Technion CMS Distinguished Lecture Series

Speaker: László Babai

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Dates: January 23, 24, and 26, 2017

Title: Local versus global symmetry and the Graph Isomorphism problem I-III

Abstract: The Graph Isomorphism problem is the algorithmic problem to decide whether or not two given finite graphs are isomorphic. Recent work by the speaker has brought the worst-case complexity of this problem down from exp ($\sqrt{n \log n}$) (Luks, 1983) to quasipolynomial (exp((log n)^c)), where n is the number of vertices.

In the first talk we state a core group theoretic lemma and sketch its role in the algorithm: the construction of global automorphisms out of local information.

The focus of the second and third talks will be the development of the main combinatorial "divide-and-conquer" tool, centered around the concept of *coherent configurations*. These highly regular structures, going back to Schur (1933), are a common generalization of strongly regular graphs and the more general distance-regular graphs and association schemes arising in the study of block designs on the one hand and the orbital structure of permutation groups on the other hand. Johnson graphs are examples of distance-regular graphs with a very high degree of symmetry.

Informally, the main combinatorial lemma says that any finite relational structure of small arity either has a measurable (say 10%) hidden irregularity or has a large degree of hidden symmetry manifested in a canonically embedded Johnson graph on more than 90% of the underlying set.