CSE 312
Foundations II:
1. Intro

Winter 2011

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University of Washington
Computer Science & Engineering

CSE 312, Wi '11: Foundations of Computing II

Administrative
Syllabus
332 Coreq.
Schedule & Reading
Course Email/BBoard
Subscription Options
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Lecture Notes

Lecture:	MUE 153 (schematic)	MWF	1:30- 2:20
Section A:	EEB 054 (schematic)	Th	1:30- 2:20
Section B:	EEB 054 (schematic)	Th	2:30- 3:20
Section C:	MGH 238 (schematic)	Th	12:30- 1:20

		Office Hours		Location	Phone
Instructor:	Larry Ruzzo, ruzzo@cs	M	2:30- 3:20	CSE 554	543-6298
TAs:	Daniel Perelman, perelman@cs	TBA			
	Leilani Battle, leibatt@cs	TBA			
	Milda Zizyte, mzizyte@cs	TBA			

Course Email: cse312a_wi11@uw.edu. Announcements and general interest Q&A about homework, lectures, etc. The instructor and TAs are subscribed to this list. Enrolled students are as well, but probably should change their default subscription options. Messages are automatically archived.

For fastest response, questions not of general interest should be directed to the instructor and TAs collectively via the "course staff" link at left. Individual email addresses (above) may also be used, if needed.

Discussion Board: Also feel free to use Catalyst GoPost to discuss homework, etc.

Catalog Description: Examines fundamentals of enumeration and discrete probability; applications of randomness to computing; polynomial-time versus NP; and NP-completeness.

Prerequisites: CSE 311; CSE 332, which may be taken concurrently.

Credits: 4

Learning Objectives: Course goals include an appreciation and introductory understanding of (1) methods of counting and basic combinatorics, (2) the language of probability for expressing and analyzing randomness and uncertainty (3) properties of randomness and their application in designing and analyzing computational systems, (4) some basic methods of statistics and their use in a computer science & engineering context, (5) the distinction between tractable and (apparently) intractable computational problems and (6) methods and appropriate reasoning for showing tractability (e.g. dynamic programming) and intractability (reduction).

Grading: Homework, Midterm, Final. Possibly some quizes. Overall weights 55%, 15%, 30%, roughly.

Late Policy: TBA

Extra Credit: Assignments may include "extra credit" sections. These will enrich your understanding of the material, but at a low points per hour ratio. Do them for the glory, not the points, and don't start extra credit until the basics are complete.

Collaboration: Homeworks are all individual, not group, exercises. Discussing them with others is fine, even encouraged, but *you must produce your own homework solutions*. Follow the "Gilligan's Island Rule": if you discuss the assignment with someone else, don't keep any notes (paper or electronic) from the discussion, then go watch 30+ minutes of TV (Gilligan's Island reruns especially recommended) before you continue work on the homework by yourself. You may *not* look at other people's written solutions to these problems, not in your friends' notes, not in the dorm files, not on the internet, *ever*. If in any doubt about whether your activities cross allowable boundaries, *tell us before*, not after, you turn in your assignment. See also the UW CSE Academic Misconduct Policy, and the links there.

Textbooks:

Required:

A First Course in Probability (8 edition), Sheldon M. Ross, Prentice Hall, 2009. (Available from U Book Store, Amazon, etc.)

Online: The last few weeks of the quarter will use the following, available free online:

Algorithms, by S. Dasgupta, C.H. Papadimitriou, and U.V. Vazirani

Reference (little direct use of this, but if you already own a copy, keep it for reference):

Discrete Mathematics and Its Applications, (sixth edition) by Kenneth Rosen, McGraw-Hill, 2006. Errata. (Available from U Book Store, Amazon, etc.)

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Empiricism

1. relying on observation & experiment, esp. in the natural sciences
2. A former school of medical practice founded on experience without the aid of science or theory

syn: Quackery, Charlatanry

merriam-webster.com

"Life is uncertain. Eat dessert first."

- Ernestine Ulmer

SYLLABUS

Counting, Probability, Random Variables

- Sum and product rules, inclusion-exclusion, product tree
- Pigeonhole principle
- Permutations & Combinations, binomial coefficients, binomial theorem
- Intro to prob. Sample spaces, events, simple examples: coins, dice, program bugs, poker hands
- Conditional probability, Bayes rule, examples: false positive/false negative, spam detection
- Independence, random variables
- Expectation, bernoulli trials, binomial distribution
- Variance, tail bounds (Chebyshev inequality)
- Chernoff bounds
- Application: Entropy and data compression
- Continuous random variables; exponential and normal distributions, Poisson approximation

Applications, Central Limit Theorem, Statistics

- The Central Limit Theorem
- Lying with statistics
- Parameter estimation, confidence intervals, bias
- Monte-carlo simulation, polling, sampling
- Maximum likelihood estimation
- Bayesian estimation, Bayes classifier, machine learning

Polynomial Time and NP-completeness

- Polynomial-time algorithms: Discussion, explanation, simple examples
- Divide-and-conquer
- Dynamic programming (least squares, edit distance)
- Search problems vs. decision problems, the class NP
- NP-completeness, SAT
- Reductions
- Practical implications of NP-completeness

CS Applications (some examples)

- Performance analysis: "events" happen randomly, workload varies, failures unpredictable, ...
- "Knowledge Discovery", Data mining, AI
  statistical description of patterns in data
- Scientific data analysis
  measurement errors and artifacts
- Algorithm design and analysis
  sometimes, a randomized approach is simpler or better than any known deterministic approach.

Beyond CS

Read the paper, listen to the news.

People throw statistics at you all the time — most of it phrased so as to bias the conclusion they hope you'll draw. Defend yourself!