

Seminar/Talk

When and why do efficient algorithms exist (for constraint satisfaction and beyond)?

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Computational problems exhibit a diverse range of behaviors in terms of how quickly and effectively they can be solved. What underlying mathematical structure (or lack thereof) in a computational problem leads to an efficient algorithm for solving it (or dictates its intractability)? Given the vast landscape of problems and algorithmic approaches, it would be simplistic to hope for a universal theory explaining the underpinnings of easiness/hardness. Yet, in the realm of constraint satisfaction problems (CSP), the algebraic dichotomy theorem gives a definitive answer: a polynomial time algorithm exists when there are non-trivial local operations called polymorphisms under which the solution space is closed; otherwise the problem is NP-complete.Inspired and emboldened by this, one might speculate a polymorphic principle in more general contexts, with symmetries in the solution space governing efficient algorithms. Beginning with some background on CSP and the polymorphic approach to understanding their complexity, the talk will discuss some extensions beyond CSP where the polymorphic principle seems promising (yet far from understood). In particular, we will discuss promise CSP'' (PCSP) where one is allowed to satisfy a relaxed version of the constraints (a framework that includes important problems like approximate graph coloring). We will provide glimpses of the emerging polymorphic theory characterizing the (in)tractability of interesting classes of PCSP as well as the ability of natural classes of algorithms to solve them.

Monday, July 1, 2024 11:00am - 12:00pm
Office Bldg West / Ground floor / Heinzel Seminar Room (I21.EG.101)

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