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 subject discusses how computing and communication can be performed by utilising subatomic particles in quantum world, a way very different from classical computing. From a computer science perspective, this subject skips the details of quantum physics and directly explains the concepts of qubits and quantum circuits for the purpose of computing. Necessary mathematical preliminaries are included. Then, this subject discusses major quantum algorithms and communication protocols. Quantum programming will be practised throughout this subject with quantum simulators and real quantum computers in clouds. Students completing this subject will develop skills for designing quantum algorithms/protocols and conducting quantum programming and can pursue careers such as quantum software engineers, quantum security engineers or quantum researchers.

School Computer, Data & Math Sciences

Discipline Programming

Student Contribution Band HECS Band 2 10cp

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

Level Undergraduate Level 3 subject

Pre-requisite(s) COMP2014 OR
COMP2015 OR
COMP2016 OR
COMP2023
AND
MATH1028 OR
MATH1030 OR
COMP1014 OR
MATH1038

Assumed Knowledge

Students should have gained knowledge and skills in basic probability theory and intermediate-level computer programming. The basics of probability are essential for understanding quantum states. Computer programming skills of using objects and simple algorithms are needed to compose quantum programs.
Linear Algebra, which is the foundation for the mathematical models in quantum computing, will be covered within the subject. Therefore, a prior knowledge on it is recommended, but not required.

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. Quantum programming on quantum simulators and real quantum computers.
3. Introduction to Complex Numbers for quantum computing.
4. Introduction to Linear Algebra for quantum computing.
5. Quantum gates and quantum circuits.
6. Basic quantum algorithms such as Deutsch's Algorithm and Deutsch-Jozsa's Algrothm
7. Quantum algorithms with applications: Grover's algorithm and Shor's algorithm
8. Quantum communication protocols such as BB84 Protocol and Ekert Protocol
9. Quantum Error Correction
10. Using Quantum Algorithms and Protocols to help achieve UN's 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.

Type	Length	Percent	Threshold	Individual/ Group Task	Mandatory
Practical	2 hours (per lab)	20	N	Individual	N
Applied Project	30 hours	20	N	Individual	Y
Quiz	30 minutes per quiz; 12 quizzes in total	20	N	Individual	Y
Final Exam	2 hours	40	N	Individual	Y

Teaching Periods

Autumn (2025)

Parramatta - Victoria Rd

On-site

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

View timetable (https://classregistration.westernsydney.edu.au/odd/timetable/?subject_code=COMP3033_25-AUT_PS_1#subjects)