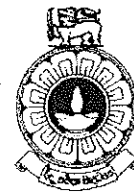


The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical and Computer Engineering



Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	: EEX6540/ECX6240 Knowledge Engineering
Academic Year	: 2019/20
Date	: 14 th August 2020
Time	: 1400-1700hrs
Duration	: 3 hours

General Instructions

1. Read all instructions carefully before answering the questions.
 2. This question paper consists of **Seven (7) questions** in ~~Six (6)~~ pages.
 3. Answer any **five (5)** questions only. All questions carry equal marks.
 5. Answer for each question should commence from a new page.
 6. This is a Closed Book Test (CBT).
 7. Answers should be in clear hand writing.
 8. Do not use Red colour pen.
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Q1

A group of undergraduate students started to develop an Intelligent Personal Assistant to answer the queries related to BTech degree programme. Identification of a method for knowledge representation was a hard problem and finally the students agreed upon using a rulebased system for knowledge representation. Based on this scenario answer the below questions.

- (i) Write 8 rules that you will include in the knowledgebase. (8 marks)
- (ii) Write a possible question that will relate at least three (03) rules in your knowledgebase. (3 marks)
- (iii) Describe the process by indicating the order of firing rules to answer part(ii). (3 marks)
- (iv) Describe three(03) strategies that you can use to solve conflicts when firing rules. (3marks)
- (v) Illustrate how you represent the same set of rules that you identified in part(i) in a decision tree. (3 marks)

Q2.

- (i) For each of the queries below write the output (true, false or a variable binding) that will be given by Prolog when executed.

- | | |
|--|-------------------------------------|
| (a) <code>?- X = 5+3.</code> | (b) <code>?- X is 5+3.</code> |
| (c) <code>?- X =5, X is X+3.</code> | (d) <code>?- first\==second.</code> |
| (e) <code>?-att(cup1, X) = att(Y, white).</code> | |
| (f) <code>?- [cup, bench, kitchen] =[X Y].</code> | |
| (g) <code>?- [c1, on(Y,Z), in(b,k)] = [X, on(X,b) W].</code> | |

(10 marks)

- (ii) Write Prolog codes for the following tasks.
 - (a) To calculate the number of items in a given list. For instance,
`length([a,b,c], X).`
`X=3` (3 marks)
 - (b) To find whether a given item X appears in a given list L. For example, `member(X, L)` is true if X appears in the list L; otherwise false. (3 marks)
- (iii) Consider the prolog knowledgebase given below.

```

male(saman).
male(sunil).
female(seela).
female(sunila)
parent(saman, sunila).
parent(seela, sunila).

```

Write suitable Prolog rules for

- (a) mother/2
- (b) brother/2

to identify mother and brother relationships using the above knowledgebase.

(2×2= 4 marks)

Q3

(i) Write the following sentences in Predicate logic.

- (a) All people who are educated and are smart are happy.
- (b) Those people who read are smart.
- (c) Happy people have healthy lives.

(2×3= 6 marks)

(ii) Convert the following predicate logic expressions into Conjunctive Normal Forms.

- (a) $\forall x \forall y (\neg(R(x,y) \wedge \neg R(y,x)))$
- (b) $\exists x \forall x \exists y P(x,y,z)$
- (c) $\forall x \forall y \exists z (\neg R(x, z) \vee \neg (R(y,z)))$

(2×3= 6 marks)

(iii) Derive by resolution an empty clause from the following clauses (where x, y, z are variables and a and b are constants)

- C1: $[\neg R(x,x)]$
- C2: $[\neg R(x,y), R(y,x)]$
- C3: $[\neg R(x,y), \neg R(y,z), R(x,z)]$
- C4: $[R(a,b)]$

(8 marks)

Q4

(i) Semantic network is a one form of knowledge representation. Draw a semantic network to represent the following facts.

```

isa(person, mammal)
instance(Anil, person)
team(Anil, Basketball)

```

(6marks)

(ii) Compare and contrast knowledge representation using semantic networks and frames.

(4 marks)

- (iii) Consider the game tree given below in which the static scores are from the first player's point of view. Assume that the first player is a maximizing player.

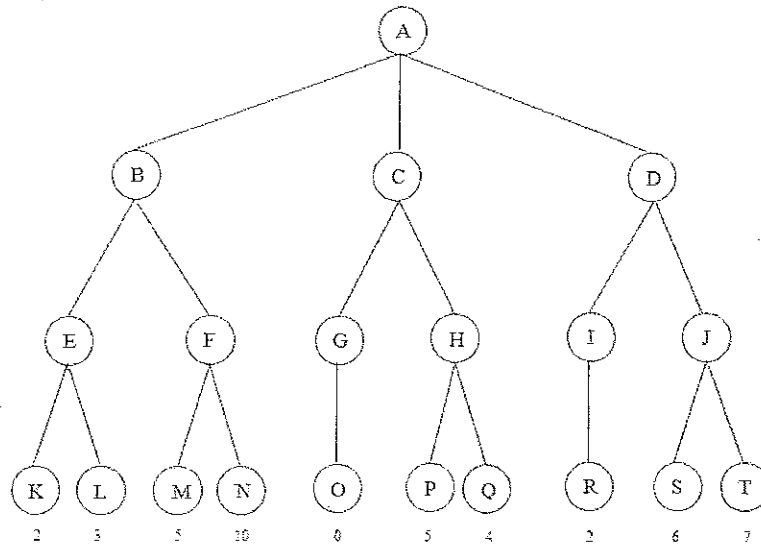


Figure 1: Two Player Game tree

- (a) Apply the mini-max search to show the backed-up values for each node in the tree in figure 1. (6 marks)
- (b) If the nodes are expanded from left to right, state what nodes would not be visited using alpha-beta pruning. For each pruned node identify alpha and beta values and explain why it is pruned. (4 marks)

Q5

- (i) Consider the below given state space, where each node represents a state and each directed link represent an operation. The state space needs to be searched starting from node *a*.

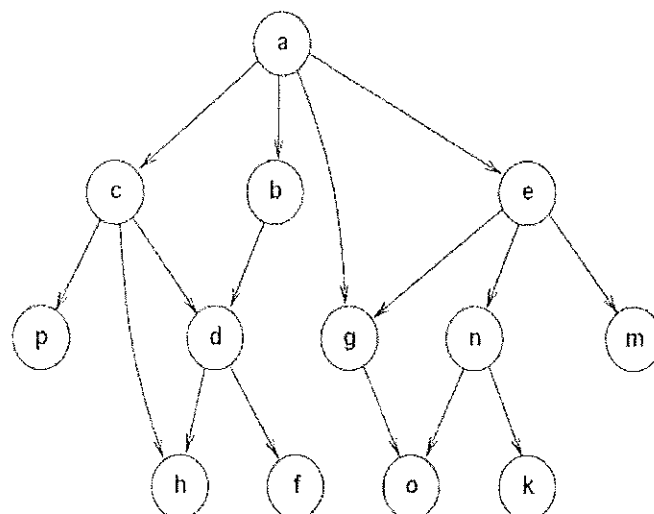


Figure2: State space graph

List the nodes of the state space shown in figure 2 in the order of expansion for the following Search algorithms.

- (a) Depth-first search method
 (b) Breadth-first search method (4×2= 8 marks)
- (ii) Consider the problem of a farmer who wants to get a lion, a fox, a goose and some corn across a river. There is a boat, but he can only take one in addition to himself on each trip, or else both the goose and the corn, or both the fox and the corn. The corn cannot be left with goose as it will eat the corn; similarly, the fox can eat goose if left together and also lion cannot be left with the fox. How does everything get across the river? Assume animals do not wander off when left alone.
- (a) Give the start and goal states along with constraints. (3 marks)
 (b) Draw state space search trees using DFS and BFS.. (6 marks)
 (c) Solve this problem using constraint satisfaction method. (3 marks)

Q6

- (i) Explain how Multi Agent Systems can be applied for a dynamic environment using an example scenario. (3 marks)
- (ii) Describe THREE features of the Multi Agent System you proposed for the scenario in part (i). (3 marks)
- (iii) Explain a situation where you can apply a Neural Network and justify your answer. (3 marks)
- (iv) Answer the following questions based on the system that you implemented for your mini project.
- (a) Explain the problem scenario you choose with the type of the system you implemented. (3 marks)
 (b) Describe the entire implementation process of your system in five (05) steps. (5 marks)
 (c) Describe three(03) steps you have taken to increase the efficiency of your system. (3 marks)

Q7

- (i) Explain what is a fuzzy variable with an example. (2 marks)
- (ii) Consider the following real situations from everyday life.
- S1: Income of a person measured in Rs.
S2: Weight of a person measured in Kilograms.
S3: A book measured in how much you are interested in reading it.
S4: A traffic light measured in what colour is on.
- (a) For each of the above situations suggest a fuzzy variable. (4 marks)
- (b) Identify the situation where a fuzzy variable is not the best choice and justify your answer. (2 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)
- (iv) Assuming that waiting time can vary from 0 seconds to 120 seconds define a set of fuzzy rules for above defined linguistics. (4 marks)
- iv. Describe how you can improve the efficiency of electricity consumption in a refrigerator by using a fuzzy controller. (4 marks)

End of the Paper