Project 1 KRR – deadline 1st December 2021

The project will consist of two parts:

1. implementation of the algorithms below (preferably in PROLOG; any other language is allowed but with 2 points penalization).
2. a written document, where you treat the two subjects below (between 2-10 pages without the code; the code is added at the end of the document).

You will upload your project in the Assignment created in the KRR team, as a single pdf file saved as LastName_FirstName_project1.pdf. **Do not send it by email**!

You must work individually for the project. **Attention:** your project will be checked for similarities with Turnitin. For this reason, you must not include pictures in your pdf, with the only exception allowed for solving the requirement 1b). The insertion of any other picture (for code or text) will be interpreted as a way to avoid the verification against plagiarism and will be penalized by grading the whole project with 1.

In the last 2 weeks before the winter holiday, I will meet individually with each of you on MS Teams to present your project (max 45 minutes for each student, there will be a planning for that). Only your institutional email address @s.unibuc.ro is allowed. **Make sure you have one**!

Attention: your project is not graded unless you present it.

Attention: a source code with any explanatory comments included will not be considered at all.

All the resources (articles, books, code) that you consult for the project must be cited.

If you have questions, my email is cidota@fmi.unibuc.ro

You are required to solve two subjects:

1. Resolution:
   Create your own KB and a Question (logically entailed from KB), expressed in natural language (as the example in the last slide of C3). You can use other examples for inspiration (and indicate the source!), but you are not allowed to copy them exactly. Your KB represented in FOL must contain variables (not like the “Toddler” example in C3 page 18).
   a) Represent your KB in FOL, using a vocabulary that you will define.
   b) Prove “manually” (as in C3 page 29) that the Question is logically entailed from KB, by applying Resolution.
   c) Prove “automatically” that the Question is logically entailed from KB (by implementing Resolution in FOL)

d) Use your implementation of the Resolution for the propositional case, for the following sets of propositional clauses, written in CNF:
   i. [[¬a,b],[c,d],[¬d,b],[¬b],[¬c,b]]
   ii. [[¬b,a],[¬a,b,e],[a, ¬e],[¬a],],[e]]
   iii. [[¬a,b],[c,f],[¬c],[¬f,b],[¬c,b]]
   iv. [[a,b],[¬a, ¬b]]

2. SAT solver – The Davis Putnam procedure
   Implement the Davis-Putnam SAT procedure. For S, a set of clauses in written in CNF, the procedure will display YES, respectively NOT, as S is satisfiable or not. In the case of YES, the procedure will also display the truth values assigned to the literals (e.g. {w/true; s/false; p/false ...}). Choose two strategies of selection of the atom to perform the • operation and discuss/compare the results.
   Use your implementation (with both strategies) for the following finite sets of propositional clauses, written in CNF:

   i. [[toddler],[¬toddler,child],[¬child,¬male,boy],[¬infant,child], [¬child,¬female,girl], [female], [girl]]
   ii. [[toddler],[¬toddler,child],[¬child,¬male,boy],[¬infant,child], [¬child,¬female,girl], [female], [¬girl]]
   iii. [[¬a,b],[c,d],[¬d,b],[¬c,b],[¬b]]
   iv. [[¬b,a],[¬a,b,e],[e],[a, ¬e],[¬a]]
   v. [[¬a,¬e,b],[¬d,e,¬b],[¬e,f,¬b],[f,¬a,e],[e,f,¬b]]
   vi. [[a,b],[¬a,¬b] ,[¬a,b] ,[a,¬b]]

Note: both procedures will be implemented in the versions presented at the course (from Ronald Brachman, Hector Levesque. Knowledge representation and reasoning, Morgan Kaufmann 2004).

For each subject, the clauses will be represented in whatever format you choose. The input data will be read from a file and the results will be displayed on the screen.

Marina Cidota

03.11.2021