ME/SE/EC 734 Hybrid Systems, Spring 2022

Instructor:
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Lectures:
Mon, Wed 2:30 – 4:15 PHO 205

Office hours:
Mon, Wed 4:30-5:30
Location: my office and also on zoom:
https://bostonu.zoom.us/j/6753569528
(Meeting ID: 675 356 9528)

Course web resources:
Lecture notes, homework, and project assignments will be available in the BU blackboard.

Prerequisites:
There are no specific prerequisites for this course. The necessary background will be provided in the class. However, a certain level of mathematical maturity is necessary, such as familiarity with linear algebra, differential equations, and some basic control theory. The background in automata theory and formal methods will be provided during the course.

Textbook:
None required. Reading material will be provided in the class.

Course learning objectives:
At the end of this course, the students will (1) understand nontrivial problems that occur when continuous and discrete dynamics are combined, (2) know the principles of formal verification and abstraction, (3) understand stability issues specific to hybrid systems, and (4) be able to use off-the-shelf software packages for simulation and verification of hybrid systems

Policy on Collaboration:
Collaboration is not allowed for homework assignments. It is allowed for team projects.

Grading policy:
Homework (40%) & Project (60%)

Tentative Schedule
Lecture 1: Introduction, motivation, and examples
Lectures 2, 3: Models of hybrid systems (syntax)
Lecture 4: Trajectories of hybrid systems (semantics)
Lecture 5: Numerical simulation of hybrid systems
Lectures 6, 7: Stability of hybrid systems
Lecture 8: Propositional logics and first order logics
Lectures 9, 10: Transition systems, languages, simulations, bisimulations
Lecture 11, 12, 13, 14: Abstractions for continuous and hybrid systems
Lecture 15: Temporal logics and model checking

Lectures 16, 17: Formal analysis for some classes of hybrid systems
Lectures 17, 18, 19: Formal synthesis of control strategies for hybrid systems
Lecture 20: Modeling and analysis of biochemical networks
Lecture 21, 22: Symbolic motion planning and control
Lectures 23, 24: Project presentations