CSE 312: Foundations of Computer Science, II

- **Instructor**
  Anna R. Karlin (karlin@cs.washington.edu)

- **TAs**
  Cyrus Rashtchian (grad)
  ?? (undergrad)

- **Course website**
  http://www.cs.washington.edu/312/

- **Calendar** will have everything on it!

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- **Probability, statistics, and algorithms**
  First ~23 lectures: prob/stats in CS
  Last ~7 lectures: algorithms & intractability

- **Books**
  - *Introduction to Probability* (2nd ed.)
    Bertekas and Tsitsiklis [required]
  - *Discrete Mathematics and its Applications*
    Rosen [optional]
  - *Algorithms*
    Dasgupta, Papadimitriou, and Vazirani [online]

- **Slides**
  Most are minor mutations of slides prepared by previous instructors of this course: James Lee, Larry Ruzzo, Pedro Domingos

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- **Homeworks** ~ 40%
  Weekly (Out Wed, due next Wed)
  we will grade a random subset of problems.

- **Daily problem** ~ 5-10%
  shouldn’t take more than 5-10 minutes,
  due at the beginning of most classes.
  can skip it 4 times during the quarter.

- **Midterm & Final** ~20% & 35%

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- **Probability**
  Counting
  Basic probability
  Conditional probability
  Random variables
  Discrete and continuous distributions
  Expectation and variance
  Tail bounds and the central limit theorem

- **Statistics**
  Maximum-likelihood estimation
  Bayesian estimation
  Hypothesis testing
  Linear regression
  Machine learning

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syllabus

*Algorithms and NP-completeness*
pretend you're a doctor

You are trying to diagnose the probability that a woman with a positive mammogram has breast cancer, even though she's in a low-risk group: 40-50 years old.

- Probability of a woman having breast cancer is 0.8%.
- If someone has cancer, probability of a positive mammogram is 90%.
- If someone doesn’t have cancer, probability of a positive mammogram is 7%.

A woman walks into your office with a positive test.

What’s the probability that she has breast cancer?

pretend you're a lawyer

OJ simpson murder trial

Prosecutors: "A slap is a prelude to homicide."

Defense: "Less than 1 in 2500 men who commit domestic abuse go on to commit homicide."

Both were considering the wrong question:
If a woman is murdered and she has been domestically abused, the chances are 90% that her husband is the killer.

Bayes rule

\[ \Pr[A \mid B] = \frac{\Pr[A \cap B]}{\Pr[B]} \]

why this course is important

- Reasoning under uncertainty
- Understanding massive data
- Learning patterns
- Exposing liars and idiots
- The line between tractable and intractable problems
- Making $$$ without coding
syllabus

- **Probability**
  - Counting
  - Basic probability
  - Conditional probability
  - Random variables
  - Discrete and continuous distributions
  - Expectation and variance
  - Tail bounds and the central limit theorem

- **Statistics**
  - Maximum-likelihood estimation
  - Bayesian estimation
  - Hypothesis testing
  - Linear regression
  - Machine learning

- Algorithms and NP-completeness