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THE OPEN UNIVERSITY OF SRI LANKA
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

FINAL EXAMINATION 2009/2010
BACHELOR OF TECHNOLOGY PROGRAM - COMPUTER ENGINEERING

ECX 6240 Knowledge Engineering

Date: 17th March 2010 **Time: 9.30 – 12.30 hrs**

Answer ONLY FIVE *questions:*

1. (a) Why are PROLOG and LISP are well suited to developing software for Artificial Intelligence? Can languages such as C++ and Java could also be used for such work? Briefly explain. (6 marks)

   (b) Define what is meant by 'Knowledge-based systems'. (3 marks)

   (c) List 5 Knowledge representation formalisms (5 marks)

   (d) What are the tasks of a knowledge engineer? (3 marks)

   (e) How does machine learning systems differ from Expert Systems? (3 marks)

2. (a) List 5 conditions that a project should meet so that development of an Expert system is justified. (5 marks)

   (b) Give one real-world application each for Expert system development under each given category below. (4 marks)
   (i) Prediction
   (ii) Diagnosis

   (c) List 5 properties that an expert system should contain. (5 marks)

   (d) What is meant by 'conflict resolution' in an expert system? List 3 methods used for conflict resolution. (6 marks)

3. (a) What is the main advantage that frame-based system has over rule-based systems? (4 marks)

   (b) Draw a frame system for communication systems for a buildings using AKO and IS-A links. Consider offices, classrooms, laboratories, and so forth. Include instances with filled slots for one type of each frame such as office and classroom. Draw minimum of 5 frames. (The communication system may consist of various data cables, wireless services, internet access, servers, computers, accessories etc.) (12 marks)

(c) Give an example of a problem you have encountered that you think would have been a good candidate for frame based representation for programming (other than the problem mentioned in (b)). (4 marks)

4. (a) Why is it preferable to use Depth-First Search Iterative Deepening rather than the Depth-First search? (4 marks)

(b) Compare and contrast heuristic search and exhaustive search. (2 marks)

(c) Define the term 'heuristic function'. (2 marks)

(d) Draw a search tree for the 8-puzzle problem (shown below) up to depth 3 (start state is depth 0) using the A* algorithm (omit repeated states) with the evaluation function $f(n) = p(n)+h(n)$, where $p(n)$ is the number of steps from the start state (start state is step 0) and $h(n)$ is the number of misplaced tiles.

Note that the actions for sliding tiles should be used in this order: right, left, up and down.

Write the values of f and of its components p and h under each state. You may use an abbreviated notation indicating only the tiles that change. (12 marks)

Start state

1	2	3
4	8	5
7	6	

→

Goal state

1	2	3
4	5	6
7	8	

5. Consider the given facts for a family tree.

Mala and Nimalawansa had 2 sons named Dumindu and Ravindu. Dumindu and his wife Kalani have 2 sons named Sesara and Resandu where as Ravindu and his wife Anjalie have two daughters called Ayansa and Manlinka.

(a) Consider the fundamental relations given below and write Prolog statements to define the following relationships. (10 marks)

Male(X) – X is a male
Female(Y) – Y is a female
Parent(X,Y) – X is a parent of Y
Brother(X,Y) – X is brother of Y

i. father
ii. mother
iii. grandfather
iv. uncle
v. daughter

(b) Write goals to extract the following information (4 marks)

Who is Malinka's father?
Who is Malinka's uncle?

(c) Prove that Nimalawansa is Ayansa's grandfather. (Assume that a grandfather is a male grandparent.) (2 marks)

(d) Define the Prolog predicate span(L,N,L1) such that, it duplicate each member of a given list(L) for a specified number of times (N) to produce a new list (L1).
e.g. span([a,b,c],2,L1) should give L1 = [a,a,b,b,c,c] (4 marks)

6. (a) How can Skolem functions be used to discharge the existential quantifiers in the following?
$\forall x$ [dog(x)) $\exists y$ [cat(y) ^ envies(x, y)]] (3 marks)

(b) Consider the following sentences.

Saman likes to see Hindi films
Bandara doesn't likes to see Hindi films
ABC is a Hindi film
All the movies shown in Lido Cinema are Hindi
Saman likes all films that Bandara doesn't like.

Do the following:

(i) Write each sentence in first-order logic (FOL). (9 marks)

(ii) Convert each FOL sentence into clausal form. (4 marks)

(iii) Prove that 'Bandara doesn't like films shown in Lido Cinema' using resolution refutation. (4 marks)

7. (a) The term "agent" in the context of computer systems has no universally accepted meaning - the term is usually defined by listing attributes that it claimed an agent has. Briefly describe what are the most commonly mentioned attributes of an agent. (4 marks)

(b) What are the advantages of a Multi-Agent Approach? (8 marks)

(c) How do the agents exchange information? (2 marks)

(d) Briefly describe a real-world example of using multi-agent systems for simulation. (3 marks)

(e) What is meant by the 'utility function' of an agent? (3 marks)

8. (a) Compare and contrast artificial neural networks and fuzzy inference systems (6 marks)

(b) List the features that distinguish Delta learning rule and Hebb's learning rule. (6 marks)

(c) Why do we need intelligent hybrid systems? Briefly explain one hybrid system with an example. (8 marks)