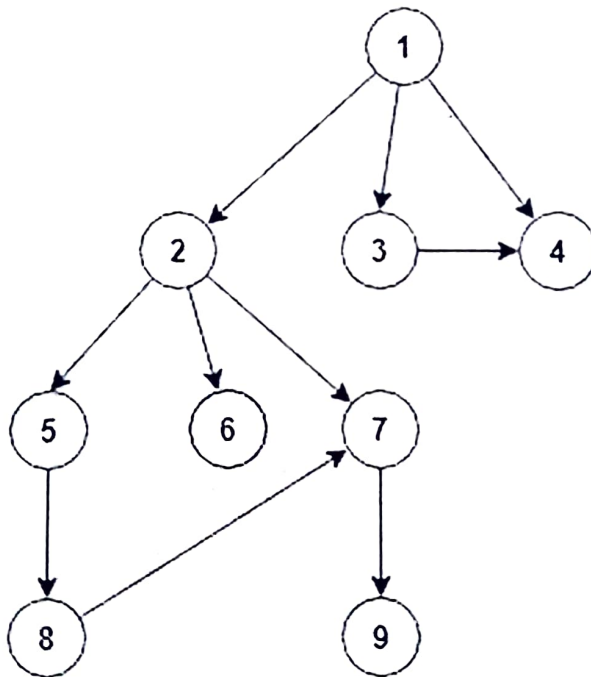




- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

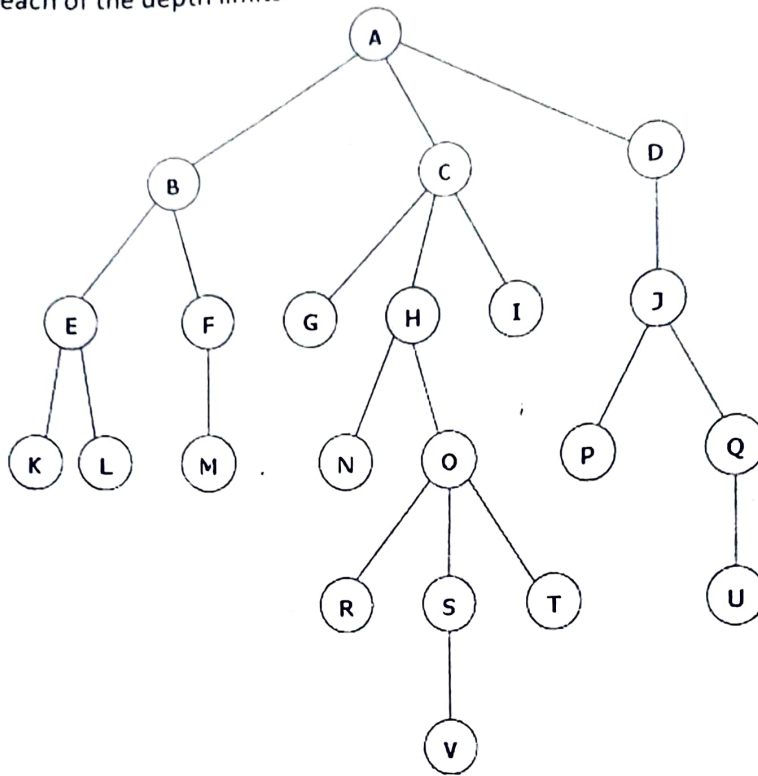
Answer ALL Questions  
 (10 X 10 = 100 Marks)

1. Suppose you have 5 different medical datasets. A dataset of MRI images, a dataset of ECG, a dataset of digital notes by clinicians, a dataset of Mammograms, a tabulated dataset of patient demographics and vitals. Identify the type of medical data for each dataset. Also, discuss the different types of AI models suitable for each dataset.
- 2.a) Perform the Depth-First Search (DFS) on the following graph to traverse all the nodes starting from node 1. Show all the stack operations and write the final traversal path.

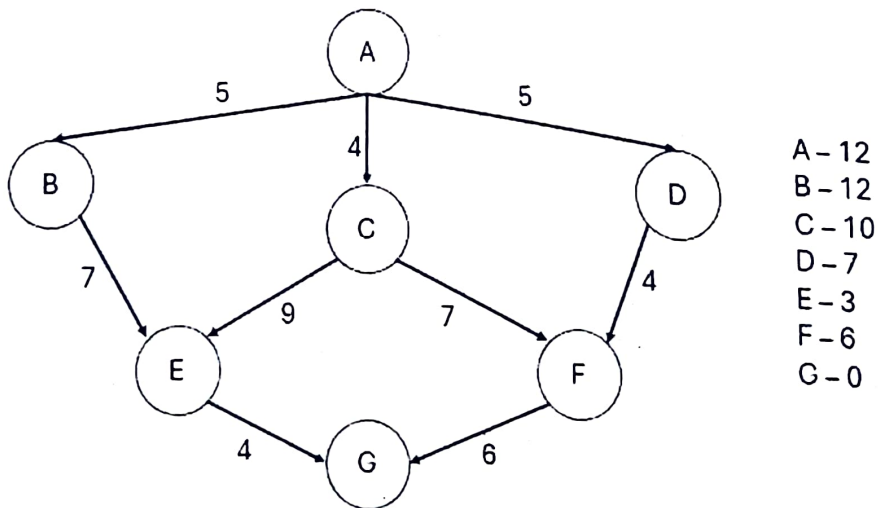


OR

- 2.b) Perform the Iterative Deepening Depth-First Search (IDDFS) on the following graph. **A** is the start node and **O** is the goal node. Show all the steps. Write the traversal paths for each of the depth limits.

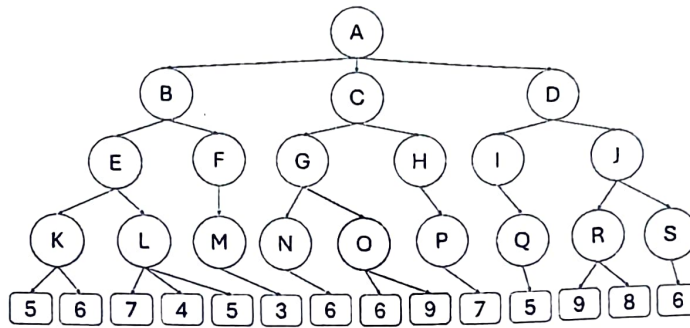


- 3.a) Find the optimal path from the start node **A** to goal node **G** using the Recursive Best First Search (RBFS). Path costs are given in the state space and the heuristic value for each node is given on the right side of the state space. Show all the steps.



OR

- 3.b) Perform Alpha Beta Pruning on the tree given below that MAX starts the game at node A. After completing the algorithm, show node values, final alpha and beta values for each node, and determine the decision value. What are the pruned nodes in the tree?



4. Find out the linear regression equation for the following set of the data with two variables?

|     |   |   |   |   |
|-----|---|---|---|---|
| $x$ | 3 | 9 | 5 | 3 |
| $y$ | 8 | 6 | 4 | 2 |

If the same data is used for logistic regression with threshold 0.5, then calculate the output (0 or 1) for  $x = 4$ .

5. a) What are differences between Bagging and Random Forest?  
b) Differentiate between Stacking and Blending methods of training the Meta-Learner in Heterogeneous Ensemble.
6. Suppose you have 7 different medicines which are characterized by two features – pH and Weight Index. Your objective is to divide these medicines into two clusters.

| Medicine | pH  | Weight Index |
|----------|-----|--------------|
| M1       | 1   | 1            |
| M2       | 1.5 | 2            |
| M3       | 2.5 | 4            |
| M4       | 5   | 7            |
| M5       | 3.5 | 5            |
| M6       | 4.5 | 5            |
| M7       | 3.5 | 4.5          |

Using k-means clustering, determine the clusters after 2 iterations. Use M1 and M4 as initial centroids and Euclidean Distance as the distance measure.

7. Suppose you are an AI Engineer, and you have a task to train an AI model to identify whether a brain tumour is Malignant or Benign. You have data of 5000 patients from different modalities. You have brain MRI images where the images are labelled in groups of 5, i.e., per 5 images are labelled as either Malignant or Benign; EEG data out of which only 1000 are labelled; EHR data where many patients are wrongly labelled. Design a Multimodal AI using suitable Weakly Supervised Learning for each modality with appropriate justification.
8. Apply the convolution on RGB image of 5X5X3 dimension using 3X3X3 filter, (1,1) padding, (1,1) stride, and determine the resultant image. The image and filters are given below –

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2 | 1 | 2 | 1 | 2 | 2 | 0 | 2 | 0 | 2 | 0 | 1 | 0 | 2 |
| 1 | 2 | 2 | 1 | 2 | 0 | 2 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| 2 | 0 | 0 | 2 | 1 | 2 | 1 | 0 | 2 | 1 | 2 | 2 | 1 | 2 | 2 |
| 2 | 1 | 1 | 0 | 1 | 2 | 2 | 2 | 0 | 0 | 2 | 0 | 2 | 2 | 2 |
| 1 | 0 | 1 | 2 | 0 | 0 | 2 | 1 | 2 | 0 | 2 | 0 | 0 | 1 | 0 |

Red

Green

Blue

RGB Image

|    |    |    |    |   |   |    |   |    |
|----|----|----|----|---|---|----|---|----|
| 1  | -1 | 0  | -1 | 0 | 1 | 0  | 0 | -1 |
| 0  | 1  | -1 | -1 | 1 | 0 | -1 | 1 | 0  |
| -1 | -1 | 1  | -1 | 0 | 1 | 0  | 1 | 1  |

Red

Green

Blue

RGB Filter

Then apply Max Pooling using 2X2 filter, no padding, (1,1) stride, and determine the resultant image.

9. Illustrate the MYCIN expert system with a suitable diagram.

10.

It is well known that Osteoporosis is prevalent in Female. Still, an AI model trained to detect Osteoporosis in patient must not be biased towards the patient's gender. Osteoporosis detection results by such an AI model for 10 female and 10 male patients are given below.

|                |   |   |   |   |   |   |   |   |   |    |
|----------------|---|---|---|---|---|---|---|---|---|----|
| Female Patient | F | F | F | F | F | F | F | F | F | F  |
|                | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Actual         | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1  |
| Predicted      | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1  |

|              |   |   |   |   |   |   |   |   |   |    |
|--------------|---|---|---|---|---|---|---|---|---|----|
| Male Patient | M | M | M | M | M | M | M | M | M | M  |
|              | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Actual       | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1  |
| Predicted    | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0  |

Keeping female as reference group, evaluate the Statistical Parity Difference (SPD), Disparate Impact Ratio (DIR), Equal Opportunity Difference (EOD), and Average Odds Difference (AOD) for this result. If 80% is the tolerance level, then from the DIR value, judge whether the AI model is fair or not.

⇔⇔⇔ W/D/TY ⇔⇔⇔