

Percolation Theory:

Code: DDO

Instructor: Dr. Ivan Veselić

Date: Tuesdays from 9.15 till 10.45

For following groups of students: fak. MMM 6-9, TMM 6-9, WMM 6-9, PHY 6-9, IF 6-9, MPM

Hours per week: 2 hour lecture session

Recomandations: The attending students should have a sound knowledge of analysis, linear algebra and discrete probability theory. Knowledge of stochastic processes, e.g. time series, Markov chains or Brownian motion will be very helpful.

Contents:

Percolation graphs are random subgraphs of an fixed infinite graph, for instance the lattice Z^d . They are generated by a stochastic process indexed by the graph vertices and taking two values: one value signifies that the vertex is active in the percolation subgraph, the other that it is deleted. Usually one assumes that the stochastic process is ergodic with respect to an appropriate set of transformations, e.g. the translations in the case of the lattice. In fact, we will mostly concentrate on the case where the random variables constituting the stochastic process are independent and identically distributed.

The objective of percolation theory is to analyse geometric properties of the percolation subgraphs. A question of prime importance is whether a subgraph has an infinite component. Note that this property is, a priori, dependent on the elements of the underlying probability space. However, under certain ergodicity assumptions it can be shown that it is almost surely constant.

We will mostly concentrate on percolation on the lattice Z^d , with special emphasis on the two dimensional case Z^2 . The course will follow the summer school article of Chayes and Chayes "Percolation and random media" published in the proceedings volume "Critical phenomena, random systems, gauge theories" of the Les Houches summer school in 1984.

Applications of percolation theory include condensed matter physics, network analysis, and the social sciences.

The following books are recommended for further reading:

G. Grimmett, "Percolation", Second edition, Springer, Berlin, 1999

R. Durrett, "Lecture notes on particle systems and percolation", Wadsworth & Brooks/Cole Adv. Books Software, Pacific Grove, 1988

D. Stauffer, "Introduction to percolation theory", Taylor & Francis, London, 1985

H. Kesten, "Percolation theory for mathematicians", Birkhäuser, Boston, 1982

Grading: Students can take a "Fachprüfung" or "benoteter Schein", i.e. partial Diploma/Bachelor/Masters exam.

This and more information is available at the course page:

<http://www.tu-chemnitz.de/mathematik/schroedinger/lehre.php>