Probabilistic methods

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Remarque
Cours donné en alternance tous les 2 ans (donné en 2018-19)

Summary
We systematically explore the exciting fact that randomness (i.e., coin flipping) can be used profitably to construct various mathematical structures with unexpected and often paradoxical properties, and to efficiently solve otherwise hopelessly difficult computational tasks.

Content
- Linearity of expectation
- Applications in combinatorics and number theory
- Randomized algorithms (sorting, convex hull, linear programming)
- The second moment method
- Random graphs

Keywords
random variable, expected value, probabilistic method, random graph, coloring

Learning Prerequisites
Required courses
Probability theory

Recommended courses
Discrete Mathematics or Graph Theory

Important concepts to start the course
Graph, random variable, expectation, variance, binomial coefficients, asymptotics

Learning Outcomes
By the end of the course, the student must be able to:
- Define and explain basic concepts in probability and discrete mathematics
• Define threshold functions, and analyze their asymptotic behavior
• Prove explain, and apply the first and second moment methods
• Prove explain, and apply the Local Lemma
• Solve exercises, design randomized algorithms
• Describe and explain the evolution of random graphs

Transversal skills
• Summarize an article or a technical report.
• Demonstrate the capacity for critical thinking
• Assess progress against the plan, and adapt the plan as appropriate.

Teaching methods
Lectures and exercises

Expected student activities
Attending the lectures, solving the exercises, reading sections from the textbook

Assessment methods
Exam written

Supervision
Office hours        Yes
Assistants         Yes

Resources
Bibliography
Noga Alon-Joel Spencer: The Probabilistic Method (Wiley)
Stasys Jukna: Extremal Combinatorics (Springer)