CS 245: Robotics and Machine Learning

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Office Hours: Mon 11-12, 3-4, Tue 10:30–12:00, 1:30-3, Wed 11-12, Thu 12:30-2:00, and by appointment

Course Objectives: The course introduces the student to the fundamentals of robotics and machine learning. The course focuses on exploration of the purpose and history of robotics and machine learning, on fundamental theoretical aspects of the field, and on practical techniques for creating and deploying intelligent machines. Upon completion of the course, you will be able to

- evaluate and be able to critique the purpose and the history of intelligent machines, as well as understand the issues that may arise in the future
- understand fundamental machine learning techniques and be able to apply these techniques in practice
- build elementary robotics systems and to apply these systems to real world tasks

Required Readings: Readings for the course will be posted on the course website. The assigned material should be read *before* the class period. This will help you understand the material better, as well as to enable you to participate and contribute during lectures in an informed manner.
You will be required to read a book for this course: "I, Robot" by Isaac Asimov. You should be able to purchase the book from any book retailer or to borrow it from any library.

Grading: The grade for the course will be based upon in-class participation, a term paper, exams, lab reports, and a team assignment and presentation.

Class participation and quizzes:	8 %
Team assignment and presentation:	10 %
Exams (2 midterms 15% each and final 20%)	50 %
Labs and lab reports:	20 %
Term paper:	12 %

Grades will be assigned using the following scale:

92% and above	A		71% - 74%	C
88% - 91%	A-		68% - 70%	C-
85% - 87%	B+		65% - 67%	D+
81% - 84%	B		61% - 64%	D
78% - 80%	B-		58% - 60%	D-
75% - 77%	C+		57% and below	F

I reserve the right to adjust (lower) the scale to utilize gaps in the distribution, but this will be done minimally if at all. The class attendance policy may also affect your course grade.

Exams: There will be two one-hour, comprehensive, closed book midterm exams during the semester. The final exam is also comprehensive and is scheduled by the registrar's office and the dates cannot be changed. Our final exam will take place on Thursday, December 6th, 10:30-12:30 for Section A, and on Monday, December 10th, 4-6 for Section B.

During the exams you may be required to write and understand short robotics and machine

learning algorithms, answer short essay and multiple choice questions, and think critically about the material covered in class and in readings. Your attendance on exams is required. No make-up exams will be given except in documented cases of emergency.

Team Presentation: During the last class period, each team will prepare a short 10-minute presentation and a demonstration of their final team project. Team members will be evaluated both by the instructor and by other team members.

Term Paper: For this paper, you will first choose a specific real-world domain for which intelligent systems exist (e.g., vision, speech, planning, navigation, etc.). Within the chosen domain, you must also choose an existing robotics system and its evaluation, including its history and purpose, as well as its current and future impact on the given domain. The examples of paper topics and the instructions for the term paper will be posted on the course website later in the semester. The term paper will account for 12% of a student's overall grade.

Work that you submit *must be your own*. No cooperation among the students is allowed unless it is explicitly approved by the instructor. You may seek help from tutors and the instructor in case you need assistance with your assignments. Copying someone else's work and disguising it as your own is a very serious offense and *will not* be tolerated. The University policy on scholastic dishonesty is outlined both in the undergraduate catalog and in the Student Handbook.

Class Participation: A small, but significant part of your overall grade will be based upon your participation in class discussions and occasional pop-quizzes. Participating in class means not only to communicate, but to do so in an informed manner. Class discussions will be based on the reading material assigned for a particular lecture. Therefore, you should read the assigned material *before* the lecture in which it is covered in order to participate in an informed discussion of lecture materials. Questions on the quizzes will come from the reading material. Note that the level and quality of a student's class participation and contribution is determined by their results on the pop quizzes and at the instructor's discretion.

Lab Reports: The laboratory component of this course will consist of one 50-minute lab session per week. Laboratory experience is a crucial component of this course, where students are exposed to practical applications of fundamental theoretical concepts covered during lectures. The class will be divided into 3-4 person teams during the first few weeks of the course. Students in a team will work on their own on laboratory exercises and will be responsible for written lab reports that will reflect their lab experience. Students in each team will work together on their final team project. Each student will receive a grade for their individual labs. The final team project accounts for 10% of your grade and it is based on both individual and team's efforts. The final project grades may be further adjusted based upon anonymous evaluations of team members by other team members, as well as self-evaluations of each team member.

Lab exercises for the first part of the course will introduce students to elementary creation and deployment of robots. Each student team will build their own robot using the Lego Mindstorms robot construction kits. Upon constructing their own robots, students will learn to instruct robots to perform a variety of tasks, starting with simple robot navigation and elementary processing of sensory inputs. A portion of the course introduces students to elementary machine learning techniques. Using these techniques, students will learn to adapt behavior of their robots based on perceived sensory inputs.

At the end of the course, each team is expected to disassemble their kits to their original condition. The robotics kits must be disassembled before the final exam date and time. Failure to do so will result in the "incomplete" grade for the course.

Attendance Policy: Attendance in this course *is required*. Students are expected to attend each lecture and to be in class on time. In case of an absence, a student must provide a *documented* excuse of his or her absence. Simply notifying the instructor about an absence is not a documented excuse. Two or more unexcused absences will result in a reduction of the student's overall course grade by a half letter grade. Four or more unexcused absences will result in a reduction of the student's overall course grade by an additional full letter grade. Six or more unexcused absences will automatically result in a grade of "F" for the course. Tardies will also result in serious consequences. A tardy is defined as being late for a class, after a class session has already begun. You are permitted one tardy without any consequences. Each tardy after the first tardy will result in one unexcused absence and a reduction of the student's overall course grade as described above.

Academic Dishonesty: All students are bound by the academic integrity policy in the most recent AU student handbook. Academic dishonesty includes, but is not limited to plagiarism (the intentional or unintentional presentation of someone else's words or ideas as one's own without proper documentation), fabrication (the intentional falsification or invention of research, citations or other information) and cheating. The process for dealing with violations and the appeals process are detailed in the student handbook. In addition, severe and blatant violation of the academic integrity policy may result in a grade of F for the course at the discretion of the instructor.

Work that you turn in must be your own. No cooperation among the students is allowed unless it is explicitly approved by the instructor. You may seek help from tutors and the instructor in case you need assistance with your assignments. Copying someone else's work and disguising it as your own is a very serious offense and will not be tolerated. Depending on the severity of the offense, as well as on other factors as determined by the instructor, the instructor reserves the right to assign a grade of F for the assignment, and possibly a grade of F for the whole course. The University policy on scholastic dishonesty is outlined both in the undergraduate catalog and in the Student Handbook.

Classroom Support: Students with documented disabilities who require academic adjustments for this class are requested to contact me to discuss reasonable accommodations. While not required, it is in the best interest of the student to have this conversation early in the semester. In order to receive academic adjustments paperwork from Disability Services must be provided to document this need. Disability Services is located in 105 Amstutz, extension 5953.

Important Dates: The last day to drop the course is November 9th

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Tentative Weekly Course Schedule, Fall 2012

Week	Dates	Topic
1	Aug 20, Aug 22, Aug 24	Introduction. History of Robotics and Machine Learning
2	Aug 27, Aug 29	Robot construction. *Machines Who Think*.
	Sep 3	*Labor Day*
3	Sep 5	Historical influences: Babbage
4	Sep 10, Sep 12	Historical influences: Tesla, Turing, Pioneering robotics systems
5	Sep 17, Sep 19	Historical influences. Philosophical perspectives
6	Sep 24, Sep 26	Philosophical perspectives: Can Machines Think?
7	Oct 1, Oct 3	Exam. Learning in Humans.
8	Oct 8, Oct 10	Basic Machine Learning Techniques. Neural Nets
9	Oct 15, Oct 17	Basic Machine Learning Techniques. Neural Nets
	Oct 22	*Fall Break*
10	Oct 24	Machine Learning: Evolutionary Computation
11	Oct 29, Oct 31	Machine Learning: Genetic Algorithms
12	Nov 5, Nov 7	Machine Learning: Genetic Algorithms
13	Nov 12, Nov 14	*Exam*. Practical Machine Learning : ML in Computer Games
14	Nov 19	ML in Computer Games
	Nov 21 - Nov 25	*Thanksgiving break*
15	Nov 26, Nov 28	"*I, Robot*" book discussion
16	Dec 3, Dec 5	Robotics in space exploration. Team presentations

Lab Schedule :

Week	Date	Topic
2	Aug 31	Robot Construction
3	Sep 7	Basic Robot Programming and Manipulation I
4	Sep 14	
5	Sep 21	Basic Robot Programming and Manipulation II
6	Sep 28	
7	Oct 5	Basic Robot Programming and Manipulation III
8	Oct 12	
9	Oct 19	Intermediate Robot Programming and Manipulation
10	Oct 26	
11	Nov 2	Advanced Robot Programming and Manipulation Team Lab Project
12	Nov 9	
13	Nov 16	
15	Nov 30	