CS4750/7750 HW #6 (20 points)

Fall 2019

In this programming assignment, implement the backtracking search with the MRV and degree heuristic, and forward checking to solve the Boolean satisfiability problem. A general description of the Boolean satisfiability problem is at https://en.wikipedia.org/wiki/Boolean_satisfiability_problem. The definition is as follows:

INSTANCE: Set of n variables. Set of c clauses, where each clause consists of a disjunction of some literals (i.e., variables or their negations).
PROBLEM: Find an assignment of truth values to the variables such that all clauses are satisfied.

Example: Given three Boolean variables x_1, x_2, x_3, and the following three clauses (each with 3 literals) to satisfy:

$(x_1 \vee x_2 \vee \neg x_3) \wedge (\neg x_1 \vee \neg x_2 \vee x_3) \wedge (x_1 \vee \neg x_2 \vee \neg x_3) \wedge (x_1 \vee \neg x_2 \vee x_3)$

where $\vee$ stands for OR (i.e., disjunction), $\wedge$ stands for AND, and $\neg$ stands for NOT (i.e. negation).

A solution is $x_1=T$, $x_2=F$, $x_3=F$.

Your algorithm should be able to read in a problem instance in this format.

```
p cnf 3 4
1 2 -3 0
-1 -2 3 0
1 -2 -3 0
1 -2 3 0
```

The first line that begins p cnf gives the number of variables *n* and the number of clauses *c*. After that, each line is a clause, consisting of a sequence of numbers, which denote the corresponding variable (if the number is positive) or its negation (if it is negative). Each line is ended with a 0.

The output should be the variable assignment if there is a solution or No Solution if there is no solution. The variable assignment should be a {T, F} sequence.

The 2 instances to be solved are:

1. testCase1.cnf
2. testCase2.cnf

Run your program on the 2 instances and report your results according to the submission

requirement. Terminate your program if it runs for more than one hour.

Your submission consists of a shared GitHub repository including two requirements:

1) A README file, written in markdown, containing your team member names, a brief description of the implementation of your algorithms, the programming language and hardware used in the experiment, and the results of your experiments.
2) Run the backtracking search with the MRV and degree heuristic only:
    a. Printout the first 8 variable-value assignments of the search process, i.e. the variable selected and its assigned value.
    b. The final solution of each of the 2 test cases; the total number of variable-value assignments tried during the search; and the CPU execution time in seconds.
3) Run the backtracking search with the MRV and degree heuristic, and forward checking:
    a. Printout the first 8 variable-value assignments of the search process, i.e. the variable selected and its assigned value.
    b. The final solution of each of the 2 test cases; the total number of variable-value assignments tried during the search; and the CPU execution time in seconds.
4) Your source code with appropriate comments. You may use code found on the Internet but need to give credits.

You may form teams of up to 3 people. Each person must contribute to the repository and should have at least one commit included in the master branch. The repository will start with a template provided through GitHub Classroom.

As with previous homework assignments, late submissions will be accepted up to three days after the due date for a penalty of 10% per day. However, you must **email the TA** in order to have the most recent commits graded. Otherwise, your repository will be graded as it was on the due date.