ENGN 2912M: Introduction to Quantum Computing and Physical Basics of Computing

Fall 2018

1 Course Overview

COORDINATES: M/W 8:30-9:50am
Barus & Holley 159
https://canvas.brown.edu/courses/1076633

INSTRUCTOR:

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Office: ERC 331 (South Wing 3rd floor)
Office Hours: M 10-11am

SYNOPSIS: Inspired by Richard Feynman's lectures in computation, we will explore how physical principles/limits have been shaping paradigms of computing, with a particular focus on quantum computing.

Topics include but are not limited to: Physical limits of computing, coding and information theoretical foundations, reversible computing, with a particular focus on quantum computing.

PREREQUISITES: Linear algebra. Although some knowledge in digital logic or computer architecture can be beneficial, basics will be covered in class.

REFERENCE MATERIAL: "Feynman Lectures on Computation", R. P. Feynman, Westview, June 2000; and "Quantum Computation and Quantum Information", M. Nielsen and E. Chung, Cambridge University Press, January 2011 represent the main texts. We will also cover classic and recent research papers on the subject matter.

GRADING:

Quiz $\times 2$	40%
Assignment $\times 5$	60%

ASSIGNMENTS: There will be 5 assignments. Assignments may include thought-provoking open-ended challenge questions, paper summaries/reviews, or very basic scripting/programming. On average, no more than 12 hours per week would be required for these assignments (including time allocated for quizzes).

QUIZZES: Each quiz may be designated as an open book/notes/... take-home to be submitted 24 hours after the release of questions (the following exam dates are to be interpreted as release dates in this case). Take-home quizzes can typically be completed in 3-4 hours.

Quiz 1: Oct 22
Quiz 2: Dec 10

MECHANICS:

- Academic integrity and scholastic dishonesty: Independent of the scope (be it a homework assignment, exam, ...), any conduct leads to F as the immediate final grade.
- The students are expected to attend all class meetings. Office hours are not designated to serve as make-up lectures.
- **All assignments are due at the beginning of class, on the designated due date. Late assignments will receive a reduction of 20% for each day they are late, except for documented illnesses and family emergencies.**

- Any question or concern about grading must be communicated to the instructor within one week after the return of the exam or assignment concerned.
- The student can work in groups to discuss assignments, as long as the submission reflects each student's own work.
- **To obtain a passing grade, *all* assignments should be turned in, *all* quizzes should be taken, and the project should be submitted.**
- Any non-submitted or non-graded item will be processed with a grade of 0.
- Brown University is committed to full inclusion of all students. Please inform me early in the term if you have a disability or other conditions that might require accommodations or modification of any of these course procedures. You may speak with me after class or during office hours. For more information, please contact Student and Employee Accessibility Services at 401-863-9588 or SEAS@brown.edu. Students in need of short-term academic advice or support can contact one of the deans in the Dean of the College office.
- A healthy learning environment demands diversity in perspectives. Please contact me (anonymously, if preferred) in case you catch escaped manifestations of implicit or explicit biases in any form.

2 (TENTATIVE) SYLLABUS

Week	Tue	Thu	Note
1	Classical Computing Basics	Classical Computing Basics	
2	Theory of Computing	Theory of Computing	Assignment I out
3	Reversible Computing	Reversible Computing	Assignment I due Assignment II out
4	Reversible Computing	Reversible Computing	Assignment II due
5	Postulates of Quantum Mechanics	Postulates of Quantum Mechanics	
6	Universal Quantum Gates	Universal Quantum Gates	Assignment III out
7	Universal Quantum Gates	Universal Quantum Gates	Assignment III due
8	Entanglement	Entanglement	Quiz I out
9	Teleportation	Teleportation	
10	Quantum Parallelim/Deutsch's Algorithm	Deutsch/Jozsa Algorithm	
11	Schor's Algorithm	Schor's Algorithm	Assignment IV out
12	Grover's Algorithm	Grover's Algorithm	Assignment IV due
13	Quantum Error Correction	Quantum Error Correction	Assignment V out
14	Quantum Error Correction	Surface Codes	Assignment V due
15	Contemporary Examples	Contemporary Examples	Quiz II out