Abstract:

The class $P$ attempts to capture the efficiently solvable computational tasks. It is full of practically relevant problems, with varied and fascinating combinatorial structure. In this talk, I will give an overview of a rapidly growing body of work that seeks a better understanding of the structure within $P$. Inspired by $NP$-hardness, the main tool in this approach are combinatorial reductions. Combining these reductions with a small set of plausible conjectures, we obtain tight lower bounds on the time complexity of many of the most important problems in $P$. I will present the most recent landscape of $P$ and the conjectures on which this project is based on (e.g. the Strong Exponential Time Hypothesis). I will discuss recent attempts on identifying new conjectures: either more reliable ones, or ones that will get us closer to a full classification of the important problems in $P$. Finally, I will highlight a surprising new reduction from Circuit-SAT to natural problems in $P$ like Edit-Distance which proves that minor improvements over the quadratic running time of Edit-Distance are enough to prove major complexity separations.