COMP 7028 HANDS-ON QUANTUM COMPUTING

Credit Points 10

Coordinator Tad Bak (https://directory.westernsydney.edu.au/search/name/Tad Bak/)

Description This subject enables students to understand the theory of quantum computing and build the skills needed for quantum programming. It covers essential topics, including basic principles of quantum mechanics, quantum bits (qubits), quantum gates, algorithms, programming with quantum simulators and with real quantum computers. Students will explore the fundamental differences between classical and quantum computation and learn quantum programming using a well-known open source toolkit. Additionally, the subject offers insights into quantum hardware and real-world applications, demonstrating the potential and relevance of quantum computing in various fields, from cryptography to optimisation problems. After completion students will be equipped with the essential knowledge to navigate the exciting realm of quantum computation.

School Computer, Data & Math Sciences

Discipline Computer Science, Not Elsewhere Classified.

Student Contribution Band HECS Band 2 10cp

Check your fees via the Fees (https://www.westernsydney.edu.au/currentstudents/current_students/fees/) page.

Level Postgraduate Coursework Level 7 subject

Restrictions

Students must be enrolled in a postgraduate program

Assumed Knowledge

Linear algebra, particularly vector and matrix manipulation. Ability to program in Python language. Familiarity with Jupyter Notebook and LaTeX typesetting is highly recommended.

Learning Outcomes

After successful completion of this subject, students will be able to:
1. Discuss the historical development and motivation behind quantum computing, including an appreciation of computing complexity and the distinctions between classical and quantum computation.
2. Design quantum circuits involving multi-qubit operations.
3. Implement quantum algorithms on simulators and real quantum hardware.
4. Assess existing quantum algorithms and their impact on problem-solving in various fields.
5. Apply basic techniques of quantum error correction to mitigate quantum noise.
6. Evaluate emerging practical applications of quantum computing.

Subject Content

1. History and motivation for quantum computing.
2. Quantum bits (qubits) and single-qubit gates.
3. Quantum circuits and multi-qubit operations.
4. Simple quantum algorithms.
5. Quantum Fourier transformation and its applications.
6. Quantum error correction.
7. Quantum cryptography and communication.
8. Emerging practical applications of quantum computing.

Assessment

The following table summarises the standard assessment tasks for this subject. Please note this is a guide only. Assessment tasks are regularly updated, where there is a difference your Learning Guide takes precedence.

Type	Length	Percent	Threshold	Individual/ Group Task	Mandatory
Practical	About one hour each	40	N	Individual	N
Applied Project	About 100 lines of code, quantum circuit with up to 10 qubits	30	N	Individual	N
Final Exam	2 hours	30	N	Individual	Y