

Knowledge Representation Exercises.

Please consider that these exercises can be solved using different languages and approaches, there is not just one solution, but one solution can be more appropriate than another. I am not including the solutions at the initial stage, I would recommend to approach them first. Solutions will be provided upon requests. Additional exercises will be provided next week.

Exercise 1

Build a knowledge base in which the following knowledge is represented:

Father, Mother, GrandMother, GrandFather, Aunt, Uncle, Niece, Nephew, Mother of at least 3 sons, Father of at most 2 Daughters.

- 1) Select the knowledge representation language (KRL) that is more appropriate for encoding this knowledge (give a reason) or as an alternative the KRL that you prefer.
- 2) Assume and encode further element of the real world that are needed for representing the above knowledge. (hints here are possible).
- 3) Write an encoding of the KB in the chosen KRL.
- 4) Write from 2 to 4 possible queries to the contents of the KB.

Exercise 2

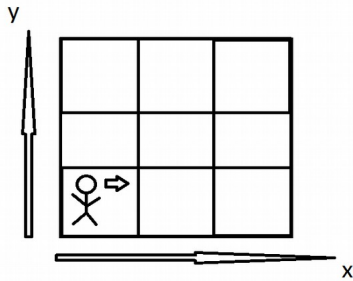
Build a knowledge base in which the following knowledge is represented

All humans are mammals; all mammals are warm blooded. All dogs are mammals. Humans own animals. There are animals that are not warm blooded. All mammals are animals. A human cannot own another human.

- 1) Select the knowledge representation language (KRL) that is more appropriate for encoding this knowledge (give a reason) or as an alternative the KRL that you prefer.
- 2) Assume and encode further element of the real world that are needed for representing the above knowledge. Assume a set of individuals for all the possible humans and animals.
- 3) Write an encoding of the KB in the chosen KRL.
- 4) Write a query that allows the user to retrieve all the animals owned by a given human which are not warm blooded. Write a query that finds the set of humans that have one warm blooded animal and one not warm blooded.

Exercise 3

A little cleaning robot moves in a room represented by the following map, having nine places encoded with coordinates x and y (eg. (1,1), (1,2).....):



A cat and a dog are also in the room in a position different from the robot. Assume that both the cat and the dog are still and do not move. The robot should clean the room (e.g. visit all the free squares) avoiding the cat and the dog.

- 1) Select a knowledge representation language to represent this scenario, and motivate your choice.
- 2) Write a KB to represent the robot, the room and the constraints. Define the robot task.
- 3) Write a query that activates the robot to perform the requested task.

Exercise 4

- 1) Select an appropriate KR language to formalize the following sentences:

All Students are smart.

There exists a student.

There exists a smart student.

Every student loves some student.

Every student loves some other student.

There is a student who is loved by every other student.

Mark is a student.

Paul is a student

Mark takes either Analysis or Geometry (but not both).

Paul takes Analysis and Geometry.

Mark doesn't take Analysis.

No students love Paul

- 2) Is the above knowledge consistent? Provide a formal justification.
- 3) Write a query that retrieve the exams that a student takes.

Exercise 5

Clara and Doris carpool to work. On even days Clara drives Doris and on odd days Doris drives Clara. In the former case, Clara is the driver and Doris is the passenger; in the latter case Doris is the driver and Clara is the passenger. When Doris is ill Clara is the driver. Both Clara and Doris have a drive license and the drive license is needed to drive. Passengers do not need the drive license.

- 1) Select a knowledge representation language to encode the above knowledge.
- 2) Write a knowledge base that encodes the above knowledge.

3) Extend the knowledge base assuming that the current day is even, and that Clara has lost her drive license, will they be able to carpool to work? Provide a formal justification.