CSE 4360 / CSE 5364
Autonomous Robots

Fall 2017 - MW 2:30 - 3:50 - NH 110

Instructor: Manfred Huber (huber@cse.uta.edu)

1 Course Description

Contents and Objectives:

This course is an introduction to Robotics from a computer science perspective and aimed at establishing the basis for the design and programming of autonomous robot systems. It covers basic kinematics, dynamics, and control as well as motion planning, sensors, and artificial intelligence techniques for robot applications. Emphasis is given to the application of these techniques to simulated and real robots. Throughout the course students will work individually and in groups to analyze robot control problems and to design hardware and software solutions. Students successfully completing this course will be able to write basic control programs for different robot platforms and to apply state-of-the-art artificial intelligence techniques to the control of robotic mechanisms.

Prerequisites:

Prerequisites include CSE 2320 and CSE 3442. Of particular importance is knowledge of the programming language C since all programming assignments will be using this language.

Course Materials:

This course draws from a number of different books. Selected parts of other textbooks will be used as part of the course readings. Copies of these materials will be put on reserve in the Physical Science Library. Additional course materials such as assignments and example solutions will be available electronically on the course web page. Changes and corrections, if any, will also be announced by e-mail.

Computer Access:

This course will use UNIX as the operating system for all programming assignments. For this purpose all students will have access to computers in the Robotics Teaching Laboratory and to OIT supported unix computers (e.g. Omega) Additional details will be announced in class.

Tentative Office Hours:

Office hours for the course will be held by the instructor either in his office in ERB 522 or in ERB 128, MW 5:30 - 6:30 and Tu 1:00 - 2:00, or by appointment. Times are subject to change and will be posted. If for some reason you can not make it to any of these office hours, please inform the instructor.

e-mail: huber@cse.uta.edu
Office phone: 817 272 2345
Faculty profile: http://www.uta.edu/profiles/manfred-huber

E-mail and WWW page:

There is a course web page at http://ranger.uta.edu/∼huber/cse4360 . All changes and supplementary course materials will be available from this site. In addition, necessary changes or important announcements will be distributed by e-mail. By default e-mail will be sent to your UTA account.

2 Assignments and Grading

Homework Assignments:

There will be 3 homework assignments in this course. The assignments consist of written parts as well as programming exercises on simulated robot mechanism and are due in or before class on the date indicated on the assignment. Solutions will be posted shortly after on the web page. Late assignments will not be accepted and extensions will only be granted in extreme situations. If you find yourself in such a situation and can not deliver a homework on time, immediately inform the instructor. Homework solutions must be your work only. Violations of this will not be tolerated and result in severe penalties for all parties involved.

Projects:

For the 3 projects groups of 3-4 students will be formed. Each project will involve designing and programming of a real robot system to solve a given task. At the end of each project, the programmed robot system has to be presented and a project report describing the design decisions made has to be delivered. Again, no extensions are generally granted for projects. If for any reason you can not finish the project or deliver the report in time, inform the instructor as early as possible.

Exam:

The exam is closed book, closed notes and will cover the materials until "Adaptation and Learning" with an emphasis on the more theoretical aspects. As in the case of homework extensions, a make-up exam will only be given in extreme situations. If for any such reason you can not attend the exam, inform the instructor.

CSE 5364:

For students enrolled in the graduate section CSE 5364 the homework assignments, as well as the exam will contain additional problems which are not required for students of CSE 4360.

Attendance:

At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator in student success. Each faculty member is free to develop his or her own methods of evaluating students academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section, I strongly encourage class attendance. Note that you are responsible for any course content covered in class irrespective of it being in the class notes. However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients begin attendance in a course. UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Blackboard. This date is reported to the Department of Education for federal financial aid recipients.

Grading Policy:

The final grade will be calculated using the following policy:

Homework Assignments	35 %
Group Project 1	20 %
Group Project 2	10 %
Final Project	25 %
Exam	10 %

3 Class Schedule

CSE 4360 / CSE 5364 - Autonomous Robots
Tentative Lecture and Assignment Schedule
Fall 2016 - MW 2:30 - 3:50 - WH 208

Class	Date	Readings	Lecture Topics	Assignments
1	08/28		Course Details and Overview	
2	08/30	Craig Ch. 2	Introduction to Robot Systems	
	09/04		*Labor Day - No Class*	
3	09/06	Craig Ch. 3	Forward Kinematics	
4	09/11		Forward Kinematics continued	
5	09/13	Craig 5.1 -5.8	Jacobian	
6	09/18	Craig 4.1 - 4.4	Inverse Kinematics	
7	09/20	Craig 9.1 - 9.5	Robot Dynamics and Control	
8	09/25		Control and System Identification	
9	09/27	Latombe pp 153 - 161, 169 - 175	Robot Motion Planning - Roadmaps	
10	10/02	Latombe pp 200 - 207, 248 - 268	Robot Motion Planning - Cell Decomposition	
11	10/04	Latombe pp 295 - 334	Robot Motion Planning - Potential Field Approaches	Homework 1 due
12	10/09		Nonholonomic Motion Planning	
13	10/11	Everett Ch. 2	Robot Sensors	
14	10/16	Everett pp 91-97	Robot Sensors	
15	10/018	Ballard 3.1 - 3.3.4	Basic Vision	
16	10/23		**Group Project 1 Presentations**	
17	10/25	Ballard 5.1 - 5.3	Basic Vision	
18	10/30	Dorst pp. 9 - 51 (by J.Crowley)	Sensing and Control	
19	11/01	Elfes & Burgard	Sensors, Map Construction, and Motion Planning	
20	11/06	Braitenberg Ch. 1 - 5	Intelligent Robot Behavior	Homework 2 due
21	11/08	Arkin 1.3 - 1.4, 4.1 - 4.3	Robot Control Architectures	
22	11/13	Arkin 4.4 - 4.7	Robot Control Architectures	
23	11/15		Robot Control Architectures	
24	11/20	Haykin 8.3 - 8.5, 6 - 6.4	Adaptation and Learning	
25	11/22		**Group Project 2 Presentations**	
26	11/27		Adaptation and Learning	
27	11/29		**Exam**	
28	12/04	Arkin 8 - 8.4	Adaptation and Learning	
29	12/06		Summary	Homework 3 due
30	12/13		**Final Project Presentations**	

Recommended Readings from:

- John J. Craig, *Introduction To Robotics*, Addison Wesley
- Jean-Claude Latombe, *Robot Motion Planning*, Kluwer Academic Publishers
- H. R. Everett, *Sensors for Mobile Robots*, A K Peters
- Dana H. Ballard and Christopher M. Brown, *Computer Vision*, Prentice-Hall
- L. Dorst, M. Lambalgen, F. Voorbraak (Eds.), *Reasoning with Uncertainty in Robotics*, Springer
- Alberto Elfes, *Using Occupance Grids for Mobile Robot Perception and Navigation*, in IEEE Computer 22(6)
- W. Burgard, D. Fox, D. Henning, T. Schmidt, *Estimating the Absolute Position of a Mobile Robot Using Position Probability Grids*, in Proc. of AAAI 1996
- Valentino Braitenberg, *Vehicles*, MIT Press
- Ronald C. Arkin, *Behavior-Based Robotics*, MIT Press
- S. Haykin, *Neural Networks*, Macmillan Publishing

This schedule is tentative and subject to change. If changes are necessary they will be announced in class and posted in the schedule on the course page.

4 University Policies and Services

Grade Grievances:

Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current undergraduate catalog.

Drop Policy:

Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. Students will not be automatically dropped for non-attendance. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (http://wweb.uta.edu/aao/fao/).

Disability Accomodations:

UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including The Americans with Disabilities Act (ADA), The Americans with Disabilities Amendments Act (ADAAA), and Section 504 of the Rehabilitation Act. All instructors at UT Arlington are required by law to provide reasonable accommodations to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of a letter certified by the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting:
The Office for Students with Disabilities, (OSD) www.uta.edu/disability or calling 817-272-3364. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability.
Counseling and Psychological Services, (CAPS) www.uta.edu/caps/ or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

Non-Discrimination Policy:

The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit uta.edu/eos.

Title IX Policy:

The University of Texas at Arlington (University) is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the

Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. For information regarding Title IX, visit www.uta.edu/titleIX or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or jmhood@uta.edu.

Academic Integrity:

Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:
I pledge, on my honor, to uphold UT Arlingtons tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.
I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.
UT Arlington faculty members may employ the Honor Code in their courses by having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System Regents Rule 50101, 2.2, suspected violations of universitys standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the students suspension or expulsion from the University. Additional information is available at https://www.uta.edu/conduct/.

Electronic Communication:

UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at http://www.uta.edu/oit/cs/email/mavmail.php.

Campus Carry:

Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit http://www.uta.edu/news/info/campus-carry/

Student Feedback Survey:

At the end of each term, students enrolled in face-to-face and online classes categorized as lecture, seminar, or laboratory are directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each students feedback via the SFS database is aggregated with that of other students enrolled in the course. Students anonymity will be protected to the extent that the law allows. UT Arlingtons effort to solicit, gather, tabulate, and publish student

feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit http://www.uta.edu/sfs.

Final Review Week:

A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week unless specified in the class syllabus. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Emergency Exit Procedures:

Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit, which is located to the right of the room exit and out of the building. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

Student Support Services:

UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to resources@uta.edu, or view the information at http://www.uta.edu/universitycollege/resources/index.php.