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

Study Programme	: Bachelor of Software Engineering Honours
Name of the Examination	: Final Examination
Course Code and Title	**: EEI6565/ECI6265 Artificial Intelligence Techniques**
Academic Year	: 2017/18
Date	: 5th February 2019
Time	: 0930-1230hrs
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.
4. Answer for each question should commence from a new page.
5. Relevant charts/ codes are provided.
6. This is a Closed Book Test (CBT).
7. Answers should be in clear hand writing.
8. Do not use Red colour pen.

Q1

(i) Let V be the set of all math problems and assume that all the x's below represent math problems. Consider the below given predicates.

P(x) = x is solvable
Q(x) = x is easy
R(x) = x is hard

Based on the above predicates translate the following formulas into English.

a. $\forall x(Q(x) \vee R(x))$
b. $\exists x(P(x) \wedge R(x))$
c. $\forall x(P(x) \rightarrow Q(x))$

Translate the below given English sentences into predicate logic.

d. Some hard problems are not solvable
e. For all problems, if it is easy then it is solvable (2 ×5=10 marks)

(ii) Prove the below given logical consequence using resolution.

$$\neg P \vee Q, \neg R \Rightarrow \neg Q \models P \Rightarrow R$$ (4 marks)

(iii) Assume that you have given the task of developing intelligent personal assistant software that can answer the questions you ask. When start developing the personal assistant the hardest problem that you encounter was how to represent the knowledge and how you can make inferences based on the knowledge to answer questions. Based on this scenario answer the below questions.

(a) Describe a knowledge representation mechanism for the intelligent personal assistant and justify your answer. (3 marks)

(b) Describe 3 situations where your intelligent personal assistant will fail to answer and describe why it fails in each of those situations. (3 marks)

Q2.

(i) Consider the below given knowledge base in Prolog

```
% prerequisite(C1,C2) means that course C1 is a prerequisite of course C2
    prerequisite(eex3417,eex4435).
    prerequisite(eex3336,eex4347).
    prerequisite(mhz3552,eex3410).
    prerequisite(eex4436,eex5346).

% passed(S,C) means that student S has passed course C
    passed(amal,mhz3552).
    passed(amal,eex3410).
    passed(ganga,eex3417).
    passed(ganga,eex3336).

% grade(S,C,G) means that student S has received grade G in course C
    grade(amal,mhz3552,77).
    grade(amal,eex3410,71).
    grade(ganga,eex3417,81).
```

grade(ganga,eex3336,69).

(a) Write Prolog clause(s) for the predicate **require(C1, C2)**. A course C1 is required for a course C2 if C1 is a prerequisite of C2 or if there is some course C3 that is a prerequisite of C2 and C1 is required for C3. (4 marks)

(b) Write Prolog clause(s) for the predicate **cantTake(S,C)**. A student S cannot take course C if there is a prerequisite of C that S has not passed. (3 marks)

(c) Write Prolog clause(s) for the predicate **bestGrade(S,G)**, which holds if G is the best grade that S has received in any course. (4 marks)

(ii) Write a Prolog predicate split/3 that split a list of integers in to two lists. One list contains only positive numbers. The other list contains negative numbers only. For example,

split ([2, -4. 6, -7, 1], P, N).
P = [2, 6, 1]
N = [-4, -7] (3marks)

(iii) Write a Prolog predicate **twice**(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 twice.
For example, the query

twice([c,4,ball],X). Then X = [c,c,4,4,ball,ball].

(3 marks)

(iv) Write a Prolog predicate 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 otherwise false. (3 marks)

Q3

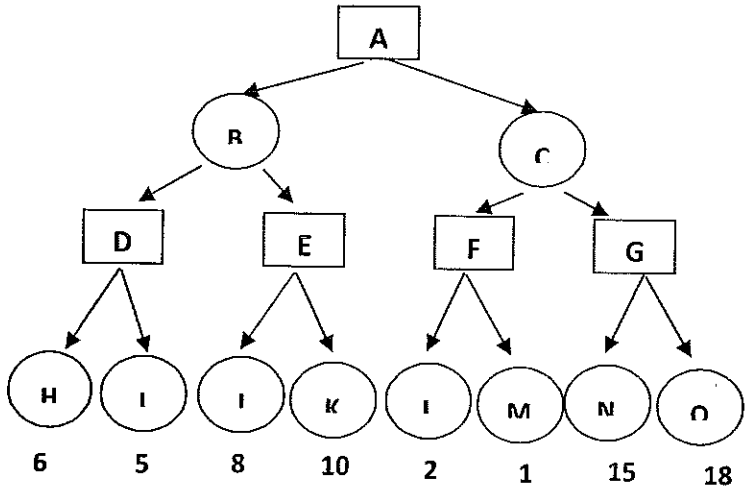
(i) Assume that you are going to play a two-player game called "Tokens". The game starts with a single stack of tokens. In this game assume that you start the game with a single stack of 7 tokens. At each move a player selects one stack and divides it into two non-empty, non-equal stacks. A player who is unable to move loses the game.

(a) Draw the complete search tree for the game Token. (8 marks)

(b) Assume two players, min and max, play the game as explained above. Min plays first. If a terminal state in the search tree developed above is a win for min, then a zero is assigned to that state. If max wins a particular state then 1 is assigned for max for that state. Apply the minimax algorithm to the search tree to assign values for all states in the search tree. (4 marks)

(ii) Describe what is alpha-beta pruning in a game tree. (3 marks)

(iii) 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.



(5marks)

Q4

(i) Assume that you are given the task of designing an Expert System to a given situation. Describe the general features that need to be satisfied in applying an Expert System to any given situation.

(4 marks)

(ii) Give a brief description of the way in which IF-THEN rules can be used as a basis for knowledge representation and reasoning. What essential elements would you expect to be included in such a system? (3 marks)

(iii) Consider the below given set of rules.

Rule 1	**Rule 2**
IF X is true AND B is true AND E is true THEN Y is true	IF Y is true AND D is true THEN Z is true
Rule 3	**Rule 4**
IF A is true THEN X is true	IF Y is true AND C is true THEN W is true

(a) What goal would the system return if A, B, C and E are given as true. (4 marks)

(b) Describe the chaining mechanism you followed in deriving the goal and justify the answer. (3 marks)

(iv) How would you represent the following statements using a semantic network:
"Amal tells his students a lot of useful things." "Chamila tells Amal's students an enormous number of useful things." (6 marks)

Q5

(i) Identify THREE features of a Multi Agent System. (3 marks)

(ii) Explain how Multi Agent Systems can apply for a dynamic environment. (3 marks)

(iii) Compare and contrast multi-agent systems and conventional software. (3 marks)

(iv) Suppose you are required to design a multi-agent system to handle online re-registration system of the OUSL. Assume that when a student starts the registration process he/she needs to know the exam results of the previous year, courses at the level you are expecting to register with the pre-requisites and financial details. It is expected that by knowing these three factors a student is able to register successfully.

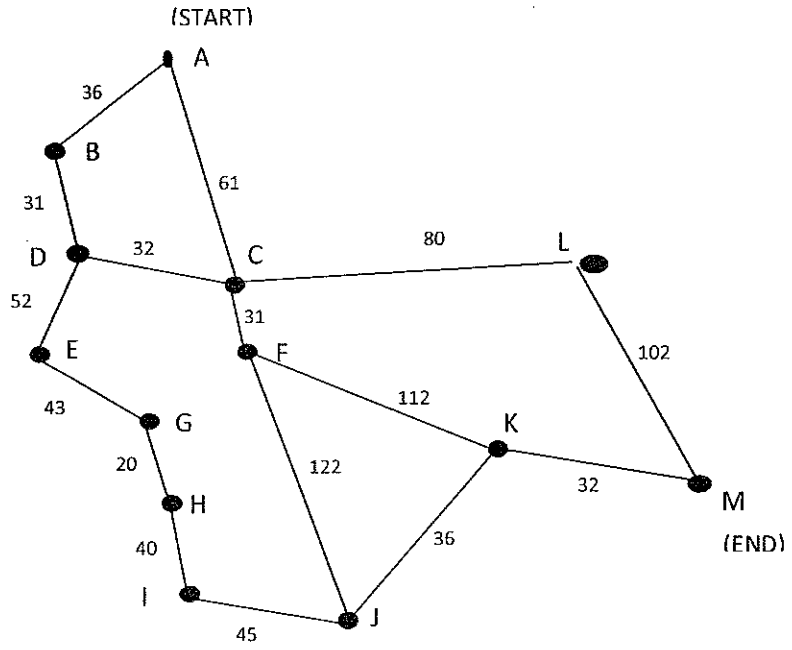
(a) Describe what kind of agents are suitable for the above application? (4marks)

(b) Briefly describe relevant PEAS description for each agent. (4 marks)

(c) Draw a block diagram to show the agent-based system you proposed indicating the communication paths. (3 marks)

Q6

Consider the below given graph that indicates distance between cities.



Straight line distance to M

A	223
B	222
C	166
D	192
E	165
F	136
G	122
H	111
I	100
J	60
K	32
L	102
M	0

The goal is to go from town A to town M using the minimum cost function considering the A* algorithm. The cost function at a particular town is calculated by adding the cost functions of

G(n) = The cost of each move is the distance between each town as shown on the map.
H(n) = The Straight Line Distance between any town and town M. These distances are given in the table on the right hand side.

(i) Develop a search tree for the above map indicating the order you expand the nodes.

(10 marks)

(ii) Determine the order in which routes are expanded according to A* algorithm and give the total cost. (5 marks)

(iii) Considering a real world scenario of your choice explain how you would formulate that scenario as a search problem in AI. (5 marks)

Q7

(i) Describe with an example under which circumstances is the use of Genetic algorithms to solve a problem is beneficial? (3 marks)

(ii) With reference to the relevant concepts that you described in part (a), explain why the following real world problems can be modeled by Genetic Algorithms

(a) Roster generation/work scheduling for TV stations, airports etc
(b) Optimized telecommunication routing
(c) Traffic and shipment routing (3× 2= 6marks)

(iii) 'Cross over' is a critical feature of genetic algorithms. Briefly explain why it is so. (3 marks)

(iv) Describe the role of hidden layers in neural networks. (2 marks)

(v) Assuming a scenario of implementing a neural network describe how you determine.

(a) Number of input nodes
(b) Number of output nodes
(c) How you validate the system (3× 2= 6marks)

End of the Paper