Graduate Seminar on Topics in Computational Complexity

Prof. Dr. Nitin Saxena

Wintersemester 2009-10: From Monday, 19th October 2009.
Monday 1200-1400, LWK 003, Endenicher Allee 60
Friday 1400-1600, N327, AVZ III/Römerstr. 164

Background:
Students who are aware of the basics of computation - Turing machines, complexity classes, P, NP, probabilistic methods - will find the seminar especially interesting.

Outline:
This seminar will study some advanced topics in computational complexity theory. It covers mainly *pseudo-random generators* (PRG), *probabilistically checkable proofs* (PCP) and *natural proofs* of computational limitations.

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

- Cryptography: One-way Functions, Encryption & PRG. `(2 lectures)`
- Pseudorandom generators for logspace.
- PCP: Hardness of Approximation of NP hard problems.
- A weak PCP Theorem: $NP \subset PCP(poly(n), 1)$.
- The PCP theorem: $NP = PCP(logn, 1)$. `(2 lectures)`
- Hastad's 3-bit PCP: Fourier Transform & Long Code. `(3 lectures)`
- Hardness of approximating Set Cover.
- Introduction to Communication Complexity.
- Introduction to Average-Case Complexity.
- Natural Properties & limitations of Natural Proofs.

Reference - Computational Complexity: A Modern Approach, *Sanjeev Arora and Boaz Barak*. Cambridge University Press, published April 2009.