NC STATE UNIVERSITY

CSC 591/791 Course Syllabus

Advanced Robotics

2025 Spring

1. Instructor Information

Instructor name: Peng Gao (pgao5@ncsu.edu)

Office location: EB II 3270

2. Course Information

2.1 Course Description

This advanced robotics course covers robotics through computer science and AI, focusing on the autonomy loop with topics like ROS, perception, decision-making, and reinforcement learning in single- and multi-robot systems. Students will gain a strong theoretical foundation and practical experience by implementing and extending algorithms in simulations and real robotic platforms.

2.3 Learning Objectives:

Students will gain insights into state-of-the-art robotic systems, learn fundamental theories and algorithms for building intelligent robots, and gain hands-on experience in constructing functional intelligent single and multi-robot systems. Additionally, they will enhance their skills in technical writing, presentation, and teamwork.

2.4 Prerequisites/Corequisites

No enforced prerequisites. But mathematical knowledge (e.g., linear algebra and probabilistic) and sufficient programming (e.g., python) skills are assumed.

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2.5 Required Textbook

No required textbook, as the course offers project-based learning. However, several textbooks are recommended as references:

• *Sebastian Thrun, Wolfram Burgard and Dieter Fox. "Probabilistic Robotics." MIT Press. 2005.*

• *Richard S. Sutton and Andrew G. Barto. "Reinforcement Learning: An Introduction." MIT Press. 2018.*

• *Roland Siegwart, Illah Reza Nourbakhsh and Davide Scaramuzza. "Introduction to Autonomous Mobile Robots." MIT Press. 2011.*

2.6 Computer Requirement

A laptop or desktop computer is required for students taking this course. NC State University Libraries offers Technology Lending, where many devices are available to borrow for a 7-day period. Computer labs are available in various locations around campus for student use.

3. Course Schedule

6-Jan	Course policy, introduction to robotics	
13-Jan	Robotics software and ROS	Project 1
20-Jan	No class (Martin Luther King Jr. Day)	
27-Jan	Markov decision making and Q learning	Project 2
3-Feb	Multi-robot collaborative decision making	
10-Feb	Imitation learning	
17-Feb	Robot localization	
24-Feb	Multi-robot relative pose estimation	Project 3
3-Mar	Robot perception	
10-Mar	No class (spring break)	
17-Mar	Multi-robot collaborative perception	
24-Mar	SLAM	Final project
31-Mar	SLAM	
7-Apr	Path planning in single robot and multi-robot systems	

14-Apr Paper reading and presentation
21-Apr Final project presentation

4. Slides, Assignments and Grade

- **All courses will be recorded** for recap purposes and for students who cannot attend, adhering to the student privacy policy.
- **All lecture slides are available on Moodle.**
- **Assignment write-ups are also posted on Moodle, along with deadlines**. All assignments involve significant programming. If you miss a class, it's your responsibility to check the course recordings.

4.1 Assignment Submission

Assignments will be submitted to Moodle and grades will also be posted on Moodle.

4.2 Exam

There will be no exams.

4.3 Grade

Grading will be 100% based on the four (4) course projects with the following weights:

- Project 1: 10% (individual project)
- Project 2: 25% (individual project)
- Project 3: 25% (individual project)
- Paper reading: 10% (individual project)
- Final project: 30% (group project)

Final letter grades will be determined by overall weighted average as follows:

100-90	89.9-85	84.9-80	79.9-75	74.9-70	69.9-60	59.9-0
A	B+	B	C+	C	D	F

5. Communication Guidelines

5.1 Respecting our learning community

The NC State Code of Student Conduct outlines expectations for behavior in the classroom (whether virtual or physical) and the consequences for students who violate these expectations. Any behavior that impacts other students' ability to learn and succeed will be addressed, but expressing diverse viewpoints and interpretations of course content is welcome.

Community guidelines for this course include:

- Use a respectful tone in all forms of communication (email, written, oral, visual)
- Maintain professionalism (avoid slang, poor grammar, etc.) in your written communication.
- Respect regional dialects and culturally embedded ways of oral communication.
- Stay home or in your dorm room if you are exhibiting symptoms of a contagious illness (fever, chills, etc.).
- Enter our virtual and/or physical classroom community respectfully by refraining from lewd or indecent speech or behavior, helping to maintain a safe physical environment, not using your cell phone for voice or text communication except when explicitly given leave to do so, and not attending class under the influence of any substance.
- Treat each community member with respect by not recording others without their consent or engaging in any form of hazing, harassment, intimidation, or abuse.
- Respect cultural differences that may influence communication styles and needs.

6. Course Policy

6.1 Late assignments

Course project deliverables are due at the date and time stated. Most project deliverables have a four-day late submission period (i.e., gracing period with late penalty), and late submission will lose 25% points per day for the deliverable. Manage your time, and start early!

6.2 Incomplete grades, withdrawals

Information on incomplete grades can be found at REG 02.50.03 – Grades and Grade Point Average. If you encounter a serious disruption to your work not caused by you and you would have otherwise successfully completed the course, contact your instructor as soon as you can to discuss the possibility of earning an incomplete in the course for the semester, including an agreement on when the remaining work must be done in order to change the grade to the appropriate letter grade.

If your student must withdraw from a course or from the University due to hardship beyond their control, see Withdrawal Process and Timeline | Student Services Center for information and instructions.]

6.3 Attendance

Class attendance will not be taken. Classes will be offered in-person during the class time, and all materials will be posted on the course website. Please don't come to class if you're feeling unwell. We will work with you to help keep you posted on class activities and materials covered. In any case, it is your responsibility to catch up (or keep up) with course materials and announcements.

6.4 Exemptions

There may be situations when you cannot submit an assignment by the due date. You may ask for an extension by emailing a formal request to the instructor or the TA in the case of illness, religious or funerary events, university-related events (athletic event, field trip, or performance), and extenuating non-academic reasons (military obligation, family illness, jury duty, automobile collision). For religious reasons, you must provide us with a written list of such dates within two weeks after the course starts. In all other instances, please provide us with written documentation as soon as possible.

6.5 Grading Corrections

Send any assignment grading correction requests to the instructor within one (1) week of receiving the grade, or before the end of the semester, whichever comes first. After that, your grade will not be adjusted. If you find any mistake in grading, please let the instructor know. Your grade will not be lowered.

6.6 Using Computers and Phones in Class

Please be respectful of your classmates by turning off/silencing your phones and using your computers only for taking notes or keeping up with the materials covered in class. Checking your email, working on other non-class related materials, web-surfing, etc., are not appropriate activities for class time. Please practice courteous cell phone and computer etiquette.

7. University Policies

Academic integrity and honesty

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct 11.35.01 sections 8 and 9. Therefore, students are required to uphold the Pack Pledge: "I have neither given nor received unauthorized aid on this test or assignment." Violations of academic integrity will be handled in accordance with the Student Discipline Procedures.

Please refer to the Academic Integrity web page for a detailed explanation of the University's policies on academic integrity and some of the common understandings related to those policies.

Student privacy

Originality Checking Software

Software is not used in this course to detect the originality of student submissions.

Class recording statement:

In-class sessions are recorded in such a way that might also record students in this course. These recordings MAY be used beyond the current semester or in any other setting outside of the course. Contact your instructor if you have concerns.

Students will not be able to be identified in any course recordings, or the course will not be recorded at all.

Class privacy statement:

This course requires online exchanges among students and the instructor, but NOT with persons outside the course. Students may be required to disclose personally identifiable information to other students in

the course, via electronic tools like email or web postings, where relevant to the course. Examples include online discussions of class topics and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.
Student information in this course may be accessible to persons beyond the instructor and students in the course. This course may involve electronic sharing or posting of personally identifiable student work or other information with persons not taking or administering the course. Students will be asked to sign a consent form allowing disclosure of their personally identifiable work. No student must sign the consent form as a condition of taking the course. If a student wants to avoid signing the consent form, he or she has the right to ask the instructor for an alternative, private means of completing the coursework.

Other Policies

Students are responsible for reviewing the NC State University PRR's which pertain to their course rights and responsibilities:

- Equal Opportunity and Non-Discrimination Policy Statement and additional references
- Code of Student Conduct
- Grades and Grade Point Average
- Credit-Only Courses
- Audits

8. Student Resources

Academic and Student Affairs maintains a website with links for student support on campus, including academic support, community support, health and wellness, financial hardship or insecurity, and more. Find Help on Campus.

Disability resources

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resource Office (DRO). For more information on NC State's policy on working with students with disabilities, please see the Policies, Rules and Regulations page maintained by the DRO and REG 02.20.01 Academic Accommodations for Students with Disabilities.

Safe at NC State

At NC State, we take the health and safety of students, faculty and staff seriously. The Office for Institutional Equity and Diversity supports the university community by providing services and resources to support and guide individuals in obtaining the help they need. See the Safe at NC State webpage for resources.

Supporting Fellow Students in Distress

As members of the NC State Wolfpack community, we each share a personal responsibility to express concern for one another and to ensure that this classroom and the campus as a whole remain a healthy and safe environment for learning. Occasionally, you may come across a fellow classmate whose personal behavior concerns or worries you, either for the classmate's well-being or yours. If you feel this way, I would encourage you to report this behavior to the NC State CARES website. Although you can report anonymously, it is preferred that you share your contact information so they can follow up with you personally.

9. Course Evaluations

ClassEval is the end-of-semester survey for students to evaluate the instruction of all university classes. The current survey is administered online and includes 12 closed-ended questions and 3 open-ended questions. Deans, department heads, and instructors may add a limited number of their own questions to these 15 common-core questions.

Each semester students' responses are compiled into a ClassEval report for every instructor and class. Instructors use the evaluations to improve instruction and include them in their promotion and tenure dossiers,

while department heads use them in annual reviews. The reports are included in instructors' personnel files and are considered confidential.

Online class evaluations will be available for students to complete during the last two weeks of the semester for full-semester courses and the last week of shorter sessions. Students will receive an email directing them to a website to complete class evaluations. These become unavailable at 8 am on the first day of finals.

- Contact ClassEval Help Desk: classeval@ncsu.edu
- ClassEval website
- More information about ClassEval

10. Syllabus Modification Statement

Our syllabus represents a flexible agreement. It outlines the topics we will cover and the order in which we will cover them. Dates for assignments represent the earliest possible time they would be due. The pace of the class depends on student mastery and interests. Thus minor changes in the syllabus can occur if we need to slow down or speed up the pace of instruction.