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 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