THE OPEN UNIVERSITY OF SRI LANKA

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

FINAL EXAMINATION 2014/2015

BACHELOR OF TECHNOLOGY PROGRAMME – COMPUTER ENGINEERING

ECX6240 – Knowledge Engineering

Date: 02nd September 2015 **Time: 09.30 – 12.30 P.M.**

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

Q1

i. Express the following English sentences in First Order Logic (predicate logic) using standard notations.

a). All house wives watch the same Teledrama. (3 marks)

b). There is at least one student who does not hate (any of) the AI home work. (3 marks)

c). There are no mushrooms that are poisonous and purple. (3 marks)

ii. Write Prolog codes for the following tasks.

a). Implement *delete_item/3* that deletes a given item in a list. (2 marks)

b). Implement a clause choose(N,L,R,S) that chooses N items from L and puts them in R with the remaining elements in L left in S. (3 marks)

c). Given the knowledgebase in the following form, answer the two questions given below;

Student(student_no, student_name, age, regional_center)
Course(course_code, course_name)
Coursetaken(course_code, student_no)

(i) List names of all students registered at Colombo Center. (2 marks)

(ii) List the student number of all the students who have taken *Knowledge Engineering* course. (4 marks)

Q2

i. Explain with justification the reasoning technique/s that can be used for following scenarios.

a). To find a particular image pattern in a given picture.

b). To develop a computer program to find the z-score of students based on the A/L results.

c). To decide on the amount of fine applicable to a driver who has broken a road rule.

(2 marks each × 3= 6 marks)

ii. Consider the sentences below.

1. Any student who pass the scholarship exam and wins the tennis match is happy.
2. Any student who studies well or is lucky can pass all his exams.
3. Amal did not study but he is lucky.
4. Any student who is lucky wins the tennis match.

a) Write the above sentences in predicate logic. (6 marks)

b). Convert the above predicate logic expression into CNF. Hence prove that Amal is happy.

(8 marks)

Q3

i. Define the following terms

Chromosome, fitness function, cross over and **mutation** (8 marks)

ii. If the population size in a genetic algorithm is restricted to 1, what search algorithm does it correspond to? Explain your answer (3 marks)

iii. Describe phases of application of genetic algorithms. (3 marks)

iv. Explain why diversity is important when using genetic algorithms to solve problems. (3 marks)

v. Give three (03) real world situations where genetic algorithms can be applied. Justify your answer. (3 marks)

Q4

i. Describe two searching methods with examples of applications. (4 marks)

ii. Assume that there are two (02) jugs, a 5-liter (5L) and another 3 liter (3L) jug with no measuring marker on them. There is endless supply of water through a tap. The goal is to get 4 liters (4L) of water in the 5L jug. The state space for this problem can be represented as a set of ordered pairs of integers (X, Y) such that X represents the number of liters of water in 5L jug and Y for 3L jug. You have to achieve the goal with minimum number of steps.

(a) Define a set of possible operations to achieve the goal. (6 marks)

(b) Represent those operations as production rules. (6 marks)

iii. State the most suitable searching technique/s to find a path of links from one web page URL to another web page URL. Clearly explain your answer giving reasons. (4 marks)

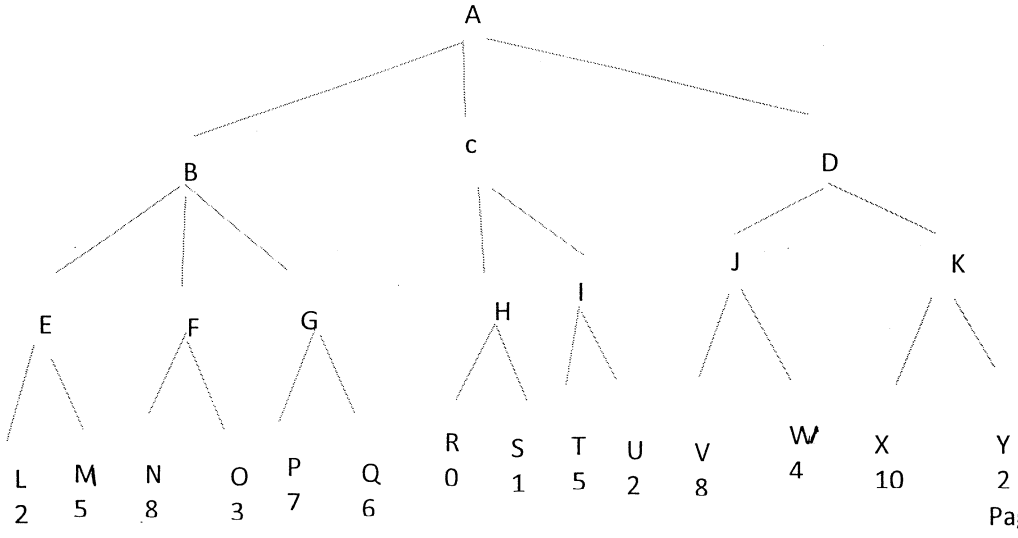
Q5

i. Explain why knowledge acquisition in expert systems has become a bottle neck. Suggest few remedies for the problem. (4 marks)

ii. Describe the usefulness of meta rules in expert systems with an example. (4 marks)

iii. Explain the use of mini-max algorithm in game playing. (3 marks)

iv. Consider the below given game tree. The static scores are shown along the leaf nodes from the first player's (MAX) point of view.



a). What move/s should the first player choose. (4 marks)

b). What nodes need to be examined using α- β pruning algorithm assuming that nodes are examined in left to right order? (5 marks)

Q6.

i. Using an example, explain what is meant by *defuzzification* (3 marks)

ii. What advantages would fuzzy expert systems have over traditional expert systems? (3 marks)

iii. Assume that you have to develop a set of fuzzy rules to control traffic lights at a four way junction. Assume that there are sensors at each junction that determine how many cars are waiting and how long they have been waiting. The fuzzy rules should control the lights to minimize delay to all cars.

a). Define a set of linguistic variables to describe the above scenario. (4 marks)

b). Assuming that waiting time can vary from 0 seconds to 120 seconds, define a set of fuzzy rules for above defined linguistics. (6 marks)

iv. Describe how you can reduce the efficiency of electricity consumption in a refrigerator by using a fuzzy controller. (4 marks)

Q7.

i. Assume that you are given a data set to identify different relations that exist among data. Describe the process that you will carry out. (4 marks)

ii. Describe two methods of grouping data with examples of application. (4 marks)

iii. Why is it always required to define the context of an Agent? (2 marks)

iv. Assume that the Open University plans to develop a multi agent system for student registration process. Design a multi agent system for the process describing the agents with their roles and communication mechanisms. Explain your design of the system with a design diagram. (10 marks)

Q8.

i. Explain what is meant by Hebbian learning. Why is forgetting important to Hebbian learning? (4 marks)

ii. Why is it impossible for a single binary perceptron to solve the XOR problem? (4 marks)

iii. Neural networks require lots of input data to be trained properly. If you have too little input data then separating them into a training set and validation set sometimes seems to be a waste of data. In such circumstance suggest a method that can be used effectively to separate the training data and validating data. (4 marks)

iv Output neuron A of a network receives 4 inputs from neurons whose activity levels are 10, -15, 6, -4. The respective connecting weights of neuron A are 0.6, 0.2, 0.3 and 0.8. Calculate the output of neuron A if it is represented by a perceptron. The activation function of a perceptron is a step function. (5 marks)

v. Describe why is it not a good idea to train a Perceptron until the error on the training set is minimized. (3 marks)