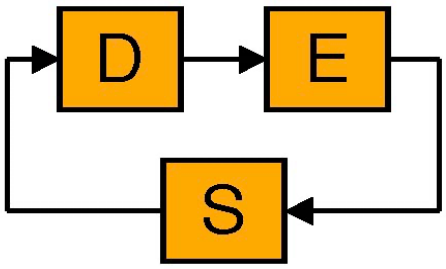
Course Announcement
FALL 2022



EECS 566 DISCRETE EVENT SYSTEMS

Instructor: Stéphane Lafortune (EECS)
stephane@umich.edu

Time: Tuesday-Thursday: 3:00 pm to 4:30 pm [1303 EECS]

Prerequisite: Graduate standing in any CoE grad program
(ECE, ME, Robotics, AERO, CSE, etc.)

Description: 566 is offered in the fall semesters of *even* years

This course is intended for engineering and computer science graduate students who want to learn about dynamic systems with discrete state spaces and event-driven transitions. Discrete Event Systems, as they are called, arise in the modeling of modern technological systems such as automated manufacturing systems, process control systems, software systems, transportation systems, and more generally autonomous systems with a supervisory control layer. In embedded and networked systems, discrete event dynamics are coupled with continuous dynamics, giving rise to what are called Hybrid Systems or Cyber-Physical Systems (CPS).

This course will introduce students to the modeling, analysis, and control of Discrete Event Systems (DES). The primary emphasis will be on the logical, or untimed, behavior of DES (i.e., high level behavior of CPS) and will encompass modeling formalisms (automata, labeled transition systems, and Petri nets), verification techniques (primarily for automata models, with a brief introduction to temporal logic), fault diagnosis, opacity, and a detailed introduction to supervisory control theory. Timed automata will also be introduced. Examples from the above areas will be used throughout the course. Various software tools will be used for homework assignments.

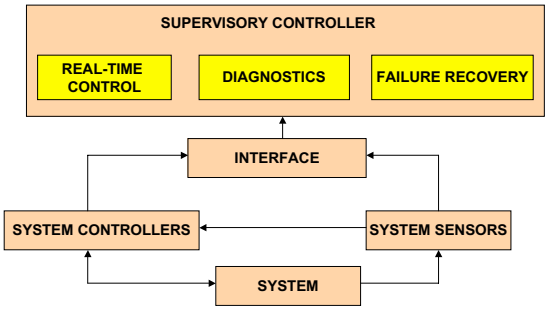
There are no specific course prerequisites. EECS 566 is also open to undergraduate seniors, but they should consult with the instructor first.

(See over for more details)

Textbook: "Introduction to Discrete Event Systems - Third Edition"
by C. Cassandras and S. Lafortune, Springer, 2021.
https://link.springer.com/book/10.1007/978-3-030-72274-6

A free PDF of the textbook is available in SpringerLink through the U. of Michigan's subscription. A softcover printed copy can be ordered at reduced cost ("MyCopy" in SpringerLink).

Grading (*tentative*)**:** Homework assignments (10), short end-of-semester project (individual or teams of 2), and two exams.



Syllabus: Chapters 1, 2, 3, 4, and 5 of textbook.

- Introduction
  [Chapter 1, section 1.3: 1 lecture]
- Finite-state automata models of DES. Notions of deadlock and livelock; product and parallel composition; observer and diagnoser automata; analysis of safety and liveness properties. Event diagnosis. Opacity.
  [Chapter 2: About 8 lectures]
- Supervisory control of systems modeled by automata. Notions of controllability and observability for DES; control under full and partial observation; nonblocking control. Synthesis algorithms for full and partial-observation supervisors.
  [Chapter 3: About 8 lectures]
- Petri net models of DES. Reachability analysis with coverability tree; structural analysis using incidence matrix. Supervisory control of Petri nets by monitor places.
  [Chapter 4: About 4 lectures]
- Timed automata models of DES. Parallel composition; reachability analysis by untiming.
  [Chapter 5: About 3 lectures]
- Introduction to labeled transition systems and temporal logic.
  [Additional materials: About 3 lectures]