Midterm Exam I (October 01, 2020, 01:15 pm - 02:35 pm) CSE 215: Foundations of Computer Science

State University of New York at Stony Brook, Fall 2020 Instructor: Prof. Pramod Ganapathi

Total points = 45. Total questions = 9. Total pages = 2. Instructions:

- Please write your full name and SBU student ID on the answer sheet.
- Please include the following integrity statement on your answer sheet:
- "Academic integrity is expected of all students at all times, whether in the presence or absence of members of the faculty. Understanding this, I declare that I shall not give, use, or receive unauthorized aid in this examination. I have been warned that any suspected instance of academic dishonesty will be reported to the appropriate office and that I will be subjected to the maximum possible penalty permitted under University guidelines."

Problem 1. [5 points]

Construct a truth table for the following statement form: $(r \land \sim p) \leftrightarrow (p \oplus q)$.

Problem 2. [5 points]

Check the logical equivalence of $(p \to r) \lor (q \to r)$ and $(p \land q) \to r$.

Problem 3. [5 points]

What truth values should be substituted for p, q, and r to make the expression true: $(\sim p \lor \sim q \lor \sim r) \equiv (p \lor q \lor r)$

Problem 4. [5 points]

Find negations of the following statements.

- (a) [3 points] Which of the following is a negation for "All dogs are loyal"? More than one answer may be correct.
 - 1. All dogs are loyal.
 - 2. No dogs are loyal.
 - 3. Some dogs are disloyal.
 - 4. Some dogs are loyal.
 - 5. There is a disloyal animal that is not a dog.
 - 6. There is a dog that is disloyal.
 - 7. No animals that are not dogs are loyal.
 - 8. Some animals that are not dogs are loyal.
- (b) [1 point] \forall integers a, b and c, if a b is even and b c is even, then a c is even.
- (c) [1 point] If the square of an integer is odd, then the integer is odd.

Problem 5. [5 points]

Use the facts that the negation of a \forall statement is a \exists statement and that the negation of an if-then statement is an and statement to rewrite each of the statements without using the word necessary or sufficient.

- (a) [3 points] Having a large income is not a necessary condition for a person to be happy.
- (b) [2 points] Having a large income is not a sufficient condition for a person to be happy.

Problem 6. [5 points]

Prove that the product of any two consecutive integers is even.

Problem 7. [5 points]

Determine which statements are true and which are false. Prove those that are true and disprove those that are false.

- (a) [2 points] If r is any rational number and s is any irrational number, then r/s is irrational.
- (b) [2 points] The sum of any two positive irrational numbers is irrational.
- (c) [1 point] The square root of any rational number is irrational.

Problem 8. [5 points]

Prove that for all integers a, if a^4 is even, then a is even.

Problem 9. [5 points]

A set of premises and a conclusion are given. Use the valid arguments forms to deduce the conclusion from the premises, giving a reason for each step. Assume all variables are statement variables.

1.
$$d \rightarrow c$$

2. $e \rightarrow \sim a$
3. $f \lor e$
4. $\sim a \rightarrow \sim c \land b$
5. $\sim f$
6. $\therefore \sim d$