Long-Range Planning with Time-Inconsistency: A Class of Computational Problems in Behavioral Economics

Abstract:
In many settings, people exhibit behavior that is inconsistent across time — we allocate a block of time to get work done and then procrastinate, or put effort into a project and then later fail to complete it. An active line of research in behavioral economics and related fields has developed and analyzed models for this type of time-inconsistent behavior.

Here we propose a graph-theoretic model of tasks and goals, in which dependencies among actions are represented by a directed graph, and a time-inconsistent agent constructs a path through this graph. We first show how instances of this path-finding problem on different input graphs can reconstruct a wide range of qualitative phenomena observed in the literature on time-inconsistency, including procrastination, abandonment of long-range tasks, and the benefits of reduced sets of choices. We then explore a set of analyses that quantify over the set of all graphs; among other results, we find that in any graph, there can be only polynomially many distinct forms of time-inconsistent behavior; and any graph in which a time-inconsistent agent incurs significantly more cost than an optimal agent must contain a large “procrastination” structure as a minor. Finally, we use this graph-theoretic model to explore ways in which tasks can be designed to help motivate agents to reach designated goals.

This is joint work with Jon Kleinberg.