Due: Monday, February 6, 2023   Written by Daniel Geschwender

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Name 1 (Print) _____   **CSE Login** _____

Name 2 (Print) _____   **CSE Login** _____

Problem	Page	Points	Score
A	-	2	
B	-	2	
C	-	3	
D	-	6	
Typesetting (bonus)		1	
Total		13	

Instructions   Follow instructions *carefully*, failure to do so may result in points being deducted.

- This homework is one of the 'honors' component of this course. It should not take more than two (2) hours to complete. If it does, please let us know.

- The homework must be submitted on paper. Homework *neatly* formatted in LaTeX will receive a 10 percent bonus. When formatting in LaTeX, submit both the .tex and .pdf files via handin, in addition to the hard copy. You will not receive the bonus points if you work with a partner (see below).

- Clearly label each problem and submit answers *in order*.

- Staple this cover page to the front of your assignment for easier grading.

- Late submissions will *not* be accepted.

- When you are asked to prove something, you must give a formal, rigorous, and complete a proof as possible. Each step in your proof must contain explanation that would allow us to understand what theorem/logic you have applied to arrive at that step.

- You are to work individually and all work should be your own. Check partner policy below.

- The CSE academic dishonesty policy is in effect (see http://cse.unl.edu/ugrad/resources/academic_integrity.php).

Partner Policy You may work in pairs as long as follow the guidelines below:

1. You must work *all* problems *together*. You may not simply partition the work between you.

2. You must use LaTeX and you may divide the typing duties however you wish.

3. You may not discuss the problems with other groups or individuals.

4. Hand in only one hard copy with both authors' names.

Terminology (review): CNF, clause, formula, literal, model, satisfiability, sentence, term, (partial) solution.

Problem A: Consider the following CNF formula:

$$
\begin{aligned}
s_1 = \quad & (a \vee b \vee c) \\
\wedge \quad & (a \vee \neg b) \\
\wedge \quad & (b \vee \neg c) \\
\wedge \quad & (c \vee \neg a) \\
\wedge \quad & (\neg a) \\
\wedge \quad & (b)
\end{aligned}
$$

Is it satisfiable? If so, provide a solution and show how *each* clause is satisfied in that solution. If not, identify clause(s) that cannot possibly be satisfied and explain why.

Problem B: Consider the following CNF formula:

$$
\begin{aligned}
s_2 = \quad & (a \vee b) \\
\wedge \quad & (\neg a \vee b) \\
\wedge \quad & (a \vee c) \\
\wedge \quad & (\neg b \vee \neg c)
\end{aligned}
$$

Is it satisfiable? If so, provide a solution and show how *each* clause is satisfied in that solution. If not, identify clause(s) that cannot possibly be satisfied and explain why.

Problem C: Consider the following satisfiable CNF formula:

$$
\begin{aligned}
s_3 = \quad & (a \vee b \vee c \vee d) \\
\wedge \quad & (\neg a \vee \neg b) \\
\wedge \quad & (\neg c \vee \neg d) \\
\wedge \quad & (a)
\end{aligned}
$$

How many unique solutions does it have? Explain your reasoning.

Problem D: For each of the three CNF formulas from the previous problems, draw the binary tree of all possible combinations while pruning any branch as soon as it cannot be extended in a satisfiable manner.