The computational complexity of Cops and Robbers

Abstract: In the classic Cops and Robbers game, a team of cops attempts to capture a robber on a graph. The game has been extensively studied, with applications ranging from video game AI to counterterrorism. It has also spawned many variants: cops in helicopters, cops with tasers, drunk robbers, and so on.

In this talk, we discuss the computational complexity of deciding whether $k$ cops can capture a robber on a graph $G$. How fast (or how slow) are the best possible computer algorithms for determining who wins? In 1995, Goldstein and Reingold conjectured that the problem is EXPTIME-complete – in other words, that Cops and Robbers is among the “hardest” problems that can be solved in time exponential in the size of the input.

Goldstein and Reingold themselves proved EXPTIME-completeness of two specialized variants of Cops and Robbers, but were unable to say anything about the original game. In fact, it was not until recently that partial results began to emerge: in 2010, Fomin et al. showed the game to be NP-hard, and in 2013, Mamino showed it to be PSPACE-hard. By combining Mamino’s ideas with our own new insights, we prove that Cops and Robbers is, in fact, EXPTIME-complete.

No prior knowledge of Cops and Robbers or complexity theory will be assumed.

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