

Introduction to Quantum Computing



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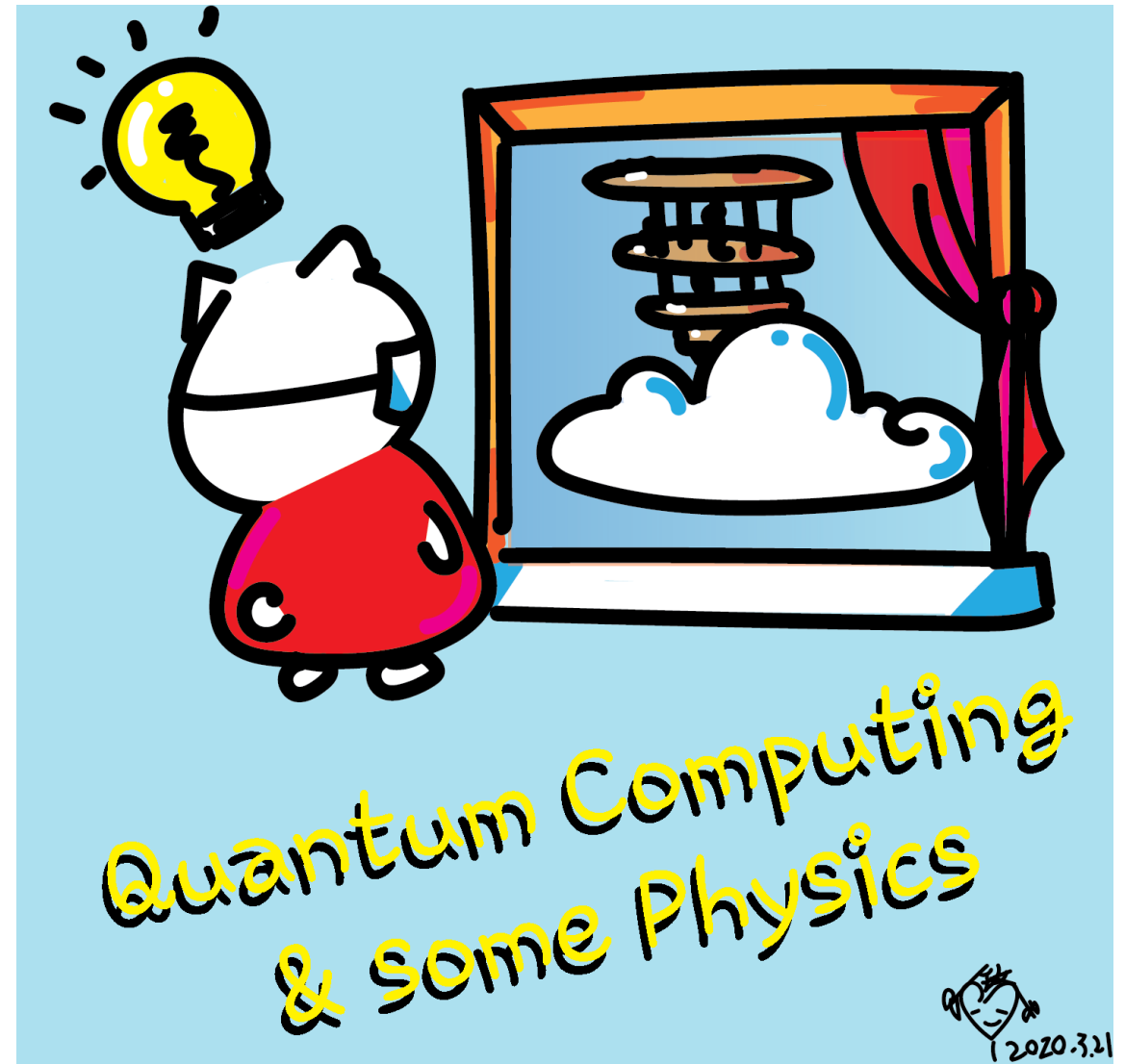
July 26, 2020

Hackaday, session 16

Other communities, session 8

Class structure

- [Comics on Hackaday – Quantum Computing through Comics](#) every Sun
- 30 mins – 1 hour every Sun, one concept (theory, hardware, programming), Q&A
- Contribute to Q# documentation
<http://docs.microsoft.com/quantum>
- Coding through Quantum Katas
<https://github.com/Microsoft/QuantumKatas/>
- Discuss in Hackaday project comments throughout the week
- Take notes



Which is the book
I'm looking for?

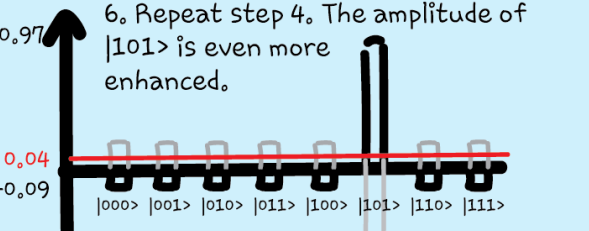
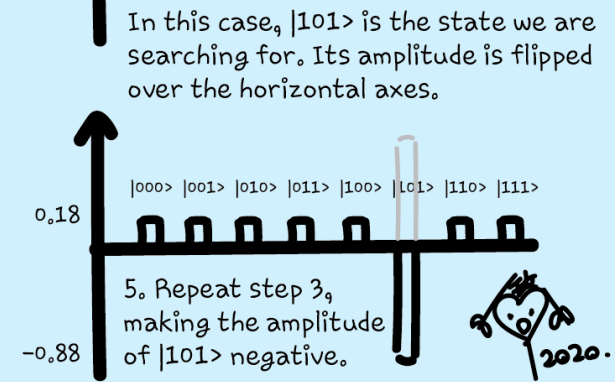
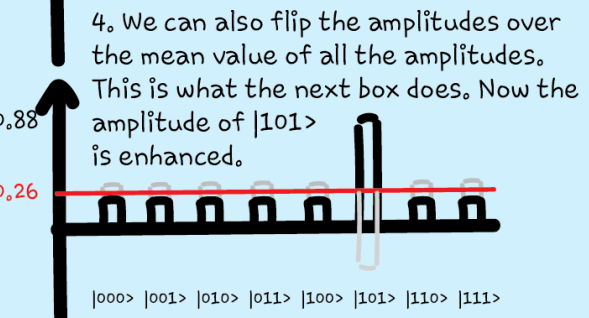
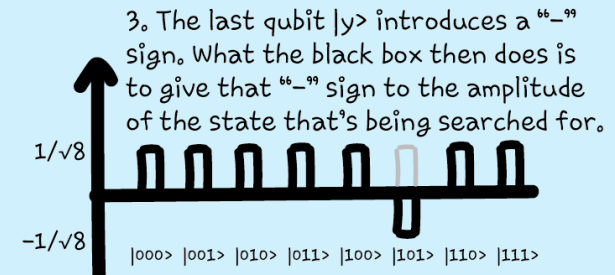
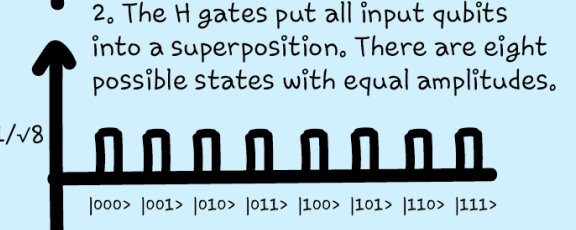
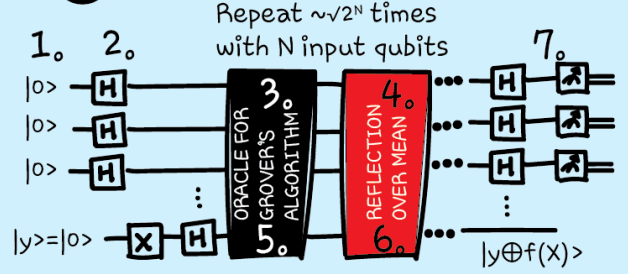
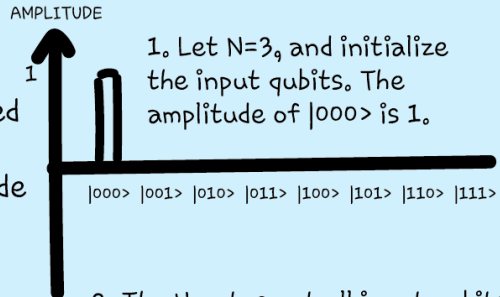


Classically need to
look at each book.
Grover's search
feeds all inputs into
the algorithm and
output the answer.
There is no "parallel
computing", but
interference between
the possibilities.



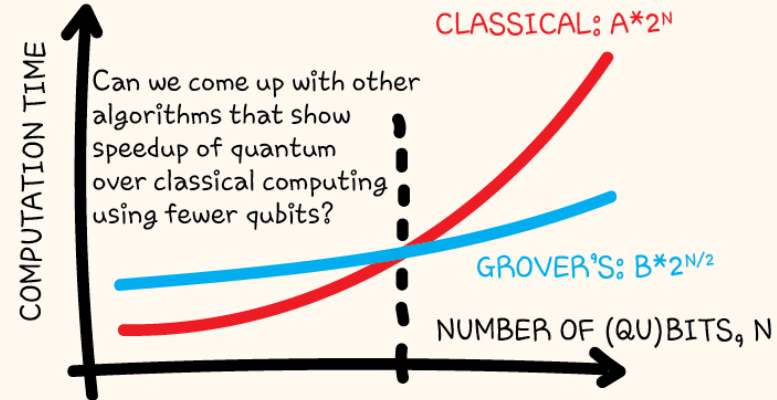


Grover's algorithm searches for an item in an unordered list by increasing that item's amplitude step by step.

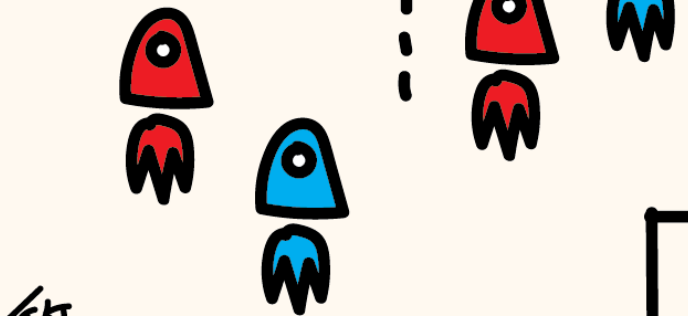


7. Now the measurement result is dominated by $|101\rangle$.

2020.5.17

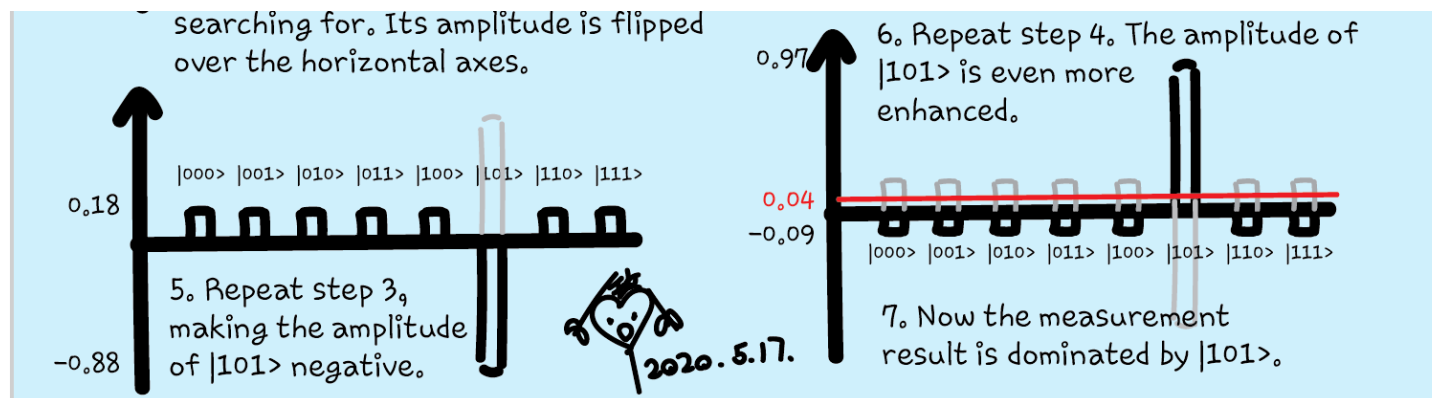
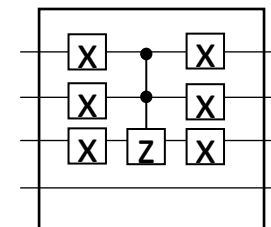
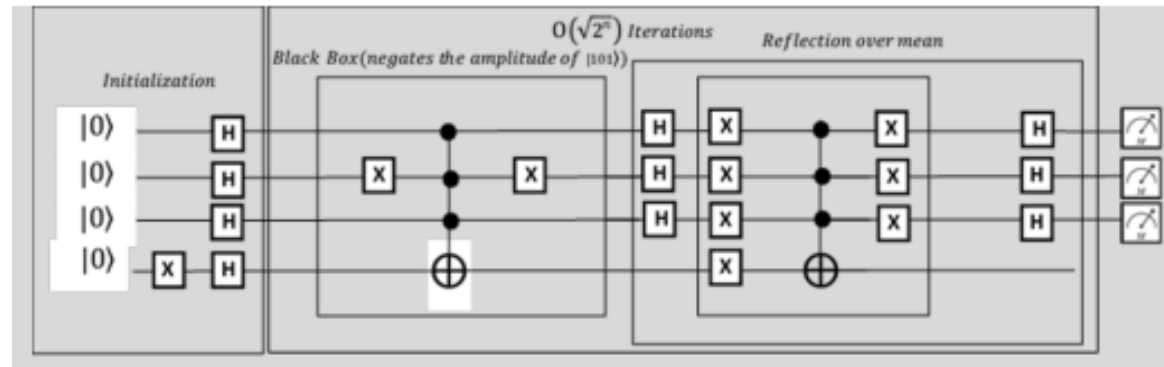
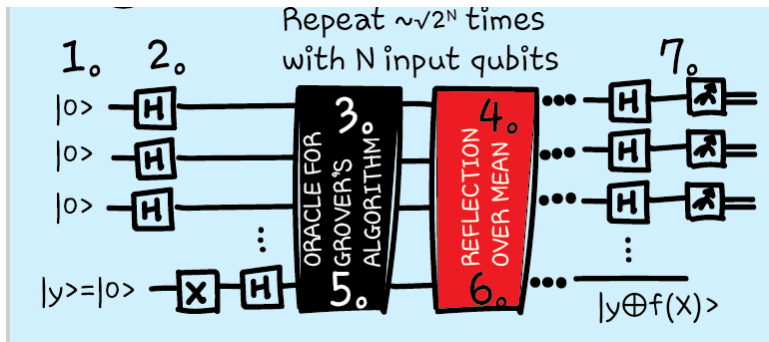


FASTEST SUPERCOMPUTER



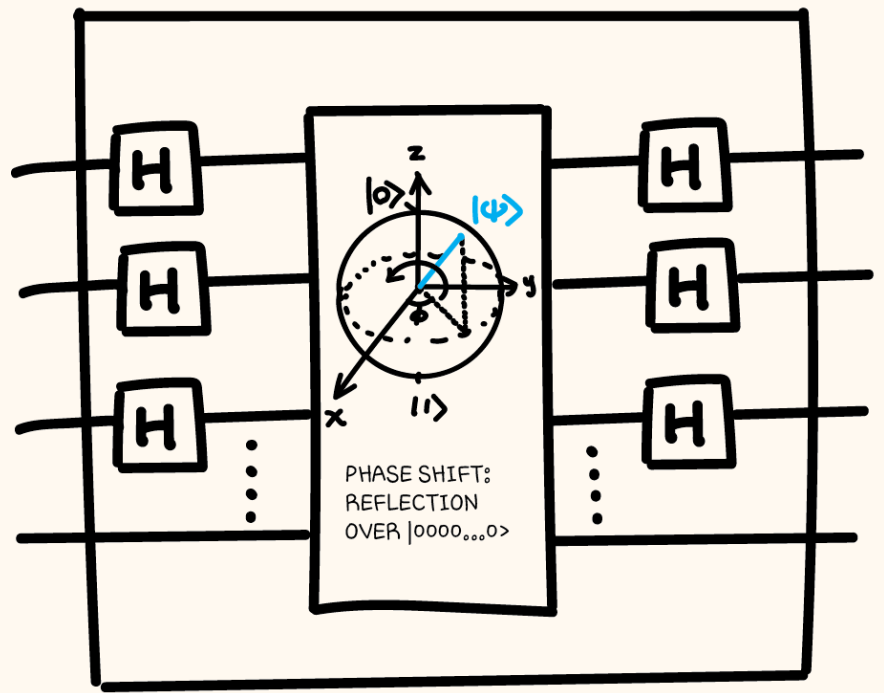
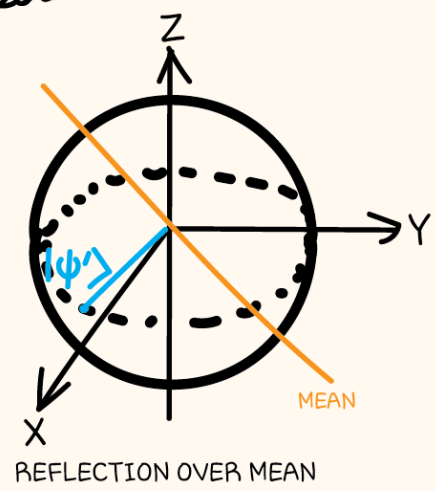
Grover's algorithm provides a speedup over classical algorithms for searching for an item in an unordered list (after a certain number of qubits are reached). A and B are factors that don't depend on N . (They describe how long it takes for the computers to complete the task for a fixed N).

The reflection over the $|000\dots 0\rangle$ state surrounded by H gates is the reflection over mean.

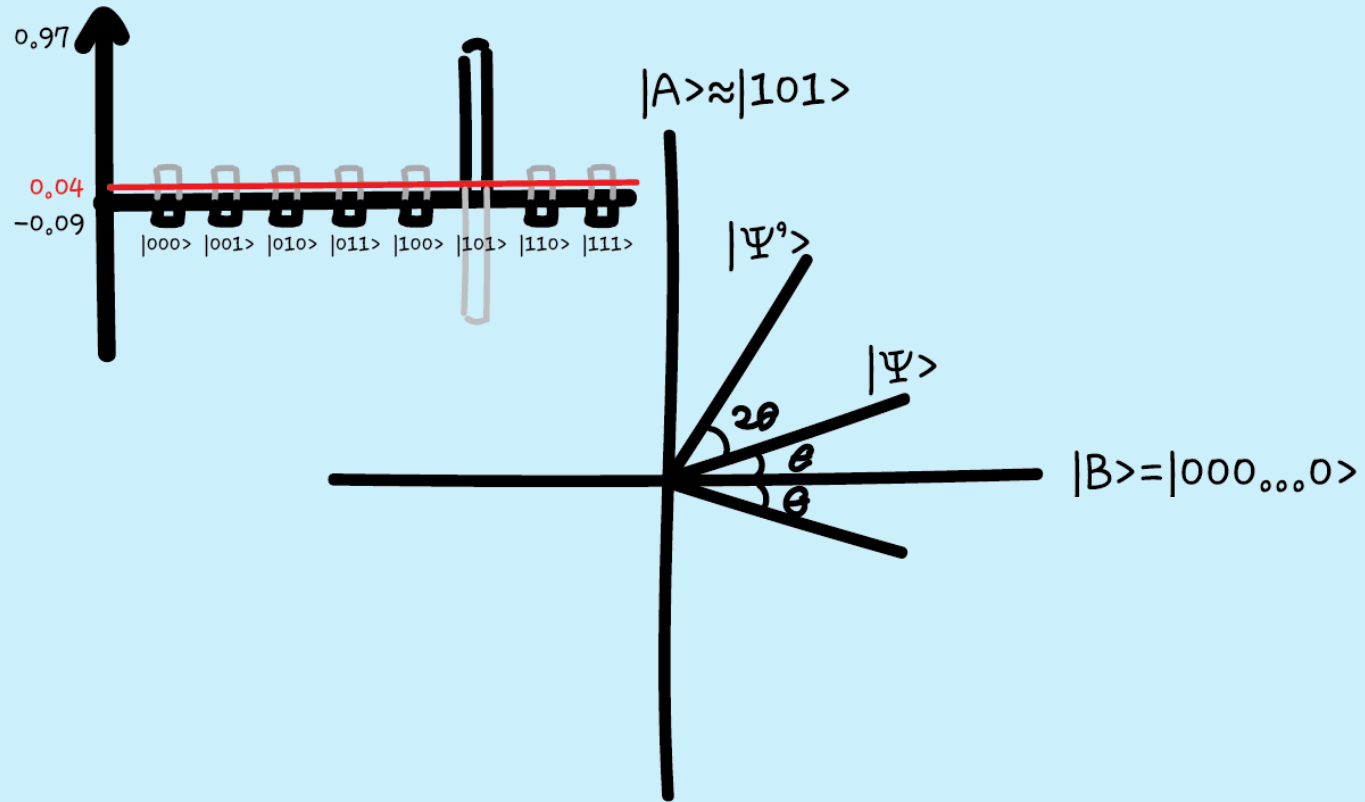


FAST
2020.7.19.

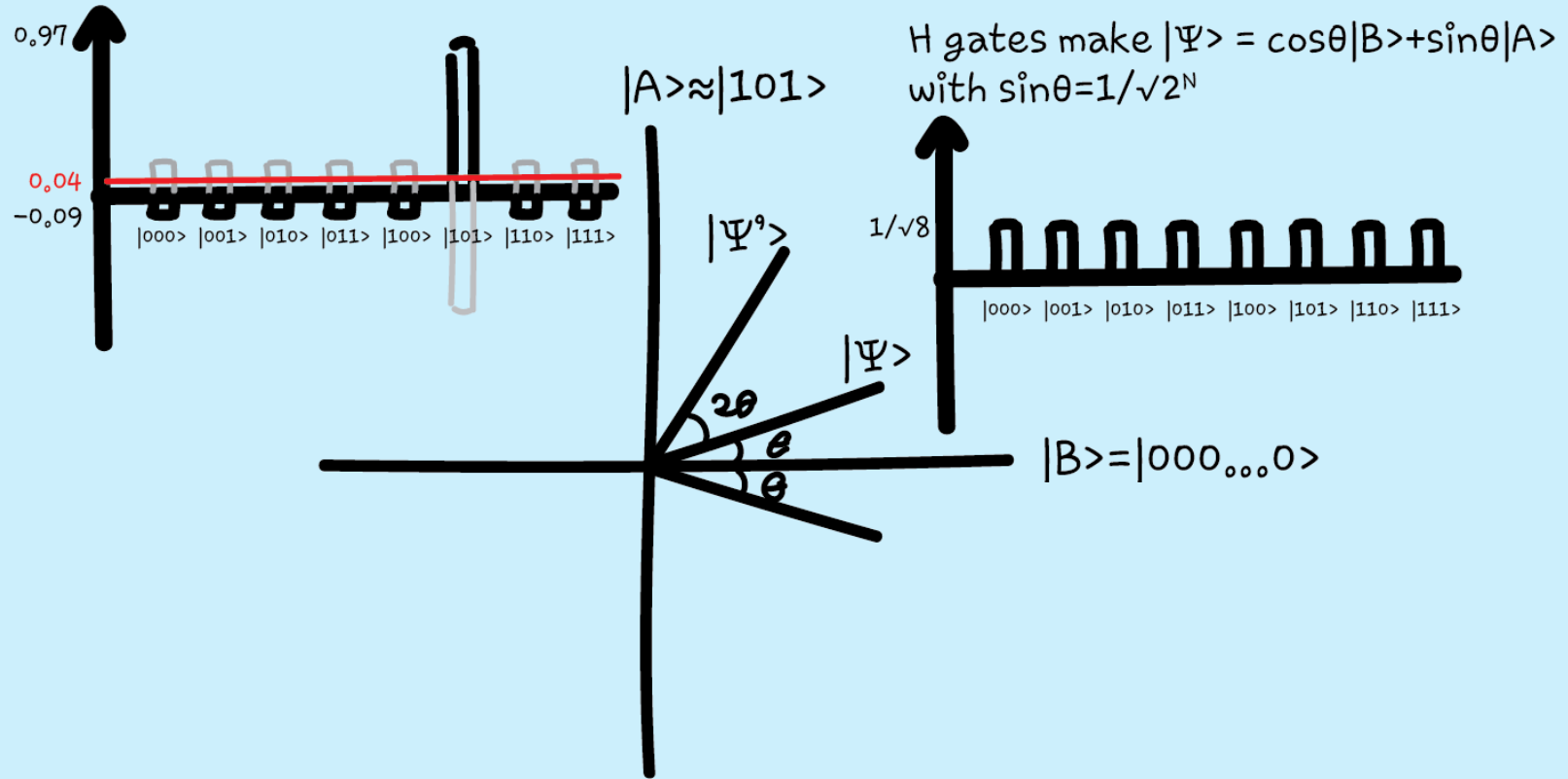
FASTEST QUANTUM COMPUTER



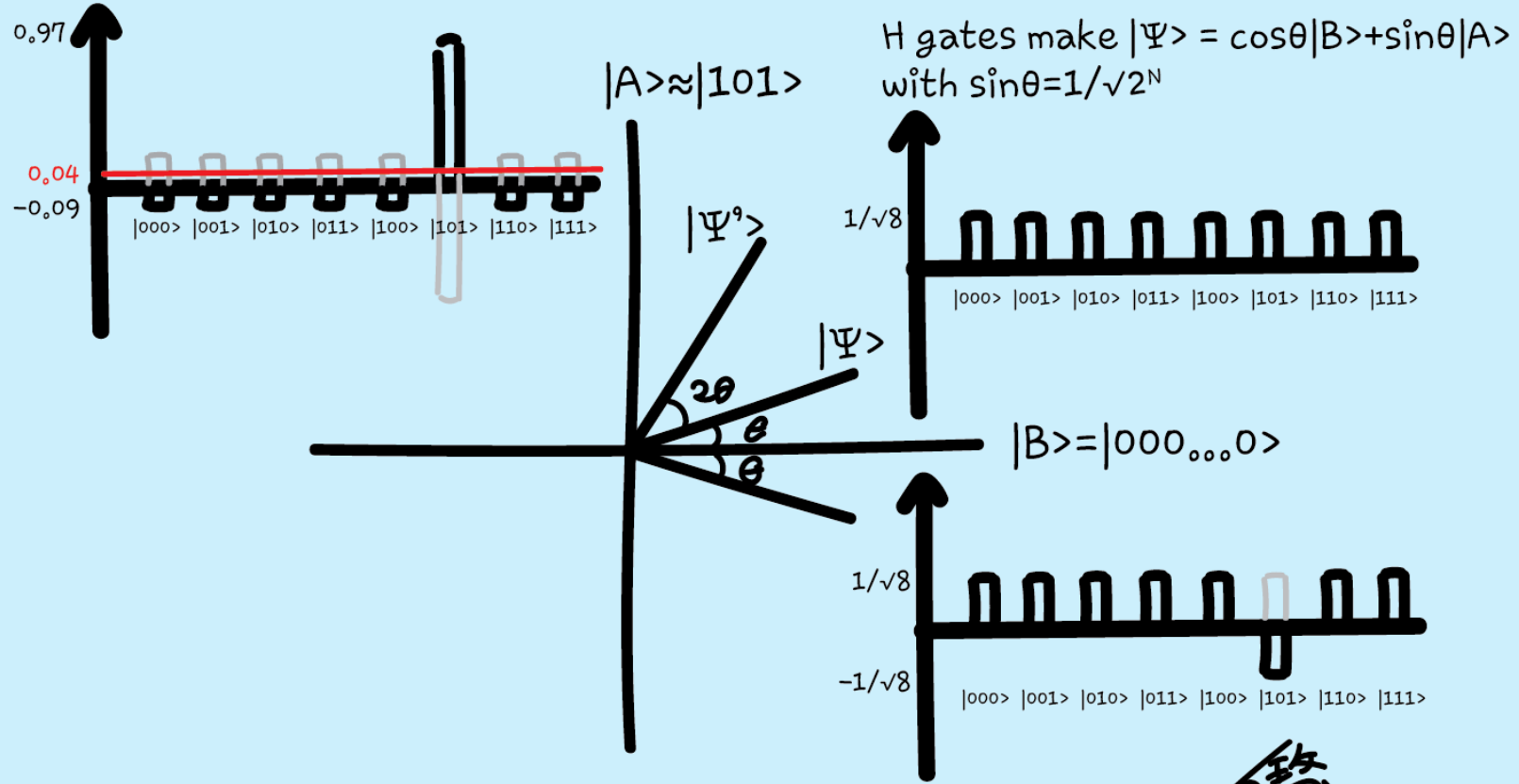
How many iterations in Grover's algorithm is enough?



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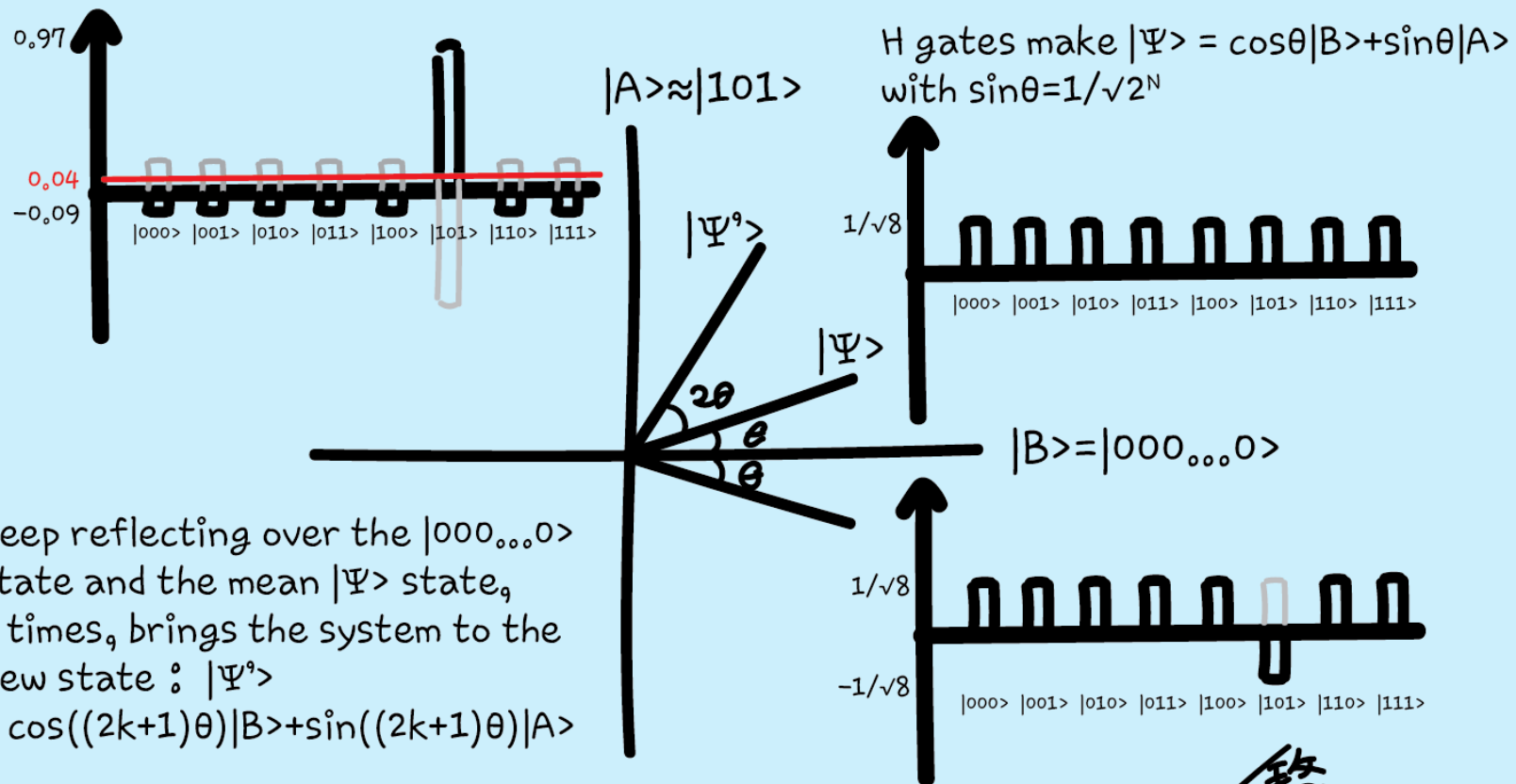


How many iterations in Grover's algorithm is enough?



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2020.7.25.

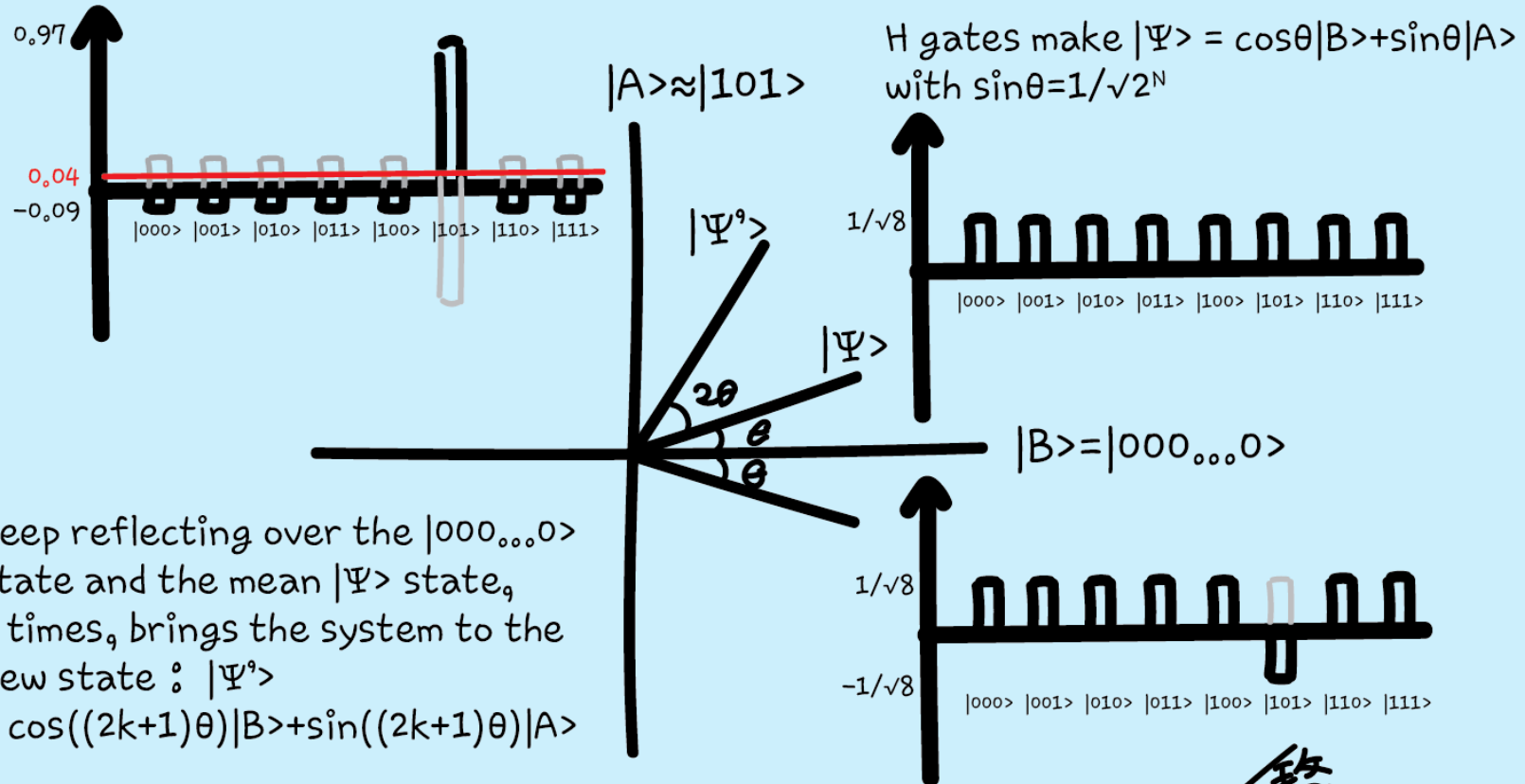
How many iterations in Grover's algorithm is enough?



Keep reflecting over the $|000\dots 0\rangle$ state and the mean $|\Psi\rangle$ state, k times, brings the system to the new state $|\Psi^k\rangle$
 $= \cos((2k+1)\theta)|B\rangle + \sin((2k+1)\theta)|A\rangle$

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 2020.7.25.

How many iterations in Grover's algorithm is enough?



Keep reflecting over the $|000\dots 0\rangle$ state and the mean $|\Psi\rangle$ state, k times, brings the system to the new state $|\Psi^k\rangle = \cos((2k+1)\theta)|B\rangle + \sin((2k+1)\theta)|A\rangle$

It is closest to $|A\rangle$ when:
 $\sin((2k+1)\theta) \approx 1 \Rightarrow (2k+1)\theta \approx \pi/2 \Rightarrow k \approx \pi/(4\theta) - 1/2$
 That's why the number of iterations is on the order of $\sqrt{2^N}$.

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Q# exercise:

Quantum Development Kit

- <http://docs.microsoft.com/quantum>
- Tutorials -> Grover's algorithm sample
- Quantum Katas GroversAlgorithm links

Questions

- Post in chat or on Hackaday project
<https://hackaday.io/project/168554-quantum-computing-through-comics>
- FAQ: Past Recordings on Hackaday project or my YouTube <https://www.youtube.com/c/DrKittyYeung>

Special classes next week



FTL SPEAKER NIGHT -
QUANTUM COMPUTING
JULY 30, 2020 19:00 - 21:00 CET

Speaker
Kitty Yeung,
Senior Program Manager
at Microsoft

The poster features a pink-to-purple gradient background with a portrait of Kitty Yeung. It includes a white geometric line-art graphic in the bottom right corner and a white icon of three people.

Female Tech Leaders
Remote Speaker Night: [Quantum Computing](#)



teensinai
presents
**AI Accelerator
2020**
**Quantum
Computing
Workshop**
27th July - 7th August 2020

Kitty Y. M. Yeung
Senior Program Manager of Quantum
Computing at Microsoft

#AIAccelerator2020 #TeensInAI2020
#TeensInAI #AIforGood

Microsoft

The poster has a dark purple-to-pink gradient background. It features a circular portrait of Kitty Y. M. Yeung, a red paperclip icon, and the Microsoft logo.

6-7:30 pm CET
Sunday Aug 2