EASTERN UNIVERSITY, SRI LANKA
DEPARTMENT OF MATHEMATICS
THIRD EXAMINATION IN SCIENCE – 2015/2016
FIRST SEMESTER (March/April, 2019)
CS 304- Artificial Intelligence

Answer all questions **Time: 2 Hours**

Q1. An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators.

a) What is meant by *rational agents* in Artificial Intelligence? [10 marks]

b) List and describe the four components necessary to define a problem formally. [24 marks]

c) Describe any two of the following four types of task environment with aid of suitable example:

i. Fully observable;

ii. Deterministic;

iii. Static;

iv. Discrete. [16 marks]

d) Describe the four properties known as *PEAS* to describe a task environment using a suitable example. [24 marks]

e) A supermarket has deployed a robot to organise items on the shelves in the supermarket rack. The robot moves from rack to rack and picks up the items that are placed on wrong shelves. The robot notes the picked-up items and the items on the shelves. The robot keeps the picked-up items in a box attached to it. If the

attached box is full, the robot will retrieve details from the database server and identifies the appropriate shelf in the rack and shelf the items accordingly. Robot will continually do these tasks to organise the items correctly in the shelves.

Identify and write the PEAS properties to describe the above task environment.

[26 marks]

Q2. A problem-solving agent finds a solution by applying various searching strategies in a state space.

a) State in your own words what is meant by *state space search problem*.

[10 marks]

b) Describe *depth-first* and *breadth-first* algorithms to search a state space for a path to a goal state. [20 marks]

c) State the purpose of a *heuristic function* in informed search strategies. [12 marks]

d) Suppose you have a slider which has one blank and four tiles of which two are labelled **L** and the other two are labelled **R**. The initial position may be depicted as **RRbLL** where **b** indicates the blank space. You are required to change the board configuration to **LLbRR** with the following conditions:

A labelled tile can move or jump over one tile to the blank position making the original position of the tile a blank space. However, the tiles labelled **L** can only move or jump in the *right-to-left* direction, and the tiles labelled **R** can move or jump in the *left-to-right* direction.

i. Draw a state space showing all possible states to move from initial state to goal state. Indicate paths that lead to the goal state from the start state.

[26 marks]

ii. Specify which of the goal states, the *depth-first* search would find first, and specify which one the *breadth-first* search would find first. [16 marks]

iii. Suggest a *heuristic* function to find a goal state with minimum moves which can be used in *best-first search* algorithm. Show how the proposed heuristic function improves the search. [16 marks]

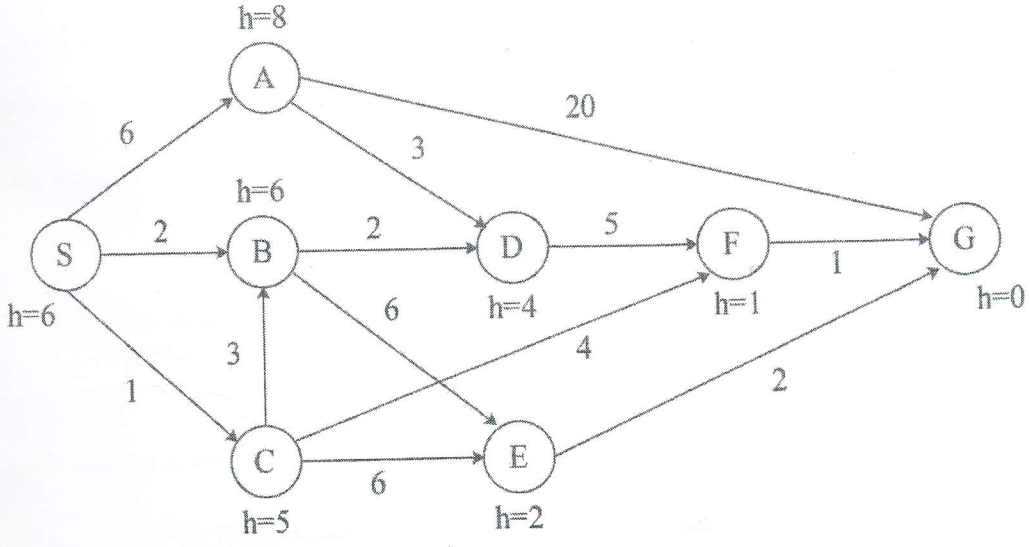
Q3. *Informed search strategies* are generally able to find solutions more efficiently than an uninformed strategy.

a) State how the *informed search* strategy differs from the *uninformed search* strategy. [12 marks]

b) State in your own words what is *hill climbing algorithm* and state clearly the problems that would arise in applying hill climbing algorithm. [26 marks]

c) *Admissibility* and *consistency* are two conditions that a heuristic function should satisfy to obtain optimal solution. Describe these two conditions using suitable examples. [22 marks]

d) Consider the search problem below with start state S and goal state G. The transition costs are next to the edges, and the heuristic values are next to the states.



i. Find the path from *S* to *G* using A* search. [25 mark

ii. Explain why heuristic function in this example is *admissible*? [15 mark

Q4. Predicate logic is another knowledge representation language like propositional logic.

a) *Propositional logic* is considered to be less expressive than *Predicate log* Explain the expressive power of predicate logic using suitable examples.

[10 mark

b) Define *Universal quantification* and *Existential quantification* with aid suitable examples. [16 mark

c) Convert the following into English sentences.

i. $\forall_X \forall_Y$ study(X) $\vee$ lucky (X) $\rightarrow$ pass (X, Y) $\wedge$ exam(Y)

ii. $\forall_X$ student (X) $\wedge$ result_AI (X, A Grade) $\rightarrow$ happy (X)

iii. $\forall_X$ student (X) $\wedge$ love (X, Mary) $\rightarrow$ happy (X)

iv. $\forall_X \forall_Y$ person (X) $\wedge$ play (X, Y) $\wedge$ football (Y) $\rightarrow \neg$ tall (X) [20 marks]

d) Consider the following paragraph:

Anyone who rides any Toyota car is a rough character. Every biker rides either Toyota car or a BMW car. Anyone who rides any BMW car is a yuppie. Ever yuppie is a lawyer. Any nice girl does not date anyone who is a rough characte Mary is a nice girl, and John is a biker.

i. Translate these statements into statements in *predicate logic*. [24 marks]

ii. Convert the predicates of part (i) into clause form. [18 marks]

iii. Prove that "*If John is not a lawyer, then Mary does not date John*" usin resolution. [12 marks]