Homework 2
CS 311: Discrete Math for CS (Bulko)
Due 02/15/19 @ 11:59 pm

Problem 1

(10 points each). Determine whether the following statements are logically equivalent using only logical equivalences:

a. \(\neg(p \land q) \land (p \lor q)\) and \(p\)

b. \((p \lor q) \land (p \lor q)\) and \(\neg q\)

Problem 2

(10 points each). a. Determine if the compound propositions are satisfiable:

a. \((\neg p \lor \neg q \lor r) \land (\neg p \lor q \lor \neg s) \land (\neg p \lor q \lor s) \land (\neg p \lor q \lor r) \land (p \lor q \lor \neg s)\)

b. \((p \lor q) \land (q \lor \neg r) \land (r \lor \neg p)\)

c. \((p \lor q \lor r) \land (p \lor q \lor \neg r)\)

Problem 3

(5 points). Determine whether the following statement is a tautology:

\((p \rightarrow q) \land (q \rightarrow \neg r) \leftrightarrow (p \rightarrow r)\)

Problem 4

(5 points each). What are the truth values of the following propositions? Use \(R(x,y,z): y^3 + 5x > 2z^2\).

a. \(R(9, 5, 40)\)

b. \(R(4, 15, 11)\)

Problem 5

(10 points each). Given the following predicates:
i. $CS - major(x)$, which means $x$ is a CS major
ii. $work(x)$, which means $x$ works hard
iii. $play(x)$, which means $x$ plays hard
iv. $succeeds(x)$, which means $x$ succeeds in life

Translate the following sentences into predicate logic:

a. Every CS major who works hard succeeds in life.
b. Some CS majors work hard, and some other CS majors only play hard.

**Problem 6**

*(5 points each)*. If the domain of $x$, $y$, and $z$ is the set of all real numbers, write an English equivalent of the mathematical property being described by the following statements. This should not just be a simple word-for-word translation of the statement.

a. $\exists x \forall y (xy = y)$
b. $\forall x \forall y \exists z (x = y + z)$
c. $\forall x \forall y ((x \geq 0 \land y < 0) \rightarrow (x - y > 0))$