Course Outline: CS 685
Autonomous Robotics

Fall 2026

Mondays from 4:30 pm to 7:10 pm
Eng. 1103

Course Overview

This course covers basic theories and practices of autonomous robotics. Concepts of most components in modern robotics systems, including perception, representation, planning, control, actuation, and learning, will be covered in the lectures. The course will include several milestones and one standardized group project where students will be encouraged to be creative. Students will have the opportunity to present their developed robotics software and systems in class presentations and write a final project report.

This course is at the introductory graduate level and aims to introduce students to various topics in robotics through hands-on projects. After the students acquire a broad understanding of the field of robotics, they will be ready to dive deeper in any of the sub-fields, such as mapping and localization, motion planning, navigation, and manipulation. In addition to preparing students to future career in robotics, the course also hones the necessary skills for students to engage in future robotics research.

Prerequisite: Graduate student standing. The main prerequisite for this course is CS 580, Introduction to Artificial Intelligence. Also recommended is CS 583, Analysis of Algorithms.

Computer Science Familiarity: Students will be using Python and/or C/C++ for project assignments. Familiarity with algorithms and data structures is highly recommended.

Mathematics Familiarity: having experience with the following topics is highly recommended:

- Probability
- Linear algebra
- Calculus

Instructor Name(s) and Contact Information

David Porfirio, Ph.D.
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Office: FUSE 7310
Office Hours: by appt.

Learning Outcomes

There are three primary objectives for the course:

- To provide a broad survey of autonomous robotics systems and a deep understanding of their internal components;
- To develop hands-on skills to program simulated and physical robots working in the real world;
- To develop engineering and research skills specific to the field of robotics.

The course is designed to present a solid entry point to the field of robotics. It will provide the foundation to go on to take other upper division robotics courses. For those students with interest, it could possibly lead to subsequent research opportunities.

Course Website

Course materials will be hosted on Canvas. Some materials may also appear on `https://dporfirio.github.io/fall2026_robotics.html`, including readings, assignment descriptions, and lecture slides. Students should refer to Canvas for any

schedule updates, which may affect the syllabus. The syllabus on Canvas will be kept up-to-date.

Canvas will primarily be used for submitting assignments and posting grades. Canvas will also be the primary means through which the instructor will communicate with students via mass email. Course materials will be backed up to Canvas periodically.

Code will be hosted here: `https://github.com/dporfirio/cs685_fall26_materials`

Course Project

The course project is inspired by Robocup at Home. The goal of the project is for a robot to complete a household task. The project will progress through several milestones from the start to the end of the semester, with the first milestone being ROS2 installation. At the end of the semester, students will apply what they have learned to develop solutions for a robot to successfully complete a *known* task in a *known* environment. The task and environment will be given to students at the start of the semester.

The project presentation and final writeup will also ask students to detail the steps that they took to extend their solutions to *unknown* tasks in *unknown* environments, and how well their solutions work. Students are encouraged to be creative. Top performing solutions will be demonstrated in class.

Team Policy: It is important that individuals grasp the basics before working together as teams. Thus, Milestones I-V will be graded on an individual basis. We will then assemble teams in the middle of the semester. Subsequently, the project presentations and the final writeup will be completed in teams of 2-3 students. The project and all assignments should be completed in the Habitat 3.0 simulator on a virtual Stretch 3 robot. In the spirit of fairness and consistency, no other simulation or robot platforms will be allowed other than in exceptional cases. In the spirit of good collaboration, teammates will provide evidence of a fairly distributed workload in their final peer evaluations.

Texts

Readings will be provided via the course website when applicable.

Course Schedule

Readings and assignments will be posted on the course website. The instructor reserves the right to modify the schedule during the semester as needed.

Date	Topic
8/24/2026	Introduction
8/31/2026	Kinematics
9/7/2026	No Class—**Labor Day** **Milestone I (individual) due:** proof of ROS2 installation
9/14/2026	Motion Control
9/21/2026	Motion Planning 1 **Milestone II (individual) due:** proof of kinematics
9/28/2026	Motion Planning 2
10/5/2026	Probabilistic Robotics
10/12/2026	No Class—**Fall Break**
10/19/2026	Localization 1 **Milestone III (individual) due:** proof of planning
10/26/2026	Localization 2 **Team Formation**

Date	Topic
11/2/2026	Vision 1 **Milestone IV (individual) due:** proof of navigation
11/9/2026	Vision 2
11/16/2026	Project Pitch Presentation (group) and work day **Milestone V (individual) due:** proof of vision
11/23/2026	Robot Learning
11/30/2026	HRI
12/7/2026	Project Presentations (group)
12/14/2026	No class—**exam week**
	Final writeup (group) due

Grading Policy

Grading Schema

A	92%	B+	87%	C+	77%	D	60%	F	<60%
A-	90%	B	83%	C	72%				
		B-	80%	C-	67%				

Grade Weights

- Participation – 14% (1% per class)
- Presentations – 20% (10% each)
- Project milestones – 40% (8% each)
- Final Writeup – 20%
- Peer Eval – 6%

Late Assignment Policy—at the discretion of the instructor, starting immediately after the due date & time, late assignments will be docked 10%, with an additional 10% docked for each late day thereafter. For example, if an assignment is 8 hours late, because it is within the first 24 hours, it will be docked 10%. If it is 36 hours late, because it is within the first 48 hours, it will be docked 20%. 50 hours late means 30% docked. Etc.

Attendance Policy—missing class results in losing 1 participation point. Students who inform the instructor at least 1 week in advance of missing class will not be penalized. There will be no exceptions to this rule.

AI Policy

Generative AI is an important tool for students to learn how to use, so the use of AI in this course is allowed in some cases, and prohibited in others. However, **you** are responsible for the solutions that you develop and the code that you submit, and this course is designed such that you must understand the material in order to perform well on the assignments. If you submit work that you do not understand, your grade will suffer.

What is allowed: AI is allowed to be used in certain technical aspects of this course, such as for your final project. You are *encouraged* to document any use of AI for transparency.

What is prohibited: The use of generative AI for writing assignments, including poster/presentation creation. All writing must be your own. Having AI complete a writing assignment on your behalf will be treated similarly to having a peer write the assignment for you, which can amount to academic dishonesty. It can be difficult to detect AI usage in writing, but if the instructor

determines that there is sufficient proof of AI usage, consequences include a reduction in assignment grade at minimum (see **Consequences of misuse**, below). Do **not** risk it.

Consequences of misuse: misuse of AI based on the rules above may result in a reduction in assignment grades, and in severe cases will be treated as plagiarism or academic dishonesty.

Unauthorized Devices and Materials

Although there are no planned assessments in this course, the instructor reserves the right to administer assessments if necessary. By default, any assessments will be closed book, closed notes, and there are no authorized devices. Policies regarding authorized material and devices will be specified per assessment. The possession of an unauthorized device or unauthorized material during any assessment will result in an automatic 0 on that assessment, even if the device or material is not used. For example, if you are asked to turn off your phone and put it away in your backpack, and then you are seen with a phone in your pocket during a quiz or exam (even if it is off), then that quiz or exam will be an automatic 0. The same rule also applies for any limited access devices or material. For example, if you are allowed some form of notes and a calculator during a quiz or exam but there are restrictions given (such as the quantity of notes, or capabilities of the calculator), and you are seen with something outside the parameters specified, then that quiz or exam will be an automatic 0. This policy is non-negotiable and it is your responsibility to confirm before the assessment if something does or does not adhere to the assessment policies.

Common Policies

Please see `https://stearnscenter.gmu.edu/home/gmu-common-course-policies/` for a description of Academic Standards, Accomodations for Students with Disabilities, FERPA and Use of GMU Email Addresses for Course Communication, and Title IX and Non-Discrimination: Access and Compliance with George Mason's Nondiscrimination Policies.