Comp 360-2: Quantum Information Systems

Wesleyan University

Spring 2017

Course Description

Models of computation that exploit quantum phenomena permit algorithms that, as far as we know, cannot be efficiently simulated by any other physically realizable model of computation. Theories of quantum information systems are conventionally presented in terms of vector spaces over the complex numbers. A complementary approach is to give an algebraic presentation, formulated in the language of category theory. This permits a more modular study of quantum systems, and enables the generalization of many results to other domains, such as control theory. It also illustrates a deep and still poorly understood connection between algebra and abstract geometry.

In this course we will study the logic of quantum information systems. We will do this by delineating the properties of quantum logic that differentiate it from the boolean logic underlying classical discrete information systems. We will see how these properties arise in the Hilbert space model of quantum mechanics and how they can be represented algebraically and diagrammatically.

Prerequisites

Required: Comp 212: Computer Science II

Recommended: Math 221: Vectors and Matrices, Math 228: Discrete Math

Useful: Math 223: Linear Algebra, Math 261: Abstract Algebra

Instructor

Ed Morehouse (emorehouse@wesleyan.edu), Exley 645

Office hours: Thursdays 1:00–3:00 and by appointment or drop-in availability.

Lectures

Mondays and Wednesdays 2:50–4:10, Exley 113

Readings

Required readings will be provided throughout the semester.

Homework

Homework will be assigned periodically. Only a subset of the homework will be evaluated. You are free to work on the homework together with others, but anything that you submit should represent your own individual understanding of the material in question. The instructor reserves the right to ask you to verbally explain some of your solutions if he suspects this to not be the case.

Quizzes

Sporadically, there will be short in-class quizzes. These are to assess the success of both the students' understanding, and the instructor's presentation, of the course material.

Participation

This is a small advanced-topics course with a diverse group of students. Therefore, your input, feedback and questions are important and encouraged. Please make every effort to attend and participate in class.

Research Project

In lieu of a final exam students will complete a research project involving quantum information systems. Students may select a topic of their own choice (with instructor approval) and work in small groups. They will then research the topic and complete a written report as well as a classroom presentation. More information about the project will be provided after spring break.

Academic Accommodations

Your instructor is committed to supporting an accessible and inclusive learning environment where disability is recognized as an aspect of diversity. Students seeking academic accommodations for this course should follow University procedure by meeting with their class dean or someone from the office of disability resources and obtaining a letter of academic accommodations. This procedure is described at `http://www.wesleyan.edu/studentaffairs/disabilities/`.