INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Mid-Spring Semester Examination 2023-24

Date of Examination: 20/02/2024 **Session:** AN **Duration:** 2 Hrs **Full Marks:** 50

Subject No. AI61005 **Subject:** Artificial Intelligence: Foundations and Applications

Department/Center/School: Centre of Excellence in Artificial Intelligence

Specific charts, graph paper, log book etc., required NO

Special Instructions (if any) : Answer all the parts of a question in same place

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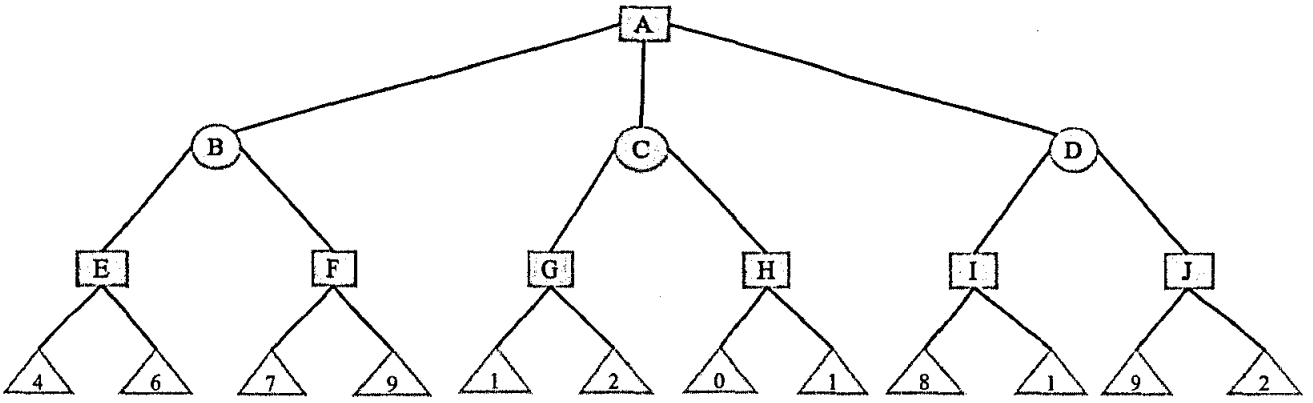
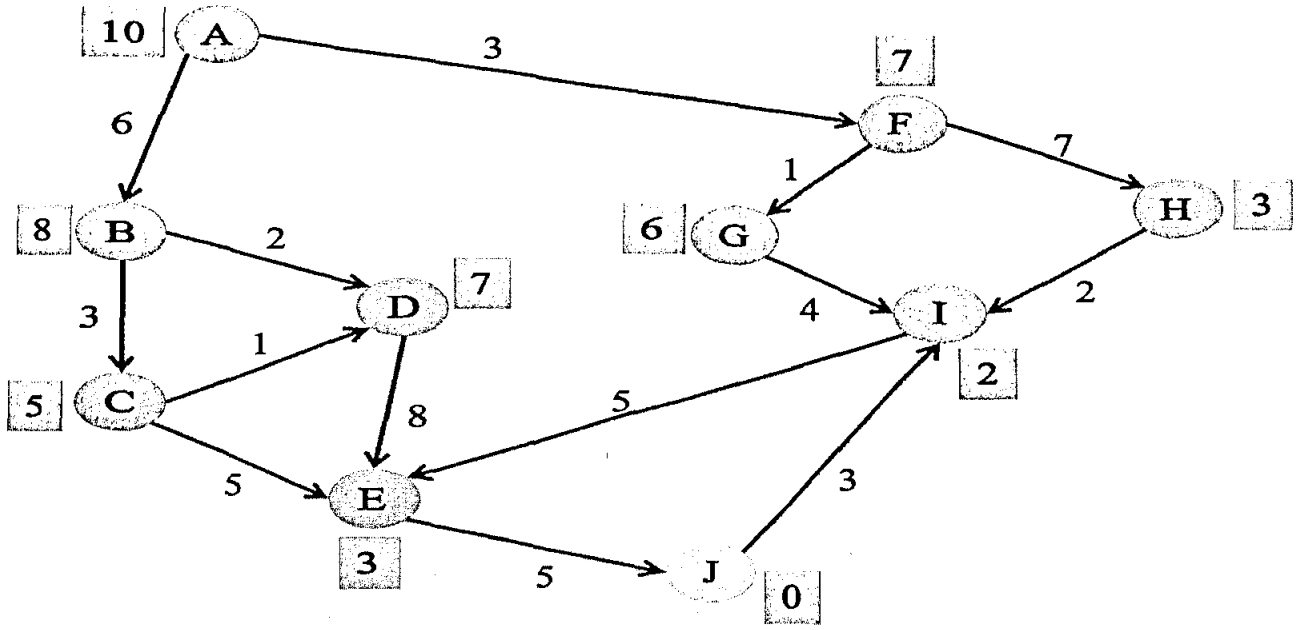
1) Consider the following tree where circles represent min and squares represent max node. The leaf nodes contain scores. Apply alpha beta pruning to find out best score of the root node (A). Show the scores, alpha, beta values at each node. Show the updates in those values during the execution of the algorithm. [10]



2) Consider following state space graph where A is the start node and J is the goal node. Edge costs are mentioned besides the edges. The heuristic values are shown beside the nodes in square boxes. Run A* algorithm on the graph and fill the following table. [6]

OPEN SET	SELECT	GOAL	EXPANDED	CLOSED



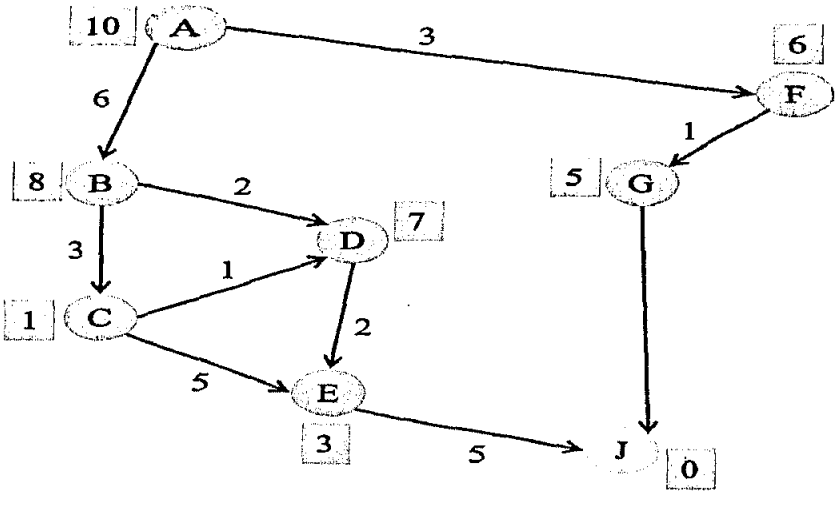
3) Consider a search problem where the branching factor is 10. The depth of the tree is 5. The goal is node 35 at depth 3 (depth count start from 1). The node numbers start from 1 in each depth. Find out the total number of nodes need to be expanded in the following search strategies. [4x2.5=10]

(a) BFS (b) DFS (c) Iterative DFS, cutoff = 2 (d) Iterative DFS, cutoff = 3

4) If h1 and h2 are admissible heuristics, which of the following are also guaranteed to be admissible? Give brief justification for each of them. [3]

a. h1 + h2 (b) max(h1,h2) (c) $\frac{1}{2}h1 + \frac{1}{2}h2$

5) Consider the following state-space graph. Find out whether the heuristic satisfies monotone property. If not, adjust and write the new heuristic values. [1 + 3]



6) Consider the following axioms: [8]

F1: Every child loves every candy

F2: Anyone who loves some candy is not a nutrition fanatic

F3: Anyone who eats any pumpkin is a nutrition fanatic

F4: Anyone who buys any pumpkin either carves it or eats it

F5: John buys a pumpkin.

F6: Lifesavers is a candy

Prove the following goal based on above axioms using resolution-refutation in Predicate logic.

G: If John is a child, then John carves some pumpkin

7) Convert the following sentences in FOPL [2+2+2=6]

a. You can fool some of the people all of the time

b. There is a fox that is faster than all snails

c. Not all students like homework

8) Prove logical equivalence of the following formula using proposition logic without truth table. [3]

$$(P \rightarrow R) \wedge (Q \rightarrow R) \leftrightarrow (P \vee Q) \rightarrow R$$