

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- APRIL-2023

COURSE CODE(CREDITS): 21B1WMA831 (3)

MAX. MARKS: 25

COURSE NAME: Soft Computing & Optimization Algorithms

COURSE INSTRUCTORS: Dr. B. K. Pathak

MAX. TIME: 1 Hour 30 Minutes

Note: All questions are compulsory. Marks are indicated against each question in square brackets.

1. To compare two sensors based upon their detection levels and gain setting, following table gives gain settings and sensor detection level with a standard item being monitored provides typical membership values to represent the detection level for each of the sensors:

Gain Setting	Sensor 1 (S_1) detection level	Sensor 2 (S_2) detection level
0	0	0
20	0.5	0.35
40	0.65	0.5
60	0.85	0.75
80	1	0.9
100	1	1

The universe of discourse is $X = \{0, 20, 40, 60, 80, 100\}$. Find the membership function for the two sensors S_1 and S_2 . Also find the fuzzy sets $S_1 \cap S_2$, $S_1 \cup S_2$, $\overline{S_1 \cap S_2}$ and $\overline{S_1 \cup S_2}$ using standard operations. [CO-2][4 Marks]

2. Let $X = \{1, 2, 3, 4, 5\}$ and fuzzy set $A = \{(1, 0.7), (2, 0.3), (3, 0.5), (4, 0.9), (5, 0.6)\}$, Find the strong α cut set for $\alpha = 0.3, 0.5$ and 0.9 . Also find the level set of A . [CO-2][4 Marks]

3. Suppose you have a set of data points representing the temperature in degrees Celsius, and you want to create a fuzzy membership function to determine the likelihood that the temperature is "hot". Using a triangular membership function with the following parameters:

Minimum temperature for "hot": 25°C

Moderate temperature for "hot": 30°C

Maximum temperature for "hot": 35°C

- (a). Write the equation for the triangular membership function.
 (b). If the current temperature is 28°C, what is the degree of membership for "hot"?
 (c). If the current temperature is 40°C, what is the degree of membership for "hot"?

[CO-3][4 Marks]

4. Consider the following fuzzy proposition: "If the temperature is cold OR the humidity is high, then the air conditioner should be turned on." The membership functions for "cold" and "high" are given by:

"Cold": $\mu_{\text{cold}}(x) = 1 - (x-10)/10$, for $x \in [0, 20]$ (where x is the temperature in degrees Celsius)

"High": $\mu_{\text{high}}(x) = (x-60)/40$, for $x \in [60, 100]$ (where x is the relative humidity in %)

If the temperature is 5°C and the relative humidity is 80%, what is the degree of membership for the antecedent of the fuzzy rule?

[CO-3][4 Marks]

5. Consider a fuzzy set A defined on the universe of discourse $X = [0, 10]$ with the following membership function:

$$A(x) = 1 - (x-5)^2/25, \text{ for } x \in [0, 10]$$

Using the center of gravity (COG) method of defuzzification, what is the crisp output value for the fuzzy set A?

[CO-3][4 Marks]

6. Suppose we are using binary encoding in a genetic algorithm to optimize a function of two variables x and y , where x and y can take values in the range $[0, 5]$ with a precision of 0.1. If we use 8 bits to encode each variable, what is the maximum number of possible solutions that can be represented using binary encoding?

[CO-5][1 Marks]

7. Fill in the blank

[CO-1&5] [4 Marks]

(a) ----- is a soft computing technique used for optimization problems?

(b) ----- soft computing technique is primarily used for data clustering and classification?

(c) Which of the following is NOT a key component of a genetic algorithm?

A) Selection B) Crossover C) Mutation D) Gradient Descent

(d) In a genetic algorithm, what is the purpose of selection?

A) To produce new offspring B) To evaluate the fitness of individuals
C) To randomly generate new individuals D) To control the rate of mutation