Quantum Computing is No Longer a Physics Problem. It is a Systems Engineering Nightmare.

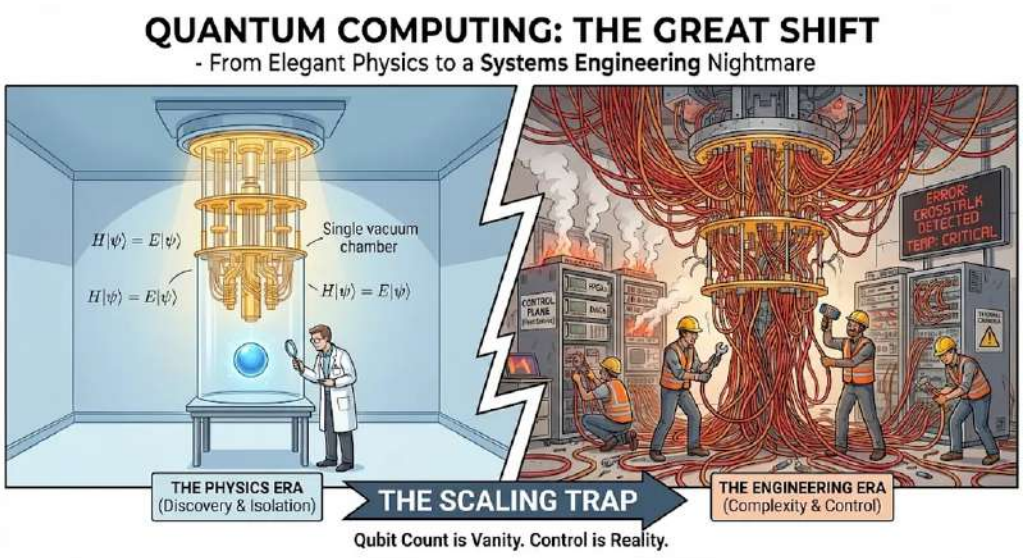
Why “Qubit Count” is the vanity metric of the decade, and why the real revolution is happening in the control plane.

4 min read · Jan 18, 2026

Volkan Erol, PhD. Follow

By Dr. Volkan Erol

If you follow the popular press, you might think the race for Quantum Computing is a simple numbers game. IBM hits 1,000 qubits. Atom Computing announces 1,000. Google aims for a million.



The charts go up and to the right. The headlines scream “Exponential Growth.”

But if you walk into a real quantum laboratory and look past the shiny golden chandeliers, you see a different reality. You see a crisis of complexity.

We have reached a pivotal moment in the history of this technology. For the last 40 years, Quantum Computing was a Physics Problem: How do we isolate a single quantum particle and make it behave?

We solved that. We can make qubits. We can make them out of superconducting circuits, trapped ions, neutral atoms, and photons.

Now, we are facing a Systems Engineering Problem: How do we control 10,000 of them at once without turning the dilution refrigerator into a furnace?

The “Hello World” Trap

In classical computing, scaling is (mostly) linear. If you can build one transistor, you can print a billion of them. They don’t interfere with each other.

In the quantum realm, scaling is chaotic.

* Crosstalk: Qubit A talks to Qubit B when it shouldn’t.

* Wiring: Every superconducting qubit requires distinct coaxial cables for control and readout.

* Heat: Every cable bridges the gap from Room Temperature (300K) to the Mixing Chamber (10mK), bringing lethal heat with it.

Building a 50-qubit machine is a heroic feat of experimental physics.

Building a 100,000-qubit machine with the same architecture is physically impossible. It is not an engineering challenge; it is a thermodynamic dead end.

The Iceberg Below the Qubit

As an Enterprise Architect looking at this landscape, I see a classic “Iceberg

Architecture."

The Qubit is just the tip – the visible 10% above the water.

The Control Plane is the massive, dangerous 90% below the surface.

To make a qubit useful, you need an entire stack of classical technologies that are currently lagging behind:

* Cryo-CMOS: We need to move classical control chips (FPGAs, DACs) inside the fridge. Standard silicon freezes and stops working at 4 Kelvin. We have to redesign the transistor for the cold.

* RF Engineering: We are trying to send precision microwave pulses to thousands of distinct targets simultaneously with nanosecond timing. This is like trying to conduct a symphony orchestra where every musician is in a different room.

* The Compilation Stack: We need software that understands the topology of the hardware. You cannot just run code; you have to "map" it to the physical reality of the chip, avoiding broken qubits and noisy couplers.

The Shift: From Discovery to Architecture

This is why I argue that we are leaving the era of the "Scientist" and entering the era of the "Architect."

The heroes of the next decade won't just be the physicists who invent a new type of qubit. The heroes will be the systems engineers who figure out how to wire them,

the thermal engineers who solve the heat load, and the software architects who build the abstraction layers that hide this complexity from the user.

We are building the most complex machine in human history. It's time we stopped obsessing over the "count" of the parts and started focusing on the "quality" of the system.

In this series, we will look beyond the hype. We will explore the Control Plane, the Wiring Bottleneck, the Cryo-CMOS revolution, and the future of Modular Quantum Data Centers.

Welcome to the real engineering challenge.

📚 References & Further Reading

For those who want to dig deeper into the "Engineering" side of Quantum Computing, here is my curated reading list:

1. The Foundational Text

* Nielsen, M. A., & Chuang, I. L. (2010). Quantum Computation and Quantum Information. Cambridge University Press.(The "Bible" of the field. Essential for understanding the math behind the engineering.)

2. The "NISQ" Era Definition

* Preskill, J. (2018). "Quantum Computing in the NISQ era and beyond." Quantum, 2, 79.(John Preskill's legendary paper defining the "Noisy Intermediate-Scale Quantum" era we are currently living in.)

3. The Wiring & Control Challenge

* Franke, D. P., et al. (2019). "Rent's rule and extensibility in quantum computing." Microprocessors and Microsystems. (An excellent analysis of why we can't just add more cables. It applies a classic classical computing rule – Rent's Rule – to quantum chips.)

4. Cryo-CMOS and Scalability

* Vandersypen, L. M. K., et al. (2017). “Interfacing spin qubits in quantum dots and donors – hot, dense, and coherent.” NPJ Quantum Information. (A deep dive into the necessity of bringing control electronics inside the cryostat.)

5. Systems Engineering Perspective

National Academies of Sciences, Engineering, and Medicine. (2019). Quantum Computing: Progress and Prospects. The National Academies Press.

(A comprehensive report on the realistic timeline and engineering hurdles facing the industry.)

> *Next Week: We will tackle the “Software Stack” and why your Python code looks nothing like the microwave pulses hitting the chip.*

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Enterprise Architect, PhD Computer Engineering/Quantum Computing: “Exploring the intersection of Quantum Computing, AI, and Enterprise Architecture."

Responses (1)

Write a response

What are your thoughts?

Alain Faure
Mar 31

Dear **Volkan**, I have been following your work on Medium and I deeply appreciate your pragmatic approach to the quantum computing crisis. Your assessment that "Quantum Computing is No Longer a Physics Problem. It is a Systems Engineering Nightmare" is... more

Reply

More from Volkan Erol, PhD.

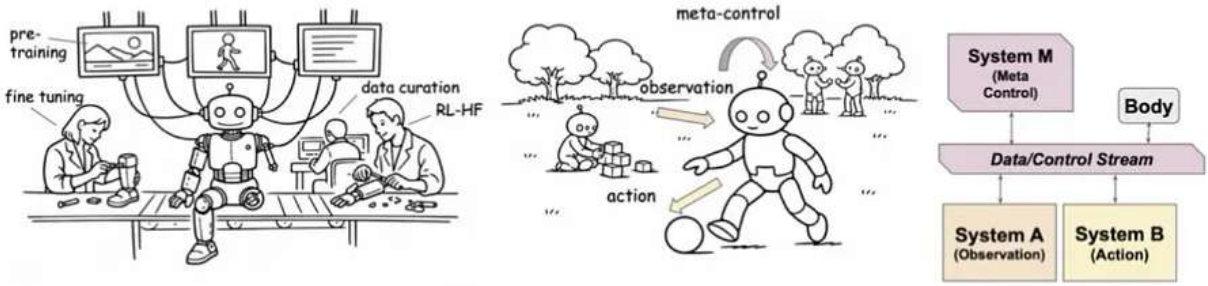

Figure 1 Standard machine learning (left). The machine does not learn by itself; it requires an assembly line of research engineers and data scientists collecting, formatting, and curating different kinds of data, each used to train successively different components of the model, each with specificly engineered loss and reward functions. The machine is then left with no ability to learn from its experience. **Autonomous machine learning (right).** The agent is learning directly in interaction with the world; the sources of data are generarated by the agent itself through different learning modes (learning by observation, by action, which can be extended to higher modes like learning by verbal interaction or self-play). Our proposed architecture include a meta controler enabling learning while operating in the real world. *(Drawings from ChatGPT).*

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The Scaling Wall and the Architectural Renaissance: A Path Toward Autonomous Learning

Introduction: The Limits of Probabilistic Prediction

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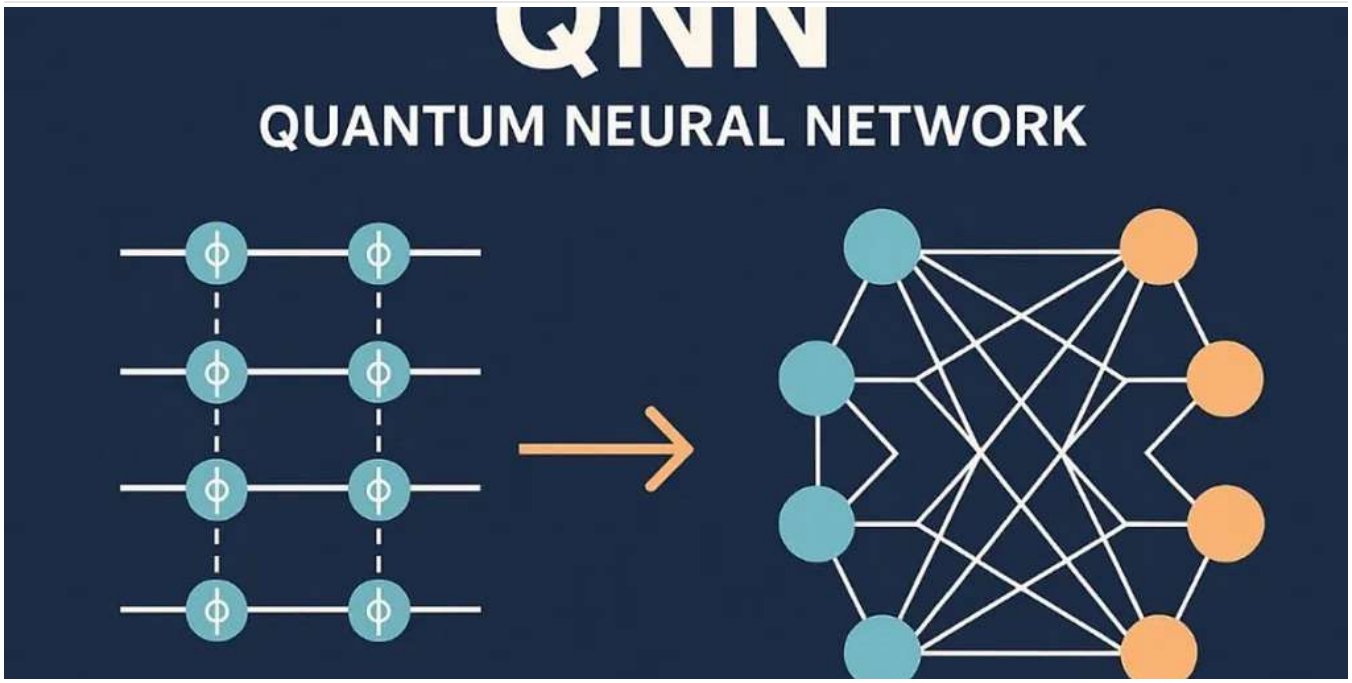

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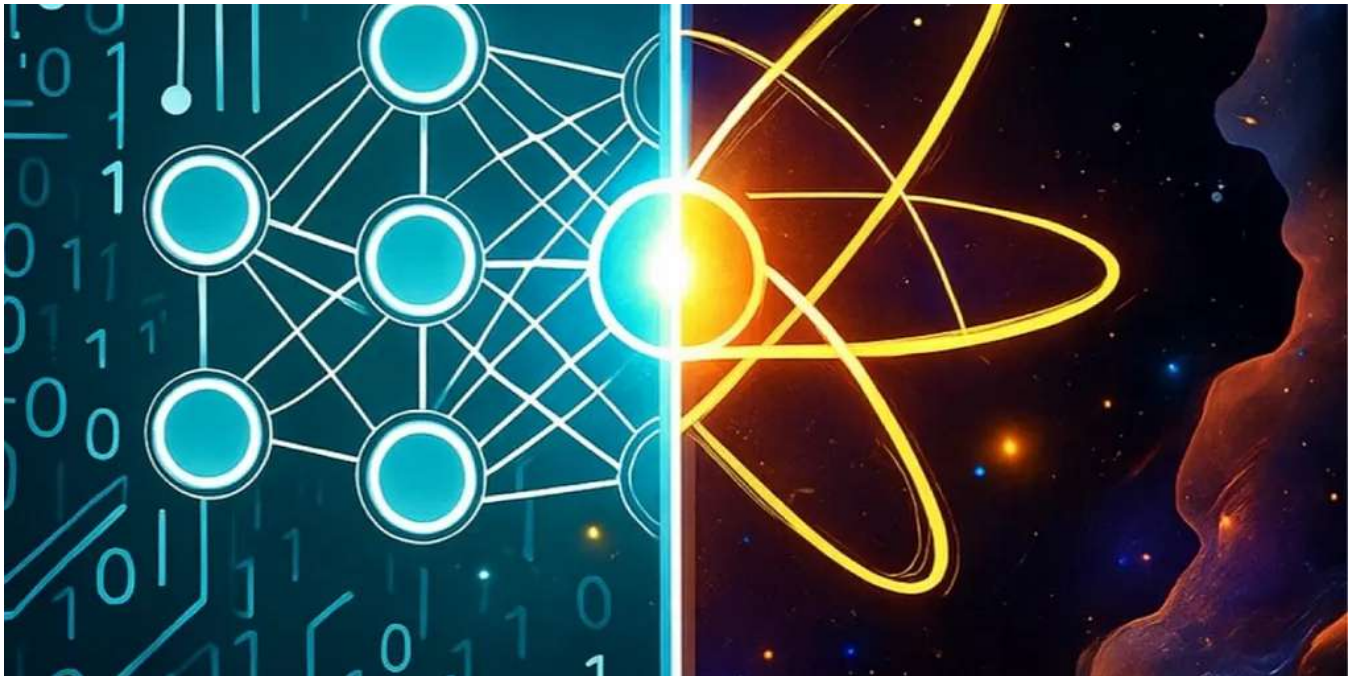

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Quantum Machine Learning: Bridging the Classical and Quantum Worlds

Let's Start with a Story

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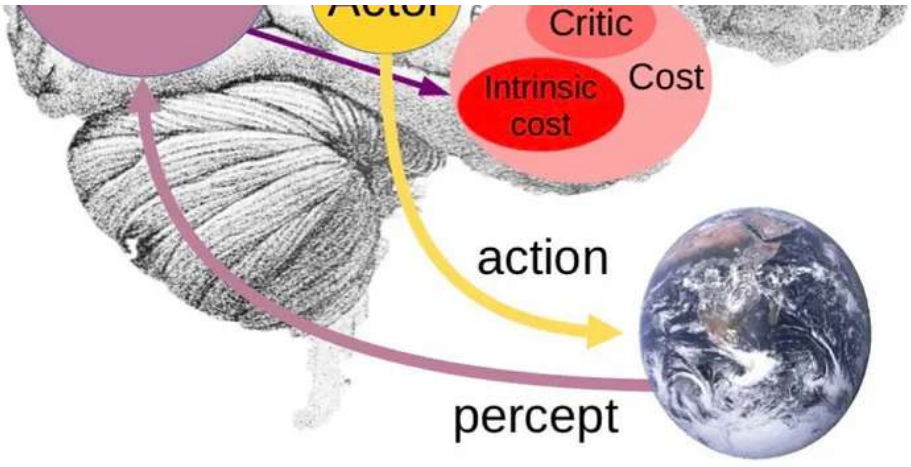

Figure 2: *A system architecture for autonomous intelligence. All modules in this model are assumed to be "differentiable", in that a module feeding into another one (through an arrow connecting them) can get gradient estimates of the cost's scalar output with respect to its own output.* **The configurator module** *takes inputs (not represented for clarity) from all other modules and configures them to perform the task at hand.*

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Autonomous Machine Intelligence Kavramı Üzerine

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See all from Volkan Erol, PhD.

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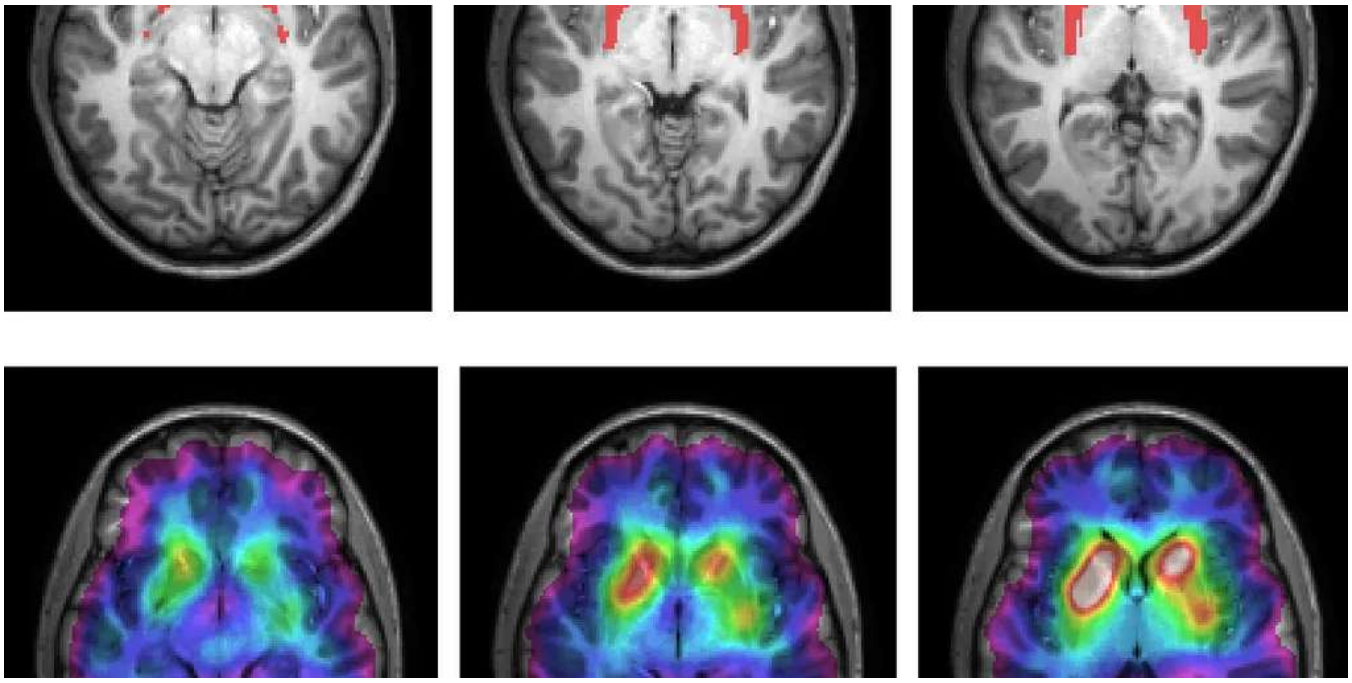

In Write A Catalyst by Dr. Patricia Schmidt

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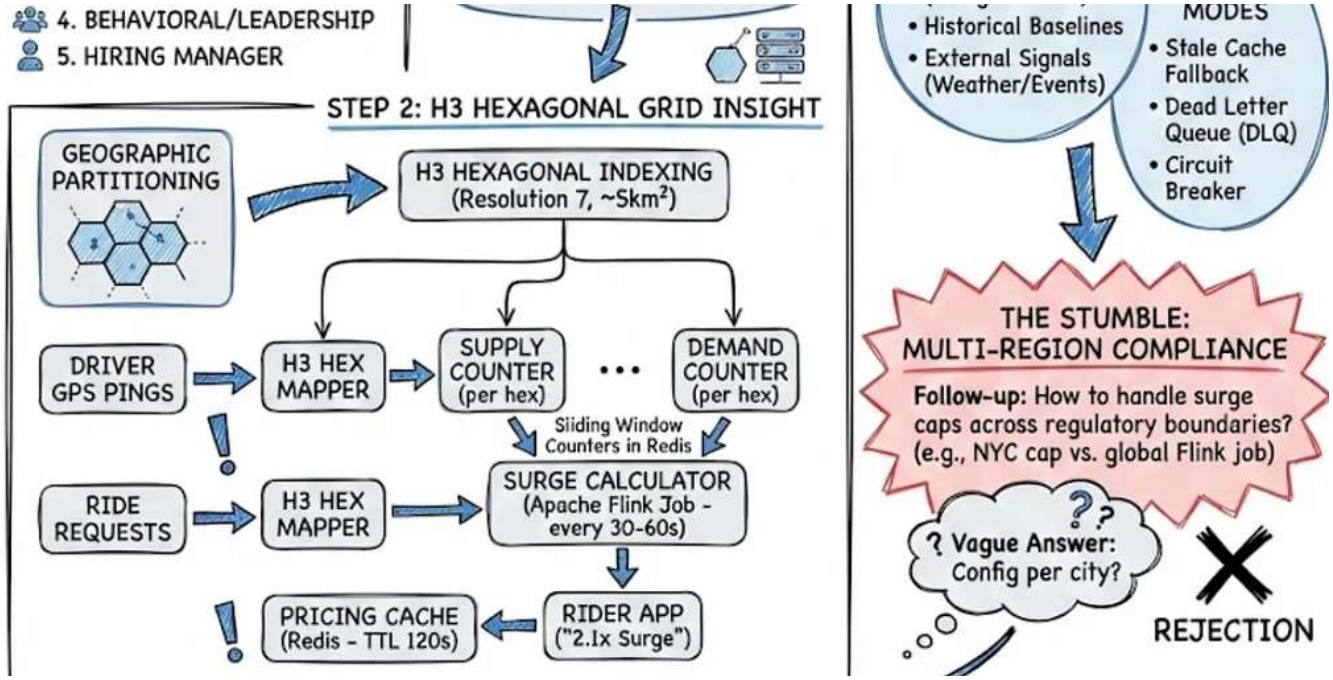

Emily

I Failed Uber's System Design Interview Last Month. Here's Every Question They Asked.

It was much harder and the rejection email taught me more than any LeetCode grind ever could.

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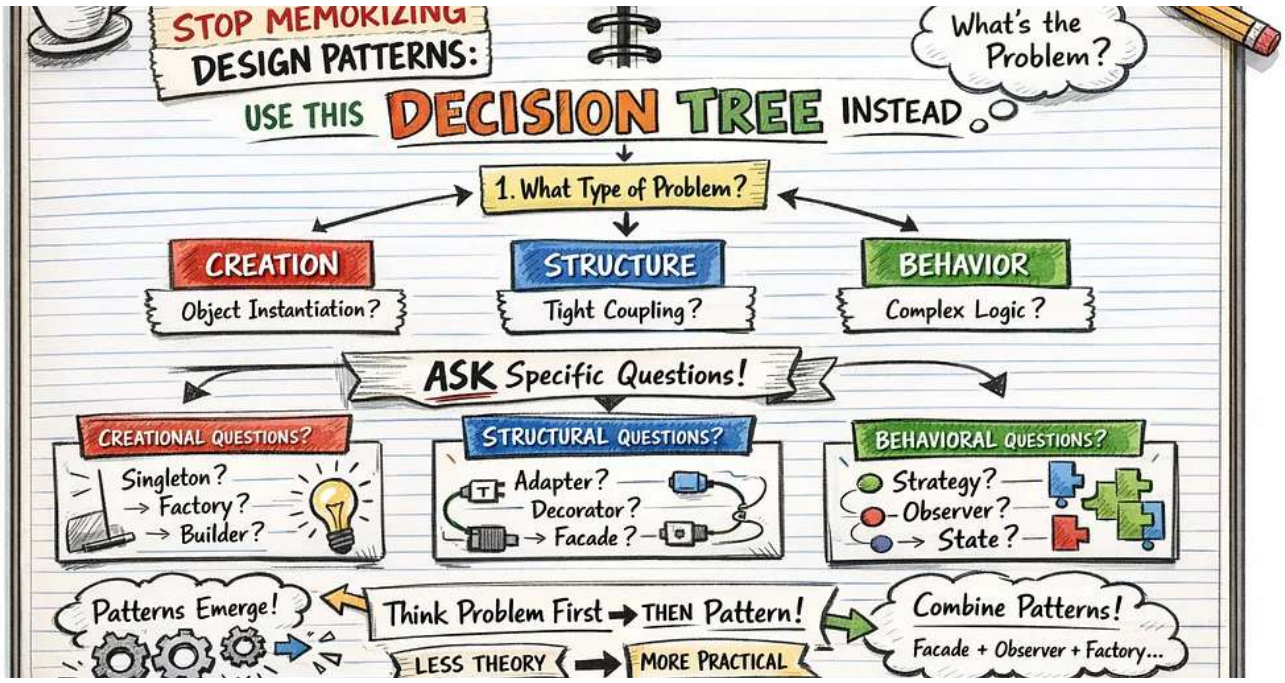

Pratik Chaudhari

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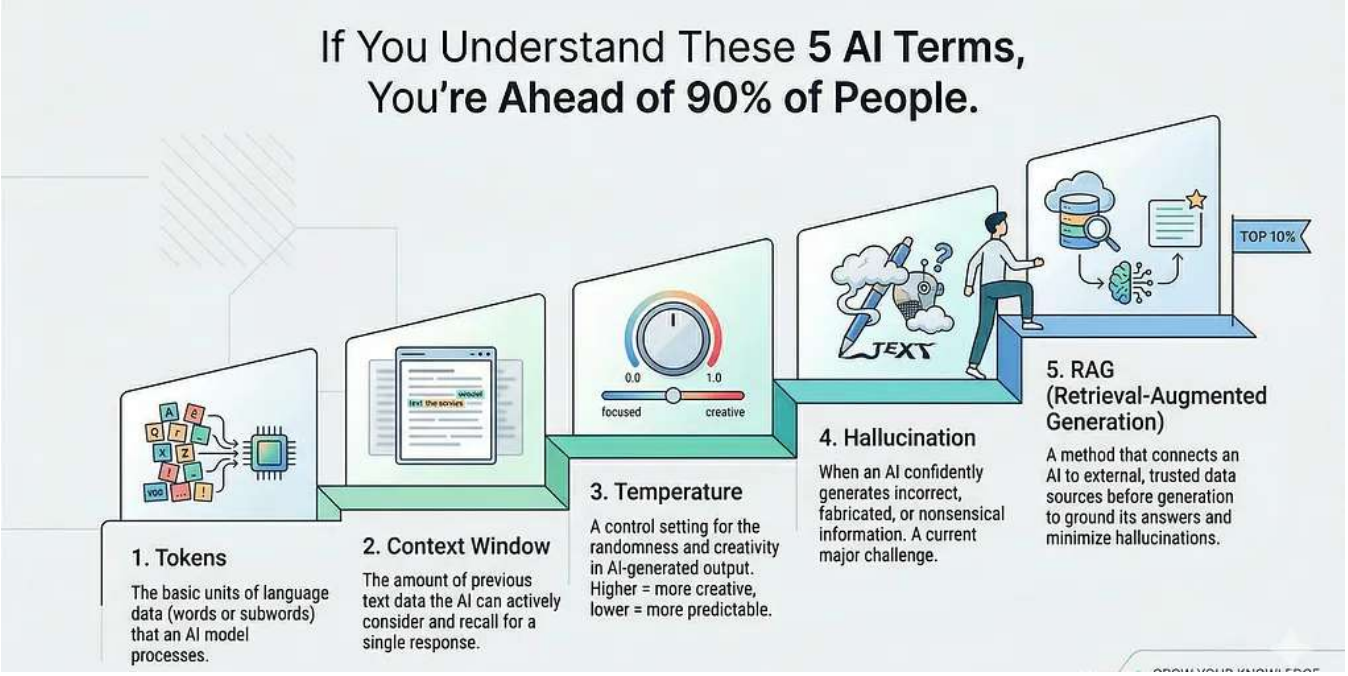

In Towards AI by Shreyas Naphad

If You Understand These 5 AI Terms, You're Ahead of 90% of People

Master the core ideas behind AI without getting lost

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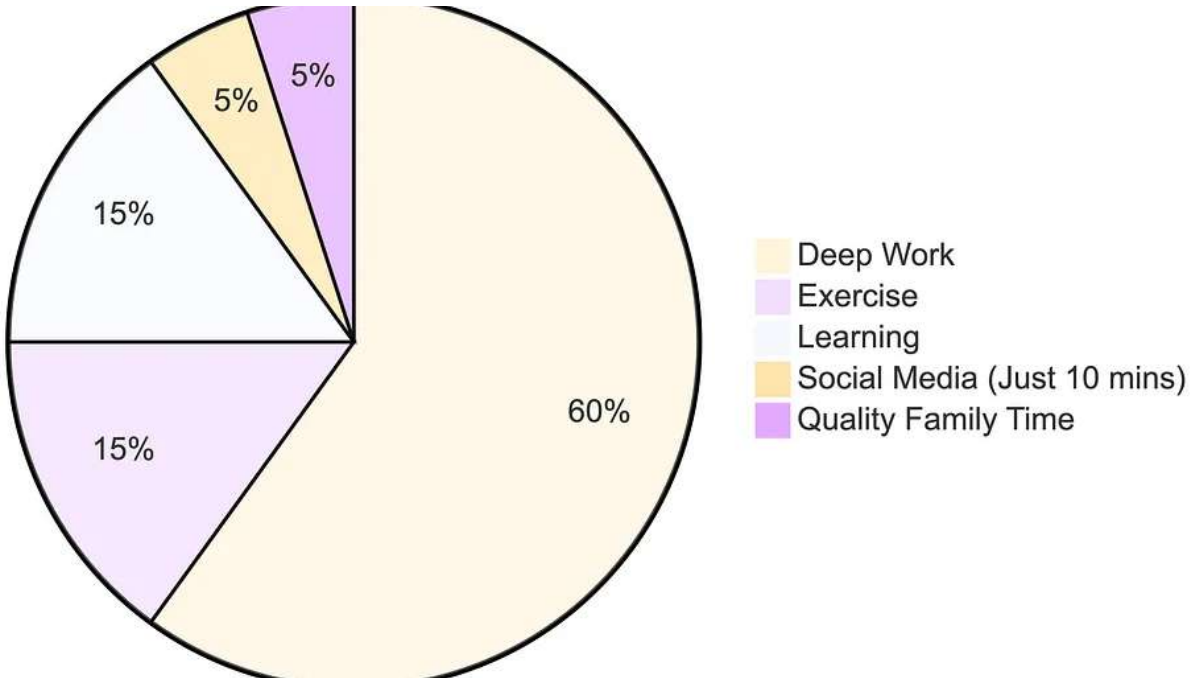

In Level Up Coding by Kusireddy

I Stopped Using ChatGPT for 30 Days. What Happened to My Brain Was Terrifying.

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In ILLUMINATION by Sufyan Maan, M.Eng

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