11 - Supercomputers

Goals

Wat aangeduid is, staat in deze samenvatting. Andere dingen zul je uit het boek moeten halen omdat het niet nuttig is dit samen te vatten

- [x] write an effective conclusion, summarizing the main points and providing a final comment
- [ ] wrap up a presentation maximizing the impact of your main message
- [x] explain the concepts of supercomputers, quantum computing and NISQ
- [x] discuss the 2 phenomena typical of quantum computing and relate this to how quantum computers are different from regular computers
- [ ] use –ing and to-infinitives correctly

SKILLS LAB

Writing a conclusion

- **restate thesis statement** to remind readers of primary focus of paper
- **summarize key points** to offer reader quick refresher of main ideas
- it can emphasize broader significance of the work
- complements introduction creating cohesive & balanced paper
- enables you to give a **final comment** (what are recommendations, what can be improved)
- **never include new info**

Main parts

Part	Sample sentences
Restating the aims of presentation	This study set out ...
	The aim of this paper was to ...
	The purpose of the current study was to ...
Summarizing main research findings	This study has shown that ...
	Let's take a look at the key findings ...
	The results of this research show that ...
	The most obvious findings to emerge from this study are that ...
Suggesting implications for the fild of knowledge	The results of this study indicate that ...
	The findings of this research provide insights for ...
	These findings have significant implications for the understanding of ...
Expanding the significance of the findings	The study provided a deeper insoght into ...
	This approach will prove useful in expanding our knowledge of how ...
	These findings contribute in several ways to our understanding of x and provide a basis for ...
Optional: **Making recommendations**	Further research needs to be done to establish whether ...

Part	Sample sentences
	Further work is required to ...
	More information on ... would help us to establish a greater degree of accuracy on this matter

supercomputers, quantum computing and NISQ

Supercomputers:

Supercomputer: any of a class of extremely powerful computers. The term is commonly applied to the fastest high-performance systems available at any given time. Such computers have been used primarily for mathematical and engineering work requiring exceedingly high-speed computations. Common applications for supercomputers include testing, scientific models for complex physical phenomena or designs, such as climate and weather, evolution of the cosmos, nuclear weapons and reactors, new chemical compounds (especially for pharmaceutical purposes) and cryptology. As the costs of supercomputing decline in 1990's, more businisses began to use supercomputers for market research and other business related models.

Quantum Computing:

Quantum computing is a revolutionary approach to computing that uses **quantum bits (qubits)** instead of traditional bits. Qubits can represent 0, 1, or both simultaneously (a property called superposition), allowing quantum computers to solve certain problems much faster than classical computers. They excel in fields like cryptography, material science, and optimization but are still in experimental stages.

Key features of quantum computing:

- **Superposition**: Qubits can exist in multiple states at once.
- **Entanglement**: Qubits can be linked, so the state of one qubit affects the other, no matter the distance.
- **Interference**: Quantum systems use interference to amplify correct solutions and cancel out errors.

NISQ (Noisy Intermediate-Scale Quantum):

NISQ refers to the current era of quantum computing, characterized by intermediate-sized quantum computers (50–100 qubits) that are still noisy and error-prone. These machines aren’t yet powerful enough for full-scale quantum computing but can tackle specialized problems beyond the reach of classical computers. The NISQ era focuses on:

- Developing algorithms that tolerate noise.
- Exploring early applications like quantum chemistry and machine learning.
- Refining hardware to reduce errors and scale up for future breakthroughs.

In short, NISQ represents the transition phase between experimental quantum devices and practical, large-scale quantum computers.

Two phenomena of quantum computing

Quantum computers are fundamentally different from classical computers because of two unique quantum phenomena: **superposition** and **entanglement**.

1. **Superposition**: While classical bits can only exist as either 0 or 1, qubits in a quantum computer can exist in both states simultaneously. This allows quantum computers to perform many calculations at once. For example, with (n) qubits, a quantum computer can explore (2^n) possibilities at the same time, providing immense parallelism compared to classical computers, which process tasks sequentially.
2. **Entanglement**: Qubits can become entangled, meaning the state of one qubit is directly linked to another, even over large distances. This allows quantum computers to perform highly coordinated operations efficiently, something classical computers cannot achieve.

These phenomena enable quantum computers to excel at tasks like cryptography, optimization, and simulating quantum systems, where classical computers are slow or ineffective. While classical computers are still better for general-purpose computing, quantum computers have the potential to solve specific, complex problems much faster.