ECE 492-054 or ECE 592-100 (Also cross listed as CSC-459-054, CSC-591-054.)

Introduction to Quantum Algorithms

Instructor(s): Dror Baron, barondror@ncsu.edu

Objective or Description: Provide a self contained introduction to quantum algorithms.

Prerequisites: Background in linear algebra (e.g., MA 305 or MA 405) and probability (e.g., ST 371) is expected. Some signal processing (e.g., ECE 410) will be helpful.
Undergraduate: MA 305/405 and ST 371 corequisite.
Graduate: MA 305/405 and ST 371 prerequisite.

Textbook: None.

Topics: (include main topics that will be covered in the course)
1. Motivation and Introduction.
2. Mathematical basics: complex numbers, Taylor series, linear algebra.
3. Signal processing basics: discrete time signals and systems, discrete time Fourier transforms, frequency interpretation of linear time invariant systems.
3. Quantum computing basics: state spaces, quantum evolution, measurement, qubits, single qubit gates, multi-qubit gates, entanglement. Deutsch's algorithm.
4. Grover search.
5. Hadamard transform: finding XOR function patterns, Deutsch-Jozsa algorithm, Bernstein-Vazirani algorithm.
6. Quantum Fourier transforms: Fast Fourier transform (classical) and quantum Fourier transform, quantum phase estimation, classical spectral estimation, noisy spectral estimation.

Grading: (include weight of homework, projects, exams, etc,; students like to know how many projects and exams will be in a class)
Homework will have a large component, perhaps 40-50%.
We will have 3 half-hour quizzes on the introductory parts of the material, and a final exam.
Finally, a project will be mandatory at the graduate level, optional for undergraduates.

Cross-listing in other departments: Cross listed as CSC-459-054, CSC-591-054.

Include anything else that is unique to the course -
In contrast to some other quantum courses offered in the department, this course emphasizes *why* some quantum algorithms work, and is much more than
a cookbook or recipe that describes them. For students who enjoy building an understanding of new concepts while learning about the rapidly evolving
quantum landscape, this course could be a good match!