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Critical probability for phase transition in a degenerate random environment

Percolation is a well-studied phenomenon in statistical physics and probability theory, which describes the behavior of fluids, gases, or other substances as they pass through a random environment. The concept of percolation theory has also been extended to other fields, including computer science, network analysis, and ecology. The critical point is a fundamental concept in percolation theory, which refers to the point at which the system undergoes a phase transition from one state to another.

This study explores how an agent behaves in a randomly generated 2D environment. The cells of our grid environment are randomly filled with either $\uparrow$ or $\leftarrow\updownarrow\rightarrow$ arrows which determine the available adjacent cells, and a parameter p controls the frequency of each one. We are interested in simulating the agent's behavior and, more importantly, approximating a value for p that acts as a critical point for our system and causes a significant change in the behavior of the environment. We use computer simulation to investigate and determine the critical probability value