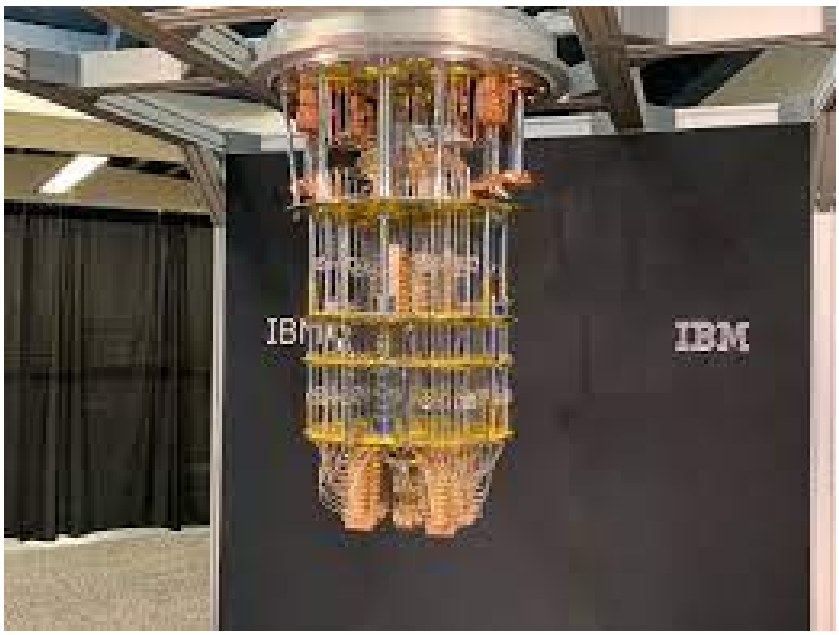
How IBM is revolutining the quantum world

Quantum Computers use the “weirdness” of quantum mechanics to do computations which our normal laptops or even supercomputers can not do in a reasonable amount of time. Unlike the classical bits that normal computers use, Quantum computers use qubits or quantum bits. These qubits follow the trends of subatomic particles and follow the rules of quantum mechanics, which leads them to their peculiar behaviour.

These devices have shown very promising applications in the past couple of years: from something a little obvious like solving linear equations in machine learning to like making vaccines.

Keeping these applications in focus the industry is at a big boom with all the tech giants wanting to get their hands on commercializable quantum computers. And with Google achieving quantum supremacy last year and IBM making quantum computers available to all, this happens to be the best time to enter the field.

A lot of new startups have also emerged which focus on the applications of these devices to various fields such as finance, machine learning, multiphysics softwares, quantum algorithms and much more.



The Golden Chandelier-The quantum processor is at the bottom of the image(source)

Recent Progress

As a lot of research is being done all over the globe in this area, we are bound to see a lot of breakthroughs and development. The main goal of researchers is to make better and bigger quantum computers which have more coherence time

and more connectivity between the qubits. Some of the major recent breakthroughs :

1. 2011 DWave launches first quantum annealing system
2. 2015 IBM demonstrated the first error correction code for making the systems more reliable
3. 2016 Researchers at IBM created an error correction strategy which focuses on Implementing error correction without increasing the number of qubits
4. 2017 First demonstration of VQE by IBM for simulating the Lithium Hydride(LiH) molecule
5. 2018 Google becomes the first corporation with 72 qubit quantum computer
6. 2019 Google reached quantum supremacy
7. 2019 IBM commercialized quantum computers by launching IBM Q System One

IBM's Initiative

IBM is one of the corporations which have taken a deep dive into the quantum world, gathering researchers from all disciplines to realize the dream of these devices. Last year they revealed their plan for a 1000 qubit quantum computer, which will open doors for running bigger and better computations. They have also worked on educating the upcoming generation about this wonderful technology.

IBM Quantum Experience

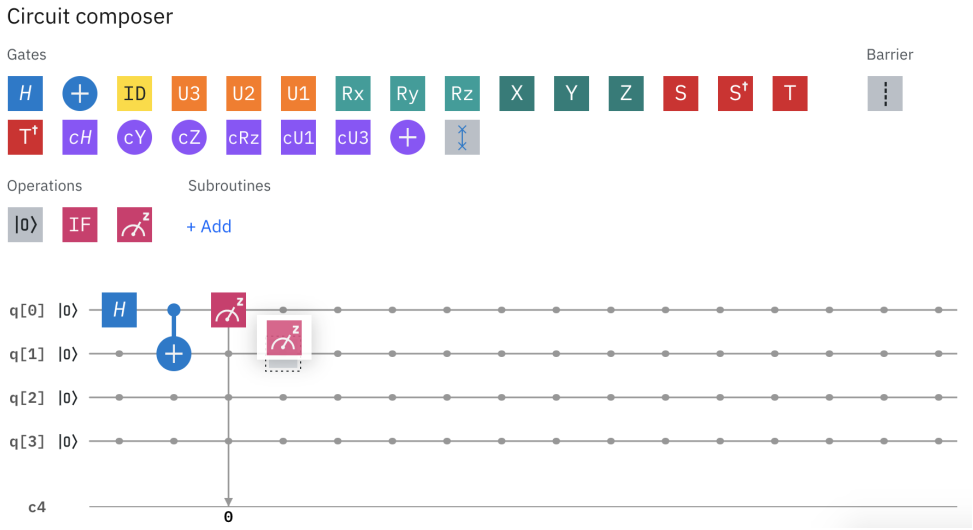
IBM Quantum Experience is one of the biggest developments in the field which provides cloud based access to quantum computers for everyone.This lead to the transformation of the general idea about quantum computing, from something far fetched and distant to something an enthusiast can experiment with by themselves.

The instructions provided are easy to follow, giving the amateurs also great hands-on experience and learning:

1. Start by visualizing the circuit you want to implement, this will mainly depend upon the type of quantum algorithm you wish to execute.
2. Once you have the circuit you can use the drag and drop option which is a lot more fun, although it is not that practical but you can start with it.
3. Choose a device as your backend.

4. Last and finally you can send your job to run on a real quantum computer that you have chosen

For a more in depth idea about doing this, checkout this amazing video by Abe Asafw.



Executing a bell state(source)

QISKIT: the open source language to program quantum computers

QISKIT, is a python library to program quantum computers. It has the ability to do a lot of things from running simulators to controlling each qubit with QISKIT Pulse and creating hardware devices through QISKIT Metal .This was a huge step up over the QASM language which was earlier used.

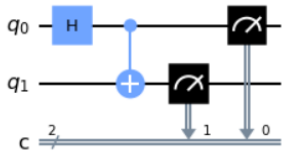
Qiskit Github is the actively maintained repositories where contributors, amateurs or professionals, can access the backend and make the library more efficient through open source contributions. People with adequate knowledge can help in taking a step towards real quantum computers and solve some real-world problems using them.

```
In [3]: from qiskit import QuantumCircuit

        circ= QuantumCircuit(2,2) #creating a quantum circuit with two qubits
        circ.h(0)                 # applying hadamard gate to create a uniform superposition
        circ.cx(0,1)              # cnot gate to create entanglement
        circ.measure(1,1)         # for measuring both the qubits
        circ.measure(0,0)

        circ.draw('mpl')
```

Out[3]:



Creating a Bell state using QISKIT

Quantum Education

One of the setbacks that quantum computing enthusiasts have faced is the lack of good resources. There were only a handful of great books and if you wanted to learn anything in depth you had to go through a plethora of research papers.

The researchers at IBM realized this problem and started providing different online courses, an interactive textbook and challenges to test how many people have benefited from the resources provided by them. The summer school hosted in 2020 was a two week intensive training for anyone who was interested to learn more about the field, there were lectures by many amazing researchers who shared their knowledge in various sub-fields, ranging from quantum error correction to simulation of LiH molecule on real hardware devices using Variational EigenSolver.

IBM released The QISKIT textbook in 2017, one of the landmark achievements in the history of Quantum Computing. It is one of a kind interactive textbook which has been written using Jupyter Notebook and can be used for experimenting with given examples that have been provided in the book.

QubitxQubit course(source)

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1.https://en.wikipedia.org/wiki/IBM_Quantum_Experience
2.https://en.wikipedia.org/wiki/Timeline_of_quantum_computing_and_communication
3.https://research.ibm.com/blog/quantum-five-years
4.https://www.ibm.com/blogs/research/2020/07/future-quantum-workforce/#:~:text=Through%20IBM%E2%80%99s%20new%20Quantum%20Educators%20P%20rogram%2C%20quantum,both%20themselves%20and%20their%20students%20at%20no%20cost.
5.https://www.sciencemag.org/news/2020/09/ibm-promises-1000-qubit-quantum-computer-milestone-2023