Introduction to quantum information processing

Course website
http://ter.ps/introqip

Overview
A quantum mechanical representation of information allows one to efficiently perform certain tasks that are intractable within a classical framework. This course aims to give a basic foundation in the field of quantum information processing. Students will be prepared to pursue further study in quantum computing, quantum information theory, and related areas. No previous background in quantum mechanics is required.

Course topics
Basic model of quantum computation (reversible computing, qubits, unitary transformations, measurements, quantum protocols, quantum circuits); quantum algorithms (simple query algorithms, the quantum Fourier transform, Shor’s factoring algorithm, Grover’s search algorithm and its optimality); quantum complexity theory; mixed quantum states and quantum operations; quantum information theory (entropy, compression, entanglement transformations, quantum channel capacities); quantum error correction and fault tolerance; quantum nonlocality; quantum cryptography (key distribution and bit commitment); selected additional topics as time permits.

For a detailed lecture schedule with recommended readings, see the course website.

Prerequisites
Familiarity with basic concepts in linear algebra (e.g., eigenvalues, eigenvectors, Hermitian and unitary matrices) is required. Students are not expected to have taken previous courses in quantum mechanics or the theory of computation.

Coordinates
Tuesday/Thursday, 11:00 am–12:15 pm, CSI 3120

Instructor
Andrew Childs (amchilds@umd.edu)
Office hours: Tuesday 1:30–2:30 pm (AVW 3225), Wednesday 3:30–4:30 pm (CSS 3100F), or by appointment

Teaching assistant
Michael Jarret (mjarret@umd.edu)
Office hours: Monday 11:30 am–12:30 pm or by appointment (CSS 3100M)

Texts

Copies of both texts will be available on reserve in the Engineering and Physical Sciences Library (Math building, room 1403).
Evaluation
Your final grade will be determined as follows:
Assignments 13% each (65% total)
Project 20%
Final exam 15%

Assignments
There will be 5 homework assignments during the course. Assignments will be made available on the course website and will be due at the start of class on Thursdays. Solutions will be posted on the course website soon after the due date, so extensions will not be granted. Graded assignments will be returned in class.

You are encouraged to discuss homework problems with your peers, with the TA, and with the course instructor. However, your solutions should be based on your own understanding and should be written independently. For each assignment, you must either include a list of students in the class with whom you discussed the problems, or else state that you did not discuss the assignment with your classmates.

Project
Students will be expected to write an expository paper on a topic of their choice from the quantum information literature. Further details, including a list of possible project topics, will be posted on the course website. Students must email a project proposal to the instructor by October 22, including a one-paragraph summary of the chosen topic and a list of selected references. Papers will be due by the date of the last lecture, December 10.

Final exam
The course will include a take-home final exam. The exam will be made available on the morning of Monday, December 14, and will be due by midnight on Wednesday, December 17. Students may choose to take the exam during any three-hour period during that time.

Academic accommodations
Any student eligible for and requesting reasonable academic accommodations due to a disability is asked to provide, to the instructor during office hours, a letter of accommodation from the Office of Disability Support Services (DSS) within the first two weeks of the semester.

If you plan to observe any holidays during the semester that are not listed on the university calendar, please provide a list of these dates by the end of the first week of the semester.

As mentioned above, extensions to assignment due dates will not be granted for any reason, so that all students can have timely access to solutions. In the event of a medical emergency that affects your ability to complete coursework, appropriate accommodations will be made. However, you must make a reasonable attempt to notify the instructor prior to the due date, and you must provide written documentation from the Health Center or an outside health care provider. This documentation must verify dates of treatment and indicate the timeframe that you were unable to meet academic responsibilities. It must also contain the name and phone number of the medical service provider in case verification is needed. No diagnostic information will ever be requested.

Course evaluations
Course evaluations are an important part of evaluating instruction. The Department of Computer Science and its faculty take student feedback seriously. Students can go to http://www.coursesevalum.umd.edu to complete their evaluations.