CSE2023

ASSIGNMENT #4

Due date: 04.12.2019

Boolean satisfiability problem (*SAT*) is evaluating given boolean equation for its satisfiability. A *SAT* solver will return any satisfying instance of variables if the equation is satisfiable otherwise will return '*UNSAT*', short for equation is unsatisfiable.

Conjunctive Normal Form (CNF) is a standard form of boolean equations where each subterm conjuncted with others:

(A or B or ~C) and (~ A or ~ B) and (~ B or ~ C)

We can split the boolean equation from conjunctions:

A or B or ~ C and
~A or ~B and
~B or ~C

where each line represents a disjunctive subterm. Since we already now all inputs in a line will be OR ed and lines will be AND ed, we can further simplify format into following:

input.cnf

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

We replaced letter variables with unique ids and logic (NOT) operation is replaced by '-'. We include a header line letter 'p', number of variables (3) and number of clause (3). Finally each line must be 0 terminated. This format is called *DIMACS CNF* which will be our strict format for the SAT solver program. Possible solution to the given boolean equation is:

output.cnf

```
SAT
1    -2    -3
```

where A=TRUE, B=FALSE and C=FALSE satisfies this equation. If there are multiple outputs satisfying the input expression, printing only one will be enough.

Given any unsatisfiable boolean expression:

(~A or ~B) and (A or ~B) and (B or C) and (A or B or ~C) and (~A or B or ~C)

written in *DIMACS CNF form:*

input.cnf

```
p    cnf  3   5
-1   -2   0
1    -2   0
2    3    0
1    2    -3  0
-1   2    -3  0
```

output will be:

output.cnf

```
UNSAT
```

What to Submit ?

In this homework you are expected to solve satisfiability problem where inputs given in DIMACS CNF format. Your program will accept boolean expressions with any number of variable and any number of clause in DIMACS CNF format from "input.cnf" file. Result will be printed into "output.cnf" with the formats explained above.You can use Java or C programming languages. Your submission will be in a single folder named with your student ID including a single source program file. Submissions that do not follow the submission rules or strict input/output formatting will not be evaluated and will get 0. Submissions will be made to the e -mail address: "cse2023.marmara@gmail.com".

Grading Hint:
A: "Your program does not accept input '.cnf' files with header line."
B: "Your program does not accept input '.cnf' files with 0 terminated clause lines."
C: "No output for UNSAT cases."
D: "Printing only SAT for satisfiable cases without printing single satisfying variables instance."
E: "Submissions are not delivered to 'cse2023.marmara@gmail.com'. "
F: "Your homework grade is 0."

(A v B v C v D v E) => F