



# THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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**MAIN EXAMINATION**

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**MAY – AUGUST 2021**

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**FACULTY OF SCIENCE**

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**DEPARTMENT OF COMPUTER AND INFORMATION SCIENCE**

**REGULAR PROGRAMME**

**CMT 208: INTRODUCTION TO ARTIFICIAL INTELLIGENCE**

**Date: AUGUST 2021**

**Duration: 2 Hours**

**INSTRUCTIONS: Answer Question ONE and any other TWO Questions.**

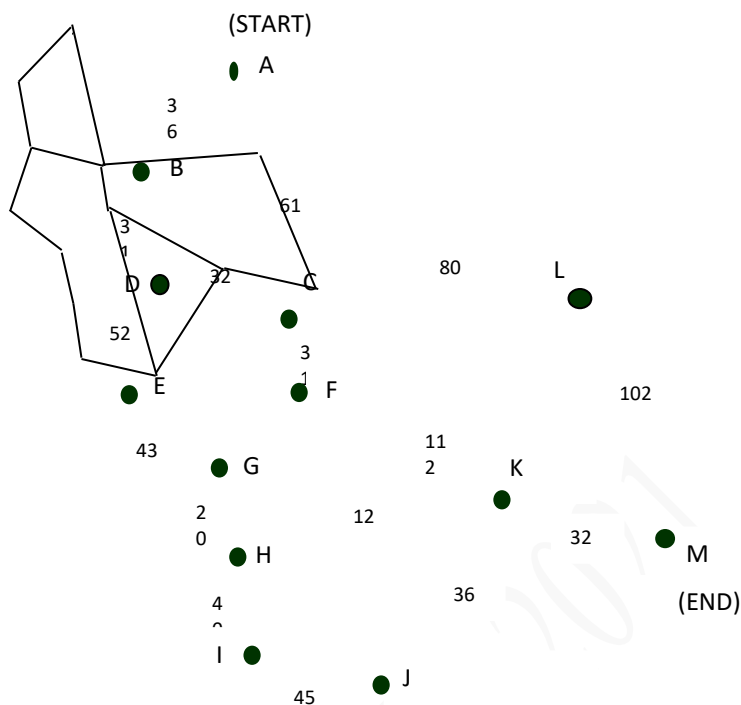
1. a) Define the following terms:

- i) Artificial intelligence (1 mark)
- ii) Agent (1 mark)
- iii) Heuristic search (1 mark)
- iv) Turing test (1 mark)
- v) Logic (1 mark)

b) Describe four ways of evaluating a search algorithm's performance. (4 marks)

c) Define four types of agents. (4 marks)

d) Consider the following map.



Straight line distance is given as:

A	233	E	165	I	100	M	0
B	222	F	136	J	60		
C	166	G	122	K	32		
D	192	H	111	L	102		

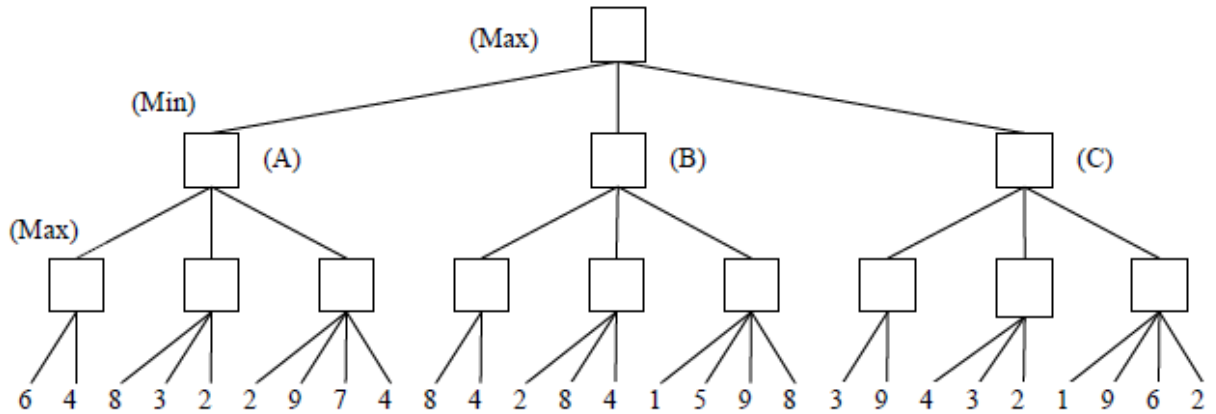
Using A\* search work out a route from town A to town M and provide the search tree that is produced. Show the cost function at each node. **(12 marks)**

e) Translate the following English sentences to first order logic.

i) Some dogs do not like any cats. **(4 marks)**

ii) Anyone passing his history exams and winning the lottery is happy. **(4 marks)**

2. a) Apply minimax with Alpha-beta pruning on the following game tree.



i) Cross out the leaf nodes and/or branches where alpha-beta prunes. **(7 marks)**

ii) Indicate the branch node values that are evaluated. **(3 marks)**

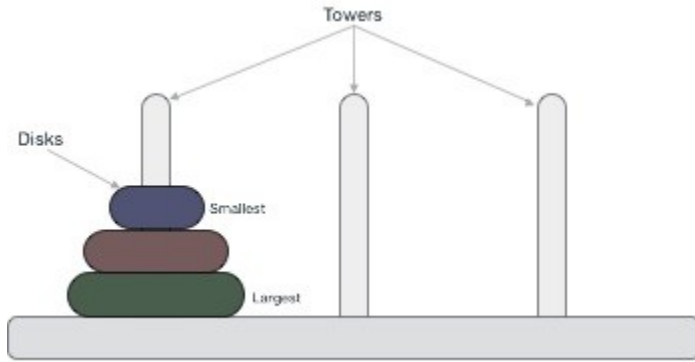
b) Fill in the value (yes/no) of the two evaluation criteria for each search strategy shown.

Criterion	Complete?	Optimal?
Breadth-first		
Uniform-cost		
Depth-first		
Depth-limited		
Iterative deepening		

**(10 marks)**

3. a) Consider the Towers of Hanoi Puzzle.

It consists of a collection of rings of different sizes and three posts mounted on a base. At the beginning all the rings are on the leftmost post as shown below and the goal is to move them all to the rightmost post by moving one ring at a time from one post to another. But at no time may a larger ring be placed on top of a smaller one. Find the solution using a search tree.

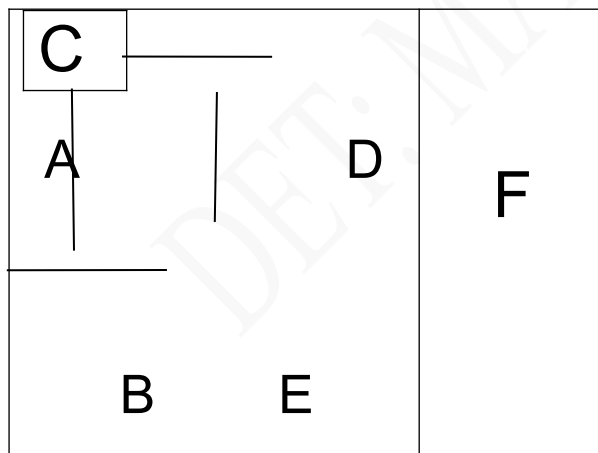


(10 marks)

b) Consider the water jug problem:

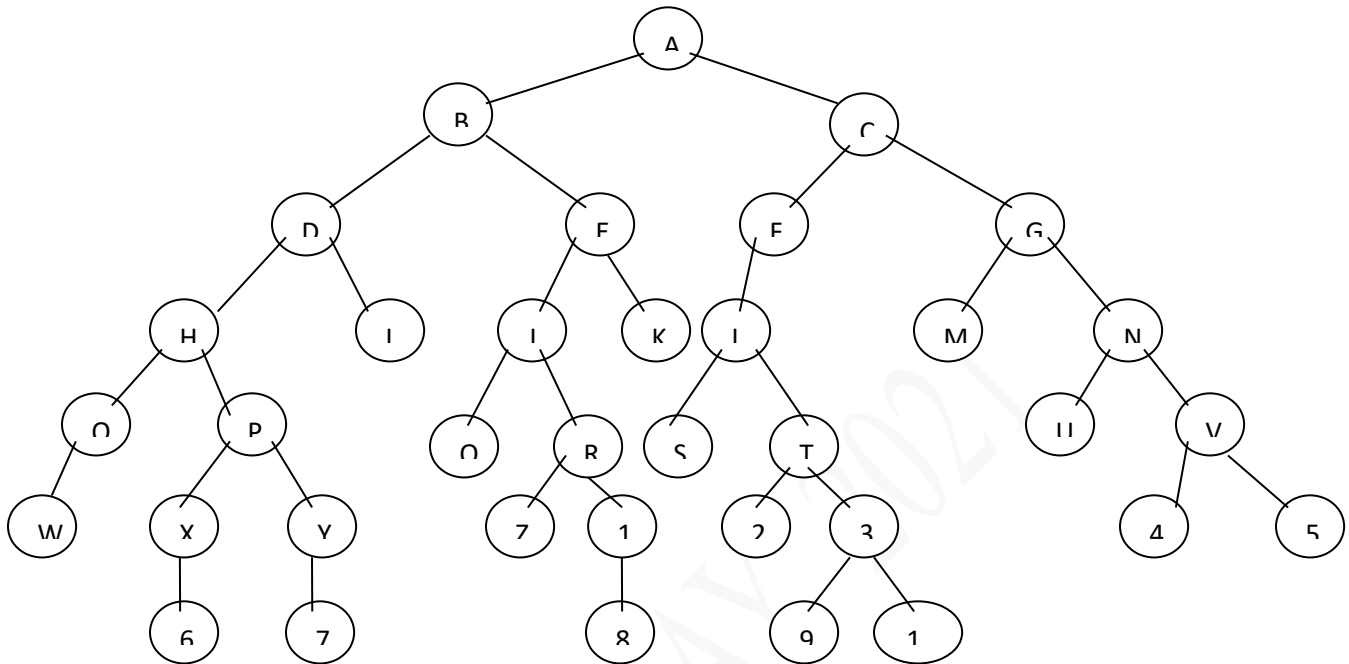
In the puzzle, you have three different sized jars, two containing water and you need to pour the water back and forth between the jars until you end up with an equal amount in two jars and nothing in the third jar. You start with an empty 19-liter jar, a full 13-liter jar and a full 7-liter jar. How can you have an empty jar and two jars containing 10 liters of water each? Use search tree to find solution. (10 marks)

4. a) Consider the following map. The task is to colour the map using three colours red, green and blue such that no two adjacent regions take the same colour. (10 marks)



b) Consider the state space below. Initial state is node A and goal state is node 10. Show the order of nodes as they are visited using:

- i) Breadth-first search (5 marks)
- ii) Depth-first search (5 marks)



5. a) For each English sentence below, write the first order logic sentence that best expresses its intended meaning.

- i) Every person eats every food **(2 marks)**
- ii) All persons are mortal **(2 marks)**
- iii) All greedy kings are evil **(2 marks)**
- iv) Mary has a sister who is Emmy **(2 marks)**
- v) There is someone at CUEA who is smart **(2 marks)**

b) Describe the four components that define adversarial search. **(4 marks)**

c) A task environment is a set of four things with the acronyms PEAS. List them.

**(4**

**marks)**

d) Both performance measure and utility function measure how well an agent is doing. Explain the difference between the two. **(2 marks)**