# Theorem Proving: Propositional Logic

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1. Using DPLL with learning, decide which of the following clause sets are satisfiable. If the clause set is satisfiable, then find a model. If the clause is not satisfiable, then find a resolution refutation.

   (a) $\{A, B\},\ \{\neg A, B\},\ \{\neg B\}$.

   (b) $\{A, B\},\ \{\neg A, B\},\ \{A, \neg B\},\ \{\neg A, \neg B\}$.

   (c) $\{\neg A, B\},\ \{A, C, B\},\ \{B, C\},\ \{B, \neg C\}$.

   (d) $\{A, B, E\},\ \{\neg A, C\},\ \{\neg B, D, E\},\ \{\neg A, \neg C\},\ \{\neg B, \neg D\}, \{\neg E\}$.

   (e) $\{P, Q\},\ \{Q, R\},\ \{P, R\},\ \{\neg P, \neg Q\},\ \{\neg R, \neg Q\},\ \{\neg R, \neg P\}$.

2. Consider clause set

   (1) $\{A\}$
   (2) $\{\neg A, B\}$
   (3) $\{\neg A, \neg B, C\}$
   (4) $\{\neg A, \neg D, E\}$
   (5) $\{\neg B, \neg D, F\}$
   (6) $\{\neg D, \neg E, \neg F, G\}$
   (7) $\{\neg A, \neg B, \neg G, X\}$
   (8) $\{\neg G, Y\}$
   (9) $\{\neg C, \neg X, \neg Y\}$

   In the beginning, clauses 1,2,3 are productive. After that, assume DPLL decides $D := \mathbf{t}$. The resulting state has $S =$

   **det**(A, 1)
   **det**(B, 2)
   **det**(C, 3)
   **decide**(D)

   and $I(A) = I(B) = I(C) = I(D) = \mathbf{t}$.

   Continue DPLL with learning in two ways, **(1)** assuming that learning uses the last decision variable, and **(2)** assuming that learning uses the last (nearest to the conflict) UIP.