Hamilton Institute

How Hard are Random Problems? Phase Transitions in Satisfiability and Graph Coloring

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Abstract

Computer science has developed notions like NP-completeness to quantify the difficulty of search and optimization problems. But NP-completeness is a worst-case notion, in which we imagine an "adversary" who constructs problems that are as hard as possible. Indeed, we might hope that hard examples of these problems are very rare, and that most examples we are likely to see are not as hard as their worst case suggests.

As an alternative to the worst case we can consider the average case: that is, construct a random 3-SAT formula, or a random graph, and ask whether it is satisfiable or 3-colorable. As it turns out, these random problems appear to have a well-defined "phase transition," analogous to the magnetization or the freezing of water, where they jump from satisfiable to unsatisfiable when the density of constraints passes a critical threshold.

This has produced an exciting collaboration between statistical physicists and computer scientists, in which deep ideas from physics have just begun to be proved rigorously, and in which the "cultures" of the two fields have interacted in interesting and challenging ways. I will outline some of the results and techniques in this area, including joint work with Dimitris Achlioptas on the location of the k-SAT threshold.

Venue: Seminar Room, Hamilton Institute, Rye Hall,
NUI Maynooth

Time: 2.00 - 3.00pm (followed by tea/coffee)

Travel directions are available at www.hamilton.ie

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