Homework I
Propositional Logic

October 8, 2015

1. Determine whether the following expressions are formulas:
   (a) $(p \vee q) \wedge r$
   (b) $(p \rightarrow q) \vee \wedge r$
   (c) $\top \vee (\neg p \wedge \bot \neg)$
   (d) $\neg p \vee q \leftrightarrow r \wedge p \vee \bot$
2. Use logical connectives to build complex propositional formulas. Write ten complex propositional formulas.
3. Translate the following sentences into propositional logic:
   (a) N is an even or an odd number.
   (b) Today is a hot and sunny day.
   (c) If you earn more than 6000 Gel a year, then you need to pay income tax.
   (d) A relation is an equivalence relation if and only if it is reflexive, symmetric, and transitive.
   (e) If the humidity is so high, it will rain either this afternoon or this evening.
4. Use truth tables to prove following equivalences:
   (a) $P \leftrightarrow Q \Leftrightarrow (P \rightarrow Q) \wedge (Q \rightarrow P)$
   (b) $P \rightarrow Q \Leftrightarrow \neg P \vee Q$
   (c) $P \vee (Q \wedge R) \Leftrightarrow (P \vee Q) \wedge (P \vee R)$
   (d) $P \wedge (Q \vee R) \Leftrightarrow (P \wedge Q) \vee (P \wedge R)$
   (e) $\neg(P \vee Q) \Leftrightarrow \neg P \wedge \neg Q$
   (f) $\neg(P \wedge Q) \Leftrightarrow \neg P \vee \neg Q$