Computing canonical forms of graphs: limitations of lexicographic methods

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Determining the computational complexity of the problem of finding canonical representatives of graphs is a long-standing unresolved question. This question is of fundamental interest in the theory of computing because of its close relationship with graph-isomorphism testing.

While the problem may be difficult in general, group-theoretic methods have enabled polynomial-time solutions for important classes of graphs, including graphs of bounded valence. In practice, however, variants of backtrack search to find lexicographic leaders have long been accepted as quite effective; for example, the system nauty is the leader in this category.

In this talk, I will discuss theoretical limitations of the lexicographic-leader approach to finding canonical forms. It turns out that this approach leads to NP-complete problems, even for very restricted classes of graphs for which there are simple polynomial-time solutions by group-theoretic methods.

Semifinite Generalized Quadrangles

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A generalized quadrangle with \( k \) points per line (\( k \) finite), but infinitely many points and lines altogether, is called semifinite. The question of existence of such structures is a long-standing open question. The combined work of Kantor, Cameron and Brouwer ruled out the cases \( k = 3, 4 \); and the case \( k = 5 \) was ruled out by Cherlin (2005) using model-theoretic techniques. I will outline Cherlin’s argument and offer some variants of his approach. The hope (currently unrealized) is to extend this approach to \( k = 6 \) or larger.

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Colorado State University

This is a joint Denver U / UC Boulder / UC Denver / U of Wyoming / CSU seminar that meets biweekly. Anyone interested is welcome to join us at a local restaurant for dinner after the talks.