Q. 1 In an MP (McCulloch-Pitts) neuron with inputs $x_1 = 1$, $x_2 = 0$, $x_3 = 1$ and weights $w_1 = 0.3$, $w_2 = 0.5$, $w_3 = -0.4$, what is the output if the threshold $\theta = 0.2$?

- ● a) 0
- ○ b) 1
- ○ c) -0.1
- ○ d) Cannot be determined without an activation function

Q. 2 A Hebbian learning rule adjusts weights according to $w_{ij}(new) = w_{ij}(old) + \eta \cdot x_i \cdot y_j$. If $\eta = 0.2$, $w_{ij}(old) = 0.5, x_i = 2, and y_j = -1$, what is the updated weight?

- ● a) 0.1
- ○ b) 0.9
- ○ c) -0.1
- ○ d) 0.3

Q. 3 If a perceptron with inputs $x = [2, -1]$ has weights $w = [0.3, 0.4]$ and bias $b = -0.5$, and produces an output of 0 when the target is 1, what will be the updated weights after one iteration with learning rate $\eta = 0.1$?

- ● a) $w = [0.5, 0.3], b = -0.4$
- ○ b) $w = [0.5, 0.3], b = -0.6$
- ○ c) $w = [0.3, 0.4], b = -0.4$
- ○ d) $w = [0.4, 0.3], b = -0.4$

Q. 4 In the ADALINE model, if the net input is 0.75, the target is 1, and the learning rate is 0.1, by how much will each input weight be adjusted if the corresponding input value is 0.5?

- ● a) 0.0125
- ○ b) 0.025
- ○ c) 0.05
- ○ d) 0.075

Q. 5 What is the key mathematical difference in the error function used by Perceptron compared to ADALINE?

- ○ a) Perceptron uses the squared error of the thresholded output, while ADALINE uses the squared error of the net input
- ○ b) Perceptron uses the absolute error of the output, while ADALINE uses the squared error of the net input
- ○ c) Perceptron uses the squared error of the net input, while ADALINE uses the squared error of the thresholded output
- ● d) Perceptron uses the error of the thresholded output, while ADALINE uses the squared error of the net input before thresholding

Q. 6 In MADALINE Rule I, if the desired output is +1 but the actual output is −1, which of the following is the correct learning strategy?

- ○ a) Adjust weights for all ADALINE units regardless of their output
- ○ b) Adjust weights only for ADALINE units that have negative outputs
- ○ c) Adjust weights only for ADALINE units that have output opposite to the desired output
- ● d) Adjust weights for the ADALINE unit with the smallest absolute net input value

Q. 7 Crossover in genetic algorithms mimics?

- ○ a) Mutation
- ○ b) Natural selection
- ● c) Biological reproduction
- ○ d) Random changes

Q. 8 For a neural network with one hidden layer using backpropagation, which formula correctly represents the weight update between an input neuron i and hidden neuron j?

- ● a) $\Delta w_{ij} = \eta \cdot \delta_j \cdot x_i$ where $\delta_j = f'(net_j) \cdot \sum(\delta_k \cdot w_{jk})$
- ○ b) $\Delta w_{ij} = \eta \cdot \delta_j \cdot x_i$ where $\delta_j = (t_j - y_j) \cdot f'(net_j)$
- ○ c) $\Delta w_{ij} = \eta \cdot (t_j - y_j) \cdot x_i$
- ○ d) $\Delta w_{ij} = \eta \cdot \delta_j \cdot x_i$ where $\delta_j = y_j \cdot (1 - y_j)$

Q. 9 In a fuzzy set, an $\alpha - cut$ is defined as?

- ○ a) The set of all elements whose membership value is exactly α
- ● b) The set of all elements whose membership value is greater than or equal to α
- ○ c) The set of all elements whose membership value is less than α
- ○ d) The set of all elements whose membership value is equal to 1

Q. 10 If the support of a fuzzy set A is $[1, 7]$ and its core is $[3, 5]$, which of the following statements must be true?

- ○ a) $\mu A(2) = 0$
- ● b) $\mu A(4) = 1$
- ○ c) $\mu A(6) < 0$
- ○ d) $\mu A(0) > 0$

Q. 11 The height of a fuzzy set is defined as?

- ● a) The maximum membership value assigned to any element in the universe.
- ○ b) The average of all membership values in the set.
- ○ c. The number of elements with membership value greater than 0.5.
- ○ d)The width of its support set.

Q. 12 The delta (δ) for a hidden layer neuron j in backpropagation is computed as?

- ○ a) $\delta_j = f'(net_j) \times \sum(\delta_k \times w_{kj})$
- ● b. $\delta_j = f'(net_j) \times \sum(\delta_k \times w_{jk})$
- ○ c) $\delta_j = (t_j - o_j) \times (net_j)$
- ○ d) $\delta_j = f'(net_j)/\sum(\delta_k \times w_{jk}$

Q. 13 Which learning rule is also known as the Least Mean Squares (LMS) algorithm?

- ○ a) Perceptron rule.
- ● b) Delta Rule (Adaline).
- ○ c) Backpropagation.
- ○ d) Hebbian rule.

Q. 14 Why might a genetic algorithm fail to find an optimal solution if only the crossover operator is used, with no mutation?

- ○ a) Crossover can always generate all possible solutions.
- ● b) Mutation is needed to introduce new genetic material not present in the initial population.
- ○ c) Crossover destroys fit individuals.
- ○ d) Mutation is only needed for selection.

Q. 15 What is the effect of using a very small population size in a genetic algorithm?

- ● a) Faster convergence but higher risk of premature convergence.
- ○ b) Slower convergence but better global search.
- ○ c. Guaranteed global optimum.
- ○ d. No effect on performance.