Indian Institute of Technology Kharagpur

Department of Mechanical Engineering

Instructions: Answer all the questions. Each question carries two marks. There is no negative marking for wrong answer. There is no part marking for the questions.

First Test (2020-2021); Date: 14.10.2020; Total Marks: 20

Subject: ME60353: Knowledge-based Systems in Engineering; Maximum Time: 1 hour

Name:	Roll No.

QUESTION 1:

Gaussian membership function distribution of a fuzzy set is represented as follows:

$$\mu = \frac{1}{e^{\frac{1}{2}\left(\frac{\mathbf{x}-20.0}{2.0}\right)^2}}$$

The value of membership (μ) corresponding to **x** = 25.0 is found to be approximately equal to

    (a) 0.04
    (b) 0.40
    (c) 0.50
    (d) 0.01

Correct Answer:

QUESTION 2:

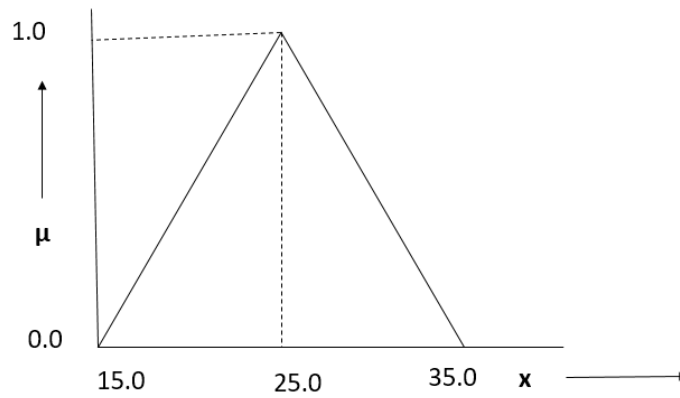Fig. A displays a triangular membership function distribution of a fuzzy set.

Fig. A: Triangular membership function distribution

Its 0.7-cut is found to be as follows:

   (a) (19.0,26.0)
   (b) (20.0,26.0)
   (c) (21.0,25.0)
   (d) (22.0,28.0)

Correct Answer:

QUESTION 3:

Let us consider two fuzzy sets as follows:

$$A(x) = \{(x_1, 0.2), (x_2, 0.3), (x_3, 0.5)\}$$

$$B(x) = \{(x_1, 0.3), (x_2, 0.4), (x_3, 0.6)\}.$$

Their INTERSECTION $(A \cap B)(x)$ is determined as

   a. $\{(x_1, 0.3), (x_2, 0.4), (x_3, 0.6)\}$
   b. $\{(x_1, 0.06), (x_2, 0.12), (x_3, 0.30)\}$
   c. $\{(x_1, 0.2), (x_2, 0.3), (x_3, 0.5)\}$
   d. $\{(x_1, 0.5), (x_2, 0.7), (x_3, 1.0)\}$

Correct Answer:

Let us consider two fuzzy sets as follows:

$$A(x) = \{(x_1, 0.3), (x_2, 0.4), (x_3, 0.5)\}$$

$$B(x) = \{(x_1, 0.6), (x_2, 0.7), (x_3, 0.8)\}$$

Their bounded difference

$A(x) \ominus B(x)$ is determined as follows:

    a. $\{(x_1, 0.3), (x_2, 0.4), (x_3, 0.5)\}$
    b. $\{(x_1, 0.1), (x_2, 0.0), (x_3, 0.3)\}$
    c. $\{(x_1, 0.3), (x_2, 0.0), (x_3, 0.1)\}$
    d. $\{(x_1, 0.0), (x_2, 0.1), (x_3, 0.3)\}$

Correct Answer:

Let us consider two fuzzy sets as follows:

$$A(x) = \{(x_1, 0.3), (x_2, 0.4), (x_3, 0.5)\}$$

$$B(x) = \{(x_1, 0.4), (x_2, 0.5), (x_3, 0.6)\}$$

Their algebraic sum $A(x) + B(x)$ is represented as follows:

    a. $\{(x_1, 0.7), (x_2, 0.9), (x_3, 1.0)\}$.
    b. $\{(x_1, 0.58), (x_2, 0.7), (x_3, 0.8)\}$.
    c. $\{(x_1, 0.4), (x_2, 0.5), (x_3, 0.6)\}$.
    d. $\{(x_1, 0.3), (x_2, 0.4), (x_3, 0.5)\}$.

Correct Answer:

QUESTION 6:

Let us consider a fuzzy set as follows:

$A(x) = \{(x_1, 0.3), (x_2, 0.4), (x_3, 0.5)\}$. Its 4-th power $A^4(x)$ is determined as

    a. $\{(x_1, 0.548), (x_2, 0.632), (x_3, 0.707)\}$.

    b. $\{(x_1, 0.027), (x_2, 0.064), (x_3, 0.125)\}$.

    c. $\{(x_1, 0.09), (x_2, 0.16), (x_3, 0.25)\}$.

    d. $\{(x_1, 0.0081), (x_2, 0.0256), (x_3, 0.0625)\}$.

Correct Answer:

QUESTION 7:

Let us consider a fuzzy set as follows:

$A(x) = \{(x_1, 0.4), (x_2, 0.6), (x_3, 0.8)\}$. Its complement $\bar{A}(x)$ is determined as

    a. $\{(x_1, 0.6), (x_2, 0.2), (x_3, 0.4)\}$.

    b. $\{(x_1, 0.4), (x_2, 0.2), (x_3, 0.6)\}$.

    c. $\{(x_1, 0.2), (x_2, 0.4), (x_3, 0.6)\}$.

    d. $\{(x_1, 0.6), (x_2, 0.4), (x_3, 0.2)\}$.

Correct Answer:

QUESTION 8:

In Mamdani approach of fuzzy reasoning tool, let us assume that two rules are getting fired for a set of inputs. The combined fuzzified output considering these two fired rules is shown in Fig. B.
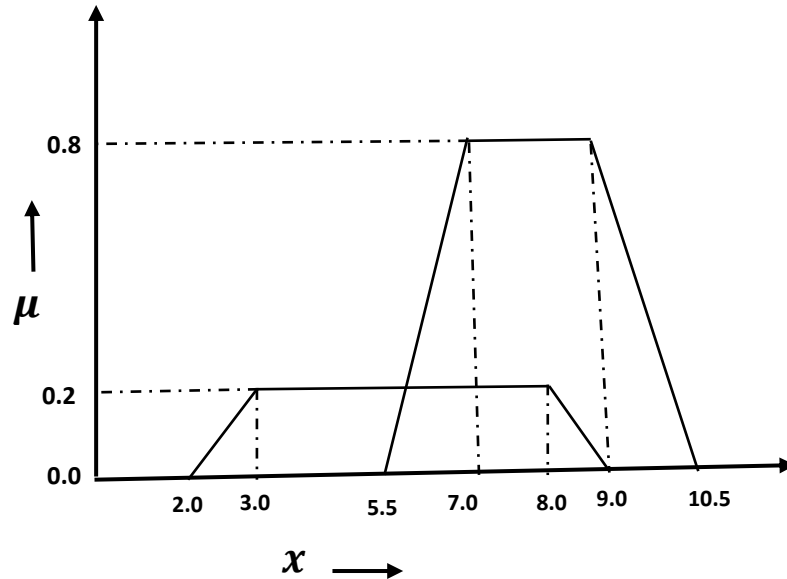

Fig. B. Combined fuzzified output.

By using the Center of Sums method, the crisp output is found to be equal to

        a. 6.25
        b. 9.05
        c. 7.25
        d. 9.25

Correct Answer:

QUESTION 9:

Let us assume that the similarity (S) between two data points P and Q is found to be equal to 0.4. Let us also consider the relationship between entropy (E) and similarity (S) as follows:

$$E = -S \log_2 S - (1 - S) \log_2 (1 - S)$$

The entropy value (E) is approximately found to be equal to

a) 0.245
b) 0.123
c) 0.998
d) 0.673

Correct Answer:

QUESTION 10:

Back-propagation algorithm used for training of a neural network is nothing but a

a. nature-inspired optimization tool.
b. direct-search optimization algorithm
c. gradient-based optimization algorithm
d. fuzziness modeling tool.

Correct Answer:

*************END***********

ANSWER KEYS

Q. 1:   Q. 2:   Q. 3:   Q. 4:   Q. 5:

Q. 6:   Q. 7:   Q. 8:   Q. 9:   Q. 10:

Name: Roll No.