CWI Lectures in Mathematics and Computer Science

Mathematics for Efficiency

for Alexander Schrijver

September 19th, 2005
14.00-17.00 hrs

speakers

László Lovász *Microsoft Research and Eötvös University*

Paul Seymour *Princeton University*

Centrum voor Wiskunde en Informatica (CWI)
Turingzaal /Z011

Invitation

Alexander Schrijver is an outstanding scholar, who has made fundamental contributions to graph theory and combinatorial optimization - Mathematics for Efficiency. This summer he is stepping down from his administrative positions at Centrum voor Wiskunde en Informatica (CWI) as Department Head and member of CWI's Management Team. As from 1 July 2005 Lex Schrijver has been appointed CWI fellow.

Schrijver's research career so far spans three decades. During these years he forged the relatively young area he is working in, to a discipline. This culminated in his standard work `Combinatorial Optimization - Polyhedra and Efficiency', which appeared in 2003. He received several international awards, including the 2003 Dantzig Prize, an oeuvre prize in mathematical optimization. Quite recently Lex Schrijver was awarded the NWO Spinoza Prize 2005 - sometimes called the Dutch Nobel Prize.
CWI is proud and grateful that for all this work Lex chose CWI as his home base, where he will continue his research. Therefore CWI offers him this meeting.

Speakers will be two of the most prominent and influencial mathematicans in Schrijver's research area: László Lovász (Microsoft Research and Eötvös University) and Paul Seymour (Princeton University) who will speak of their current work in graph theory.

The lectures will aim at a general audience of nonspecialist mathematicians and computer scientists.

You are kindly invited to attend the CWI Lectures and to registrate at www.cwi.nl/cwilectures.

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Programme

Mathematics for Efficiency stands for those areas in the interface of mathematics and computer science that concern the fundamental issues behind computational problems as how to design a good railway timetable or how to route connections when designing a computer chip. Designing good algorithms for such problems requires structural understanding of the underlying environments. In combinatorial optimization and graph theory these issues are investigated.

13.30	Arrival with coffee and tea
14.00	Opening | **Jan Karel Lenstra**
14.05	Graph homomorphisms and limits of graph sequences | **László Lovász**
14.55	Tea
15.10	Structure theorems in graph theory | **Paul Seymour**
16.00	Closure
	Reception in Newtonzaal

Abstracts

Graph homomorphisms and limits of graph sequences | László Lovász

Counting homomorphisms between graphs has a surprising number of applications. Many models in statistical mechanics and many questions in extremal graph theory can be phrased in these terms.

We introduce a matrix, which we call the connection matrix, and show, that this is positive semidefinite (in statistical mechanics, a related fact is called 'reflection positivity'). This fact contains many results in extremal graph theory and in the theory of quasirandom graphs. This matrix was used by Freedman, Lovász and Schrijver to characterize graph parameters that are obtained by counting homomorphisms into a fixed graph.

Using properties of this matrix, one can define and characterize 'convergence' for a sequence of graphs whose size tends to infinity, and construct a limit object from which the limiting values of many graph parameters can be read off. This is closely related to 'property testing' in computer science.

This is joint work with many people, including also Christian Borgs, Jennifer Chayes, Jeff Kahn, Lex Schrijver, Vera Sós, Balázs Szegedy, Kati Vesztergombi and Dominic Welsh.

Structure theorems in graph theory | Paul Seymour

Fix a graph H. What is the most general graph that does not contain H? In other words, how do we explicitly construct all the graphs that do not contain H? To begin to make this precise, we have to say what 'contain' means; we have in mind either minor containment, or, induced subgraph containment. But what do we mean by an 'explicit construction' of a class of graphs? We give some examples, and describe some connections and differences between the two containment relations, and discuss several open questions in the area. There will be no detailed proofs, and very little knowledge of graph theory will be assumed.