POST

Rock . . . smart?

September 12, 2021

Computational power of nature-------2 lb rock = a million trillion trillion trillon bits per second

---“Nature is computing. Everything is essentially making ‘yes/no’ decisions. And if it’s making a ‘yes/no’ decision, it can also be used to compute.” - Jed Anderson, EnviroAI

Popular Mechanics

1949

---"Where a calculator on the ENIAC is equipped with 180,0000 vacuum tubes and weighs 30 tons, computers in the future may have only 1,000 vacuum tubes and perhaps weigh 1.5 tons."

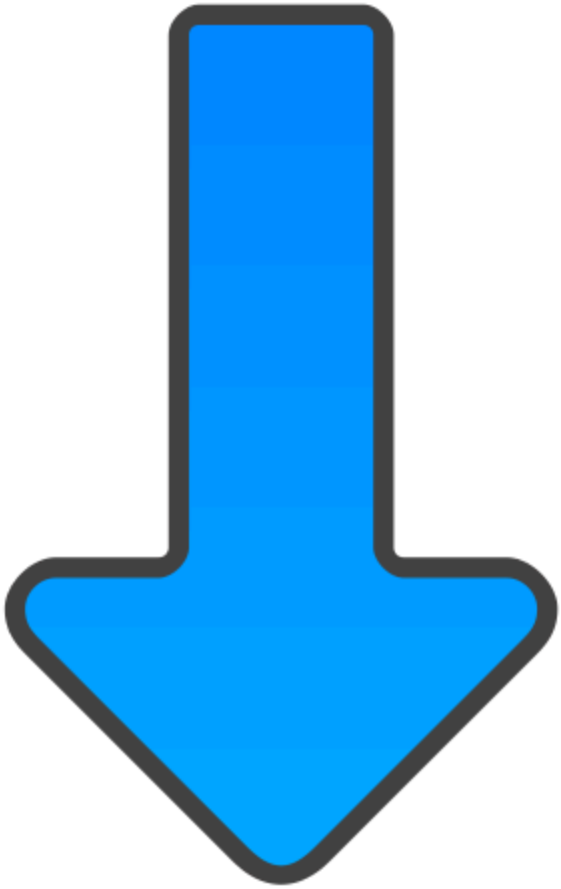
---Popular Mechanics, 1949

---“Our kids will look at us performing calculations on silicon like we look at our parents performing calculations on 180,000 vacuum tubes. It will look gigantic to them.” - Jed Anderson, EnviroAI

Silicon of course has been incredible and has gotten us down to calculating almost at the molecular scale, and in fact, almost to the atomic scale (the smallest transistor is now only about 6 silicon atoms wide). But that is gigantic, Now we are beginning to calculate even below the subatomic scale harnessing the probability characteristics of electrons (quantum computing). Silicon of course as 14 electrons in each atom. And the potential configuration of these 14 electrons at the quantum scale is dizzying.

---“Computer science is no more about computers than astronomy is about telescopes.”

- E.W. Dijkstra



Super Molecular Computing

(ex/ silicon microchip)

Molecular Computing

(Computing with Molecules)

(ex/ DNA)

Atomic Computing

(Computing with Atoms)

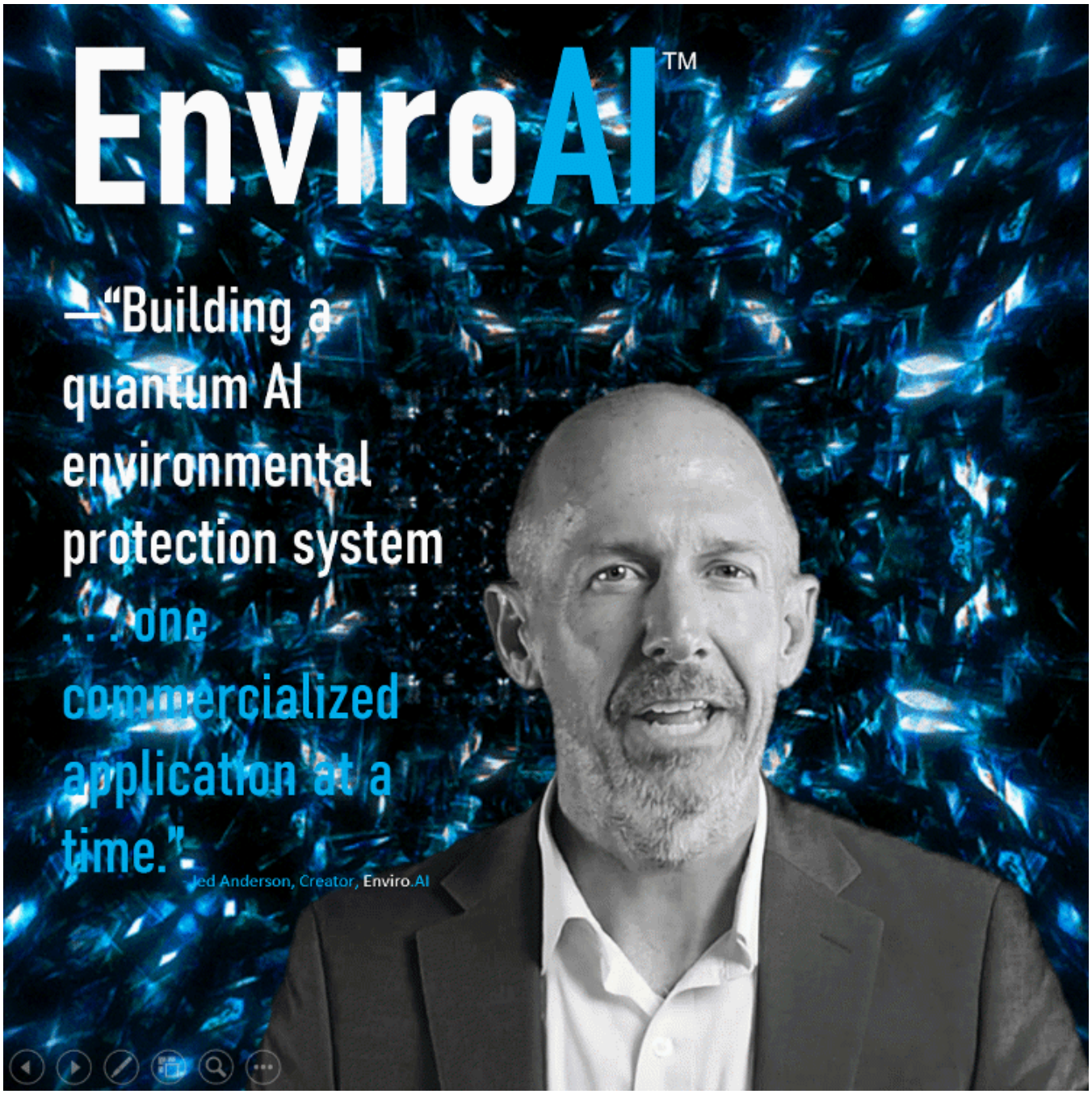
Subatomic Computing

(Computing with Electrons)

(ex/ quantum computing)

It's helpful sometimes to think of the computing that is occurring in a common rock. A 2-pound rock for example has about 1025 atoms. Despite the apparent solidity of a rock, the atoms of course are all in motion as everybody knows—sharing electrons back and forth, changing particle spins, and generating rapidly moving electromagnetic fields (making trillions of yes/no decisions). The University of Oklahoma in one demonstration stored 1,024 bits of data in the magnetic interactions of the protons of a single molecule containing nineteen hydrogen atoms. This would equate to approximately 1027 bits of memory in the rock. In terms of computation, and just considering the magnetic interactions, there are about 1015

changes in state per bit per second happening in a 2-pound rock, equating to approximately 1042 or a million trillion trillion calculations per second. That's a lot of yes/no decisions being made.



Simplicity of Simulating Nature

A calculation (https://r20.rs6.net/tn.jsp?f=001cfZ6LzjIA_szUGhY4dfRkDuYlTxp8J_b7Z5YTmsJz017ejwtqIrur5vNLL2wjEL5ABYHFaf-8NBuy3xCJsn_6t0uqhh7VWw0S_DK8dpL7S6yUaTioKl9zHhEJlSHJ-pJcQjEf-atyPiAFVJ4ndyTkErHZXI45O0Cd490qM4BEOT3twrMF2CyH2L3SntVgApA&c=&ch=) performed by MIT found that the universe has performed the equivalent of

10120 ops on 1090 bits. The earth's atmosphere contains 1.04 × 1044 molecules. Assuming approximately 4.140×1022atoms in an an average mole of air, and a full-ci (https://r20.rs6.net/tn.jsp?f=001cfZ6LzjIA_szUGhY4dfRkDuYlTxp8J_b7Z5YTmsJzo17ejwtqIrur5vNLL2wjEL5FaVMjMq_0mMf3RK4blB3PlAmvhfmTV5EkWstt1xGA6JsTXrabxUZ45KcQApvgFZs_cHAT3OXBP5rBSBXDezb_vnyVvA8e-xBl-4J7OCsN71x7OuldBEnZB8mqc6X6yob&c=&ch=) in the range of 1044, that's 10111 computational variables.

My point is not to show computations, nor certainly the correct computations. My point is to show that nature and environmental protection are computable. The challenge is exponents. Exponents are not complicated. They're just really really big.

Dealing with Exponents …

Let me quickly explain the exponents involved in computing. Let's take for example a very simple 3 bit system. There are 8 possible three-bit combinations: 000, 001, 010, 011, 1000, 101, 110, and 111. That's 23. There are 2 choices for the first bit. 2 choices for the second bit. And 2 choices for the third bit. If instead we use qubits instead of bits, then each of these 8 combinations is associated with a basis vector and so the vector space is 8-dimensional. As the number of qubits grow, the number of basis vectors grows exponentially … and gets very very big … very very fast. China two days ago created the most powerful quantum computer at 62 qubits (https://r20.rs6.net/tn.jsp?f=001cfZ6LzjIA_szUGhY4dfRkDuYlTxp8J_b7Z5YTmsJzo17ejwtqIrur5vNLL2wjEL5CByRdeEx5wg0NaB5Su9BGqCQk6RDb2qzQUuuxnS4rIHJYBds55ijxkz6LmSU-PeH-phtJMvaY6IwlpzcIln86iZ6aE9gufgKTeBtsZjU4wzSkOi0jWs9FGK8Ao_VO16ldnyssgbtJ_7Cpg0zTRT0-_aLl6qkwBG2&c=&ch=). Google has the 54 qubit Sycamore Computer (https://r20.rs6.net/tn.jsp?f=001cfZ6LzjIA_szUGhY4dfRkDuYlTxp8J_b7Z5YTmsJzo17ejwtqIrur5vNLL2wjEL5FjPrh4ttlDe2bfvlsjT-INqyVJHrEcpn9_7IgYjHOlOcrTLtB4iEV-KbKEznPzoVD9xzaeNy4uvHIgHhtbFkQP1ybC1pMi1mXh1G_U4ZInzuczKPPO8QzQ==&c=&ch=). IBM's Quantum Eagle computer slated for later this year is expected to be 127 qubits (https://r20.rs6.net/tn.jsp?f=001cfZ6LzjIA_szU

GhY4dfRkDuYlTxp8J_b7Z5YTmsJzo17ejwtqIrur5vNLL2wjEL5k2ZOl2q96xS6s8lv1Q_pySHZbuo7B6cjs7lRK_FXfL_Pe50Ghle-odKKDLCBULajq_lBGhCOe3A7Q8Cc_SmV-3es7RBiXcoAfrs2g_S9oGPLP6MXPuVLeKJNjWH6Bp-coioyybgnew_-cu7CtCljEg==&c=&ch=). IBM has also announced its 1,121-qubit Condor device (https://r20.rs6.net/tn.jsp?f=001cfZ6LzjIA_szUGhY4dfRkDuYlTxp8J_b7Z5YTmsJzo17ejwtqIrur5vNLL2wjEL5nIOXEpyb-3SUAr7x4uDNYfvtAFifTX5F-TN72F7SQQVE-XpNP4OAmIDOG-AD7SsjdxTWSdsHgb5hc9mQxO6brGoouC1XDhD5CKzz1Zjs2OTguu591j4__TY8C05E7BGFT_tsieQ6fIAcjupmauYiZw_M_fYFxN7y5DFpv7GgBhZWsVZsBQgCSRS9s9609pYK&c=&ch=) planned for 2023. Once a machine reaches 300 qubits, that computer will be using more than the number of elementary particles in the universe as its computational basis. 2300 is a whopping big number of basis elements. Quantum computing will allow us to work back through the complicated phenomena to find more of the simple equations and computational programs that started and still are guiding the phenomena—and allow us to simulate the protection of natural systems. Quantum computing will deal with the exponents.

---“Protecting nature will become very simple.”

- Jed Anderson, Creator, EnviroAI

Nature = Simple Equations

Mathematical equations that explain nature we are finding are very simple:

Einstein's Special Relativity Equation

$$E=mc^2$$

Shrodinger's Equation (Probability Waves – Quantum)

$$i\hbar(\partial/\partial t)\Psi=\hat{H}\Psi$$

Nature = Simple Computations

Computational programs that explain nature we are finding are very simple:

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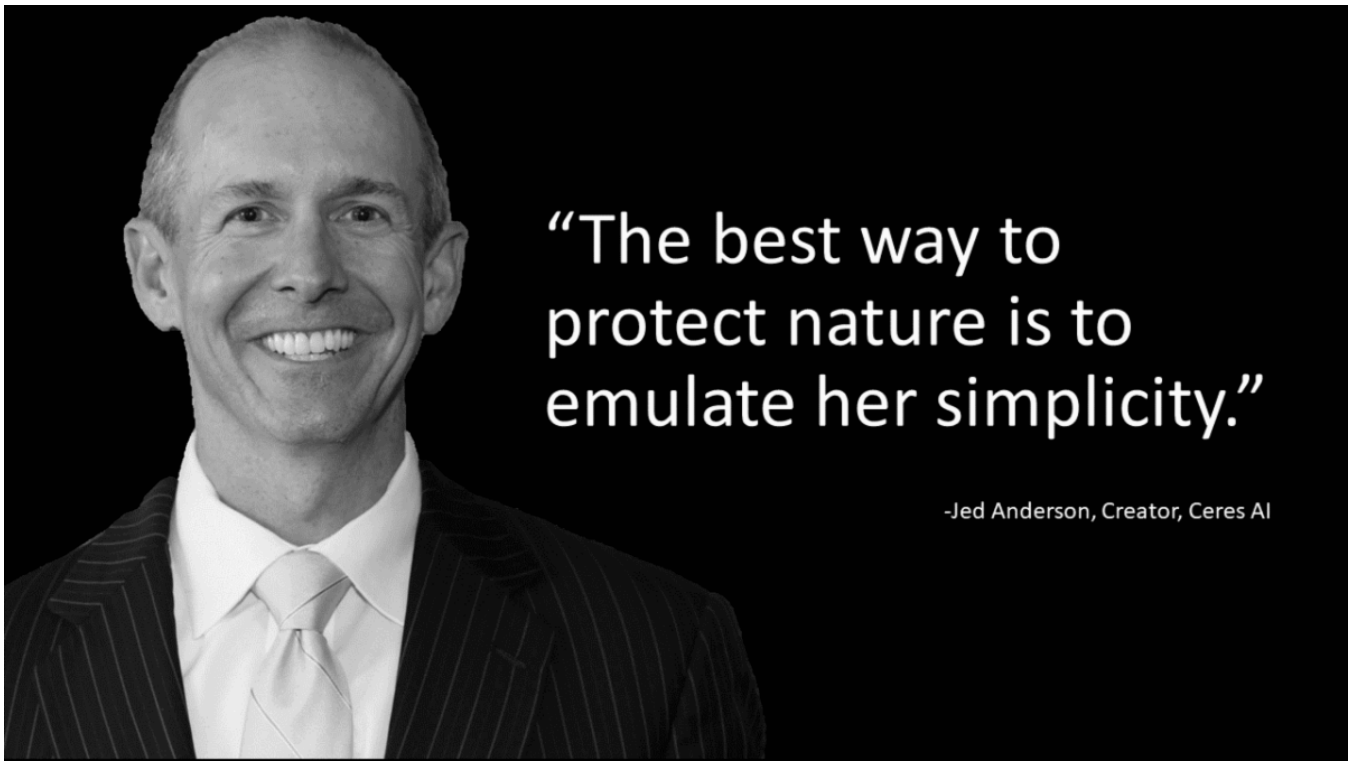
SIMPLICITY

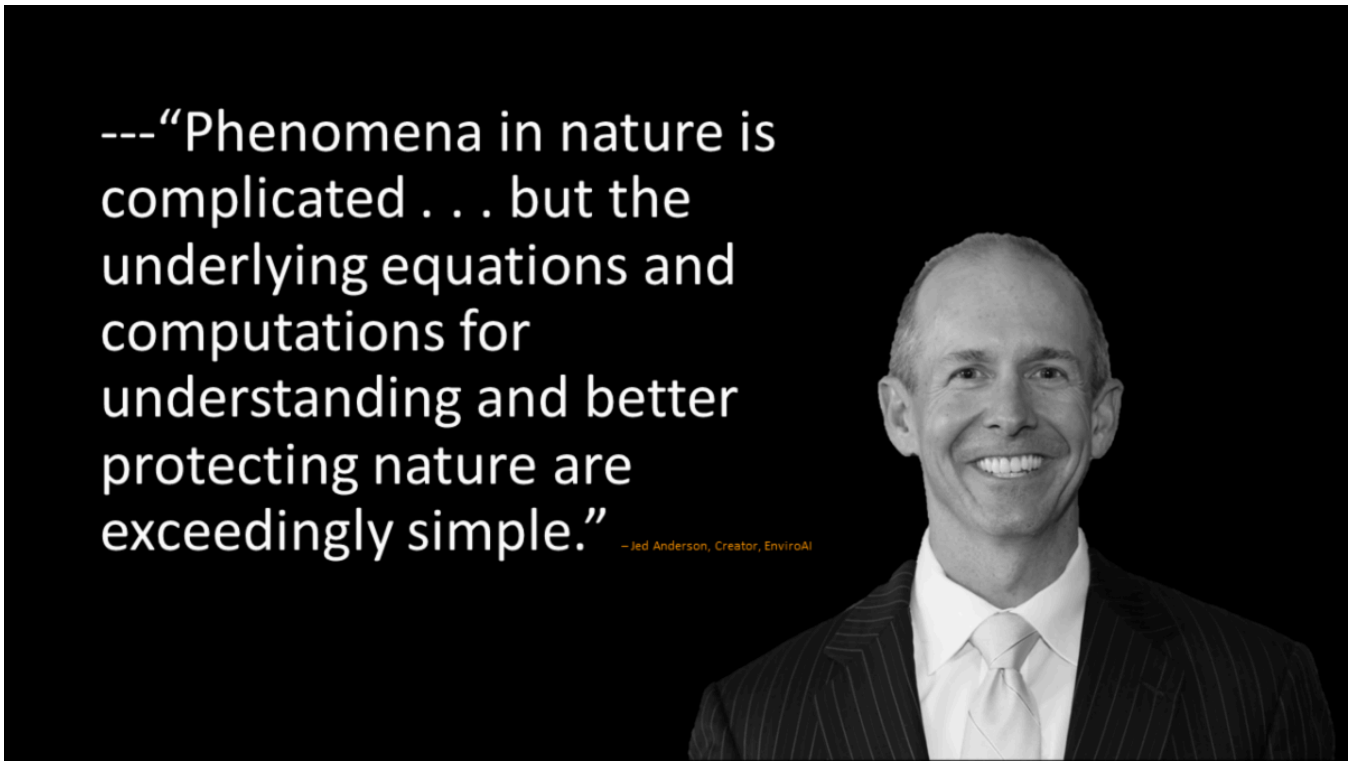
- “Nature operates in the shortest way possible.”---Aristotle
- “Phenomena complex—laws simple.”—Richard P. Feynman
- “When the solution is simple, God is answering.” —Albert Einstein
- “Nature is pleased with simplicity. And nature is no dummy.” — Isaac Newton

- “The main purpose of science is simplicity and as we understand more things, everything is becoming simpler.” – Edward Teller
- “Nature does not multiply things unnecessarily; that she makes use of the easiest and simplest means for producing her effects”—Galileo



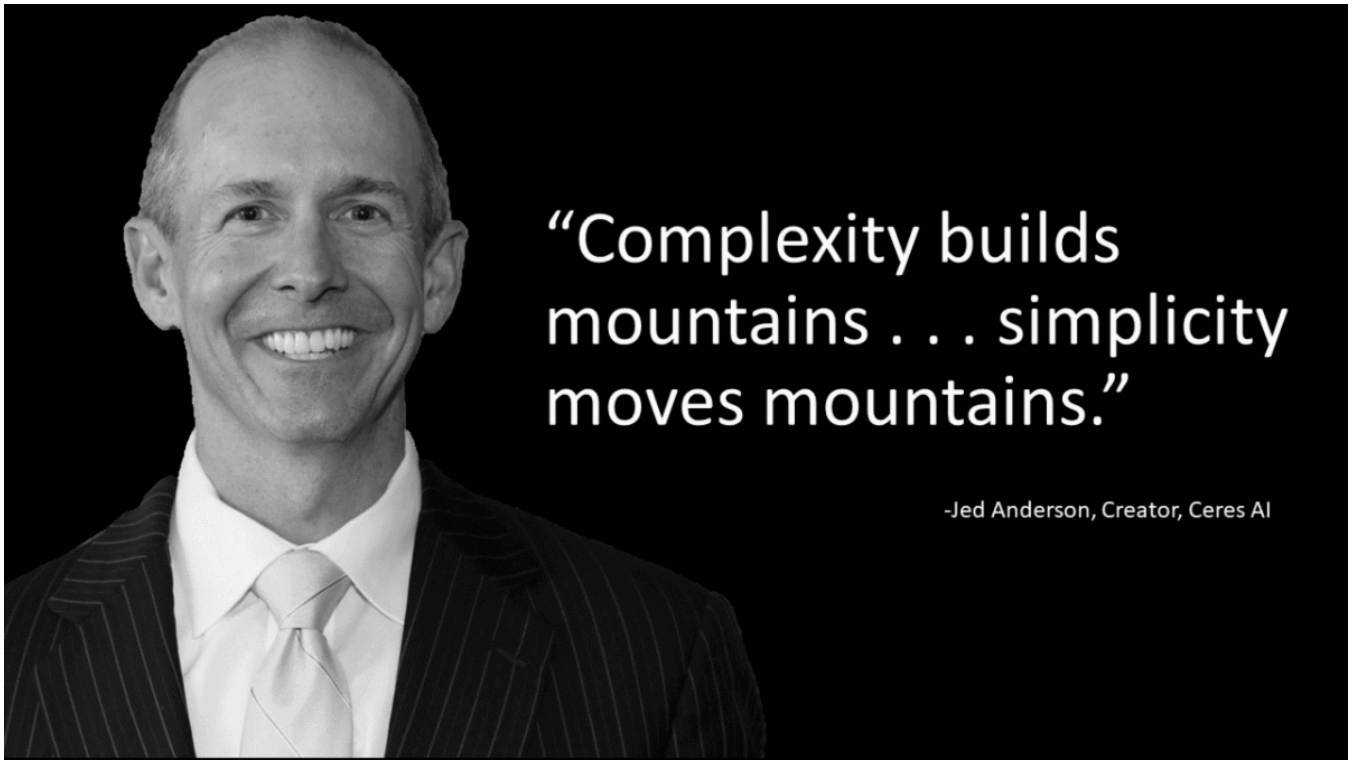
- “To be simple is to be great.”—Emerson
- “Rudiments or principles must not be unnecessarily multiplied —Immanuel Kant
- “There is no greatness where there is not simplicity.” — Leo Tolstoy
- “All the great things are simple.” —Winston Churchill
- “Out of clutter, find simplicity.” —Albert Einstein

- “AI is about making machines more fathomable and more under the control of human beings, not less. Conventional technology has indeed been making our environment more complex and more incomprehensible …” - Donald Michie
- “Plurality should not be assumed without necessity.” —William of Ockham
- “Knowledge is a process of piling up facts; wisdom lies in their simplification.” ~ Martin H. Fischer
- “Complexity is your enemy. Any fool can make something complicated. It is hard to make something simple.”---Richard Branson.
- “The definition of genius is taking the complex and making it simple.” —Albert Einstein



- "Beauty of style and harmony and grace and good rhythm depend on simplicity"—Plato
- "Simplicity is the ultimate sophistication." – Leonardo da Vinci
- "Simplicity is the key to brilliance."–Bruce Lee
- "Out of intense complexities, intense simplicities emerge." –Winston Churchill
- "Simplicity, simplicity, simplicity!" —Henry David Thoreau
- "Simplicity is the glory of expression." ~ Walt Whitman
- "Nothing is more simple than greatness; indeed, to be simple is to be great." ~ Ralph Waldo Emerson
- "The great artist and thinker are the simplifiers."—Henri Frederic Amiel
- "It is vain to do with more what can be done with less." ~ William of Occam

- “Clutter and confusion are failures of design, not attributes of information.” ~ Edward Tuft
- “The most complicated skill is to be simple.” – Dejan Stojanovic
- “Fools ignore complexity. Pragmatists suffer it. Some can avoid it. Geniuses remove it.” – Alan Perlis



- “Truth is ever to be found in simplicity, and not in the multiplicity and confusion of things.” – Isaac Newton
- “It is always the simple that produces the marvelous.” – Amelia Barr
- “Simplicity is a prerequisite for reliability.” – Edsger Dijkstra
- “Almost all quality improvement comes via simplification of design, manufacturing, layout, processes, and procedures.” – Tom Peters

- “Simplicity is the most difficult thing to secure in this world; it is the last limit of experience and the last effort of genius.” – George Sand
- “Order and simplification are the first steps toward the mastery of a subject.” – Thomas Mann
- “Simplicity is the outcome of technical subtlety. It is the goal, not the starting point.” – Maurice Saatchi
- “The greatest ideas are the simplest.” – William Golding
- “People often associate complexity with deeper meaning, when often after precious time has been lost, it is realized that simplicity is the key to everything.” – Gary Hopkins
- “Growth creates complexity, which requires simplicity.” – Andy Stanley
- “Our life is frittered away by detail. Simplify, simplify.” – Henry David Thoreau
- “It is not a daily increase, but a daily decrease. Hack away at the inessentials.” – Bruce Lee
- “Complexity is impressive, but simplicity is genius.” – Lance Wallnau
- “Complexity is enemy of execution”. – Anthony Robbins
- “Simplicity will stand out, while complexity will get lost in the crowd.” – Kevin Barnett
- “Very often, people confuse simple with simplistic. The nuance is lost on most.” – Clement Mok

- “Anything simple always interests me.”—David Hockney
- “I would not give a fig for the simplicity this side of complexity, but I would give my life for the simplicity on the other side of complexity.”—Oliver Wendell Holmes
- “Any intelligent fool can make things bigger, more complex, and more violent. It takes a touch of genius…and a lot of courage to move in the opposite direction.” ~ E.F. Schumacher
- “The simple thing is the right thing.” ---Oscar Wilde
- “To simplify complications is the first essential of success.”—George Earle Buckle
- “You know you’ve achieved perfection in design, not when you have nothing more to add, but when you have nothing more to take away.”—Anotine de Saint-Exupery
- “A complex system that works is invariably found to have evolved from a simple system that worked. A complex system designed from scratch never works and cannot be patched up to make it work. You have to start over, beginning with a working simple system.”—John Gall
- “Although there are no textbooks on simplicity, simple systems work and complex don’t.” ––Jim Gray
- “Simplicity does not precede complexity, but follows it.”- Alan J. Perlis
- “The simplest things are often the truest.”—Richard Bach

- “A lady once offered me a mat, but as I had no room to spare within the house, nor time to spare within or without to shake it, I declined it.” —Henry David Thoreau

- “Five lines where three are enough is stupidity. Nine pounds where three are sufficient is stupidity.”—Frank Lloyd Wright

- “Don’t be fooled by the many books on complexity or by the many complex and arcane algorithms you find in this book or elsewhere. Although there are no textbooks on simplicity, simple systems work and complex don’t.” ––Jim Gray

- “When you first start off trying to solve a problem, the first solutions you come up with are very complex, and most people stop there. But if you keep going, and live with the problem and peel more layers of the onion off, you can often times arrive at some very elegant and simple solutions.”—Steve Jobs

- “I do believe in simplicity. […] When the mathematician would solve a difficult problem, he first frees the equation of all incumbrances, and reduces it to its simplest terms. So simplify the problem of life, distinguish the necessary and the real. Probe the earth to see where your main roots run.” —Henry David Thoreau

- “Complexity is a sign of technical immaturity. Simplicity of use is the real sign of a well-designed product whether it is an ATM or a Patriot missile.”– Daniel T. Ling

- “[T]he grand aim of all science…is to cover the greatest possible number of empirical facts by logical deductions from the smallest possible number of hypotheses or axioms.”—Albert Einstein

- “Simplicity is the law of nature for men as well as for flowers.” —Henry David Thoreau

- “In building a statue, a sculptor doesn’t keep adding clay to his subject. Actually, he keeps chiselling away at the inessentials until the truth of its creation is revealed without obstructions.”—Bruce Lee

- “Simplifications have had a much greater long-range scientific impact than individual feats of ingenuity. The opportunity for simplification is very encouraging, because in all examples that come to mind the simple and elegant systems tend to be easier and faster to design and get right, more efficient in execution, and much more reliable than the more contrived contraptions that have to be debugged into some degree of acceptability…. Simplicity and elegance are unpopular because they require hard work and discipline to achieve and education to be appreciated.”– Edsger W. Dijkstra

- “I’ll tell you what you need to be a great scientist. You don’t have to be able understand very complicated things. It’s just the opposite. You have to be able to see what looks like the most complicated thing in the world and, in a flash, find the underlying simplicity. That’s what you need: a talent for simplicity.”—Mitchell Wilson

- “Science may be described as the art of systematic over-simplification.”— Karl Popper

- “The ability to simplify means to eliminate the unnecessary so that the necessary may speak.” —-Hans Hofmann

- “The field of Artificial Intelligence is set to conquer most of the human disciplines; from art and literature to commerce and sociology; from computational biology and decision analysis to games and puzzles.” –Anand Krish

- “A year spent in artificial intelligence is enough to make one believe in God.”—Alan Perlis

- “The whole world is certainly heading for a great simplicity, not deliberately, but rather inevitably. The simplicity towards which the world is driving is the necessary outcome of all our systems and speculations and of our deep and continuous contemplation of things. For the universe is like everything in it; we have to look at it repeatedly and habitually before we see it. It is only when we have seen it for the hundredth time that we see it for the first time. The more consistently things are contemplated, the more they tend to unify themselves and therefore to simplify themselves. The simplification of anything is always sensational. […] Few people will dispute that all the typical movements of our time are upon this road towards simplification. Each system seeks to be more fundamental than the other; each seeks, in the literal sense, to undermine the other. In art, for example, the old conception of man, classic as the Apollo Belvedere, has first been attacked by the realist, who asserts that man, as a fact of natural history, is a creature with colourless hair and a freckled face. Then comes the Impressionist, going yet deeper, who asserts that to his physical eye, which alone is certain, man is a creature with purple hair and a grey face. Then comes the Symbolist, and says that to his soul, which alone is certain, man is a creature with green hair and a blue face. And all the great writers of our time represent in one form or another this attempt to reestablish communication with the elemental, or, as it is sometimes more roughly and fallaciously expressed, to return to nature. […] But the giants of our time are undoubtedly

alike in that they approach by very different roads this conception of the return to simplicity. Ibsen returns to nature by the angular exterior of fact, Maeterlinck by the eternal tendencies of fable. Whitman returns to nature by seeing how much he can accept, Tolstoy by seeing how much he can reject."— G.K. Chesterton

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