CSC5991: Introduction to Cyber-Physical Systems

Winter 2017
0318 State Hall
M W 2:30 P.M. – 3:45 P.M.

Course Instructor: Hongwei Zhang (hongwei@wayne.edu)

Course Description

Tightly integrating sensing, networking, computing, and control with physical systems and processes, cyber-physical systems are expected to transform the physical world around us and the way we interact with the physical world, and they will serve as foundations for a wide range of domains such as transportation, industrial automation, advanced manufacturing, healthcare, power grid, and public safety. This course is designed to introduce the technology foundations of cyber-physical systems to graduate students and senior undergraduate students, and it addresses the following topics:

- Modeling, design, analysis, and implementation of cyber-physical systems
- Dynamic behavior modeling, state machine composition, and concurrent computation
- Sensors and actuators
- Embedded systems and networks
- Feedback control systems
- Analysis and verification techniques, temporal logic, and model checking
- Machine learning

This course will prepare graduate and senior undergraduate students for pursuing advanced topics in areas such as connected and autonomous vehicles, Industrial Internet, Internet of Things (IoT), and smart and connected health.

Prerequisites

Undergraduate courses in computer architectures and algorithms (e.g., CSC 3100/ECE 4680, CSC 3110/ECE 4050, or equivalent).

Textbook

Course learning outcomes

• Through this course, students will be able to master the following fundamentals of cyber-
physical systems:
  o Dynamic behavior modeling, state machine composition, and concurrent computation
  o Sensing and actuation mechanisms
  o Architectures and algorithms for embedded systems and networks
  o Feedback control theory
  o Temporal logic and model checking
  o Machine learning techniques

• Students will be able to apply the aforementioned cyber-physical systems fundamentals to
application domains such as connected and autonomous vehicles, industrial internet, and
smart and connected health.
• Students will be able to implement cyber-physical systems solutions (e.g., embedded
networking protocols, real-time scheduling algorithms, and networked control algorithms).
• Students will also be able to explore (e.g., survey) cutting-edge research findings in cyber-
physical systems.

Student outcomes

Through the course, students will achieve the following:

• An understanding of the technology foundations of cyber-physical systems.
• An ability to understand advanced topics in cyber-physical systems.
• A skill set necessary for making innovative contributions to both cyber-physical
systems technologies and applications.
• An ability to apply knowledge of cyber-physical systems to real-world problem
solving.
• An ability to function effectively on teams to accomplish a common goal.
• An ability to use current techniques, skills, and tools necessary for cyber-physical
systems practice.

Policies

Lecture: Attendance is required. Advance notice and permission are required if students
cannot attend certain lectures due to hard constraints.

Homework: Homework assignments will be designed to stimulate independent thinking
among the students. They will be due at the beginning of class, usually a week after they are
given. Homework assignments will not be accepted after the due date. An exception to this
rule is that you give in advance a strong and convincing reason.

Exam: Exams will be scheduled in advance. Unless prior arrangements are made, a grade of
zero will be recorded for missed exams.
Grading: The tentative grade weighting for the semester will be:

- Class participation: 10%
- Homework assignments: 30%
- Exams: 30%
- Projects/programming: 30%

- Letter grades will be assigned based on performance relative to other students. A tentative grading scale is as follows:

  A: 93-100
  A-: 90-92
  B+: 85-89
  B: 80-84
  B-: 75-79
  C+: 70-74
  C: 65-69
  C-: 60-64
  F: 0-60

- A regrading request will cause the entire exam/homework/project to be regraded, and thereby the overall grade can increase or decrease.

Miscellaneous

Students are expected to carefully read all material handed out in class and to read the book according to the reading assignments announced in class. Students are encouraged to discuss the material presented in class with one other and with the instructor, but shall not collaborate with anyone in solving the homework problems. The Wayne State University Student Code of Conduct applies.

If a student have a documented disability that requires accommodations, the student will need to register with Student Disability Services (SDS) for coordination of his/her academic accommodations. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TDD only). Student Disability Services’ mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University. Please be aware that a delay in getting SDS accommodation letters for the current semester may hinder the availability or facilitation of those accommodations in a timely manner. Therefore, it is in the student’s best interest to get his/her accommodation letters as early in the semester as possible.

Effective Fall 2011, students must add classes no later than the end of the first week, including online classes. During the second week of the semester, students must personally request departmental permission in order to register. If departmental permission is granted, students must register themselves for the class in Pipeline during the second week.
Receiving departmental permission is NOT the same as registering for the class! Students may continue to drop classes (with full tuition cancellation) through the first two weeks of the term.

Effective Fall 2011, the withdrawal deadline becomes the end of the 10th week of classes. After the deadline, the Withdraw option will not be available in Pipeline. The Registrar’s Office does not grant exceptions to this deadline.