Laboratory assignment no. 2

Resolution derivation rule for propositional logic sentences

Given. The external memory (file) contains a set of propositional logic sentences - knowledge base. Sentences are written in the disjunctive form. The number of propositional logic characters, the number of sentences, and the number of disjunctions in sentences can generally vary.

File example:

$A \vee B$
$\neg A \vee B \vee C$
$D \vee \neg Q$
P
$\neg R$
…

You can come up with your interpretations of these sentences. As an example, you can take Jones, Smith, and Clark professions problem discussed during the lecture.

Required: Write a program that, with the help of resolution rule (1), would derive from this knowledge base all the other sentences that can be derived. Print newly derived sentences to a file.

$$\frac{\alpha \vee \beta, \neg\beta \vee \gamma}{\alpha \vee \gamma} \quad (1)$$

Notes:

1. Store all knowledge base sentences, both old and newly derived, in one large array of sentences.
2. In the KB sentences array, the indexes of the "parents" of the newly derived sentences (sentences to which the resolution has been applied) should be memorized and printed at the end.
3. Newly derived logic sentences should be simplified if possible.

   $\neg Q \vee P \vee \neg Q \vee \neg T$ (needs to be simplified)
   $P \vee \neg Q \vee \neg T$ (simplified sentence)

4. A newly derived logic sentence does not need to be included in the knowledge base if it overlaps or says nothing new compared to any existing knowledge base sentence.

   $P \vee \neg Q \vee \neg T$ (existing KB sentence)
   $P \vee \neg Q \vee \neg T$ (new, overlapping sentence)
   $P \vee \neg Q \vee \neg T \vee M$ (new, saying nothing new (weaker), sentence)

5. A newly derived logic sentence does not need to be included in the knowledge base if it is equivalent to an always True sentence, e.g.

   $P \vee \neg Q \vee Q$
   $P \vee \neg T \vee \neg P \vee \neg M$

Appendix. Tests

Test 1

Knowledge base	Newly derived sentences
A ∨ B ∨ ¬C	A ∨ ¬C ∨ D
¬C ∨ ¬B ∨ A ∨ D	

Test 2

Knowledge base	Newly derived sentences
A ∨ B ∨ ¬C	
C ∨ ¬B	

Test 3

Knowledge base	Newly derived sentences
A ∨ C ∨ D	A ∨ C
A ∨ B ∨ C	
C ∨ ¬B	

Test 4

Knowledge base	Newly derived sentences
A ∨ C	
A ∨ B ∨ C	
C ∨ ¬B	

Test 5

Knowledge base	Newly derived sentences
A	
A ∨ B ∨ C	
C ∨ ¬B	

Test 6

Jones, Smith, and Clark professions problem

We have three people: Jones, Smith and Clark. They work as a programmer, data analyst, and manager (not necessarily in the same order). Jones owes the programmer 10€. The manager's wife forbids her husband from borrowing money. Smith is single. Which person does what job?

Mark the facts with symbols
JP - Jones is a programmer
SP - Smith is a programmer
CP - Clark is a programmer
JA - Jones is a data analyst
SA - Smith is a data analyst
CA - Clark is a data analyst
JM - Jones is a manager
SM - Smith is a manager

CM - Clark is a manager

Knowledge base content

JP ∨ SP ∨ CP // someone is a programmer
JA ∨ SA ∨ CA // someone is a data analyst
JM ∨ SM ∨ CM // someone is a manager
JP ∨ JA ∨ JM // Jones has a job
SP ∨ SA ∨ SM // Smith has a job
CP ∨ CA ∨ CM // Clark has a job
¬JP ∨ ¬SP // Jones and Smith can not both be programmers
¬JP ∨ ¬CP // Jones and Clark can not both be programmers
¬SP ∨ ¬CP
¬JA ∨ ¬SA
¬JA ∨ ¬CA
¬SA ∨ ¬CA
¬JM ∨ ¬SM
¬JM ∨ ¬CM
¬SM ∨ ¬CM
¬JP ∨ ¬JA // Jones can not both be a programmer and a data analyst
¬JP ∨ ¬JM // Jones can not both be a programmer and a manager
¬JA ∨ ¬JM
¬SP ∨ ¬SA
¬SP ∨ ¬SM
¬SA ∨ ¬SM
¬CP ∨ ¬CA
¬CP ∨ ¬CM
¬CA ∨ ¬CM
¬JP // Jones owes the programmer 10€.
¬JM // The manager's wife forbids her husband from borrowing money.
¬SM // Smith is single.

Newly derived sentences

Aprox. 75 new sentences.