QUANTUM COMPUTING AND COMMUNICATIONS ALGORITHMS

ECE 557 and 493-05, MW 2:00 – 3:20 pm

Quantum information science is an exciting, broad, rapidly progressing, cross-disciplinary field, and that very nature makes it both attractive and hard to enter. In this class, we first answer the three essential questions that any newcomer needs to know: How is quantum information represented? How is quantum information processed? How is classical information extracted from quantum states? We then discuss several basic quantum algorithms that offer computing advantages over their classical counterparts. The class focuses on algorithms for quantum error correcting codes and multi-party games, which have gained supreme importance in 1) quantum computing practice and 2) physics and computing fundamentals.

Prerequisites: Calculus, linear algebra, and probability at an undergraduate level and familiarity with complex numbers are required. Prior exposure to quantum mechanics is helpful but not essential.

Learning Objective:

The students will learn the fundamentals of quantum information science, error correction, and some more advanced topics of their interests.

Grading: (weekly) homework 60%, final exam (around Thanksgiving) 25%, project 15%.

Instructor: Emina Soljanin (contact info on the web page, office hours by appointment).

Required reading:

Course notes, posted weekly in separate documents on the class (Canvas) web page.

Recommended reading:

N. D. Mermin, *Quantum Computer Science: An Introduction,* Cambridge University Press, 2007.

J. D. Hidary, *Quantum Computing: An Applied Approach,* Springer 2019.

M. A. Nielsen and I. L. Chuang *Quantum Comput. and Quantum Informat.,* Cambridge University Press, 2010.

L. Susskind and A. Friedman, *Quantum Mechanics: The Theoretical Minimum,* Basic Books 2015.

J. Preskill, *Lecture Notes for Physics 229: Quantum Information and Computation.*

F. W. Byron and R. W. Fuller, *Mathematics of Classical and Quantum Physics,* Dover 1992.

Registration: Undergrad students can request an SPN through a waiting list at http://www.ece.rutgers.edu → Academics