

CSE 6369.001

Reasoning with Uncertainty for Data Interpretation, Modeling, and Decision-Making

Fall 2015 - TTh 9:30 - 10:50, WH 308

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

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1 Course Description

Contents and Outcomes:

This course explores modern reasoning techniques for the extraction of information from noisy data sources, for the integration of multiple information streams, and for decision-making in the presence of uncertainty. While this course will investigate these techniques often in the context of physical sensor applications and robotics, they are also applicable in a wide range of other fields including mobile networking, data mining, and control of physical processes. Students completing this course will gain an understanding of advanced methods to work with uncertain data and be able to apply them to real world problems.

Prerequisites:

Many of the techniques covered in this course are based on probabilities and knowledge of basic statistics is useful. Prerequisites for this course are either *Data Modeling (CSE 5301)*, *Artificial Intelligence (CSE 5361)*, *Robotics (CSE 5364)*, an advanced statistics course, or consent of instructor. In addition, experience with programming in C or C++ will be useful to perform assignments and projects.

Course Materials:

This course does not have a dedicated textbook.

Readings will consist of chapters taken from a variety of books and papers from technical conferences and journals. Course materials will be available from the instructor or electronically on the course page.

E-mail and WWW page:

There is a course web page at <http://www-cse.uta.edu/~huber/cse6369> . All changes and supplementary course materials will be available from this site. In addition, necessary changes or important announcements will also be distributed by e-mail.

Tentative Office Hours:

Office hours for the course will be held by the instructor either in ERB 128 or in 522 ERB, TTh 11:00 - 12:00, and TTh 4:30 - 5:20. 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

2 Course Work and Grading

In-class presentation of a technical paper:

Each student will be given a technical topic/paper to present in class and to lead the following discussion of the material.

Homework Assignments:

Two hands-on homework assignments will be given where learned techniques are applied to practical problems.

Projects:

Two small projects will be assigned where students implement and test some of the techniques.

In addition, every student will perform a final project that will be presented at the end of the course.

Attendance:

At The University of Texas at Arlington, taking attendance is not required. Rather, 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.

Grading Policy:

The final grade will be calculated using the following policy:

Presentation & Class Participation	15 %
Assignments	30 %
Projects	30 %
Final Project	25 %

3 Course Topics

Topics covered in this course include:

- Representations and interpretation of uncertain information:
 - Bayesian reasoning
 - Dempster Schaefer
- Graphical reasoning models:
 - Bayesian networks
 - Markov networks
- Information fusion and prediction:
 - Kalman filters
 - Particle filters
- Randomized and sampling-based inference techniques:
 - Sampling Bias and weighted sampling
 - Gibbs Sampling
 - Markov Chain Monte Carlo Techniques
- Probabilistic model construction:
 - Hidden Markov Models
- Decision-making with uncertain actions and sensors:
 - Fully and Partially Observable Markov Decision Processes
 - Monte-Carlo simulation techniques

4 Tentative Class Schedule

<p style="text-align: center;">CSE 6369 Reasoning with Uncertainty for Data Interpretation, Modeling, and Decision Making Tentative Lecture and Assignment Schedule Fall 2015 - TTh 9:30 - 10:50</p>				
Class	Date	Readings	Lecture Topics	Assignments
1	08/27		Course Details and Overview	
2	09/01		Reasoning with Uncertainty - Statistical Approaches	
3	09/03		Fuzzy Logic, Bayesian & Non-Bayesian Belief Systems	
4	09/08		Bayesian Reasoning	
5	09/10		Dempster Shafer Theory	
6	09/15		Dempster Shafer Theory	
7	09/17		Optimal Estimation and Filtering	
8	09/22		Graphical Models	
9	09/24		Graphical Models	Homework 1 due
10	09/29		Sampling Methods	
11	10/01		Markov Chain Monte Carlo Methods	
12	10/06		Optimal Estimation and Filtering	
13	10/08		Kalman Filter	
14	10/13		Kalman Filter	
15	10/15		Monte Carlo Methods & Bootstrap Filters	Project 1 due
16	10/20		Particle Filters	
17	10/22		Markov Models	
18	10/27		Hidden Markov Models	
19	10/29		Learning Hidden Markov Models	
20	11/03		Learning Hidden Markov Models	
21	11/05		Learning Hidden Markov Models	Homework 2 due
22	11/10		MDPs	
23	11/12		POMDPs	
24	11/17		Decision-Making in POMDPs	
25	11/19		Monte Carlo Dynamic Programming Examples	
26	11/24		Game Theory	Project 2 due
	11/26		<i>Thanksgiving Break - No Class</i>	
27	12/01		Student Presentations	
28	12/03		Student Presentations	
29	12/08		Student Presentations	
30	TBD		Final Project Presentations	

²All information is tentative and subject to change.

5 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:

The standard UTA drop policy applies to this course. 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://www.uta.edu/ses/fao>).

Disability Accommodations:

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). 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.

Counseling and Psychological Services, (CAPS) www.uta.edu/caps/ or calling 817-272-3671.

Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Title IX: 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. For information regarding Title IX, visit www.uta.edu/titleIX.

Academic Integrity:

All students enrolled in this course are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington's 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.

Instructors may employ the Honor Code as they see fit in their courses, including (but not limited to) 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, paragraph 2.2, suspected violations of university's 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 student's suspension or expulsion from the University.

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 www.uta.edu/resources.

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>.

Student Feedback Survey:

At the end of each term, students enrolled in classes categorized as lecture, seminar, or laboratory shall be directed to complete a 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 student's feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. 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 at the end of the hallway when exiting the room. 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 handicapped individuals.