Name: Eddie C. Fox

Username: foxed

October 4, 2015

Section 2.1: 5, 10 , (25-31), 52, 54

5. Indicate which of the following sentences are statements.

a. 1024 is the smallest four-digit number that is a perfect square.

This is a statement because it is a sentence that is either true or false, but not both. Either 1024 is the smallest number or it is not.

b. She is a mathematics major.

This is not a statement because the reference of the pronoun “she” is unclear. For some values, the sentence be true, and for other values, the sentence may be false.

c. $128 = 2^6$.

This is a statement because even though it is false, it is a sentence that is either true or false, but not both at the same time. 2^6 has a definite value which can be compared to 128.

d. $x = 2^6$

This is not a statement because changing the value of X changes whether or not the sentence is true, similar to question 5B. It could be both true and false at the same time, rather than remaining statically one.

10. Let p be the statement “DATAENDFLAG is off,” q the statement “ERROR equals 0,” and r the statement “SUM is less than 1,000.” Express the following sentences in symbolic notation.

a. DATAENDFLAG is off, ERROR equals 0, and SUM is less than 1,000.

p^q^r. Because all statements are true, we can symbolically notate it as the conjunction between all three of them.

b. DATAENDFLAG is off but ERROR is not equal to 0.

p^ ~q. p is true, and but is equivalent to and. The ERROR not being equal to 0 indicates ~q. Therefore, we can combine the two to make p^~q

c. DATAENDFLAG is off; however, ERROR is not 0 or SUM is greater than or equal to 1,000.

p^(~q ∨ ~r). P is true. Error is not 0 indicates ~q. Sum is greater than or equal to 1,000 indicates ~r. The or in between error or sum tells me that I should group them together in parentheses, separate from P, and use the or operator.

d. DATAENDFLAG is on and ERROR equals 0 but SUM is greater than or equal to 1,000.

~p^q^ ~r. Data flag is on, so P isn't true. And links it to error, so I include that symbol. Q is true because error equals 0. R is false because the sum is greater than or equal to 1,000. The phrase but tells me to link it to p and q with the ^ operator.

e. Either DATAENDFLAG is on or it is the case that both EROR equals 0 and SUM is less than 1,000.

~p ∨ (q^r). And between error and sum tells me to group q and r together with parentheses. They both evaluate to true. P is false because data flag is on, and I separate it from Q and R with the ∨ symbol because of the either or wording.

25. Hal is a math major and Hal's sister is a computer science major.

M^C (where M is hal being a math major and C is Hal's sister being a computer science major)

De Morgan's laws say ~(M^C) = ~M ∨ ~C

Translated to English**: Hal is not a math major or Hal's sister is not a computer science major.**

26. Sam is an orange belt and Kate is a red belt.

O^R (where O is Sam being an orange belt and R is Kate being a red belt)

De Morgan's laws say ~(O^R) = ~O ∨ ~R

Translated to English: **Sam is not an orange belt or Kate is not a red belt.**

27. The connector is loose or the machine is unplugged.

L = Connector is loose. M = Machine is unplugged

L ∨ M

De Morgan's Laws say ~(L ∨ M) = ~L ^ ~M

Translated into English: **The connector is not loose and the machine is not unplugged.**

28. The units digit of 4^{67} is 4 or it is 6.

4 = Units digit is 4. 6 = Units digit is 6

4 ∨ 6

De morgan's Laws say $\sim(4 \vee 6) = \sim 4 \wedge \sim 6$

Translated into English: **The units digit of 4^{67} is not 4 and not 6.**

29. This computer program has a logical error in the first ten lines or it is being run with an incomplete data set.

LE = Logical Error ID = Incomplete Data

$LE \vee ID$

De Morgan's laws say $\sim(LE \vee ID) = \sim LE \wedge \sim ID$

Translated into English: **This computer program does not have a logical error in the first ten lines and it is not being run with an incomplete data set.**

30. The dollar is at an all-time high and the stock market is at a record low.

DH= Dollar High SL = Stock Low

$DH \wedge SL$

De Morgan's laws say $\sim(DH \wedge SL) = \sim DH \vee \sim SL$

Translated into English: **The dollar is not at an all-time high or the stock market is not at a record low.**

31. The train is late or my watch is fast.

TL = Train late WF= Watch fast

$TL \vee WF$

De Morgan's laws say $\sim(TL \vee WF) = \sim TL \wedge \sim WF$

Translated into English: **The train is not late and my watch is not fast.**

Use theorem 2.1.1 to verify the logical equivalencies in 50-54. Supply a reason for each step.

52. $\sim(p \vee \sim q) \vee (\sim p \wedge \sim q) = \sim p$

$\boldsymbol{(\sim p \wedge \sim(\sim q))} \vee (\sim p \wedge \sim q)$ De Morgan's law

$\boldsymbol{(\sim p \wedge q)} \vee (\sim p \wedge \sim q)$ Double Negative Law

$(\boldsymbol{\sim p \wedge (q \vee \sim q))}$ Distributive Law

(**~p ^ t)** Negation Law. Q or not Q is a tautology.

= **~p.** Identity law says p ^ t = p, so tautology is just canceled out.

54. (P^ (~(~p V q))) V (P^Q) = P

(P ^ (~(~p) ^ ~Q))) V (P^Q) = P De Morgan's Laws

(**P ^ (P ^ ~Q))** V (P^Q) = P Double negative law

(~Q ^ (P ^ P)) V (P^Q) = P Associative law

(**~Q ^ P)**V (P^Q) = P Idempotent law

(P ^ ~**Q)** V (P^Q) = P Commutative Law

P ^ **(Q V ~Q)** = P Distributive Law

P ^ **T** Negation Law. Q or not Q is a tautology

P = P Identity law. P ^ T = P