KUNGL TEKNISKA HÖGSKOLAN
Datavetenskap och kommunikation
Johan Håstad

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DD2446, Complexity Theory, 2011 Preliminary plan

1 Lectures with fixed content

F1 Overview of the course, discussion of the format of the course.

F5, F6 Proof complexity.

The main plan of the course is to, with the exception of the above defined lectures F5 and F6, go through the basic topics in order. We try to keep and updates log on the home page of what is happening. Currently we are working on [B1].

If time permits we will discuss which advanced topic(s) to address.

2 Basic topics

B1 Recursive sets and the time and space hierarchies. The universal Turing machine

B2 Nondeterministic computation, NP, NP-complete problems, statement and (sketch) of proof of Cook's theorem.

B3 Some more complicated NP-completeness reduction(s).

B4 PSPACE, Savitch' theorem, TQBF is PSPACE-complete.

B5 Counting problems, #P.

B6 Logarithmic space (L), non-deterministic logarithmic space (NL), NL and P-completeness, co-NL=NL.

B7 Boolean circuits. Shannon's lower bound, hierarchy theorem for non-uniform computation.

B8 NC, problems solvable in poly-log time on a polynomial number of processors (addition multiplication). Relation of parallel time and sequential space.

B9 Randomized computation; complexity classes BPP, R and R-NC.

3 Advanced topics

A1 Gödel incompleteness theorem (in most situations, not all true theorems are provable).

A2 Constant depth circuits, the switching lemma.

A3 Monotone circuits, lower bounds.

A4 Kolmogorov complexity.

A5 Zero-knowledge proofs.

A6 Interactive proofs. Proof that either PSPACE = IP (or possibly only co-NP$\subseteq$ IP).

A7 Multiprover interactive proofs and PCPs. Consequences for approximability of NP-hard optimization problems.

A8 Average time complexity.

A9 Property testing.

A10 Communication complexity.