
arising in computational mathematics

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and in computational physics.
I was in the news because
I invented
how to reduce that **time-to-solution**
and how to reduce that time
from years to minutes
and even seconds.
That reduced **time-to-solution**
enables us
to make the impossible-to-compute
possible-to-compute.
Without my invention
of the massively parallel processing
supercomputer,
the field of extreme-scale
computational physics will not exist.
I experimentally discovered
that the conventional wisdom
described in supercomputer textbooks
as Amdahl's Law was wrong.
Amdahl's Law claims that
it will be impractical
to efficiently parallel process **across**

eight processors. 1274
It made the news headlines
that I efficiently parallel processed
and that I experimentally discovered
a supercomputer speedup increase
of a factor of 65,536, or more.
I invented
how to record that speedup
and how to do so **across**
a new internet
that is a new global network of
65,536, or more,
tightly-coupled commodity processors,
with each processor
operating its own operating system
and with each processor
having its own dedicated memory
that shared nothing with each other.
I was searching for a deeper understanding
of how the massively parallel processing
supercomputer
becomes the fastest computer
and I gained that enlightenment

on the Fourth of July 1989.
That was when my invention
rose from the ashes of rejection
to be studied in schools
as the contributions of **Philip Emeagwali**
to the development of the computer.