CSE 663 Advanced Knowledge Representation
Professor Shapiro
Homework 2: Dishes
Maximum Points: 90
Due: 9:00 AM, Monday, September 27, 2004

September 10, 2004

Before this homework is due, submit a file containing your solution, suitable for loading and running, by executing the Unix command

`submit_cse663 hw2`

Make sure the file is headed with a comment identifying it and you.

Then, hand in a hard-copy of your solution at the beginning of class. The hard-copy must be prepared in LATEX or other suitable formatting program, and must be formatted for human reading.

1   Domain

The domain for this homework is a set of dishes consisting of some dinner plates, salad plates, bread plates, salad bowls, soup bowls, cups, and saucers. We'll be interested in ontological questions such as:

- Is a soup bowl a dish?

- Is a bread plate a saucer?

- Is a salad plate a salad bowl?

In addition, some dishes have been stacked up. We'll say that

- one dish is **on** another if it's immediately on it;

- one dish is **above** another if's somewhere on the stack above it.

We'll be interested in questions about the stacks such as:

- Is a cup on a saucer?

- Is a bowl above a plate?

You are to formalize this domain for SNePSLOG Mode 3. All rules for transitive relations must be given as path-based rules. That is, you are not to use any recursive node-based rules. Other node-based rules, however, are permitted. You may find that the file `/projects/robot/Fevahr/fevahr.snepslog`, along with the paper (Shapiro, 2003), has some useful examples.

2 To Do

Your solution needn't have the following elements strictly in the order given below, except for the questions, which are to be at the end in the order given.

1. (3 points) The hard-copy solution you hand in must look like a paper, formatted for human reading. It must not be just a printout of the file you submit.

2. (10 points) Give the syntax and semantics of all the atomic symbols you use for formalizing this domain.

3. (5 points) Use `define-frame` to define the case frames to be used for all the function symbols in your formalization.

4. (10 points) State, in SNePSLOG, the taxonomy of this domain. This must include the categories: dishes, plates, bowls, cups, saucers, dinner plates, salad plates, bread plates, salad bowls, and soup bowls.

5. (15 points) Formalize the rules for the taxonomic (ontological) relations used in this domain. See the questions for the relations you will need. Use path-based rules rather than recursive node-based rules.

6. (5 points) Create the following two place settings: dinnerPlate1, saladPlate1, breadPlate1, saladBowl1, soup-Bowl1, cup1, saucer1, dinnerPlate2, saladPlate2, breadPlate2, saladBowl2, soupBowl2, cup2, saucer2. Each of these dishes is to be of the category indicated mnemonically by its name.

7. (5 points) Create the following two stacks:

   (a) cup1 on saladBowl1 on soupBowl1 on saucer1 on breadPlate1 on saladPlate1 on dinnerPlate1.
   (b) cup2 on saucer2.

8. (10 points) Formalize the rules for the relations "on" and "above" for use in reasoning about the stacks. Use path-based rules rather than recursive node-based rules.

9. (22 points) After loading the above knowledge base into SNePSLOG, ask it the following questions. The correct answers are shown in square brackets following each question.

   (a) (2 points) Is a soup bowl a dish? [Yes]
   (b) (2 points) Is a bread plate a saucer? [No]
   (c) (2 points) Is a salad plate a salad bowl? [No]
   (d) (2 points) Is saucer1 on breadPlate1? [Yes]
   (e) (2 points) Is saladBowl1 above dinnerPlate1? [Yes]
   (f) (2 points) Is saladPlate1 above cup1? [No]
   (g) (2 points) Is dinnerPlate1 on dinnerPlate2? [No]
   (h) (2 points) Is breadPlate2 on cup2? [No]
   (i) (2 points) What bowls do we have? [soupBowl1, saladBowl1, soupBowl2, and saladBowl2]
   (j) (2 points) Is a cup on a saucer? [cup2 is on saucer2.]
   (k) (2 points) Is a bowl above a plate? [soupBowl1 and saladBowl1 are each above breadPlate1, saladPlate1, and dinnerPlate1.]

10. (5 points) Discussion question: Answer in English in the hard-copy version only: How could a system answer the question *Is cup1 above soupBowl2?* Note that the answer should be "no".

References

Shapiro, S. C. (2003). FevahrCassie: A description and notes for building FevahrCassie-like agents. SNeRG Technical Note 35, Department of Computer Science and Engineering, University at Buffalo, Buffalo, NY. Available as `http://www.cse.buffalo.edu/~shapiro/Papers/buildingFevahrAgents.pdf`.