Decision Procedures and Verification

Seminar 2

1. (1 point) Consider the following CNF formula: $(x_5 \vee \neg x_1 \vee x_3) \wedge (\neg x_3 \vee x_4) \wedge (\neg x_5 \vee x_1) \wedge (x_6 \vee x_1) \wedge (\neg x_1 \vee x_2) \wedge (\neg x_3 \vee \neg x_4) \wedge (\neg x_5 \vee \neg x_6) \wedge (x_3 \vee \neg x_4) \wedge (x_3 \vee x_5)$
   Simulate CDCL on the formula. Draw implication graphs. Derive conflict clauses.

2. (0.5 points) Prove that in the conflict graph, the notion of a first UIP is well-defined, i.e. there is alwaysa single UIP closest to the conflict node.

3. (1 point) What is the worst-case space complexity of CDCL algorithm?

   - without clause learning
   - with clause learning
   - with clause learning where learned clauses have at most k literals

4. (1 point) Consider following restriction in CNF formulae:

   - Every clause contains at most one positive literal
   - Every clause contains at most two literals

   Suggest efficient algorithms for satisfiability testing of formulae in above cases.

5. (1 point) **(incremental satisfiability)** Given two CNF formulas C_1 and C_2, under what conditions can a conflict clause learned while solving C_1 be reused when solving C_2? In other words, if c is a conflict clause learned while solving C_1, under what conditions is C_2 satisfiable if and only if $C_2 \wedge c$ is satisfiable? *Hint:* think of CNF formulas as sets of clauses.