Participating Seminar in Theoretical Computer Science

Organizers Will Rosenbaum, Siddharth Bhaskar, Zach Norwood

Instructor of Record Yiannis Moschovakis

Time & Location Wednesdays 4-6, MS 3915D

Course Description We will study three classical topics in computer science: Space-Time tradeoffs, Communication Complexity, and Automata Theory. On a technical level, first two will be combinatorial in nature, and the last is algebraic. We will get through the whole course without ever having to define a Turing machine. This should be a fun an accessible course.

Here are the topics in more detail:

1. **Space-time tradeoffs**. Space and time are two fundamental measures of complexity of a computation. It turns out that in some classical problems, for example sorting, by allowing ourselves more of one resource we can use less of the other. We will read "A Time-Space tradeoff for sorting on non-oblivious machines" by Borodin et al.

2. **Communication complexity.** Communication complexity is concerned with understanding the amount of communication required to compute a function whose input is distributed among two or more parties. Following the works of Yao ("Some Complexity Questions Related to Distributed Computing") and Razborov ("On the Distributional Complexity of Disjointness"), we will formalize the notion of communication complexity and give several methods for computing lower bounds.

3. **Automata theory**. Deterministic automata are a machine model of computation dating back to the roots of the subject. It turns out that automata and various fundamental relations on them (like simulation) have categorical formulations. We will read "Automata and Coinduction" by J.J.M.M. Rutten.