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



FINAL EXAMINATION 2010/2011
BACHELOR OF TECHNOLOGY/ BACHELOR OF SOFTWARE ENGINEERING

ECX 6240 Knowledge Engineering/ ECI6265 AI Techniques

Date: 3rd April 2011

Time: 14.00 – 17.00 hrs

This paper contains EIGHT (8) questions on 4 pages. Answer ONLY FIVE (5) questions:

1. (a) Compare and contrast declarative knowledge and procedural knowledge. (4 marks)
(b) Briefly describe what knowledge based systems are. (4 marks)
(c) Draw a block diagram to show the main components of a 'knowledge-based system' and briefly describe the components. (8 marks)
(d) Explain the difference between forward and backward chaining and under what conditions each would be best to use for a given set of problems. (Use examples to explain) (4 marks)
2. (a) Why does Min-Max approach important in game playing ? Briefly explain. (3 marks)
(b) What is meant by Alpha-Beta pruning? Explain with an example. (3 marks)
(c) Compare and contrast two search techniques used for game playing programs. (4 marks)
(d) What are the disadvantages of hill climbing search? (6 marks)
(e) How does Best first search overcome the drawbacks of the hill-climbing search? (4 marks)
3. (a) Differentiate between *Frame systems* and *Production systems* in terms of their unit of knowledge, relationship between units, inference engine, knowledge base design, relation between inference engine and knowledge base, skill of the developer, range of suitable applications. (14 marks)
(b) Represent the following relationships given in sentences by a Semantic Network. (6 marks)
Truck is a vehicle
Trailer truck is a truck
Trailer truck has a part 'trailer'
Truck has wheels
Truck has cargo-capacity
Truck has an engine

4. Define the following Prolog predicates

(a) Find the summation of elements in a list L. (5 marks)
e.g. `sum([2,4,5,6], S)` should give `S = 17`

(b) Find the nth element of a list. (5 marks)
e.g. `find_n([1,3,5,7,9],3,X)` should give `X=5`

(c) Find the `member(X,L)`: true if X is a member of the List L; otherwise false. (4 marks)
e.g. `member(5, [1,3,5,7])` is true

(d) Define the predicate `disjoint(L,K)` true if L and K are disjoint i.e. if they have no elements in common. Where L and K are lists.

e.g. `disjoint([2,1,3,4],[8,5,6,7])` is true

[Hint: Use `member(X,L)` true if X is a member of List L; otherwise false.] (6 marks)

5. (a) How can Skolem functions be used to discharge the existential quantifiers in the following?
 $= (\forall x) (\exists y) (\text{Favourite_singer}(x, y) \wedge (\forall Z) \text{Song}(z, x) \rightarrow \text{song_like}(y, z)$ (3 marks)

(b) Consider the following sentences.

If x is on top of y, y supports x

If x is above y and they are touching each other, x is on top of y

A TV is above a TV-stand

A TV is touching a TV-stand

Do the following:

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

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

(iii) Prove that the predicate 'supports(TV-stand, TV)' is true using resolution refutation. (4 marks)

6. (a) Not all problems are suited to model with a Artificial Neural Network (ANN). If there are certain features in the in the program we can say it is not a problem suitable for ANN. Explain what kind of problems are not suited to model with ANN. (3 marks)

(b) List 3 application areas where use of an artificial neural network is appropriate. Justify your answer. (3 marks)

(c) The "iris plant data set" is a famous dataset that has been used in multivariate analysis. When 4 attributes of the flowering plant Iris are given a neural network is proposed to identify the class which the flower belongs.

Number of Attributes: 4

Attribute Information:

1. sepal length in cm
2. sepal width in cm
3. petal length in cm
4. petal width in cm

There are 3 classes that flowers can be classified into

- 1 Iris Setosa
- 2 Iris Versicolour
- 3 Iris Virginica

State the following for the neural network you propose to use for Iris flower classification.

- i. Number of nodes for input layer
 - ii. Number of Hidden nodes and layers
 - iii. Number of nodes for output
- (6 marks)

(d) Compare and contrast supervised learning and unsupervised learning found in Neural networks (give an example application for each) (6 marks)

(e) What is the suitable neural network to be used when the output of the neural network is unknown? Justify your answer. (2 marks)

7. Consider the following system requirements given to design an agent-based system and answer the questions asked below. (20 marks)

Consider updating a data mart. A data mart is typically made up of a number of data sources, so updates need to be coordinated.

The designed system should be able to control which data sources are loaded and when. In doing so it may take into account system use, historical load times, priorities, and the data source pipeline. It should use any knowledge that it has at its disposal to make such scheduling decisions.

The system should also be able to track the arrival of new data sources and also the source availability and pre-processing time.

The system should monitor and report back that the first data source is available for loading and the second data source is currently being processed with an estimated completion time of one hour. Depending on the length of time needed to load the given data sources, the load scheduling agent may decide it's better to wait for the second data source to complete before proceeding with loading the first data source. If the estimated arrival time of the second data source was two days, the scheduling agent may decide to go ahead with the load of the first data source.

- (a) Identify the agents necessary to design an agent based system for the above requirements.
- (b) What are the features the agents in the proposed system have?
- (c) Briefly explain what each agent behaviour is necessary for the work it has to do in the system.
- (d) Draw a block diagram to show the agent-based system you proposed.

8. (a) Briefly describe what is meant by a 'fuzzy inference system'. (3 marks)
- (b) List the two main types of fuzzy inference systems. (4 marks)
- (c) Is shape of the fuzzy membership function important in building fuzzy systems? Justify your answer. (2 marks)
- (d) Give 3 example shapes used in fuzzy systems. (3 marks)
- (e) For following applications what are the shapes you would suggest?
 (i) Control systems (ii) Social science applications (2 marks)
- (f) Intelligent hybrid systems are designed to overcome disadvantages of stand alone applications of fuzzy, neural or expert systems. Briefly explain 3 different ways to combine 2 or 3 AI techniques to create hybrid systems. (6 marks)