

Graduate Seminar on Topics in Quantum Computation

Prof. Dr. Nitin Saxena

Sommersemester 2011: From Friday, 8th Apr 2011.

Monday 1200-1400, LWK Neubau-0.007, Endenicher Allee 60.

Friday 1400-1600, LWK Neubau-0.007.

Background:

Students who are aware of the basics of computation and basic algebra will find the seminar especially interesting.

Outline:

This seminar will study some basic and advanced topics in *quantum* computing. The focus will be on understanding the complexity of problems on a quantum computer.

The students are encouraged to present at least two lectures during the semester. Some topics to choose from are given below (see Reference). To send your choices or to ask for more details contact ns@hcm.uni-bonn.de

- Introduction: quantum mechanics and notation.
- Weirdness: Teleportation and superdense coding.
- Circuits: universal quantum gates.
- Complexity classes: classical, quantum and query complexity.
- Algorithms: Deutsch-Jozsa, Bernstein-Vazirani and Simon.
- Fourier transform: Shor's factoring and Hidden subgroup.
- Fast search: Grover's algorithm (and its optimality).
- More quantum algorithms: AND-OR tree, collision problems & element distinctness.
- Quantum certificate: group non-membership and local Hamiltonians problems.
- Quantum interactive protocols.
- Quantum error correction.
- Quantum cryptography: key distribution and commitments.

Reference -

- 1) *Quantum Complexity Theory*, Scott Aaronson. Lecture notes at <http://stellar.mit.edu/S/course/6/fa08/6.896/materials.html>
- 2) *Quantum Computation*, Umesh Vazirani. Lecture notes at <http://www.cs.berkeley.edu/~vazirani/quantum.html>
- 3) *Quantum Computation*, John Preskill. Lecture notes at <http://www.theory.caltech.edu/people/preskill/ph229/>
- 4) *Quantum Cryptography*, Dominique Unruh. Short notes at <http://www.infsec.cs.uni-saarland.de/teaching/SS08/qcrypto/notes.pdf>