

## Variational formula for the time-constant of first-passage percolation

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### **Abstract:**

Consider first-passage percolation with positive, stationary-ergodic weights on the square lattice in  $d$ -dimensions. Let  $T(x)$  be the first-passage time from the origin to  $x$  in  $\mathbb{Z}^d$ . The convergence of  $T([nx])/n$  to the time constant as  $n$  tends to infinity is a consequence of the subadditive ergodic theorem. This convergence can be viewed as a problem of homogenization for a discrete Hamilton-Jacobi-Bellman (HJB) equation. By borrowing several tools from the continuum theory of stochastic homogenization for HJB equations, we derive an exact variational formula (duality principle) for the time-constant. Under a symmetry assumption, we will use the variational formula to construct an explicit iteration that produces the limit shape.