

# Artificial Intelligence for Robotics

## Syllabus

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### Course Overview

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. In this course, 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 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) to localize moving objects subject to noisy observations.
- Implement planning algorithms (such as Dijkstra's algorithm and A\*) to plan the shortest path between two states, subject to costs on different types of movement.
- Implement PID controls to smoothly correct an autonomous robot's course.
- Implement a simultaneous localization and mapping (SLAM) algorithm for a robot moving in at least two dimensions.

### Prerequisites

Success in this course requires some prior 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.

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. Some geometry and trigonometry will also be useful.

### Required Texts

There are no required texts for this course; however, a supplementary reading you may find helpful is [Probabilistic Robotics](#) by Wolfram Burgard, and Dieter Fox, and Sebastian Thrun. The book provides much of the math and the derivations omitted in Sebastian's lectures.

## Course Support

All class communication will take place on Piazza; you can find a link to Piazza on T-Square.

The instructors reserve the right to make reasonable changes to the syllabus; therefore, **you need to check Piazza daily for any announcements indicating any such changes.**

All course lectures are available through Udacity. You must log in to Udacity using Georgia Tech credentials in order to view the lectures and submit quizzes. (Choose “Sign In with Georgia Tech” from the [Udacity sign-in page](#).)

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 anyone to access.

If you are unable to participate in an office hours session, you may submit your questions in advance by posting them in the designated Piazza thread beforehand.

## 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.

## Problem Sets

You should submit all Problem Sets through the Udacity interface. You may submit your solutions as many times as you wish. A quiz will be counted correct if you submit a correct response (as judged by the site’s autograding script) before the deadline. If you wish to change your response afterwards, that is fine: you only need a single “Correct” from the autograder per quiz. You must correctly complete all the quizzes in a Problem Set before the deadline to earn credit for the Problem Set.

Only quizzes in the Problem Sets will count for a grade. You may skip quizzes in the Lessons without penalty, though we certainly encourage you to attempt them all.

**Note:** Even if you have already completed the Problem Sets using a personal Udacity account, you must (re)submit the Problem Sets using your Georgia Tech-associated Udacity account to receive credit for completing them.

## Deadlines

- Problem Set 1: Mon., May 22, 8:00 a.m. EDT
- Problem Set 2: **Sun., May 28, 11:59 p.m. EDT\***
- Problem Set 3: Mon., June 5, 8:00 a.m. EDT
- Problem Set 4: Mon., June 19, 8:00 a.m. EDT
- Problem Set 5: Mon., June 26, 8:00 a.m. EDT
- Problem Set 6: **Sun., July 2, 11:59 p.m. EDT\***

\*Note the unusual deadlines for Problem Sets 2 and 6.

## Projects

You will submit all Projects via T-Square. We will release details about projects and submitting them later in the semester via Piazza and T-Square.

## Deadlines

- Project 1: Mon., June 12, 8:00 a.m. ET
- Project 2: Mon., July 10, 8:00 a.m. ET
- Final Project: Mon., July 31, 8:00 a.m. ET

## Grading Policy

- 6 Problem Sets: (30%, 5% each). You will receive full credit if you complete all quizzes in a Problem Set on-time, and you will receive zero credit otherwise. Please double-check that you have correctly finished all the quizzes by the deadline. Because the answers for the Problem Sets are available on Udacity and you have the opportunity to submit solutions as often as you like, ***we will not award partial credit for Problem Sets.***
- Project 1 (20%)
- Project 2 (20%)
- Final Project (30%)
- Extra Credit: 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.

We will post grades using the Gradebook on T-Square.

The minimum required scores for final letter grades will be:

- A: 90%
- B: 80%
- C: 70%
- D: 60%

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

## Deadlines, Extensions, and Excused Absence Policy

Problem sets and projects are due at 8:00 a.m. Eastern Time (except for Problem Sets 2 and 6) on their respective due dates, which can be found above and on the course calendar. Due to the large-scale nature of this course and to be fair to all students, it is not possible for us to make exceptions to deadlines except for an emergency situation (e.g. illness or death in the family) or an officially sanctioned Georgia Tech absence (usually not applicable for online students). Therefore, **we will not accept late submissions** except in these circumstances. Please plan ahead in order to submit the assignments on time.

If you have an emergency involving personal illness or family illness or death, you should file a [care request](#) with the Office of the Dean of Students so the office can verify your situation. If you have an emergency situation not covered by the above, send a private message to the instructors on Piazza with the details of your request. You must make your request in a timely manner in order for us to consider it. Moreover, if you are requesting an extension of  $N$  days for an assignment, you must turn in the assignment within  $N$  days of the regular deadline, or else the assignment will still be late.

## Technical Requirements

Make sure to check the [minimum requirements](#) for using the Udacity platform. Additionally, Georgia Tech's Office of Student Computer Ownership issues [minimum hardware requirements](#) to incoming undergraduates; you should meet or exceed these guidelines.

## Academic Integrity Policy

All Georgia Tech students, including students in the OMSCS program, must read and uphold the [Georgia Tech Academic 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).

In this course, you may not share any graded project code, either with other students or via online code sharing sites such as Github. Additionally, you may not use a substantial amount of code from outside resources. While using a code snippet from StackOverflow or the SciPy documentation is fine (so long as it is cited), wholesale lifting from a classmate's work or an online source is not. To enforce this policy, we will use a plagiarism detector on submissions.

You may only discuss Problem Set code after the submission deadline for that Problem Set has passed.

You should address any questions about Project or Problem Set code directly to "Instructors" (the alias for all instructors and TAs) using a private message on Piazza.

You may discuss code for ungraded quizzes (e.g., the programming quizzes in the Lessons but not the Problem Sets) on Piazza any time, but please put the word "Spoiler" in the title of the post to alert other students who may not wish to see the answer.

If OSI finds you responsible for violating the Honor Code, you can expect, at minimum, to receive a score of zero on the assignment or project in question and to receive a warning posted to your academic record. Repeat offenders may receive increased penalties such as automatic course failure, suspension, or expulsion.

## Learning Accommodations

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.

## Course Calendar

You can access the course calendar through the links below. We will announce any changes to the calendar on Piazza.

- ICAL: <http://tinyurl.com/cs8803o01summer2017ical>
- HTML: <http://tinyurl.com/cs8803o01summer2017html>