CS 309: Autonomous Intelligent Robotics
FRI I

Instructor: Justin Hart

http://justinhart.net/teaching/2017_fall_cs378/

Today

- Basic Information, Preliminaries
- FRI – Autonomous Robots Overview
- Panel with the mentors

Basic Information

- Lectures (on lecture days): CBA 4.344
- Website: http://justinhart.net/teaching/2018_spring_cs309/

Basic Information

- Syllabus: Handouts and available on website
- Media Release: If you do not sign one, please do not appear in media representing or hosted with course content.

Office Hours / Contact / Mentors

Instructor – Justin Hart

Office: GDC 3.402

Email: hart@cs.utexas.edu

Office Hours: Monday & Wednesday 4:00pm-5:00pm or by appointment

Instructor – Yuqian Jiang

Office: GDC 3.410F

Email: jiangyuqian@utexas.edu

Office Hours: Tuesday & Thursday 2:30pm-3:30pm or by appointment

Office Hours / Contact / Mentors

Mentors (office hours TBD)

- Kathryn Baldauf
- Mehrdad Darraji
- Jamin Goo
- Jeffrey Huang
- Nathan John
- Mayuri Raja
- Rishi Shah
- Stone Tejeda
- Nick Walker
- Anna Wang

Meet mentors in the lab, GDC 3.414 when needed

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.

I will work in conjunction with you and them to make appropriate arrangements.

Attendance and Participation

Students are expected to attend every class session and to actively participate. This includes in-class discussions and effective use of laboratory time to pursue semester projects.

If you miss a session, it is your responsibility to find out what you missed, including in-class announcements.

Academic Integrity

Cheating, plagiarism, and other academic misconduct will be handled according to UT's guidelines.

http://www.cs.utexas.edu/users/ear/CodeOfConduct.html#honesty

Grading

- Class Participation and Attendance – 10%
- Reading Responses – 10%
- Homework – 60%
- Final Project – 20%
  - Final Presentation
  - Final Project Report

FRI: Autonomous Robots!

- CS 309 – FRI I
  - Basic exposure to research, preparation and classroom instruction on ROS, final robotics project
- CS 378 – FRI II
  - Project-based course intended as participation in a real lab, doing real research
- Mentoring, Volunteering, RoboCup@Home
  - FRI I & II have prepared you to do research, now I give you research opportunities

FRI: Autonomous Robots!

- CS 309 – FRI I
  - This can be the start of your research path or self-contained experience learning about robotics
- CS 378 – FRI II
  - More research-focused, designed to prepare you for long-term research projects
- Mentoring, Volunteering, RoboCup@Home
  - Research experience at the undergraduate level

FRI: Autonomous Robots!

- Your FRI experience can either serve to prepare you for graduate school, or as a self-contained educational module
- This class is designed to give you the knowledge that you need to work in a real laboratory

FRI: Autonomous Robots!

- CS 309 – FRI I
  - No experience assumed
  - Lecture-based
  - Intended to expose students to themes in robotics research
  - Intended to teach students about academic papers
  - Brief overview of C++
  - Robot Operating System
  - Homeworks and projects on real robots
  - Final project

FRI: Autonomous Robots!

- CS 378 – FRI II
  - Experience from FRI I assumed
  - Project-based
  - Students perform robotics research
  - Designed as a laboratory research experience

Some thoughts before we begin

- What is the purpose of scientific research?
  - Learn new things on behalf of **humanity**

- What makes a good scientific project?
  - Nobody wants to go to a talk where the punchline is that the speaker is smart
  - What is the question?
  - How did you develop your hypothesis and why?
  - How did you test your hypothesis?
  - What can we conclude from your studies and experiments?

Some thoughts before we begin

- What makes a good scientist?
  - Being the smartest person in the room is not even a qualifying criterion
    - You really only need to be smart **enough** to understand your topic
  - Science is hard work
    - Understanding what has come before you
    - Developing good hypotheses
    - Developing good tests
    - Making your results clear to others
  - Understand the limit of your understanding, then push past that limit

Some thoughts before we begin

- A university is not a sieve
  - The cycle of continual evaluation throughout your education has led many of you to believe that we're finding the smartest people
  - You will not get through UT by being the brightest, but through your efforts
  - Professors want smart students, but they want **motivated, hard-working** students more
    - If you are motivated and work hard, you can learn everything you need to know
  - Similarly, your professors may be very smart, but that isn't how they became your professors
  - Our research heroes are our heroes because they made **us** smarter, not because they were smart

Some thoughts before we begin

- You have often learned to try to hide when you don't know something
  - Don't do this. Admit you don't know it and learn it.
  - Find the limits of what you know quickly, and then learn what you need to know.
- If as a researcher you always know all of the answers, you are asking the wrong questions.
  - I look for problems that I don't know the answer to, but that I have a hunch about.

What does good research look like?

- Bad
  - “Let me baffle you with mathematics and hope you don't see the flaws in my work.”
    - Note: Veteran academics will see the flaws.
  - “We spent $1M and built the coolest robot ever.”
    - The point is so that **others** understand and build cool robots.
- Good
  - “Human handovers follow these dynamics.”
  - “Eye-motion follows Listing's Law.”
  - “People are more compliant with the demands of physically-present robots.”

What do we research here?

- LARG – Learning Agents Research Group
  - Reinforcement Learning
  - Deep Learning
  - Skill-Transfer
  - Multi-Agent Reasoning
- Building-Wide Intelligence
  - A fleet of autonomous robots that roam GDC responding to spoken commands
- RoboCup@Home
  - Domestic Service Robots

Building-Wide Intelligence

- BWIBots
  - Segway base
  - LIDAR
  - Depth Camera
  - Respond to voice commands
- Tasks
  - Give directions
  - Manipulate objects
  - Scavenger hunt
  - ??

Building-Wide Intelligence

- Current research directions
  - Adding a face
  - Autonomous semantic labeling of map data
  - Improved manipulation
  - Social navigation
  - Studies in gaze
  - Self-modeling

RoboCup@Home

- Domestic Standard Platform League
- Domestic service robots scored on their performance of a set of tasks


RoboCup@Home League
Domestic Standard Platform
Hibikino-Musashi@Home SPL
eR@sers
UT Austin Villa
2
1
3
RoboCup 2017
Nagoya Japan
RoboCup 2017
Nagoya Japan
ロボカップ2017名古屋世界大会
27 to 30 JULY
RoboCup 2017
Nagoya Japan
RoboCup 2017
Nagoya Japan
ロボカップ2017名古屋世界大会
27 to 30 JULY

RoboCup@Home

Goal

Win RoboCup@Home in 2018

RoboCup@Home Tasks – Stage 1

- Storing Groceries
  - Groceries are placed on a table
  - Stack them onto a shelf
  - Place similar items together
- Speech & Person Recognition
  - Listen to a question
  - Turn towards the person asking the question
  - Answer the question

RoboCup@Home Tasks – Stage 1

- General Purpose Service Robot
  - Operator gives the robot an instruction in English
  - Robot is to perform the operator's request
- Help Me Carry
  - Operator asks for help carrying groceries
  - Operator leads the robot to a car
  - Operator hands bag of groceries to robot
  - Robot brings groceries to kitchen
  - Robot asks person in apartment for help
  - Robot leads this person to the car

RoboCup@Home Tasks – Stage 2

- Restaurant
  - Robot performs as a waiter in a restaurant, taking orders from patrons, telling them to kitchen staff, and delivering meals
  - Robot has not been in this restaurant before, and can not have a pre-programmed map of it
- Prepare a meal and clean it up
  - Robot sets a table, places a meal on the table, and cleans it up after a judge eats the meal. The judge chooses the meal.

RoboCup@Home Tasks – Stage 2

- Enhanced Endurance General-Purpose Service Robot
  - Same as in Stage 1, but much more difficult verbal requests.
- Open Challenge
  - Each lab chooses their own presentation

What makes these problems interesting?

- We can't do these things yet.
- The goal of BWI is **not** to build the world's most awesome robot.
  - Building the world's most awesome robot gives us a target.
  - The goal is to identify the research problems that we must solve to build the BWI robot.
- The goal of RoboCup@Home, similarly, is to spur the correct questions to ask so we can reduce domestic service robots to an engineering problem.
  - Right now, there is no amount of money that you could spend that would get you a real robot housekeeper.
  - We're so far from that goal that the tasks in RoboCup@Home sound like science fiction to experienced scientists.

Questions?

Panel

Quick Run-Through of the Semester

- Lectures roughly:
  - 50% technical content
    - ROS
    - Programming
  - 50% research content
    - What is the meaning of all of this stuff?

Quick Run-Through of the Semester

- Introductory class
- Intro to AI
- Intro to C++
- AI as Search & Symbolic AI
- What is ROS? & Intro to ROS
- Behavior-Based Systems
- Robotic Representations & Basic Computer Vision
- The BWI Code, Running Robot Simulators and Real Robots
- Research Themes in Robotics
- Final Projects