

Indian Institute of Technology, Jodhpur
B.Tech.(CSE) 3rd Year, II (Fall) 2015
CS324: Artificial Intelligence Assignment # 3

M.M.: 10

1. Consider a robotic-hand which can move between several bins, pickup an object from the bin if the hand is above the bin and the hand is empty. The hand can drop an object into the bin if the hand is holding an object and the hand is above the bin. Moving of hand from any bin to any other bin is always possible, it does not require any preconditions. The actions are:

$drop(x, y)$ (drop object x into bin y)
 $move(y)$ (move hand to be above the bin y)
 $grab(x, y)$ (pickup object x from bin y).

The fluents are:

$holding(x, s)$ (the hand is holding x in situation s)
 $over(y, s)$ (the hand is over bin y in situation s)
 $in(x, y, s)$ (object x is in the bin y in a situation s).

- (a) Write the axioms for $move$, $drop$ and $grab$ actions.
(b) Write the successor state axioms for all the *fluents*.
2. Given the following set of facts and default rules:
- (a) People typically live in the same city where they work (default: d_1)
(b) People typically live in the same city where their spouses are (default: d_2)
(c) John works in New Delhi (fact: f_1)
(d) John's spouse works in Mumbai (fact: f_2)

Answer these questions:

- (a) Where does John live according to default logic?
(b) Where does John live according to your intuition?
3. Compute the default extensions of following theories $T = (M, D)$:
- (a) $M = \{a\}, D = \{\frac{a:\neg b}{c}, \frac{\neg c}{d}, \frac{\neg d}{e}\}$
(b) $M = \{a \rightarrow c, b \rightarrow c\}, D = \{\frac{\neg b}{a}, \frac{\neg a}{b}, \frac{\neg d}{e}\}$
(c) $M = \{\}, D = \{\frac{\neg b}{a}, \frac{\neg a}{b}, \frac{\neg d}{d}\}$
(d) $M = \{p \wedge q\}, D = \{\frac{b:a}{a}, \frac{\neg a}{a}, \frac{\neg a}{\neg c}, \frac{\neg q}{b}, \frac{\neg p}{q}, \}$
4. There are many words in English language which can be used as noun and verb, for example, "book" in "Book my ticket" and "This is my book" have used the word "book" as verb and noun, respectively. In the following words, what are their different parts of speech?

milk, house, liquid, airborne, group, set. Suggest a method in each case, as how you will reason the true meaning.

5. Represent the relationships between quadrangle, parallelogram, rhombus, rectangle and square in the form of a semantic network. Is the semantic network unique, or are there many different forms it can take?
6. Represent the following statements using semantic networks:
 - (a) "Rajan teaches his students a lot of innovative things."
 - (b) "Raman tells Rajan's students number of useful things."
 - (c) Mike and Mary's telephone number is the same.
 - (d) John believes that Mike and Mary's telephone number is the same.
7. Represent the following knowledge in a semantic network:

Dogs are Mammals	Birds have Wings
Mammals are Animals	Bats have Wings
Birds are Animals	Bats are Mammals
Fish are Animals	Dogs chase Cats
Worms are Animals	Cats eat Fish
Cats are Mammals	Birds eat Worms
Cats have Fur	Fish eat Worms

8. Suppose you learn that "Tom is a cat". What additional knowledge about Tom can be derived from your representation? Explain how.
9. Suppose Tom is unlike most cats and does not eat fish. How could one deal with this in the semantic network?
10. Express the following sentences in description logic:
 - (a) All employees are humans.
 - (b) A mother is a, female who has a child.
 - (c) A parent is a, mother or a father.
 - (d) A grandmother is a, mother who has a child who is a parent.
 - (e) Only humans have children that are humans.

Note: You need to work out the solution of all these. But submit the solution of any four. Submission deadline 16 March 2015, 23:59 hrs (IST). Assignment shall be submitted online only at email id kr.chowdhary at iitj dot ac dot in, with subject marked as AI-HW3-rollno. Format: pdf, prepared through latex or word.