San José State University

Computer Science Department

CS 286 Quantum Computation, Sec 01, Fall 2015

Course and Contact Information

Instructor:	Thomas D. Howell
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Email:	Thomas.Howell@sjsu.edu
Office Hours:	Monday and Wednesday 9:00 am- 11:00 am Also by appointment.
Class Days/time:	Monday and Wednesday 4:30 pm- 5:45 pm
Classroom:	DH 450
Prerequisites:	No prior knowledge of quantum mechanics is assumed. Math 129A, complex numbers, vectors, matrices, inner products, eigenvalues, and eigenvectors. Students should know some basic computer science: algorithms, running time analysis, big O notation.

Course Information

Selected topics in computer science. Topics vary each semester and may be repeated for a maximum of 6 units

Detailed description:

We will explore quantum computation including basic quantum mechanics, qubits, entanglement, quantum gates and circuits, quantum teleportation, quantum algorithms, including factoring and search, implementing qubits, adiabatic computation.

Required materials:

Most of the course material will be provided online. There are video lectures, lecture notes, textbook excerpts, and problem sets. The following textbook is inexpensive and highly recommended but not required.

E. Reiffel and W. Polak, Quantum Computing, A Gentle Introduction, MIT Press, Cambridge, MA, 2011. ISBN 978-0-262-01506-6

Course Requirements

This course will be taught using a "flipped classroom". This means lectures will occur outside of the class period, and most of our class time will be spent working on exercises, quizzes, and problem sets. The material is divided into eight units. Each unit consists of approximately two hours of lectures available on video, one or more chapters of reading, and a set of homework problems.

There will be no programming assignments, although students might find computing tools such as computer algebra systems useful in doing and/or checking homework computations.

A project will be required for CS 286. The project topic will be chosen by the student in an area related to material covered in the course. The student will do a more in-depth study of this topic, possibly involving computation related to a quantum algorithm, and submit a report.

NOTE that University policy F69-24 at http://www.sjsu.edu/senate/docs/F69-24.pdf states that "Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to insure maximum benefit for all members of the class. Attendance per se shall not be used as a criterion for grading."

Grading Policy

Grades will be based on:

Quizzes and participation in class and online discussions	(10%)
Homework problems	(30%)
Project	(10%)
Midterm exam	(25%)
Final exam	(25%)

My grading system allows some flexibility, but is not curved and generally follows the categories 85-100% = A, 75-85 = B, 60-75 = C, 50-60 = D, < 50 = F. Extra credit may be given on exams and assignments, but individual assignments for extra credit are never given. Partial credit is given, so show your work on all assignments and exams.

Note that "All students have the right, within a reasonable time, to know their academic scores, to review their grade-dependent work, and to be provided with explanations for the determination of their course grades." See University Policy F13-1 at http://www.sjsu.edu/senate/docs/F13-1.pdf for more details.

University Policies

Workload

Success in this course is based on the expectation that students will spend, for three units of credit, a minimum of one hundred thirty-five hours over the length of the course (normally 9 hours per week with 2.5 of the hours used for classroom activities and 2 hours for video lectures) for instruction or preparation/studying or course related activities.

General Expectations, Rights and Responsibilities of the Student

As members of the academic community, students accept both the rights and responsibilities incumbent upon all members of the institution. Students are encouraged to familiarize themselves with SJSU's policies and practices pertaining to the procedures to follow if and when questions or concerns about a class arises. See University Policy S90–5 at http://www.sjsu.edu/senate/docs/S90-5.pdf. More detailed information on a variety of related topics is available in the SJSU catalog, at http://info.sjsu.edu/web-dbgen/narr/catalog/rec-12234.12506.html. In general, it is recommended that students begin by seeking clarification or discussing concerns with their instructor. If such conversation is not possible, or if it does not serve to address the issue, it is recommended that the student contact the Department Chair as a next step.

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester's Catalog Policies section at http://info.sjsu.edu/static/catalog/policies.html. Add/drop deadlines can be found on the current academic year calendars document on the Academic Calendars webpage at http://www.sjsu.edu/provost/services/academic_calendars/. The Late Drop Policy is available at http://www.sjsu.edu/aars/policies/latedrops/policy/**.** Students should be aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the Advising Hub at http://www.sjsu.edu/advising/.

Consent for Recording of Class and Public Sharing of Instructor Material

University Policy S12-7, http://www.sjsu.edu/senate/docs/S12-7.pdf, requires students to obtain instructor's permission to record the course and the following items to be included in the syllabus:

- "Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission to make audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the intellectual property of the instructor; you have not been given any rights to reproduce or distribute the material."
    - It is suggested that the greensheet include the instructor's process for granting permission, whether in writing or orally and whether for the whole semester or on a class by class basis.
    - In classes where active participation of students or guests may be on the recording, permission of those students or guests should be obtained as well.
- "Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not publicly share or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without instructor consent."

Academic integrity

Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The University Academic Integrity Policy S07-2 at http://www.sjsu.edu/senate/docs/S07-2.pdf requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The Student Conduct and Ethical Development website is available at http://www.sjsu.edu/studentconduct/.

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 at http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf requires that students with disabilities requesting accommodations must register with the Accessible Education Center (AEC) at http://www.sjsu.edu/aec to establish a record of their disability.

CS 286 Quantum Computation, Fall 2015, Course Schedule

Week	Date	Topic	Reading	Assignment
0	8/24/2015	Introduction and preliminaries		
	8/26/2015	Lecture 1: Double-slit experiment	chap1	
1	8/31/2015	Lecture 2: Qubits and uncertainty principle		hw1
	9/2/2015	Quantum coin flipping		
2	9/7/2015	Labor Day Holiday		
	9/9/2015	Lecture 3: Axioms of QM, two qubits, and entanglement	chap2	
3	9/14/2015	Lecture 4: Bell Inequalities		hw2
	9/16/2015			
4	9/21/2015	Lecture 5: Quantum gates	chap3	
	9/23/2015	Lecture 6: Quantum teleportation		hw3
5	9/28/2015			
	9/30/2015	Lecture 7: Quantum circuits	chap4	
6	10/5/2015	Lecture 8: Early quantum algorithms		
	10/7/2015			hw4
7	10/12/2015	Midterm		
	10/14/2015	Lecture 9: Quantum Fourier transform	chap5	
8	10/19/2015	Lecture 10: Quantum factoring		
	10/21/2015			
9	10/26/2015	Lecture A: Adiabatic Computation and DWave		
	10/28/2015	Lecture 11: Quantum search	chap6	
10	11/2/2015			hw5
	11/4/2015	Lecture 12: Observables and Schroedinger□s equation	chap7	
11	11/9/2015	Lecture 13: Particle in a box & implementing qubits	chap8	
	11/11/2015	Veteran's Day Holiday		
12	11/16/2015	Visit NASA / Dwave facility		
	11/18/2015	Particle in a box		
13	11/23/2015	Implementing Qubits	chap9	hw6
	11/25/2015	Day before Thanksgiving, office hours only		

Week	Date	Topic	Reading	Assignment
14	11/30/2015	Lecture 15: Spin	chap10	
	12/2/2015	Lecture 16: Manipulating spin	chap11	hw7
15	12/7/2015	Review		
16	12/10/2015	Final Exam☐ 14:45 - 17:00		