Lab03

PROPOSITIONAL LOGIC

1. Description

You are given a **knowledge base KB** and a **sentence** α that are in CNF. Implement the Resolution Algorithm PL-Resolution in slide 27 lecture 11 - Propositional Logic to check whether **KB entails** α.

Write your own opinion regarding the advantages and disadvantages of this algorithm.

2. Specifications

- **Input:** The CNF-formatted KB and α are stored in the **input.txt** file, whose format is described as follows:

    o The first line contains the sentence α.

    o The second line contains an integer N indicating the number of clauses in KB.

    o Each of N next lines represent each clause in KB.

    o A literal is represented by only one uppercase letter A-Z. Literals are connected by the OR keyword. There may be several white spaces between literals and keywords. There is a minus symbol ('-') right before the letter (no white spaces between) if it is a negative literal.

- **Output**: The file **output.txt** stores the sets of clauses after each loop of the **loop do** in the PL-resolution function. The output file format is described as follows:

    o The first line contains an integer N indicating the number of clauses in the set `new U clauses` after the first loop.

    o N next lines represent clauses in the set `new U clauses` after the first loop, each clause is on one line. Clauses in the set `new` go first and then the clauses in the original set `clauses` (i.e. before union)

    o The following lines for subsequent loops have the same format.

    o The last line shows the conclusion regarding whether "KB entails α". Print YES if KB entails α. Otherwise, print NO.

- o Note: you are asked to print the clauses in the set `new U clauses` right after the **loop do** finishes (before the `if` command). If the function is returned before this point, nothing is printed for the current loop.
- The **main function** must perform the following basic actions
  - o Read the input data from the input file and store it in appropriate data structures.
  - o Call the function **PL-Resolution**, which implements the Resolution Algorithm.
  - o Show the outputs.
- The function PL-RESOLVE returns **the set of all possible clauses** obtained by resolving its two inputs.
- Be careful with the meanings of `true` and `false` in the PL-Resolution to make a correct conclusion. Do not forget to negative the sentence α.
- Duplicate clauses are discarded.
- For example, the clause B ∨ B ∨ A is equivalent to True ∨ A which is equivalent to True. Deducing that True is true is not very helpful. Therefore, any clause in which two complementary literals appear can be discarded.
- Students do not need to check the validity of the input data.

An example of the given KB and sentence α in the input.txt file.

Input.txt	Output.txt	Note
-A 4 -A OR B -C OR B A OR C OR -B -B	8 **-A** **B** **-C** **-A OR B** **-C OR B** **A OR C OR -B** **-B** **A** YES	Resolution of -A OR B and -B Resolution of (negative of α) and (-A OR B) Resolution of -C OR B and -B *Red clauses are in the set* `new` *and blue clauses are in the set* `clauses` Negative of α KB entails α since an empty clause is created after resolving A and -A.

Another example of the same KB yet another sentence α.

A 4 -A OR B -C OR B A OR C OR -B -B	7 **-C** **C OR -B -A** **OR B** **-C OR B** **A OR C OR -B** **-B** **-A** 9 **A OR -B** **C OR -A** **-C** **C OR -B -A** **OR B** **-C OR B** **A OR C OR -B** **-B** **-A** 10 **A OR -C** **A OR -B** **C OR -A** **-C** **C OR -B -A** **OR B** **-C OR B** **A OR C OR -B** **-B** **-A** 10 **A OR -C** **A OR -B** **C OR -A** **-C** **C OR -B -A** **OR B** **-C OR B** **A OR C OR -B** **-B** **-A** NO	Resolution of -C OR B and -B Negative of α KB does not entails α since no new clause is created.

3. Grading

No.	Specifications	Scores
1	Successfully read the input data and store it in some data structures	10%
2	Correctly implement the PL-Resolve function	20%
3	Correctly implement the PL-Resolution function	20%
4	Make a correct conclusion about "KB entails α?"	20%
5	The output.txt file strictly follows the specifications	10%
6	Reasonable opinions regarding the pros and cons of the algorithm	20%
Total		100%

4. Notice

• This is an **INDIVIDUAL** assignment.

• 10% bonus will be given as an award for students who can submit a perfect solution within 5 days.

• You are allowed to use data structure functions/libraries (e.g. queue, stack), yet **you must implement the Resolution Algorithm by yourself**.

• Report can be written in English or Vietnamese.