Practice Problems:

1. Which of the following are propositions:
   (a) Blaise Pascal constructed the first mechanical adding device.
   (b) Charles Babbage ought to get more credit as the inventor of programmable devices.
   (c) Really? Miley Cyrus, really?!!
   (d) The moon is made of blue cheese.

2. Which of the following compound propositions are a tautology? You may use a truth table, but are not required to. To prove a proposition is NOT a tautology you need just give one setting for p and q for which the compound proposition is false. You may want to use any tautology below as practice in proving that a proposition is a tautology WITHOUT using a truth table.
   (a) \((p \rightarrow q) \rightarrow (q \rightarrow p)\)
   (b) \(((p \rightarrow q) \land \neg q) \rightarrow \neg p\)
   (c) \(q \rightarrow (\neg p \lor \neg q)\)

3. Show the following formulas are equivalent:
   \((r \land (p \lor q)) \equiv (q \land r) \lor (r \land p)\)

   using the proof rules discussed in class (associative, idempotent, DeMorgan, etc.). You can find these rules in the lecture notes or textbook.

Problems to Turn in:

1. Let \(M\) be the proposition “you cause a memory overflow error”
   Let \(P\) be the proposition “you use pointers incorrectly”

   Express each of the following statements using M, P, and logical connectives, for example, in an expression that might look like: \((M \land P) \rightarrow \neg P\).
   (a) You cause a memory overflow error only if you use pointers incorrectly
   (b) You use pointers correctly but you cause a memory overflow error.
   (c) If you used pointers incorrectly but didn’t cause memory overflow error then you used pointers correctly.

2. Consider the expression: \((Q \land P) \lor \neg (\neg Q \rightarrow \neg P)\). In any way that you like, find an equivalent expression that is as short as possible. Prove that your expression is equivalent.