Percolation, Old and New

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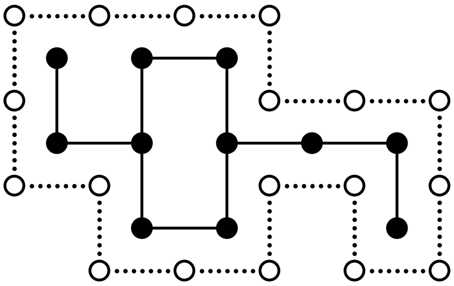

Percolation is the archetypal random network, and is the gateway to probabilistic models of spatial disorder, including those arising in statistical physics, epidemiology, spatial statistics, etc. A beautiful theory has evolved since 1957. Percolation is notorious for its 'easy-to-state' problems requiring new ideas, and each step forward seems to lead to more such problems.

General aims of these four lectures are threefold:

- to introduce the basic theory of percolation in a digestible manner to 'beginners', with the emphasis on basic techniques and the big picture,
- to give the flavour of selected recent work,
- to review open problems in percolation and related systems.

The five sub-headings of the course are:

1. *Percolation, the old.* In the first talk, we survey the basic model and summarise the theory thereof. No new results will be presented, and *cognoscenti are welcome, but are invited to pursue something more personally productive elsewhere.*
2. $\mathbb{Z}^2$ *remains alive.* Problems in two dimensions. Conformal invariance, Cardy's formula, and stochastic Löwner equations.
3. *Random-cluster model.* Results and conjectures.
4. *Entanglements.* Existence, uniqueness, and open problems.
5. *Stochastic pin-ball.* Lorentz/Ehrenfest models, and their 'stochastic relaxations'.

The principal single reference is the second edition of *Percolation*, published in 1999 by Springer.