

Computer Science G11 at The Dragon
Assignment 1
Propositional Logic
Due date: Tue Sep. 18 2018

September 21, 2018

Fri Sep. 2018

1. (KtiCa) Express the following statements in propositional logic
 - (a) I'm tired and hungry
 - (b) If I'm hungry, I whinge
 - (c) I only get tired if I did not have a nap
 - (d) Either I eat dinner or I get hungry
2. (Ktica) What does it mean that two logical expressions A and B are equivalent? Give an example.
3. (KtiCa) Use the truth tables to decide which of the following pairs of propositions are equivalent. Hint: Just make one big truth table in which you can discuss all cases.
 - (a) $(p \vee q) \vee r$ and $p \vee (q \vee r)$
 - (b) $(p \rightarrow q) \rightarrow r$ and $p \rightarrow (q \rightarrow r)$
 - (c) $\neg(p \wedge q)$ and $\neg p \vee \neg q$
 - (d) $p \rightarrow q$ and $\neg q \rightarrow \neg p$
4. (kTica) Repeat question 3 this time using an algebraic method instead of truth tables.
5. (kTica) A box has 3 buttons and a light. The light goes on when, and only when, exactly 2 buttons are pressed. Produce a truth table for such an setting. Using the truth table, find a formula (a proposition) for each case. Can you find a unique formula for the whole box?
6. (KticA) Simplify the boolean expression $[(p \vee q \vee r) \wedge \neg(s \vee t)] \vee [(p \vee q \vee r) \wedge (s \vee t)]$ and choose the best answer:

- (a) $p \vee q \vee r$
 - (b) $s \vee t$
 - (c) $\neg q \wedge \neg q \wedge \neg r$
 - (d) $\neg s \wedge \neg t$
 - (e) None of the above. Write your answer then.
7. (KticA) Simplify the boolean expression $[\neg(p \vee q) \wedge \neg(r \vee s \vee t)] \vee \neg(q \vee q)$ and choose the best answer:
- (a) $p \vee q$
 - (b) $\neg p \wedge \neg q$
 - (c) $r \vee s \vee t$
 - (d) $\neg r \wedge \neg s \wedge \neg t$
 - (e) None of the above. Write your answer then.
8. (KticA) Given the function $F(p, q, r) = [p \wedge r] \vee [r \wedge (\neg p \vee (p \wedge q))]$ find the equivalent simplified expression for F
- (a) $r \vee (q \wedge r)$
 - (b) $r \vee (p \wedge q \wedge r)$
 - (c) $p \wedge r$
 - (d) $p \vee (q \wedge r)$
 - (e) r
 - (f) None of the above. Write your answer then.
9. (kTica) Demonstrate algebraically that $(\neg p \rightarrow q) \wedge (p \rightarrow \neg q)$ is equivalent to $(\neg p \wedge r \wedge q) \vee (\neg r \wedge q \wedge \neg p) \vee (r \wedge p \wedge \neg q) \vee (\neg r \wedge p \wedge \neg q)$.
10. (kTica) Argue algebraically whether $\neg p \rightarrow (q \vee r)$ is equivalent to $\neg((p \rightarrow q) \vee r)$