

# CSE 312 Final Topics

## What to bring to the exam

- Calculator, note sheet (8.5"x11", handwritten or typed, both sides), pencil/pen, eraser, student ID

## Study suggestions

- Go through lecture notes, and write down important theorems, definitions, and concepts on note sheet
  - If your class notes aren't clear, check out course slides or the textbook for alternative explanations (both linked from course web)
  - If you were absent for any lectures, find the lecture notes on the course calendar.
- **Do lots of practice problems.** Do as many past worksheet problems as you can.
- After studying, test yourself by doing the practice final on the course calendar.
- Ask your peers or the course staff if you're confused about anything.
  - Post questions on the discussion board under the topic "Final Exam".

## List of topics

### Counting

- Product rule
- Permutations (order matters)
  - k-permutations
- Combinations (order doesn't matter)
  - Binomial Theorem
- Understand "with vs. without replacement" (whether repeats are allowed)
- Complementing
- Inclusion-exclusion
- Pigeonhole principle

### Probability

- Basic axioms and their corollaries
- Sample space and events
- Equally-likely outcomes
- Independent events
- Conditional probability: definition, chain rule
- Law of Total Probability
- Bayes' Theorem
- Naïve Bayes Classifier

### Discrete random variables and expectation

- Definition of random variable
- Probability mass function
- Expectation
  - Definition
  - $E[aX+b] = aE[X]+b$ , if  $a$  and  $b$  are constants
  - $E[X+Y] = E[X]+E[Y]$
  - Indicator random variables
- Independence of random variables
- Variance and standard deviation
  - Definition

- $\text{Var}(X) = E[X^2] - (E[X])^2$
- $\text{Var}(aX + b) = a^2 \text{Var}(X)$ , if  $a$  and  $b$  are constants
- **If  $X$  &  $Y$  independent**,  $\text{Var}(X + Y) = \text{Var}(X) + \text{Var}(Y)$
- Important distributions: uniform, Bernoulli, binomial, geometric, Poisson
  - Know what situations they are used for, their probability mass functions, expectations, variances
  - Approximation of binomial random variable by Poisson random variable
  - Application of binomial and Poisson to error-correcting codes

### Continuous random variables

- Probability density function
- Cumulative distribution function
- Analogy between discrete and continuous cases (sum vs. integral, PMF vs. PDF, etc.), leading to definitions of expectation and variance
- Important distributions: uniform, exponential, normal
  - Know what situations they are used for, their probability density functions (except for the normal), cumulative distribution functions (Phi table for the normal), expectations, variances
  - Memorylessness of exponential and geometric
- Central Limit Theorem
  - Know versions for both sum and average of i.i.d. samples
  - How to standardize a random variable
  - Continuity correction
  - Approximation of binomial random variable by normal random variable

### Tail bounds

- Markov's inequality
- Chebyshev's inequality
- Cantelli's inequality
- Chernoff's inequality for the binomial distribution

### Weak law of large numbers

### Maximum likelihood estimators

- Likelihood function
- Know the procedure for finding maximum likelihood estimators
- Maximum likelihood estimators for the two parameters of the normal distribution
- Bias
- Confidence intervals

### Probabilistic algorithm

- Quicksort
- Freivalds' algorithm for verifying matrix multiplication
- Karger's min cut algorithm