Final Assessment Test – November 2024

Course: BCSE306L - Artificial Intelligence

Class NBR(s): 1424/1428/1433/1437/1441/1453/1458/1463/1468/1472/1476/1478/1480/1482/1484/1487/1492/1495/1499/1503/3566/5795

Slot: E2+TE2

Time: Three Hours

Max. Marks: 100

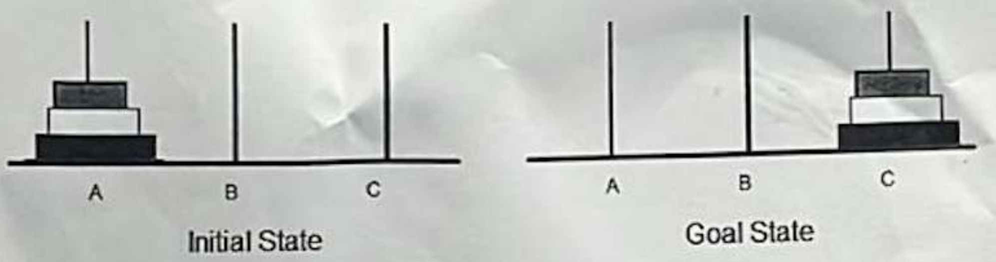
- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

Answer ALL Questions

(10 X 10 = 100 Marks)

1. Describe various AI environments (e.g., fully observable, partially observable, deterministic, stochastic, static, dynamic, discrete, continuous). How do these affect agent design and behaviour Provide examples to explain the same.

2. Formulate the Towers of Hanoi problem with the given initial and goal states.



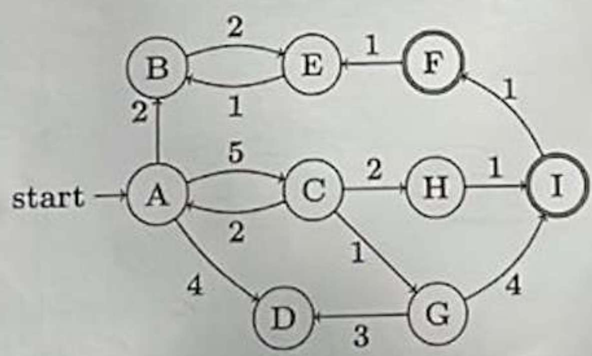
The goal is to move all the disks to another peg, following these rules:

I. Only one disk can be moved at a time.

II. A disk can only be moved to a peg that is empty or has a larger disk on top.

Draw the complete state space tree for this scenario.

3.



You are given the state space shown below, where A is the initial state, and F and I are goal states. The numbers on the edges indicate action costs. Explain how Depth First search and Breadth First search algorithm can be applied to find out the optimal path from initial state to the goal state for this problem. Discuss the advantages and disadvantages of these algorithms in this context.

4. Explain how simulated annealing can address the plateau problem in hill climbing. Provide an example to illustrate this solution.

5. A manufacturing facility has a set of jobs to be processed on a set of machines. Each job has a specific processing time on each machine. The goal is to schedule the jobs on the machines in a way that minimizes the total completion time by using genetic algorithm.

Consider that there are 4 jobs (A, B, C, D) and 2 machines (M1, M2). Jobs can be processed on any of the machines. For e.g., job A can be processed on either M1 or M2.

The processing times (in mins) for each job on each machine are given in the following table:

Job	M1	M2
A	3	5
B	2	4
C	4	2
D	5	3

[Hint to create the initial population: Chromosome 1: A(M1)B(M2)C(M1)D(M1). Fitness value of this is 3+4+4+5 = 16].

6. Consider a maze with the following layout:

Here • is the robot, G is the goal where the robot has to reach, white blocks are open and the shaded blocks are walls. The robot can move one step at a time.

Compare and contrast forward search and backward search algorithms for solving this maze navigation problem. Write every step.

Discuss the advantages and disadvantages of each approach.

7. Consider a scenario where multiple autonomous robots are tasked with exploring an unknown environment and mapping its layout. Discuss the challenges and strategies involved in planning and coordinating the actions of these robots in a continuous environment.

8. Consider the problem of image retrieval in a large-scale database of images. Discuss at least 4 challenges involved in image retrieval, the different approaches that can be used to address these challenges.

Write the factors that influence the effectiveness of image retrieval systems.

9.a) i) Write the logical representation of the following statements:

1. Every student who studies hard will pass the exam.
2. There exists a city such that all its residents are happy.
3. If it's sunny and there's no wind, then the picnic will be enjoyable.
4. There is a student who likes all math courses except for calculus.
5. Every dog has a bone, and every bone has a dog.

OR

9.b) ii) Given the following propositional logic formula: $(P \land Q) \rightarrow (R \rightarrow S)$

1. Determine whether this sentence is valid, satisfiable (but not valid), or unsatisfiable. Justify your answer with laws used for inference. 7
2. Convert the given sentence into CNF, showing each step.

10.a) A patient presents with symptoms of fever, cough, and fatigue. A doctor wants to diagnose whether the patient has influenza or a common cold. The doctor has prior knowledge about the prevalence of these diseases in the community and the probabilities of various symptoms given each disease.

Consider: Influenza (I), Common Cold (C), Fever (F), Cough (Co), Fatigue (Fa)

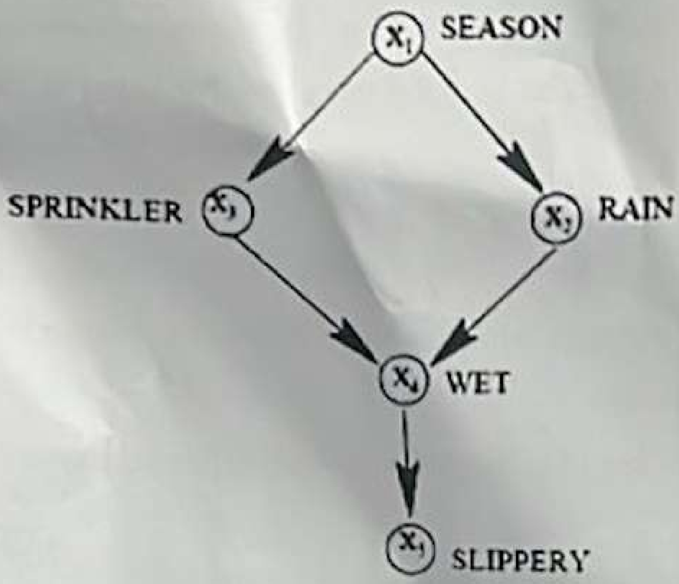
Edges: $I \rightarrow F$, $I \rightarrow Co$, $I \rightarrow Fa$, $C \rightarrow F$, $C \rightarrow Co$, $C \rightarrow Fa$

Probabilities: $P(I) = 0.2$, $P(C) = 0.8$, $P(F|I) = 0.9$, $P(F|C) = 0.7$, $P(Co|I) = 0.8$, $P(Co|C) = 0.6$, $P(Fa|I) = 0.7$, $P(Fa|C) = 0.5$

Given the patient's symptoms (fever, cough, and fatigue), what is the probability that the patient has influenza? Solve using Bayes' theorem.

OR

10.b) Consider the following scenario.



Domain of different variables are as follows:

Season = {Dry, Rainy}, Sprinkler = {On, Off}, Rain = {Yes, No}, Wet = {Yes, No}, Slippery = {Yes, No}.

Probabilities are as follows:

P(Season = Dry) = 0.6

P(Sprinkler|Season=Dry)= 0.8

P(Sprinkler|Season=Rainy)=0.2

P(Rain| Season=Dry) = 0.3

P(Rain| Season= Rainy) = 0.8

P(Wet|Rain=Yes,Sprinkler=On) = 0.8

P(Wet|Rain=No,Sprinkler=On) = 0.1

P(Wet|Rain=Yes,Sprinkler=Off) = 0.8

P(Wet|Rain=No,Sprinkler=Off) = 0.1

P(Slippery=Yes|Wet=Yes)=0.8

P(Slippery=No|Wet=No)=0.9

i) What is the probability of slippery if the season is dry?

ii) What is the probability of wet if the ground is slippery?

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