UNIVERSITY OF COLORADO - BOULDER
Robotics Program

CSCI 5202/ROBO 5000

Instructor
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Fri 2:30 - 3:30 ECCS 114E

Lectures
TTh 8-9:15, ECCR 150

Course Description

Provides a broad introduction to principles and skills related to the field of robotics and is intended to create a strong robotics-focused foundation for students with a wide range of technical backgrounds. Topics include: software development, path planning algorithms, kinematics, dynamics & controls, perception and actuation. Through these topics students will develop skills that enable them to implement algorithms that encompass the entire robot operational loop of sensing, thinking and acting. Assessment will take the form of bi-weekly homeworks, take-home midterms and a final project. There are no formal prerequisites, but prior programming experience is recommended.

Teaching Staff Contact

The primary mode of contact for this course will be a *Piazza* discussion board (`https://piazza.com/colorado/fall2024/coen5830`, access code: grohl). All homework and course related questions should be directed there (questions can be asked anonymously), as this allows the entire class to view and benefit from the discussion. If you have a question about the course structure or material then it is likely that others have similar concerns. Email will only be accepted for personal matters.

Office Hours

A sign up link will be provided for office hours where specific timeslots within each session (please indicate which topics you would like to discuss when signing up) will be made available. This scheduling system will not be followed strictly and specific discussion slots may run shorter/longer than the intended time. You are welcome to attend any of the sessions, but students that have signed up for specific time slots will be given precedence with their questions. You are encouraged to view the sign up link to see which topics other students are interested in discussing (or sign up for a different slot to create your own discussion topic), this way you can join in on the discussions you are interested in. Please do not sign up for a timeslot to discuss personal matters, rather email the lecturer and set up a time outside of office hours to meet.

Homework Policy
Problem sets will be distributed on *Canvas* and answers will typically be due 2-3 weeks after they are assigned. Each homework will consist of 4-10 questions and will typically include problems that require Python code and/or neatly prepared handwritten solutions. As an alternative to handwritten submissions, you may also submit pdfs of well-formatted solutions using LaTeXor other suitable typesetting programs. Homework submissions will only be accepted in pdf format (code to be submitted as .py Python files) through *Canvas* and will nominally be due at 11:59pm on the assigned due date. **Students are provided with ample time to complete homework assignments. As such, late homework submissions will receive a score of zero without exception.**

Grading Policy

Some key points on the grading policy and course structure are described below:

- Homework assignments will be equally weighted.
- One take-home midterm exam will take place. You will be allowed a 2 hour window (of your choosing) within a larger 48 hour period to take the midterm. Midterms will be open-book and are strictly individual assessments (no groupwork or consultation with others is allowed).
- The course will culminate in a simulation-based project that incorporates aspects of the theory and skills you have learnt throughout the course. The project is to be completed in groups of two, where groups will compete against one another for glory and honor.
- Although points will not directly be awarded for class participation, this will be a factor when determining edge cases for final grades. A reminder that a grade of B- is required for this course if you are a student in the Robotics Program.
- There will be no grading scale for this course and collaboration is strongly encouraged. However, individual work must be presented at all times (apart from the group project). Teaching staff may at any time ask students to verbally explain their work after it has been turned in. Cases of plagiarism will be taken seriously and due action with the college of engineering will be taken will be taken.
- All grading queries are to be directed to the TA.
- Grade weighting is detailed in Table 1.

Homeworks	50%
Midterm	20%
Project	30%

Table 1: Assignment grade distribution

Course Text and References
There are no required texts for this course, and you will be provided with a complete set of lecture notes. The following texts may serve as good references, but are by no means required.

- N. Correl, B. Hayes, C. Heckman and A. Roncone, **Introduction to Autonomous Robots**, The MIT Press, 2022. The following URL contains the latex code which you can compile into pdf form.

Course Outline

Week	Topic	Description
1-3	Programming	Python Basics, NumPy, SciPy, Matplotlib, Object-Oriented Programming, Debugging, Visual-Studio Code, Git.
4-5	Path Planning	Discretization, Random Trees, Djikstra, A*, Probabilistic Road Maps, RRT, RRT*
6-8	Kinematics	Linear Algebra, Forward Kinematics, Denavit-Hartenberg (DH) Parameters, Inverse Kinematics, Differential Kinematics.
9-10	Dynamics	Ordinary Differential Equations (ODEs), Modeling physical systems, Laplace Transforms
11-12	Control	Transfer Functions, Stability, Proportional-Integral-Derivative (PID) Control
13	Perception	Encoders, Computer Vision
14	Thanksgiving Break	Take a break!
15	Perception	Inertial, Lidar
16	Actuation	DC Motors, Stepper Motors, Servos, Linear Actuators, Soft actuators

Holidays

- 25-29 November - Thanksgiving Break (No Class)

Classroom Behavior

Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, marital status, political affiliation, or political philosophy.

For more information, see the classroom behavior policy, the Student Code of Conduct, and the Office of Institutional Equity and Compliance.

Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or DSinfo@colorado.edu for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions.

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the Honor Code may include but are not limited to: plagiarism (including use of paper writing services or technology [such as essay bots]), cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. Understanding the course's syllabus is a vital part in adhering to the Honor Code.

All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution: StudentConduct@colorado.edu. Students found responsible for violating the Honor Code will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Visit Honor Code for more information on the academic integrity policy.

Any discovered incidents of academic dishonesty will lead to an automatic academic sanction in the course and a report to the College of Engineering and Applied Science and the Honor Code Council. Note that asking another student for a helpful suggestion, or providing such a suggestion, is encouraged and does not constitute academic dishonesty. However, plagiarizing others work, or allowing others to plagiarize your work, will be considered a dishonest act.

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits protected-class discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner abuse (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who have been subjected to misconduct can contact OIEC at 303-492-2127 or email CUreport@colorado.edu. Information about university policies, reporting options, and support resources including confidential services can be found on the OIEC website.

Please know that faculty and graduate instructors must inform OIEC when they are made aware of incidents related to these policies regardless of when or where something occurred. This is to ensure that individuals impacted receive outreach from OIEC about resolution options and support resources. To learn more about reporting and support for a variety of concerns, visit the Don't Ignore It page.

Religious Accommodations

Campus policy requires faculty to provide reasonable accommodations for students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Please communicate the need for a religious accommodation in a timely manner. You are required to report any religious accommodation needs by the end of the first week of class via email to the instructor (leopold.beuken@colorado.edu) to ensure appropriate accommodations. See the campus policy regarding religious observances for full details.

Mental Health and Wellness

The University of Colorado Boulder is committed to the well-being of all students. If you are struggling with personal stressors, mental health or substance use concerns that are impacting academic or daily life, please contact Counseling and Psychiatric Services (CAPS) located in C4C or call (303) 492-2277, 24/7.

Free and unlimited telehealth is also available through Academic Live Care. The Academic Live Care site also provides information about additional wellness services on campus that are available to students.