CSCE 235H SAT Homework 07 Spring 2020

Due: Monday, March 30, 2020 Written by Daniel Geschwender

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

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

Problem	Page	Points	Score
A	-	6	
B	-	3	
C	-	3	
Typesetting (bonus)		1	
Total		12	

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.

Problem A: Briefly describe, in two to four sentences and in your *own* words, how each of the following mechanisms operate within MiniSAT. Consult the slides, the MiniSAT paper (`http://minisat.se/downloads/MiniSat.pdf`), or any other resource, online or from the scientific literature. *Clearly* and *fully* cite your sources. Importantly, your description must express your own understanding: copy-paste content will not be accepted.

1. Unit propagation

2. Activity-based variable ordering (VSIDS heuristic)

3. Clause learning

4. Intelligent backtracking (conflict-driven backtracking)

5. Watched literals

6. Restarts

Problem B: Consider the following CNF formula:

$$
\begin{aligned}
& (\neg x_1 \vee \neg x_4 \vee \neg x_6) \\
\wedge \quad & (x_2 \vee x_3 \vee x_5) \\
\wedge \quad & (\neg x_1 \vee x_2 \vee x_6) \\
\wedge \quad & (x_4 \vee \neg x_5 \vee \neg x_6)
\end{aligned}
$$

Report the following:

1. Assume the first assignment $x_1 = 1$ (as a decision). Report the assignment trail (i.e., decision followed by all possible unit propagations) and give the implication graph.

2. Consider the second decision assignment $x_2 = 0$. Update the assignments trail and implication graph.

Problem C: Using the assignment trail reported in Figure 1 and implication graph of Figure 2, answer the following questions. Note that no CNF formula is provided; the clauses can be inferred from the implication graph.

1. What clause causes the conflict?

2. What clause is learned as a result of this conflict?

3. To which assignment do we backtrack to and what new assignment do we make?

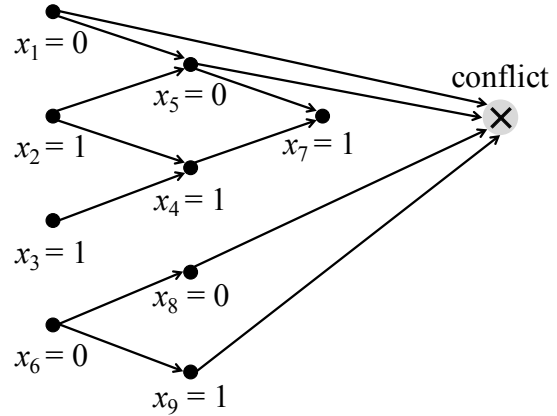| Decision Level	Assignment
1	$x_1 = 0$
2	$x_2 = 1$
	$x_5 = 0$
3	$x_3 = 1$
	$x_4 = 1$
	$x_7 = 1$
4	$x_6 = 0$
	$x_8 = 0$
	$x_9 = 1$

Figure 1: The 'trail' of current assignments

Figure 2: An implication graph that has reached a conflict.