TA 1

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QisKit

https://qiskit.org/

Python

https://www.python.org/downloads/

Jupyter

https://jupyter.org/

Google colab

https://colab.research.google.com/?utm_source=scs-index

Coding standards

- Coding standards are guidelines for code style and documentation.
- They may be formal (IEEE) standards, or company specific standards.
- The aim is that everyone in the organization will be ableto read and work on the code.
- Coding standards cover a wide variety of areas:

– Program design

– Naming conventions

– Formatting conventions

– Documentation

– Use (or not) of language specific features

• Why bother with a coding standard?

– Consistency between developers

– Ease of maintenance and development

– Readability, usability

• Example should make this obvious!

• No standard is perfect for every application.

– If you deviate from the standard for any reason, document it!

Coding style

• There are several examples of coding styles. Often they differ from company to company

• They typically have the following in common:

– Names

• Use full English descriptors

• Use mixed case to make names readable

• Use abbreviations sparingly and consistently

• Avoid long names

• Avid leading/trailing underscores

– Documentation

• Document the purpose of every variable

• Document why something is done, not just what

Coding style

– Accessors

• Use getX(), setX() functions on all class variables.

– Member function documentation

• What & why member function does what it does

• Parameters/return value

• How function modifies object

• Preconditions/postconditions

• Concurrency issues

• Restrictions

– Document why the code does things as well as what it does.

Standards

• Standards rare documented agreements containing technical specifications or other precise criteria to be used consistently as guidelines, rules, or definitions of characteristics, to ensure that materials, products, processes and services are for for their purpose.

• International standards are supposed to contribute to making life simpler, and to increasing reliability and effectiveness of the goods and services we use.

• Standards represent best, or most appropriate, practice:
– They encapsulate historical knowledge often gained through trail and error.
– They preserve and codify organizational knowledge and memory
– They provide a framework for quality assurance.
– Ensure continuity over a project’s lifecycle.

Standards

There are many industry standards governing all aspects of software development:

– Terminology

– Notation

– Requirements gathering

– Design

– Coding

– Documentation

– Human computer interaction

– Verification and validation

– Quality assurance

– Even ethics!

Who writes standards?

– ISO

International Organization for Standardization

– SAA

Standards Australia

– BSI

British Standards Institute

– ANSI

American National Standards Institute

– IEEE

Institute for Electronic and Electrical

Engineers

– And about 80 or so others!

Relevant standards

• ISO 646 – 7-bit ASCII with national variants

• ISO 8859 – several 8-bit ASCII extensions:

– ISO 8859-1: West European languages (Latin-1)

– ISO 8859-2: East European languages (Latin-2)

– ISO 8859-5: Latin/Cyrillic

• ISO 6429 – ASCII control codes

• ISO 2382 – Information technology vocabulary

• ISO 8652 – the Ada programming language

• ISO 9899 – the C programming language

• ISO 9660 – CD-ROM volume and fie structure

• ISO 3166 – codes for the representation of names of counties:

– Defines a 2-letter, 3-letter and numeric code for every country.

– US/USA/840 = United States

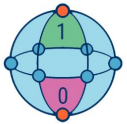
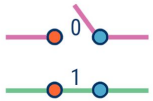
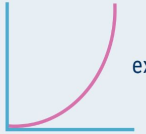
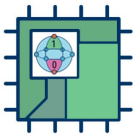
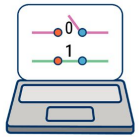
– GB/GBR/826 = United Kingdom

• The 2-letter codes are well known as the internet top level domain names.

Quantum computing

“ Quantum computing is a multidisciplinary field comprising aspects of computer science, physics, and mathematics that utilizes quantum mechanics to solve complex problems faster than on classical computers. The field of quantum computing includes hardware research and application development.”

Quantum Computing Vs. Classical Computing

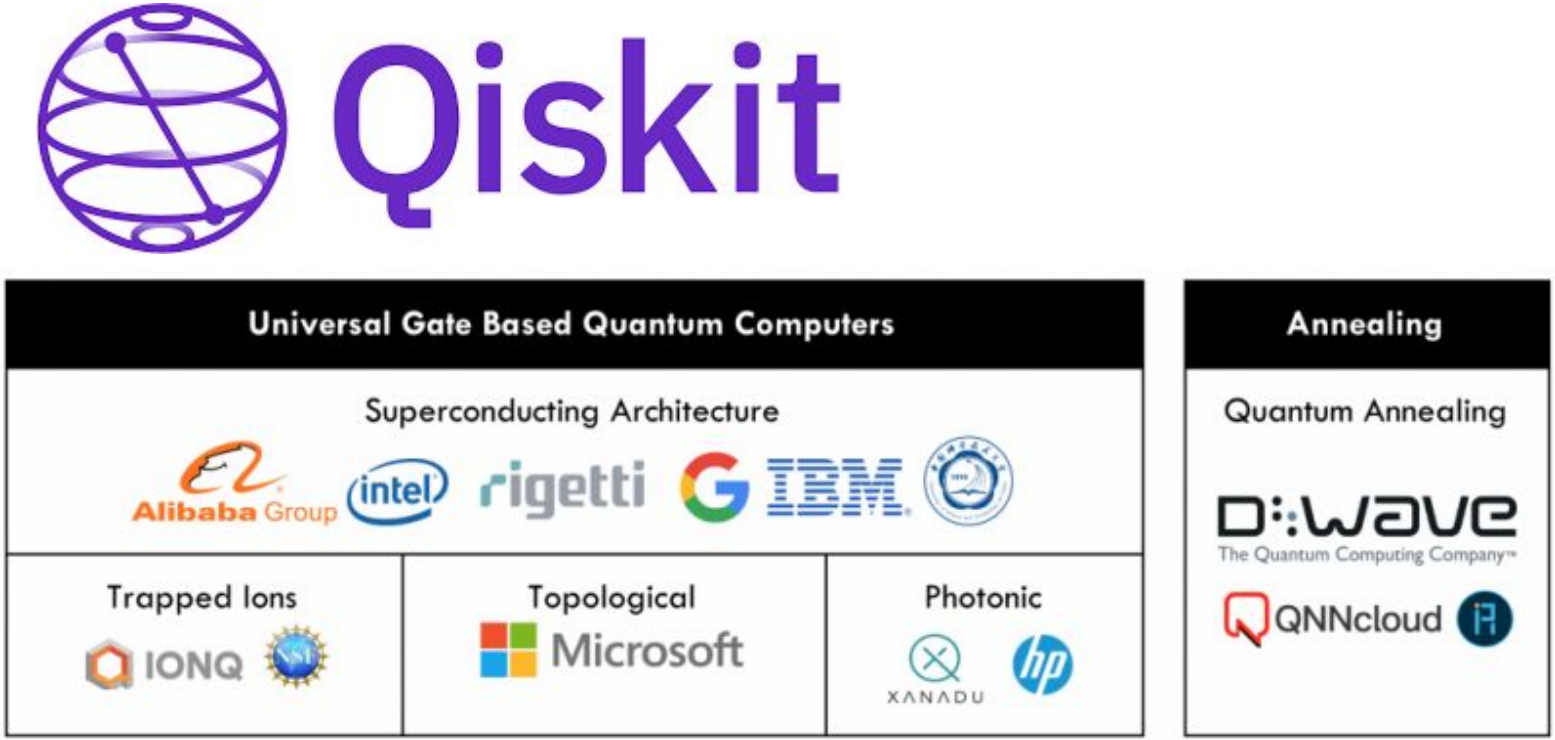
Quantum Computing	Classical Computing
 Calculates with qubits, which can represent 0 and 1 at the same time	Calculates with transistors, which can represent either 0 or 1 
 Power increases exponentially in proportion to the number of qubits	Power increases in a 1:1 relationship with the number of transistors 
 Quantum computers have high error rates and need to be kept ultracold	Classical computers have low error rates and can operate at room temp 
 Well suited for tasks like optimization problems, data analysis, and simulations	Most everyday processing is best handled by classical computers 

CBINSIGHTS

Some straightaway big applications

- Artificial intelligence
- Better batteries
- Cleaner fertilization
- Cybersecurity
- Drug development
- Electronic materials discovery
- Financial modeling
- Traffic optimization
- Weather forecasting and climate change

Softwares/Modules/Platforms



Softwares/Modules/Platforms

https://arxiv.org/abs/1807.02500

LaRose, Ryan. "Overview and comparison of gate level quantum software platforms." Quantum 3 (2019): 130.

Some interesting learning examples

Building a Quantum Random Number Generator

Implementing Grover’s Search Algorithm

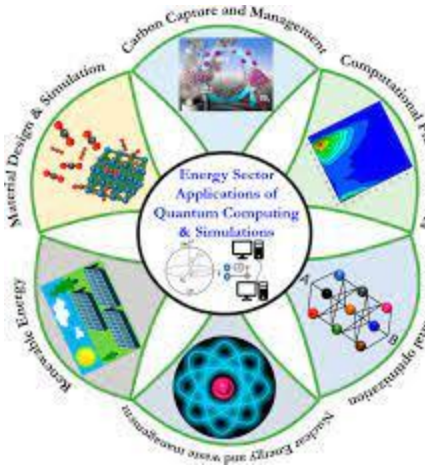
Use Shor’s Algorithm to Factor a Number

Find the Ground State Energy of a Lithium Hydride Molecule

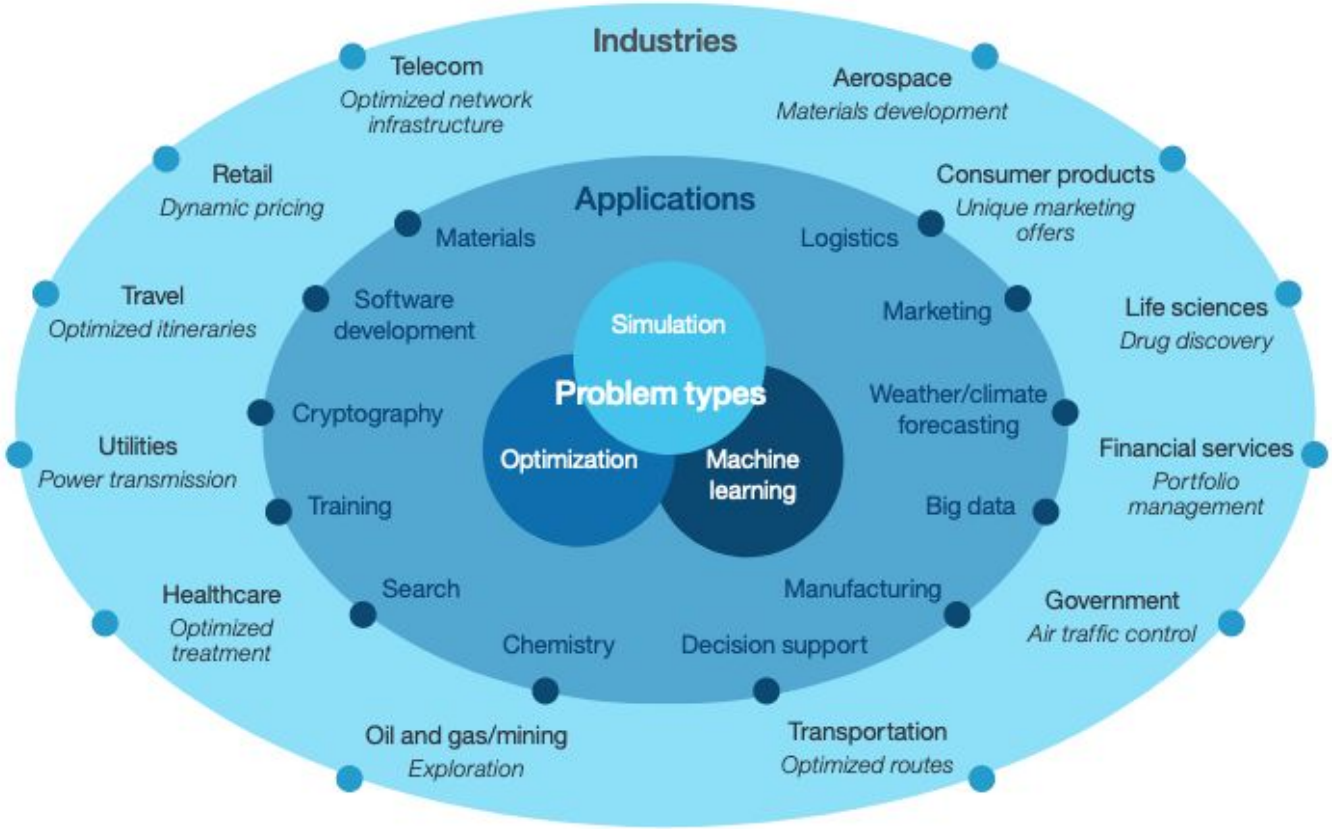
Tackle Noise With Error Correction

Explore Quantum Hardware With Qiskit Pulse

Sort Images Using a Quantum Machine Learning Algorithm


Carbon Capture and Management
Computational Fluid Dynamics
Combinatorial optimization
Nuclear Energy and waste management
Renewable Energy
Material Design & Simulation
Energy Sector Applications of Quantum Computing & Simulations


5 Industry Applications of Quantum Computing
Insurance
Retail
Gaming
Healthcare
Agriculture


Industries
Telecom
Optimized network infrastructure
Aerospace
Materials development
Retail
Dynamic pricing
Consumer products
Unique marketing offers
Travel
Optimized itineraries
Life sciences
Drug discovery
Utilities
Power transmission
Financial services
Portfolio management
Healthcare
Optimized treatment
Government
Air traffic control
Oil and gas/mining
Exploration
Transportation
Optimized routes
Applications
Materials
Logistics
Software development
Marketing
Cryptography
Weather/climate forecasting
Training
Big data
Search
Manufacturing
Chemistry
Decision support
Simulation
Problem types
Optimization
Machine learning

Content focus

- Light matter interactions
- laser spectroscopy is to unveil the quantum behaviors from optical signals
- Related Quantum mechanics part (solve/understand selection rules, perturbation theory, particle in the box)

connect theory with experiment (applied physics, like signal processing and some interesting physics simulations)

Research aspect

Idea from Dr. Tian

“

to resolve a laser pump-probe transient absorption spectrum

“

For early starters

https://qiskit.org/learn/

https://qiskit.org/documentation/tutorials.html