

Quantum Computing

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Casualty Actuarial Society
 Ratemaking, Product and Modeling Seminar

1

our agenda

- 01** The Science
- 02** The Work
- 03** The Industry
- 04** Insurance

2

Let's Set the Baseline

Show of hands...

- Who has a degree in Physics?
- Who likes to read articles on Quantum Computing?
- Who saw Ant Man & the Wasp: Quantumania?

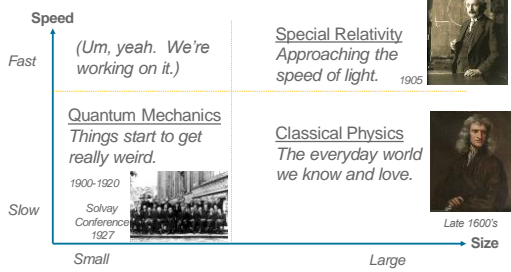
"Do you guys just put the word 'quantum' in front of everything?"

- Scott Lang



3

The Universe According to Physics

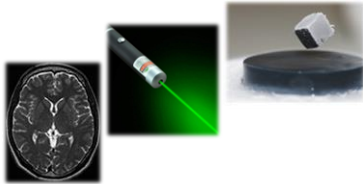


4

Practical Implications

The study of Quantum Mechanics has led to and/or impacted...

- Materials science – superconductors, semiconductors, transistors
- LEDs and lasers
- Medical imaging
- Many, many more



5

Making the Weirdness Work Scientifically

At a quantum level, matter exhibits some strange behavior, a couple of which are being leveraged to make quantum computers.

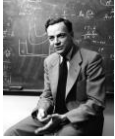
Superposition – the best description of matter is that it doesn't exist in precise locations with precise characteristics (unless someone goes poking around).

Entanglement – only certain combinations of matter can exist. Pairs of particles thus entangle, and if you poke around and nail one down, the other instantly gets poked too, getting nailed down in the complementary state.

6

Making the Weirdness Work *Computationally*

The *science* was developed in the 1920's



The idea of *computation* didn't come till 1982

7

Making the Weirdness Work *Computationally*

Why Quantum Computing? → *to simulate a quantum system*



Everything beyond this is hypothetical*



8

Making the Weirdness Work *Computationally*

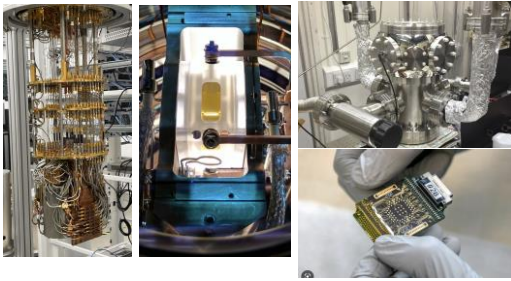
We have a *use-case* problem

Which drives a *modality* problem

Which in-turn drives the use-case problem

9

Physical Modalities



10

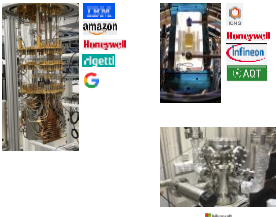
A Quick Analogy



11

Who is Doing This Work?

Who isn't?!?!?



- The Etc.
- "Middleware" to support Quantum systems
 - Quantum cryptography
 - Quantum key distribution
 - Quantum software compiling & deployment
 - Quantum Annealing

12

What's Next

- "Quantum Winter" ?
- Modality competition
- First-mover advantage
- RSA/cryptography



13

What's this got to do with Insurance?

Remember, a quantum computer is not faster than a classical computer. It is *different* than a classical computer. So...

What does QC seem to be good at?

- Optimization
- True randomness
- Monte Carlo
- Bayesian approaches



14

What's this got to do with Insurance?

- | | |
|--|----------------------------------|
| <i>Asset management</i> | <i>Financial forecasting</i> |
| <i>Credit scoring</i> | <i>Fraud detection</i> |
| <i>Data enrichment</i> | <i>Optimized claims handling</i> |
| <i>Data privacy</i> | <i>Portfolio management</i> |
| <i>Enhanced pricing and risk pooling precision</i> | <i>Risk modeling</i> |
| <i>Weather forecasting</i> | <i>Scenario planning</i> |

15

What's this got to do with Insurance?

Again, don't just think of speed. Sometimes what wasn't possible suddenly is.

Current situation – fit a zero-inflated negative binomial model. Run 10K simulations for individual applications.

Must limit predictors and make simplifying assumptions to fit the model in one hour.



16

To learn more

Ars Technica – Quantum Computing

Quanta Magazine – 2021 article by Scott Aaronson, “What Makes Quantum Computing So Hard to Explain?”

National Academies Press – Open Book, “Quantum Computing: Progress and Prospects”, 2019

- Chapter 3: Quantum Algorithms and Applications

17

Any Questions?

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18