Quantum Computing Spring 2009
Monday/Wednesday 4:40-6:30 p.m.
Marek Perkowski

On February 13, 2007 the first commercial quantum computer in history has been officially demonstrated by Dwave Corporation. We entered thus a new era of civilization. These computers will speed-up quadratically every problem and exponentially many problems, opening calculation and simulation capabilities that would be never reachable by standard computers.

This introductory class will teach you about the new wave of computers based on principles of quantum mechanics. We will cover systematically the following subjects: classical oracles, reversible logic circuits and synthesis methods, basic binary circuit model of quantum computing, Deutsch-Jozsa algorithm, Simon algorithm for period finding, d-level quantum circuits, quantum state machines, quantum oracles and Grover algorithm for unordered data base search, advanced quantum search algorithms, Shor algorithm for integer factorization, quantum spectral transforms, quantum communication, error-correcting codes and quantum error correcting codes, fault tolerant reversible and quantum computing, testing of quantum computers, teleportation and pseudo-telepathy, and quantum robots. Several new subjects will be also presented in a tutorial way, including quantum games, Adiabatic Quantum Computers, One-Way Quantum Computers, NMR technology, ion trap computers and new ideas in quantum computer programming and system architectures.

The only background is graduate standing in Electrical Engineering. All necessary topics from linear algebra, physics, digital design and logic synthesis will be reviewed before the more advanced material will be presented. This class not only teaches you about new breakthrough technology but reinforces in practical setting the classical digital design and algebraic/spectral methods in synthesis. Class will be graded based on student reports and presentations.