2nd Semester Final Examination, Summer 2023	Intake: Fall 2022, Spring 2023
Duration: 3.0 Hours	Full Marks: 60
Course Code: PMIT – 6107	Course Title: Artificial Intelligence and Neural Network

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. **[06]**
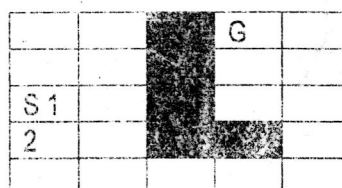

Starting from S node how to reach goal G node by BFS and DFS using illustration.

(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) Considering the following initial (level zero state) and goal states of an 8-puzzle problem. **[05]**
Perform an A* search to find the goal state. Stop the search as soon as the search expands
a state at level three. Use the "Manhattan distance" as a heuristic to guide the search.

2	8	3
1	6	4
7		5

→

1	2	3
8		4
7	6	5

Initial State　　　　　**Goal State**
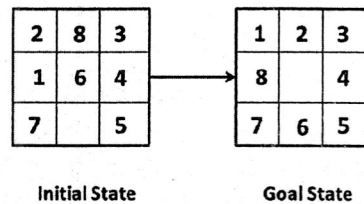
(b) In a "Two Jugs Problem" or "Water Pouring Puzzle," The goal is to use the two jugs of known **[05]**
capacities (A liters and B liters) and an unlimited water supply to measure out a specific amount of
water (x liters) in one of the jugs (jug A). In the example, you have A = 4 liters, B = 3 liters, and you
want to measure exactly 2 liters in jug A.

Here are the rules, the state, and the process to solve this problem:

Rules:

1. You can only use the jugs and the unlimited water supply to solve the problem.
2. You can empty the jugs as many times as you like.
3. You can fill either jug from the unlimited water supply at any time.
4. You can pour water from one jug into the other until the jug you are pouring into is full or the
jug you are pouring from is empty.

State: You start with two empty jugs, Jug A (4 liters) and Jug B (3 liters), and you have access to an
unlimited supply of water. The goal is to measure exactly 2 liters of water in Jug A.

Write the process to measure 2 liters in Jug A.

(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.

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

(b) Let A be a fuzzy set that tells about a student as shown in figure 3 and the elements with corresponding **[03]**
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
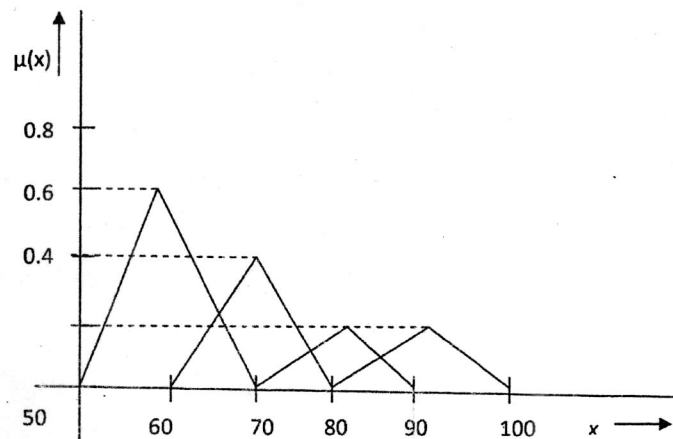
(c) $X = \{x_1, x_2\}$, $Y = \{y_1, y_2\}$, and $Z = \{z_1, z_2, z_3\}$. Consider the following fuzzy relations: [03]

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

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

Relation R   Relation 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

K=12

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

Question 7:

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

(b) What is Pooling on CNN, and How Does It Work? What will be the output after applying average pooling on a 4 X 4 matrix, as shown below, with a filter of size 2 and a stride of 2 in a Convolutional Neural Network (CNN)? Explain major advantages of using convolutional layers over using just fully connected layers. [06]

1	3	2	1
2	9	1	1
1	3	2	3
5	6	1	2