ME 495: Embedded Systems in Robotics

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Location: Zoom (See Canvas)
Time: TuTh 9:40-11:00 AM
Office Hours: To Be Determined, and by appointment.
Notes: https://nu-msr.github.io/me495_site

Software: This course requires a computer running Ubuntu Linux 20.04 LTS. It cannot be running in a virtual machine.

Other software will be downloaded throughout the class. All software used in the class is free and much of it is developed by volunteers sharing their code with the world. You are encouraged to do the same with your projects.

Course Description: This project-based course provides experience with a variety of software tools and concepts useful for a robotics engineer working with practical embedded systems. The Robot Operating System (ROS) will be used as an example framework, and learning ROS will be a primary goal of the course. By the end of the course, student teams will have completed a robotics project using a real robot.

Prerequisites: Proficiency in at least one programming language is required (`MATLAB` is fine), and experience in Python, C, C++, Linux, and git would all be useful. The primary programming language used in the course will be Python.

Course Structure: The course is divided into five modules, covering the following topics:

1. ROS Fundamentals (nodes, messages, catkin, etc..).
2. Modeling Robots (urdf, tf, robot state publisher, rviz, etc...).
3. Simulation (with ROS and Gazebo)
4. Navigation and Sensing (navstack, realsense, etc...).
5. Robot Arms (MoveIt, Baxter, Sawyer)

Assignments There will be four individual homework assignments (approximately due every other week) and a final group project.

Final projects will be presented via zoom on **December 7, 2020, 12pm - 2pm** , during the final exam period for this class.

All homework will be submitted as a git repository on github. I will grade the latest commit on the master branch of your repository as of the time that I clone your repository. I will clone your repository no earlier than 9:30am on the due date (i.e., 10 minutes prior to the start of class). There is no penalty for pushing code after the deadline; however, I will only grade the code that is present on your master branch when I clone your repository.
Grading Each of the homework assignments is 18 percent of your final grade.
The final project is 28 percent of your final grade.

It is imperative for you to complete all homework assignments so you can be a valuable member of your final project team. If you make a good faith effort to complete all of the homework assignments and the final project (at my sole discretion), I will substitute your final project grade for your lowest homework grade, if it will help your grade.

Academic Integrity To create a positive and collaborative learning environment, I trust everyone in this class to act with integrity. To enhance this trust, I will not be specifically looking for academic integrity violations. However, if a violation comes to my attention, it will be subject to Northwestern and McCormick's policy on academic integrity, as found here http://www.northwestern.edu/uacc/.

In this class, you will be writing software and likely finding help from your peers or on the internet. You are encouraged to help each other and are permitted to use external websites to find information. However, any code adapted or copied from an external source must be cited in the source code. You will not receive full credit for significantly copied code but if it is cited properly it is not an academic violation.

You should use comments to indicate which code originated externally, where it came from, and whether it is copied verbatim or modified by you. The comments should clearly delineate the start and end of such copied code.

If the code came from a website, the citation should include its URL and the date of access. If the code came from a peer, cite the person's name.

If you are unsure whether something needs to be cited, you can either ask me or cite it just to be certain.

Academic Environment I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability, and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

Accessibility Statement Northwestern University is committed to providing the most accessible learning environment as possible for students with disabilities. Should you anticipate or experience disability-related barriers in the academic setting, please contact AccessibleNU to move forward with the university's established accommodation process (e: accessiblenu@northwestern.edu; p: 847-467-5530). If you already have established accommodations with AccessibleNU, please let me know as soon as possible, preferably within the first two weeks of the term, so we can work together to implement your disability accommodations. Disability information, including academic accommodations, is confidential under the Family Educational Rights and Privacy Act.

COVID Statement Students, faculty, and staff must comply with University expectations regarding appropriate classroom behavior, including those outlined below and in the COVID-19 Code of Conduct. With respect to classroom procedures, this includes:

1. Students, faculty, and staff are required to wear a face covering in all public and shared environments on campus, including during class sessions when others are present.

2. Students, faculty, and staff are expected to observe the rules of social distancing, which require that you are no closer than six feet from other individuals.

3. No food is allowed inside classrooms. Drinks are permitted, but please keep your face covering on and use a straw.

4. Chairs and tables in classrooms are set to maintain a six foot distance between individuals. Do not move chairs from their place in the room.

5. There will be assigned seating in every class. Instructors may be asked to provide seating information to aid in contact tracing if a student tests positive for COVID-19.

6. Class dismissals will start with the seat/row closest to the exit door and be managed by the instructor so as to minimize congestion near the exit.

7. Students and faculty will allow those occupying rooms to fully exit before they enter the room.

In the event that a student fails to comply with the COVID-19 Code of Conduct or other University expectations related to COVID-19, the instructor may ask the student to leave the class. The instructor is asked to report the incident to the Office of Community Standards for additional follow-up.

I reserve the right to cancel any in-person activities at any time and for any reason. In addition to these University-wide rules, our class may have additional rules imposed as part of the specific activities required. **Non-compliance with any COVID related regulation will jeopardize not only that individual student's ability to participate in hybrid activities but that of the whole class.**

In-Person Activities The final project is the primary hybrid activity in the course and is designed to allow students to use industrial robots in the lab. Depending on the number of students in the online or hybrid sections final project groups may contain both hybrid and online-only students, or the online-only students may be given individual projects instead of a group project.

The course also provides robot kits for students to borrow. I will schedule pick-up and drop-off times to receive and return the kits, as needed. Hybrid and online-only students in Evanston are eligible to receive the kits; they cannot be shipped.

Students in the hybrid class section may choose to participate in an online-only fashion at any time. Students in the online section may choose to participate in hybrid activities at any time.

Recordings of Class Northwestern University is committed to providing the most accessible learning environment as possible for students with disabilities. Should you anticipate or experience disability-related barriers in the academic setting, please contact AccessibleNU to move forward with the university's established accommodation process (e: accessiblenu@northwestern.edu; p: 847-467-5530). If you already have established accommodations with AccessibleNU, please let me know as soon as possible, preferably within the first two weeks of the term, so we can work together to implement your disability accommodations. Disability information, including academic accommodations, is confidential under the Family Educational Rights and Privacy Act.

Unauthorized student recording of classroom or other academic activities (including advising sessions or office hours) is prohibited. Unauthorized recording is unethical and may also be a violation of University policy and state law. Students requesting the use of assistive technology as an accommodation should contact AccessibleNU. Unauthorized use of classroom recordings – including distributing or posting them – is also prohibited. Under the University's Copyright Policy, faculty own the copyright to instructional materials – including those resources created specifically for the purposes of instruction, such as syllabi, lectures and lecture notes, and presentations. Students cannot copy, reproduce, display, or distribute these materials. Students who engage in unauthorized recording, unauthorized use of a recording, or unauthorized distribution of instructional materials will be referred to the appropriate University office for follow-up.