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Homeland Security & Cybersecurity

No Silver Bullets

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Lesson 33
No Silver Bullets

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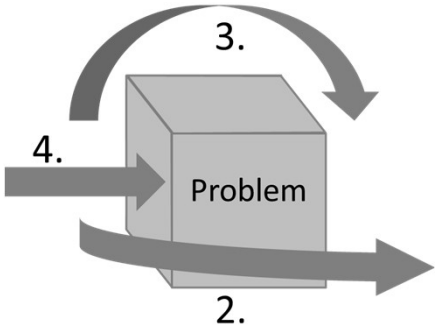
- In the previous lesson we asserted that there are at least four general options for dealing with the cybersecurity problem: 1) ignore it, 2) go around, 3) go over, or 4) go through it.
- In that lesson we **ruled out options one and two**, and said that current approaches may be likened to option four.



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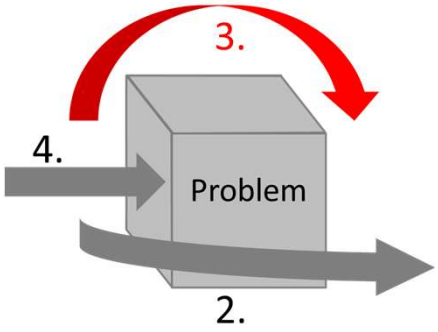
- This leaves us with option three, “go over”.
- **Option three implies that we find an alternative solution that essentially renders cybersecurity unnecessary**.



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- What is needed is a revolutionary technological advance.
- It’s happened before.

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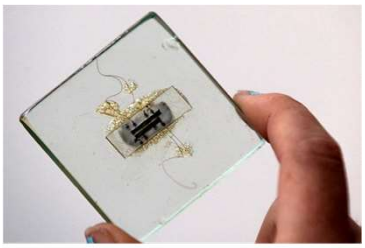
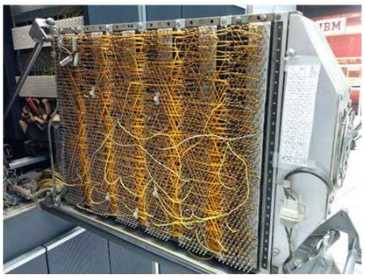
- **The microchip was a revolutionary advance in computer evolution**.
- Before its development, computers were constrained in capacity by the problem of wiring together the increasing number of components.
- The microchip overcame this challenge by combining the fabrication of components and wires into a single step, leading to the incredible shrinking computer.





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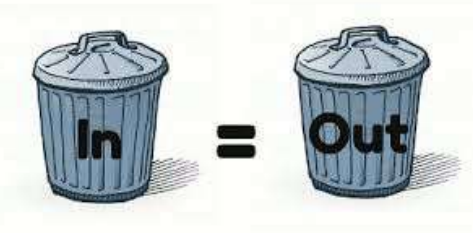
- Despite its increasing power, though, the computer remains inherently vulnerable to cyber attack.
- In Lesson 10 we attributed this problem to the fact that **computers are basically stupid**.
- They are stupid because unlike humans, **computers are incapable of making value judgments** regarding their actions and will perform as directed regardless of the outcome, even if the consequences are catastrophic.



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A computer's blind adherence to instructions is related to the three basic functions of its central processing unit:

1) fetch the next instruction,
2) execute the instruction, and
3) store the results.

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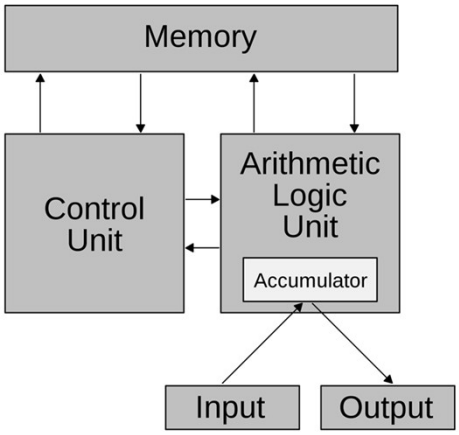
This is the **"Von Neumann Architecture",** so named for John Von Neumann, the famous polymath who first penned the concept in in his "First Draft Report on the EDVAC" in 1945.



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- To be fair, the concept had occurred to J. Prespert Eckert and John Mauchly while they were building the ENIAC, the world's first electronic digital computer.
- Von Neumann drafted his report while observing construction of the ENIAC at the University of Pennsylvania.

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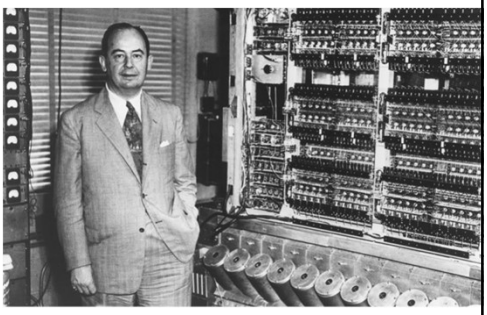
- Be that as it may, Von Neumann's report became the blueprint for 99% of today's computers, and it is this simple formula that has created the devilish problem of cybersecurity.
- **So the obvious answer is "let's find a new architecture."**



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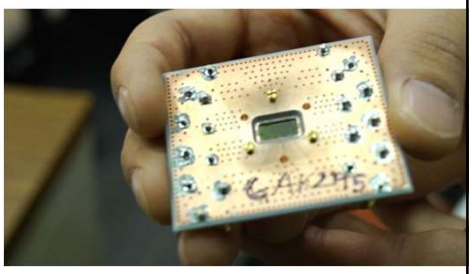
- Perhaps the next biggest advance in computer architecture is **quantum computing.**
- Needless to say, it is completely different.



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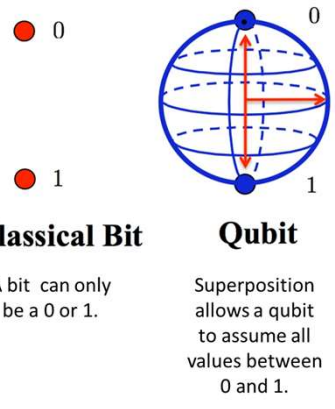
- Computation in Von Neumann machines is predicated on the choreographed opening and closing of billions of microscopic circuits.
- **Computation in quantum computers is predicated on the quantum fluctuations of only a few atomic particles packaged into qubits.**



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- Ten years ago the prospect of building a quantum computer seemed improbable.
- Today, quantum computers are not only probable, they are commercially available.

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The state of the art for quantum computers today is comparable to the state of conventional computers in the 1940s**… it's still about getting the design and hardware right.**

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- At any rate, do quantum computers hold the key to solving the cybersecurity problem?
- Can they lead to computers that can't be hacked?

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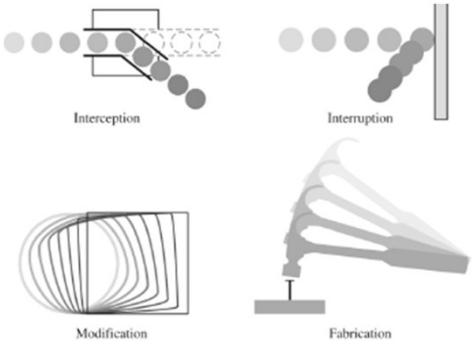
- The answer is "unlikely".
- To date, there's **nothing in their design that will inherently enforce confidentiality, integrity, and availability.**



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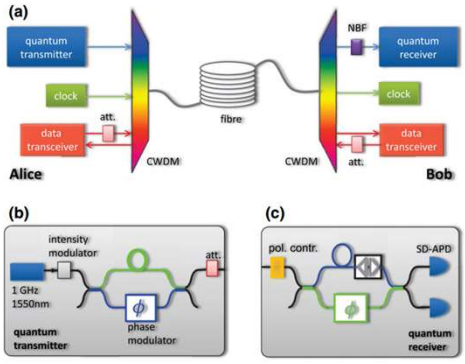
- Yes, current work on **quantum networks** make it easier to **detect interception**, but consider this may alternately be used as a means to **prevent availability**.
- **Also consider that quantum computers will make it easier to break cypher codes.**



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- And even if they don't, quantum computers **still can't overcome the insider attack**.
- So long as humans require access to a computer, conventional or otherwise, there will always be opportunity for malicious action.

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- As of the moment, quantum computers offer no solution to the cybersecurity problem.
- **Is there something we can do, then, to make computers smarter, so they won't blindly inflict catastrophe?**

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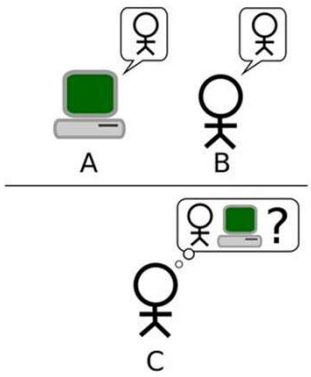
- One answer might be **"artificial intelligence"**; that is, incorporate a controlling intelligence **so computers "know" not to commit actions that would result in catastrophe.**
- As humans, our bodies will process anything we ingest, but we "know" not to eat poison.



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- While AI has made great advances, particularly in the realm of human speech recognition, it still has a long way to go.
- The essential problem is that human intelligence is predicated on what we call "common sense".
- **The problem with common sense is that it's anything but common.**
- Put another way, **human intelligence has a great capacity for resolving ambiguity.**

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- A classic example is "a boy saw a bike in the store and wanted it."
- The question is, **what is "it"?**
- Is "it" the bike or the store?
- As humans we assume "it" is the bike, but that **reasoning rests on hundreds of subtle understandings and assumptions** that have yet to be successfully grasped by AI.

Disambiguity

A boy saw a bike in the store and wanted **it**.

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And even if these obstacles can be overcome, **do we want a computer that can countermand a human order based on its own reasoning?**

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- There was an interesting experiment by the Department of Defense where they trained a computer neural network to identify hidden tanks.
- **The program performed brilliantly in the lab, but failed utterly in the field.**
- The reason for the failure?

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- As it turned out, all the pictures used to train the AI program were taken of tanks on a sunny day;
- The AI program had learned to associate tanks with sunny days, but was incapable of recognizing tanks on a cloudy day.
- **The point is, we may be able to teach a computer, but we won't necessarily know what it learned.**

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That may be acceptable for playing on Jeopardy, but not necessarily for controlling the electric grid.

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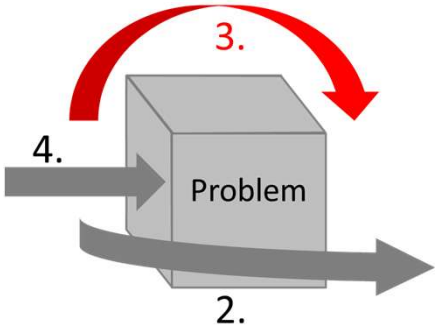
Given the current state of technological development, **there does not appear to be any technological solution on the current horizon that will eliminate the cybersecurity problem.**



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Conclusion

Questions?

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