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THE OPEN UNIVERSITY OF SRI LANKA

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

FINAL EXAMINATION 2016/2017

BACHELOR OF TECHNOLOGY PROGRAMME – COMPUTER ENGINEERING

ECX6240 – KNOWLEDGE ENGINEERING

Date: 26th November 2017 **Time: 09.30 – 12.30 P.M.**

This paper contains **SEVEN (07)** *questions on 5 pages. Answer* **ONLY FIVE (5)** *questions*:

Q1

(a) Consider the following facts

- If Nuwan is intelligent and studies hard, then he will get good grades and pass the courses.
- If Nuwan studies hard but lacks intelligence, then his efforts will be appreciated.
- If his efforts are appreciated, then he will pass his courses.
- If Nuwan is intelligent, then he studies hard.

(i) Represent these facts in predicate logic. (6 marks)

(ii) Convert the above in part (a) to clausal form (CNF). (4 marks)

(iii) Use resolution to prove that Nuwan will pass his courses. (5 marks)

(b) Write a predicate double(In, Out) whose left argument is a list, and whose right argument is also a list consisting of every element in the left list written two times.

For example, the query

double([a,4,cat],X). Then X = [a,a,4,4,cat,cat]. (2 marks)

(c) Consider a list consisting of integer numbers such as [6, 5, 4, 2, 3] and write Prolog predicates for each of the operations.

(i) Find the summation of elements of the above list.
e.g. sum([6,5,4,2,3],S) should give S=20 (2 marks)

(ii) Write a Prolog predicate to find whether integer 2 is a member of the above list. (1 mark)

Q2.

(a) Consider the below given space exploration knowledgebase in Prolog and answer the questions.

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apollo(7, schirra, eisele, cunningham).
apollo(8, borman, lovell, anders).
apollo(11, armstrong, collins, aldrin).
apollo(12, conrad, gordon, bean).
apollo(13, lovell, swigert, haise).
apollo(16, young, mattingly, duke).
apollo(17, cernan, evans, schmitt).
crew_landed_on_moon(A) :- apollo(A,_,_,_), A>10, not(A=13).
walked_on_moon(X,Z) :- apollo(A, X,_,Z), crew_landed_on_moon(A).
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(i) Write a Prolog query to find the astronauts who went in Apollo 13. (3 marks)

(ii) What is the solution to the query?

apollo(A, armstrong, Y, aldrin). (2 marks)

(iii) Trace the first solution to the query.
walked_on_moon(conrad, bean). (5 marks)

(b) Briefly describe 3 methods of knowledge representation. (4 marks)

(c) Draw a frame based system to represent the following knowledge with appropriate relations.

- In a cricket team all are cricket team members
- There are bowlers , batsmen and fielders in a team
- Assume all players are men
- All members belong to a particular team such as Mumbai cricket team, Rajasthan cricket team etc.
- There is a batting average related to bowlers as 0.25 and batsman as 0.85
- Spinners and medium pacers are kinds of bowlers (6 marks)

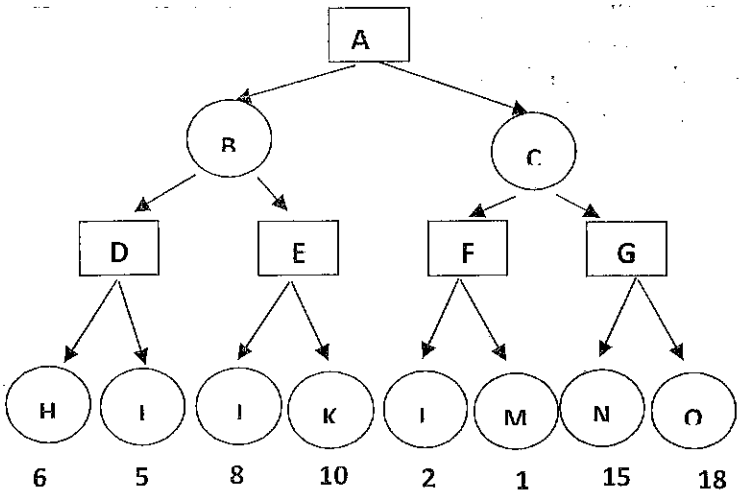
Q3

(a) Translate the following English sentences into predicate logic:

(i) All horses, cows, and pigs are mammals.
(ii) Offspring and Parent are inverse relations.
(iii) Not all basketball players are tall. (2 × 3=6 marks)

(b) Describe what is alpha-beta pruning in a game tree. (4 marks)

(c) Given the following search tree, apply the alpha-beta pruning algorithm to it and show the search tree that would be built by this algorithm. Make sure that you show where the alpha and beta cuts are applied and which parts of the search tree are pruned as a result.



(10 marks)

Q4

(a) "A multi-agent system is a computerized system composed of multiple interacting intelligent agents within an environment."

(i) Briefly explain what is an "Intelligent Agent". (2 marks)

(ii) Identify 3 characteristics of a Multi Agent System. (3 marks)

(iii) Multi Agent systems are giving less performance for some systems. Briefly explain such systems with examples. (3 marks)

(b) Assume that you are required to design a Multi Agent system for a cab service company. There are more than 500 cabs registered with the company and the system is required to provide facilities to add multiple passengers (known passengers) for a visit and multiple vehicles are allowed when passengers need the fastest solution. Using Multi Agent approach, answer the questions given below.

(i) Identify different kinds of agents suitable for the above scenario with justifications. (4 Marks)

(ii) Briefly describe relevant tasks of each agent. (3 marks)

(iii) Draw a block diagram to show the agent-based system you proposed. (5 marks)

Q5

(a) "Artificial Neural Networks (ANN) are a computational model used in computer science and other research disciplines, which is based on a large collection of simple neural units."

(i) Compare and contrast biological neural networks and artificial neural networks. (3 marks)

(ii) Briefly explain the three (03) basic learning methods in neural networks (3 marks)

(iii) Describe how the training error can be computed in a back propagation algorithm. (4 marks)

(iv) If the available data set for training the neural network is small describe how you do the training and testing. (3 Marks)

(b) Answer the questions given below considering Expert Systems (ES).

(i) "ES are Computer applications which embody some non-algorithmic expertise for solving certain types of problems". Explain this statement. (3 Marks)

(ii) Considering each step of Expert System development explain how to build an Expert System to channel a doctor. (4 marks)

Q6

(a) Compare and contrast classical sets (crisp set) and fuzzy sets? (3 marks)

(b) You are required to develop a fuzzy system to identify temperature of air-conditioner. To handle the temperature use the following rules.
Temperature is measured in centigrade (C^0) and categorized as Freezing, Cool, Warm or Hot.

if temperature < 10^0C it is recognized as freezing cool
if temperature > 5^0C and temperature < 20^{0C} it is recognized as cool
if temperature > 20^0C and temperature < 30^0C it is recognized as Warm
if temperature > 27^0C it is recognized as Hot

(i) Draw a Membership function for the above system. (5 marks)

(ii) Use the above Membership function and describe
How cool is 16°C?
How cool is 23°C? (2 × 2=4 marks)

(iii) Explain why "Cross Over" is a critical feature of genetic algorithms. (4 marks)

(c) Explain whether genetic algorithms can be used for learning fuzzy rules from data. (4 marks)

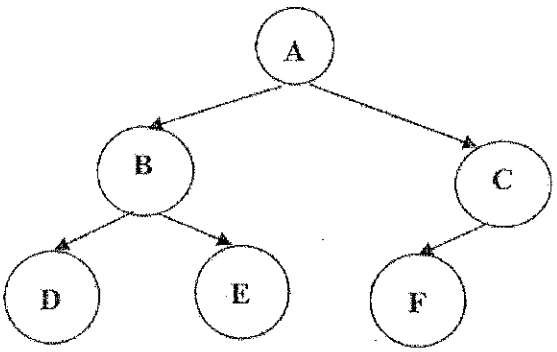
Q7

(a) Briefly explain three (03) properties of search methods. (4 marks)

(b) Explain the differences and similarities between depth first search and breadth first search using examples. (4 marks)

(c) Describe what is A* searching algorithm with an example. (4 marks)

(d) For the search tree below, show at each step what nodes are in the queue for both the Breadth First Search and Depth First Search. Show the list of nodes that are expanded.



(8 marks)

End of Paper