

# Lab Assignment 8: CS2233

7th November, 2024

A **boolean** formula is called **CNF** (conjunctive normal form) if it is represented via **conjunction** (**boolean-AND**) of several clauses such that each clause is a **disjunction** (**boolean-OR**) of literals (variables or negation of variables). Following is an example of the CNF formula

$$(x_1 \vee \neg x_2 \vee x_3) \wedge (\neg x_1 \vee \neg x_3) \wedge (x_4 \vee x_5 \vee \neg x_2 \vee x_1).$$

Further, a **boolean** formula is called **2-CNF** if each clause consists of exactly two literals.

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

A **boolean** formula is called **satisfiable** if there exists an assignment of the boolean variables that makes the formula evaluate to **True**.

**Problem statement:** Suppose a 2-CNF formula over  $n$  variables and  $m$  clauses is given as input, write a program that determines whether the formula is **satisfiable** or not. If the formula is **satisfiable**, then output the assignments of the variables that satisfy the formula. The running time of the algorithm should be polynomial in  $n, m$ .

**Hint:** Search 2-CNF is in P.

## Input format

- The first line of input consists of number of testcases.
- For each testcase, first line contains  $n$  and  $m$ , which indicates the number of variables and clauses respectively.
- next  $m$  line contain  $m$  clauses as shown in sample test cases.

## Output format

- Output contains one line corresponding to each testcase.
- For each testcase it contains the variable values for which given boolean formula evaluated as **True**.
- Otherwise print "Unsatisfiable".

**Example:**

**Input:**

```
3
3 3
1 -2 # x1 ¬x2
-1 -3 # ¬x1 V ¬x3
-1 2 # ¬x1 V x2
3 4
1 2 # x1 V x2
-1 -2 # ¬x1 V ¬x2
1 -3 # x1 V ¬x3
-1 3 # ¬x1 V x3
2 2
1 2 # x1 V x2
-1 -2 # ¬x1 V ¬x2
```

**Output:**

```
0 0 1 # x1 = False, x2 = False, x3 = True
Unsatisfiable
0 1 # x1 = True, x2 = False
```