



LH-207
CS-1

Qn. Set Code-1

Semester: 5th
Programme: B.Tech
Branch: CSE, IT, CSSE, E&CSE

AUTUMN END SEMESTER EXAMINATION-2022

5th Semester B.Tech

COMPUTATIONAL INTELLIGENCE

CS 3031

(For 2021 (L.E), 2020 & Previous Admitted Batches)

Time: 3 Hours

Full Marks: 50

Answer any SIX questions.

Question paper consists of four SECTIONS i.e. A, B, C and D.

Section A is compulsory.

Attempt minimum one question each from Sections B, C, D.

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

SECTION-A

1. Answer the following questions. [1 × 10]

- (a) What are the characteristics of soft computing?
- (b) Find the power set and cardinality of the given set $X = \{2, 4, 6\}$. Also find the cardinality of power set.
- (c) Consider the following two fuzzy sets

$$A = \left\{ \frac{0.3}{x_1} + \frac{0.7}{x_2} + \frac{1}{x_3} \right\}$$

$$\text{And } B = \left\{ \frac{0.4}{y_1} + \frac{0.9}{y_2} \right\}$$

Find the cartesian product over these given fuzzy sets.

- (d) Write down the characteristics of derivative free optimization.
- (e) Define mutation in GA.
- (f) Given a two-input neuron with parameters, bias(b)=1.4, weight(w)=[3,2] and input(p)=[-4,5]^T. Find the neuron output for a symmetrical hard limit transfer function.

- (g) Mention the advantages and limitations of hybrid systems.
- (h) Compare the single point and two- point crossover in GA.
- (i) Compare biological neural network and artificial neural network.
- (j) State the difference between fuzzy set and probability.

SECTION-B

- 2. (a) Construct the schematic diagram of an intelligent system and explain how it differs from traditional Expert System. [4]
- (b) What is soft computing and its application? How does it differ from hard computing? [4]
- 3. (a) Consider two given fuzzy sets [4]

$$A = \left\{ \frac{1}{2} + \frac{0.3}{4} + \frac{0.5}{6} + \frac{0.2}{8} \right\}$$

$$B = \left\{ \frac{0.5}{2} + \frac{0.4}{4} + \frac{0.1}{6} + \frac{1}{8} \right\}$$

Solve Union, intersection, difference and complement over fuzzy sets A and B.

- (b) Let F be a fuzzy set of matured persons where the maturity is measured in terms of age in years. The fuzzy membership function followed is given below [4]

$$\mu_F(x) = \begin{cases} 0, & \text{if } x \leq 5 \\ \left(\frac{x-5}{20} \right)^2, & \text{if } 5 \leq x \leq 25 \\ 1, & \text{if } x \geq 25 \end{cases}$$

The universe consists of the individuals Sunny, Moon, Pikoo, Gina, Osho, Chang, Paul, Lalu, Lila and Poly whose ages are 15,20,10,27,32,12,18,24,3 and 8 years respectively. Solve the normalcy of the set as well as Height (F), support (F), core (F) and cardinality(F).

SECTION-C

4. (a) Define defuzzification. Discuss in detail on the various types of defuzzification methods. [4]
- (b) Define the Extension Principle. Apply this principle to the given fuzzy set A in space X to obtain its image as a fuzzy set B in space Y using the extension principle given the mapping function as: [4]

$$y=f(x)=x^2+2x-5$$

where $x \in X$ and $y \in Y$

$$A=0.2/-3 + 0.4/-2 + 0.6/-1 + 1/0 + 0.7/1 + 0.3/2 + 0.1/3$$

5. (a) Construct a neat flowchart & write the basic genetic algorithm used for solving optimization problems. [4]
- (b) 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 x be calculated as: [4]

$$f(x) = (a + b) - (c + d) + (e + f) - (g + h),$$

and let the initial population consist of four individuals with the following chromosomes:

$$X1 = 6\ 5\ 4\ 1\ 3\ 5\ 3\ 2$$

$$X2 = 8\ 7\ 1\ 2\ 6\ 6\ 0\ 1$$

$$X3 = 2\ 3\ 9\ 2\ 1\ 2\ 8\ 5$$

$$X4 = 4\ 1\ 8\ 5\ 2\ 0\ 9\ 4$$

Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last. For the above problem perform the following crossover operations:

- Cross the fittest two individuals using one-point crossover at the middle point.
- Cross the second and third fittest individuals using a two-point crossover (points b and f).

6. (a) For the fuzzy relation R [4]

$$R = \begin{bmatrix} 0.2 & 0.5 & 0.7 & 1 & 0.9 \\ 0.3 & 0.5 & 0.7 & 1 & 0.8 \\ 0.4 & 0.6 & 0.8 & 0.9 & 0.4 \\ 0.9 & 1 & 0.8 & 0.6 & 0.4 \end{bmatrix}$$

Solve the λ -cut relation for $\lambda=0.2, 0.4, 0.7$ and 0.9

- (b) Compare between Mamdani fuzzy inference systems and Sugeno fuzzy inference systems. [4]

SECTION-D

7. (a) Explain adaptive neuro-fuzzy inference systems. [4]

- (b) Two fuzzy relations are given by [4]

$$R = \begin{bmatrix} 0.6 & 0.3 \\ 0.2 & 0.9 \end{bmatrix}$$

$$\text{And } S = \begin{bmatrix} 1 & 0.5 & 0.3 \\ 0.8 & 0.4 & 0.7 \end{bmatrix}$$

Determine fuzzy relation T as a Max-min composition between the fuzzy relations.

8. (a) Explain all the activation functions (normally used in ANN) with necessary diagrams and formulations. [4]

- (b) Discuss the training algorithm used in Adaline network. [4]
