Computer Science Seminar

Risk-Sensitive Safety Analysis and Control for Trustworthy Autonomy

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Abstract: Methods for managing dynamic systems typically invoke one of two perspectives. In the worst-case perspective, the system is assumed to behave in the worst possible way; this perspective is used to provide formal safety guarantees. In the risk-neutral perspective, the system is assumed to behave as expected; this perspective is invoked in reinforcement learning and stochastic optimal control. While the worst-case perspective is useful for safety analysis, it can lead to unnecessarily conservative decisions, especially in settings where uncertainties are non-adversarial. The risk-neutral perspective is less conservative and useful for optimizing the systems performance on average. However, optimizing average performance is not guaranteed to protect against harmful outcomes and thus is not appropriate for safety-critical applications. In this talk, I will first present an analytical and data-driven computational toolkit for managing triple-negative breast cancer that I have developed with cancer biologists at Oregon Health and Science University by invoking the worst-case perspective. In addition to providing biological insights about breast cancer and theoretical insights about switched systems, this work has motivated the need for new mathematical methods that facilitate less conservative but still protective control of dynamic systems. Towards this aim, I have devised a risk-sensitive mathematical method for safety analysis that blends the worst-case and risk-neutral perspectives by leveraging the Conditional Value-at-Risk measure. The next part of my talk will focus on this new risk-sensitive mathematical method and its application to evaluating safety of urban water infrastructure in joint work with water resources specialists at the Berkeley Water Center and Tufts University. In the last part of my talk, I will present the aims of my future research program Decision Analysis for Trustworthy Autonomy that will extend the theories of control, risk, and learning to address safety-critical challenges in society.

Bio: Margaret Chapman is a PhD Candidate advised by Dr. Claire Tomlin in Electrical Engineering and Computer Sciences (EECS) at UC Berkeley. She is grateful to be a recipient of the Fulbright Scholarship, the NSF Graduate Research Fellowship, and the Berkeley Fellowship for Graduate Study. She earned her BS degree (with Distinction) and her MS degree in Mechanical Engineering from Stanford University. Margarets research interests are the development of data-driven dynamic models and mathemati-cal decision analysis methods for safety-critical stochastic systems with applications to sustainable cities and healthcare. Margaret is delighted to be a participant of 2019 Rising Stars in EECS, and she aims to become a professor at a university with strong interdisciplinary research.

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