CSE20       Fall 2016  
Assignment 1

- All problems have the same weight.
- Explain your solutions in full details. If you are unsure about definitions / assumptions / anything else, explain what you assumed in detail.
- Only one group member should submit the homework.
- List all group members (names and student IDs) at the top right corner of your submitted answer.
- Starred * questions are challenge questions, and are optional. If you can solve them, you really got it!

EXPLAIN ALL YOUR SOLUTIONS!!!

1. Identify all of the following statements that are a proposition.

   a. “Every rule has an exception.”
   b. “The truth value of this sentence is False”
   c. “Every odd number is prime”
   d. “None of the other sentences in this question are propositions.”
   e. “This sentence is not a proposition.”
   f. “Every sentence in English is a proposition”

2. Which of the following expressions are syntactically legal statements of propositional logic?

   a. \((p \leftarrow \neg q) \rightarrow (r \lor s)\)
   b. \(p \rightarrow q \rightarrow r \rightarrow s\)
   c. \((p \rightarrow q) \rightarrow \neg \neg \neg q \rightarrow p\)
   d. \(p \neg \rightarrow q\)

3. Write each statement as a **Boolean expression** and then for each one write their **Truth Table**.

   a. If it's a weekend and the weather is good, then we go running!
   b. If you work hard then you will get a good grade in CSE 20.
   c. If you can’t fly then you can run and if you can’t run then you can walk and if you can’t walk then you can crawl.
4. Write down the truth table for the following expressions.

a. \((p \lor r) \land (p \lor \neg q)\)

b. \((s \rightarrow q) \land (s \oplus q)\)

c. \((p \rightarrow q) \rightarrow ((\neg p \rightarrow q) \rightarrow (q \rightarrow p))\)

d. \(\neg (q \lor s) \rightarrow \neg ((r \rightarrow s) \lor (p \land q))\)

5. Two boolean expressions are said to be equivalent if their truth tables are exactly the same. For example, \(p \rightarrow q\) and \(\neg p \lor q\) are equivalent.

For the following pairs of expressions, decide whether or not they are equivalent. If they are, show so using their truth tables. If not, give an assignment to the variables (e.g. \(p = T, q = F\)) for which the two expressions evaluate to different values.

A. \(p \rightarrow q\) and \(q \rightarrow p\)

B. \(p \rightarrow q\) and \(\neg q \rightarrow \neg p\)

C. \(p \land q \rightarrow r\) and \(p \land \neg r \rightarrow q\)

*6. Using exactly \(k\) boolean variables, how many boolean expressions one could make that are not equivalent to each other?

For example, for \(k=1\) there are only four non-equivalent expressions: \(p, \neg p, T, F\). So the answer for \(k=1\) is 4. You need to figure out the answer for \(k=2,3,...\). If you simply try to count non-equivalent boolean expressions, then this is a very hard problem. Instead, try to find an equivalent formulation for the question, one in which the answer will become evident.