TEXAS A&M UNIVERSITY

# SYLLABUS

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| Course title and number | CSCE 635 600 AI Robotics |
| Term (e.g., Fall 200X) | Spring 2017 |
| Meeting times and location | MWF 3:00-3:50PM, ETB 1035 |

## Course Description and Prerequisites

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, relying on biological and cognitive principles that are often quite different from control theory formulations. The course emphasizes software organization and provides a survey of the broad range of algorithms for each component in an intelligent system.

The course has three novel pedagogical aspects:

1. It is a "flipped course" where lectures and reading material are provided online and the classroom time is spent in discussion, examination of working code, and working with robots. The online materials will be provided and students will have to read pre-prints of the new textbook (good news is that you don't have to buy the book and you will be named in the acknowledgments!)

2. The class project is service-based learning- you will work with response experts in the US and Europe to create an fleet of homogeneous, autonomous lifeguard assistant robots to help prevent boat refugee drownings.

3. It will use case studies of actual robots plus stories from science fiction in order understand design constraints and the role of autonomy in unmanned systems. The inclusion of science fiction stories stems from the instructor's High Impact Learning Fellowship.

## Learning Outcomes or Course Objectives

By the end of the 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 have the knowledge and comprehension, as measured by written assessment of the book chapters and tests, to be able to answer:

- What is autonomy?
    - describe the different aspects of teleoperation, automation, and autonomy
    - describe the 4 primitives of AI robotics (sense, act, plan, learn) and how those are represented within a hybrid deliberative/reactive architecture

- How is it programmed?
    - 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
- What are the societal and ethical considerations in robotics?
    - describe the merits of affective computing and apply the principles of human-robot interaction
    - describe the types of ethics and the responsibility of designers

## Instructor Information

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| Name | Dr. Robin R. Murphy |
| Telephone number | 979-845-8737 |
| Email address | murphy@cse.tamu.edu **NOTE: email MUST HAVE "CSCE 635" in the subject line or it will not be read** |
| Office hours | TR 2:15-3:30 and by appointment |
| Office location | HRBB 333A |

## Textbook and/or Resource Material

Pre-prints of Introduction to AI Robotics, 2nd edition (on-line, free)

Pre-prints of Robotics Through Science Fiction (on-line, free)

We will use piazza as the website and repository for the course, please go entroll at piazza.com/tamu/spring2016/csce635/home

## Grading Policies

There will be no incompletes or make-up sessions for labs or the project.

- 40% Tests. There are 4 tests.
- 20% Chapter readings from textbook. Students will fill in a form showing that they have read and comprehended the chapter. There are 19 chapters, the lowest score will be dropped.
- 10% Case studies.
- 10 % Research paper.
- 20% Group project. Students will work in teams of 2-3 on projects related to the deployment of unmanned marine vehicles and unmanned aerial vehicles for rescuing drowning victims; the projects will be based on lessons learned from the instructor's deployment to Greece to assist with rescuing refugees. Students can choose their own team and pick their project from a list given by the instructor. The group project will have 5 graded phases, the phases are not equally weighted. The final deliverable will be a conference quality report with accompanying video suitable for the AAAI or IEEE ICRA conference.

## Course Topics, Calendar of Activities, Major Assignment Dates (Tentative)

| Date | Day | Topic | Reading Assignments Due |
|---|---|---|---|
| 18-Jan | W | Autonomy | 1 |
| 20-Jan | F | *AI Robotics in Greece* | 2 |
| 23-Jan | M | Automation and Autonomy | 3 |
| 25-Jan | W | Software Organization of Autonomy | 4 |
| 27-Jan | F | Project work | |

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| 30-Jan | M | Telesystems | 5 |
| 1-Feb | W | Review, project work | |
| 3-Feb | F | **Test 1: AI Framework** | |
| 6-Feb | M | Behaviors | 6 |
| 8-Feb | W | Perception and Behaviors | 7 |
| 10-Feb | F | Project work | |
| 13-Feb | M | Behavior coordination | 8 |
| 15-Feb | W | Locomotion | 9 |
| 17-Feb | F | Project work | |
| 20-Feb | M | Sensors and Sensing | 10 |
| 22-Feb | W | Range sensing | 11 |
| 24-Feb | F | *Review, project work* | |
| 27-Feb | M | **Test 2: Reactive Functionality** | |
| 1-Mar | W | Deliberation | 12 |
| 3-Mar | F | Project work | |
| 6-Mar | M | Navigation | 13 |
| 8-Mar | W | Metric path planning and motion planning | 14 |
| 10-Mar | F | Project work | |
| 20-Mar | M | Localization, Mapping, and exploration | 15 |
| 22-Mar | W | Learning | 16 |
| 24-Mar | F | Review, project work | |
| 27-Mar | M | **Test 3: Deliberative Functionality** | |
| 29-Mar | W | Multi-robot systems | 17 |
| 31-Mar | F | Project work | |
| 3-Apr | M | Human-robot interaction | 18 |
| 5-Apr | W | Designing and evaluating autonomous systems | 19 |
| 7-Apr | F | Project work | |
| 10-Apr | M | Ethics | 20 |
| 12-Apr | W | **Test 4: Interactive and Design** | |
| 14-Apr | F | No class | |
| 17-Apr | M | Project work | |
| 19-Apr | W | Project work | |
| 21-Apr | F | Project work | |
| 24-Apr | M | Project work | |
| 26-Apr | W | Project work | |
| 28-Apr | F | Project work | |
| 1-May | M | Project presentations | |
| 8-May | M | Project reports, final video due | |

**Other Pertinent Course Information**

This class is in transition from the first edition of *Introduction to AI Robotics* (in print) to a second edition (in prep). Much of material on paradigms and software organization has been condensed, while about 50% new material has been added. You will get the new material as handouts to download. The online

lectures may not reflect the details in the handouts, so listening to the lecture may not be sufficient. Be aware that material may not be covered in the online lecture.

This class requires class discussion and analysis as it is a design class. It also requires individual programming and group work. This is NOT a standard “read the book, go to a lab and follow the exercise, take the test” class.

**Americans with Disabilities Act (ADA)**

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information, visit http://disability.tamu.edu.

Accommodations cannot be made after the fact; therefore if you need accommodations you should inform the instructor on the first day of class and then submit the documentation within the first two weeks of the semester if possible. If I know that the documentation is coming, I can work with you.

**Academic Integrity**

*For additional information please visit: http://aggiehonor.tamu.edu*

*“An Aggie does not lie, cheat, or steal, or tolerate those who do.”*

Please be aware I will seek the most stringent penalty for violations of academic integrity. If you have trouble keeping up, talk to me and let me help. Cheating on tests and written materials will only compound problems in acquiring the fundamental understanding of AI robotics needed to pass the course.