MATH-434 **Lattice models**

| Cursus | Sem. | Type |
|---|---|---|
| Ing.-math | MA1, MA3 | Opt. |
| Mathématicien | MA1, MA3 | Opt. |

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|---|---|
| Language of teaching | English |
| Credits | 5 |
| Session | Winter |
| Semester | Fall |
| Exam | Written |
| Workload | 150h |
| Weeks | 14 |
| **Hours** | **4 weekly** |
| Courses | 2 weekly |
| Exercises | 2 weekly |
| **Number of positions** | |

### Remark

Pas donné en 2026-27 - Cours donnés en alternance tous les deux ans

### Summary

Lattice models consist of (typically random) objects living on a periodic graph. We will study some models that are mathematically interesting and representative of physical phenomena seen in the real world.

### Content

We will discuss some classical lattice models, such as: random walks, percolation, Ising model, random spanning trees, gaussian free field.
We will prove non-trivial theorems for each of the models. The goal is to allow students to learn general methods and concepts from a number of detailed case studies.

### Keywords

probability, graph theory, complex analysis, lattice models, statistical mechanics

### Learning Prerequisites

#### Required courses

Basic probability, basic analysis, linear algebra
While the class will be completely rigorous, the emphasis is more on revealing some interesting phenomena (that somehow exists in nature) rather than on constructing some theories. The goal is to learn things that are generalizable, but I almost always prefer to work out particular cases first.

#### Recommended courses

None of this is mandatory, but it could help: complex analysis, basic graph theory, simulations

### Learning Outcomes

- Reason with probabilistic lattice models
- Manipulate random variables in geometric settings
- Manipulate discrete and continuous objects

### Assessment methods

Written exam
Dans le cas de l'##art. 3 al. 5 du réglement de section, l'##enseignant décide de la forme de l'##examen qu'##il

communique aux étudiants concernés