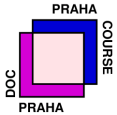
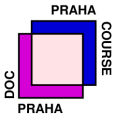


DocCourse Prague 2006
Harmonic Analysis in Computer Science and Combinatorics
Programme coordinators: Jiří Matoušek and Jaroslav Nešetřil
http://kam.mff.cuni.cz/∼matousek/doccourse06.html



Harmonic Analysis
in Computer Science and Combinatorics

February 2 – March 3, 2006

Program for February 2 – February 10

All lectures are held in S5.

`Thu, Feb 2`
9 – 12 *N. Linial* Harmonic Analysis in Computer Science and Combinatorics
14 – 17 Excercises

`Fri, Feb 3`
9 – 12 *N. Linial* Harmonic Analysis in Computer Science and Combinatorics
14 – 17 Excercises

`Mon, Feb 6`
9 – 12 *N. Linial* Harmonic Analysis in Computer Science and Combinatorics
14 – 17 Excercises

`Tue, Feb 7`
9 – 12 *N. Linial* Harmonic Analysis in Computer Science and Combinatorics
14 – 17 Excercises

`Wed, Feb 8`
10:40 *N. Linial* **57th Mathematical Colloquium:**
Complexity Measures of Sign Matrices

`Thu, Feb 9`
10:40 *O. Regev* Harmonic Analysis and Lattices
14:00 *O. Regev* Harmonic Analysis and Lattices, the sequel (1/2)

`Fri, Feb 10`
10:40 *O. Regev* Harmonic Analysis and Lattices, the sequel (2/2)

Abstracts of lectures

Nathan Linial: Complexity Measures of Sign Matrices

Why is our progress in computational complexity so slow? We claim that computational complexity ought to be investigated within a broader context. There are too few general mathematical tools to systematically deal with complexity, even though understanding complexity is one of the most important challenges of modern science. We have initiated a systematic study of complexity measures of matrices and matrices of ± 1 in particular. The measures we consider come from a variety of mathematical disciplines including Banach Space theory, Communication Complexity and Machine Learning.

This talk is based on joint papers with Adi Shraibman and with Shraibman, Schechtman and Mendelson.

Abstracts of lectures

Oded Regev: Harmonic Analysis and Lattices

Lattices are mathematical objects with many applications in computer science. In this talk, we will survey some of the progress made in the last decade on lattice problems. Starting from Ajtai's discovery of an average-case problem that is as hard as worst-case instances of lattice problems, we will describe some of the recent progress in the area. A special emphasis will be put on the use of harmonic analysis, a technique that turns to be very useful in the context of lattice problems.

Oded Regev: Harmonic Analysis and Lattices, the sequel

In these two talks, we will describe in detail some of the recent results in the field. Time permitting, we will discuss an approximation algorithm for the Closest Vector Problem with Preprocessing, how to show that approximating the Closest Vector Problem is in coNP, and discuss a theorem by Banaszczyk.

Some references can be found here:

- Stefankovic's thesis describes harmonic analysis in R^n, and contains Banaszczyk's proof:
  http://people.cs.uchicago.edu/∼stefanko/Publications/2000%20-%20Fourier%20Transforms/MAIN.PS.
- A paper containing some of the things we will talk about:
  http://www.cs.tau.ac.il/∼odedr/papers/cvpconp.ps
- Lecture notes of a course on lattices,
  http://www.cs.tau.ac.il/∼odedr/teaching/lattices_fall_2004/index.html
- Two books on computational aspects of lattices (without harmonic analysis) are: Complexity of Lattice Problems by D. Micciancio and S. Goldwasser, and An Algorithmic Theory of Numbers, Graphs, and Convexity by L. Lovász.