Assignment (Soft Computing)

Q.1

What is the difference between crisp and fuzzy relations? Write the properties of fuzzy relations with example.

Q.2

Define membership function. Using your own intuition anddefinitions of the universe of discourse, Plot fuzzy membership function for "weight of people".

Very thin (VT): $W \leq 25$
Thin (T): $25 < W \leq 45$
Average (AV): $45 < W \leq 60$
Stout (S): $60 < W \leq 75$
Very stout (VS): $W > 75$

Q.3

Suppose you have an Adaline neural network with three input features (2, 3, -1) and weights (w1, w2, w3) initialized as (0.5, -0.2, 0.8). The learning rate (η) is set to 0.2. During the training process, the network produces an output for a given input. If the target output is 0.8, calculate the updated weights after two iteration using the Adaline weight adjustment rule.

Q.4

Below is a diagram if a single artificial neuron (unit):

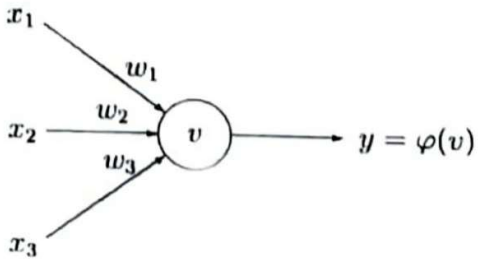

Figure 1: Single unit with three inputs.

The node has three inputs $\mathbf{x} = (x_1, x_2, x_3)$ that receive only binary signals (either 0 or 1). How many different input patterns this node can receive? What if the node had four inputs? Five? Can you give a formula that computes the number of binary input patterns for a given number of inputs?

Q.5

Consider the unit shown on Figure 1. Suppose that the weights corresponding to the three inputs have the following values:

$$\begin{array}{|lcl|}\hline w_1 & = & 2 \\ w_2 & = & -4 \\ w_3 & = & 1 \\ \hline\end{array}$$

and the activation of the unit is given by the step–function:

$$\varphi(v) = \begin{cases} 1 & \text{if } v \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

Calculate what will be the output value y of the unit for each of the following input patterns:

Pattern	P_1	P_2	P_3	P_4
x_1	1	0	1	1
x_2	0	1	0	1
x_3	0	1	1	1

Q.6: Name and describe the main features of GA.

Q.7

Suppose a genetic algorithm uses chromosomes of the form x= abcdefgh with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual z be calculated as:

f(x)=(a+b) - (c+d) + (e+) - (g+h), and let the initial population consist of four individuals with the following chromosomes:

x1=2165413532

x2=2287126601

x3=2323921285

x4=2441852094

a) Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last.

b) Perform the following crossover operations:

i) Cross the fittest two individuals using one-point crossover at the middle point.

ii) Cross the second and third fittest individuals using a two-point crossover (points b and f)

iii) Cross the first and third fittest individual (ranked 1st and 4th) using a uniform Crossover

c) Suppose the new population consists of the six offspring individuals received by the crossover operations in the above question. Evaluate the fitness of the new population, showing all your workings. Has the overall fitness improved?

d) By looking at the fitness function and considering that genes can only be digits between 0 and 9 find the chromosome representing the optimal solution (i.e. with the maximum fitness). Find the value of the maximum fitness

Q. 8

A budget airline company operates 3 plains and employs 5 cabin crews. Only one crew can operate on any plain on a single day, and each crew cannot work for more than two days in a row. The company uses all planes every day. A Genetic Algorithm is used to work out the best combination of crews on any particular day.

a) Suggest what chromosome could represent an individual in this algorithm?

b) Suggest arhat could be the alphabet of this algorithm? What is its size?

c) Suggest a fitness function for this problem.

d) How many solutions are in this problem? Is it necessary to use Genetic Algorithms for solving it? What if the company operated more plains and employed more crews?