Course Syllabus: CPSCI 240

Reasoning About Uncertainty – Fall 2013

Note: Scheduling and room assignments are tentative and reflect available information as of Aug 27, 2013. For the most recent scheduling information, please check Spire.

Section Times and Locations				
	Lectures	**Discussion D01**	**Discussion D02**	**Discussion D03**
Time:	M/W/F 2:30-3:20pm	F 1:25-2:15	F 10:10-11:00	12:20-1:10
Location:	Hasbrouck 134	LGRC A201	LGRC A201	LGRT 173

Course Staff			
	Instructor	**Teaching Assistant**	**Teaching Assistant**
Name:	Prof. Benjamin M. Marlin	Yi Lu	Kyle Wray
Office:	CS234		
Office Hours:	TBA		
Email:	**cs240staff@cs.umass.edu**		

Course Description: This course is designed to help you develop the mathematical reasoning skills needed to solve problems involving uncertainty. The skills you will learn are crucial for many exciting areas of computer science that inherently involve uncertainty, including artificial intelligence and machine learning, data mining, financial modeling, natural language processing, bioinformatics, web search and information retrieval, algorithm design, cryptography, system design, network analysis, and more. These skills may also help you analyze the uncertainty in your day-to-day life. The course is divided into three parts: sample space and probability; random variables and expectations; and modeling, inference and estimation.

Prerequisites: CMPSCI 187 (or ECE 242) and MATH 132.

Textbook: *Introduction to Probability, 2nd Edition.* Dimitri P. Bertsekas and John N. Tsitsiklis. Athena Scientific. 2008.

Course Website: The course website will be hosted on UMass's new Moodle course management portal https://moodle.umass.edu/. You log into the portal using your OIT NetID and password. The course website will host lecture notes, assignments, pointers to readings and videos, announcements, and discussion forums.

Announcements: Official announcements for the course will go out through the Moodle portal

as email and will be automatically logged as news items. Email will be sent to your *official UMass email address* (@student.umass.edu, @cns.umass.edu, etc...).

Grading Plan: The coursework will consist of homework assignments (written and programming), discussion exercises, two midterm exams and a final exam. There is also a participation component (in class participation, iClicker quizzes, asking and answering discussion forum questions, etc.). The grading plan is given below:

Participation	5%
Discussion Exercises	10%
Homework Assignments	27%
Midterm Exam 1	15%
Midterm Exam 2	15%
Final Exam	28%

Course Policies:

- **Homework Submission:** Written homework assignments must be submitted to the CS240 drop box in the CS main office before 4:00pm on the day they are due. Programming assignments must be uploaded to Moodle by the specified deadline. Unlimited resubmissions are permitted on Moodle up to the deadline.
- **Late Homework:** In general, late homework will not be accepted. In the case of an extraordinary situation documented by suitable evidence (doctor's note, etc...), an extension or exemption will be granted.
- **Homework Collaboration:** You are encouraged to discuss solution **ideas** for assignments and other course material with other students. However, you must write solutions to written problems and code for programming problems **individually**. Copying is not permitted. Neither is collaboration so close that it looks like copying. If identical homework solutions are detected, all will receive a grade of 0. A good practice is to divide your work into an **ideas phase** where you collaborate, followed by a **writeup or coding phase** where you work alone. You must write a list of all your collaborators at the top of each assignment. This list should include anyone with whom you have discussed the assignment.
- **External Resources:** If you make use of any printed or online reference sources while working on an assignment (other than specific course materials such as the textbook or slides), these must be listed as references in your write-up or code. **Copying written solutions or code from the web is not permitted and is considered cheating.**
- **Re-grading Policy:** If you believe you've found a grading error, submit a **detailed written request** along with your assignment or exam to the instructor (not an email) explaining where you believe a mistake was made. Note that re-grading may result in

your original grade increasing or decreasing as appropriate.

- **Attendance:** Students are expected to attend each class as well as the discussion section they are registered for.
- **iClicker Use:** Part of your participation grade will be based on answering in-class iClicker questions. You must be physically present in class to participate. **Having someone else click for you constitutes cheating both by you and the person clicking for you.**

Approximate Schedule: (Subject to change over the semester)

Activity	Date	Topics
Lecture 1	Wed Sept 4	Course overview, motivating examples and course logistics
Lecture 2	Fri Sept 6	Sets, experiments, events, probability laws and models
Discussion 1	Fri Sept 6	Working with sets
Lecture 3	Mon Sept 9	Discrete probability laws and properties of probability laws
Lecture 4	Wed Sept 11	Conditional probability laws
Lecture 5	Fri Sept 13	Modeling sequential experiments with conditional probability
Discussion 2	Fri Sept 13	Analyzing the Monte Hall problem
Lecture 6	Mon Sept 16	Total probability theorem and Bayes rule for events
Lecture 7	Wed Sept 18	Independence and conditional independence of events
Lecture 8	Fri Sept 20	Independent trials and the Binomial law
Discussion 3	Fri Sept 20	Analyzing medical testing results
Lecture 9	Mon Sept 23	The counting principle and counting permutations
Lecture 10	Wed Sept 25	Counting k-permutations and combinations
Lecture 11	Fri Sept 27	Counting partitions and applications of counting
Discussion 4	Fri Sept 28	Review for Midterm 1
Lecture 12	Mon Sept 30	Random variables and probability mass functions
Lecture 13	Wed Oct 2	Bernoulli and Binomial random variables
Midterm 1	TBA	7:00-9:00pm. Covers lectures 1 to 11.
Lecture 14	Fri Oct 6	Geometric and Poisson random variables
	Fri Oct 6	Discussion section canceled
Lecture 15	Mon Oct 7	Functions of random variables and expectations
Lecture 16	Wed Oct 9	Higher moments, variance and expected value rule
Lecture 17	Fri Oct 11	Properties of expectations, means and variances
Discussion 5	Fri Oct 12	Analyzing decision making using expected utility
	Mon Oct 14	Holiday – Columbus Day
Lecture 18	Tue Oct 15	Multiple random variables: Joint and conditional PMFs

Lecture 19	Wed Oct 16	Multiple random variables: Expectations
Lecture 20	Fri Oct 18	Multiple random variables: Independence
Discussion 6	Fri Oct 18	Analyzing independence assumptions
Lecture 21	Mon Oct 21	Continuous random variables
Lecture 22	Wed Oct 22	The Gaussian distribution
Lecture 23	Fri Oct 25	Correlation, covariance and causation
Discussion 7	Fri Oct 25	Analyzing correlations
Lecture 24	Mon Oct 28	Markov inequality
Lecture 25	Wed Oct 30	Chebyshev inequality
Lecture 26	Fri Nov 1	The weak law of large numbers
Discussion 8	Fri Nov 1	Review for Midterm 2
Lecture 27	Mon Nov 4	Information, entropy and probability
Lecture 28	Wed Nov 6	Compression and coding
Midterm 2	TBA	Covers lectures 12 to 26.
Lecture 29	Fri Nov 8	Error correcting codes
	Fri Nov 8	Discussion canceled
	Mon Nov 11	Holiday - Veterans' Day
Lecture 30	Wed Nov 13	Maximum likelihood inference
Lecture 31	Fri Nov 15	Maximum a posteriori inference and priors
Discussion 9	Fri Nov 15	Analyzing the effect of priors on inference
Lecture 32	Mon Nov 18	Model selection
Lecture 33	Wed Nov 20	Model estimation, method of moments and maximum likelihood
Lecture 34	Fri Nov 22	Naïve Bayes classification and evidence combination
Discussion 10	Fri Nov 22	Classification with Naive Bayes
Lecture 35	Mon Nov 25	Estimating naïve Bayes model parameters
Lecture 36	Wed Nov 27	General Bayesian networks
	Fri Nov 39	Holiday - Thanksgiving
Lecture 37	Mon Dec 2	Markov chains: States, transitions and Markov properties
Lecture 38	Wed Dec 4	Markov chains: Path probabilities and n-Step distributions
Lecture 39	Fri Dec 6	Markov chains: Reducibility, periodicity and steady state
Discussion 11	Fri Dec 6	Review for final exam
Final Exam	TBA	Covers lectures 1 to 39