United International **University (UIU)**

Dept. of Computer Science & Engineering (CSE)

Mid Exam: Summer 2023

Course Code: CSE 3811, Course Title: Artificial Intelligence

Total Marks: 30 Duration: 1 hour 45 minutes

Answer all questions. Marks are indicated in the right side of each question.

[Any examinee found adopting unfair means will be expelled from the trimester/program as per UIU disciplinary rules.]

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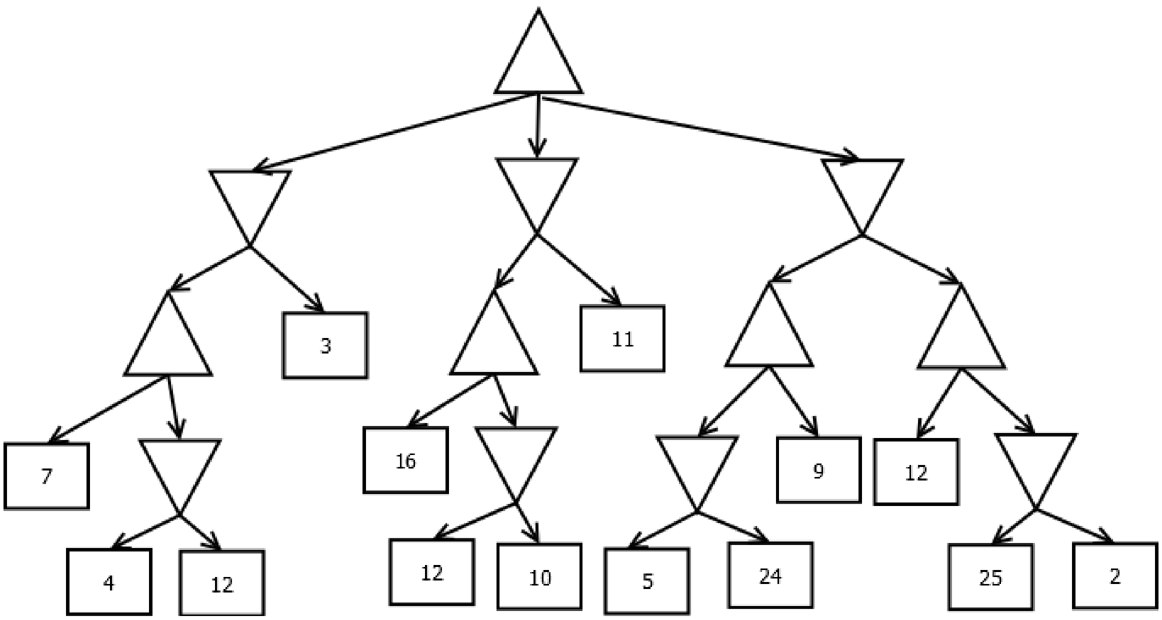
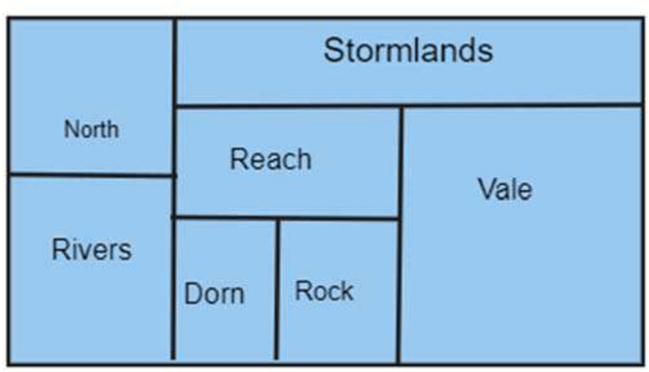
1. Consider the following game tree. **[4]**

Apply minimax search and show which nodes will be pruned **if you use alpha-beta pruning**.



2. Consider the following map of a Country where borders among the seven states have been marked. You need to color each of these divisions using three colors (Red/Green/Blue) such that two adjacent states do not receive the same color.
   Now formulate the problem as CSP, Show the Constraint Graph, and solve the problem must applying both Minimum Remaining Values(MRV) and Least Constraining Value(LCV) heuristics. **[2.5+2.5]**



3. You are designing an insect-killer robot for a sophisticated room. The robot can only detect 5 insects at a time inside the room. The success rate for killing an insect is 95%. If the insect dies then the bodies get disposed of automatically. Determine the PEAS specification for the agent. Characterize the agent's environment as Fully vs. Partially Observable, Deterministic vs. Stochastic, Episodic vs. Sequential, and Static vs. Dynamic. **[2]**

4.

A	A	A	A
A	A	A	A
B	K	A	A
A	B	A	A
A	B	A	A

t=0

A	A	A	A
A	K	A	A
B	K	K	A
A	B	A	A
A	B	A	A

t=1

You are given a room of n x m dimension divided into n x m cells. The positions are numbered using a row number and a cell number e.g. (1,2) means the cell in the 1st row and 2nd column. A cell can be of 'A' type or 'B' type. The top left of the cell is (1, 1) cell. The bottom right is (n, m) cell. At the beginning (t=0) there is a killer robot whose position is given. A killer robot produces 4 more killer robots in 4 adjacent cells in one unit of t (top, left, bottom, and right only if there aren't any robots in those cells already and the cell type being 'A' can't produce on 'B' type). You need to find out whether a given cell will get a robot or not given enough time. Now give a formal description of this search problem. **[2]**

5. a.

A	A	A	A
A	A	A	A
B	K	B	A
A	B	A	A
A	B	A	B

BFS target (1,4)

A* target (5,3)

In this problem, a n x m room is given and the position of the 'K' robot is given. The robot wants to travel to another place whose position is given too. It can move to the top, left, bottom, and right adjacent 'A' cells but not 'B' cells. You are trying to find the shortest path from the K robot's position to the target cell. [If P1 (x1, y1) and P2 (x2, y2) are two points then the Manhattan distance between those two is |x1 - x2| + |y1 - y2| & Euclidean distance is (x1 - x2)2 + (y1 - y2)2]

Draw the search tree for

i. A star search algorithm with Manhattan distance as a heuristic. (target is (5,3)) **[2]**

ii. BFS algorithm (target is (1,4)) **[2]**

Between Euclidean distance and Manhattan distance which heuristic is better choice for this case? **[1]**

b. Mark the following statements as true/false with proper reasoning: **[3]**

i. Greedy Best First search with admissible heuristic will always return the optimal solution.
ii. Uniform Cost Search is a special case of A* search.
iii. Depth limited search is complete if limit is greater than or equal to shallowest goal depth.

6. a. In route finding problem, straight line distance between cities is used as an admissible heuristic. Explain why this heuristic is admissible. **[1]**

b. Suppose you have three heuristic functions **h1, h2 and h3.** Among these **h1 and h2** are **admissible** but **h3** is **inadmissible**. You have decided to create several new heuristic functions defined as follows:

- h4(n) = 0
- h5(n) = 2 × h2(n)
- h6(n) = (h1(n)+h2(n))/2
- h7(n) = max(h1(n), h2(n))
- h8(n) = min(h1(n), h3(n))
- h9(n) = max(h2(n), h3(n))

Now answer the following questions: **[2]**

i. Which two heuristics are possibly inadmissible?
ii. Among h6 and h7 which one is dominant?
iii. Which heuristic will expand the maximum number of nodes?
iv. In your opinion which heuristic is the best?

7. a. Suppose you are trying to solve the problem mentioned in Question 2 with greedy hill climbing search. Now answer the following:

i. Design a proper heuristic function. **[1]**
ii. Will it be a maximization or minimization problem? **[0.5]**
iii. Can the algorithm guarantee optimal solution? Explain. **[1.5]**

b. Suppose you are using simulated annealing to solve a problem with the following schedule function:

$$T_k = \frac{T_{k-1}}{1+\alpha}$$

You have two values of α to choose from: 0.2 and 0.9. Which value will you choose and why? **[1.5]**

c. “Local beam search with k=1 is the same as greedy hill climbing search”—Is this statement true or false? Explain briefly. **[1.5]**