



Computer Science

Quantum computing promises a future where we can take advantage of quantum phenomena to perform calculations that are currently impossible with modern classical computing systems. With the power of quantum entanglement and superposition, a future quantum computer could break the encryption schemes in common use today, allow us to simulate quantum systems, perform unstructured search or create new types of machine-learning algorithms.

Quantum computers are composed of qubits as the basic unit of information (compared to bits in a classical computer). Instead of having just two states, a qubit has many different states, and can become entangled with other qubits, meaning that changes in one qubit affect the others. Various technologies are being developed to represent qubits, such as superconducting wires and trapped ion atoms. The biggest quantum computer today has over 1,000 qubits.

However, quantum computing is still in its infancy and some question whether it will ever mature to a point where it is useful. Currently there is no quantum computer that is more useful or efficient than today's classical machines. Aside from manufacturing issues, quantum computers suffer from reliability challenges, requiring techniques such as quantum error correction to enable scaling to large numbers of qubits. But if these and other challenges can be overcome, there is potential for significant strides to be taken in many different fields.

We'd like you to explore quantum computing for Caius Explore and write a report to summarise your findings and opinions. You are free to look into any aspect of quantum computing that piques your interest. The only limitation is that your report should be no longer than four pages of A4 in length. For example, you may wish to research one or more of these topics:

- The applications of quantum computing and the problems it could solve;
- The way that qubits are created and manipulated in current quantum computers;
- How you program a quantum computer;
- What quantum error correction is and why it is needed;
- The impacts on society of quantum computing;
- The maths and theory behind quantum computing;
- Why some people believe that quantum computers will never live up to their hype;
- Existing quantum computers that are available today