Aliah University

Autumn Semester Examination - 2024

B.Tech 4th year, 7th semester Examination

Paper Name: Machine Learning and Soft Computing **Full Marks: 80**

Paper Code: CSEUGPC24 **Time: 3 hrs**

Group-A **Answer any five** **(2x5=10)**

1. Define Binary Fuzzy relationship. **(2) (CO1), (Rem)**
2. Write the basic steps for a Genetic Algorithm problem. **(2) (CO2), (Eva)**
3. Compare Genotype and Phenotype with simple examples. **(2) (CO3), (Und)**
4. What is Gradient-Descent? **(2) (CO4), (Rem)**
5. Discuss the concept of a Self-organizing map. **(2) (CO5), (Und)**
6. Analyze uniform crossover and single point crossover in Genetic Algorithm. **(2) (CO2), (Ana)**

Group-B **Answer any four** **(5x4=20)**

7. Give a brief explanation for the conceptual working flow diagram of a fuzzy-based system. **(5) (CO1), (Ana)**
8. Maximize the function f(x) = $3x^2 - 5x + 1$, where x = 4, 9, 14, 17 with (Chromosome size = 5 such that (i) selection operation (Rank Selection), (ii) Uniform crossover, (iii) Up to two iterations. **(5) (CO3), (Eva)**
9. Consider the following grading system for a course: (i) Excellent = Marks ≤ 90, (ii) Very good = 75 ≤ Marks ≤ 90, (iii) Good = 60 ≤Marks ≤75, (iv) Average = 50 ≤ Marks ≤ 60, (v) Poor = 35 ≤ Marks ≤ 50, (vi) Bad= Marks ≤ 3. Establish the fuzzy Grading System. **(5) (CO2), (App)**
10. Consider the following two fuzzy sets A and B defined over a universe of discourse [0,5] of real numbers with their membership function: $\mu_A(x) = \frac{x}{1+x}$ and $\mu_B(x) = 2^{-x}$. Determine the membership functions of the (*i*) $\overline{A}, \overline{B}$, and (ii) $A \cap B$ and draw them graphically. **(5) (CO2), (Eva)**
11. Write short notes on activation functions: (i) Threshold, (ii) Sigmoid, (iii) Hyperbolic Tangent. **(5) (CO4), (Ana)**

Group-C **Answer any five** **(10x5=50)**

12. Describe the Roulette-wheel selection for the GA-based selection operator. Suppose, two relations A and B are given as follows: A: 'x is considerably larger than y', B: 'x is very close to y'. Find the fuzzy relationships between 'x is considerably larger than y' or 'x is very close to y'. Analyze the mamdani Fuzzy inference system? **(2+4+4=10) (CO3, CO2), (Rem, Eva, Ana)**

A	y1	y2	y3	y4
x1	0.6	0.7	0.4	0.6
x2	0.5	0.6	0.3	0.7
x3	0.2	0.1	0.3	0.8

B	z1	z2	z3
y1	0.5	0.9	0.3
y2	0.8	0.1	0.8
y3	0.9	0.5	0.2
y4	0.4	0.2	0.4

13. Draw a very clear 5-4-4 ANN architecture with explaining all its components. Give the parameters requirement for the good clustering algorithms. What are Core and Support in fuzzy logic? **(5+3+2=10) (CO4, CO4, CO2), (Cre, Ana, Rem)**

14. Suppose a genetic algorithm uses chromosomes of the form x = abcdefgh with a fixed length of 6 genes. Each gene can be any digit between 0 and 9. Let the fitness of individual x be calculated as: f(x) = (a * b) + (c * d) + (e * f) − (g * h). Let the initial population consist of four individuals with the following chromosomes:

x1 = 7 2 4 1 3 5 3 2; x2 = 9 7 1 2 1 6 0 1; x3 = 5 3 2 2 1 2 8 5; x4 = 7 1 8 5 2 4 9 4. Use the following (i) Evaluate the fitness of each individual, (ii) Cross the fittest two individuals using one–point crossover at the middle point, (iii) Evaluate the fitness of the new population with the best four chromosomes (two-old and two-new) (iv) Perform (ii) to (iii) up to three iterations. What is the difference between L1 regularization and L2 regularization?

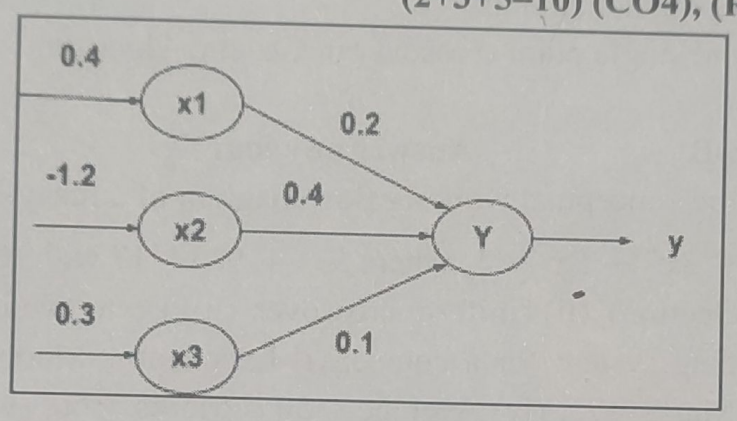
(7+3=10) (CO3, CO4), (Eva, Rem)

15. What is the relationship between ROC and AUC? Give explanations about convex optimization and Linearity vs. Non-linearity concepts in ML. Discuss a covariance matrix with suitable examples. Write about bias and variance tradeoff.

(2+4+2+2=10) (CO4), (Rem, Und, Rem)

16. What is singular value decomposition (SVD)? How is it related to principal component analysis (PCA)? Find the value of outcome (y) from the given network using ReLU activation function.

(2+3+5=10) (CO4), (Rem, Und,Ana)



17. Analyze the Training and Testing operation of a Recurrent Neural Network. What are the steps involved in designing a fuzzy logic controller? Explain the different types of membership function used in the fuzzification process.

(3+3+4=10) (CO4, CO1, CO1), (Ana, Und, Ana)