Welcome to CS 3630!

Spring 2021:
• Flipped class!
• New projects!
• A new course outline!
Course Instructors

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School of Interactive Computing

Seth Hutchinson, Professor  
School of Interactive Computing

TAs: Binit Shah, Yetong Zhang, Rachit Bhargava, Dashiel Heidt, Pratyusha Karnati, Maya Rajan, John Yi
Robots are useful!

- Manufacturing
- Logistics (inventory, warehouse logistics, packaging)
- Transportation (self-driving cars)
- Consumer and professional services (cleaning, mowing)
- Health, independence and quality of life (exoskeletons, semi-autonomous wheelchairs)
- Agriculture
Robot Taxonomy

- Industrial Robots
- Service Robots
- Field Robots
- Humanoid Robots
- Medical Robots
- Self-Driving Cars
- Aerial Vehicles

http://www.kuka.com
Robot Taxonomy

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http://www.frc.ri.cmu.edu/robots/
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Schedule
5 Modules

• Agents
• Blind Duckiebot
• Car + LIDAR
• Seeing Duckiebot
• Drone

• Articulated Robots guest lecture
### Agents

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Notes</th>
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<tr>
<td>Mon, Jan 25</td>
<td>Agents</td>
<td>Dijkstra etc</td>
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<td>Wed, Jan 27</td>
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<td>Probabilistic Actions</td>
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<tr>
<td>Mon, Feb 1</td>
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<td>Markov Decision Processes</td>
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<td>Wed, Feb 3</td>
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<td>Probability and Bayes Nets</td>
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<tr>
<td>Mon, Feb 8</td>
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<td>Inference in HMMs</td>
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<tr>
<td>Wed, Feb 10</td>
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<td>Inference in Graphical Models</td>
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Blind Duckiebot

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<thead>
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<tr>
<td>Mon, Feb 15</td>
<td>Blind Duckiebot</td>
<td>Kinematics in the Plane</td>
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<td>Wed, Feb 22</td>
<td>RRT and Probabilistic Roadmaps</td>
<td>3 out - 2 due</td>
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<td>Mon, Feb 24</td>
<td>Growing Obstacles + Voronoi</td>
<td>Motion Planning</td>
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<td>Wed, Mar 1</td>
<td>Continuous densities and bananas</td>
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<td>Mon, Mar 3</td>
<td>Monte Carlo Localization</td>
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## Car + LIDAR

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<tr>
<td>Wed, Mar 8</td>
<td>Car + LIDAR</td>
<td>Autonomous Vehicles</td>
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<td>Mon, Mar 10</td>
<td>Motion Planning for Driving</td>
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<td>Wed, Mar 15</td>
<td>Iterated Closest Points</td>
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<td>Mon, Mar 22</td>
<td>SLAM with LIDAR</td>
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<td>Wed, Mar 24</td>
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Seeing Duckiebot

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<tr>
<td>Mon, Mar 29</td>
<td>Seeing Duckiebot</td>
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<td>Computer Vision Fundamentals</td>
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<td>Wed, Mar 31</td>
<td>Pinhole Cameras</td>
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<td>Mon, Apr 5</td>
<td>Visual SLAM</td>
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<td>Wed, Apr 7</td>
<td>Deep Learning for Vision</td>
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<td>Quiz 4</td>
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# Drone

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<tr>
<td>Mon, Apr 12</td>
<td>Drone</td>
<td>SE(3)</td>
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<td>Wed, Apr 14</td>
<td>Continuous Path Planning</td>
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<td>Mon, Apr 19</td>
<td>Stereo Vision → 3D world</td>
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<tr>
<td>Wed, Apr 21</td>
<td>3D Mapping</td>
<td>6 due (Fri mn) Quiz 5</td>
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Syllabus
Learning Objectives

• Describe and explain what robots are and what they can do
• Describe mathematically the position and orientation of objects and how they move
• Develop a control architecture for a mobile robotic system
• Implement navigation and localization algorithms based on sensor fusion and environment representation
• Write moderately involved programs in Python and Java to control a robotic system
• Construct, program, and test the operation of a robotic system to perform a specified task
Prerequisites

• The only formal prerequisite is CS1332 Data Structures & Algorithms.
• Prior knowledge of fundamentals of linear algebra and probability is helpful, but not required.
• Background in AI and Machine Learning is not assumed.
• The course requires access to a computer.
• All programming assignments will be completed in Python.
Lecture Delivery and Grading Components

• Lectures will be pre-recorded and available 2 workdays before class time. Students are expected to watch the lecture before each class time.

• Questionnaires: to reinforce the lecture and prepare for class time, the students will be required to answer a short questionnaire by Sunday evening about the two lectures assigned for viewing. This will count for 5% of your grade.

• Quizzes: there will be 5 modules, as indicated on the schedule. At the end of each module, there will be an online quiz worth 6% of your grade each, for a total of 30%. Quizzes will have a combination of multiple choice and essay questions, as appropriate.

• Q&A: students are expected to attend each class period, Monday and Wednesday at 3.30. Class will start with a 30 minute quick review and Q&A, followed by project-related activities (see below).

• Activities: there will be six projects, each having an in-class activity component which forms an integral part of your participation grade, for a total of 5%. For these activities, you will be placed in groups that will remain stable for two projects, then shuffled.

• Projects: each project will additionally have a powerpoint template that will have to be submitted on Gradescope as a pdf and, possibly accompanied with code and/or videos. Project are released and are due on Fridays, and project deliverables will make up 60% of your grade.
Academic Integrity

• Academic dishonesty will not be tolerated. This includes cheating, lying about course matters, plagiarism, or helping others commit a violation of the Honor Code. Plagiarism includes reproducing the words of others without both the use of quotation marks and citation. Students are reminded of the obligations and expectations associated with the Georgia Tech Academic Honor Code and Student Code of Conduct, available online at www.honor.gatech.edu.

• You are expected to implement the core components of each project on your own, but the extra credit opportunities often build on third party data sets or code. That’s fine. Feel free to include results built on other software, as long as you are clear in your hand-in that it is not your own work.

• You should not view or edit anyone else’s code. You should not post code to Piazza, except for starter code / helper code that isn’t related to the core project.
The grading distribution is:

<table>
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<tr>
<th>Component</th>
<th>Nr.</th>
<th>Grade</th>
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<tr>
<td>Questionnaires</td>
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<td>5%/12</td>
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<tr>
<td>Quizzes</td>
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<tr>
<td>Activities</td>
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<tr>
<td>Projects</td>
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<td>60%</td>
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100%
Questions?