CSEP 590TV - Quantum Computing

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Lecture: Wednesday 6:30-9:20 p.m. in EE1 045
Instructor Office Hours: Tuesday 5-6 p.m. and by appointment in 460 CSE
TA Office Hours: Wednesday 5:30-6:30 in 430 CSE
Text: Quantum Computation and Quantum Information by Michael Nielsen and Isaac Chuang
Useful Supplementary material: John Preskill's lecture notes, http://www.theory.caltech.edu/people/preskill/ph229/ and David Mermin's lecture notes, http://people.ccmr.cornell.edu/~mermin/qcomp/CS483.html

Course Description: An introduction to and survey of the field of quantum computing. Quantum computation is an emerging field whose goal is to design effectively atomic sized computers which exploit the parallelism of the quantum mechanical laws of the universe. While this sounds futuristic, quantum computers are fast becoming a reality, and have the potential to revolutionize computation over the next twenty years. Topics include quantum algorithms, quantum error correction, and quantum cryptography. This course will give you the knowledge to understand why quantum computers can break certain public key cryptosystems, the engineering challenges in building a physical quantum computing device, and the level of security assured by quantum crytopgraphic devices. Prior knowledge of quantum theory is not necessary.

Format: This course will be taught with a mixture of blackboard and powerpoint presentations. Powerpoint slides will be made available on the course website.

Homework: There will be approximately seven homework assignments. They will be due at be the beginning of class the week after they are distributed. An extra day will automatically be granted to those who send me an excuse. Any excuse, true or false, is sufficient. Also for one homework you can also claim a one week extension. Again just send me an email. If more serious extensions are needed due to extenuating circumstances, get in contact with me and we will arrange accommodations. Don't panic, I really am not a mean guy about this kind of stuff.

Reading: Mike and Ike is a great book and you will benefit greatly by keeping up with the reading. We will not be covering the entire book.

Final: There will be a take home final due on the last day of class, August 17th. For this final, collaboration is not allowed.

Grade: 70% Homework, 30% Final Exam

Academic Accommodations: To request academic accommodations due to disability, please contact disabled Student Services, 448 Schmitz, (206) 543- 8924 (V/TTY). If you have a letter from Disabled Student Services indicating that you have a disability that requires academic accommodations, please present the letter to me so we can discuss the accommodations you might need in this class.

Course Outline:
June 22: Historical overview and motivation
June 29: Complex numbers, linear algebra, bras, kets, qubits, two qubits
July 6: Quantum circuits, deutsch's algorithm, teleportation, superdense coding
July 13: Quantum algorithms of the Shor type
July 20: Grover's algorithm, simulation of quantum systems
July 27: Entanglement, Bell's theorem, quantum communication complexity
Aug 3: Physical implementations of quantum computers, decoherence
Aug 10: Quantum error correction
Aug 17: Open.

Reading: We will not cover all of the material in the book and not everything in each chapter will be relevant. However, the general outline of reading is:
June 22-July 5: Chapters 1, 2, and 3
July 5-July 12: Chapters 4.
July 13-July 19: Chapter 5
July 20-July 26: Chapter 6
July 27-Aug 2: Chapter 7
Aug 3-Aug 9: Chapter 10