1. Consider a fuzzy set \( A \) defined by the trapezoidal membership function \( \text{trapezoid}(x; 10, 20, 50, 90) \).

Determine de-fuzzification results using (a) Bisector of Area (b) Mean of Maximum

\[ 8+2=10 \]

2. Consider a Mamdani Fuzzy Model for inferencing with the following rules (Universe for \( X \) is \([-10,10]\) and universe for \( Y \) is \([0,10] \)):

i. If \( x \) is Small then \( y \) is Small

ii. If \( x \) is Medium then \( y \) is Medium

iii. If \( x \) is Large then \( y \) is Large

The antecedent fuzzy set memberships are defined as:

\( \text{Small } X = \text{trapezoid}(x; -10, -10, -6, -2); \)

\( \text{Medium } X = \text{trapezoid}(x; -6, -2, 2, 6); \)

\( \text{Large } X = \text{trapezoid}(x; 2, 6, 10, 10); \)

The consequent fuzzy sets are defined as:

\( \text{Small } Y = \text{trapezoid}(y; 0, 0, 2, 4); \)

\( \text{Medium } Y = \text{trapezoid}(y; 2, 4, 6, 8); \)

\( \text{Large } Y = \text{trapezoid}(y; 6, 8, 10, 10). \)

What would be the Mamdani Model output for

(a) crisp input \( x = 0 \) using centroid defuzzification

(b) crisp input \( x = -8 \) using centroid defuzzification

(c) crisp input \( x = -4 \) using mean of maximum defuzzification

(d) crisp input \( x = 4 \) using largest of maximum defuzzification

\[ 6+6+4+4=20 \]

3. Consider the following set of data points: \( \{0, 10, 3, 12\} \). Assume an initial pseudo-partition with memberships defined as follows:

<table>
<thead>
<tr>
<th>Data point</th>
<th>0</th>
<th>10</th>
<th>3</th>
<th>12</th>
</tr>
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<tr>
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<td>0.75</td>
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<td>A2</td>
<td>0.9</td>
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Determine the pseudo-partition after one iteration of c-means clustering (with \( c = 2 \)) using \( m = 2 \). \[15\]
4. Consider maximization of the objective function $f(x) = x^2$ for $x = 0..31$. Use population size of 4 chromosomes.
   (a) Form the initial population
   (b) Show the next generation using
       (i) stochastic remainder sampling without replacement
       (ii) stochastic sampling with replacement

Note: You need to show only one next generation. First, by starting from the initial population using (i); then once again starting from the initial population, but this time using (ii)

Use the following random nos. for answering question no. 4. Whenever you are using a random no., mention the corresponding Srl No. for ease of tracking the steps.

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<tr>
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