

ECE597/697MB Special Topic – Modeling and Verification of Embedded Systems

- **Lecture:** MWF 10:10-11:00AM ELAB 323
- **Office hours:** M 11-12 and F 9-10
- **Professor:** Daniel Holcomb, 309H KEB, holcomb@engin.umass.edu
- **Teaching Assistant:** Aftab Usmani, musmani@umass.edu
Edward A. Lee and Sanjit A. Seshia, Introduction to Embedded Systems, A Cyber-Physical Systems Approach, Second Edition, <http://LeeSeshia.org>, 2017.
- **Textbook:**

Description

Embedded systems sense, actuate, compute, and communicate to accomplish tasks in domains such as medical, automotive, and industrial controls. Informal methods of hacking together embedded systems are at odds with the criticality of their applications. This course will introduce recent developments toward more rigorous modeling and verification of embedded and cyber-physical systems. By the end of the course, students should understand the capabilities and limitations of different representations of embedded systems, and should be able to model (and sometimes verify) systems using appropriate abstractions.

Major Course Topics

- Introduction
- Discrete Dynamics and FSMs (ch 3, 5)
- Basic Reachability Analysis
- Invariants, Temporal Logic (ch 13)
- Equivalence, Refinement/Abstraction, Simulation Relations (ch 14)
- Model Checking (ch 15)
- Hybrid Systems and Timed Automata (ch 4)
- Continuous Dynamics, Sensors, ADC (ch 2, 7)
- Models of Computation (ch 6)
- Scheduling (ch 12)
- Case Studies
- Security
- Project Presentations

Grading Policy (Subject to change)

In-class participation is expected, especially pertaining to reading and discussing research papers. Students will be required to lead the discussion of research papers. All students taking 697MB will be required to complete a project individually or with a partner. The project is optional for students taking 597MB; if not doing a project, the weights of other grade components will scaled up proportionally.

Exams (2)	40%
Problem Sets (approx. 5)	10%
Lab 1	10%
Lab 2	7.5%
Lab 3	7.5%
Project	15%
Participation/Discussion	10%

Lab Assignments

The course will involve a number of tool-based lab assignments. The focus of these labs is modeling and verification. No advance familiarity with any tools is expected.

1. Reachability Analysis (explicit and SAT-based symbolic)
2. Verification of timed automata (using UPPAAL)
3. Hybrid verification (using PHAVER)

Academic Honesty Policy Statement

Since the integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst.

Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. The procedures outlined below are intended to provide an efficient and orderly process by which action may be taken if it appears that academic dishonesty has occurred and by which students may appeal such actions.

Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent. For more information about what constitutes academic dishonesty, please see the Dean of Students website: http://umass.edu/dean_students/codeofconduct/acadhonesty/

Disability Statement

The University of Massachusetts Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological, or learning disability on file with Disability Services (DS), Learning Disabilities Support Services (LDSS), or Psychological Disabilities Services (PDS), you may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires an accommodation, please notify me within the first two weeks of the semester so that we may make appropriate arrangements.