Kingdom of Saudi Arabia
Ministry of Education
College of Computer
Department of Computer Science

المملكة العربية السعودية
وزارة التعليم
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Course: CS 432 "Artificial Intelligence"
Second Semester 1445 (452)

Midterm Exam
Duration: 1 hour 15 minutes
Monday 25 / 3 / 2024

Marks 20 **/ 20**

Student Name:	Student ID:

Question	1	2	3	4	5	Total
Allocated mark	4	3	4	3	6	**20**
Earned mark						

Question 1: MCQs / Fill in the Blanks ***[4 marks]***

i. Mark all choices for costs d_{ij} that make running Uniform Cost Search (UCS) algorithm with these costs d_{ij} equivalent to running Breadth-First Search (BFS).

a. $d_{ij} = 0$
b. $d_{ij} = \alpha, \alpha > 0$
c. $d_{ij} = \alpha, \alpha < 0$
d. $d_{ij} = -1$
e. $d_{ij} = 1$
f. None of the above

ii. In the context of search algorithms, the set of all leaf nodes available for expansion at any given point is called _____

iii. A non-observable problem is a _____ problem.

a. Contingency
b. Conformant

iv. Let $h_1(n)$ be an admissible heuristic, and let $h_2(n)$ be an inadmissible heuristic. Then $(h_1 + h_2)/2$ is necessarily admissible.

a. True
b. False

Question 2 ***[3 marks]***

Given b as the branching factor, m as the maximum depth of the tree, and d as the depth of the shallowest goal node, fill the following table?

Algorithm	Time complexity	Space complexity
BFS		
DFS		
DLS		
UCS		
IDS		

Question 3: Intelligent Agents ***[2+2 Marks]***

i. Fill the following table by mentioning the performance measure, environment, actuators, and sensors (PEAS).

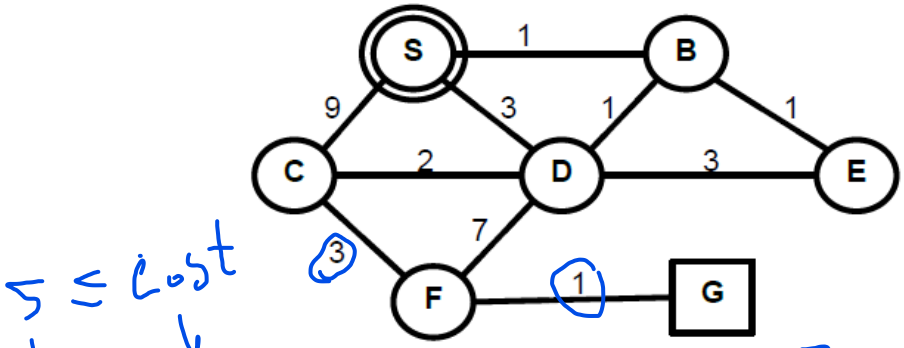
Type of Agent	**Performance Measure**	**Environment**	**Actuators** how the action perform	**Sensors**
Medical supply delivery drone				

ii. Categorize the environment into various types, e.g. single vs multi-agent

Environment types: _____, _____, _____, _____, _____,

Question 4: Heuristics ***[1.5 + 1.5 marks]***

Here, you are asked to compare different heuristics and to determine which, if any, dominate each other. You are executing Tree Search through this graph (i.e., you do not remember previously visited nodes). The start node is *S*, and the goal node is *G*. The actual step costs are shown next to each link. Heuristics are given in the following table. As is usual in your book, h* is the true (= optimal) heuristic; here, h_i are various other heuristics.



Node	h_1	h_2	h_3	*h* (optimal)*
S	*5*	*5*	*5*	*8*
B	*4*	*4*	*5*	*7*
C	*5*	*3*	*2*	*4*
D	*3*	*1*	*4*	*6*
E	*4*	*3*	*4*	*8*
F	*1*	*0*	*1*	*1*
G	*0*	*0*	*0*	*0*

i. Which heuristic functions are admissible among h_1, h_2 and h_3?

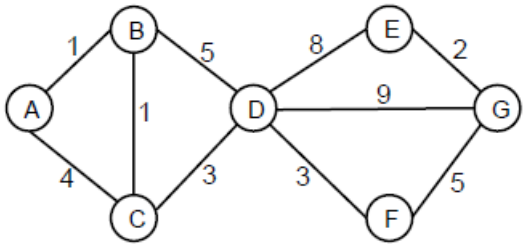
ii. Which of the following statements are true?

a. h_1 dominates h_2: _____
b. h_1 dominates h_3: _____
c. h_2 dominates h_1: _____
d. h_2 dominates h_3: _____
e. h_3 dominates h_1: _____
f. h_3 dominates h_2: _____

Question 5: Graph Search ***[1+1+1+1.5+1.5 marks]***

Consider the search graph provided next, where *A* is the start node and *G* represents the goal. The arcs are labeled with the cost of traversing them. List the sequence of node visits and the final path for the following algorithms.

When everything is the same, nodes should be visited in alphabetical order.



Node	*A*	*B*	*C*	*D*	*E*	*F*	***G***
h (n)	9.5	9	8	7	1.5	4	0

i. BFS: *Order of visiting* _____ *Path* _____

ii. DFS: *Order of visiting* _____ *Path* _____

iii. UCS: *Order of visiting* _____ *Path* _____

iv. Greedy Search:

Order of visiting _____ *Path* _____

v. A* Search:

Order of visiting _____ *Path* _____