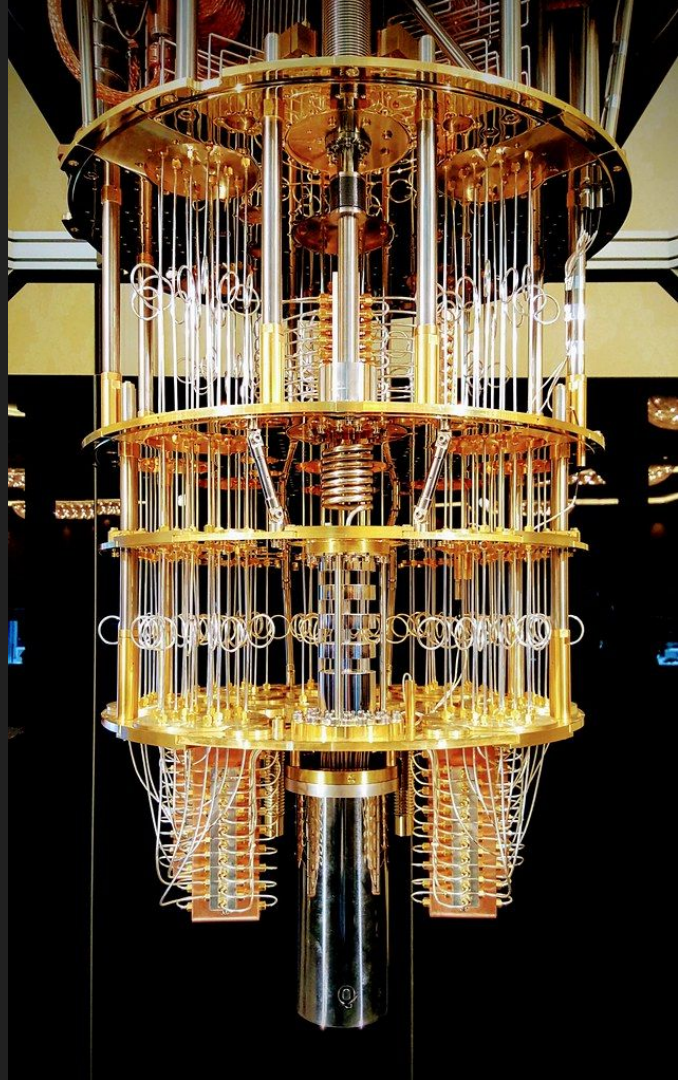
Life and Communication Post and Pre Quantum Supremacy

Quantum Computing IRL

Google

IBM

NASA



quantum supremacy and quantum advantage

- quantum supremacy is the goal of demonstrating that a programmable quantum device can solve a problem that classical computers practically cannot (irrespective of the usefulness of the problem)

- quantum advantage is the demonstration that a quantum device can solve a problem merely faster than classical computers.

Quantum supremacy

Quantum advantage

Google is actively try to achieve quantum supremacy as shown by their recently leaked paper. https://ai.googleblog.com/2019/10/quantum-supremacy-using-programmable.html

While they did manage to maintain a stable quantum computing environment with ‘Sycamore’, performing a optimized 2.5 day calculation [IBM] in 200 seconds, this is still not exactly quantum supremacy because this calculation is predicted to scale linearly, not exponentially.

However this has shown that a quantum computing environment can be maintained, and that a quantum computer can outpace a normal one. Sycamore has proved “quantum advantage”. Quantum Supremacy still has not been achieved by any experiment or device.

Quantum advantage

While quantum advantage isn’t quite as exciting as quantum supremacy it is still pretty awesome.

Think about how limited Unity, Maya and VR currently are

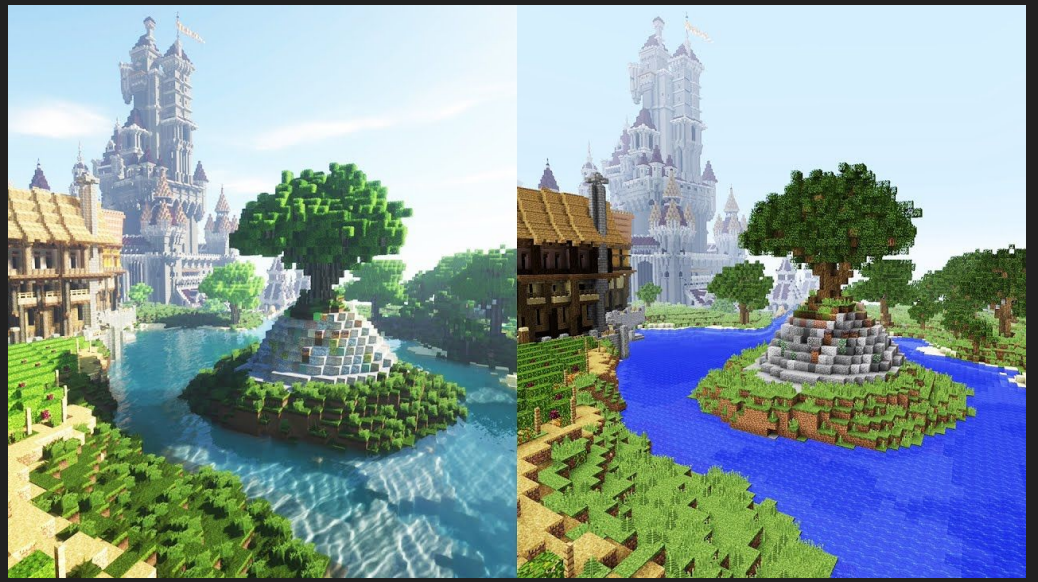
Imagine if the number of actions taken in 2.5 days only took about 3 minutes.

(This means that any unity program you've ever written that's lagged a bit would now run perfectly fine.)

Here are some ways we could improve VR if for every 1 calculation we could perform 1080

- Add processing for other senses
- Increase rendering
- More shadows and particle effects
- More real physics and less approximations

We could even potentially start to run computational experiments in the same VR simulations we are looking at.



Minecraft with ray tracing vs Minecraft without

Communication in VR

If we can connect VR systems we could have college lectures, conferences, and more (together and by recording) anywhere.

- Improvements in accessibility for people with disabilities and who cannot afford travel, potential erasure of bias by appearance, and more.

(though this assumes access to a VR system. Usually technology follows a period of being very expensive but then becomes less expensive and more integrated into culture and society over time)

New types of Communication through VR

In VR we also don’t have to follow the rules of the natural world. Communication could become something like realistic 3D+ emojis or something fully different.

Random numbers

Another application of Quantum computing is generating “high quality” random numbers.

Simple functions like “math.random()” actually aren’t completely random. And actually getting “quality” random numbers can take days. These types of random numbers are important for artificial intelligence, machine learning, and behavioral markov chains.

Achieving more human-like AI and communicating with these systems could let us explore our humanity

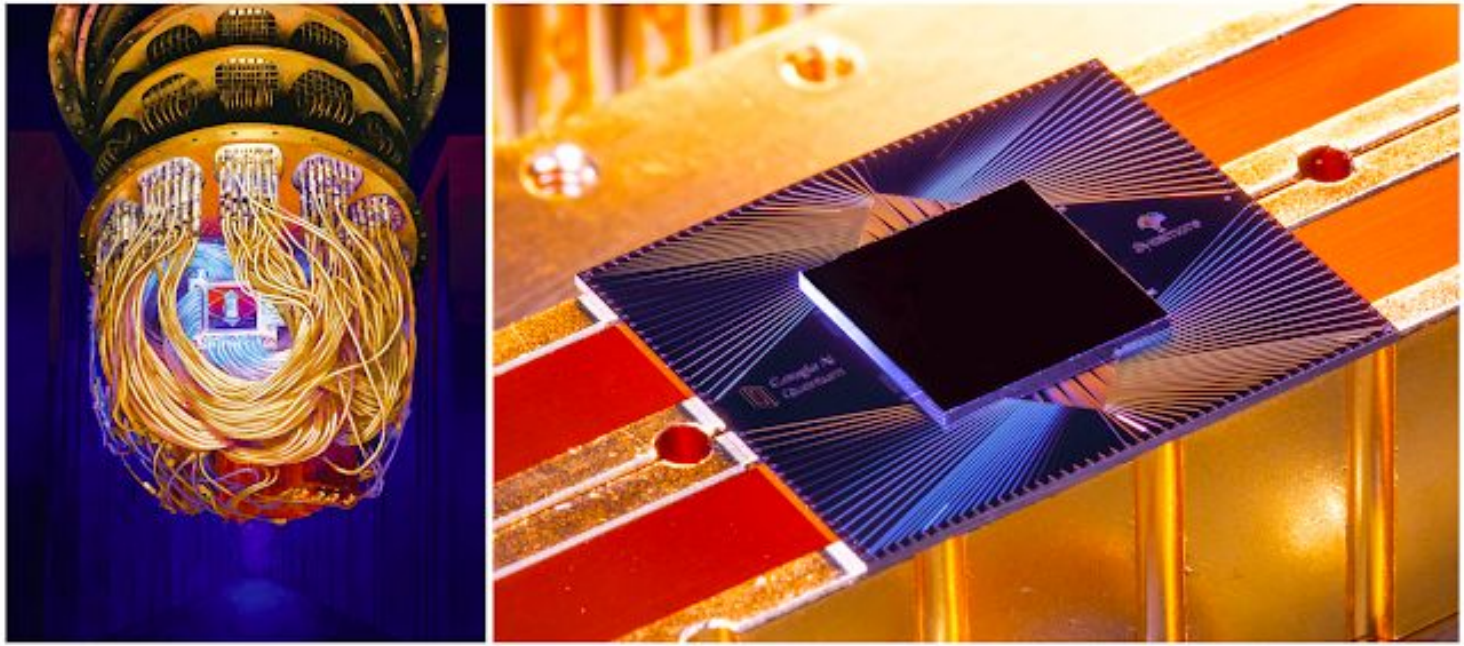
or even just provide ‘people’ to talk to which would do a better job of talking about sensitive subjects such as therapists, teachers and medical professionals.

Machine learning programs have taught themselves to walk.

With good VR and AI a quantum computer could be its own simulation turned world inside our own.

We could choose to communicate with its inhabitants, or we could leave it completely alone and let them communicate with each other.

We could also try and simulate the start of life from a primordial soup.

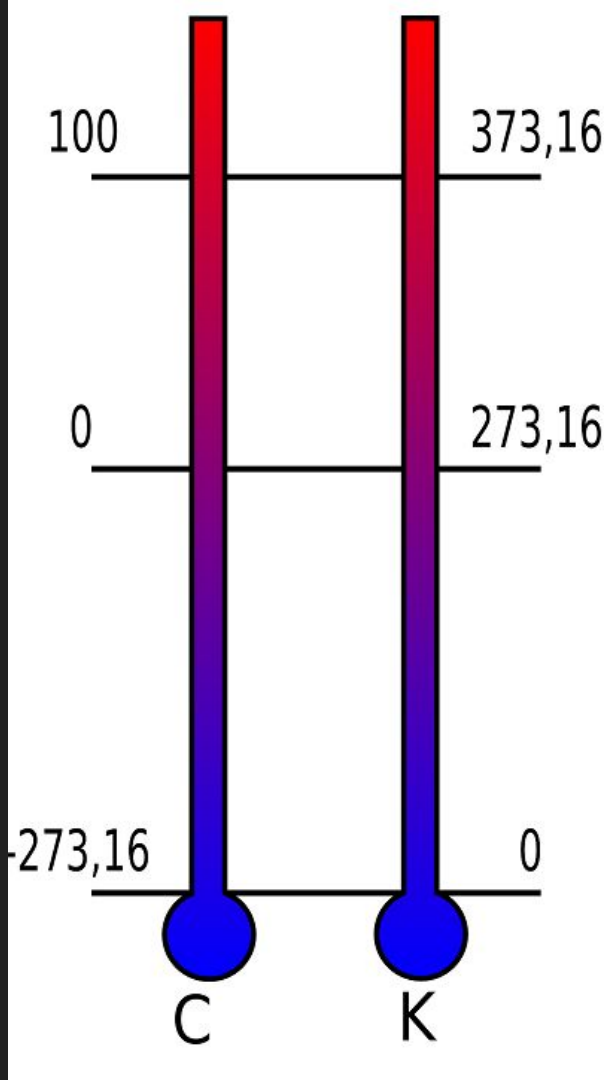


Left: Artist's rendition of the Sycamore processor mounted in the cryostat. (Full Res Version; Forest Stearns, Google AI Quantum Artist in Residence) **Right:** Photograph of the Sycamore processor. (Full Res Version; Erik Lucero, Research Scientist and Lead Production Quantum Hardware)

Temperature dependence

The kelvin scale was developed based on energy. At 0 kelvin, or absolute zero enthalpy and entropy of a gas is at the minimum possible value (theoretically).

This corresponds to about -273.16 degrees celsius. For scale, Antarctica can reach a temperature of about -60 C, in winter, and at minimum. And this is only in the coldest regions. (other sources generally throw out -10 C for Antarctica as a whole)



Energy costs of quantum computing

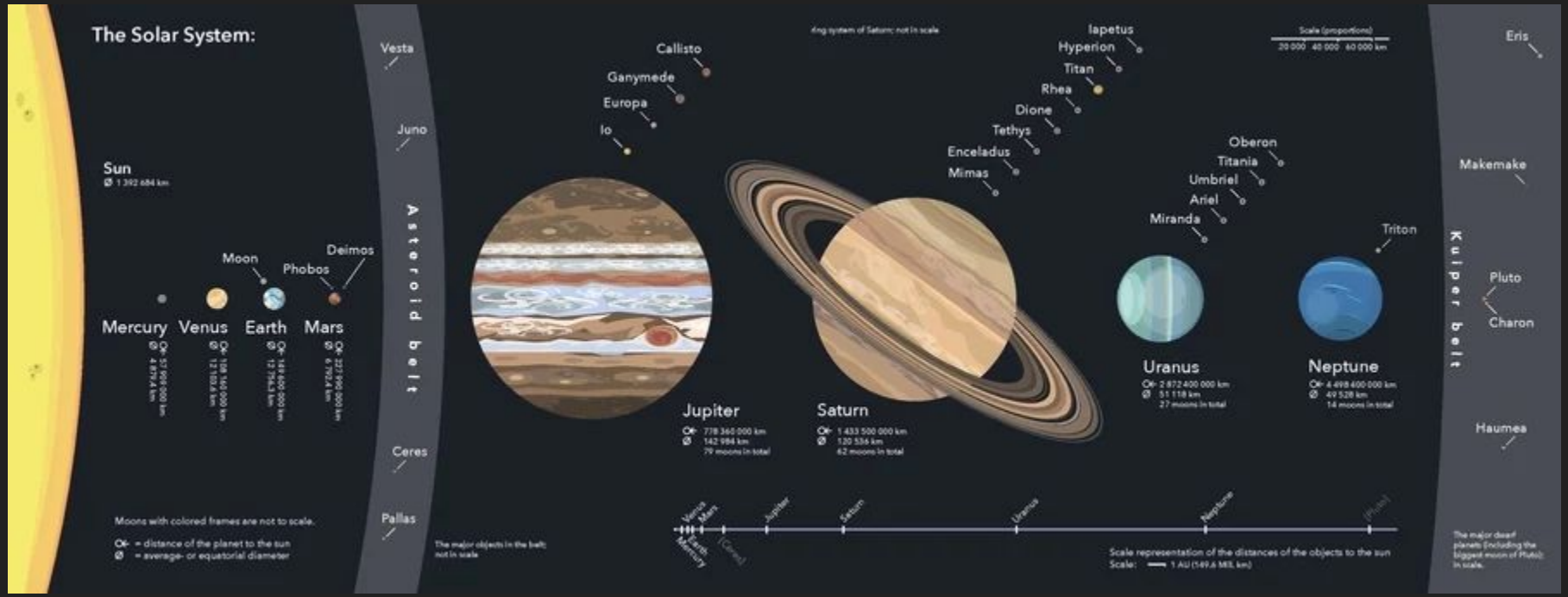
https://www.technologyreview.com/f/613053/intels-new-cryo-prober-for-qubits-could-help-bring-quantum-computers-to-market/

This machine is just for generating qubits, the main component for quantum computers. Even the qubits themselves must stay as close as possible to 0K, as must the quantum computers themselves.

To put into perspective how important the removal of energy from a system is, a person can simply *walk past the room* a quantum computer is running in a mess up the results.

Most of the energy costs of quantum computing is just keeping the system cool

Where would a quantum computer want to live?



Some of the coldest places in the solar system:

https://www.universetoday.com/35664/temperature-of-the-planets/
http://earthguide.ucsd.edu/eoc/special_topics/teach/sp_climate_change/p_planet_temp.html
https://www.universetoday.com/13893/temperature-of-pluto/amp/

Again for reference: Antarctica, Earth ~ -10 C

Uranus~ -224 C

Neptune~ -218 C

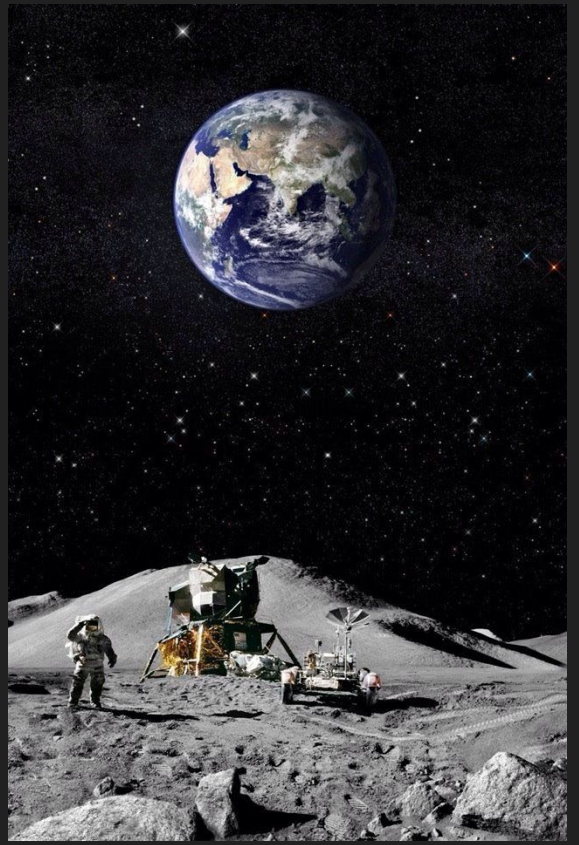
Uranus and Neptune are gas giants, which are much hotter at their cores and don't have a solid surface which makes them poor contenders.

Pluto is solid and also quite cold, (yay!) and ranges -240 to -229 C

https://www.nasa.gov/feature/ames/ice-confirmed-at-the-moon-s-poles

Surprisingly Earth's moon could be the best of all these options. At the poles the moon is very cold due to lack of sunlight, leading to a minimum temperature of -173 C. (maximum temperature is +127 C.)

While this isn't quite as cold as Pluto there is a relatively small difference in temperature for all the benefits the proximity of the moon would lend for a Quantum computing location. (The main one being we can actually visit the moon while we still can't put people as far as Mars)



Communication

Another benefit of putting a quantum computer on the moon instead of pluto is that we could potentially communicate with it via light signals with much more ease than a computer on pluto. Light from pluto gets to earth in a few hours, while we can receive light based communication from the moon in 1.3 seconds.

(this doesn't add much to our baseline 200 s to 2.5 days from Googles Sycamore calculation.)

Power sources on remote Planets

Unlike on earth where we are limited by trying to continue to support biological life we don’t necessarily have to have these concerns on uninhabited planets. This could open up options involving radioactive power sources or other systems we haven’t considered on Earth due to health and environmental concerns.

The moon’s hot spots of +127 C (for comparison 100 C is the boiling point of water) could also potentially provide an energy source.

Life on Other Planets

If we could create a self sufficient system that survives in a quantum computer we could send these systems to inhabit colder regions of the universe where we cannot live. They could send back information to us, expand themselves and repair themselves with robotic systems connected to the computer, and would eventually die in the same way earth also will eventually be destroyed.

A final note

Recent magnetic-field data from the Galileo orbiter showed that **Europa** has an induced magnetic field through interaction with **Jupiter's**, which suggests the presence of a subsurface conductive layer. This layer is likely a salty liquid-**water** ocean.

Discoverer: Galileo Galilei

Star system: Solar System

Drawing of underwater quantum computer inspired by Europa and it's theorized ocean which in the past has been put forward as one of the most likely places in our solar system for off world life. Studies were done on microorganisms living in the arctic ocean and some have believed that Europa could host similar organisms.