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Class	18CLC1

Introduction to Artificial Intelligence
CSC14003

Lab02: PL Resolution

REPORT

I. Check list:

No.	Criteria	Degree of completion
1	Read the input data and successfully store it in some data structures.	100%
2	The output file strictly follows the lab specifications.	100%
3	Implement the propositional resolution algorithm.	100%
4	Provide a complete set of clauses and exact conclusion.	100%
5	Five test cases: both input and output files.	100%
6	Discussion on the algorithm's efffiency and suggestions.	100%

II. Breif description of main functions:

1. main.py

a. main

This function performs all of the following basic action with each test of 5 test cases:

- Read the input data and store it in appropriate data strutures.
- Call the function pl_resolution, which implements the PL Resolution algorithm.
- Write the output data to the output file in valid format.

2. MyAlgorirthms.py

Class MyAglorithms has 4 attributes:

- *alpha*: stores information of the alpha query (list).
- *KB*: stores information of the Knowledge Base (list).
- *new_clauses_list*: stores new clauses after each loop of the PL Resolution algorithm (list).
- *solution:* represent the result of the query (bool).

a. read_input_data

This function helps you read an input data from an input file into the Knowledge Base (*KB*) and Alpha (*alpha*).

All of clauses are standardized:

- Get rid of all of duplicated literals.
- Literals within a clause are sorted following the alphabetical order.

KB and *alpha* are standardized also:

- Get rid of all of duplicated clauses.
- Get rid of all of clauses in which two complementary literals appear.

b. pl_resolution

This function helps you query *alpha* based on the *KB* by the PL Resolution algorithm, the result of the query *alpha* is stored in *solution*, all of new clauses of each loop are stored in *new_clauses_list*.

c. wirte_output_data

This function helps you write an ouput data to an output file in valid format.

d. standard_cnf_sentence

This function helps you to standardized a CNF sentence such as *KB* or *alpha*:

- Standardize all of clauses.
  - Get rid of all of duplicates.
  - Literals within a clause are sorted following the alphabetical order.
- Discard all of clauses in which 2 complementary literals appears.

e. negation_of_cnf_sentence

This function helps you generate a negation of a CNF sentence. I use the distribution algorithm to implement this function.

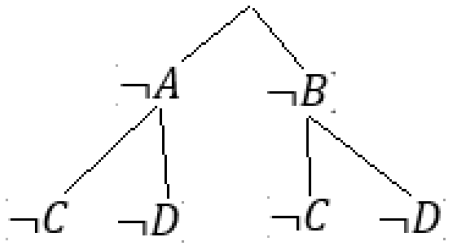
Idea:

$$alpha: (A \vee B) \wedge (C \vee D)$$

$$negation\ of\ alpha: (\neg A \wedge \neg B) \vee (\neg C \wedge \neg D)$$
$$\equiv (\neg A \vee \neg C) \wedge (\neg A \vee \neg D) \wedge (\neg B \vee \neg C) \wedge (\neg B \vee \neg D)\ (distribution)$$

To implement the distribution, I create a tree recursively likes the below one. The result of the distribution is conjunction of clauses, with each clause is a disjunction of all literals on each branch of the tree.

Please read 2 functions generate_combinations and generate_combinations_recursively for more understandings.



f. *resolve*

This function helps you to resolve 2 clauses then return a list of resolvents (list of clauses).

III. Discussion on the algorithm's efficiency and suggestions to improve:

According to the original PL Resolution algorithm, there are many redundant resolutions. For example:

KB and not alpha	Loop 1	Loop 2	Loop 3
(1) …	(5) …	(8) …	(12) …
(2) …	(6) …	(9) …	
(3) …	(7) …	(10) …	
(4) …		(11) …	

At Loop 2, we don't need to resolve (1) with (2), (1) with (3), … (3) with (4) because these resolution are done at Loop 1.

My suggestion: At loop n, we just need to resolve Ci with Cj (Ci is a clause from all of clauses in the above table, Cj is a clause from new clauses at loop n – 1).

For example: at loop 3, $Ci \in \{(1), (2), (3), (4), (5), (6), (7), (8), (9), (10), (11)\}$ and $Cj \in \{(8), (9), (10), (11)\}$.

THE END