Problem Session 7
Due: Wed, March 16, 2016, Sun, March 20, 2016

All homeworks are due at 12:55 PM in the CS22 bin on the CIT second floor, next to the Fishbowl.

Include our cover sheet or equivalent, write your Banner ID (but not your name or your CS login) on each page of your homework, label all work with the problem number, and staple the entire handin before submitting.

Be sure to fully explain your reasoning and show all work for full credit. Consult the style guide for more information.

Problem 1

Create Truth Tables for each of the following

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

b. \((p \lor \neg q) \land (\neg p \lor q)\)

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

d. \((p \rightarrow q) \rightarrow r\)

Problem 2

Let \(S = \{p_1, p_2, \ldots, p_n\}\) be a set of propositions.

Consider propositions formed from the elements of \(S\) in the following way:

a. You can use any \(p_i\) as well as the negation of any \(p_i\).

b. You can OR together any combination of \(p_i\) and \(\neg p_i\). For example, the proposition \((p_1 \lor p_3 \lor \neg p_7)\) can be formed this way.

c. You can AND together terms of the form from (2). For example,

\[(p_1 \lor p_3 \lor p_7) \land (\neg p_2 \lor p_1) \land (p_6 \lor p_1) \land (\neg p_3 \lor p_2)\]

can be formed this way.

The following is a short list of things that are not in the correct form:
• \( p_1 \Rightarrow p_2 \)
• \( (p_1 \land p_3) \lor (p_1 \land \neg p_4) \)
• \( \neg(p_1 \lor p_2) \)

Express the following propositions over the set \( S = \{p, q, r, s\} \) in the given form, showing all steps.

a. \( (p \Rightarrow q) \oplus r \)
b. \( p \Rightarrow (q \land (r \Rightarrow \neg s)) \)

**Problem 3**

State the converse, inverse, negation, and contrapositive of each of the following statements:

a. If Jim pranks Dwight, Pam laughs.
b. The Dunder Mifflin Paper Company is never a dull place to work.
c. You are enjoying yourself if you are watching The Office.

**Problem 4**

It’s promotion time at the Office, and Jim isn’t prepared. Michael has decided to ignore emotion so all promotions are on the basis of ability to solve a single logic problem. Help Jim solve it, and explain your reasoning.

Which of the following is correct? There is exactly one answer.

a) none of the below  
b) none of the below  
c) one of the below  
d) all of the below  
e) none of the above  
f) all of the above
Problem 5

Draw a circuit for the following logical expressions. Simplify the expressions first if possible.

a. \( \neg(x_1 \land x_2) \land (x_1 \lor \neg x_3) \land (x_2 \lor x_4) \)

b. \( (x_1 \land (x_2 \lor \neg x_2) \land (x_3 \lor \neg x_1)) \lor ((x_1 \lor x_2) \land (\neg x_2 \land x_4)) \)