CS 378: Autonomous Intelligent Robotics FRI II

http://justinhart.net/teaching/2018_spring_cs309

Fall 2017
Tuesday & Thursday 3:30-5:00pm
CBA 4.344
University of Texas at Austin

Instructor: Justin Hart

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Course Description

This class provides students with an understanding of modern research in the areas of robotics, artificial intelligence, and human-robot interaction. It is the first part of a two-course sequence, and serves in-part as preparation for the more complex work in CS 378: FRI II. In FRI II, students pursue a semester-long robotics research project. In this course, students learn the meaning and value of robotics research. They learn some of the technical skills necessary for research on the Building-Wide Intelligence project, and for participation in the RoboCup@Home team. On its own, it serves as a primer on the topics that it covers. As a two-course sequence, it provides exposure to performing research in a real laboratory with real robots. It also can serve as a preparation for long-term research projects on a volunteer basis, as a peer mentor, or as a member of the UT Austin Villa RoboCup@Home Team.

More details about BWI can be found at http://www.cs.utexas.edu/~larg/bwi_web/. More details about RoboCup@Home can be found at http://www.robocupathome.org/.

Teaching Objectives

The following topics will be covered:

- Introductory C++ programming
- Robot Operating System (ROS)
- Basics of Artificial Intelligence & Human-Robot Interaction
- Reading & writing scientific research papers

- Performing and understanding good research

Readings

There is no textbook for this course. There will be a series of 4 papers to which students are expected to give written responses and participate in in-class discussions. At the end of the semester, a final research project will be performed as groups. For this, students are expected to act on what they learned this semester and perform a brief literature survey to justify the ideas in their experiments.

Organization

Class sessions will be held in CBA 4.344 on Tuesdays and Thursdays. Attendance is mandatory. Students are expected to email the instructor in advance to inform of any potential absences. Several of the homeworks will involve working on real robots, which can be found in the laboratory, GDC 3.414.

Prerequisites

Students are also expected to be able to work independently. There is no programming pre-requisite for this course, though a working knowledge of programming will be helpful. Four of the six first lectures in the class will be dedicated to C++ programming, with intensive programming instruction in ROS to follow. Homeworks and projects will utilize ROS in the C++ programming language.

Grading

Grades will be based on:

Class participation and attendance	10%
Reading Responses	10%
Homework	60%
Final Project	20%

The final project will comprise the following components. You will be graded equally on both of these as well as successful completion of the project:

Final Presentation
Final Project Report

Plus and minus grades will be used in final grading of the course.

Final project reports will be due on Monday, December 11 by 11:59pm.
Final project presentations will be during the final exam slot on Saturday, December 16 from 2:00-5:00pm.

Planned Lecture Schedule

(Subject to change due to pace of class, see website for updates)

Reading responses due the night before corresponding reading discussions at 11:59pm.

01/18/18	Introduction, Panel with Peer Mentors
01/23/18	Setting the Stage: An Introduction to Artificial Intelligence
	Introduction to C++ & Make
01/25/18	Guest Lecturers Guest Topics
01/30/18	Setting the Stage: An Introduction to Artificial Intelligence
	Introduction to C++ & Cmake
02/01/18	Intro to "Search" Methods
	C++ Continued
02/06/18	Intro to Symbolic Reasoning / Strips / PDDL
	C++ End
02/08/18	Symbolic Reasoning
	Symbolic Reasoning and Search
02/13/18	Reading Discussion: No Fair!! An Interaction with a Cheating Robot
	Intro to Human-Robot Interaction
02/15/18	What is ROS?
	ROS Technical Intro (Setting up Catkin Workspace)
02/20/18	What is Publish/Subscribe? What are ROS Topics?
	ROS Publish/Subscribe Tutorial
02/22/18	What is a Remote Procedure Call? What is a ROS Service?
	ROS Service Tutorial
02/27/18	ROS Action Servers & Message Formatting
03/01/18	Reading Discussion: Elephants Don't Play Chess
	Introduction to Behavior-Based Systems
03/06/18	Behavior-Based Systems
03/08/18	Intro to Computer Vision
	Vision Processing in OpenCV
03/13/18	SPRING BREAK
03/15/18	SPRING BREAK
03/20/18	Intro to Coordinate Transforms & Robotic Representations
	Intro to Computer Vision
03/22/18	Reading Discussion: To Kill a Mockingbird Robot
	The BWI Code Base: Part 1 Loading the Simulator
03/27/18	Overview Building-Wide Intelligence
	The BWI Code Base: Part 2 Driving the Robot
03/29/18	Combining Reactive / Deliberative Reasoning & 3T Architectures
	The BWI Code Base: Part 3 BWI KR Execution
04/03/18	Overview - RoboCup@Home
	UT Austin Villa @ Home

04/05/18	Presentation Previous Good Final Projects
	Discussion Final Project Brainstorming
04/10/18	Presentation What Makes a Good Final Project?
	Discussion Final Project Brainstorming
04/12/18	Introduction to Machine Learning
	Final Project Concept Debugging
04/17/18	Git & Github
	Machine Learning II
04/19/18	Robotics Research Areas
	Learning from Demonstration
04/24/18	HRI II
	Developmental Robotics
04/26/18	Reading Discussion: Paper TBA
	Reading & Writing Research Papers
05/01/18	Giving Research Talks
	Autonomous HRI & Robotics Research Wrap-up
05/03/18	Project Work Session in Lab
05/08/18	EXAMS WEEK
05/10/18	Final Project Presentations

Assignment Due Dates

All assignments due 11:59pm unless otherwise noted.

02/06/18	HW 1: C++ Exercises
02/20/18	HW 2: Planning with PDDL
03/06/18	HW 3: ROS Basics
03/27/18	HW 4: Simple Color Segmentation
04/10/18	HW 5: Follow the Hat
04/12/18	HW 6: 2-Page Final Project Description
05/07/18	Final Project Paper
05/10/18	Final Project Presentation - In Class

Academic Integrity

As this is a research course, it is important to use the many tools at your disposal to achieve your research goals. Students will work in groups in this course, and are expected to collaborate with their teams and outside of their immediate teams in order to achieve the best results possible. When you leverage someone else's work, cite them. Citations are the currency of the scientific community. Use third-party software, but make sure to honor licenses and cite the authors. In this course, you will be graded on what you accomplish above and beyond what is already freely available. If this means implementing an algorithm, state which parts were your original work or implementation in your progress reports, and which parts were downloaded or were someone else's ideas. In this class, leveraging such resources is encouraged. It makes code easier to maintain and update, and encourages potential collaborations with other institutions. Invest your efforts in making novel discoveries or implementing functionality beyond what is freely available. Do, however, abide by Computer Science Department's Academic Honesty Policy, which can be found at http://www.cs.utexas.edu/users/ear/CodeOfConduct.html#honesty

Students with Disabilities

The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. To determine if you qualify, please contact the Dean of Students at 471-6529; 471-4641 TTY. If they certify your needs, I will work with you to make appropriate arrangements. Further information can be found at http://www.utexas.edu/diversity/ddce/ssd/.