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Problems in first-passage percolation. 1: Limit shapes

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First-passage percolation was introduced in the '60s by Hammersley and Welsh, and is a random growth model which can describe a simplified version of processes like cell growth or the propagation of flame fronts. Despite decades of attention, many of its fundamental properties are yet to be verified. To define the model, one places, on the cubic lattice $\mathbb{Z}^d$, i.i.d. nonnegative edge-weights, and considers the induced (random) weighted graph metric $T = T(x, y)$. In this first of three lectures, I will focus on the first order growth of T, through the view of limiting shapes. As t grows, the random ball of radius t centered at the origin, scaled by a factor of t, converges to a deterministic (limiting) shape, B. I will cover the main conjectured properties of B (for instance, smoothness and curvature), along with what little is proved toward verifying them. This talk will be introductory and not assume any knowledge of percolation.

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