State University of New York Polytechnic Institute
CS 528 : Quantum Computing
Fall 2017

Instructor: Dr. Chen-Fu Chiang
Time: TR 10:00 am - 11:15 am
Location: Kunsela Hall C108
Office Hours: W: 10:00 am - 11:30 am | TWR: 2:30 pm - 4:00 pm | by appointment
Office: Kunsela C225
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Required Text

An Introduction to Quantum Computing, Phillip Kaye, Raymond Laflamme and Michele Mosca (Oxford)

References and Additional Notes

Quantum Computation and Quantum Information, M. Nielsen and I. Chuang (Cambridge University Press)
Quantum Computing Lecture Notes by Stephen Fenner
Quantum Computing Lecture Notes by Ronald de Wolf
Quantum Computing Lecture Notes by Mark Oskin

Prerequisites

This course is self-contained and students are encouraged to work together in study groups.

Course Description

Quantum information and computation exploits quantum mechanical rules to process information. As a new branch of interdisciplinary science, it has both fundamental and technological implications. This course is designed to introduce graduate computer science students (or advanced undergraduate students) to the fundamentals of quantum computing and its applications.

Student Learning Outcomes

Upon completion of this course the student should be able to:

- Describe the Foundations of Quantum Systems

- Interpret the Quantum Circuit Model

- Explain the Physical Principles of Quantum Computation and Apply the Core Quantum Algorithms

Topics

- Linear Algebra & the Dirac Notation

- Qubits and the Framework of Quantum Mechanics

- The State of a Quantum System
- Composite System
- Measurement

- Quantum Circuit Model

  - Quantum Gates
  - Universal Sets of Quantum Gates

- Superdense Coding and Quantum Teleportation

- Introductory Quantum Algorithms

  - Deutsch algorithm, Deutsch-Jozsa algorithm
  - Bernstein-Vazirani algorithm, Simon's algorithm

- Intermediate Quantum Algorithms

  - Quantum Fourier Transform, Phase Estimation
  - Amplitude Amplification Algorithms: Grover's Algorithm, Quantum Counting
  - Discrete Time Quantum Walk and Continuous Time Quantum Walk

- Quantum Computation Platforms and Applications

  - Adiabatic Quantum Computation (AQC)
  - Quantum Walk Computation (QWC)
  - Universality of AQC and QWC

- If time allows, we will explore topics such as Quantum Error Correction

Grading (Tentative)
The lecture format will be the basic mechanism used in the course. Computer demonstrations in the classroom will be used whenever appropriate. Assessment of student performance will use a criterion-referenced model which will include written assignments (25%), regular examinations (midterm 25%), presentation along with a short report (25%), and a comprehensive final exam (25%). Late assignment will not be accepted unless you have made prior arrangements with me. The acceptable format of your solution will be specified in the assignment. All examinations are closed-book. A typical grading scale will be as follows:

Percent   Grade
[89.5 - 100]   A
[79.5 - 89.5) B
[69.5 - 79.5) C
[59.5 - 69.5) D
Below 59.5   F
(+/- modifiers will also be used ; for instance, [95.5-100]: A+, [92.5-95.5): A, [89.5-92.5): A-)

Attendance Policy
Attendance and active class participation are required. Be prepared to participate by asking and answering questions during class meetings. Please send me an email if you know you have to miss a class.

Academic Integrity/Policy

Plagiarism and Cheating of any kind on an examination, quiz, or assignment will result at least in an F for that assignment (and may, depending on the severity of the case, lead to an F for the entire course). I will assume for this course that you will adhere to the academic creed of this University and will maintain the highest standards of academic integrity. In other words, do not cheat by giving answers to others or taking them from anyone else. The code of academic conduct is detailed on page 30 of the SUNY Poly student handbook. Make-ups are only given under extreme circumstances. I will also adhere to the highest standards of academic integrity, so please do not ask me to change (or expect me to change) your grade illegitimately or to bend or break rules for one person that will not apply to everyone.

Accommodations for Students with Disabilities registered at SUNY Polytechnic Institute

In compliance with the Americans with Disabilities Act of 1990 and with Section 504 of the Rehabilitation Act, SUNY Polytechnic Institute is committed to ensuring educational access and accommodations for all its registered students seeking access to meet course requirements and fully participate in programs or activities. SUNY Poly students with documented disabilities and medical conditions are encouraged to request these services by registering with the Disability Services Office and discussing your need for accommodations. For information or an appointment contact Director of Disability Services, located in Utica, B101 Kunsela Hall and in Albany in the Student Services Suite 309 Nano Fab South or by phone (315) 792-7170; or by email ds@sunyit.edu.