Sarah Keren: Instructor
Office: Taub 736
Reception hour: Wednesday (upon request)
Prerequisites: Intro to AI 236501 (or similar – by approval from course staff)
Credits: 3

The number of participants is limited. To express interest in registering for the course, follow the link below. Note that filling in the form does not guarantee a spot in class due to space constraints (it is also possible to send an email to the course instructor mentioned above).

https://forms.office.com/r/3CQKXtd1c

Teaching arrangement and method of instruction

The course will include a weekly 2-hour lesson and a 1-hour tutorial. In addition, at the middle and end of the semester, we will have special meetings for presenting the course projects.
Course Description

The course will cover different approaches to designing and modeling single-robot and multi-robot systems. The tools we will explore are based in a variety of artificial intelligence (AI) fields such as automatic planning, sequential decision making under uncertainty, model-based reasoning, game theory, multi-agent systems, reinforcement learning and more.

The course will include learning the theoretical aspects of these tools as well as practical work with robots using the Robotic Operating System (ROS). We will work both with simulated and actual robotic settings.

Course Objectives

- Learning about various AI frameworks for modeling single-agent and multi-agent robotic settings.
- Acquiring experience using AI tools and implementing them in robotic applications.

Learning Outcomes

After completing the course students will be able to analyze and implement computational tools that will make robots move, sense and react using different algorithms. This will be done by gaining familiarity with a variety of AI approaches to modeling single-agent and multi-agent settings.

Course/Module Content
The course is divided into three main units

In the first unit we will learn about a single robot as a multi-component system that involves sensing, movement, and command and control. As part of this unit, we will research and explore the role of different AI techniques in operating robots in different environments and with different objectives. We will learn about different approaches for planning and control, real-time mapping, and navigation. For all these tasks, we will examine and compare data-driven and model-based approaches.

In the second unit we will examine different approaches for planning for robots that need to accomplish long-term and complex tasks. Such approaches need to consider the long-term effects of the robot’s actions and the inherent uncertainty in their environment. This requires efficiently combining motion planning in the actual continuous space and task planning in a high-level symbolic space which allows the robot to reason about the long-term effects of its actions. For this purpose, we will explore different approaches for Integrated Task and Motion Planning and examine their efficiency.

The last part of the course will be devoted to multi-robot and human-robot settings. This will include an exploration of different approaches for modeling and controlling a team of autonomous agents, a discussion on the theoretical properties of such methods, and an investigation of challenges that arise when implementing these methods in practice.

During the course and as part of the course’s assignments students will develop a robotic system that will be presented to the other participants.

Note that the above is a general description of the course. Every semester we will focus and deeply investigate a subset of these topics.

Evaluation and Grading

80% - three assignments of increasing weight that will be presented at dedicated sessions.
20% - attendance and participation in the discussions in class.

Adaptations for students with disabilities will be provided as needed.

Recommended Reading:

- /ROS Wiki: http://wiki.ros.org
- ROS Tutorials: http://wiki.ros.org/ROS/Tutorials
- An Introduction to MultiAgent Systems by Michael Wooldridge John Wiley & Sons