Quantum Computing: Foundations to Frontier
CSC2451HF/MAT1751HF

Essentials.

- **Instructor**: Henry Yuen
- **Course website**: `http://www.henryyuen.net/classes/fall2019`
- **Piazza site**: `http://piazza.com/utoronto.ca/fall2019/csc2451mat1751`
- **Place and time**: GB 119, Wednesdays 1-3pm
- **Office hours**: by appointment

Description. This graduate course will give a broad overview of the field of quantum computing. We will start with a crash course in the fundamentals of quantum computing (qubits, quantum circuits, basic quantum algorithms such as Grover's search algorithm and Shor's factoring algorithm). Armed with the basics, we will then explore topics at the frontier of quantum computing: quantum simulation, quantum cryptography, connections with physics, quantum machine learning algorithms, and quantum supremacy.

Prerequisites. This is a theoretical course that requires mathematical maturity and a strong background in linear algebra and probability theory. No background in physics is required. Some familiarity with algorithms and complexity is a plus, but also not required.

Grading. Grades will be determined by:
50% project report
50% problem sets

Project. The course project is an important part of the class. In small teams (at least one partner, at most two), you will choose a topic at the frontier of quantum computing, read the relevant papers, and write a report of what you have learned. The report can be an in-depth survey, or better yet can be original research.

I will separately provide a list of suggested project topics, as well as additional guidelines.

Problem sets. There will be approximately 4 problem sets. Collaboration on problem sets is encouraged, but please limit the groups to size three or less. Your writeups should also have the names of your collaborators. Everyone must submit their own solutions.

We will use Crowdmark to distribute and mark assignments. All assignments must be turned in via Crowdmark. Uploads to Crowdmark must be legible.

Questions and answers. We will use Piazza for course announcements, problem sets, solutions, finding homework/project collaborators, and help with homework. Questions you may have for me should be posted on Piazza, as usually many others are wondering the same thing!

Textbooks. There is no official textbook for the course, but here are some recommended ones:

- *Quantum Computation and Quantum Information* by Michael Nielsen and Isaac Chuang
- *An Introduction to Quantum Computing* by Phillip Kaye, Raymond Laflamme, and Michele Mosca
- *Quantum Computing Since Democritus* by Scott Aaronson

There are lots of quality courses online with lecture notes; links can be found at

`http://henryyuen.net/resources/`

Important dates.

- **September 11**: First meeting of the course
- **September 23**: Last day to add course for credit (for grad students)
- **October 16**: Project proposal due
- **October 28**: Last day to drop course without penalty
- **November 6**: No class, reading week
- **December 4**: Last meeting of the course