Explosive Percolation in Erdős-Rényi-Like Random Graph Processes

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Abstract

The evolution of the largest component has been studied intensely in a variety of random graph processes, starting in 1960 with the Erdős-Rényi process. It is well known that this process undergoes a phase transition at $n/2$ edges when, asymptotically almost surely, a linear-sized component appears. Moreover, this phase transition is continuous, i.e., in the limit the function $f(c)$ denoting the fraction of vertices in the largest component in the process after $c * n$ edge insertions is continuous. A variation of the Erdős-Rényi process are the so-called Achlioptas processes in which in every step a random pair of edges is drawn, and a fixed edge-selection rule selects one of them to be included in the graph while the other is put back. Recently, Achlioptas, D'Souza and Spencer (2009) gave strong numerical evidence that a variety of edge-selection rules exhibit a discontinuous phase transition. However, Riordan and Warnke (2011) very recently showed that all Achlioptas processes have a continuous phase transition.

In this talk we present several Erdős-Rényi-like processes all of which have a discontinuous phase transition, namely (i) half-restricted processes in which in every step we connect two vertices, one chosen uniformly at random from all vertices, and one chosen uniformly at random from a restricted set of vertices, (ii) a component process in which in every step we draw a pair of components uniformly at random from the set of all components and insert an arbitrary edge between them, (iii) a mixed process in which in every step we draw one vertex uniformly at random and one component uniformly at random and connect the vertex to an arbitrary vertex of the component.