Course Syllabus

Introduction

In this course, you will learn how to program all the major systems of a robotic car based on lectures from the former leader of Google's and Stanford's autonomous driving teams, Sebastian Thrun. You will learn some of the basic techniques in artificial intelligence, including probabilistic inference, planning and search algorithms, localization, tracking, and PID control, all with a focus on robotics. Extensive programming examples and assignments in Python will apply these methods in the context of autonomous vehicles.

Learning objectives

Upon successfully completing this course, you will be able to:

- Implement filters (including Kalman and particle filters) in order to localize moving objects whose locations are subject to noise.
- Implement search algorithms (including A*) to plan the shortest path from one point to another subject to costs on different types of movement.
- Implement PID controls to smoothly correct an autonomous robot's course.
- Implement a SLAM algorithm for a robot moving in at least two dimensions.

Prerequisites

Success in this course requires programming experience and some mathematical fluency. **Programming in this course is done in Python**. We will use some basic object-oriented concepts to model robot motion and perception. If you don't know Python but have experience with another language, you should be able to pick up the syntax fairly quickly but *must budget extra time for learning a new programing language*. If you are NOT fluent in some programming language already, learning python and coding the projects will be extremely time consuming. The math used will primarily be probability and linear algebra. You need not be an expert in either, but some familiarity with concepts in probability (e.g., that probabilities must add up to one, the definition of conditional probability, and Bayes' rule) will be extremely helpful and reduce the amount of time you will need to spend (re)learning the mathematical underpinnings.

Dramatis personæ

Course Creator: Dr. Sebastian Thrun
Instructor of Record: Dr. Jay Summet <summetj@gatech.edu>

Materials & Websites

There are no required texts for this course; however, a supplementary reading you may find helpful is Probabilistic Robotics by Wolfram Burgard, Dieter Fox, and Sebastian Thrun. The book provides much of the math and the derivations omitted in Sebastian's lectures.
http://probabilistic-robotics.org/

Lectures and problem sets will be delivered via the Udacity website. You must log in to Udacity using your Georgia Tech credentials in order to view the lectures and submit quizzes and problem sets. (Choose "Sign In with Georgia Tech" from the Udacity sign-in page.)

Your grades will be returned and assignment submission (Problem Sets & Projects) will be handled using T-Square. (https://t-square.gatech.edu) Please refer to the course guidelines document for further details. Official course announcements will be sent via the "Announcements" tool on T-Square, and will be archived there for viewing.

All course communication including public questions about content and private questions about individual grades will be handled via the Piazza website. Clarifications to course policies and project specifications may also be discussed on Piazza so it is vital that you maintain awareness of the question & answer content. See the "Using Piazza" in the course guidelines document posted on T-Square for more details.

Office Hours

We will hold office hours sessions throughout the semester. We will post the office hours schedule on Piazza. We will stream the sessions live and then upload them to YouTube for you to access after the fact. You may submit your questions in advance by posting them in the designated Piazza thread beforehand, or post questions "live". Dr. Sebastian Thurn will also make several guest appearances at office hours to discuss robotics and the course content from an industry standpoint.

Privacy Notice: Students' voices and images will not appear in the office hours; only the instructors and TAs will be on camera. However, we may read aloud the names of students who choose to ask questions during the session. If this is unappealing to you, please feel free to ask your question anonymously on Piazza.

Important Dates & Deadlines

- Monday, May 14th, 2018 First Day of Class
- Friday, May 18th, Registration/Schedule change period ends (4pm ET)
- Monday, May 21st, Midnight AOE* – *Problem Set 1 Due* (Project 1 posted)
- Monday, May 28th, Midnight AOE* - *Problem Set 2 Due*

  ** Note: In the USA, Monday May 28th is Memorial day, so you may wish to submit this problem set early depending upon your plans.**

- Monday, June 4th, Midnight AOE* - P*roblem Set 3 Due*
  (Project 2 / MiniProject:PID posted)
- Monday, June 11th, Midnight AOE* - **Mini-Project: Runaway Robot** *(parts 1-4) Due*
- Monday, June 18th, Midnight AOE* - **Project 1 Due**

- Monday, June 25th, Midnight AOE* - *Problem Set 4 Due*
- *Saturday, June 30th, Institute Withdrawal deadline (4pm ET)*
- Monday, July 2nd, Midnight AOE* - *Problem Set 5 Due*

  ** Note: In the USA July 3rd & 4th are institute holidays for Independence day, so you may wish to turn this assignment in early depending upon your plans. **

- Monday, July 9th, Midnight AOE* - **Mini-Project: PID Due**
- Monday, July 16th, *Midnight AOE* - Problem Set 6 Due*
- Monday, July 30th, Midnight AOE* - **Project 2 Due**

* Midnight AOE = Midnight Anywhere On Earth – You may read this as 8am ET on the following day, but we recommend that you always plan to submit before Midnight your local time to ensure you meet the deadline. Please change your T-Square “timezone” settings to your local timezone to avoid timezone confusion.

Grading Policy

Your overall course grade will be calculated from your weighted scores on the following deliverables:

- 6 problem sets (36%; 6% each)
- Runaway-Robot mini-project (10%)
- Project 1 (10%)
- Project 2 (30%)
- PID mini-project (14%)

- Extra Credit Opportunities: Worried you might end up right below a grade cutoff line? You can earn extra credit in several ways, including:
  ○ Exceptional participation and helpfulness on Piazza throughout the semester.
  ○ Participating in optional challenge assignments (details of which we will announce on Piazza).
  We will not add extra credit for the challenge assignments or Piazza participation to your overall score. Instead, we will take it into consideration at the end of the semester if you are within two points of the threshold for the next higher letter grade.

You will submit all assignments using the Assignments tool in T-Square (See the course guidelines document for more details.) We will post grades using the Gradebook tool on T-Square. We will do our best to return grades to you as quickly as possible. We ask that if you have a concern about a grade received to please notify us within one week of receipt.

The minimum required scores for course letter grades are:

- A: 90.00%
- B: 80.00%
- C: 70.00%
- D: 60.00%

If circumstances warrant, the instructor may lower these grade cutoffs (that is, make them more favorable to your grade) at the end of the semester.

Academic Integrity Policy

All Georgia Tech students, including students in the OMSCS program, must read and uphold the Georgia Tech Academic Honor Code. (http://osi.gatech.edu/content/honor-code)
Georgia Tech expects honest and ethical behavior of you at all times. We will report all incidents of suspected dishonesty to the Office of Student Integrity (OSI). Please refer to the course guidelines document for further details. We actively scan project submissions with automated means to detect cases of plagiarism.

Disability Services

Georgia Tech is an ADA-compliant educational institution. If you have a disability that requires accommodations, contact Disability Services. To receive accommodations, ask Disability Services to forward the instructor a letter specifying the accommodations you should receive. Do this as soon as possible, as it can take up to 15 business days for the office to process your initial application.
http://disabilityservices.gatech.edu/