

MATH-467

**Probabilistic methods in combinatorics**

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Cursus	Sem.	Type
Computer science	MA1, MA3	Opt.
Cybersecurity	MA1, MA3	Opt.
Ing.-math	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Courses	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

We develop a sophisticated framework for solving problems in discrete mathematics through the use of randomness (i.e., coin flipping). This includes constructing mathematical structures with unexpected (and sometimes paradoxical) properties for which no other methods of construction are known.

**Content**

- Linearity of expectation
- The second moment method
- Local lemma
- Random graphs and matrices
- Applications in combinatorics and graph theory

**Keywords**

random variable, expected value, probabilistic method, random graph

**Learning Prerequisites****Required courses**

Probability theory

**Recommended courses**

- Discrete Mathematics or Graph Theory
- Linear Algebra

**Important concepts to start the course**

Graph, random variable, expectation, variance, binomial coefficients, asymptotics, eigenvalues

**Learning Outcomes**

By the end of the course, the student must be able to:

- Define and explain basic concepts in probability and discrete mathematics
- 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 method of interlacing polynomials

### 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

Dans le cas de l'art. 3 al. 5 du Règlement de section, l'enseignant décide de la forme de l'examen qu'il communique aux étudiants concernés.

### Resources

#### Bibliography

Noga Alon-Joel Spencer: The Probabilistic Method (Wiley)

#### Ressources en bibliothèque

- [Noga Probabilistic method](#)