On the Complexity of Detecting Planted Solutions

Many combinatorial problems appear to be hard on average for natural distributions over inputs, e.g., k-SAT, k-CSP, max-clique etc. This continues to be true even after planting solutions, i.e., ensuring that all clauses of a formula are generated from ones that satisfy a specific assignment, adding a large clique to a random graph etc. There are large gaps between the number of random clauses at which the planted solution can be found efficiently vs where it becomes the unique solution (and therefore can be identified information-theoretically), or the size of the planted clique that can be found efficiently vs the largest clique without the planting. How to explain these computational gaps? We demonstrate a paring transition phenomenon in the solution space as the number of clauses (size of the planted clique) grows, and discuss how it directly affects the complexity of a large class of algorithms known as statistical algorithms. Of course, it is entirely possible that Prof. Frieze comes up with a crazy algorithm that gets around this barrier.

The talk is based on joint work with Vitaly Feldman, Elena Grigorescu, Will Perkins, Lev Reyzin and Ying Xiao.