

Special Topics: AI (Artificial Intelligence) Robotics

CSCE 698 Section 601

TR 02:20- 03:35PM

Dr. Robin Murphy, instructor

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Course Objectives

Grading

Course topics, calendar of activities, major assignment dates

Required textbook

Policy statement on missed work

Reminder to student who anticipate being absent from class due to religious observances

Course objectives

This course is an introduction and survey of artificial intelligence methods for mobile robots (ground, aerial, or marine) for graduate students or highly advanced undergraduates in science and engineering. It covers both the theory and the practice of unmanned systems, focusing on biological and cognitive principles that are often quite different from control theory formulations. The course emphasizes software organization and algorithms.

About the necessary background...

Students should be in an engineering or computing discipline and competent in an object oriented language such as C++, though they may need to learn C# or other language. No prior knowledge of AI or robotics is required. Programming will be done using AI Robotics robots, except for the Learning Project, which will be done on a platform agreeable to both the student and instructor. The final project will meet, and go beyond, the missions for the AUVSI RoboBoat competition using Marcy, the new unmanned surface vehicle.

This is an intensive course that requires a significant amount of reading in the first part of the semester to set the stage for the principled programming in the second part of the semester. Programming robots requires a large amount of time working with and testing the robot in different environments, despite the use of simulators. Students will have to work outdoors/hands-on and arrange time to work on the project in the field in order to be successful.

Typically students expecting to do work in robotics, AI or cognitive science, software engineering, or just love hands-on work excel in this class. (The

software engineers love the “big software” nature of the project.)

Specific Objectives...

By the end of the Fall Semester, the student should have a firm foundation in the organization and practical implementation of software for intelligent robots. As the result, the student should be able to:

- describe the different levels of teleoperation and autonomy
- describe the 4 primitives of AI robotics (sense, act, plan, learn) and how those are represented within a hybrid deliberative/reactive architecture
- express and program the major ways of organizing and combining behaviors in behavior-based systems
- list the most common sensors, their strengths and weakness and state of the art
- discuss the differences and apply the major path planning and simultaneous localization and mapping (SLAM) algorithms
- describe the dimensions and facets of coordination of teams of robots
- discuss and apply appropriate learning algorithms for a specific problem
- describe the merits of affective computing and apply the principles of human-robot interaction

Grading

Tests (3, approximately 1X month): 30%

Review of Literature: 10%

Behavioral programming project: 15%

Learning programming project: 15%

Final Team Programming Project (but individual grading): 30%

Course topics, calendar of activities, major assignment dates

Week	Topic	Chapter
1	Introduction	
2	Automation & Autonomy	1
3	Architectures, teleoperation	2,4,7
4	Behavioral Control	3,4
5	Test 1, Behavioral Programming Project	
6	Locomotion	5
7	Sensing	6
8	Topological Navigation	9
9	SLAM	11
10	Learning and Natural language	
11	Test 2, Case studies of Deliberative Robots; Ethics	

12	Human-robot interaction	
13	Multi-agents: tasks and teams	8
14	Learning Programming Project	
14	Final Project work	
15	Final Project review	

Required textbook or materials

The required textbook is Introduction to AI Robotics by Murphy, MIT Press. This book is under revision and additional material will be supplied. Due to instructor travel, some lectures will be provided as podcasts or via skype.

Policy on Missed Work

If you miss work: Material missed due to recognized absences (illness with doctor's excuse, death in the family) can be made up for full credit. Late material is accepted solely at the discretion of the instructor, assuming that at least 1 class period's prior notice was given.

Reminder to student who anticipate being absent from class due to religious observances

Students who anticipate the necessity of being absent from class due to the observation of a major religious observance must provide notice of the date(s) to the instructor, in writing, by the second class meeting.

Syllabus

Week	Topic	Chapter
1	Introduction	
2	Automation & Autonomy	1
3	Architectures, teleoperation	2,4,7
4	Biological Behaviors	3
5	Behavioral Control	4
6	Locomotion	5
7	Sensing	6
8	Case studies of Behavioral Robots	
9	Topological Navigation	9
10	SLAM	11
11	Learning and Natural language	
12	Human-robot interaction	
13	Multi-agents: tasks and teams	8
14	Case studies of Deliberative Robots; Ethics	
14	Project work	
15	Project reviews	