CSCE 311 - Spring 2026:
Exam 1 Study Guide

Prof. Edward Talmage

February 16, 2026

Learning Goals

This is an outline of the topics we have covered in lecture. Problems on the exam will reference these, showing why these problems were selected to test your knowledge. This outline is not complete–at a minimum, material from quizzes, homeworks, and recitations may also appear.

1. Math Background

    (a) Logarithms

    (b) Definition of Algorithm

    (c) Pseudocode

    (d) `InsertionSort` and Analysis

2. Proof Techniques

    (a) Direct

    (b) Contradiction

    (c) Contrapositive

    (d) Construction

    (e) Cases

    (f) Induction

3. Algorithmic Analysis

    (a) Asymptotics: $O, \Omega, \Theta, o, \omega$

        i. Usage for upper and lower bounds
        ii. Tight bounds (Θ)
        iii. Strict bounds (little-o, little-omega)
        iv. Anonymous asymptotics
        v. Rules for combining functions, polynomials, hierarchy

    (b) Runtime Recurrences

        i. Recursion Trees
        ii. Substitution
        iii. Master Theorem

4. Divide & Conquer

    (a) Recursive and non-recursive parts of a D&C Algorithm

    (b) Deriving a Runtime Recurrence

    (c) 0-1 Knapsack Problem

    (d) Using a recurrence to guide algorithmic improvements (Strassen's Algorithm)

5. Dynamic Programming

   (a) Formal Outline
   (b) Bottom-Up vs. Top-Down/Memoization
   (c) Requirements: Optimal Substructure, Overlapping Subproblems
   (d) Subproblem Graphs (If we get this far.)
   (e) Examples: Fibonacci, Rod Cutting