Autonomous systems in the intersection of formal methods, learning, and control

Professor Ufuk Topcu

UT Austin

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Abstract:

Autonomous systems are emerging as a driving technology for countlessly many applications. Numerous disciplines tackle the challenges toward making these systems trustworthy, adaptable, user-friendly, and economical. On the other hand, the existing disciplinary boundaries delay and possibly even obstruct progress. I argue that the nonconventional problems that arise in designing and verifying autonomous systems require hybrid solutions at the intersection of learning, formal methods, and controls. I will present examples of such hybrid solutions in the context of learning in sequential decision-making processes. These results offer novel means for effectively integrating physics-based, contextual, or structural prior knowledge into data-driven learning algorithms. They improve data efficiency by several orders of magnitude and generalizability to environments and tasks that the system had not experienced previously. I will conclude with remarks on a few promising future research directions.