# Institute of Information Technology
## Jahangirnagar University
## Professional Masters in IT

**Do not write anything on the question paper.**
There are **7 (seven)** questions. Answer any **5 (five)** of them.
Figures in the right margin indicate marks.

**Question 1:**

(a) Draw a functional block diagram of an Agent and explain its all component using a real-life example. A company is planning to design an agent for rice cooker. How can you design a model? Discuss about the environment.  [03]

(b) Distinguish between supervised and unsupervised learning algorithms.  [03]

(c) There are mainly six groups of environments, and an environment can be in multiple groups. Fill up the following table for the real time example given on the 1st column  [06]

| Example | Fully vs Partially Observable | Deterministic vs Stochastic | Episodic vs Sequential | Static vs Dynamic | Discrete vs Continuous | Single vs Multi Agents |
|---|---|---|---|---|---|---|
| Brushing Teeth | | | | | | |
| Playing Cards | | | | | | |
| Autonomous Vehicles | | | | | | |
| | | | | | | |

**Question 2:**

(a) Maze shown in Figure 2 where square S is the initial position and G is the goal position. The goal of our agent is to find a way from the initial position to final position. The possible actions are move up, down, left, and right to an adjacent square. The shaded squares are obstacles. No state is visited twice and label the start state as '1', the next state as '2', etc.  [0?]

| | | | G | |
|---|---|---|---|---|
| 2 | | | | |
| S 1 | | | | |
| | | | | |
| | | | | |

Starting from S node how to reach goal G node by BFS and DFS using illustration.

(b) Distinguish between DLS and BFS algorithms.  [03]

(c) Translate the following to Predicate Logic  [03]
1. Every house is a physical object
2. Some physical objects are houses
3. Peter does not own a house

## Question 3

(a) Consider the following tree, what is the minimax value for the root? Use minimax to determine the best [05] strategy for both players and give the actions that would be chosen and their values. How would you re-order the nodes to get maximal pruning when using the alpha-beta algorithm? Feel free to use the figure to show the re-ordering
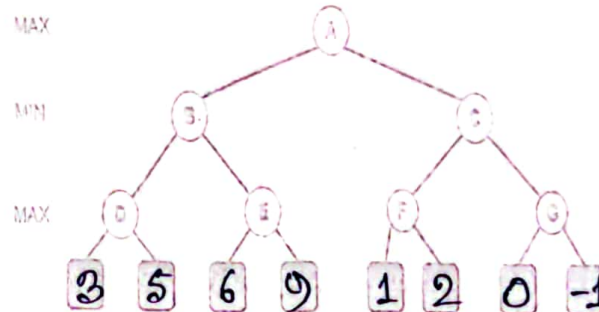


(b) There are two jugs of volume A litre and B litre. Neither has any measuring mark on it. There is a [05] pump that can be used to fill the jugs with water. How can you get exactly x litre of water into the A litre jug. Assuming that we have unlimited supply of water. Let's assume we have A=4 litre and B= 3 litre jugs. And we want exactly 2 Litre water into jug A (i.e 4 litre jug) how we will do this. Write the rule, state and process of this problem

(c) How can you overcome the infinite loop problem of DFS? [02]

## Question 4:

(a) We have studied the Wumpus World game in the class. A different version is presented here. Find how [06] to reach the square where the Gold is located. Also prove that Wumpus is in (1,4) square of the cave.

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 4 | Wumpus | Stench | Breeze | Pit |
| 3 | Stench | Breeze | Pit | Breeze |
| 2 | | | Breeze Gold | |
| 1 | Agent | Breeze | Pit | Breeze |

(b) Let A be a fuzzy set that tells about a student as shown in figure 3 and the elements with corresponding [06] maximum membership values are also given A = {(P, 0.6), (F, 0.4) (G, 0.2) (VG, 0.2), (E, 0)}
Here, the linguistic variable P represents a Pass student, F stands for a Fair student, G represents a good student, VG represents a Very Good student and E for an Excellent student.
Using Weighted Average Method, find the defuzzified value
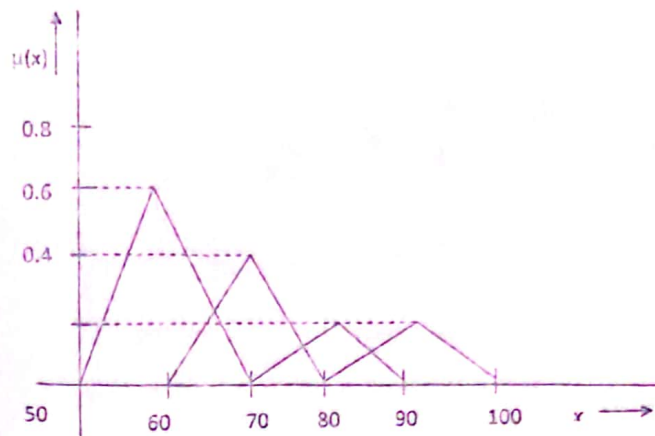
(c) $X = \{x_1, x_2\}$, $Y = \{y_1, y_2\}$, and $Z = \{z_1, z_2, z_3\}$. Consider the following fuzzy relations:　　　　　[03]

$$\bar{R} = \begin{array}{c} \\ x_1 \\ x_2 \end{array} \begin{array}{cc} y_1 & y_2 \\ \begin{bmatrix} 0.7 & 0.6 \\ 0.8 & 0.3 \end{bmatrix} \end{array}$$

$$\bar{S} = \begin{array}{c} \\ y_1 \\ y_2 \end{array} \begin{array}{ccc} z_1 & z_2 & z_3 \\ \begin{bmatrix} 0.8 & 0.5 & 0.4 \\ 0.1 & 0.6 & 0.7 \end{bmatrix} \end{array}$$

Relation $\underline{R}$ 　　　　　　　　　　　　　　　　Relation $\underline{S}$

Using Max-Product composition, find $\underline{T} = \underline{R} \circ \underline{S}$

## Question 5:

Create a fuzzy control system which models how you might choose to tip at a restaurant. When tipping, you consider the service and food quality, rated between 0 and 10. You use this to leave a tip of between 0 and 25%.

We would formulate this problem as:

Antecednets (Inputs)

*service*

- Universe (ie, crisp value range): How good was the service of the wait staff, on a scale of 0 to 5?

- Fuzzy set (ie, fuzzy value range): poor, acceptable, amazing

*food quality*

- Universe: How tasty was the food, on a scale of 0 to 5?

- Fuzzy set: bad, decent, great

Consequents (Outputs)

*tip*

- Universe: How much should we tip, on a scale of 0% to 15%

- Fuzzy set: low, medium, high

(a) Design a rule base system [04]

(b) Draw membership functions (use illustrations) [04]

(c) Show that if the service and food quality are great, the tip will be high [04]

## Question 6:

(a) Solve the following Knapsack problem by Genetic Algorithm. Find which item should be kept in the knapsack so as it will maximizes knapsack value without breaking it. [08]

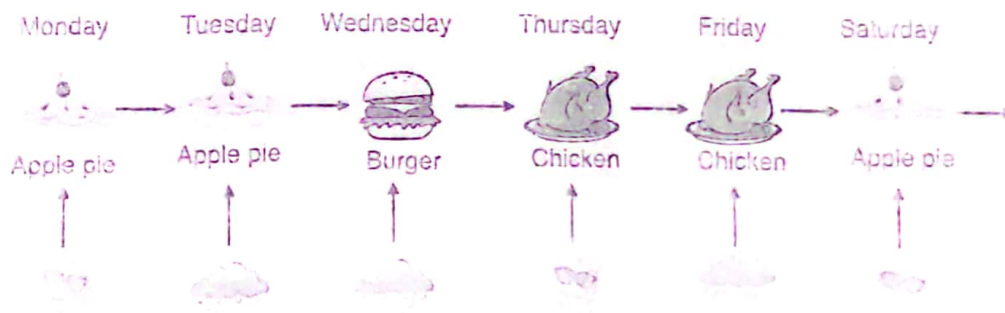| Item | Weight (Kg) | Value (Tk) |
|------|-------------|------------|
| A | 5 | 12 |
| B | 3 | 5 |
| C | 7 | 10 |
| D | 2 | 7 |

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(b) Write GA using a flow chart [04]

## Question 7:

(a) Explain Neural Representation of NAND gate using the perceptron algorithm [06]

(b) Cooking scheduling problem discussed in the class in given below: [06]

Food item to be cooked: Apple pie, Burger and Chicken.

Weather: Sunny and Rainy

| Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|--------|---------|-----------|----------|--------|----------|
| Apple pie | Apple pie | Burger | Chicken | Chicken | Apple pie |

The cooking decision is made based on the weather – sunny and rainy. If the weather is sunny the you are not cooking for the next day (see Fig 2), whereas if the weather is rainy, you are not going outside and have plenty of time for cooking next in the list.

Draw an RNN for solving this problem and explain your model for solving the above problem