

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 and quiz questions. This material summarizes some important content and gives some example questions from homework assignments and quizzes as review exercises. Please don't expect to receive the exact same (but very similar) questions from the the following summary. Students should master these exercises problems in order to succeed the exam. Good luck!**

Unit 1: Logic Expressions (30%)

- **Propositions; Simple Formulas (10%)**

Students should master the concept of proposition and should be able to translate between simple logic formulas and English sentences and find the converse, contrapositive, inverse and negation of English sentences using logic formulas.

Example questions from Assignments and Quizzes:

Homework 1 (Part 1) – 10, 25-31, Homework 1 (Part 2) - 20

Quiz 1: Q6, Q7, Q10

- **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, and the other is to use a series of equivalences to derive from one logical formula to another. Students should master the first method and be very familiar with second one.

Example questions from Assignments and Quizzes:

Homework 1 (Part 2) – 11, 13, 15

Quiz 1: Q 11

- **Predicates and Quantifiers (10%)**

Students should master the concepts of predicates and quantifiers and should be able to translate between quantifications and English sentences. Also, they should be able to find the negation of quantifications.

Example questions from Assignments and Quizzes:

Homework 2(Part 1) – 3.1(18), 3.2 (4)

Quiz 2: Q1, Q2, Q3

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

- **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: Homework 2 - (4.1) 32, 61, (4.2) 20, 25

Quiz 2: Q6

b) Proof by contraposition: Homework 2- (4.6) 28

Quiz 2: Q7

- **Contradiction & Other techniques (10%)**

Students should master the technique of proof by contradiction.

Example questions from Assignments and Quizzes:

Homework 3 – (4.6) 28

Quiz 3: Q1, Q2

****For proofs – Go through the problems in the exercise sets where the solutions are provided at the back of the book.**

Unit 3: Basic Discrete Structures (20%)

- **Set Notation (0 ~10%)**

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.)

- **Set Operations (10 ~ 20 %)**

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

b) Students should master the technique of proving set identities. Given two sets A and B, you need to show that $A = B$. The way is to show that $A \subseteq B$, and $B \subseteq A$ (textbook page 356).

c) Students should master the “algebraic” method for deriving new set properties from set properties already known to be true.

Example questions from Assignments and Quizzes:

Homework 3 (Part 2) – (6.1) 3, 7, 18, 33, Homework 4 (Part 1) –(6.1) 12, 16, (6.2) 4, 10, 14 , (6.3) 12, 37, 42 (Try similar problems of 6.3 like 36, 38, 40, 41.

Book Examples from page 353 to page 359, page 371

Demo Quiz 4: Q2, Q3

Quiz 3: Q3, Quiz 4: Q2, Q3

- **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:

** Homework Assignment 4 from previous term (in week 4 module) – 31, 32

Book reading – Page 230 -233

Demo Quiz 4: Q5

Quiz 4: Q4, Q5

Unit 4: Induction (10%)

- **Weak Induction**

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:

Book Examples (Chapter 5) – example 5.2.1, 5.2.3, 5.3.1, proposition 5.3.1, example 5.3.2, proposition 5.3.2

- **Strong Induction**

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:

Book Examples (Chapter 5) – example 5.4.1, 5.4.2.

Exercise: Set 5.4: 10