In this seminar we will take a closer look at an area of probability that originates in a very applied problem, but leads to many interesting theoretical questions. Suppose we submerge a large porous rock into water. Can the water reach its center? In other words, how does a fluid flow in a porous medium where the different channels and paths are randomly blocked?

Mathematically speaking, we are interested in the component structure of random subgraphs of graphs. We will start by looking at the case where the underlying graph is the square lattice $\mathbb{Z}^2$ and the subgraph is obtained by removing edges independently with some probability $p > 0$. We will answer questions such as how the choice of p influences the probability that a fluid percolates across the entire graph and how this behavior changes drastically at some specific value of p. Towards the end of the seminar we will take a closer look at newer results such as conformal invariance and Smirnov's Theorem.

Seminar details

Time of seminar: Wednesdays, 14:00 - 15:30, starting on **03.04.2019**
Place of seminar: Übungsraum 1 des Mathematischen Instituts
Grading scheme: Seminar talk - 60%, Protocol - 30%, Active participation - 10%
Literature: B. Bollobás and O. Riordan, Percolation, Cambridge University Press
Seminar organisation:

Talk: Every student must prepare and give a talk on their assigned topic. The talk should be approximately 75 minutes long and be done by writing on the board or by using slides (or a combination of both). Most topics are better suited to one or the other and the decision which to use is entirely up to the student.

Protocol: Every student must write a protocol/report for a talk given by another student. The protocol should be 4-8 pages, written in LaTeX. The protocol should be written in a self-contained manner, so that a reader who has not attended the talk but is familiar with previous talks can easily follow what is covered by the protocol. You should submit your protocol at most 3 weeks after the corresponding talk was given.

Language: This seminar is being conducted in English, so the talk and report should be done in the english language. However, the level of English used and any grammatical/vocabulary mistakes will have no effect on the final grade. If despite this you prefer to do your talk or write your protocol in German, you are free to do so without any negative effects. Any correspondence with the seminar organizer can be done in English or German.

Consultations: In order to prepare a good talk you are advised to arrange a meeting at least 2 weeks before your seminar talk, so that you can discuss the details of your topic and get advice on how to structure the talk. Additionally, you should not hesitate to get in touch and/or arrange a meeting if you have any questions or require additional help/advice.

Participant list, assigned topics and dates of talks

Below is the list of participants, with the corresponding topic code and date on which the seminar talk is scheduled. Each participant is also assigned a talk, for which they must write a protocol/report.

Topic	Date	Speaker	Protocol writer
1.	03.04.19	~~KS~~	SZ
2.	10.04.19	JM	NF
3.(a)	17.04.19	NL	FB
3.(b)	24.04.19	CS	VW
	01.05.19		
3.(c)	08.05.19	SZ	KS
4.(a)	15.05.19	NF	JM
4.(b)	22.05.19	FB	NL
5.(a)	29.05.19	VW	CS
5.(b)	05.06.19	SE	*Open*
	12.06.19		
6.(a)	19.06.19	KS	SE
6.(b)	26.06.19	*Open/Organizer*	

List of topics

Below is the full list of topics that will be covered during the seminar. The corresponding chapters and sections are listed next to the talk name. Your talk should be based on the contents of the given reference.

1. Basic concepts and results (Chapter 1)
2. Probabilistic tools (Chapter 2)
3. Bond percolation on $\mathbb{Z}^2$
   (a) The Russo-Seymour-Welsh method & Harris's Theorem (Sections 3.1 and 3.2)
   (b) A sharp transition & Kesten's Theorem (Sections 3.3 and 3.4)
   (c) Dependent percolation and exponential decay & Sub-exponential decay (Sections 3.5 and 3.6)
4. Exponential decay and critical probabilities
   (a) The van den Berg-Kesten inequality and percolation & Oriented site percolation (Sections 4.1 and 4.2)
   (b) Menshikov's Theorem (Section 4.3)
5. Uniqueness of the infinite open cluster and critical probabilities
   (a) The Aizenman-Kesten-Newman Theorem (Section 5.1)
   (b) Site percolation on the triangular and square lattices (Section 5.3)
6. Conformal invariance
   (a) Crossing probabilities and conformal invariance (Section 7.1)
   (b) Smirnov's Theorem (Section 7.2)