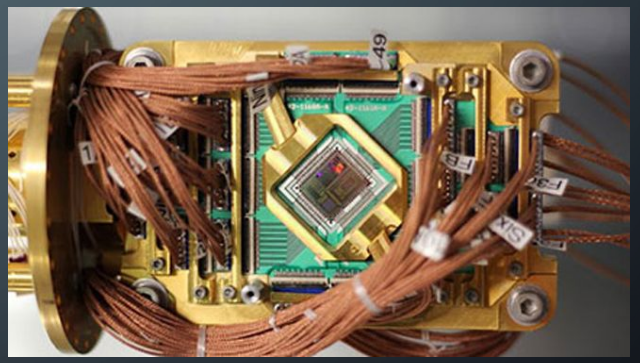
D-WAVE

THANANON PATINYASAKDIKUL



D-Wave

The Quantum Computing Company™

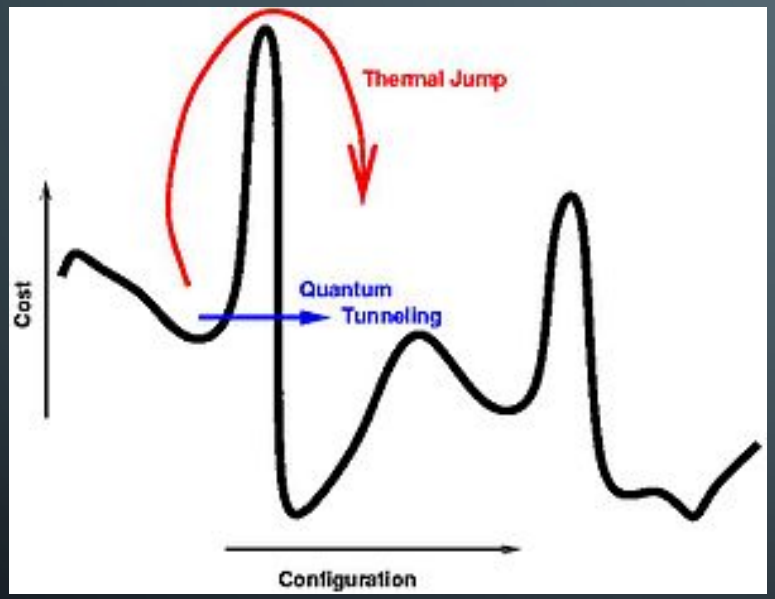
D-WAVE

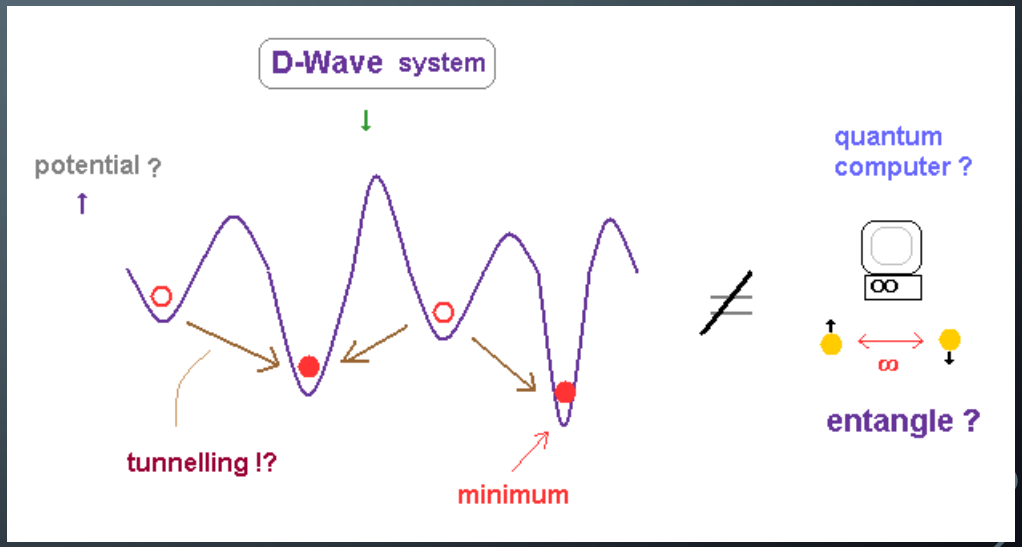
- First and only commercial quantum computer company.
- Canadian
- Founder was a Ph.D candidate in physics.
- Debuted in 2007 with a prototype computer that solves cool problem.
- First commercially available computer released in 2011 with 128 qubits.
- First client? Lockheed-Martin
- Their latest computer, D-WAVE 2x has 1000+ qubits.

PROBLEMS

- Quantum computer is very sensitive.
- Need error correction mechanism.
- More qubit, more correction.
- Might spend a lot more in the error correction than the computation itself.

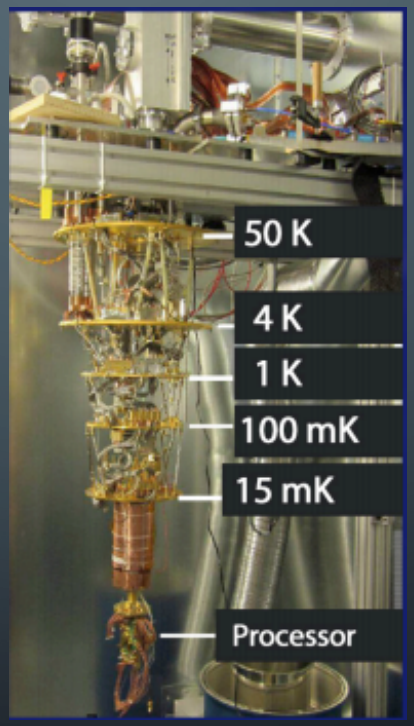
QUANTUM ANNEALING

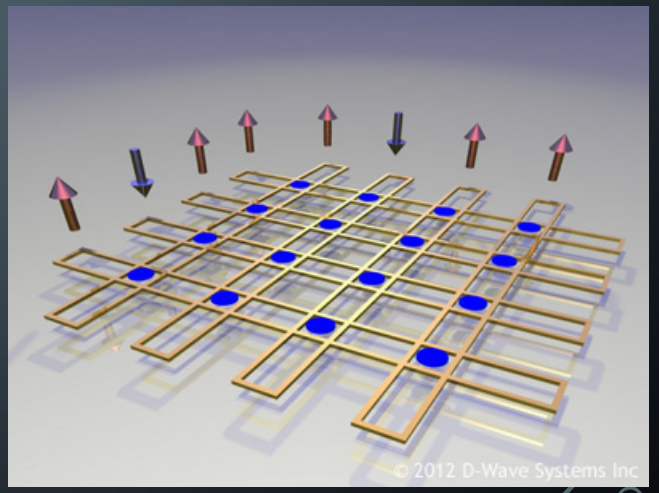




- Great for optimization problem. (Find global minimum)

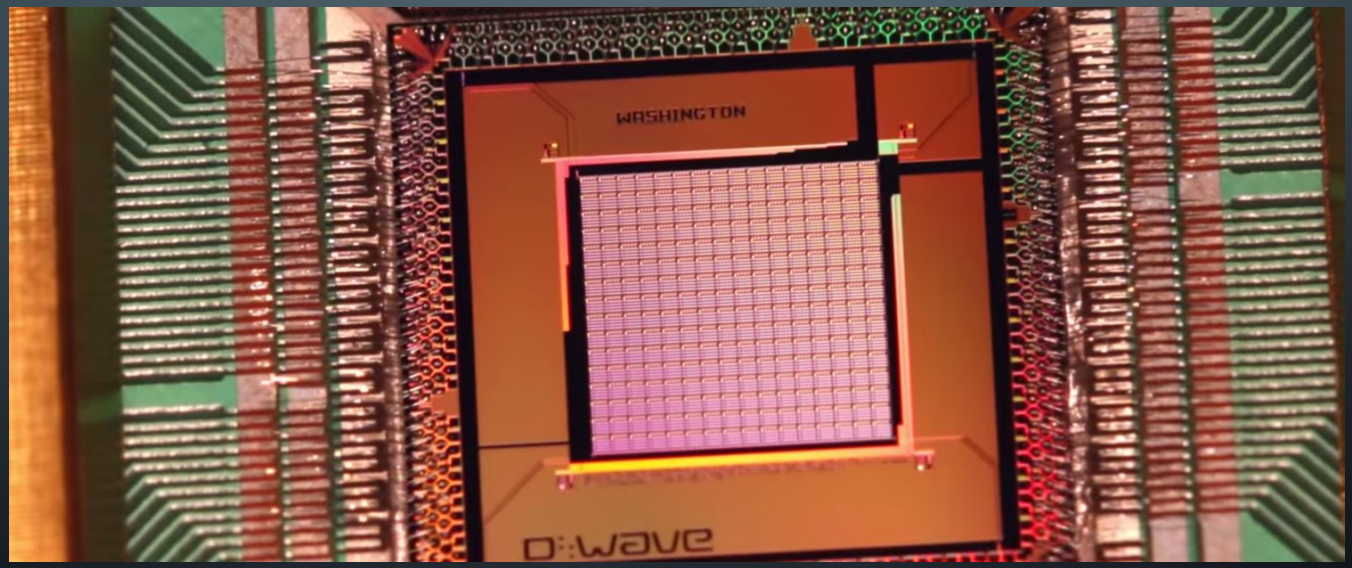
HOW DOES THIS THING WORK?





HOW DOES THIS THING WORK?

- Using Niobium loops, cool down close to abs zero –> superconductor



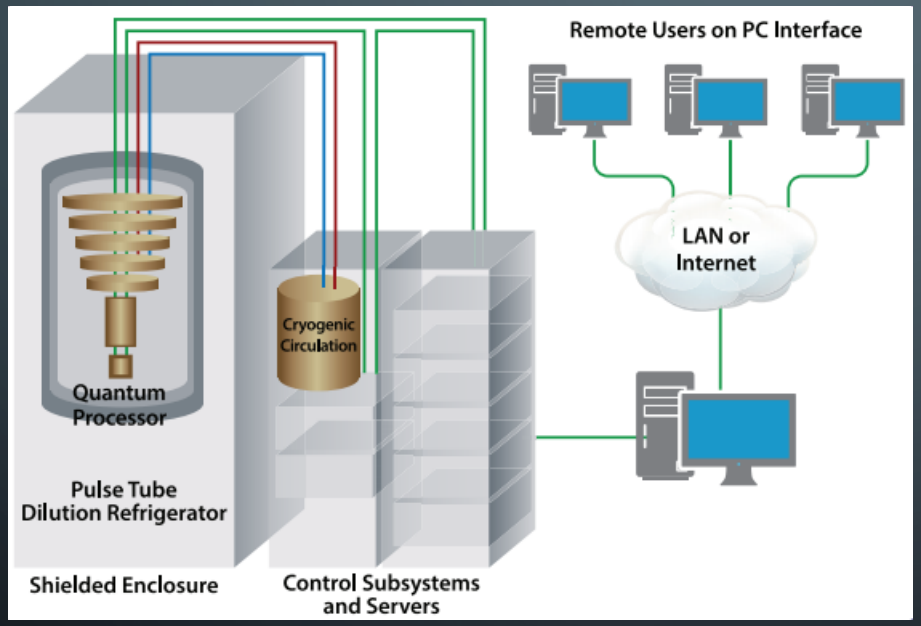
Niobium?

Nb 41

Niobium

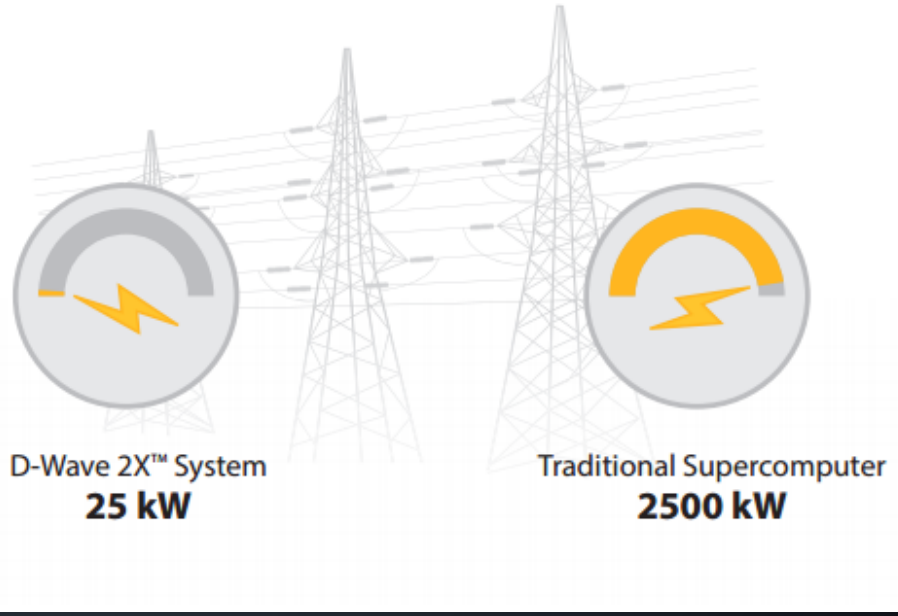
1																	18
H	2											13	14	15	16	17	He
Li	Be											B	C	N	O	F	Ne
Na	Mg	3	4	5	6	7	8	9	10	11	12	Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo
		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb		
		Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No		

HOW TO PROGRAM?



- C
- C++
- Python
- MATLAB

POWER CONSUMPTION



APPLICATIONS

- Water network optimization
- Protein Folding
- Binary Classification
- Video Compression

TRENDS


10,000
1,000
100
10
1
Number of Qubits
2002
2006
2010
2014
2016
4 qubit
16 qubit
28 qubit
D-Wave One
128 qubit
D-Wave Two
512 qubit
D-Wave 2X
1000 qubit

“ DWAVE IS THE BEST QUANTUM COMPUTER EVER! ”

- D-WAVE

OR IS IT?

CONTROVERSIES

IS IT REALLY QUANTUM?

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- A team of researchers tested D-WAVE for quantum behavior.
- Google/NASA does an acceptance test on the machine.
- Another team of researchers tested for the entanglement.

STILL DOESN'T MEAN IT'S QUANTUM.

DOES IT REALLY GIVE SPEEDUP OVER CONVENTIONAL COMPUTER?

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BUT IT'S RIGGED!

- They compared the exact method with heuristic method.
- The problem can be solved with classical annealing with similar speed.
- When they compare D-WAVE against tabu search, they still find the advantage but they become much much smaller (no number disclosed).

DOES IT REALLY GIVE SPEEDUP OVER CONVENTIONAL COMPUTER?

- Another researcher has come up with an optimized simulated annealing code that performs 15x faster on a personal computer.

- Another researcher has found that D-WAVE is 10k times slower than his laptop on different problem.

CONCLUSION…

QUESTION?

REFERENCES

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- Scott Aaronson, *D-Wave: Truth finally starts to emerge*
- Wikipedia
- physicsworld.com, *Is D-Wave's quantum computer actually a quantum computer?*
- Nature.com, *Computing: The quantum company*