COMP 3033 QUANTUM COMPUTING AND COMMUNICATION

Credit Points 10

Legacy Code 301437

Coordinator Weisheng Si (https://directory.westernsydney.edu.au/search/name/Weisheng Si/)

Description This unit introduces how computing and communication can be performed by harnessing quantum phenomena such as superposition and entanglement. From a computer science perspective, this unit directly starts with the mathematical models delivered by those quantum phenomena while skipping the details of Quantum Mechanics. Based on these mathematical models, this unit introduces the concept of qubits and quantum circuits, and then discusses the design of quantum algorithms and communication protocols, with an emphasis on their applications in Cyber Security. Besides being highly mathematical, this unit is also highly practical: quantum programming will be done throughout the unit with a user-friendly quantum simulator. Students completing this unit will develop skills in designing quantum algorithms and protocols which will be highly sought after in the current and emerging job markets.

School Computer, Data & Math Sciences

Discipline Programming

Student Contribution Band HECS Band 2 10cp

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

Level Undergraduate Level 3 subject

Pre-requisite(s) INFO 3006 AND
MATH 1028 OR
MATH 1030

Learning Outcomes

On successful completion of this subject, students should be able to:

1. Apply the mathematical models enabled by Quantum Mechanics.
2. Compose quantum circuits to implement programming logics.
3. Design quantum algorithms that are faster than classical algorithms.
4. Design secure quantum communication protocols.
5. Apply techniques for correcting quantum errors.
6. Conduct quantum programming on a quantum simulator and some real quantum computers in clouds.

Subject Content

1.Introduction to qubit, superposition, entanglement, and measurement.
2.Guide to quantum programming on a quantum simulator and some real quantum computers in clouds.
3.Introduction to Complex Numbers for quantum computing.
4.Introduction to Linear Algebra for quantum computing.
5.Quantum gates and quantum circuits.
6.Elementary quantum algorithms: Deutsch-Jozsa's algorithm and Simon's algorithm
7.Quantum algorithms with applications: Grover's algorithm and Shor's algorithm
8.Quantum communication: Quantum Teleportation, BB84 protocol and B92 protocol
9.Quantum Error Correction
10.Using Quantum Algorithms and Protocols to help achieve UN?fs SDGs (Sustainable Development Goals)

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.

Item	Length	Percent	Threshold	Individual/ Group Task
Report	2 hours (per lab)	40	N	Individual
Applied Project	30 hours	20	N	Individual
Final Exam	2 hours	40	N	Individual

Teaching Periods

Autumn

Penrith (Kingswood)

Day

Subject Contact Weisheng Si (https://directory.westernsydney.edu.au/search/name/Weisheng Si/)

View timetable (https://classregistration.westernsydney.edu.au/even/timetable/?subject_code=COMP3033_22-AUT_KW_D#subjects)

Parramatta - Victoria Rd

Day

Subject Contact Weisheng Si (https://directory.westernsydney.edu.au/search/name/Weisheng Si/)

View timetable (https://classregistration.westernsydney.edu.au/even/timetable/?subject_code=COMP3033_22-AUT_PS_D#subjects)