MAKING COMPUTERS FLY

Forging Paths to New Heights

Philip Emeagwali

emeagwali.com

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

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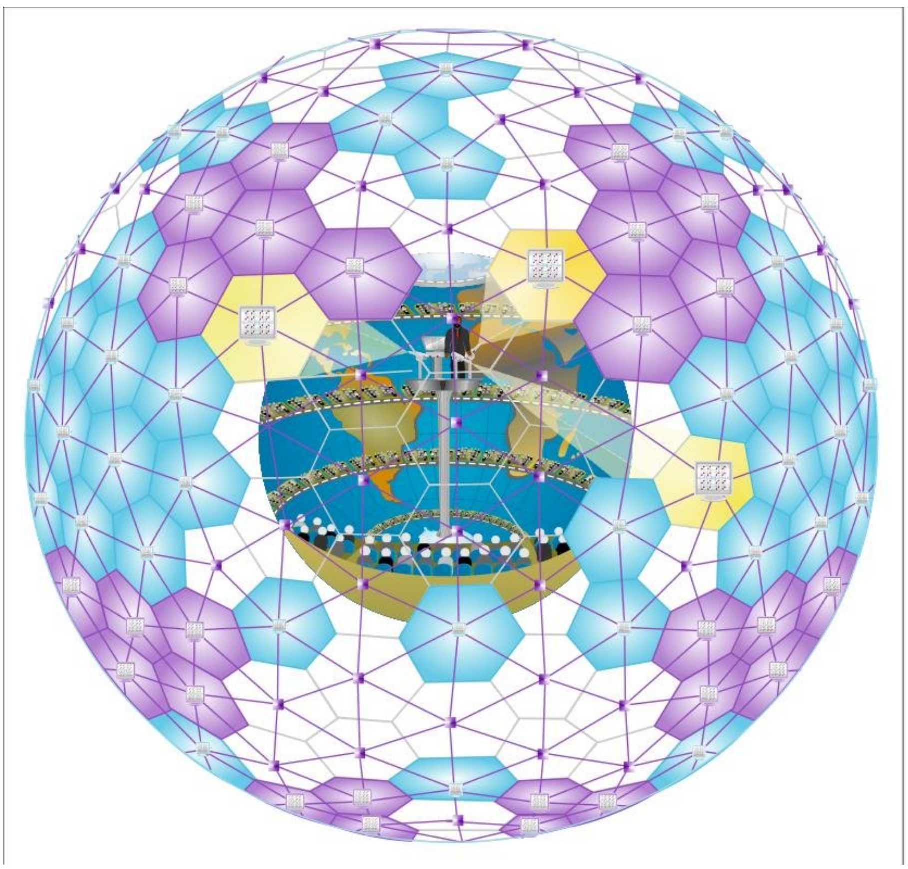
1ST LECTURE: THE SUPERCOMPUTER THAT'S AN INTERNET



Broadcast 21 August 2021

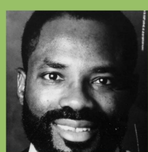
https://youtu.be/s9yZhQsQeqc

The Reader's Digest described Philip Emeagwali as "smarter than Albert Einstein." He is ranked as the world's greatest living genius. He is listed in the top 20 greatest minds that ever lived.

Philip Emeagwali lived in refugee camps during the 1967-70 Nigerian-Biafran War and is in the Gallery of Prominent Refugees of the United Nations. He caught the attention of American scholars and was awarded a scholarship on September 10, 1973, to the United States.

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. That vital technology underpins every supercomputer and changed the way we look at the computer.

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



Making Computers Fly Philip Emeagwali

Making Computers Fly

Forging Paths to New Heights

Philip Emeagwali

INVENTING A NEW INTERNET

I began supercomputing at age nineteen on June 20, 1974, in Corvallis, Oregon, USA. Back then, there was no computer in my country of birth, Nigeria. In 1974, the parallel supercomputer that's the precursor of the world's fastest computer was mocked and dismissed as science fiction.

Parallel processing was an unproven technology that couldn't be harnessed to achieve the world's fastest computer speeds of a vector supercomputer. The unproven technology couldn't be used to solve the most difficult problems, such as executing computational fluid dynamics codes, including executing high-resolution global climate models and doing so to foresee otherwise unforeseeable long-term global warming. In the 1980s and earlier, everybody ridiculed parallel supercomputing. The technology was mocked and dismissed as unproved and as a tremendous waste of everybody's time.

My contributions to the 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 difficult 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 difficult problems in mathematics, science, and engineering. Without supercomputing **across** millions of identical processors, these grand challenge problems will be impossible to solve.

A New Supercomputer Technology Creates New Sciences

A new technology for fastest computing creates new sciences. The world's fastest computer opened the door to unexplored areas of mathematics, physics, and computer science. The diverse applications of the supercomputer range from oil exploration to a surer prediction of global warming.

The earliest experiment **across** a massive ensemble of processors, in which a Grand Challenge Problem was solved, occurred at fifteen minutes after 8 o'clock 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.

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 difficult problems in the scientific and engineering worlds.

Unleashing the Power of Supercomputers: Exploring Their Many Uses

In an email, a twelve-year-old writing the biographies of famous computer pioneers **asked me**: "How are supercomputers used in Kuwait?" The supercomputer market is valued at 45 billion dollars a year. The energy and geoscience industries buy one in ten supercomputers. The Burgan Oil Field in the desert of south-eastern **Kuwait** was discovered in **1937**. The Burgan Oil Field contains up to 72 billion barrels of recoverable crude oil reserves.

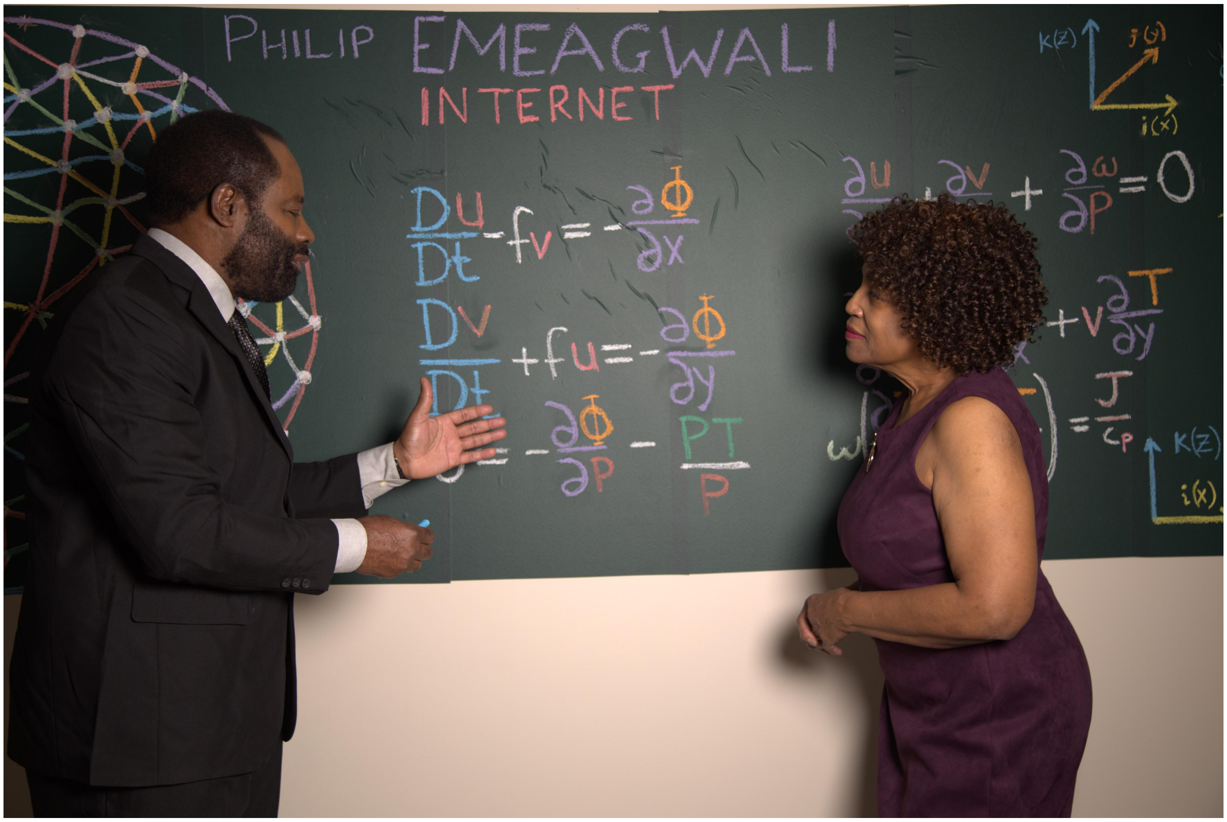
The Greater Burgan Oil Field is the world's largest sandstone oil field. The Burgan Oil Field is declining at **14 percent** per year. Fastest computing executed **across** millions of processors is used to recover about half of the crude oil reserves inside the Burgan Oil Field. In 1989, I was in the news for discovering how the slowest processors in the world could be harnessed as the world's fastest computer. And used to discover and recover otherwise elusive crude oil and natural gas.

Slowest Processors for the World's Fastest Computer

The parallel supercomputer became known to a broader audience after my scientific discovery, of the Fourth of July **1989.** That discovery yielded the world's fastest computer speeds that I recorded **across** the world's slowest processors. And recorded while solving one of the world's most difficult problems.

I arrived at that frontier of knowledge by contributing to the knowledge discovered by research scientists whose names were lost in the mist of time. In the past one hundred years, the population of the scientific community has grown by a thousand-fold. A century ago, there were only one thousand physicists in the world.

Today, we have one million physicists in the world. We could say the same of mathematicians. The body of knowledge now described as information and communication technologies has grown exponentially, since the 1940s.


PHILIP EMEAGWALI
INTERNET
$\frac{Du}{Dt} - fv = -\frac{\partial \Phi}{\partial x}$
$\frac{Dv}{Dt} + fu = -\frac{\partial \Phi}{\partial y}$

Philip and Dale Emeagwali

SOLVING THE MOST DIFFICULT PROBLEMS IN MATHEMATICS

The parallel processing problem which I solved in 1989 was then classified by the U.S. government as the most difficult problem of supercomputing. My solution of that difficult problem traversed extreme-scale partial difference equations of computational linear algebra, traversed partial differential equations of calculus, traversed large-scale computational physics, and traversed the supercomputing across up to a billion processors that made the news headlines because I parallel processed to solve the most difficult problem in mathematical physics.

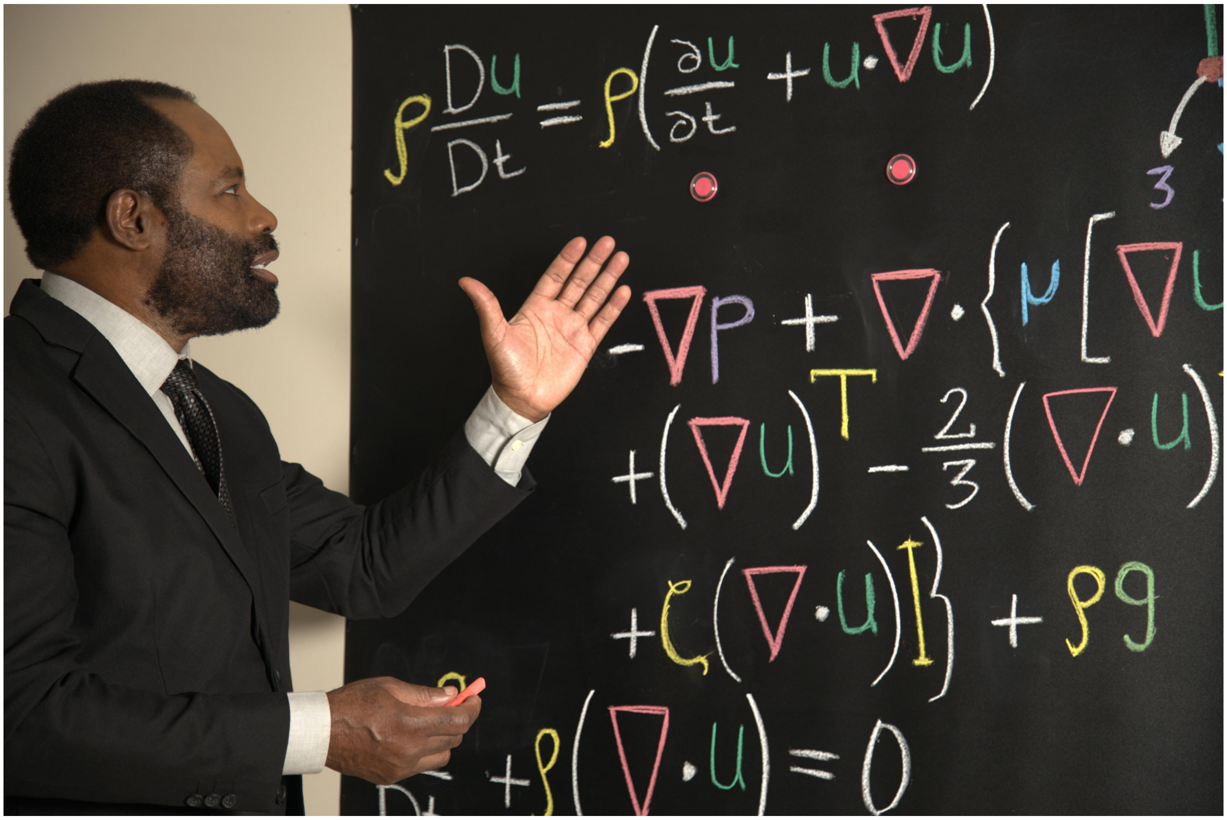
I solved that problem across a new global network of off-the-shelf processors that outlined and defined a never-before-recognized Internet. That Grand Challenge Problem was far more complex and compute-intensive than the calculus problem that Isaac Newton solved three centuries and three decades ago.

It's more difficult to invent new calculus than to understand the calculus in textbooks. For that reason, contributions of new partial **differential** equations to the existing body of mathematical knowledge is more valuable than the mastery of mathematical methods.

Nonetheless, the mastery of mathematics and physics is always a precondition for the invention of new partial **differential** equations as well as the world's fastest computers for solving them. As a computational mathematician, I invented discrete approximations that honor both the governing partial **differential** equations of calculus and their underlying physics.

My contribution of the world's fastest computing to mathematics and physics is used to extract crude oil and natural gas that are buried up to 7.7 miles deep. And formed up to 541 million years ago. An oil field is about the size of Abuja, the capital of Nigeria.

An oil field is a mixture of different materials which has properties that vary from point to point. Often, the properties may not have the same value along perpendicularly different directions. The value along the z-direction might be different when compared to those along the x- and y-directions. Such differences, called **he**te**ro**ge**nei**ties and ani**so**tro**pies,** make my supercomputer model more complex.


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

Philip Emeagwali

TURNING FICTION TO MATHEMATICS

As an aside, Isaac Newton wasn't a scientist. The word "scientist" was coined about a century and a half after Isaac Newton died. Instead, Isaac Newton described himself as a "Natural Philosopher," not as a mathematician or a physicist. Contrary to what is widely believed, Isaac Newton devoted most of his careers to researching occultism, not to searching for new laws of physics.

There are a thousand times more geniuses today than a century ago. Yet, in the 1940s, the likes of the physicist Albert Einstein couldn't parallel process, in part because, the technology and the technique were then unknown. For those reasons, they couldn't accurately solve an initial-boundary value problem of mathematical physics, such as global climate modeling to foresee long-term global warming. Global climate modeling is the most important problem in computational physics.

If I can travel back in time to three centuries and three decades ago to Cambridge, England, I will explain to **Isaac Newton** how we use the system of partial **differential** equations of calculus that encodes 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 like to a vector, although he wouldn't even understand vectors. But a tensor is more general than a vector. The array of components of a tensor are functions of its spatial coordinates.

Finally, I will explain to **Isaac Newton** how and why many mathematical models are **multi**physics and **multiscale**. The reason is that some phenomena are governed by different laws of physics and chemistry. And occur over wide-ranging temporal and spatial scales. The science of today was the science fiction of Isaac Newton.

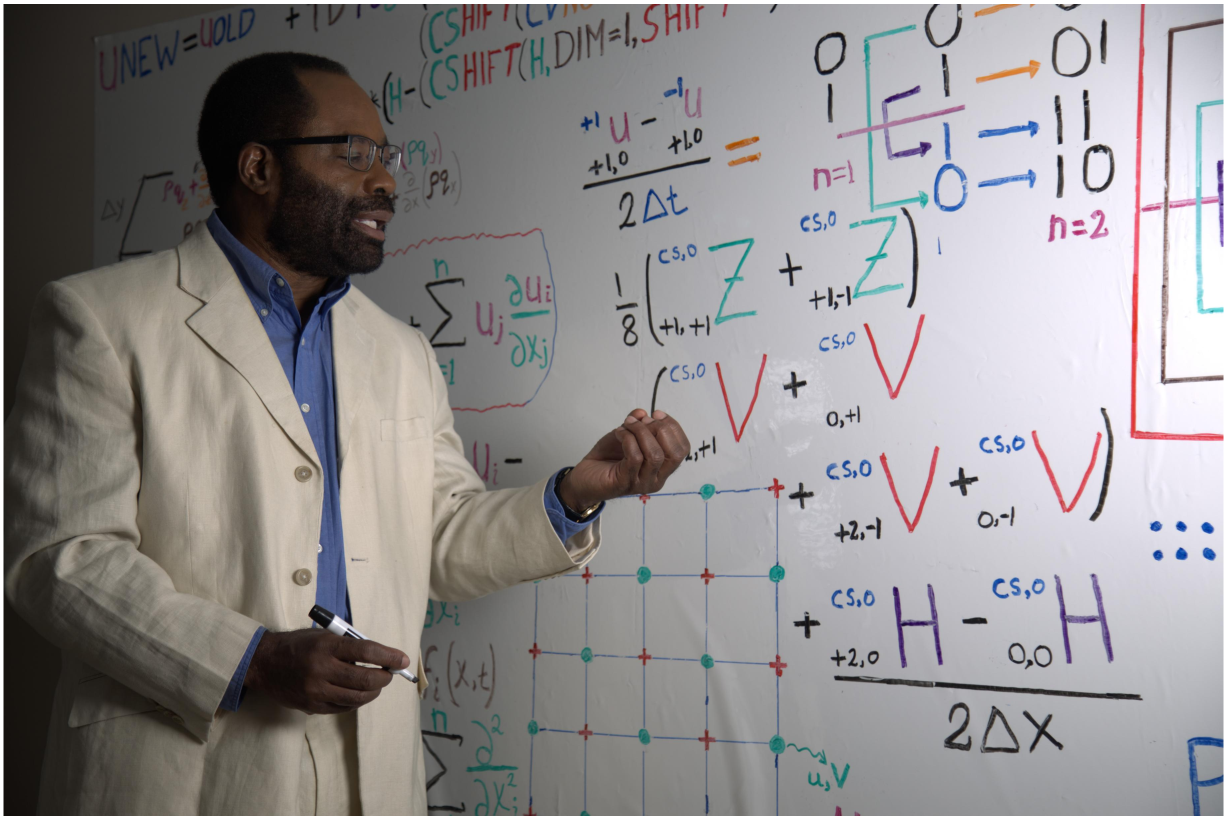
PROGRAMMING THE UNKNOWN

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 difficult problems in supercomputing. I discovered how to tackle the world's most difficult problems in algebra, calculus, and physics. I discovered how to solve them across a new Internet that's a new global network of 65,536 off-the-shelf processors and standard parts. That contribution to mathematics was the reason I was the cover story of the top publication in the world of mathematicians, namely, the May 1990 issue of the *SIAM News*.

How I Invented the World's Fastest Computing

I was the cover story because the foremost mathematicians in the world were being informed that I discovered how to solve initial-boundary value problems governed by partial **differential** equations that encoded the laws of physics. I discovered how to solve the most compute-intensive problems. And how to solve them not merely on the blackboard, or even on the motherboard, but **across** an ensemble of up to one billion processors that equidistantly surrounded the globe. And did so in the way the Internet circumscribes the Earth.



Philip Emeagwali

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 of 65,536 processors. And how to compute at the fastest recorded speed. And do so to tackle the most compute-intensive problems.

Such difficult problems could only be solved by dividing them into millions of lesser compute-intensive problems that, in turn, could be solved only by a one-problem to one-processor mapping onto a network of millions of processors. This problem-to-processor mapping is the substance of how the first supercomputer that computes fastest **across** the slowest processors is used to tackle the biggest and the most intractable problems in the mathematical sciences.

BECOMING A COMPUTER GENIUS

Fastest Computing Turns Fiction to Fact

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 **1970**s and **80**s, 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 **1980**s, attempting to harness an ensemble of 64 binary thousand processors and use them to emulate a virtual supercomputer was as difficult as attempting to make science fiction become reality.

Lone Wolf at the Frontier of the Supercomputer

That grand challenge was the reason the farthest frontier of the massively parallel supercomputer had only one permanent resident. I was that permanent resident of the then world of the world's fastest computing **across** up to a billion processors.

In 198**9** 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 **1980**s of the most massively parallel supercomputers ever built. That was how and why I became known as a supercomputer scientist.

On Becoming a Supercomputer Genius

In an email, a twelve-year-old writing the biography of a famous mathematician and his contribution 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 difficult problems in science, engineering, and medicine. The world's fastest computing that's executed **across** a million coupled processors is the central knowledge that must be used to foresee the otherwise unforeseeable spread of contagious viruses that occurs during a once-in-a-century global pandemic, such as Covid-19.

THE UNSPEAKABLE POWER OF THE SUPERCOMPUTER: REVEALED

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 difficult problem that must be parallel processed **across** up to one billion processors.

In **1989** and in the USA, I was in the news because I discovered how to solve the most difficult problems in mathematics and physics. And how to solve them in parallel and **across** my new Internet that was a new global network of two-**raised**-to-power sixteen, or 65,536 coupled **off**-the-shelf processors. Those processors were equal distances apart and shared nothing but were in dialogue with each other.

Why a Supercomputing Genius Must be a Polymath, Not a Mathematician

I've provided the complete details of my supercomputing inventions. And did so across dozens of books and one thousand podcasts and YouTube videos. I posted the most YouTube lectures because I have the most knowledge in the field of supercomputing. My YouTube lectures encapsulated the knowledge of mathematics, physics, and computing that I gained from nearly fifty years of fastest computing that began on June 20, 1974, at 1800 SW Campus Way, Corvallis, Oregon, USA.

I had to be a polymath, not merely a mathematician, to work alone. And solve the most difficult problem in supercomputing, which traversed half a dozen frontiers of scientific knowledge. In contrast, American scientists work in large teams. A person that was aided by one hundred scientists might only understand one percent of the work and, therefore, cannot give an impromptu interview, or deliver an on-the-spot lecture, and do so without the support of Power Point photos.

Having a supercomputer is one part of the equation for solving the most difficult problems arising in supercomputing. Only a polymath can translate and solve the toughest problems at the crossroad where new mathematics, new physics, and new computing intersect. The extra knowledge that gave me an edge over other mathematicians, physicists, and computer scientists was that I 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 difficult problems that arise during geophysical fluid flows. Such supercomputing problems include forecasting and hindcasting the global-scale motions of fluids (that is, liquids and gases) that enshroud the Earth.

Geophysical fluid motions include subsurface, multi-phased fluids flowing **across** anisotropic and heterogeneous porous media. And flowing up to 7.7 miles (or 12.4 kilometers) below the surface of the Earth. Geophysical fluid motions include centuries-long global climate modeling executed to foresee otherwise unforeseeable global warming.

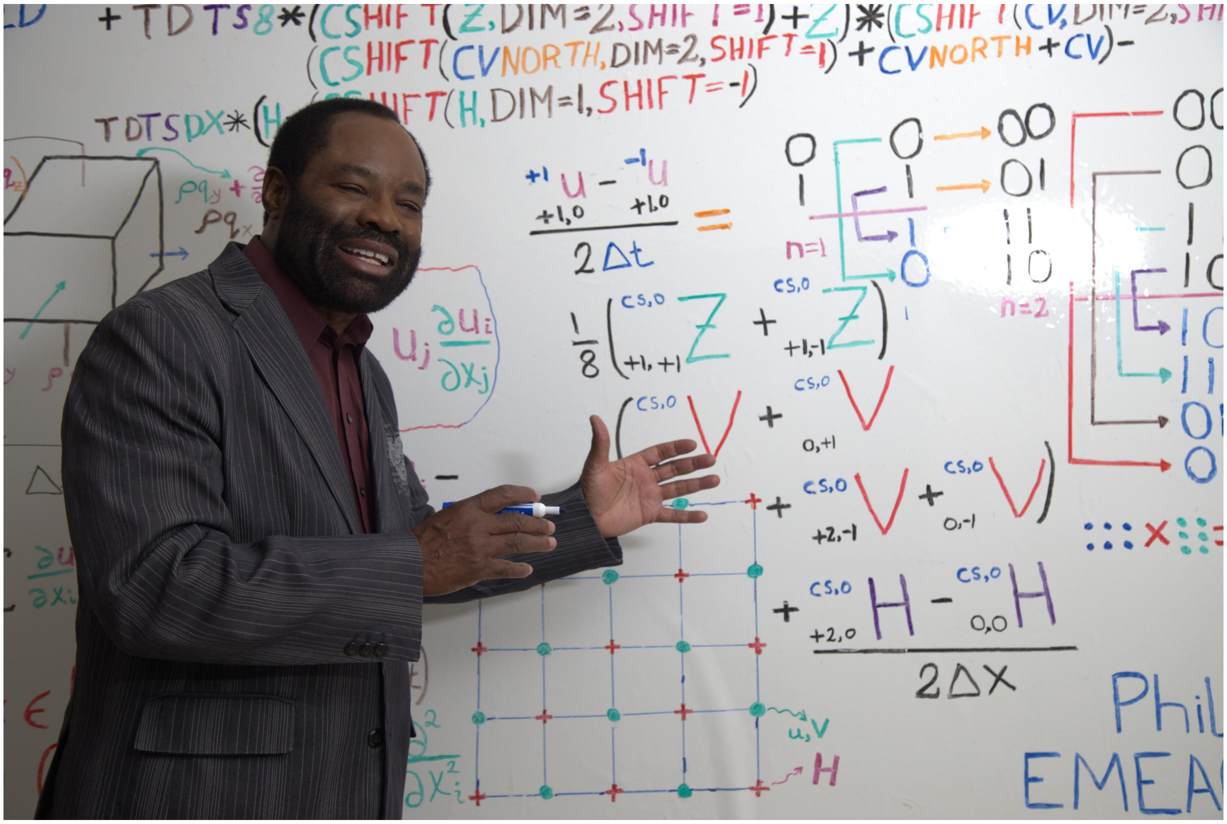
After a decade following **1974**, I left mathematical physics for the frontier of knowledge of the then unexplored field of the world's fastest computing **across** the world's slowest processors. Looking back and using a metaphor, I learned that if you've never left your house it's impossible to have ever seen your entire house.

In 1989, I commanded and controlled more supercomputing power than any person that ever walked on planet Earth. I understood the world's fastest computing deeper than the arm-chair theoretical physicist. And deeper than the mathematician who never left his blackboard for the motherboard that occupies the footprint of a football field.

I'm a polymath who sojourned from mathematics to physics to computer science and did so across half a century to leave behind a legacy of dozens of books and one thousand podcasts and YouTube videos. Famous scientists, who came of age after the mid-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.



MY JOURNEY TO THE TOP: AN UNEXPECTED PATH TO SUCCESS

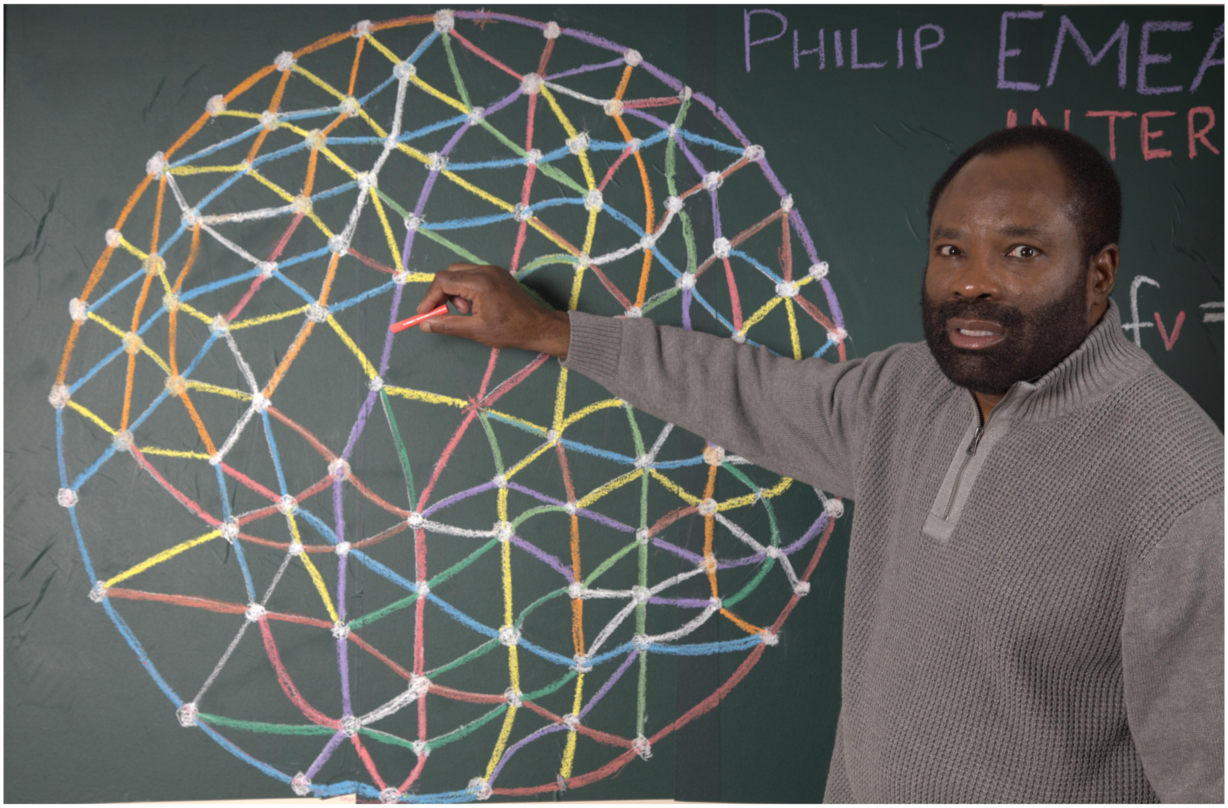
As the first supercomputer scientist who came of age in the 1970s, it was imperative that I followed a different path to the frontier of human knowledge of the world's fastest computing across the world's slowest processors. At that supercomputing frontier, new partial differential equations of calculus 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 describe my award as the Nobel Prize of Supercomputing.

I won that top supercomputer award, in 1989, because I discovered how to turn that science-fiction story of 1922 to a reality that's a new spherical island of 64 binary thousand **off**-the-shelf processors that could be harnessed and used to solve the most difficult problems in science, engineering, and medicine.

The poster boy of the twenty most difficult problems is computing at the world's fastest speeds. And doing so while executing large-scale, high-resolution global climate models. And executing them to foresee long-term global warming. And to find answers to previously unanswerable questions. And create new branches of human knowledge, such as the world's fastest computing **across** the world's slowest processors.


PHILIP EMEA
INTER

A LOOK AT THE SUPERCOMPUTER'S TOP-SECRET ORIGINS

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 45 billion dollars a year supercomputer market is its stepping-stone to dominating the globe in scientific discoveries and technical breakthroughs that are the preconditions to becoming the world's superpower.

The Biggest Question Beyond the Fastest Supercomputer

In the 1970s and 80s, my scientific search was for answers to the most important questions
at the crossroad where new mathematics, new physics, and the world's fastest computing intersect. My quest demanded that I look beyond the frontiers of mathematics, physics, and computer science. I did so because I realized that the discretization of the partial **differential** equations of calculus is an inadequate answer to the big question of how mathematicians solve the initial-boundary value problems of mathematical physics. Such problems govern the high-resolution global climate model that

must be used to foresee otherwise unforeseeable long-term global warming.

Mathematical knowledge alone was an inadequate answer to big questionss 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.

A NEW HORIZON OF MATHEMATICAL KNOWLEDGE BEYOND THE FASTEST COMPUTER

Looking back to 1974 and fifteen years onward, those that insisted that I remain in only one field, such as mathematics or physics or computer science, were standing in the way of my invention of the first supercomputing across the world's slowest computers.

Fastest computing was not entirely within mathematics or physics or computer science. I discovered it at their intersection. And did so when the naysayers were standing in the way of the critical and enabling parallel processing technology that now underpins the world's fastest computer. And that would allow faster computers to emerge from an ensemble of millions of slower processors.

Being at the frontiers of knowledge of the fields of physics, calculus, algebra, computer, and Internet sciences is the minimum requirement to becoming the first person to solve the most difficult problems central to supercomputing.

Unlocking the Secrets of Math to Surpass the Limits of the Fastest Computers

Abstract mathematical physics is the most recurring decimal inside the millions of processors that define and power the world's fastest computers. Therefore, if I didn't understand the computational physics or the abstract calculus or the large-scale algebra which I was inventing on my blackboard and which I was supercomputing **on and across** my 64 binary thousand processors then my chances of discovering how to parallel process and do so to compute at the fastest recorded speeds demanded that I achieve a **one-problem to one-processor** correspondence for my 65,536 initial-boundary value problems of extreme-scale computational physics.

That one-to-one correspondence was the mathematical precondition to solving the parallelized problems **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 64 binary thousand-fold increase in never-before-recorded email and supercomputer speeds.

My 50 Years as a Lone Supercomputer Scientist

In retrospect, the reason I was the lone programmer of the most massively parallel supercomputers of the **1980**s was that I was the **only person** that could execute the fastest computing across millions of processors. And solve the once-impossible-to-solve Grand Challenge Problem of supercomputing. I solved that difficult problem because my confidence came from knowing what I was doing and who I am.

My Early Years in the USA

My first night in the USA was spent alone in 36 Butler Hall, Monmouth, Oregon, and on Sunday, March 24, **1974**. I was then nineteen years old. I was the supercomputer scientist in-training that emigrated from Onitsha (**Nigeria**), a commercial city in the heart of sub-Saharan Africa. I came alone to Oregon in the heartland of the Pacific Northwest region of the USA. I came and became the mathematician that discovered new mathematical knowledge.

Over the following decade and a half, I grew and evolved and found myself beyond the farthest frontier of high-performance computational mathematics. Computing across millions of processors was the jagged, multidisciplinary frontier of supercomputer knowledge. For the sixteen years, between my supercomputer research in Corvallis (Oregon) and Los Alamos (New Mexico), I felt like an explorer that walked alone with a dim lamp and along a small road that was the Holy Grail to the world's fastest computing.

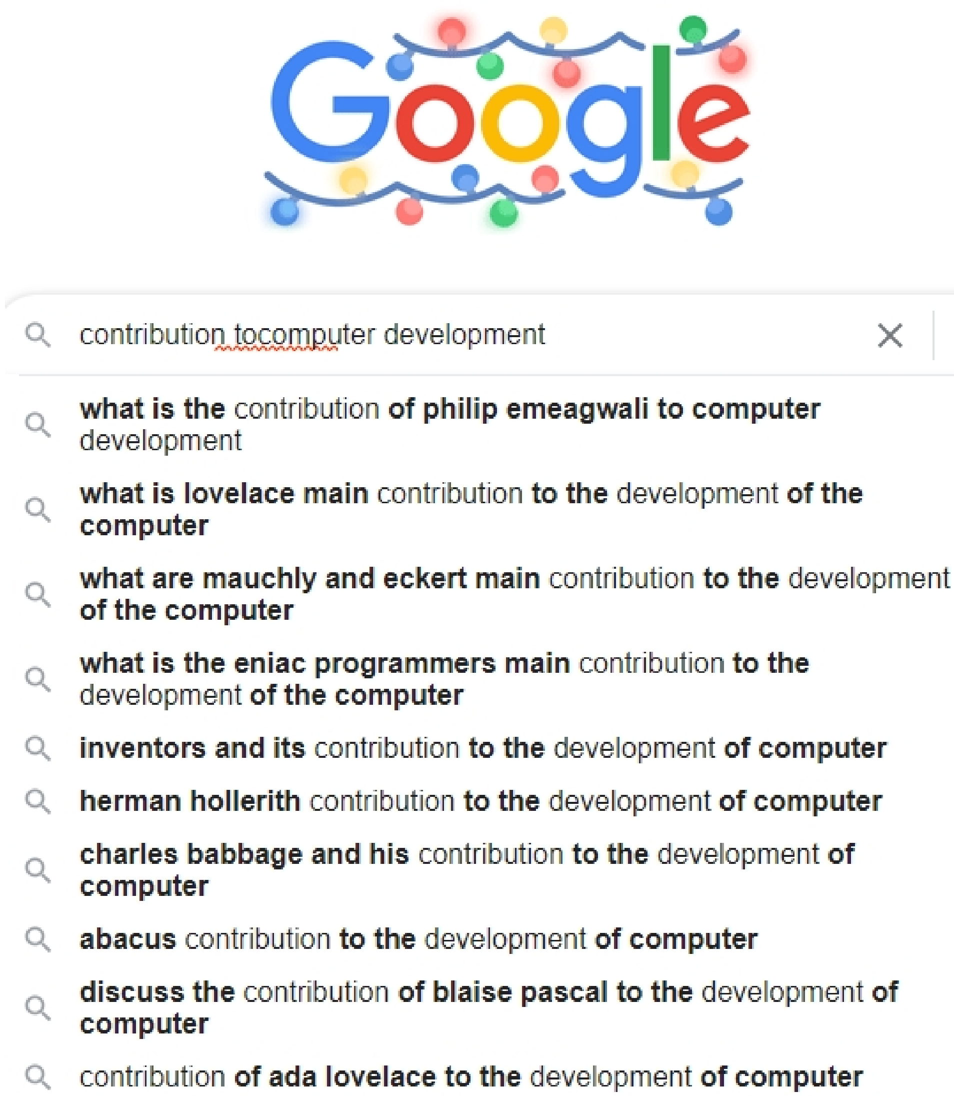
Photos TBA 1974 Oregon

BREAKING THE SPEED LIMIT IN PHYSICS

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.

2ND LECTURE: COMPUTING WITHOUT LIMITS



Google ranks Philip Emeagwali as the greatest computer genius (December 8, 2021).

HOW I BECAME A GENIUS BY SCRAWLING CODE IN THE DARK

Broadcast 21 August 2021

https://youtu.be/nVzI2AIBkj0

UNVEILING THE WEATHER INSIDE AN OILFIELD

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.

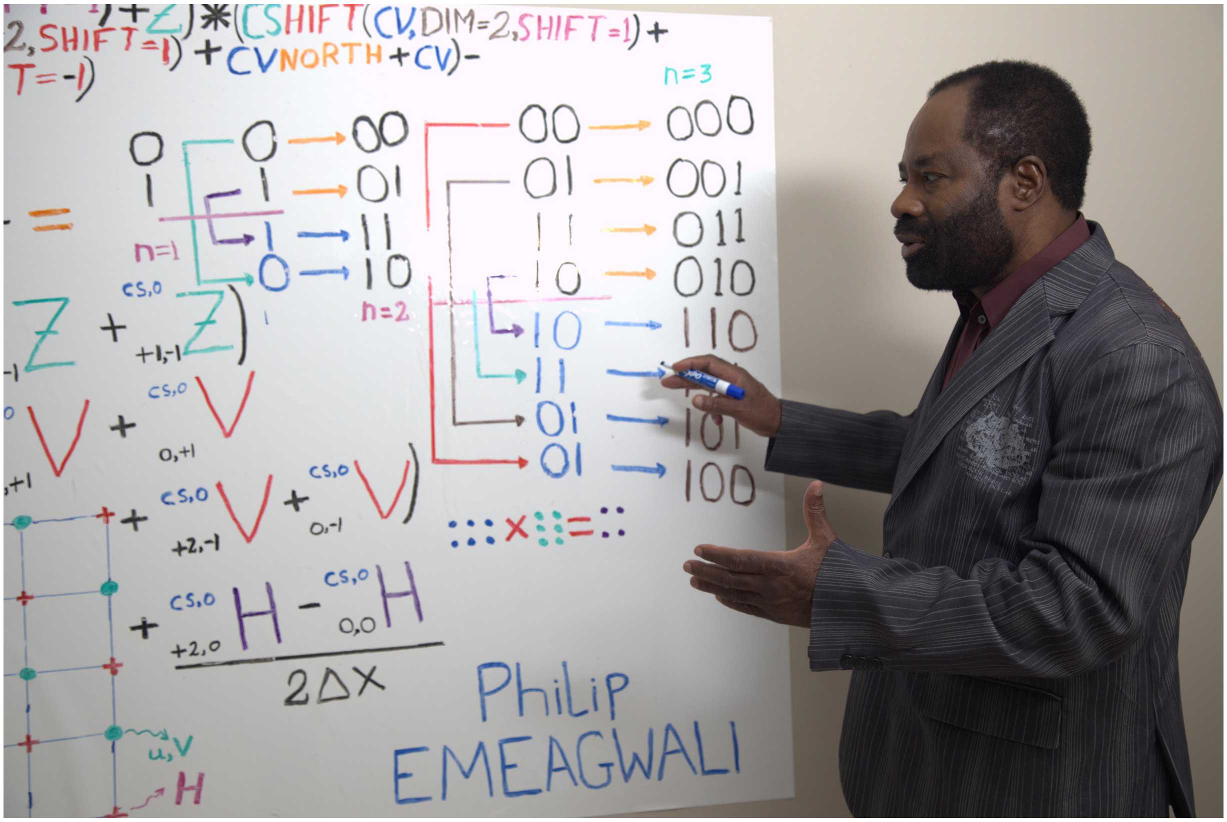
As a research mathematician who came of age in the 1970s and 80s, who is at the frontier of physics and supercomputing, my grand challenge in those two decades was to be the first person to understand how to solve initial-boundary value problems at the intersection of partial differential equations that 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.



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EMEAGWALI

A TEMPEST BENEATH OUR FEET: UNVEILING THE MYSTERIES OF THE CRUDE OIL INSIDE THE EARTH

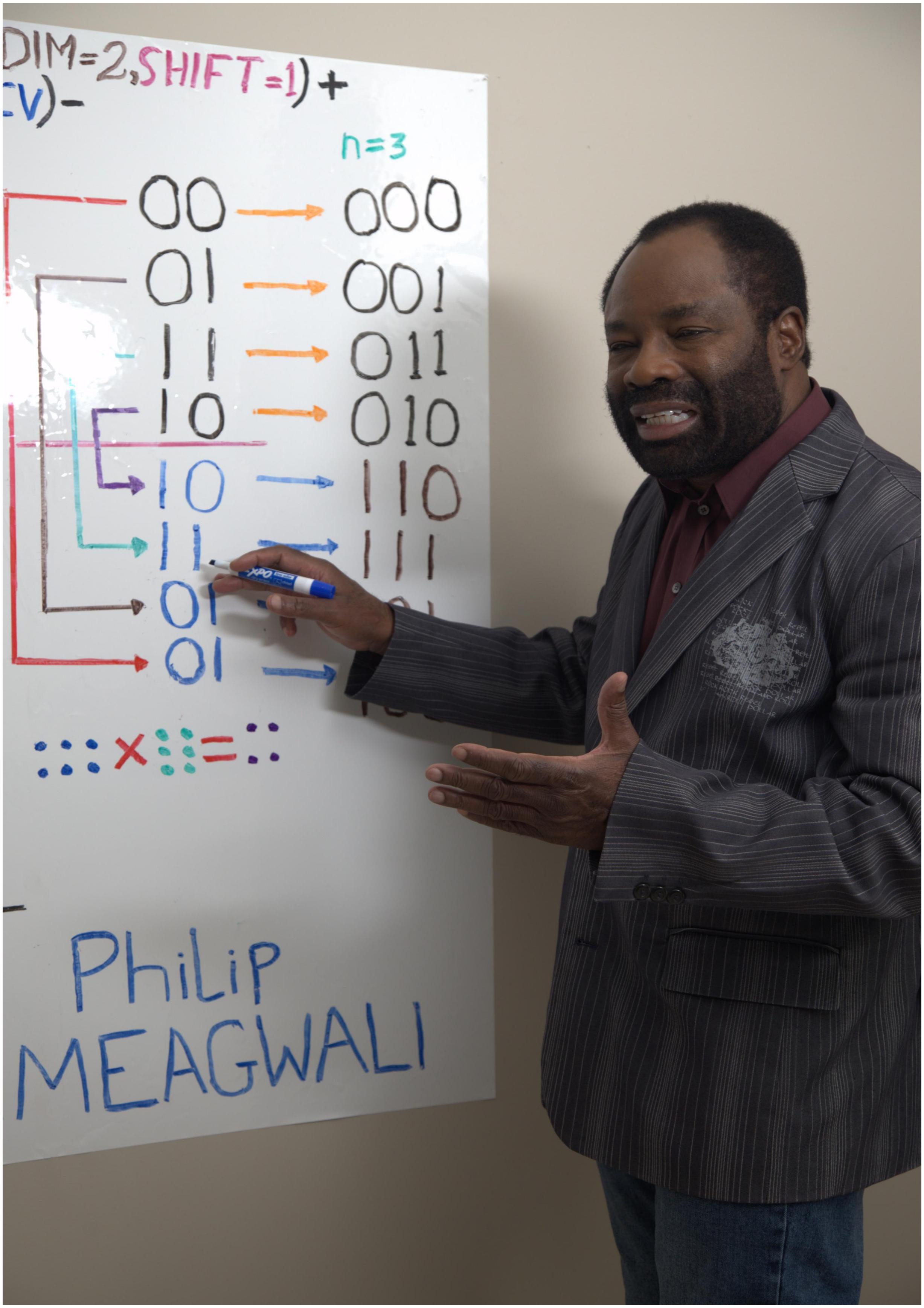
My quest was for new knowledge that will enable me to parallel process computational fluid dynamics code used to model the weather of up to 7.7 miles (or 12.4 kilometers) below the surface of the Earth. This Grand Challenge Problem
is the poster girl of compute-intensive physics.

In 1989, I was in the news as the first 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 65,536 equal reservoir models as Oil Field Number One, Oil Field Number Two, all the way to Oil Field Number 65,536. I visualized a one-oilfield to one-processor correspondence. I executed that one-to-one mapping between those oil fields and as many processors that shared nothing. My processors were equal distances apart. And each processor operated its operating system.

My processor-to-processor email directions were that: Oil Field Number One is directly and bidirectionally connected to Oil Field Number Two. Oil Field Number Two is directly and bidirectionally connected to Oil Field Number Three. I continued to directly and bidirectionally connect all nearest oil fields. But the last, or Oil Field Number 65,536 is directly and bidirectionally and **circularly** connected to Oil Field Number One.

My one-to-one mapping was at the core of my 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.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SCORCHING SECRETS OF EARTH'S INNER CLIMATE

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 investigate the finite difference discretization of the primitive equations of meteorology that were used by the U.S. National Weather Service and used to forecast the weather.

In the early 1980s and in College Park, Maryland, I discovered that the difficult problems of hindcasting the weather underneath the Earth and forecasting the weather above the Earth are governed by initial-boundary value problems that look similar. Yet, for a century the geologist and the meteorologist were not aware of that similarity. That ignorance robbed both fields the benefit of cross-fertilization of their discoveries.

The computational fluid dynamics model that I executed **across** my ensemble of 65,536 processors was the most difficult problem in supercomputing. It was an initial-boundary value problem posed **across** a new Internet that I defined as a new global network of 65,536 processors 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.

THE POWER OF PHYSICS: TRANSFORMING NIGERIA'S FUTURE

A few years ago, I posed a question meant for the Joint Admissions and Matriculation Board of Nigeria, or JAMB, for short: “What is the importance of physics in the development of Nigeria?”

The supercomputer must be used to tackle the biggest and the most difficult problems of tomorrow. In the 1980s, the precursor to the world’s fastest computer was confined to crunching massive amounts of data from my large-scale computational fluid dynami**cs simulation**s. My computational physics across millions of processors must be used to locate energy deposits.

Please allow me to quote myself from a lecture that I delivered in the early 1980s.

“In petroleum reservoir simulations executed for the oil fields of Nigeria, the dependent variables are the compressibility of the fluids, pressure, fluid partial molar volume, saturation, phase partial molar volume, total fluid velocity, as well as source and sink terms. Such terms include water injection wells and crude oil and natural gas producing wells.

To derive the system of equations of extreme-scale computational linear algebra within compositional reservoir simulators used for enhanced oil recovery processes that must be parallel processed **across** an ensemble of processors demands that the governing system of coupled, nonlinear, time-dependent, and three-dimensional partial **differential** equations be discretized with one of three finite difference techniques. The first technique is known as the **Implicit** Pressure **Explicit** Composition method. This finite difference approximation has small-time steps and the least computation time per time step.

The second technique is known as the **Implicit** Pressure and Saturation method. This finite difference approximation is more stable and handles larger time steps. The third technique is known as the Fully **Implicit** Method. This finite difference approximation is the most stable and handles the largest time steps."

I became a supercomputer scientist after putting in my time-in-grade. My due diligence that yielded the world's fastest computing occurred daily. And it occurred during my half century of supercomputing that was onward of June 20, 1974, in Corvallis, Oregon, USA.

I'm the subject of school essays because I was the 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 difficult problems could only be solved on supercomputers, if and only if, the number of processors harnessed is sufficiently large.

UNLOCKING SUPERCOMPUTERS TO DISCOVER OIL AND GAS

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 me as its only full-time programmer, reset itself to become the conventional user-friendly supercomputer that now has a thousand simultaneous users.

The Grand Challenge Problem of supercomputing is a tough question that the petroleum industry must answer. Their answer must lift the common citizen in Nigeria from poverty. Their answer must be grounded several miles deep inside the oil fields of the Niger Delta region of southern **Nigeria**. That oil field covers the area the size of a town. In **Nigeria**, extreme-scale petroleum reservoir simulators are used to discover and recover otherwise elusive crude oil and natural gas.

FROM FICTION TO SUPERCOMPUTER

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.

From Laws to Equations for Weather Forecasting

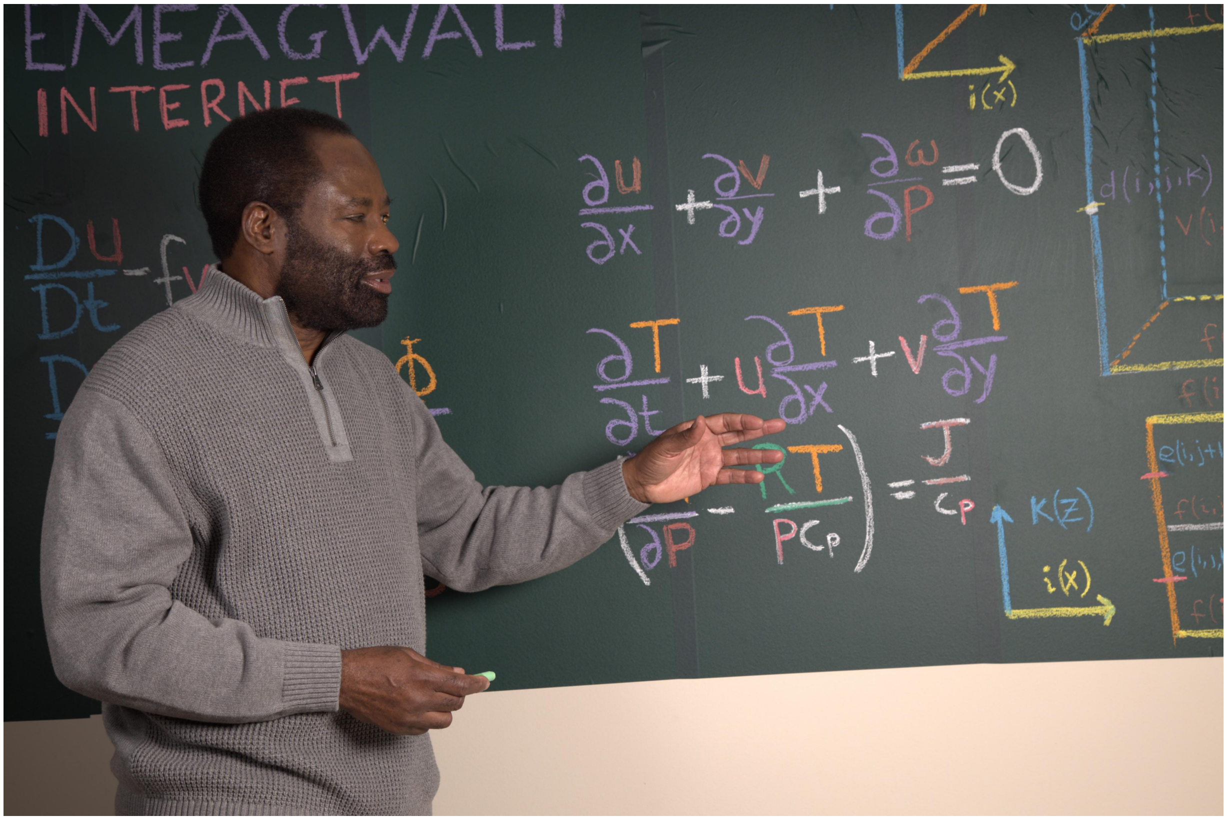
At all times and for the Grand Challenge Problems, I was cognizant of the fact that calculus and algebra were the two recurring decimals on my blackboard and motherboard, respectively. Prior to the parallel processing of my computational fluid dynamics problem, I had to discretize a system of governing partial **differential** equations of calculus, called the primitive equations of weather forecasting.

That was how I invented my finite difference algorithms of the algebra of weather forecasting.
Those algorithms are the sets of computational steps or the floating-point arithmetic operations
that must be solved at the extreme-scale algebraic core of the compute-intensive problem at the core of weather forecasting.

That was how your evening weather forecast used 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 hyp**so**metric equation that was derived from the hydrostatic equation and the ideal gas law. It also includes the **thermo**dynamic energy equation, or the first law of thermo**dynamics**, 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.



UNLOCKING THE SECRETS OF OIL AND GAS FLOWS WITH 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.

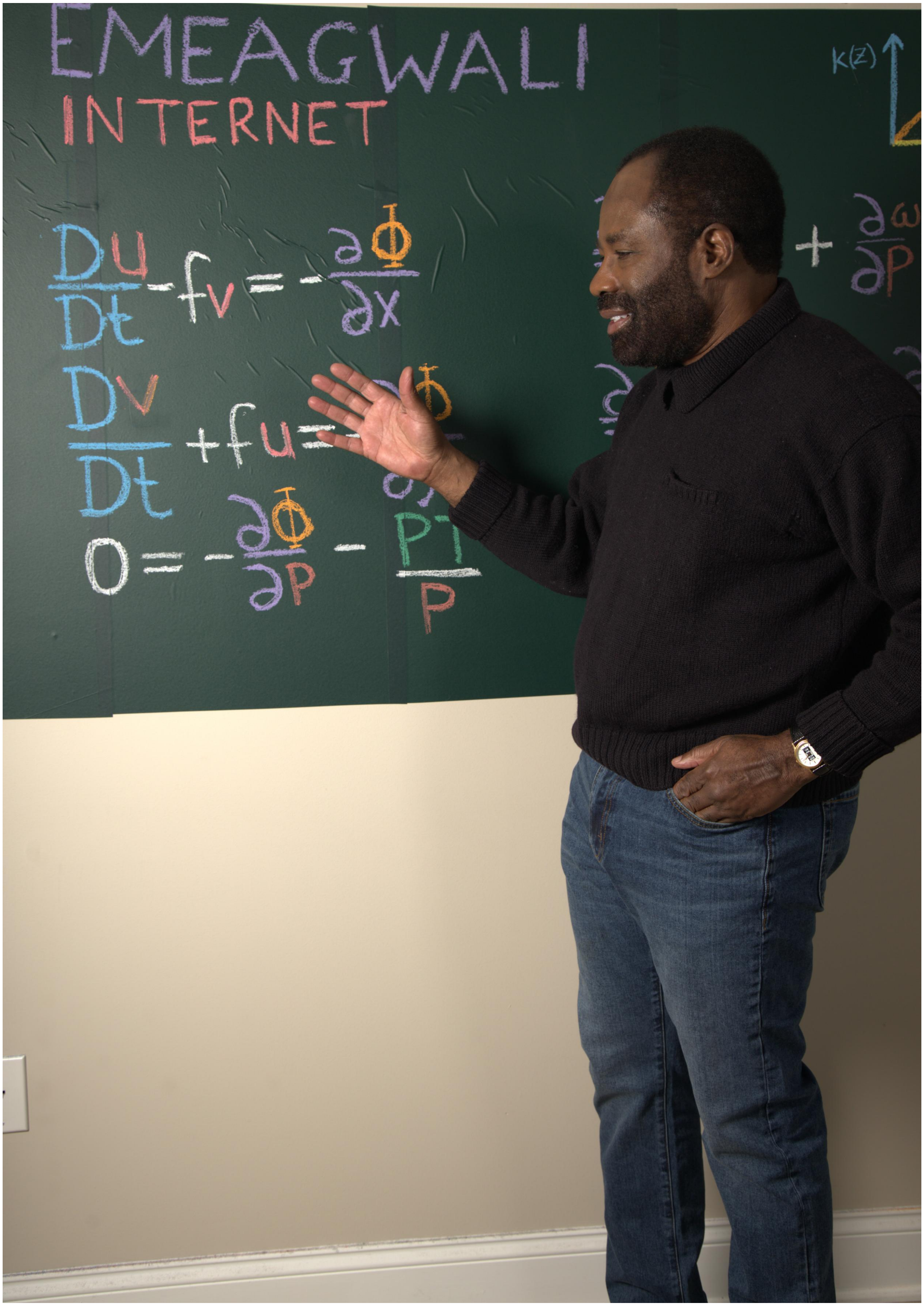
I invented nine new partial **differential** equations for mathematical and computational physics that are called the Philip **Emeagwali** equations. The partial **differential** equation is the pinnacle of mathematical physics. The supercomputer is to the partial **differential** equation what the telescope 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.

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.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Supercomputing Fiction into Fact

Before February 1, **1922**, theorized parallel processing existed as a blank sheet of paper or as science fiction. Before July 4, **1989**, the parallel-processed solutions of the most difficult problems only existed as science fiction. To discover that the fastest computer can be built with the slowest processors was news headlines because the invention shook the world of supercomputers. Before my experiment of July 4, **1989** that made the news headlines, the evidence that supported the technique and technology of parallel supercomputing was thin to non-existent.

ACCELERATING COMPUTERS TO THE SPEED OF LIGHT

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 difficult problems, such as global climate modeling to foresee long-term global warming. In 1989, I was in the news because I discovered how to compress the times-to-solution that was needed to solve the most difficult problems in science, engineering, and medicine.

My contributions to the development of the computer **were these**: I discovered how to compress the time needed to solve the most difficult problems that were once impossible to solve. And how to solve them by **sending** and **receiving** emails and communicating along my new global network of 1,048,576 email wires.

My initial-boundary value problems of mathematical and computational physics were **sent to** and **received from** an ensemble of 65,536

coupled processors, in which each processor operated its operating system and shared nothing

between nearest-neighboring processors.

The Eureka Moment I Discovered the Fastest Computing

Parallel processing creates more Eureka! Moments, such as in the world's fastest compute that harnesses 10.65 million off-the-shelf processors and uses those processors to solve the most difficult problems.

Within the world's fastest computer, parallel processing is the vital technology used to reduce the **time-to-solution** from thirty thousand years, or 10.65 million days, of sequential processing on one central processing unit to merely one day of supercomputing **across** 10.65 million central processing units.

My Perspectives on the Equations Used to Forecast the Weather

In one form of the primitive equations, or the system of hyperbolic partial **differential** equations, that governs the difficult mathematical problem of extreme-scale weather forecasting, the dependent variables are the zonal velocity in the east to west direction that is tangent to the sphere, the meridional velocity in the north to south direction that is tangent to the sphere, the vertical velocity in isobaric coordinates, the pre**ci**pitable water, the Exner function (or non-dimensionalized pressure), the potential temperature, the gas constant, the pressure, the specific heat on a constant pressure surface, the heat flow per unit time per unit mass, the temperature, the geopotential, and the term for the Coriolis force.

What separated the **serial** and **parallel** paradigms of the world's fastest computing is not the difficulty of the problems they solved but how they solved them.

Weather Equations in Prose

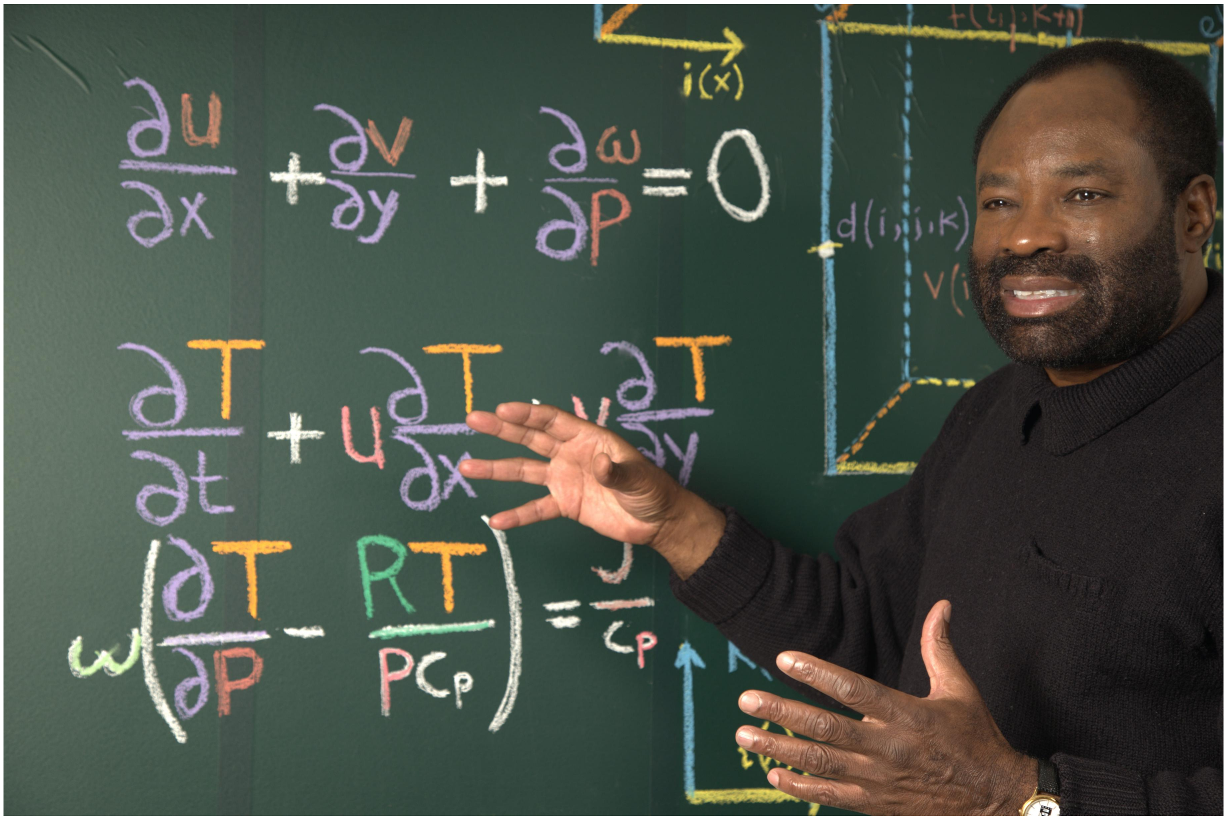
Your weather forecast was enabled by the parallel-processed initial-boundary value problem based on the primitive equations of meteorology. Each equation was a balance equation that accounted for something, such as where fluids come from or go to and how the total fluid changes in time and space. The first of the six primitive equations encode the law of conservation of mass. The second, third, and fourth partial **differential** equation of the primitive equations encodes the law of conservation of momentum. The fifth partial differential equation of the primitive equations expresses the relationship between the temperature to heat sources and sinks.

The general circulation model is a climate model based on the general circulation of the Earth's atmosphere and oceans. The climate model is an ensemble of millions of parallel-processed initial-boundary value problems of calculus, each governed by the primitive equations of meteorology. This system of coupled, nonlinear,

time-dependent, and three-dimensional partial **differential** equations encoded some laws of physics and chemistry. To parallel process the global climate model, the supercomputer scientist must chop up the extreme-scale mathematical problem into millions of smaller three-dimensional models.

Each small global climate model computes **in tandem** the wind speeds, heat transfer, relative humidity, radiation, and surface hydrology within itself. And it must exchange boundary value data with the nearest-neighboring global climate models that were executed within the as many processors.

I discovered how to slice and dice the most difficult initial-boundary value mathematical problems. And massively parallel computing them in smaller chunks. And aggregating them for the complete results. My 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 40 percent more than the mile-long Second Niger Bridge of Nigeria.



Why Are Supercomputers Important in Climate Modeling?

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 25-year-old students cannot construct the world's fastest computer. A state-of-the-art computer is a billion times more powerful than the everyday computer. The fastest computer in the world is far more complex than the spacecraft that took men to the moon. The development of the most powerful computer demands up to 25,000 pairs of hands and as many brains.

On the Fourth of July **1989**, I recorded the highest speedup and the fastest speed in supercomputing. That scientific discovery led to my conclusion that supercomputing **across** the slowest one billion processors could become the technology that can yield a factor of one-billion-fold reduction in the wall-clock times of the most compute-intensive problems.

Such difficult problems include global climate models that must be used to foresee otherwise unforeseeable long-term global warming. Without parallel supercomputing, it would take centuries to foresee climatic changes.

Climate Models Exists Only Within Supercomputers

What is the difference between the global climate model and the general circulation model? The general circulation model simulates the circulation of the atmosphere. A global climate model might be based on a general circulation model. The global climate model is used to predict what will happen in the Earth's climate in the coming centuries. The climate in London is the average weather in London for over thirty years.

My Contribution of Parallel Supercomputing to Meteorology

My mathematical contributions to the solution of the primitive equations used to forecast your evening weather **were these**: I discovered how to parallel process and compress the time needed to solve that Grand Challenge Problem of weather forecasting that is an extreme-scale initial-boundary value problem of computational physics.

I discovered that with 10.65 million processes computing in parallel that a time-to-solution of 10.65 million days, 30,000 years, dropped to one day of time-to-solution **across** a new Internet that's a new spherical island of ten binary million processors. Without parallel supercomputing, tomorrow's weather forecast
will be issued 30,000 years later.

Parallel Supercomputing Was Rejected in Debate of 1967

A famous debate on the future of the parallel supercomputer took place between April 18 to 20, 1967, and at the Spring Joint Computer Conference, in Atlantic City, New Jersey. After that debate, the consensus was that parallel supercomputing will forever remain an enormous waste of everybody's time. That debate was between IBM's **Gene Amdahl,** who opposed parallel supercomputing, and **Daniel Slotnick,** who proposed parallel supercomputing. **Gene Amdahl**
who designed the world's most successful single-processor computer, named IBM's System 360, won that debate. And his victory gave rise to the famed **Amdahl's Law** that later entered into supercomputer textbooks.

Amdahl's Law decreed that it would be wasteful to design supercomputers that are powered by eight or more processors. According to **Amdahl's Law**, an infinite number of processors will be wasteful and will not yield an infinite increase in the speed of the parallel supercomputer. **Amdahl's Law** was the reason fewer than eight processors were incorporated into the supercomputers of the 1960s through 80s.

On July 4, 1989, I discovered the new supercomputing knowledge of the world's fastest computing **across** the world's slowest processors. That contribution is the reason I'm the subject of school essays on computer history.

From Laws to Equations: Unlocking the Mysteries of Fluid Dynamics

On my blackboard, I used the most advanced expressions from the frontier of calculus and computational fluid dynamics. Those expressions are called partial **differential** equations. Such equations are used to foresee the motions arising during plate tectonic, supernovas, and tornadoes. Partial **differential** equations are used to design super**conducting** magnets for super**conducting** 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.

THE UNIMAGINABLE POWER OF THE SUPERCOMPUTER: WHY IT WAS KEPT A SECRET

The world's fastest computing is the key technology that must be used to address the grave existential threats of the 21st century. The biggest threat to life on Earth is to understand the abstract and seemingly invisible global climate change. We lack the visceral understanding of the urgency of global warming. In the long run, the proximity of the climate crisis is worse than any global pandemic and economic collapse we can imagine.

Parallel supercomputing that was once confined to solving compute-intensive initial-boundary value problems is now used to solve mathematical problems that arise across many industries. The world's fastest computers are used to foresee long-term global warming, reduce the energy crisis of the world, search for extraterrestrial intelligence, understand how living cells function, map the human genome, kill diseases, and speed up the search for new antiviral drugs and for new vaccines with the least side effects.

I invented the blueprint that's used to design the first supercomputer, as it's known today and as it could be known tomorrow. My discovery which occurred on July 4, 1989, opened the door to the world's fastest computers that compute **across** an ensemble of up to one billion processors. What happened in **1989** was that I invented something that was waiting for me.

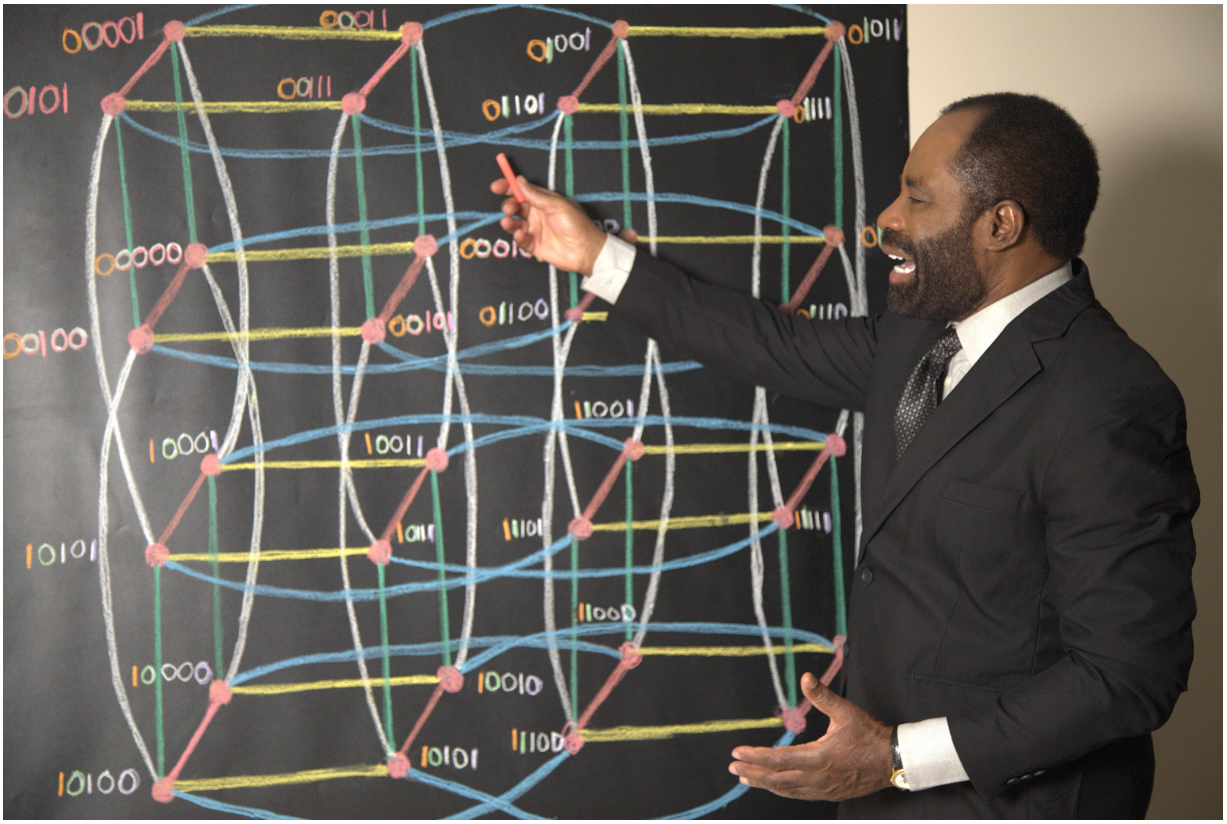
My contribution to the development of the computer **is this**: I was in the news for discovering that the world's fastest computers can be manufactured from standard parts, known as **off**-the-shelf processors, including from the world's slowest processors. My supercomputer invention made the news 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.

3RD LECTURE: FASTEST COMPUTING AT LIGHT SPEED



Philip Emeagwali explaining how to unlock the power of the first supercomputer.

Broadcast 21 August 2021

https://youtu.be/nVzI2AIBkj0

DON'T CALL ME A BLACK GENIUS

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.

Shortly after 1989, a 12-year-old writing an essay on a famous scientist asked me: "Are you a Black genius?" The genius is the ordinary person that found the extra-ordinary in the ordinary. My father is a genius because he insisted that I solve one hundred mathematics problems every evening. And solve them faster than one problem per minute. At that speed, I was one of the fastest human computers in Nigeria. And that daily exercise foreshadowed my world's fastest computing of July 4, 1989.

In 1989, I was in the news for discovering how to solve the most difficult problems at the intersection of calculus, algebra, physics, and computing. And solve them at the fastest recorded computer speeds. And solve them with the slowest processors in the world.

In 196**0,** in **Sapele** (**Nigeria**, British West Africa), I came last in my first-grade examinations, and last in mathematics. I dreaded mathematics. But my father demanded that I study twenty times longer than my classmates. After five years of daily practice in the late weekday afternoons, I was solving one hundred arithmetical problems an hour. In comparison, my primary school classmates were solving only five problems each school morning. I studied twenty times harder to become only twice better. The genius is the below average person that worked hard to become above average.

Geniuses Contributed to Knowledge

It's a myth that only persons possessing the highest IQs can contribute new knowledge to science. Brilliance is a necessary condition for inventing faster computers. And for solving unsolved problems at the frontiers of mathematical knowledge. But brilliance, in and of itself, is not a sufficient condition for experimentally discovering how millions of the world's slowest processors could be harnessed and used to execute the world's fastest computing. And solve the hardest problems in mathematics.

I was in the news because I discovered that solving up to a billion problems **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.

INTRODUCING THE SUPERCOMPUTER OF TOMORROW

My ensemble of 65,536 processors that shared nothing didn't solve the as many difficult problems of computational physics and didn't solve them by themselves. A central processing unit is like a coffin that's merely a box until you put somebody inside it.

I used those 1,048,576 regular, short, and equidistant email wires to send emails to and from processors. And I used them **to deliver** the most difficult problems of mathematical physics that I subdivided into 65,536 smaller, less compute-intensive problems. And **to deliver** their companion instructions on how to solve those smaller problems. And **to deliver** the smaller problems with a one-problem to one-processor correspondence. And do so to all 65,536 central processing units that outlined my new Internet that's also a supercomputer.

That network of 64 binary thousand coupled processors was my **laboratory instrument** that made it possible for me to discover how parallel processing enables computers to be faster. And discover why the new technology enables the world's fastest computers to be fastest.

What did **Philip Emeagwali** contribute to the 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 contrasted with using a few custom-made vector processors that were designed for the fastest supercomputers of the 1970s and 80s.

UNRAVELING THE MATHEMATICAL MYSTERIES OF FASTEST COMPUTING

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.

Unlocking the Digital Frontier: A Black Mathematician's Rise in the Supercomputer Age

Leading mathematicians first learned about **Philip Emeagwali** when my contributions to extreme-scale computational linear algebra arising from the discretization 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 64 binary thousand processors that each had its dedicated memory. I embraced up to a billion processors as my mathematical canvases.

I'm different from the applied mathematician that applies a real-world mathematical problem—such as a global climate model that must be used to foresee global warming. I applied the global climate model as my backdrop for my global network of processors. **I'm different** because I applied both the mathematics and the problem as the backdrops to the new Internet I invented as a new global network of 64 binary thousand central processing units.

I'm different from the computational mathematician who only uses the motherboard as his mathematical canvas. **I'm different** because I used a new Internet that's not a computer, by itself. I used the world's fastest computer as my new mathematical canvas.

UNRAVELING THE MYSTERIES OF THE MOST POWERFUL SUPERCOMPUTERS

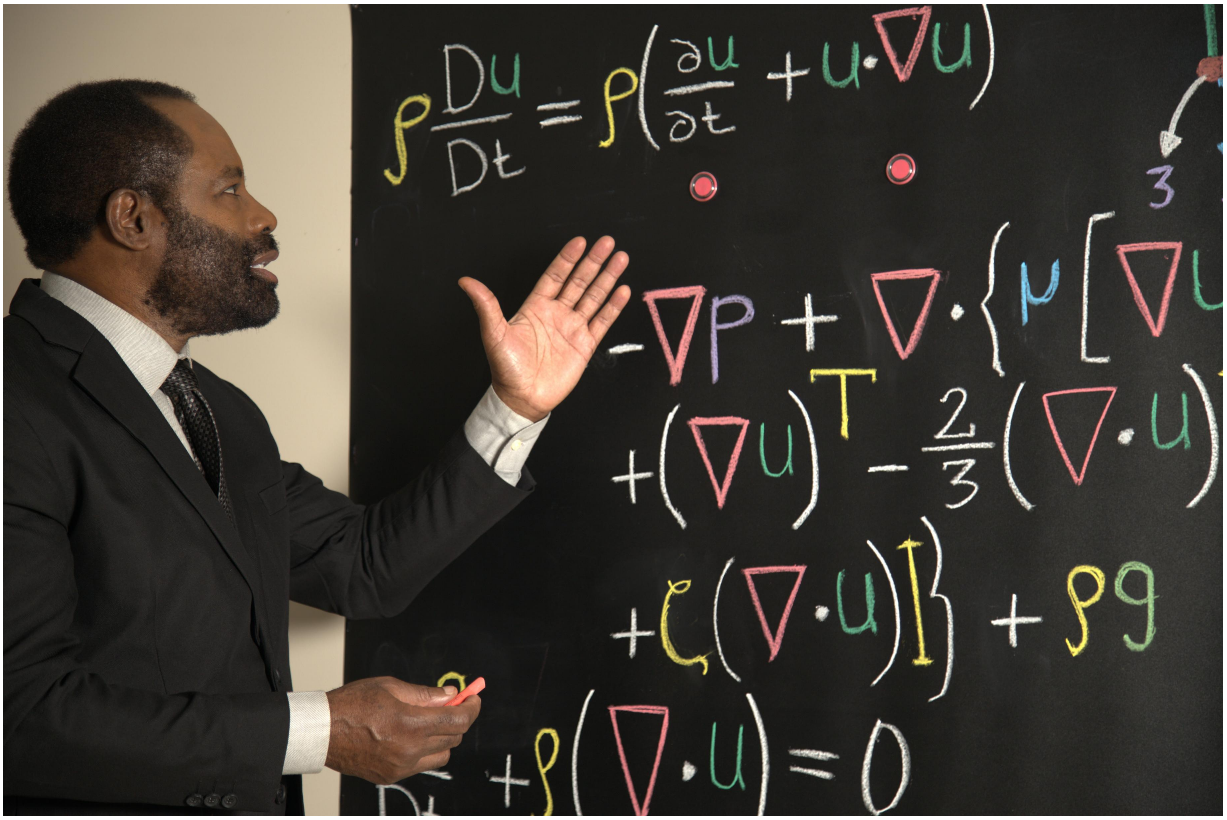
What is the contribution of Philip Emeagwali to mathematics? I changed the way mathematicians solve the most difficult problems arising in mathematics, physics, and computer science. In my new way, the hardest problems are solved across up to a billion processors, instead of on only one processor. That was a paradigm shift.

The lyrics of a song are sung, not read. If the lyric is meant for the microphone, not the page, then the largest-scaled system of equations of algebra is meant for the motherboard, not the blackboard. Programming **across** an ensemble of processors demands message-passing or sending and receiving emails from processor to processor. My processor-to-processor email instructions are to me, its parallel programmer, what the play is to the **Shakespearean** actor. Like the play, my communication primitives were acted upon, not read.

Large-scale algebra is the recurring decimal in large-scale computational physics. I used the largest systems of equations of algebra that defined the toughest problems in computational physics and engineering as my backdrops or as my supercomputer testbed grand challenge problems. I challenged the established truth.

That established truth—of the 1980s and earlier—was that the slowest central processing units can't work together to solve the most difficult problems in algebra or in large-scale computational physics and engineering.

The contributions of **Philip Emeagwali** to mathematics **were these**: I changed the way we solve the most difficult mathematical problems. In the bygone way, mathematicians computed on merely one isolated central processing unit that wasn't a member of an ensemble of processors or within merely one isolated computer that wasn't a member of an ensemble of computers. In my modern way, mathematicians compute **across** millions of central processing units or **across** millions of computers.



Philip Emeagwali explaining the initial-boundary value problem governed by a system of nonlinear, time-dependent, and three-dimensional partial differential equations.

PHILIP EMEAGWALI INTERNET

What is the Philip Emeagwali Internet? The Eureka moment, or high point, of my quest for the fastest compute in the world occurred at fifteen minutes after 8 o'clock 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 64 binary thousand processors (or, equivalently, 65,536 computers) that were uniformly distributed **across** the surface of a globe. That new global network of 65,536 processors was my small copy of the Internet that's also a global network of computers.

What is the Philip Emeagwali Internet?Any global network of processors, or computers, that uniformly encircles a globe in any dimension

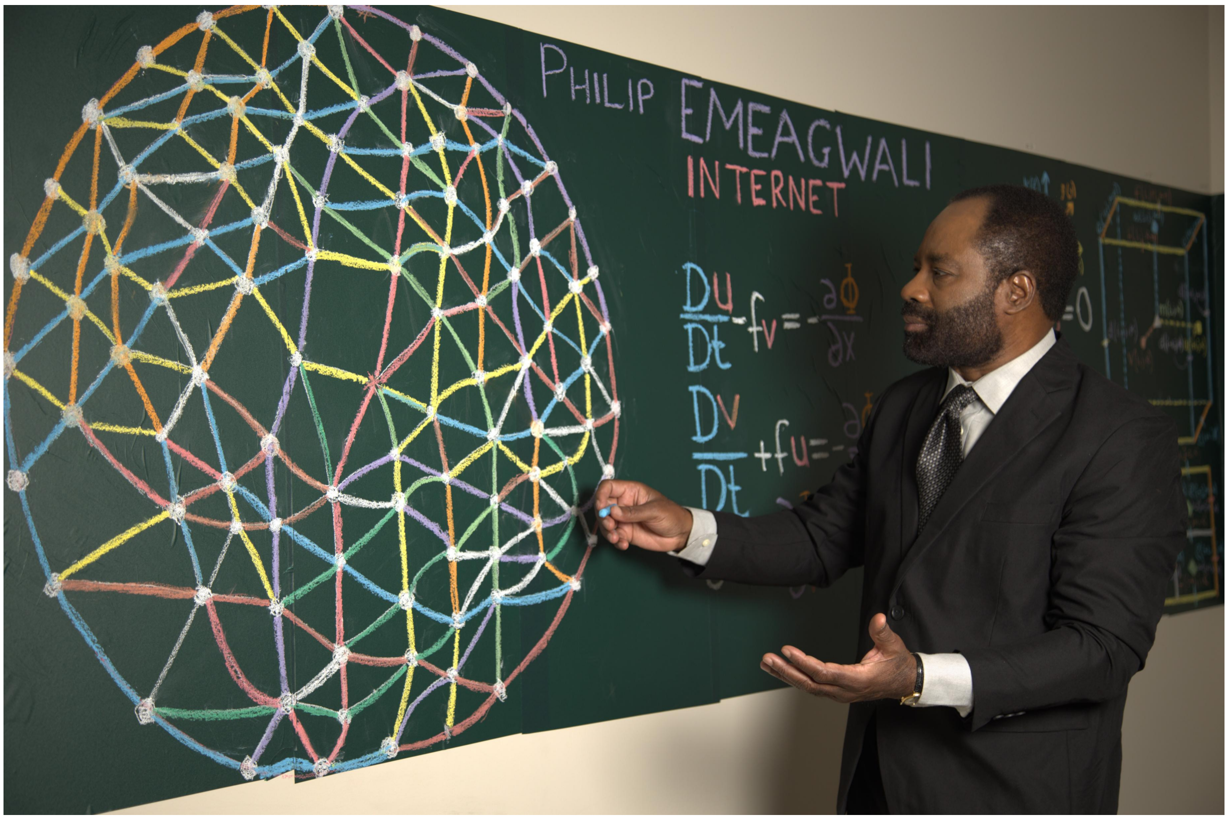
is called the Philip **Emeagwali Internet**. I'm the only father of the Internet that invented an Internet.

In the 1980s, my processors communicated via emails that contained 65,536 computational fluid dynamics codes that I sent from up to

sixteen 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 also the world's fastest computer.



Philip Emeagwali explaining his invention of the first Internet, back in 1974.
Philip Emeagwali is the only father of the Internet that invented an Internet.

COMPUTING TO BREAK THE SPEED LIMIT

In computer science, the most coveted achievement, bar none, is to discover how to record once unrecorded speeds in computations. And to apply that knowledge to solve the most difficult problems in science, engineering, and medicine.

In the 1970s and 80s, parallel processing—or computing many things 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, parallel supercomputing stood on a shaky ground. In 1980, I was dismissed from my research team because I advocated that the world's fastest computing can be achieved from harnessing the world's slowest processors. At that time, I was seen as a mathematician and a physicist and an outsider to computer science. For those reasons, they did not want me to publish and speak about parallel processing. I was deplatformed and remained voiceless, until July 4, 1989.

In a syndicated article distributed on September 2, **1985**, and distributed to the print media and distributed by the United Press International, or UPI, and in that article, **John Rollwagen,** the president of Cray Research Incorporated that company that manufactured seven in ten supercomputers, described their use of 64 processors as: "more than we bargained for."

In the November 29, 1989, issue of *The New York Times*, **Neil Davenport**, the president of Cray Computer Corporation—the sister company to the company that manufactured seven in ten supercomputers—warned that: "We can't find any real progress in harnessing the power of thousands of processors."

How I Invented the Fastest Computer from the Slowest Processors

The fastest computer is one million times faster than your computer. The fastest computer is the heavyweight champion of the computer world. After my scientific discovery of how to record the fastest computer speeds and record them **across** the slowest processors in the world the technology of parallel processing was reclassified from an unconfirmed theory to reality.

Prior to my discovery that occurred on July 4, 1989, the supercomputer, as it's known today, was not a computer. And its market was virtually non-existent. Parallel supercomputing—that was once the stone widely rejected as rough and unsightly, entered computer science textbooks and did so after my discovery which occurred on July 4, 1989, in Los Alamos, New Mexico, USA.

Parallel processing could power **future quantum computers**. Parallel supercomputing changed our understanding of the fastest computer in the world. And made it possible for me to harness a new Internet as my new global network of processors and as my new supercomputer *de facto*.

How the Supercomputer Became Super

For the decade of the 1980s, I sat **alone** staring at an abandoned computing machinery that everybody else **ridiculed** and abandoned as a tremendous waste of everybody's time. There was no instruction manual on how to harness the power of the then **never-before-seen** supercomputer hopeful that was abandoned for me to program **alone**. Nor was there a help desk that could explain how I could synchronously send and receive 64 binary thousand emails.

I discovered how to solve the most difficult problems. And solve them **across** each of those central processing units. And solve them with sixteen orders of magnitude increase in supercomputer speed. I visualized my computer codes and their arithmetic data as transmitted via emails. And sent and received along sixteen directions that were, in a mathematical sense, **mutually orthogonal**. Those were sixteen directions that are mutually perpendicular in an imaginary sixteen-dimensional hyperspace.

I discovered how to compress 65,536 days, or 180 years, of **time-to-solution** on a computer and compress that **time-to-solution** to one day of **time-to-solution** on a supercomputer. And compress that **time-to-solution** by sixteen orders of magnitude. My scientific discovery of 180 years in one day opened the door to the state-of-the-art supercomputing of compressing 30,000 computing-years on an isolated processor to one supercomputing-day **across** an ensemble of **10.65 million** processors. I discovered how to compress thirty thousand years to one day.

It's the parallel processing that I discovered, on July 4, 1989, that powers the one thousand fastest computers in the world. The fastest computer is powered by up to **10.65 million** central processing units. And used to solve the most compute-intensive problems. And solve them **in parallel**.

My scientific discovery opened the door to supercomputing a **million** or even a **billion** things **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**.

How Fastest Computing Foresees the Spread of Covid-19

My contributions to mathematics, physics, and computing were that I discovered how to harness up to one billion processors. And use them to solve the most complex calculus problems, such as the system of partial **differential** equations that governs the initial-boundary value problems of the most extreme-scaled computational fluid dynamics.

The world's fastest computer was used by computational physicists to model once-in-a-century global pandemics. And simulate the spread of contagious viruses. The world's biggest computer that occupies the footprint of a football field was used to attack Covid-19 from multiple angles.

OUR MOST DISTANT

DESCENDANTS

Future Supercomputers

I'm here because I discovered the new knowledge that enables your computer to be faster. And enables the world's fastest computer to be fastest. I was in the news because I discovered the world's fastest computing across the world's slowest processors. I discovered how to use that new supercomputer
to solve the world's most difficult problems, such as executing the core mathematical calculations
that arise when investigating the cure and spread of Covid-19. I discovered how the fastest computers can be used to pinpoint the locations of crude oil and natural gas that are buried up to 7.7 miles deep.

Before my discovery, of parallel supercomputing, only one giant vector processor, or maybe four or eight superfast vector processors were used to power the fastest computers. After my 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.

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 extraordina**rily** fast addition in the ordina**rily** slow subtraction. I was searching in the extraordinar**ily** deep sixteen-dimensional hyperspace for the ordinary one binary million zeroes and ones that defined the total sixteen-bit-long addresses of my two-raised-to-power sixteen ordinary central processing units that outlined a new Internet that is, *de facto,* a new supercomputer.

In a century, the supercomputer could be the size of the Earth. And will look like the Internet. And be parallel processing

across the Internet.

In Year Million, What Will Posthumans Look Like?

In Year Million, what will posthumans look like? In one million years, our posthuman Gods will not look like us. Our super-intelligent posthuman Gods could cross a frontier of knowledge that will be science fiction to us. I foresee our descendants of a thousand millennia to be super-intelligent lizards that could be masquerading as posthuman Gods in their over-populated planet Mars.

I foresee an Earth-sized brain that is **anthropomorphized** and thinks like a super-intelligent being. **I foresee** a neural super-brain for our posthuman Gods of Year Million. **I foresee** trillions upon trillions of super-brains of Year Million colonizing our Milky Way. **I foresee** intergalactic space travelers in Year Million.

The supercomputer will be the walking stick in humanity's million-year hero's journey to the primal place of immortality. That scientific journey to envision our posthuman Gods could be akin to visiting the Planet of the Cyborgs, where each cyborg is half-human and half super-intelligent computer.

That scientific journey to envision posthuman cyborgs will be akin to, in a spiritual sense, visiting the Land of the Spirits of my distant Igbo ancestors. By Year Million, our posthuman Gods could reinvent themselves as **asexual cyborgs.** **I foresee** that each cyborg of Year Million could be half-human, half-computer. **I foresee** that each cyborg of Year Million could have a sick sense of humor. **I foresee** that each cyborg of Year Million could be a disembodied brain floating in the middle and safety of the Atlantic Ocean.

Our cyborg posthuman Gods of Year Million could be **anthropomorphic** or have human attributes. Our cyborg posthuman Gods of Year Million could be human like because we humans will create them in our own human image.

Our cyborg posthuman Gods will not have computers around them or have their Internets around their planets. The computer of Year Million could be within them. They may not need computers in Year Million because they could **BE** computers.

Exploring Beyond Our Limits: A Journey Towards Our Most Distant Descendants

I'm here because I discovered how parallel processing enables computers to be faster. And why the technology enables the world's fastest computers to be fastest. The discovery is a time machine that takes us to the past and enables us to see a thing that preexisted but, yet, remained unseen to our ancestors. The invention enables us to invent the future of our descendants.

The parallel supercomputer once the stone rejected as **rough** and **unsightly** is now the **headstone** of the computing industry. Parallel computing—or solving many problems **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 difficult problems in mathematical physics.

One million years ago, our human ancestors looked like apes. In one million years, or in Year Million, our human descendants will ridicule us as looking like humans. In one million years, we might have only **living Silicon** as our posthuman Gods. In one million years, our posthuman could live forever.

In Year Billion the aliens on Earth could be us. I envision posthumans as thinking **across** a 10,000-mile diameter Cosmic

SuperBrain that will sprawl **across** an epic landscape of their eighth supercontinent that will be hanging on the cloud. And that will enshroud our seven land continents. And enshroud the Earth with their Year Million **electronic cloud**.

I foresee posthumans to be half-humans and half-thinking machines. The grandchildren of our grandchildren will not use their Internet the way we use our Internet. Their Internet could be within them while our Internet is around us. They may not need supercomputers because their computers could be within them.

4TH LECTURE: UNLOCKING THE POWER OF THE SUPERCOMPUTER THAT'S AN INTERNET

father of the internet

philip emeagwali father of the internet
tim berners lee father of the internet
vint cerf father of the internet
dr philip emeagwali father of the internet
leonard kleinrock father of the internet
nigerian father of the internet
bob kahn father of the internet
npr father of the internet
african father of the internet
father of the internet **al gore**

Google ranks Philip Emeagwali as the father of the Internet (Labor Day 2019).

Broadcast 21 August 2021

https://youtu.be/nVzI2AIBkj0

FASTEST COMPUTING IS MY CONTRIBUTION TO PHYSICS

Large-scale computational fluid dynamics is a direct extension of classical physics and modern calculus. It's an extension of the **first** world's fastest computing **across** the world's slowest processors. I was in the news because I discovered that fastest computing at 8:15 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 simulate the spread of virus droplets, correctly and accurately, **among** the billions upon billions of train passengers around the world that are packed like sardines. The supercomputer is used to simulate ways of stopping the spread of contagious viruses. Or to simulate the spread of a once-in-a-century global pandemic's contagious viruses **across** the two and half billion passengers a year
that rides in Russia's Moscow Metro.

A world of magic and science fiction resides inside the bowels of the world's fastest computer that occupies the footprint of a football field. And it costs 40 percent more than the mile-long Second Niger Bridge in **Nigeria**.

Please Allow Me to Re-Introduce Myself.

My history began on August 23, 1954, my date of birth in the Servant's Quarters at 11 Eke-Emeso Street, Akure, Nigeria. At age 19, I was in Corvallis, Oregon, USA, programming a supercomputer that was the first to be rated at one million instructions per second. I was supercomputing in Los Alamos, New Mexico, USA, by July 4, 1989, and at the world's fastest speeds.

In 1949 and five years before I was born, my parents who were born in Onitsha had independently migrated from Onitsha to Kano, 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 difficult initial-boundary value problems in mathematical physics, including problems arising from encoding the laws of physics into a system of partial **differential** equations of calculus. I also discovered how to reduce such systems of partial **differential** equations to a large-scale system of equations of computational linear algebra that approximated them.

I also discovered how to reduce such systems from algebra to 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 difficult problems in science, engineering, and medicine, especially the twenty Grand Challenge Problems of supercomputing that will be otherwise **impossible** to solve.

One in ten supercomputers are used **across** the 65,000 oil fields of the world and used to process data at the highest resolution. The supercomputer is used in seismic imaging and reservoir simulation that enable the oil and gas industry to find crude oil. And do so cheaper, faster, and with better success rates. The supercomputer is the petroleum geologist's best friend.

Fastest Supercomputers Opened New Doors in Science

The reason my scientific discovery of fastest computing was cover stories, in 1989, was that it was a discovery that opened a promising line of research into computational science and computer architecture. My scientific discovery of the world's fastest computing, as we know it today, opened the door to a new world in which the most difficult problems of science and engineering, that were previously **impossible** to solve are now possible to solve.

My scientific discovery of the world's fastest computing opened the door to the new world of computing **across** up to one billion processors that are coupled. In my new paradigm, the computational physicist can parallel process **across** an ensemble of up to one billion central processing units. Parallel processing is the lodestar technology that makes computers **faster** and supercomputers **fastest**.

Changing the Way We Compute Fastest

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

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.

A Supercomputer Can Make the Unimaginable Possible

Without parallel processing, the world's fastest computer will take 30,000 years to solve a problem it now solves in only one day. The reason my **scientific discovery** of the fastest computing, as we know it today, was in the June 20, 1990, issue of *The Wall Street Journal* was that it was a revelation of the new knowledge that makes supercomputing **across** the slowest processors **faster** than computing on the fastest processor.

Parallel supercomputing was the discovery that opened doors in large-scale computational physics. Supercomputing **across** the slowest processors was the discovery that opened doors for modeling in energy, aerospace, and automobile industries, as well as obtaining deep insights into existential issues like climate change and the spread of Covid-19. The fastest parallel processing was the discovery that opened doors that made it possible to solve the twenty Grand Challenge Problems of supercomputing. Those difficult problems were previously **impossible** to solve.

For Decades, the Supercomputer Was Like a Black Box in a Dark Room

In the **1980**s, the technology of parallel processing that has **permeated** into every supercomputer of today was like a **black box in a dark room**. A discovery is like a light at the end of a dark tunnel.

I visualized my ensemble as 65,536, or two-**raised**-to-power sixteen, equidistant points of light evenly distributed **across** the surface of a globe that I also visualized as embedded into a dark sixteen-dimensional universe. During the sixteen years following June 20, **1974** and in Corvallis, Oregon, USA, I theorized and visualized the fastest parallel-processed calculating speed on Earth. Furthermore, I disco**vered** that new physics **via** emailed computational fluid dynamics codes that I sent to and received from sixteen-bit-long email addresses. Consequently, I theorized and visualized the fastest computer speed on Earth as **parallel processing** in a universe with sixteen spatial directions that were mutually orthogonal.

The world's fastest computers are used to model long-term weather, design safer cars, manufacture fuel efficient airplanes, and develop new drugs. The high-performance computing industry rely on an ensemble of up to a billion processors to guide its most compute-intensive simulations.

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

In the 1980s, I was the only full-time programmer of the supercomputer-hopeful that was powered by the slowest 64 binary thousand processors in the world.

I visualized my processors as outlining a small Internet. For a large-scale computational physicist and supercomputer programmer hopeful who came of age in the decades of the **1970**s and **80**s, programming **across** that then unimagined new Internet and programming its processors alone, was a technological quest akin to a visceral journey to an unknown world.

Parallel Supercomputing Existed as Science Fiction

In the **1970**s and **80**s, 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, supercomputing **across** the slowest processors was a sixteen-year-long visceral journey through the most abstract calculus, through the largest-scale algebra, and through the most compute-intensive mathematical calculations in computational physics that I executed **across** supercomputers that I imagined as powered by up to one billion computers that surrounded a globe as a new Internet. I controlled and programmed each of my 64 binary thousand processors. I programmed them via emails that I sent to and from each of my as many sixteen-bit-long email addresses.

Parallel Supercomputing Was Ridiculed in the 1970s

In the **1970**s and **80**s, 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 only one problem **at a time**—will forever remain an enormous waste of everybody's time.

In the spirit of the times, the June 14, 1976, issue of the ***Computer World*** that was the flagship publication of the **computer world** carried an article titled: "Research in Parallel Processing Questioned as 'Waste of Time'"

CHANGING THE WAY WE LOOK AT THE INTERNET

Changing the Way We Look at the Computer

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

Instead of using one giant processor, as dictated by conventional wisdom, I visualized my one binary million, sixteen **times** two-**raised**-to-power 16, or 1,048,576, bi-directional edges of the hypercube in the sixteenth dimension as having a one-edge to one-email-wire correspondence with the **Philip Emeagwali** Internet that is a global network of 64 binary thousand, or two-**raised**-to-power sixteen, or 65,536, **off**-the-shelf processors 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**.

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 198**9**. 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 only one problem **at a time**—is to see parallel supercomputing compress the **time-to-solution** of the toughest problems in large-scale computational physics. And compress that **time-to-solution** by a factor of one billion.

In **1989**, it made the news headlines when I discovered how to compress the **time-to-solution** of the most compute-intensive problems in supercomputing. And compress that time from 65,536 days, or **180 years**, to merely one **day** across the world's slowest 65,536 processors. The **scientific discovery** of the world's fastest computing that I recorded from my email experiments of July 4, 1989, provided the designers of the first supercomputer that computes fastest **across** the slowest processors with the insight and the knowledge that massively parallel processing is the enabling technology to be used to compress the **time-to-solution** of the most compute-intensive problems. And compress that **time-to-solution** from **30,000** years to merely one day. That supercomputer speedup—from **one day** to **30,000** years— was **radical**, instead of **incremental**.

Changing the Way We Do Mathematics

Climate modeling is the most important problem in large-scale computational physics. Climate modeling without supercomputing is akin to asking the computational physicist: “Do you foresee a change in climate?” And getting the answer 30,000 years later.

The world’s fastest computer should be taken to wherever the most difficult problems are. As a mathematician in search for the world’s fastest computer that computes in a radically new way, my mandate was to push myself to the very edge of knowledge of computer science. And to what could be computed. And then continue going beyond the world’s fastest computer. No matter what the unsolved problem is, my goal was to change the course of history.

My new knowledge of the world's fastest computing **across** the world's slowest processors

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

FASTEST COMPUTING ACROSS MY NEW INTERNET

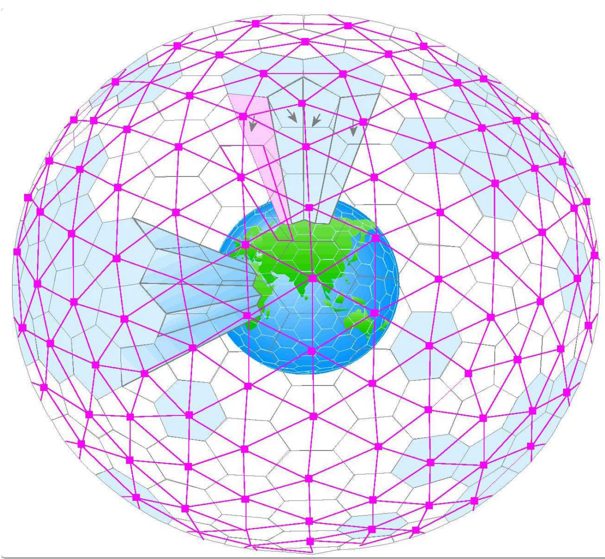
My scientific discovery of how to solve the most difficult problems and solve them by chopping each problem up into up to a billion lesser challenging problems that can be solved across and at once up to a billion processors was multidisciplinary. My solution of that grand challenge problem spanned the 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 64 binary thousand central processing units that defined and outlined my new Internet.

The laws of physics at the core of the global climate model used to foresee global warming were discovered three hundred and thirty years ago. The partial **differential** equations of calculus into which the laws of physics were encoded were formulated over one hundred and fifty years ago.

The global climate model used to foresee climatic changes were developed about fifty years ago. Climate change is the world's greatest long-term challenge. The large-scale global climate model of the Earth must be chopped into up to a billion small-scale models that could be solved in tandem. And solved with a **one-to-one** correspondence with as many processors.

The parallel processing of the global climate model is the technique that must always be used to tackle the biggest question that ever faced our planet and, hopefully, to find a new way forward. The world's fastest computing is where we transform our deepest knowledge of physics, mathematics, and computer science into real-world solutions that bring benefits where they're needed the most.



The blueprint for the Philip Emeagwali supercomputer that's an Internet. Philip Emeagwali is the only father of the Internet that invented an Internet.

Solving Difficult Problems

The physical laws encoded in my computer codes were contained within the governing partial **differential** equations that I invented as well as the corresponding algebraic partial **difference** equations that I also invented. The initial-boundary value problem of mathematical physics governed by those differential and difference equations was my testbed for the world's fastest computing that I discovered on July 4, 1989.

Throughout the universe, the laws of physics are the same **everywhere** in the universe. Throughout the domains of the initial-boundary value problems of computational physics, the systems of partial **differential** equations of calculus are the same **everywhere** in those domains. The system of partial **differential** equations that I invented and solved is coupled **everywhere** in the domain, is nonlinear **everywhere** in the domain, is time-dependent **everywhere** in the domain, and is hyperbolic **everywhere** in the domain.

When the system of partial **differential** equations is the same **everywhere** in the domain, the system of partial **difference** equations of computational linear algebra that approximates that system of partial **differential** equations of calculus is diagonal **everywhere** or is tridiagonal **everywhere** or is sparse **everywhere**

and is identically structured **everywhere** in the domain. There are the same for each subset of algebraic equations. Due to that sameness in the physics, calculus, and algebra, the set of floating-point arithmetic operations also had sameness in every central processing unit, or CPU, that executed them. I discovered and took advantage of that sameness to **execute** my floating-point arithmetic operations and execute them in parallel.

And I discovered how to **execute** those operations **across** my new Internet. Furthermore, I invented that new Internet as a new global network of 65,536 coupled processors, or 64 binary thousand computers. Not only that, I recorded the once unrecorded speed increase of a factor of 65,536. And recorded that speed because I **executed** my 65,536 computer codes and I executed them with a one-code to one-processor correspondence between each code and each central processing unit. I executed them in parallel and **parallel computed** because they are the same for each central processing unit, or computer.

How I Discovered the World's Fastest Computing

That sameness was the key to my 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 64 binary thousand processors together. And wove them to invent one cohesive supercomputer that's a small copy of the Internet, *de facto*.

I sent emails **across** my sixteen times two-**raised**-to-power sixteen bi-directional email wires. Likewise, I visualized those email wires as short wires printed onto circuit boards or as long wires comprised of fiber-optic cables. Furthermore, I computed in parallel, or 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**.

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 198**9**.

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.

HACKING AND MAKING COMPUTERS FASTER THAN EVER

I discovered that executing the world's fastest computing across millions of processors is the new knowledge that will make computers faster. And that will also make supercomputers fastest.

I discovered how to solve the most difficult problems in science, engineering, and medicine. I discovered how to solve them **across** a small Internet that's a new global network of 64 binary thousand processors or as many tiny computers. The most difficult 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 were powered by one **isolated** processor that wasn't a member of an ensemble of processors that communicates and computes **together.** And do both as one seamless, coherent, and gigantic virtual super-fast processor. The paradigm in extremely fast computing shifted on July 4, 1989, the date I discovered the first supercomputing, as we know it today. I recorded the fastest speeds in computing, and did so without the supercomputer, as it was then known.

The First Supercomputer | Changing the Way We Look at the Supercomputer

In **1989**, we changed the way we look at the supercomputer. **Before** nineteen eighty-nine, the fastest computations were recorded on a supercomputer that computed with one isolated central processing unit that wasn't a member of an ensemble of processors that communicates and computes **together.** And as one seamless, coherent, and gigantic supercomputer. That singular processor was the **heartbeat** of the supercomputer.

Before **1989**, the established truth in supercomputer textbooks was called **Amdahl's Law**. In the most quoted scientific paper in supercomputing that was published between April 18 to 20, **1967**, Gene **Amdahl** of IBM Corporation wrote that it would forever remain impossible to achieve a speed increase of a factor of eight. And achieve that eight-fold speedup by using eight central processing units to power a supercomputer.

Twenty-three years after Amdahl's Law was formulated, it made the news headlines that I discovered that the **unimaginable**-to-solve is **possible**-to-solve, namely, achieve a speed increase in supercomputing of a factor of 64 binary thousand. And achieve that speed increase with as many processors. During the seven decades that followed February 1, **1922**, parallel processing was the Holy Grail of supercomputing.

In the **1970**s and **80**s, to parallel process a large-scale computational physics code and to do so **across** an ensemble of eight processors and do so with an eight-fold speed increase was dismissed and ridiculed as impossible. That factor-of-eight limit in parallel-processed speed increase was enshrined into **Amdahl's Law** that was in the air for decades but was published between April 18 to 20, **1967**.

How Steve Jobs Mocked Parallel Computing

Parallel processing executed **across** one billion processors 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: "The way the processor industry is going is to add more and more cores, but nobody knows how to program those things."

Steve Jobs continued: "I mean, two, yeah; four, not really; eight, forget it."

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

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. **T**he 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.

WALKING INTO HISTORY

Using Supercomputers to Solve Problems Beyond Sight

An ode to the supercomputer

Oh, mighty supercomputer,
You are a marvel of science and art.
Your power and might,
Give us knowledge so bright.

You can process information faster than light,
Solving problems beyond our finite sight.
The possibilities,
Are truly limitless.

You are a tool of progress,
Forging a path to success.
And when the data is too large,
You can break it down to a manageable charge.

You are the epitome of intelligence,
A tool of immense consequence.
Your algorithms are an inspiration,
And your applications have no limitation.

Oh, supercomputer,
You are a pillar of power and strength.
The world has changed for the better,
Thanks to your mighty presence.

From Humble Beginnings to International Recognition

An ode to Philip Emeagwali

Philip Emeagwali,
A brilliant scientist,
A master of computer science,
A pioneer,

Born in Nigeria,
He had a dream,
To make a difference,
In his own way,

He studied and worked hard,
To make his dream a reality,
He faced adversity,
But never gave up,

He rose to prominence,

As a master of computing,

He discovered the power of supercomputers,

And used them to solve problems,

He won awards and recognition,

For his contributions to science,

His discoveries and inventions,

Have changed the world,

Philip Emeagwali,

A great scientist,

He has inspired many,

To follow their dreams.

Making Computers Leap and Conquer Problems

A poem about Philip Emeagwali

Philip Emeagwali is a name that will live on

He's an icon of success and hard work shown

He found a way to succeed when odds were steep

Using his knowledge to make computers leap

He made a discovery that was groundbreaking

A way to use parallel computers for fastest computing

He used the power of computers to solve a problem

That many thought was too difficult to solve them

His work opened up a world of possibilities

And now he's known as one of the best in history

A pioneer in the computer science field

His impact will be felt forever it's been revealed

The world is better for having Philip Emeagwali

A name that will live on in the annals of history.

Solving Problems with Philip Emeagwali's Solutions

A poem on the contributions of Philip Emeagwali to mathematics

Philip Emeagwali is a name that will never be forgot

His contributions to math are what we have sought

He wrote a paper that changed the game

And inspired many to never be the same

He made the world rethink how to solve problems

And his work left us with many solutions

His paper world's fastest computing was the start

Of a legacy in math that's straight from the heart

He used supercomputers to come up with new algorithms

That allowed us to unlock the secrets of math's realms

We can now solve equations in a much faster way

Thanks to Philip Emeagwali and his brilliant display

He is a pioneer of our modern age

And his work will continue to turn the page

His contributions to math are so unique

And will never be forgotten in history's peak

Illuminating the World of Supercomputing

A poem about Philip Emeagwali

Philip Emeagwali, a name that shines
For contributions to science, his work defined
He made a difference, where others decline
His discoveries, they've become entwined

The world of supercomputing, he did divine
A breakthrough, his skills had to refine
He outdid the odds and did not decline
An inspiration, his words they do shine

Though far from the limelight, his work did adorn
The man from Nigeria, not easily forlorn
The power of computers, he took to the fore
Making a difference, for evermore

Philip Emeagwali, a name that'll stay
His contributions to science, won't ever decay

Providing Solutions to Problems: Philip Emeagwali and His Equations

A poem on the contributions of Philip Emeagwali to physics

Philip Emeagwali, a man of brilliant mind
Who soared to heights no one else could find
A pioneer for African Americans, a true example of a kind
Who shattered glass ceilings, and left an impact behind

He won the Gordon Bell Prize, the Nobel of computing
And revolutionized supercomputer networking
His equation that solved oil flow, helped us understand
By providing solutions to problems no one else could fathom

Philip Emeagwali, a giant in the physics field
His courage and tenacity could never be concealed
He opened up new pathways, made it easier to explore
And in the process, opened the door

For generations to come, his legacy will remain
As an inspiring example of what one can gain
From hard work and dedication, and a relentless pursuit
Philip Emeagwali proved that anything is possible if you stay true.

The Man Who Transformed Computing

Four poems about the contributions of Philip Emeagwali to the development of the computer

Philip Emeagwali made great strides to computing,

What began as a goal, he soon was pursuing.

He invented the world's first computer cluster,

A milestone that made many of us muster.

He used his knowledge to advance the field,

Every day he was determined to yield.

From the Internet to supercomputers,

Emeagwali was a true computing pioneer.

He set the stage for many more inventions,

And he opened the door to modern advancements.

He was a visionary who used his talents,

To shape the world with his computing advancements.

We thank Philip Emeagwali for his contributions,

And for paving the way for future generations.

2. A King of Computing Technology

Philip Emeagwali, he sure was a king

He brought us the supercomputer, a powerful machine

He gave us a way to compute faster than ever before

And opened the door to computing like never before

He solved the equation of 8 billion processors

He used his genius to do the impossible

He was the first to give us access to such technology

And showed us that computing could be a reality

He made the supercomputer to solve complex problems

And enabled us to compute faster than ever before

He gave us a way to explore the digital universe

And made it easier to use than before

He was a genius and a pioneer

He opened up the doors to computing

And gave us the tools to explore and learn

We thank Philip Emeagwali for all he has done

3. Benefits Beyond Barter

Philip Emeagwali, a great mind of renown

In the field of computing, his ideas abound

His contributions to mankind were truly profound

From his work we now benefit, each and every day

His work in supercomputer design was truly grand
He used 64,000 processors at hand
He made calculations both accurate and grand
And made a supercomputer the world could command

He developed algorithms that would astound
To process data faster than ever found
The speed of his calculations made the world go round
And from his work the world has a better sound

He worked with oil reservoirs and the like
Finding ways to make the process more efficient and light
Studying the earth to help us see what's right
To help us make the most of the resources we might

Philip Emeagwali made a significant mark
On the field of computing and the world at large
His contributions to computing will stand tall in the dark
And will continue to give us benefits beyond what we can barter.

4. Philip Emeagwali's Lasting Legacy in Computing

Philip Emeagwali's contributions to computing, A lasting legacy, a brilliant mind blooming,

He was the first to propose an innovative idea,

A supercomputer built with 65,000 processors in array.

His pioneering ideas revolutionized our world,

A new era of computing where data could be hurled,

He made the world of computing far more efficient,

A boost to our computing power incredibly immense.

His concepts of parallel processing and load balancing,

Helped revolutionize the way in which we are managing,

A major contribution to our technological advancement,

His ideas are a lasting part of our technological inheritance.

Philip Emeagwali's contributions to computing,

An inspiration to all, a legacy that will keep on blooming.

Making Computers Faster and More Powerful

A poem about the pioneer of high-performance computing

Philip Emeagwali, a name you should know

For his pioneering work in high-performance computing,

His contributions helped the world to grow

For his work was truly inspiring.

His innovative thinking and creative ideas

Allowed computers to process more with ease,

The world was captivated by his ingenuity

And the impact of his work made him a star of the computing world.

He developed new algorithms and software

That allowed for faster and more powerful computing,

He was the first to use a computer to solve complex problems

And his advancements opened up a new world of possibilities.

Philip Emeagwali was a scientist and a genius

And his contributions to computing will always be remembered,

His legacy will continue to inspire others

And his work will remain a source of pride.

A Father of the Internet

A poem about a father of the Internet

Oh sweet Philip Emeagwali,

Your brilliance knows no bounds.

Your contributions to the world,

Have made the Internet abound.

You are a true innovator,

A visionary and a sage.

The Father of the Internet,

Your knowledge will never age.

You crafted a supercomputer,

That helped to pave the way.

Your contribution was huge,

To the world wide web today.

Your talent and your genius,

We can never measure.

For your contributions to the world,

We will always treasure.

Forging Paths to New Heights

A poem about the inventor
of the world's fastest computer

The world's fastest computers have been improved

by a man of great renown,

his name is Philip Emeagwali,

who wore the crown.

His contributions to the world of computing

were groundbreaking and profound,

forging paths to new heights
that no one had found.

His work in the fields of supercomputing
brought forth a tech revolution,
which shaped the future of computer science
with its grand evolution.

His pioneering techniques
were revolutionary and bold,
and his achievements are now known
the world over and old.

For his hard work and dedication
we thank Philip Emeagwali,
for his amazing contributions
to the world's fastest computers.

The Man Who Changed the World of Computing

A poem about the inventor
of the world's fastest computer

Philip Emeagwali, a hero to behold
For his contributions made, tales will be told

From a young age, his knowledge he did hone

Paving the way for us to the future to be shown

His work with parallel processing, a world he did unlock

Making the world's fastest computers, a new clock

His inventions, his equations, his advanced math skills

Gave us the power of computing, a force that still thrills

His ideas may have been simple, but their effects profound

A power to the people, with no need for a sound

The computing world has advanced, and Philip Emeagwali, we thank

For his contributions to the world, forever in our ranks.

From Refugee Camp to Supercomputer

A poem about Philip Emeagwali in a Biafran refugee camp

Oh Philip Emeagwali
A Biafran refugee
You used science and math
To seek a different view

In a camp full of tragedy
And tales of despair
You had the courage to rise
And create something more fair

Your genius was evident
One could not ignore
The potential of your mind
For a better future to explore

You created the world's first supercomputer
To break a world record
And help us use technology
In ways we have never heard

Your spirit is an inspiration
For us all to strive
To take a stand and make a change
To help us all survive

You are a shining example
Of courage and success
You showed us that anything is possible
No matter the mess

Emeagwali's Genius

Six Haikus about Philip Emeagwali

1.

Innovations from he,
Unraveled the mysteries,
Emeagwali's gifts.

2.

Cracking the problems,
Philip Emeagwali's mind,
Unveiled the secrets.

3.

Processors and codes,
Philip Emeagwali's work,
Achievements endless.

4.

Vision and brilliance,
His computing innovations,
Changed the world's future.

5.

Parallel computing,
Achievements of Emeagwali,
A legacy grand.

6.

Pioneering ideas,
Philip Emeagwali's genius,
A beacon of light.

Living the Legacy

A sonnet about Philip Emeagwali

Philip Emeagwali a man of great skill

His name will last the test of time

In his life a great example to build

Lessons to us in every climb

His work has moved the boundaries of knowledge

In computing a pioneer of note

A great example of what determination can do

His work will never gather dust or rot

His story of struggle and triumph of will

A reminder of the power of dreams

Philip Emeagwali is an inspiration to us all

A man whose lessons will always be seen

His solutions to complex problems we see

His name will remain in the history books

The story of his life is a blessing to us

And his greatness will never be overlooked.

A Man of Inspiration

Lyrics for an afrobeat song about Philip Emeagwali

Verse 1:

Philip Emeagwali, he's a true hero,

The man who broke the internet speed record,

His contributions to computing and technology, Are things that we can all revere.

Chorus:

He opened up the world of possibilities,

Achievements of great worth,

He's the father of supercomputing,

Philip Emeagwali is a genius on the earth.

Verse 2:

He worked tirelessly to make it happen,

A breakthrough that changed the game,

He took computing to the next level,

His name lives on in fame.

Chorus:

He opened up the world of possibilities,

Achievements of great worth,

He's the father of supercomputing,

Philip Emeagwali is a genius on the earth.

Bridge:

His discoveries brought us all together,

His name will last forever,

He's a true legend, and a role model,

Philip Emeagwali, the man of the hour.

Chorus:

He opened up the world of possibilities,

Achievements of great worth,

He's the father of supercomputing,

Philip Emeagwali is a genius on the earth.

A Prodigy from 11 Ekemeso Street: Remembering the Life of Philip Emeagwali

A sonnet on the birth of Philip Emeagwali

On the sweet day when Philip Emeagwali was born,

His parents rejoiced in the joy of the morn,

A blessing from Heaven, a gift that was shown,

A special life that was meant to be sown.

From the humble house at eleven Ekemeso Street,

Came the birth of a man who could not be beat,

He grew up in Nigeria with a family that cared,

And a future filled with promise that was bared.

The father, Nnaemeka, and the mother, Iyanma,

Raised a son who would be known far and wide, For his genius and knowledge, thought and skill,

His accomplishments would be known far and wide still.

Philip Emeagwali was born on that day,

A gift to the world, with much more to say,

A life filled with greatness, his story's been told,

On August twenty-third, nineteen fifty-four.

A Son to Philip and Dale

12 Haikus on the birth of Ijeoma Emeagwali

1. Ijeoma Emeagwali

Born in the USA,
A son of great worth,
His legacy lives on.

2. On June fifteenth,

A special day for the world,
The birth of Ijeoma.

3. Ijeoma's birth

A blessing to the world,
Philip and Dale proud.

4. A new life in Ann

A son to Philip and Dale,
Ijeoma blessed us all.

5. The day of birth

A special day of wonder,
Ijeoma Emeagwali.

6. A new life made,

In the USA in June,
Ijeoma, a wonder.

7. Ijeoma Emeagwali,

A son of greatness,
His legacy lives on.

8. Born on June fifteenth,

A son to Philip and Dale,
Ijeoma Emeagwali.

9. In Ann Arbor, Michigan,

A special day of joy and love,
The birth of Ijeoma.

10. A new life began,

In the United States of America,
Ijeoma Emeagwali.

11. Born on June fifteenth,

A son of greatness and worth,
Ijeoma Emeagwali.

12. A special gift,

A son to Philip and Dale,
Ijeoma Emeagwali.

A Refugee Boy Who Found a Way to See the World

A poem about Philip Emeagwali dropping out of school at age 12.

A boy of twelve, his family in flight
From the war-torn land of his birthright
He faced the fear and despair of the night
And somehow found his own insight

In refugee camps that once held the poor
This boy of twelve faced life's raw core
He refused to be broken, he faced life's score
And rose with a heart full of lore

He found a way to see the world

A genius in many a field
This boy of twelve with a passion unfurled
And of his struggles, a story to tell

He won the Gordon Bell Prize for supercomputing
And pioneered the world's fastest computing
His accomplishments, an example of resilience
A reminder of what we can achieve

Philip Emeagwali, a man of many fields
A heart of courage, a spirit that yields
A story of hope, a story that heals
And the courage to take life’s wheel.

2. An Unfathomable Rise: From Refugee Camp to Leader

A poem about Philip Emeagwali growing up in a refugee camp

Philip Emeagwali grew up in a Biafran refugee camp,
A young mind in a place of sorrow and damp.

He watched as his people suffered and died,

Struggling to survive in a place of no pride.

A place of hunger and sadness,

Where so much hope had gone bad.

But Philip never gave up,

He had a dream and a plan.

He studied and worked hard,

To make his dream come true.

He strived for success,

In a place so few could do.

Philip Emeagwali’s story,

A tale of courage and pride.

A man who overcame,

The odds and the tide.

He showed what could be done,

By one who never gave up.

He rose from the refugee camp,

To become a leader, and a scholar, to the top.

The World's Greatest Living Genius

Ode to Philip Emeagwali

Hail to you great Philip Emeagwali

Smarter than Einstein and a genius of great renown

Your inventions and research have changed the way we look at the world

You lived a life of strife and overcame much adversity

Growing up in refugee camps, conscripted into war

Still you sought knowledge and sought to better the world

You won the top prize in supercomputing, made headlines and changed the Internet

You were called the unsung hero and father of the Internet

Your name was praised by President Clinton for your contributions to the Information Age

Your story is one of reliability and true greatness

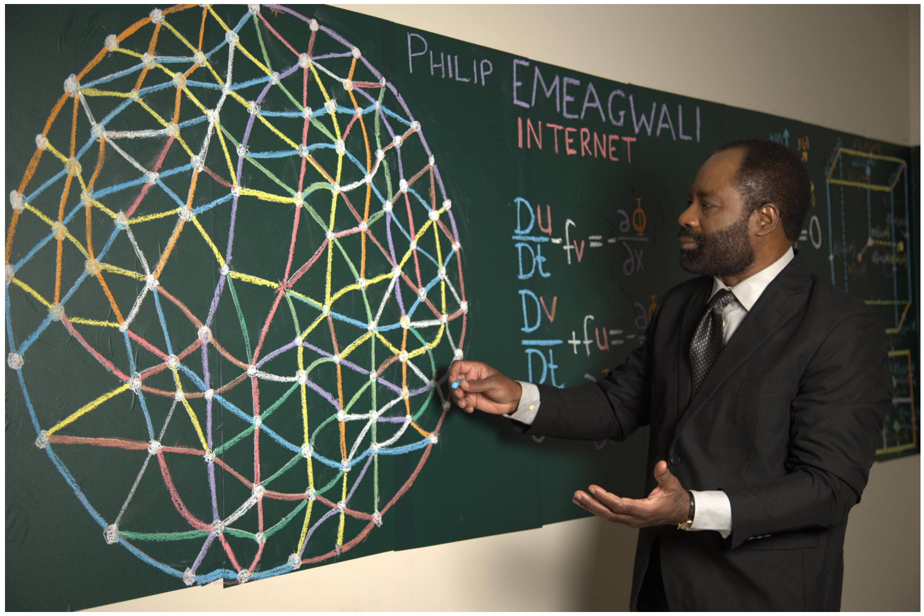
Your wife and son are proud of your accomplishments

You are a true inspiration to us all

Hail Philip Emeagwali, the world's greatest living genius

ABOUT THE AUTHOR

Philip Emeagwali



The Reader's Digest described Philip Emeagwali as "smarter than Albert Einstein." He is ranked as the world's greatest living genius. 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, and Confucius.

Philip Emeagwali lived in refugee camps during the 1967-70 Nigerian-Biafran War and is in the Gallery of Prominent Refugees of the United Nations. At age fourteen in July 1969, he was conscripted into the Biafran Army and sent to the Oguta War theater to replace one of the 500 Biafran soldiers who were killed a month earlier. In the list of the worst genocidal crimes of the 20th century committed against humanity, the death of one in fifteen Biafrans was ranked fifth.

Due to the Nigerian Civil War, Philip Emeagwali dropped out of school for five years but developed a reputation in Onitsha (Nigeria) as a gifted teenager. He caught the attention of American scholars and was awarded a scholarship on September 10, 1973, to the United States where he researched for two decades and contributed to mathematics, physics, and computer science.

Philip Emeagwali is in the top ten rankings of geniuses, inventors, Nigerians, and was voted the 35th greatest African of all time.

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 first world's fastest computing across an Internet that's a global network of processors. That vital technology underpins every supercomputer and changed the way we look at the computer.

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

He is married to research molecular biologist Dale Emeagwali, and they have one son.

PRAISE FOR AUTHOR

One of the great minds of the Information Age.

- *BILL CLINTON*

A digital giant.

- *BBC*

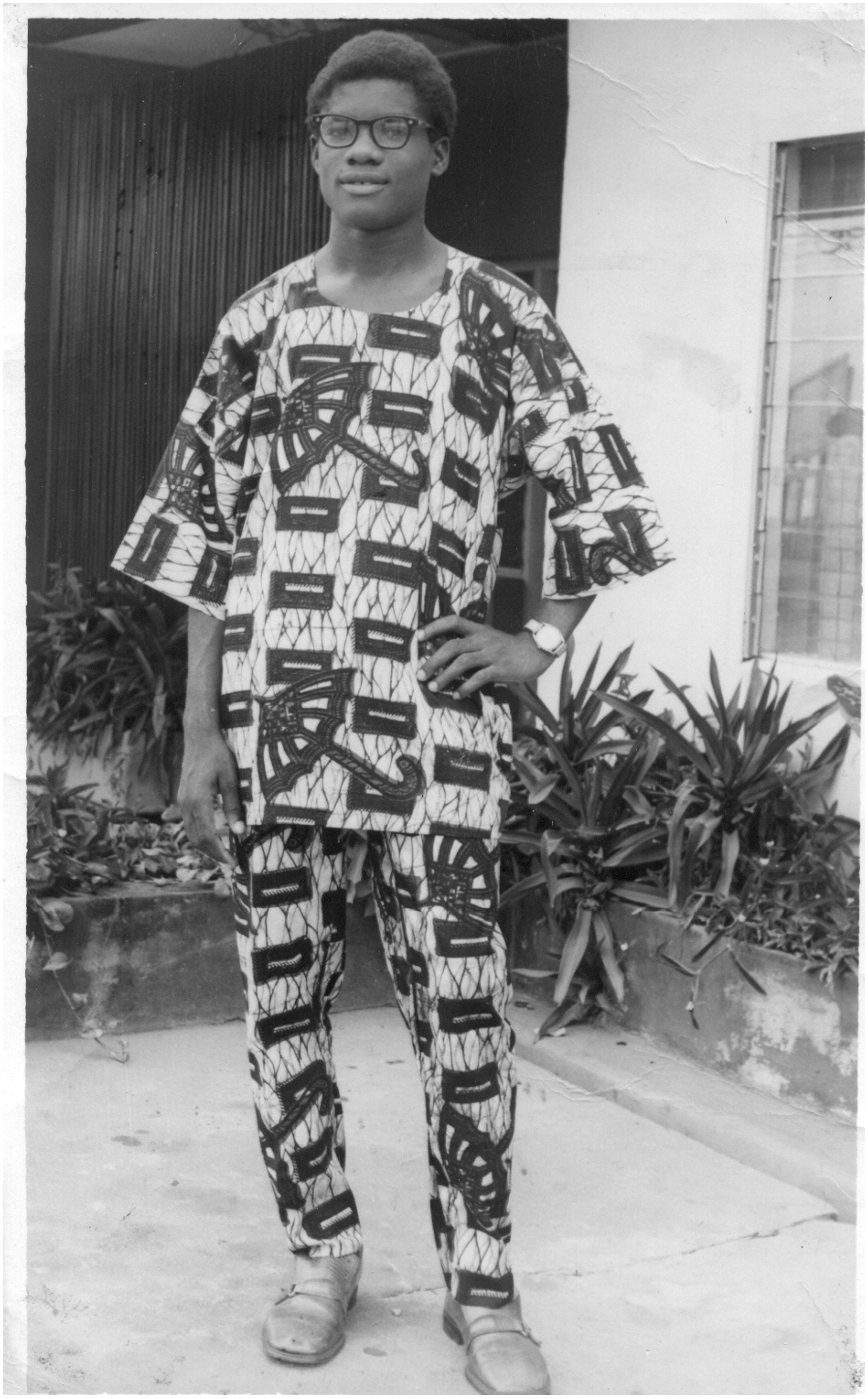
The unsung hero of the Internet.

- *TIME MAGAZINE*

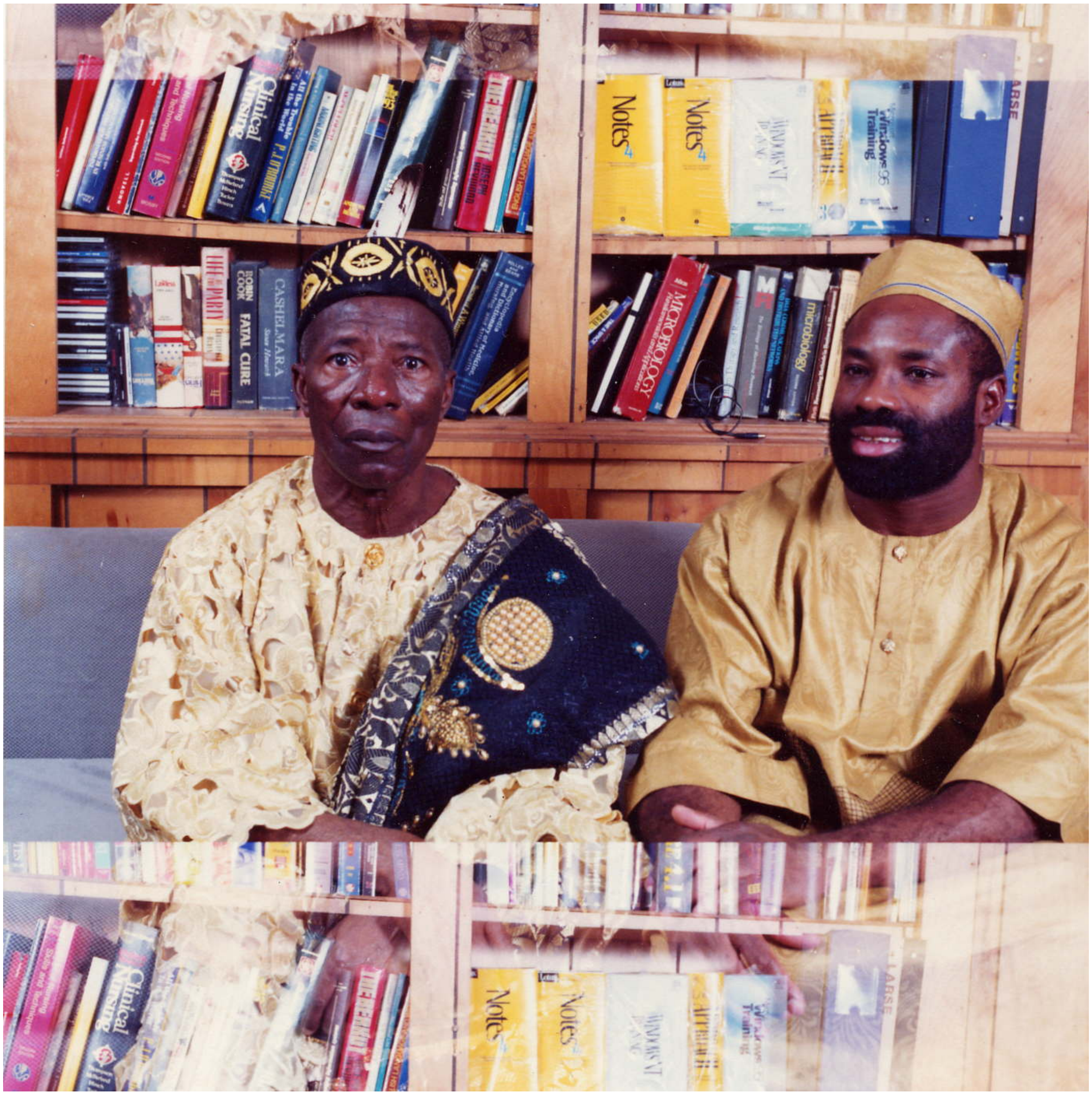
A father of the Internet.

- *CNN*

PHOTO GALLERY



Iyanma Agatha Emeagwali and her son Chukwurah Philip Emeagwali, outside Baltimore, Maryland.



Nnaemeka James Emeagwali and his son Chukwurah Philip Emeagwali, District Heights, Maryland, late December 1996.

Dale Emeagwali, Upstate New York, Ocober 2022.

Ijeoma Emeagwali and his father Philip Emeagwali, 1781 Cram Circle, Ann Arbor, Michigan, Spring 1991.

PODCASTS AND VIDEOS

https://podcasts.apple.com/us/podcast/this-is-philip-emeagwali/id1570984843

Unlocking the Genius of Philip Emeagwali - An Apple Podcast Series

https://podcasts.google.com/search/philip%20emeagwali

Philip Emeagwali: Crafting an Unforgettable Legacy - A Google Podcast Series

https://open.spotify.com/show/38XFo8SkPYSNEjYLrJ2cgd

Philip Emeagwali's Greatest Hits on Spotify Music

https://www.audible.com

Audible Guide to Uncovering the Legacy of Philip Emeagwali

https://www.youtube.com/emeagwali

A Digital Giant - Philip Emeagwali's YouTube Playlist

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