Homework 2: Discrete Mathematics Spring 2021 – Logic I

Due Sunday January 31 @11:59:00pm

Show all your work to receive full credit

1. Complete the truth table for the compound proposition

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

2. Let a and b be two integers. State whether the following proposition is True or False:

$$\text{If } (a > b \text{ and } a < b) \text{ then } a = b.$$

   Simply justify your answer with a sentence or two.

3. Consider the following propositions:

   1. If the program is efficient, it executes quickly.
   2. Either the program is efficient, or it has a bug.
   3. The program does not execute quickly.
   4. Neither the program is efficient nor it executes quickly.
   5. The program is efficient and it does not have a bug.
   6. A sufficient condition for the program to be efficient is that the program has no bug.
   7. The program executes quickly only if it has no bug.

   Rewrite the propositions using propositional logic. We will use the connective $\vee$ to represent the OR (Please do not use the exclusive or).

   Use the following atomic propositions E, Q and B as follows:

   - E: "program is efficient"
   - Q: "program executes quickly"
   - B: "program has a bug"

4. Write the negation in propositional logic of **the propositions in the previous question**. Please distribute the negation so that no parenthesis are left.

5. Using the laws of propositional logic, prove the following statement is a tautology. Please show your steps clearly, one per line. No need to cite the law used.

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

6. Simplify the **condition of the if statement**. Simplify means rewrite the condition as an expression that can't be reduced further.

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if not((a<b) or even(a)) or (not(a<b) and even(a))
    c=a-b
else:
    c=b-a
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