ORF 570: Probability in High Dimension

Description. The aim of this course is to provide an introduction to nonasymptotic methods for the study of random structures in high dimension that arise in probability, statistics, computer science, and mathematics. The emphasis is on the development of a common set of tools that has proved to be useful in a wide range of applications in different areas. Topics may include, depending on time and the interests of the audience: suprema of random processes; Gaussian and Rademacher inequalities; chaining and generic chaining; entropy and combinatorial dimensions; concentration of measure; functional (log-Sobolev, Poincaré), transportation cost, and martingale inequalities; isoperimetry; Markov semigroups, mixing times, and random fields; hypercontractivity; thresholds and influences; Stein's method; selected applications.

Prerequisites. Probability at least at the level of ORF 526.

References. The course will not follow any textbook. Some useful references include:

- *Concentration Inequalities* by Boucheron, Lugosi, Massart.
- *The Concentration of Measure Phenomenon* by Ledoux.
- *The Generic Chaining* by Talagrand.
- *Probability in Banach Spaces* by Ledoux, Talagrand.
- *Uniform Central Limit Theorems* by Dudley.
- *Weak Convergence and Empirical Processes* by van der Vaart, Wellner.
- *Markov Semigroups at St Flour* by Bakry, Ledoux, Saloff-Coste.
- *Normal Approximation by Stein's Method* by Chen, Goldstein, Shao.
- Various papers and review articles.

Grading. A homework set will be due every week. In addition, there will be a final project (but no midterm or final exam). Breakdown: homework 60%; project 40%. Additional points will be available for serving as a scribe during lectures.

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