University of Asia Pacific

Department of Computer Science and Engineering

Program: B.Sc. in CSE

Final Examination **Fall-2022** 4th year 1st Semester

Course Code: CSE 403 Course Title: Artificial Intelligence and Expert Systems Credit: 3

Time: 3.00 Hour. Full Mark: 150

Instructions:

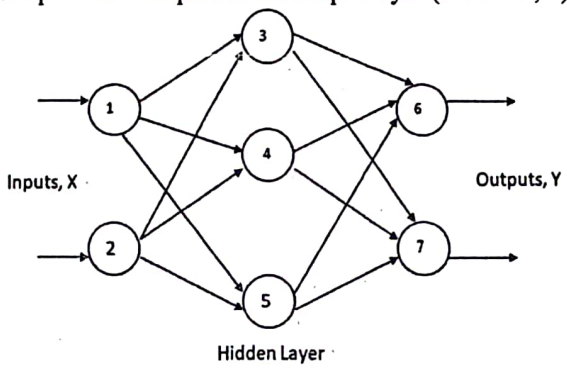
1. There are **Six (6)** Questions. Answer all of them. All questions are of equal value. Part marks are shown in the margins.
2. Programmable calculators are not allowed.

1. a. Differentiate between supervised learning and un-supervised learning. **[5] CO5**

b. For the following Back-propagation Neural Network (BPNN), assume that the feature vector, X = [0, 1] and desired output vector, Y = [1, 0], the threshold value $\theta_3 = \theta_4 = \theta_5 = 0.2$ and learning rate $\alpha = 0.1$. Consider the initial weights as: $W_{1,3} = 0.3$, $W_{1,4} = 0.5$, $W_{1,5} = W_{3,7} = 0.5$, $W_{2,3} = W_{2,4} = 0.2$, $W_{2,5} = 0.2$, $W_{3,6} = W_{5,6} = 0.4$, $W_{4,6} = W_{4,7} = 0.3$ and $W_{5,7} = 0.1$. **[20] CO5**

i) Determine the predicted outputs of the hidden layer (neuron 3, 4 and 5)

ii) Determine the predicted outputs of the output layer (neuron 6, 7)



2. a. How gradient decent control/determine the learning rate? **[5] CO5**

b. Suppose the probability of being "windy" on Friday is 0.5. The Probability Transition matrix is given below. Calculate the probability of being "not windy" on Sunday? Draw the Markov Chain of the given scenario. **[20] CO4**

Friday	Next day	Probability
windy	windy	0.5
windy	not windy	0.5
not windy	windy	0.3
not windy	not windy	0.7

OR

a. What does parameter optimization mean in machine learning model? **[5] CO5**

b. A training dataset of Weather and the corresponding target variable "Playing Cricket" are given below. Convert the dataset into a Frequency Table. Create a Likelihood Table and calculate the posterior probability using Naïve Bayes Theorem to solve the problem- "Players will play cricket if the weather is Cloudy". **[20] CO4**

Weather	Playing Cricket
Rainy	No
Sunny	Yes
Cloudy	No
Rainy	No
Sunny	Yes
Sunny	No
Cloudy	Yes
Rainy	Yes

3. a. What is a membership function of a fuzzy set? Differentiate between fuzzy set and crisp set. **[10] CO3**

b. Consider the following two fuzzy sets, A and B, (written in standard Zadeh notation): **[15] CO3**

A = [0.1/1 + 0.3/2 + 0.6/3 + 0.9/4 + 0.8/5 + 0.5/6 + 0.4/7 + 0.5/8]

B = [0.3/1 + 0.8/2 + 0.5/3 + 0.3/4 + 0.6/5 + 0.9/6 + 1.0/7 + 0.2/8]

Calculate the following fuzzy sets using fuzzy operators:

i) NOT B ii) A OR B iii) {A AND (NOT B)}

4. a. Determine whether the statement, $\{(P \vee Q) \wedge (\sim R)\} \rightarrow (R \vee Q)$ is: Satisfiable, Contradictory or Valid? **[10] CO3**

b. A group of 5 students of CSE department have been found to be **very good** big data analyst with membership values: [0.6, 0.5, 0.8, 0.7, 0.9] respectively. **Estimate** what would be membership values in order to represent them to be: i) **extremely good** big data analyst ii) **good** big data analyst and iii) **more or less good** big data analyst. Also **show** the graphical representation for each of the big data analysts. **[15] CO3**

5. a. Explain crossover and mutation with necessary example. **[5] CO2**

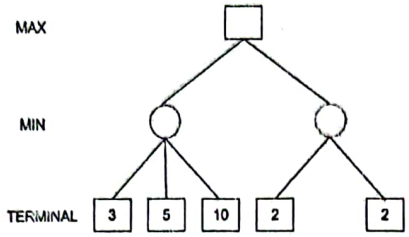
b. Simulate one step of Genetic Algorithm (selection, cross over and mutation) for the function in Equation-1. Represent "x" using 4 bits. The population size is 5. For parent selection, you may use Roulette-Wheel Technique. **[20] CO2**

$$F(x) = \{MAX(x^2): 0 <= x <= 10\} \text{ over } \{0, 1, \ldots, 10\} \ldots\ldots\ldots (1)$$

OR

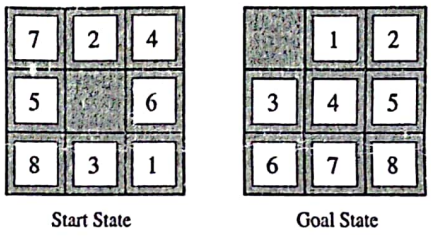
a. Explain Zero Sum Game with necessary payoff matrix. **[5] CO2**

b. Consider the following game tree. **Illustrate** the step by step pruning process with **graphical representations** using alpha beta pruning. Assume that the first player is the maximizing player. **[20] CO2**



6. a. Is the solution of the following 8-puzzle game has admissible heuristic? Why? Here, consider h_1 as number of misplaced tiles and h_2 as total Manhattan distance (city block distance). **[10] CO2**

- $h_1(S) = ?$
- $h_2(S) = ?$



b. Suppose, your target is to reach the goal node 'G' from the start node 'S' with the optimal cost. **Simulate** the following problem with **A* Search** algorithm and **determine** the shortest path with **fringe** for each iteration. Consider the heuristic values of the nodes as follows: **[15] CO2**

Node	h(n)
S	1
A	h(S) + 2
B	h(A) + 3
C	h(B) + 4
G	0