DS & AI

Artificial Intelligence

Informed and Uninformed Search

Lecture - 02

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Topic : Artificial Intelligence

#Q. Consider the following graph:

What is the correct DFS traversal starting from node A? Assume that you visit alphabetically smaller nodes first.

done

A (A B S C D E H G F)

B (A B S C D E G F H)

C (A B S C H E D G F)

D (a B C S D E H G F)

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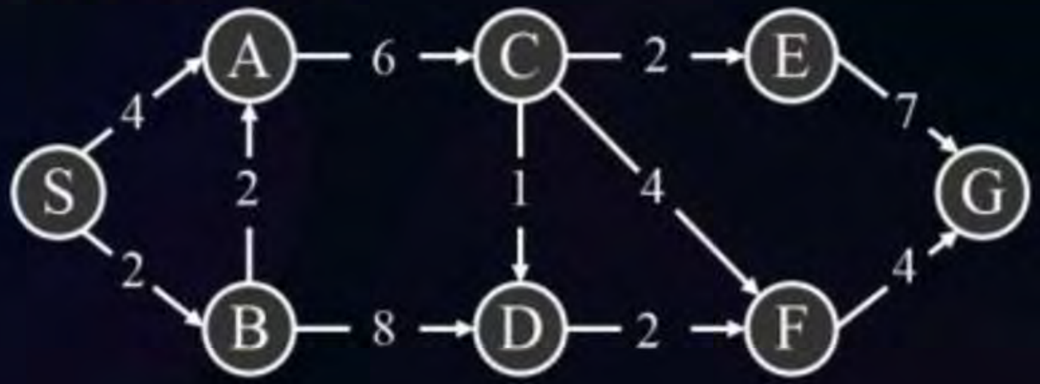
#Q. Consider the undirected graph given below where S is the start node and G is the goal node.

Apply A* algorithm to find the shortest path from node S to node G.

Note– Use alphabetical order for tie-breaker.

Use the heuristic value given in table for each node.

Find out the cost of shortest path found by A* for heuristic h1.



State	h_1	h_2
S	12	15
A	11	12
B	11	13
C	6	7
D	4	5
E	5	5
F	3	4
G	0	0

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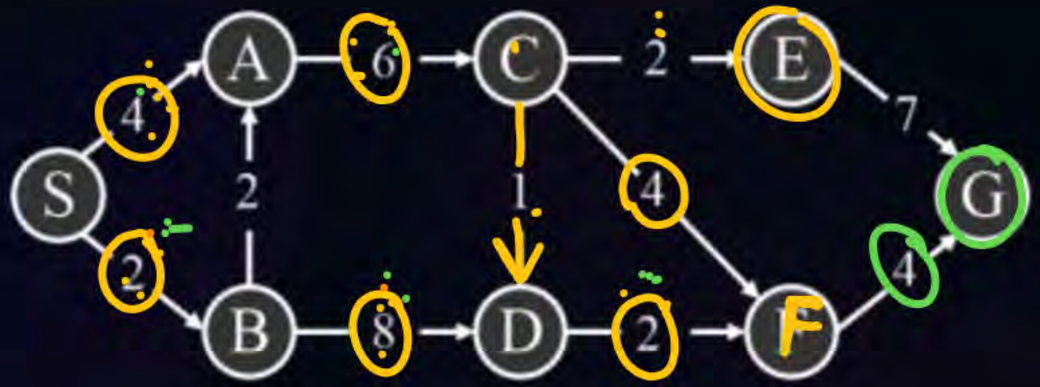
	S	B	D	A	F	C	G
S	0	0	0	0	0	0	
A	15	15	15	15	15	15	
B	13	13	13	13	13	13	
C	-	-	-	16	16	16	
D	-	14	14	14	14	14	
E	-	-	-	-	-	17	
F	-	-	15	15	15	15	
G	-	-				16	16

open list 1
Close list 7

Cost 16

is the start node and G

State	h_1	h_2
S	12	15
A	11	12
B	11	13
C	6	7
D	4	5
E	5	5
F	3	4
G	0	0



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	S	B	D	A	F	G
S	0	0	0	0	0	
A	16	16	16	16	16	
B	15	15	15	15	15	
C	–	–	–	17	17	←
D	–	15	15	15	15	
E	–	–	–	–	–	
F	–	–	16	16	16	
G	–	–	–	–	16	←

is the start node and G

State	h_1	h_2
S	12	15
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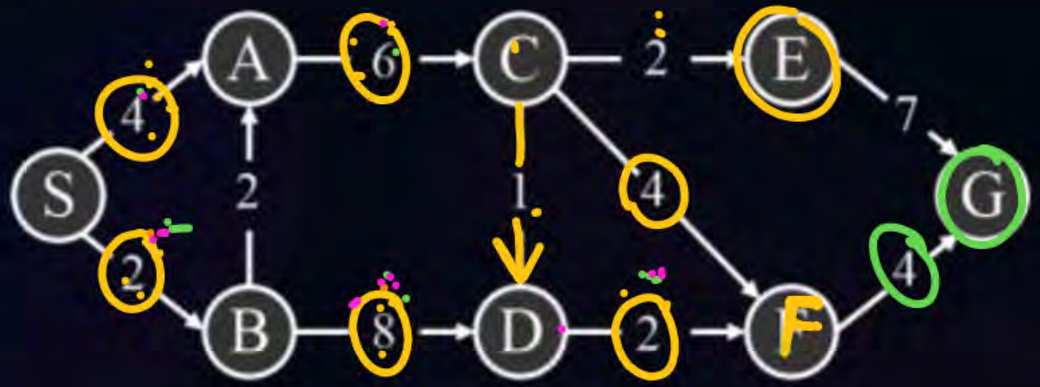
G	0	0



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#Q. In the below graph, what will be the nodes that still remain in OPEN list when "Goal" nodes is reached by DFS (depth first search) algorithm?
Note: When two nodes have same cost then take node in alphabetical order for tie breaker. And also function generates neighbour alphabetically.

A. E, D

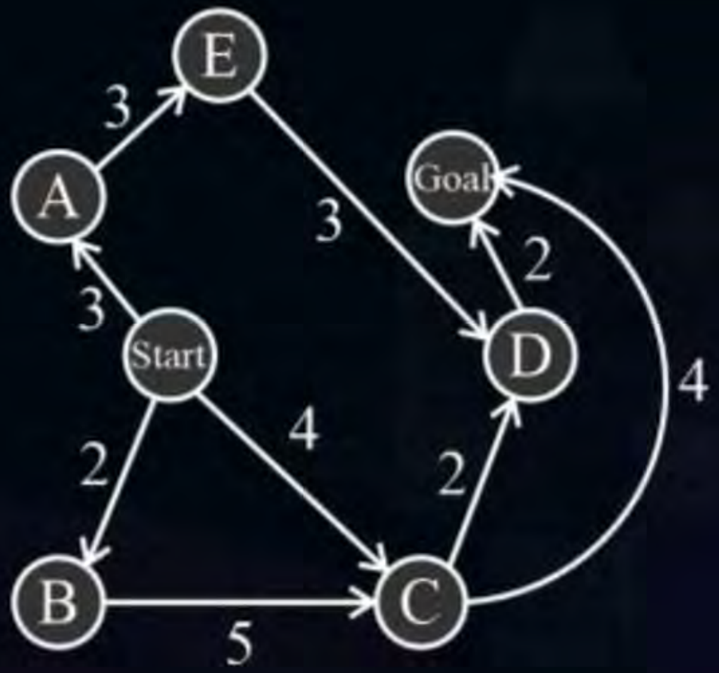
B. B, C ✓

C. A, B

D. A, B, D

Close S A E D G

Open ~~S~~ C B ~~X X X X~~



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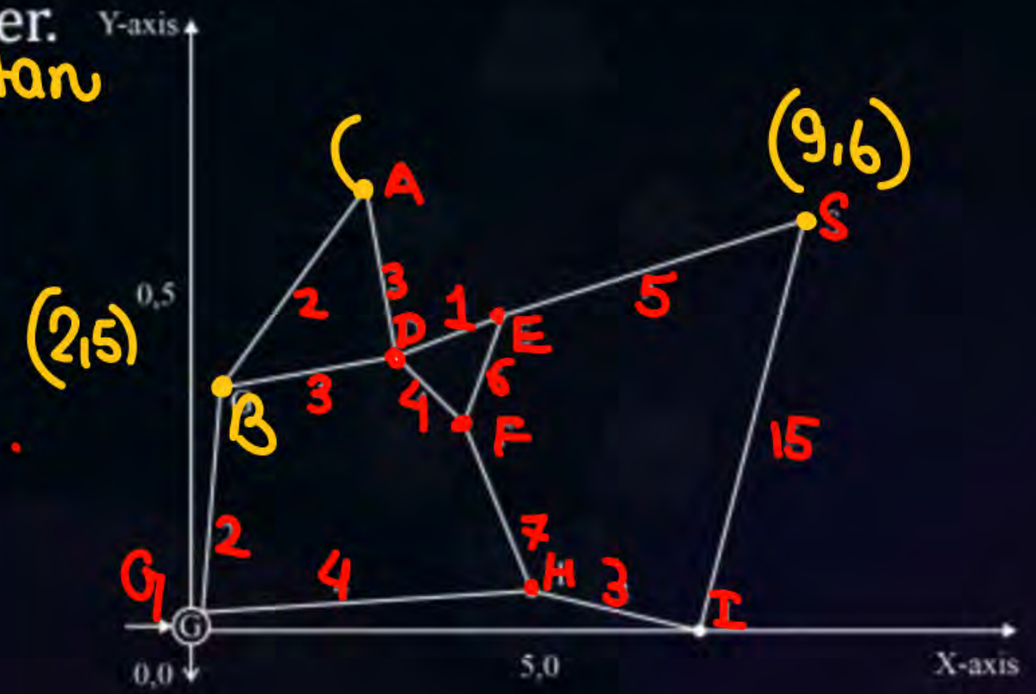
#Q. Consider the below undirected graph with cartesian coordinate in which G is the "Goal" node with coordinate (0,0) and S is the starting node with coordinate (9,6). Apply the A* algorithm on the below graph and find the node that is not generated as neighbour (except S) in searching for the shortest path from S to G with ~~euclidean~~ manhattan distance from G node as heuristic value and edge cost is given on the edge. Note If two nodes have same cost then for tie-breaker use alphabetical order.

A: 4,7	D = 4,5	H = 5,1	S: (9,6)
B: (2,5)	E = 5,6	I = 6,0	G: 00
	F = 5,4		



	S	E	D	B
S	0	0	0	0
A	–	–	20	20
B	–	–	16	16
D	–	15	15	15
E	16	16	16	16
F	–	20	19	19
H	–	–	–	–
I	21	21	21	21
G	—	—	—	11

H

A: 4,7 | D = 4,5 | H = 5,1 | S: (9,6)

B: (2,5) | E = 5,6 | I = 6,0 | G: 00

F = 5,4

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#Q. In the context of Breadth-First Search (BFS), what does 'b' represent in the time and space complexity?

A Branching factor

B Depth of the shallowest solution

C Maximum depth of the search tree

D Cost of each action

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#Q. Which of the following statements accurately describes the concept of state space?

A State space is the set of all actions that an agent can take in a given environment.

B State space is a representation of an agent's internal through processes.

C State space is the set of all states that can be reached from the initial state by any sequence of actions.

D State space is a measure of an agent's computational complexity.

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#Q. Which search algorithm combines the benefits of depth-first and breadth-first search?

A Uniform-Cost Search

B Iterative Deepening DFS ✓

C Depth-Limited Search

D Bidirectional Search

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#Q. When are the two frontiers in Bidirectional Search checked for intersection to find a solution?

Next Class

A When nodes are generated

B After the search is complete

C During the goal test

D When nodes are expanded

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#Q. What data-structures are used to store OPEN/FRONTIER nodes, in BFS and DFS algorithms, respectively?

done

A. Queue, Stack

B. Stack, Stack

C. Queue, Queue

D. Stack, Queue

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#Q. For FINITE state spaces that have a path from start to goal, which of the following algorithms will always find a path?

MSQ

A. Iterative Deepening Depth First Search

B. Depth Limited Search

C. Depth First Search

D. Breadth First Search

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#Q. For INFINITE state spaces that have a path from start to goal, which of the following algorithms will always find a path?

b,d

A. Depth First Search

B. Breadth First Search

C. Depth Limited Search

D. Iterative Deepening Depth First Search

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#Q. Consider the following statements:

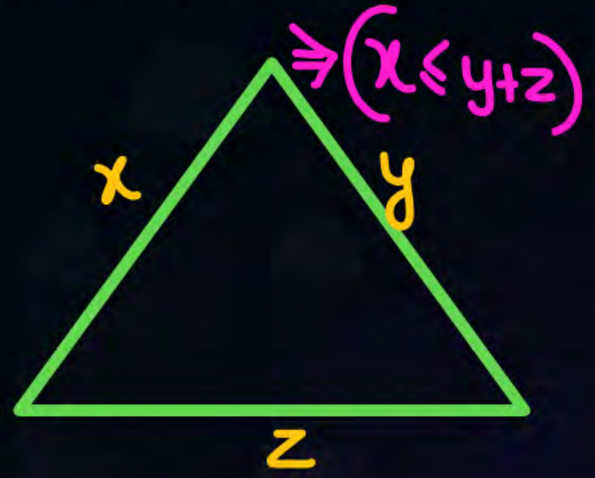
S1: A heuristic is admissible if it never overestimates the cost to reach the goal.

(Consistent)

S2: A heuristic is monotonous if it follows triangle inequality property.

$\rightarrow (h(n) \leq h(\text{neighbou}) + C_{n\text{-neigh}})$

Which one of the following is true referencing the above statements?



A. Statement S1 is true but statement S2 is false.

B. Statement S1 is false but statement S2 is true.

C. Neither of the statements S1 and S2 are true.

D. Both the statements S1 and S2 are true. ✓

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#Q. What are the Advantages of A* Search Algorithm in Artificial Intelligence?

I. Memory usage
II. Completeness
III. Efficiency
IV. Heuristic accuracy
V. Optimal solution

A) I, II, III

B) II, III, IV

C) II, III, V

D) III, IV, V

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#Q. Which of the following is/are not an Uninformed Search algorithms:

I. Breadth-first search
II. Greedy Search
III. Depth limited search
IV. A* Search
V. Iterative deepening depth-first search

A I, II only

B II and IV only

C III, IV and V only

D I, II, and IV only

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#Q. Consider the following statements:

S_1: If the heuristic h(n) overestimates the actual cost to the goal, then A* algorithm will still be optimal.

S_2: IDDFS guarantees the optimal solution for all types of problems.

S_3: IDDFS performs better than DFS in the term of space complexity.

Which of the following is false?

A. Only S_1

B. Only S_1 and S_3

C. Only S_1 and S_2

D. Only S_2 and S_3

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#Q. Which of the following algorithm is backtracking algorithm?

MSQ

b, c

A Greedy Best-first search

B Min-max algorithm

C Depth first search

D A* algorithm

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#Q. Which of the following statements is/are correct a heuristic function that makes it 'consistent' (or 'monotonic')?

S_1: The heuristic function h(n) must be non-negative for all nodes n.

S_2: For any node n and any successor n' reached from rn, the heuristic function must satisfy $h(n) \leq c(n, n') + h(n')$, where c(n, n') is the step cost from n to n'.

(done) ©

A Only S_1

B Only S_2

C Both S_1 and S_2

D Neither S_1 nor S_2

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#Q. Which of the following statements is/are correct?

S_1: DLS guarantees finding the shortest path if the depth limit is sufficient.

S_2: BFS always find the optimal solution, if the path cost is uniform across all edge.

- DFS give non optimal sol

In BFS → algo avoids the path cost and it give the optimal path that has min No of edge from S → G

S_2

(A) Only S_1

(B) Only S_2 ✓

(C) Both S_1 and S_2

(D) None of these

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#Q. Which of the following statements is/are true?

MSQ

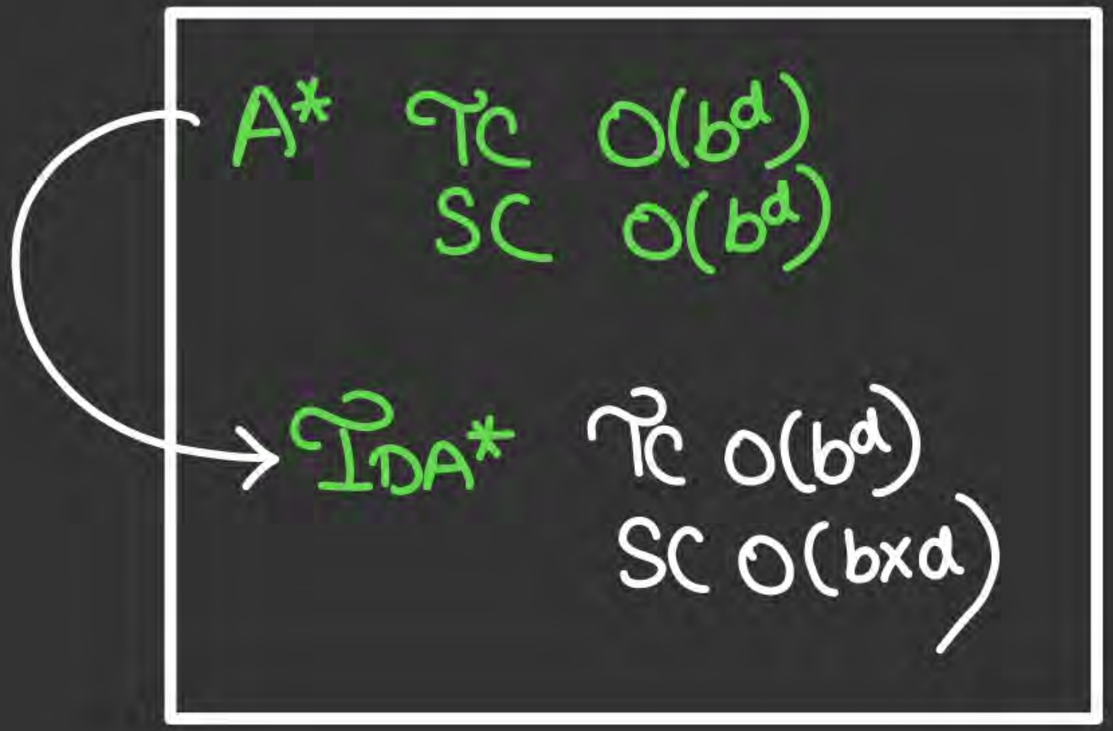
- If heuristics are not admissible then can A* give optimal sol.
  IDA* false.

A. In IDA*, the heuristic function h(n) must always overestimate the cost to the goal to ensure optimality. (False)

B. IDA* performs worse than A* in terms of memory usage for large search spaces. (False)

C. IDA* can revisit nodes multiple times due to its iterative nature. ✓

D. The time complexity of IDA* is always lower than that of A*.



Dfs: TC : O(b^d)
SC : O(bxd)

IDDFS: TC : O(b^d)
SC : O(bxd)

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#Q. Which of the following statements about Uniform Cost Search (UCS) is/are true?

UCS → Priority Queue

If Cost of each edge Same then BFS ≡ UCS

(a, b, c)

A. UCS is similar to BFS but considers the cost of the path when choosing nodes to expand.

B. UCS guarantees finding the optimal solution for graphs with varying edge costs.

C. UCS can be more efficient than BFS in terms of memory usage if edge costs vary significantly.

D. UCS can be implemented using a stack data structure.

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#Q. Which of the following statements about Breadth-First Search (BFS) and Depth-First Search (DFS) are correct?

S_1: DFS can be used to find solutions in graphs with deep solutions efficiently if memory is not a constraint.

S_2: BFS requires less memory than DFS when dealing with very large search spaces.

S_3: DFS is more likely to get stuck in infinite loops than BFS if the graph contains cycles.

A. Only S_1 and S_2

B. Only S_2 and S_3

C. Only S_1 and S_3

D. S_1, S_2 and S_3

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#Q. Consider the following scenario:
In an A* search algorithm, the heuristic function(x) is admissible. Suppose this heuristic is modified to h(x) + c, where c is a positive constant.
What impact does this change have on the A search algorithm?

Optimal Sol, admissible ✗ Consistent ✗

A A* may still find the optimal path, but it will not be admissible.

B A* will still be admissible, but the search will be less efficient.

C A* will no longer be admissible and may not find the optimal path.

D The change has no impact on the admissibility or efficiency of the A search algorithm.

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#Q. Which of the following statements correct about minimax search with heuristic evaluation?

S_1: Heuristic function estimate the value of incomplete non-terminal states.

S_2: Minimax with heuristic evaluation always find the optimal move, regardless of heuristic quality.

A Only S_1

B Only S_2

C Both S_1 and S_2

D None of these

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#Q. Consider the following statements:

(a) If a heuristic is both admissible and consistent, A* search is optimal and complete.

(b) A consistent heuristic is always admissible, but an admissible heuristic is not necessarily consistent.

(c) The A* search algorithm is guaranteed to find the optimal solution, even if the heuristic used is not admissible.

(d) A heuristic that always returns the actual cost to the goal is admissible but not useful for reducing the search space.

Which of the above is/are correct?

A a

B b

C c

D d

#Q. Consider two heuristics h_1 and h_2 for the A* algorithm applied to the graph in

1. $h_1(n)$ = Manhattan distance to F.
2. $h_2(n) = 2 \times$ actual cost to F.

Which of the following is correct?

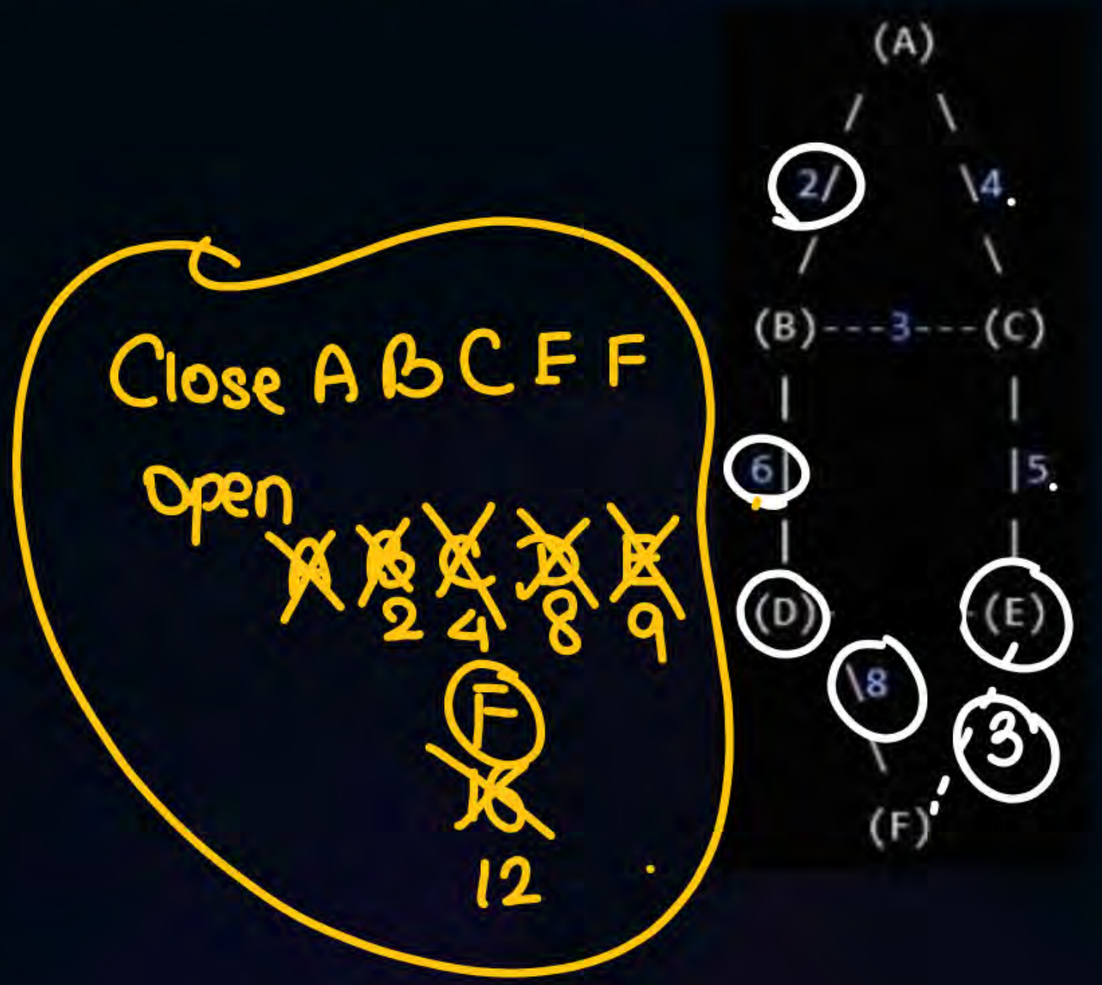
A Both h_1 and h_2 are admissible.

B h_1 is admissible, but h_2 is not.

C Both h_1 and h_2 are inadmissible.

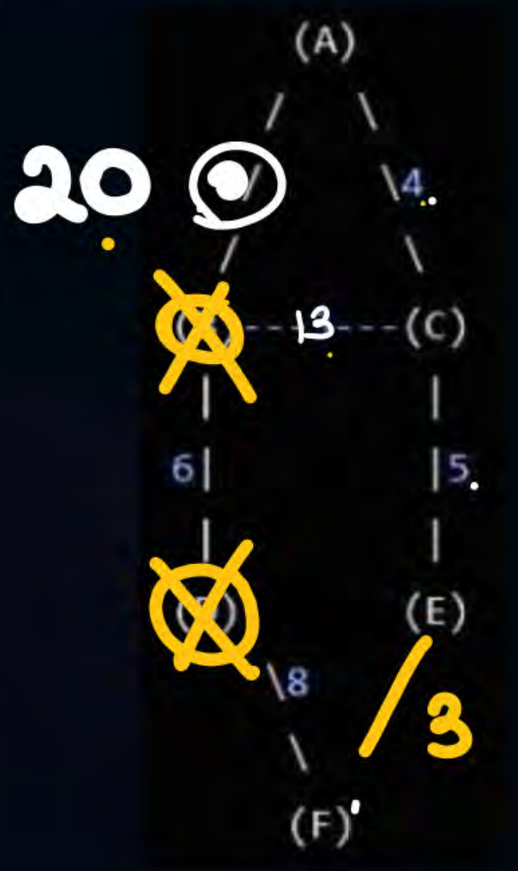
D Neither h_1 nor h_2 can be used for A∗.

#Q. Question: What is the total cost of the shortest path?



	A	B	C	D	E	F
A	0	0	0	0	0	
B	2	2	2	2	2	
C	4	4	4	4	4	
D	-	8	8	8	8	
E	-	-	9	9	9	
F	-	-	-	16	12	

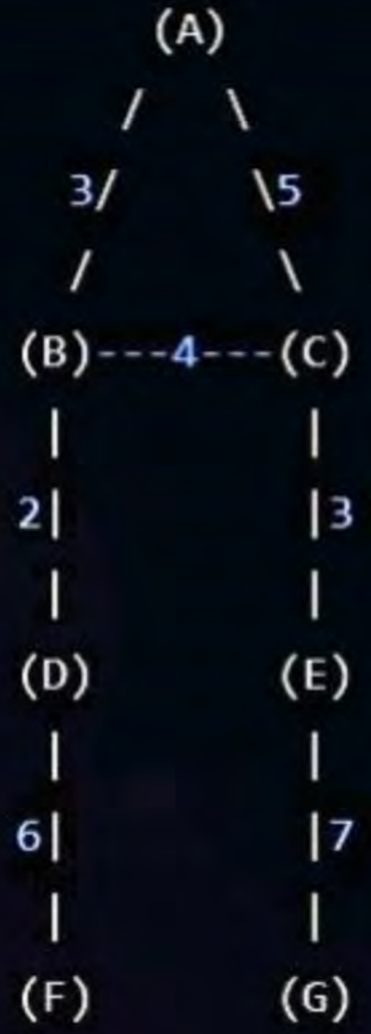
#Q. Question: What is the total cost of the shortest path?



✓	A	C	E	F
A	0	0		
B	20	17		
C	4	4		
D	-	-		
E	-	9		
F	-	-		12

#Q. DFS is applied starting from node 1, exploring the leftmost child first. How many times is a node pushed onto the stack during the DFS traversal of this graph?

#Q. You need to find the shortest path from A to any of the goal nodes {F, G} using UCS.



#Q. For any binary classification dataset, let $S_B \in \mathbb{R}^{d \times d}$ be the between-class and within-class scatter (covariance) matrices, respectively. The Fisher linear discriminant is defined by $u^* \in \mathbb{R}^d$, that maximizes

$$J(u) = \frac{u^T S_B u}{u^T S_W u}$$

If $\lambda = J(u^*)$, S_w is non-singular and $S_B \neq 0$, then (u^*, λ) must satisfy which ONE of the following equations?

Note: 1R denotes the set of real numbers.

A $S_w^{-1} S_B u* = \lambda u*$

B $S_w u* = \lambda S_B u*$

C $S_B S_w u* = \lambda u*$

D $u*^T u* = \lambda^2$

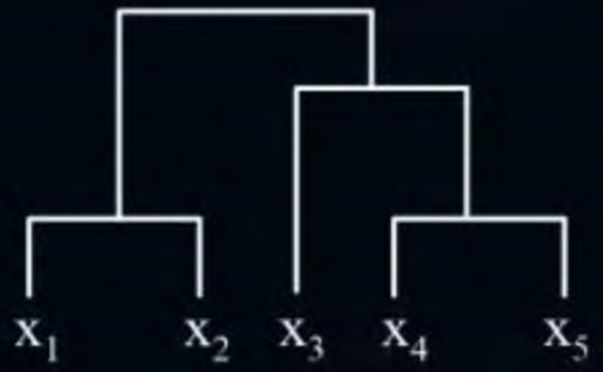
#Q. Consider the table below, where the $(i, j)^{th}$ element of the table is the distance between points x_i and x_j. Single linkage clustering is performed on data points. x_1 x_2, x_3, x_4, x_5.

	x_1	x_2	x_3	x_4	x_5
x_1	0	1	4	3	6
x_2	1	0	3	5	3
x_3	4	3	0	2	5
X_4	3	5	2	0	1
x_5	6	3	5	1	0

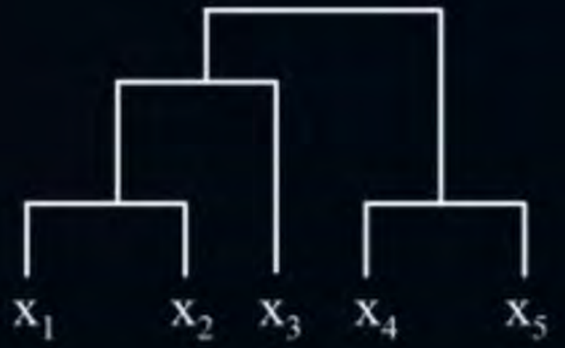
Which ONE of the following is the correct representation of the clusters produced?

Continue...

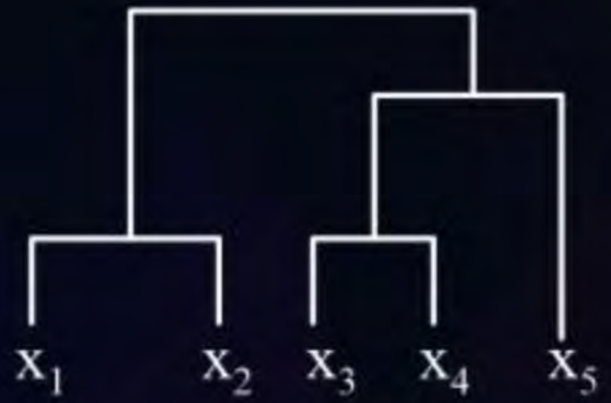
A



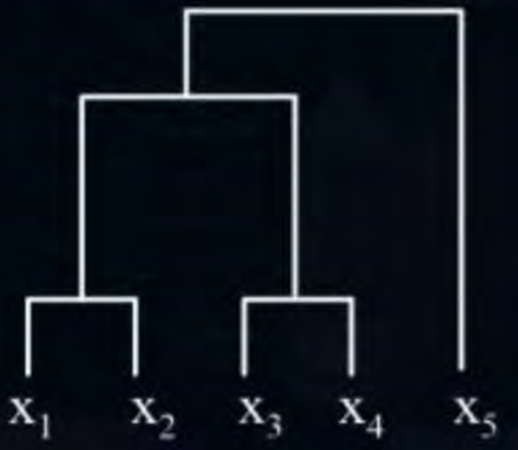
B



C



D



#Q. Consider the grid world shown in the figure below. An agent is planning to move from the starting location (x_s,y_s) to the final location (x_f,y_f). The obstacles along the path are triangular in form.
Consider the following heuristic functions to conduct A* search.

(a) h_c assumes the obstacles are the smallest circles circumscribing the triangles.

(b) h_r'assumes the obstacles are smallest rectangles circumscribing the triangles.

(c) h_c' assumes the obstacles are largest circles inscribed in the triangles.

(d) h_r' assumes the obstacles are largest rectangles inscribed the triangles.

Continue...

Which of the following statement(s) is (are) true?

A h_c is an admissible heuristic

B h_r is an admissible heuristic

C h_c' is an admissible heuristic

D h_r' is an admissible heuristic

#Q. Consider the search space depicted in the figure below. S is the initial state.

Continue…

#Q. G1 and G2 are two states that satisfy the goal test. The cost of traversing from one state to another is depicted by the numerical value close to the edge connecting the two states. The estimated cost to the goal is reported inside the states. Use alphabetical order of nodes to break ties. Which goal state is reached if you perform an A* (graph) search? What is the largest value that the heuristic function can take for node B while still being admissible?

A G1 and 18

B G1 and 17

C G2 and 18

D G2 and 17

#Q. Consider the grid world shown in the figure below.

An agent is planning to move from the starting location (x_s, y_s) to the final location (x_f, y_f). The obstacles along the path are circular in form.

Consider the following heuristic functions to conduct A* search:

- h_a: assumes the obstacles are the largest squares inscribed in the circles.
- h_b: assumes the obstacles are the smallest squares circumscribing the circles.
- h_c: assumes the obstacles are the largest hexagons inscribed in the circles.
- h_d: assumes the obstacles are the smallest hexagons circumscribing the circles.

Which of the following statements is(are) true?

Continue…

#Q. Consider Which of the following statements is(are) true?

A G1 and 18

B G1 and 17

C G2 and 18

D G2 and 17

THANK - YOU