

Course Assessment Document for CS 363 Robotics

Departmental Outcomes

1. Proficiency in computational thinking
2. Ability to analyze systems at the three levels of computer science: theory, software, and hardware
3. Proficiency in the design and implementation of algorithms using multiple programming languages
4. Ability to apply computational thinking to a diverse set of problems and disciplines
5. Ability to communicate effectively and collaborate with others
6. Ability to adapt to new challenges and computational environments

Course Description

Addresses the problems of controlling and motivating mechanical devices to act intelligently in dynamic, unpredictable environments. Major topics will include sensing, navigation and control, mapping and localization, robot perception using vision and sonar, and robot kinematics. In addition to short homework assignments, students will undertake more extensive projects using both existing software and implementing their own algorithms on medium sized mobile robots capable of functioning in human spaces. Projects will focus on enabling the robots to execute tasks, explore, and interact with people and objects in their environment.

Prerequisites: CS 231 and CS 251

Rationale for prerequisites: CS 251 provides experience with data analysis and machine learning techniques, as well as coordinate system manipulation. CS 231 provides experience with a C-style language and programming experience.

Desired Course Outcomes

- A. Students understand and can implement fundamental algorithms for robot control and navigation.
- B. Students understand and can make use of a variety of sensors to enable autonomous robot behaviors.
- C. Students understand the concept of state estimation applied to sensing, localization, and mapping.
- D. Students work in a group to design software for controlling a robot.
- E. Students present methods, algorithms, results, and designs in an organized and competently written manner.
- F. Students write, organize, and manage a large software project.

We will disseminate the desired course outcomes to students via the course web page, syllabus and in class.

Course Matrix

Outcome	Activities	Method of Assessment	Departmental Outcome
A	Lecture, labs, textbook, projects, homeworks, handouts	Exams, project reports, demonstrations	1, 3, 4, 6
B	Lecture, labs, textbook, projects, homeworks, handouts	Exams, project reports, demonstrations	1, 3, 4, 6
C	Lecture, labs, textbook, projects, homeworks, handouts	Exams, project reports, demonstrations	1, 2, 3, 4, 6
D	Projects	Project reports and observation in lab, demonstrations	5
E	Projects, homeworks	Project reports	5
F	Lecture, labs, projects	Project reports and evaluation of code	3, 6

Grade Calibration Matrix

Outcome	Meaning of the grade A
A	The student implements the required algorithms for robot control and navigation, explores variations of those algorithms, and takes the initiative to implement algorithms not covered in lecture. The algorithms work robustly in a realistic environment.
B	The student makes use of multiple sensors in a single application, balancing the capabilities of the sensors to achieve robust autonomous behaviors. The decisions are well documented and demonstrate experimentation with different configurations and algorithms.
C	The student demonstrates the ability to set up state estimation algorithms properly and implement them for simple cases. The student takes the initiative to implement state estimation algorithms in one or more projects to improve the robustness of the robot's behavior.
D	Work is shared evenly between the members of the group. The group is able to effectively divide the task into parts, each group member completes their task on time and is able to integrate it into the project. Group members communicate effectively and work collaboratively.
E	Reports are well written, concise and clear. The reports clearly describe the algorithms used and show images and figures to support the text. The reports are written so that students outside the course could understand the work.
F	The student's code is modular, well-organized, well-commented, and functional. The student makes effective, possibly innovative use of development tools.

Outcome	Meaning of the grade B
A	The student implements the required algorithms for robot control and navigation, exploring a few variations of those algorithms. The algorithms work in a realistic environment, but may be brittle or sensitive to the specific conditions.
B	The student makes use of multiple sensors in a single application, demonstrating an attempt to balance the strengths and weaknesses of the sensors. The decisions demonstrate some experimentation with different configurations and algorithms.
C	The student demonstrates the ability to set up state estimation algorithms properly and implement them for simple cases.
D	Work is shared between the members of the group. The group is able to divide the task into parts, and each group member completes their task on time and is able to integrate it into the project. Group members communicate sufficiently to integrate their work.
E	Reports are well written and clear. The reports describe some or all of the algorithms used and use some images and figures to support the text. The reports are written so that students taking the course could understand the work.
F	The student's code is modular with a reasonable level of commenting and functional. The student makes use of development tools.

Outcome	Meaning of the grade C
A	The student implements most of the required algorithms for robot control and navigation. The algorithms work most of the time under controlled conditions.
B	The student makes use of multiple sensors in a single application, possibly following guidance from lectures or the textbook to combine the sensor outputs.
C	The student is able to set up state estimation algorithms with some guidance and complete most of the implementation for a simple case.
D	Work is unevenly shared between the members of the group, possibly duplicated. The group divides the work between members based on which members are likely to finish the work. Not all group members complete their work on time. Group members communicate, but may have difficulty integrating their work.
E	Reports describe the work, but may take the form of a narrative of what went wrong rather than focusing on the algorithms. The reports describe at least the primary algorithm used in the assignment and include at least the required images. The reports assume the reader is familiar with the material.
F	The student's code is modular and mostly functional, but may lack comments. The student uses development tools, but may not make effective or appropriate use of them.

Outcome	Meaning of the grade D
A	The student implements some of the required algorithms for robot control and navigation. The implemented algorithms work some of the time under controlled conditions but do not exhibit robust behavior.
B	The student makes use of at least two sensors in a single application using simple sensor fusion algorithms that may not provide robust sensing.
C	The student is able to set up a state estimation algorithm with guidance for a simple case.
D	The student works on their own or is loosely affiliated with another person or group. Group members do not communicate often or effectively and have difficulty integrating code.
E	The student's reports are incomplete or not well written. The report includes the required images but no description of how they were made or their significance. The report contains little information about the algorithms and methods.
F	The student's code is mostly functional, lacks comments, and is not well formatted. The student has a difficult time using development tools.

A student who receives an F does not meet the criteria for a D or any higher grade.