Artificial intelligence and knowledge engineering

lab

Exercise 3. Simple knowledge base and reasoning in Prolog.

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Purpose of the exercise

Performing simple exercises on representing knowledge in a symbolic form based on a subset of first-order predicate logic (exactly the language of Horn clauses) and starting the reasoning process based on the resolution principle.
On the example of the Prolog programming language and the selected programming environment, you will learn about the possibility of using ready-made solutions to represent symbolic knowledge and run inference.

Implementation of the exercise

There are 2 classes planned for the implementation of the exercise. The exercise should be largely done during lab work and is intended to be more illustrative than a complete solution.

For the correct implementation of the tasks, you should carefully read (and necessarily before the laboratory) the following materials:

- "Lecturead4. Inference and symbolic representation of knowledge"

  (https://eportal.pwr.edu.pl/course/view.php?id=57104),
- environment for programming in Prolog:
  - online version(b ęused lab): https://swish.swi-prolog.org
  - accessit's pm With versionto I will downloadciaSWI Prologue:https://www.swi-prolog.org
- examples available in SWISH (very simple): "Knowledge bases" and "Lists",
- additional examples and resources (optional) are provided in the Additional Literature and Resources (end) section.

The leitmotif will be the construction of a knowledge base describing the selected device or application and, on its basis, the construction of a simple program supporting the user in diagnosing and solving the problem. You can also think about extending the exercise with a kind of system that answers simple questions about the selected device or application (based on a simple question menu, rather natural language input is beyond the possible scope of the exercise).

As part of your work on the exercise, you should do the following:

- Select a specific device (eg printer, photocopier, home appliance) or computer application and then read its manual, especially the troubleshooting section.
- On this basis, a simple semantic network of terms relevant to the description of the device should be defined and saved in Prolog, and its components (i.e. specific objects) should be described in it.
- The possibilities of inference and the operation of unification based on the built network should be shown on several well-chosen examples of prolog queries and inferences.
- Then extract from the content sentences describing diagnostic rules, rules of conduct, ways to deal with problems, etc. and try to translate them into rules written as Prolog clauses and predicates.
    - o Probably the first time effect bIt will leave much room for improvement, so you should save major versions and present them as part of the exercise report as an illustration of the process of working out a solution.
- The capabilities of the developed knowledge base should be demonstrated on a few examples of problems solved by reasoning (minimum 3). In the selection of examples, attention should be paid to showing the possibilities of the inference process, e.g. depth, interesting use
- As part of the report on the implementation of the exercise, the code of the knowledge base should be presented along with a commentary on the meaning of individual facts, clauses and adopted solutions.

Evaluation of the task implementation

Constructing complicated recursive predicates or advanced operations on data structures (e.g. difference lists) is not expected, although of course it is not forbidden.

The following aspects will affect the grade for the exercise:

- complexity of knowledge written in the form of rules,
- foldedch of the developed semantic network and the level of generalization (e.g.defined classes of components, parts, users, etc.),
- the complexity of built clauses,
- multi-timech the inference process and the scope of generalization processinference,
- good and interesting use of the unification mechanism.

Punctation:

- Construction of a simple semantic network describing a selected device or application: 20 points.
- Showing the possibility of inference and the operation of unification on several well-chosen examples of queries and inference: 10 points.
- Extracting from the content of the manual sentences describing diagnostic rules, rules of conduct, methods of proceeding in the event of problems, etc.: 10 points.
- Development of a knowledge base in Prolog (clause database) describing the knowledge expressed in these sentences: 30 points
- Demonstration of the capabilities of the developed knowledge base on several examples of problems solved by reasoning (minimum 3).: 30 points.

Literature

1. “Lecture 4. Inference and symbolic representation

   knowledge”(https://eportal.pwr.edu.pl/course/view.php?id=57104),
2. Prolog Lectures:
   http://www.cs.sjsu.edu/~pearce/modules/lectures/prolog/
   examples:
   a. Prologue Knowledge Base

      http://www.cs.sjsu.edu/~pearce/modules/lectures/prolog/kbase.htm
   b. interesting task list:

      http://www.cs.sjsu.edu/~pearce/modules/labs/prolog/index.htm
   c. representation of a UML diagram in Prolog

      http://www.cs.sjsu.edu/~pearce/modules/labs/prolog/UMLProlog2.htm
3. Learn Prologue Now!
   - chapters 1-3
   - https://cs.union.edu/~striegnk/learn-prolog-now/html/index.html
   - http://www.let.rug.nl/bos/lpn//lpnpage.php?pageid=top
   - notes for this course: https://github.com/lorenzo-stoakes/learn-prolog-now

Additional literature and resources

1. Logic Programming course
   - https://athena.ecs.csus.edu/~mei/logicp/prolog/programming-examples.html
2. manual prologue
   - http://www.cs.ru.nl/~peterl/teaching/KeR/prolmanual.pdf
3. Introduction to Prologue
   - http://www.sfu.ca/~tjd/383summer2019/prolog_intro.html

4. Using Prolog as a Database
   - http://www.sfu.ca/~tjd/383summer2019/prolog_intro.html#using-prolog-as-a-database
5. ARTIFICIAL INTELLIGENCE 2E FOUNDATIONS
   OF COMPUTATIONAL AGENTS
   - general AI manual: https://artint.info/index.html
   - It includes a chapter on knowledge representation and inference
   - https://artint.info/code/ailog/ailog_man.html
   - examples of exercises for a simple reasoning
     systemabout https://artint.info/2e/online.html
     - o (theory: http://artint.info/2e/html/ArtInt2e.Ch5.S4.SS3.html)
6. Examples of Prolog exercises:
   - https://files.ifi.uzh.ch/ddis/oldweb/ddis/teaching/teaching-archive/winter-0304/bi2003/assignment-2-knowledge-intensive-processing/creating-a-knowledge-base-in-prolog/index.html
   - e.g. diagnostic rules for the selected device:
     - o https://files.ifi.uzh.ch/ddis/oldweb/ddis/teaching/teaching-archive/winter-0304/bi2003/assignment-2-knowledge-intensive-processssing/index.html
7. Materials about the Prologue from PWr.
   - https://kcir.pwr.edu.pl/~witold/ai/aie_prolog_s.pdf
8. Lots of different examples
   - https://dtai.cs.kuleuven.be/problog/tutorial/basic/05_smokers.html
   - https://dtai.cs.kuleuven.be/problog/tutorial/tutslides/02_more.html
9. Amzi! Prologue - another open Prologue, a little different
   - https://www.amzi.com/AmziOpenSource/
   - exercises and resources:
     - https://github.com/AmziLS/PrologCourse