RYERSON UNIVERSITY

DEPARTMENT OF MATHEMATICS

GRAPHS AT RYERSON (G@R) SEMINAR

Dr. Dejan Delic

Department of Mathematics, Ryerson University

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Atomization of Constraint Satisfaction Problems and Partition Pebble Games

Abstract: The problem of classifying computational complexity of constraint satisfaction problems (CSPs, for short) has generated a lot of interest in theoretical computer science, logic, and, lately, in algebra. The central problem in the area is the Dichotomy Conjecture, due to T. Feder and M. Vardi, asking whether every CSP over a finite relational template is either in P or NP-complete. The classes of templates for which the conjecture was known to hold had been rather ad hoc until some 10 years ago, when it became increasingly clear that all known tractable cases split into two categories: the classes of finite relational width and those for which the solving algorithm exploits the idea that the solution space has a relatively small generating set. Both classifications involved substantial advances coming from the field of general algebra.

In his MSc thesis (2015), A. Habte showed that the CSPs with Maltsev templates can be defined in the logic FP+Rk. In the attempt to refine that result and prove the conjecture that all such CSPs belong to the complexity class $MOD_k\ L$, we developed a different approach to solving any CSP which meets a very weak algebraic condition necessary for avoiding intractability, which attempts to "atomize? the given CSP by replacing it with a disjunction of polynomially many CSPs over well understood and simple (from the algebraic point of view) templates. The method of dismantling the more complicated CSP into simpler ones relies heavily on the inductive descent within the lattice of *congruences* of the structure; i.e. the positive-primitive definable equivalence relations of the structure. By applying this method to the class of conservative CSPs (originally shown to satisfy the Dichotomy Conjecture by A. Bulatov), we discovered a game characterizing the CSP solvability in this particular context, which fits the pattern of the so-called *partition pebble games*, developed by A. Dawar and B. Holm, in order to characterize the definability in the logic FP+Rk.

All Faculty, staff, students and guests are welcome to attend