

T-79.7001 Postgraduate Course in Theoretical Computer Science (2–10 cr) P V

Autumn 2007

Topic: Propositional Proof Complexity

- Basics of Boolean functions and circuits
- Circuits as a computation model
- Proof complexity
- Complexity of proofs in major propositional proofs systems (sequent calculus, resolution, algebraic refutation systems, cutting planes, Frege systems)

Material

Clote, Kranakis: Boolean Functions and Computation Models, Springer, 2002.

(Sections 1 and 5).

Weekly Sessions and Course Personnel

Seminars: Mondays 16–20, TB353

Teacher: Prof. Ilkka Niemelä,
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Web: <http://www.tcs.hut.fi/Studies/T-79.7001/>

Passing the course

The course is organized as a research seminar and taken by

1. giving seminar talks and
 2. doing homework.
- The grade of the course (0–5) is determined by the respective grades of (i) the seminar talks (70%) and (ii) homework (30%).

Seminar talks

A seminar talk involves:

- giving a 45 min presentation on a particular part of the course material
- no written report; slides in pdf form on the course web page
- Each seminar talk is graded by the other students w.r.t. the merits of the presentation

Grading

- **The grade of a seminar talk:**
determined by the grades given by fellow students (given as part of their homework).
- **The grade for the homework:**
 - The teacher grades learning diaries (0–2 points each) (a diary can be submitted only for talks which have been attended).
 - Submitting a talk evaluation (1 point each)
 - These points form the homework points which translate into grades as follows:

Grade:	1	2	3	4	5
Lower bound:	50%	57%	64%	71%	78%

Homework Practice

- The submission deadline for the homework is one week from the corresponding seminar talk
- For each talk the homework consists of two items (submitted to the teacher):
 1. Learning diary of the talk: summary of what has been learned from the presentation (1-2 paragraphs) + one's own example of an important construction, result, proof step, ... covered in the presentation and/or corresponding material
 2. Evaluation of the talk including the grade

Why is Proof Complexity Interesting for Computer Science

- Proof complexity is related to major open problems in CS: $P = NP?$, $NP = coNP?$, ...
- Can be used for comparing, classifying and developing automated theorem proving techniques like propositional satisfiability (SAT) checkers.
- Can be used for analysing complexity and strength of search procedures and heuristics.
- Can be used for analysing cryptographic primitives and assumptions.