Seminar on Combinatorial Computing
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Graph coloring in expected polynomial time

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Abstract

Graph coloring has long been notoriously known for its computational difficulty. Recent complexity results indicate that one should not even expect to obtain an approximation algorithm for the chromatic number of a graph with non-trivial approximation ratio.

This, combined with the extreme importance of graph coloring and its wide applicability, stimulates the development of graph coloring algorithms which perform well on average, as opposed to the somewhat pessimistic worst case scenario. In particular, a natural yet challenging task is to develop efficient coloring algorithms whose average running time is polynomial over the probability space $G(n, p)$ of random graphs.

In this talk we discuss two such results. The first one (a joint work with Van Vu from Microsoft Research) provides an approximation algorithm for the chromatic number of G, whose expected running time is polynomial and whose approximation ratio is about $\sqrt{np}$, for all values of the edge probability $p = p(n) >> 1/sqrtn$. The analysis of the algorithm relies upon a large deviation inequality for eigenvalues of random symmetric matrices, obtained through the celebrated Talagrand Inequality.

The second algorithm, for every fixed $k \geq 3$, decides k-colorability in expected polynomial time over the probability space $G(n, p)$, where $p(n)$ can be as small as $p(n) = C/n$ with $C = C(k) > 0$. The key notion here is that of the vector chromatic number, introduced by Karger, Motwani and Sudan in their work on approximate coloring algorithms.

For further information contact Janos Pach at pach@cims.nyu.edu, or visit our website: http://www.math.nyu.edu/ pach/combinatorics_seminar.html