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CS225: Discrete Structures in CS
Homework 1, Part 1
Exercise Set #2.1 Problem # 5, 10, (25 – 31), 52, 54

5.

a) Yes
b) Not a statement. The issue resides in the pronoun “she”. She may refer to a student who is a math major or she may refer to a student who is studying economics. Due to this ambiguity, this sentence has the ability to be true and false, therefore, it is not a statement.
c) Yes
d) Not a statement. This sentence may be true and false. If X is a constant with the value 2^6 assigned to it, then it is true; whereas if X is a variable that can take on many different values not equal to 2^6, then it is false.

10.

a) $p \wedge q \wedge r$
b) $p \wedge \neg q$
c) $p \wedge (\neg q \vee \neg r)$
d) $(\neg p \wedge q) \wedge \neg r$
e) $\neg p \vee (q \wedge r)$

25. Hal is not a math major or his sister is not a CS major.

26. Sam is not an orange belt or Kate is not a red belt.

27. The connector is not loose and the machine is not unplugged.

28. The units digit of 4^67 is not 4 and it is not 6.

29. This computer program has no logical error in the first 10 lines and it is not being run with an incomplete data set.

30. The dollar is not at an all-time high or the stock market is not at a record low.

31. The train is not late and my watch is not fast.

52.

$\neg p \equiv \neg(p \wedge \neg q) \vee (\neg p \wedge \neg q)$

$\neg p \equiv (\neg p \wedge \neg \neg q) \vee (\neg p \wedge \neg q)$ by De Morgan’s law

$\neg p \equiv (\neg p \wedge q) \vee (\neg p \wedge \neg q)$ by double negative law

$\neg p \equiv \neg p \wedge (q \vee \neg q)$ by distributive law

$\neg p \equiv \neg p \wedge T$ by negation law

$\neg p \equiv \neg p$ by identity law

54.

$p \equiv (p \wedge (\neg(\neg p \vee q))) \vee (p \wedge q)$

$p \equiv (p \wedge (\neg\neg p \wedge \neg q)) \vee (p \wedge q)$ by De Morgan's law

$p \equiv (p \wedge (p \wedge \neg q)) \vee (p \wedge q)$ by double negative law

$p \equiv ((p \wedge p) \wedge \neg q) \vee (p \wedge q)$ by associative law

$p \equiv (p \wedge \neg q) \vee (p \wedge q)$ by idempotent law

$p \equiv p \wedge (\neg q \vee q)$ by distributive law

$p \equiv p \wedge (q \vee \neg q)$ by commutative law

$p \equiv p \wedge t$ by negation law

$p \equiv p$ by identity law