CS225 Midterm Exam Review

The midterm exam will cover the material from week1 to week5. The exam questions will be very much in the spirit of the homework questions. This material summarizes some important content and gives some example questions from homework assignments and quizzes as review exercises. Note that similar examples from the textbook are also good review exercises, although we do not list them all here. Students should master these exercises problems in order to succeed the exam. Good luck!

Unit 1: Logic Expressions (30 %)

1.1) Propositions; Simple Formulas (10%)

Students should master the concept of proposition and should be able to translate between simple logic formulas and English sentences.

Example questions from Assignments and Quizzes:

Sec. 1.1: 6, 10

Quiz 1: Q1, Q2

1.2) Logical Equivalence (10%)

Students should master the techniques of proving logical equivalence. Usually there are two ways to prove logical equivalence, one is to use truth table (textbook Example 2, pp. 22, Ex. 3, 4, pp. 23), and the other is to use a series of equivalences to derive from one logical formula to another(textbook Example 6, 7, pp. 26). Students should master the first method and be very familiar with second one.

Example questions from Assignments and Quizzes:

Sec. 1.2: 14, 16, 20

Quiz 1: Q 5

1.3) Predicates and Quantifiers (10%)

Students should master the concepts of predicates and quantifiers and should be able to translate between quantifications and English sentences.

Example questions from Assignments and Quizzes:

Sec. 1.3: 6, 8, 24

Quiz 2: Q1, Q2

Unit 2: Non-Inductive Proof Techniques (30%)

2.1) Direct Proof & Contrapositive (20%)

Students should master the technique of direct proof and proof by contraposition.

Example questions from Assignments and Quizzes:

a) Direct proof:

   Sec. 1.6: 2, 6, 14

   Quiz 2: Q4

b) Proof by contraposition:

   Sec. 1.6: 18 (a)

   Quiz 2: Q5

2.2) Contradiction & Other techniques (10%)

Students should master the technique of proof by contradiction.

Example questions from Assignments and Quizzes:
Sec. 1.6: 8, 22, 24,

Quiz 3: Q2

Unit 3: Basic Discrete Structures (20%)

3.1) Set Notation

Student should master the concept of set, elements (members) of set, subset and set builder notations. (This section is included because concepts in this section are the basic for later sections.)

3.2) Set Operations (10%)

a) Student should master the concepts of union, intersection, difference, disjoint, complement of set, subset.

b) Students should master the techniques of proving set identities. Given two sets A and B, there are generally three ways to show that A = B. The first way is to show that $A \subseteq B$, and $B \subseteq A$ (textbook Example 10, pp.125). The second is to use set builder notations and logical equivalences to derive from one expression to another (textbook Example 11, pp.125). Another method is to use membership tables (textbook Example 13, pp.126).

Example questions from Assignments and Quizzes:

Sec. 2.2: 16, 18, 20

Quiz 4: Q2, Q3

3.3) Sequences and Sums (10%)

Students should master the concept of sequence and summations, and should master the technique of compute sequence summations using formula. (It is not required to remember the summation formula. But students should be able to recognize the sequences in the summation and apply formulas to calculate summations.)

Example questions from Assignments and Quizzes:

Sec. 2.4: 13, 15, 16

Quiz 4: Q4

Unit 4: Induction and Recursion (20%)

4.1) Weak Induction (10%)

Student should master the technique of proof by mathematical induction. A proof by mathematical induction has two parts, a *basis step*, where we show that P(1) is true, and an *inductive step*, where we show that for all positive integers k, if P(k) is true, then P(k + 1) is true.

Example questions from Assignments and Quizzes:

Sec. 4.1: 8, 14, 28

4.2) Strong Induction (10%)

Student should master the technique of proof by strong induction. Similar with a proof by mathematical induction, a strong induction also has two parts, a *basis step*, and an inductive step. The basis step of strong induction is the same with mathematical induction, where we show that P (1) is true. Differently, in the *inductive step*, we show that if P (j) is true for all positive integers not exceeding k, then P (k + 1) is true.

Example questions from Assignments and Quizzes:

Sec. 4.2: 2, 4, 12