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**“AZƏRBAYCAN HAVA YOLLARI” CJSC**

**NATIONAL AVIATION ACADEMY**

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Quantum computing is an area of computer science that uses the principles of quantum theory. Quantum theory explains the behavior of energy and material on the atomic and subatomic levels.

**Quantum computers**

Quantum computers perform calculations based on the probability of an object's state before it is measured - instead of just 1s or 0s - which means they have the potential to process exponentially more data compared to classical computers.

Classical computers carry out logical operations using the definite position of a physical state. These are usually binary, meaning its operations are based on one of two positions. A single state - such as on or off, up or down, 1 or 0 - is called a [bit](https://en.wikipedia.org/wiki/Bit).

In quantum computing, operations instead use the quantum state of an object to produce what's known as a [qubit](https://en.wikipedia.org/wiki/Qubit). These states are the undefined properties of an object before they've been detected, such as the spin of an electron or the polarisation of a photon.

Rather than having a clear position, unmeasured quantum states occur in a mixed 'superposition', not unlike a coin spinning through the air before it lands in your hand.

These superpositions can be entangled with those of other objects, meaning their final outcomes will be mathematically related even if we don't know yet what they are.

The complex mathematics behind these unsettled states of entangled 'spinning coins' can be plugged into special algorithms to make short work of problems that would take a classical computer a long time to work out… if they could ever calculate them at all.

Such algorithms would be useful in solving complex mathematical problems, producing hard-to-break security codes, or predicting multiple particle interactions in chemical reactions.

**Types of quantum computers**

Building a functional quantum computer requires holding an object in a superposition state long enough to carry out various processes on them.

Unfortunately, once a superposition meets with materials that are part of a measured system, it loses its in-between state in what's known as [decoherence](http://www.informationphilosopher.com/quantum/decoherence/) and becomes a boring old classical bit.

Devices need to be able to shield quantum states from decoherence, while still making them easy to read.

Different processes are tackling this challenge from different angles, whether it's to use more robust quantum processes or to find better ways to check for errors.

## **Uses and Benefits of Quantum Computing**

Quantum computing could contribute greatly to the fields of security, [finance](https://www.investopedia.com/terms/f/finance.asp), military affairs and intelligence, drug design and discovery, aerospace designing, utilities (nuclear fusion), polymer design, [machine learning](https://www.investopedia.com/terms/m/machine-learning.asp), artificial intelligence (AI), [Big Data](https://www.investopedia.com/terms/b/big-data.asp) search, and digital manufacturing.

Quantum computers could be used to improve the secure sharing of information. Or to improve radars and their ability to detect missiles and aircraft. Another area where quantum computing is expected to help is the environment and keeping water clean with chemical sensors.4

Here are some potential benefits of quantum computing:5

* Financial institutions may be able to use quantum computing to design more effective and efficient investment portfolios for retail and institutional clients. They could focus on creating better trading simulators and improve fraud detection.
* The healthcare industry could use quantum computing to develop new drugs and genetically-targeted medical care. It could also power more advanced DNA research.
* For stronger online security, quantum computing can help design better data encryption and ways to use light signals to detect intruders in the system.
* Quantum computing can be used to design more efficient, safer aircraft and traffic planning systems.

## **Quantum Computer vs. Classical Computer**

Quantum computers have a more basic structure than classical computers. They have no memory or processor. All a quantum computer uses is a set of superconducting qubits.

Quantum computers and classical computers process information differently. A quantum computer uses qubits to run multidimensional quantum algorithms. Their processing power increases exponentially as qubits are added. A classical processor uses bits to operate various programs. Their power increases linearly as more bits are added. Classical computers have much less computing power.

Classical computers are best for everyday tasks and have low error rates. Quantum computers are ideal for a higher level of task, e.g., running simulations, analyzing data (such as for chemical or drug trials), creating energy-efficient batteries. They can also have high error rates.9

Classical computers don't need extra-special care. They may use a basic internal fan to keep from overheating. Quantum processors need to be protected from the slightest vibrations and must be kept extremely cold. Super-cooled superfluids must be used for that purpose.9

Quantum computers are more expensive and difficult to build than classical computers.

**What is a quantum computing chip?**

A quantum computing chip serves as the processor for quantum computers. These quantum computing chips contain quantum bits, or “[qubits](https://seeqc.com/quantum-computing/bits-and-qubits)" — quantum’s key advantage over classical computing.

A classical computing bit can have a value of 0 or 1, but a qubit can have a value of 0, 1, or both. This gives quantum computers the ability to process equations and algorithms exponentially faster than classical computers. For now, this technology is at a small-scale, but it has the potential to significantly alter the way that we look at computing.

**How are quantum computing chips manufactured?**

Our facility has [fabricated](https://seeqc.com/chip-foundry-services/chip-fabrication) more than 5,000 separate superconductive electronic chip designs. The foundry has the ability to produce virtually any superconductor chip for commercial, academic, and government markets; offering design, development, simulation, layout, fabrication, cryogenic high-speed testing and packaging in a world-class production environment.

Our state-of-the-art, 150mm wafer processing capability is supported with advanced equipment in manifold clean rooms. The high-volume capability allows customers to take advantage of rapid improvements in both yield and performance.