Quantum Computing Since Democritus: Scott Aaronson

Chapter 1 Summary: Atoms and the Void

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Outline

Quantum
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Chapter 1
Summary:
Atoms and
the Void

1. Democritus in 400 BC
2. Color and taste are not intrinsic to atoms

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Intellect: By convention there is sweetness, by convention bitterness, by convention color, in reality only atoms and the void.
Senses: Foolish intellect! Do you seek to overthrow us, while it is from us that you take your evidence?

Quantum Mechanics

- RULE 1: it describes the evolution in time of the state of a region
- superposition of all the possible configurations of elementary particles in that region
- splitting into copies of ourselves
- RULE 2: act of measurement forces particle to choose 1 outcome probabilistically

Dilemma

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1. What IS a measurement?
2. Aren't physical laws supposed to be universal?
3. Modern Democritus Dilemma
4. Where do I put myself on the coherent superposition line?

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1 TYPE 1: There is no issue.
- Line between quantum experiment and measuring device
- Because a quantum state is just a representation of your knowledge
- Ex: Copenhagen and its Bayesian and Epistemic grandchildren

The Different Interpretation Religions

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1. TYPE 1: There is no issue.
   - Line between quantum experiment and measuring device
   - Because a quantum state is just a representation of your knowledge
   - Ex: Copenhagen and its Bayesian and Epistemic grandchildren
2. TYPE 2: What if I'm part of the quantum universe?
   - Put yourself in coherent superposition
   - Bohr's reply
   - Accomodator examples: many-worlds, Bohmian mechanics, etc.

Importance of Philosophy

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- Usually, a boring, over-explaining vulture
- Here, a scout
- Capacities of quantum channels, error probabilities of quantum algorithms

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Who can I put in coherent superposition for 500 million years?

- A human?

Aha! Connection

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Who can I put in coherent superposition for 500 million years?

- A human?
- A computer!