SCOA Assignment No. 1

Roll.no. - 41163

Title: Fuzzy Set

Problem Statement:
Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.

Objectives:
1. Understand Fuzzy Set & its operations
2. To implement different operations of Fuzzy Set

Outcomes:
1. Understood the concepts of Fuzzy Set
2. Implemented different operations of Fuzzy Set

Software & Hardware Requirements:
- Jupyter-Notebook / Google Colab
- 64 bit OS

Theory:
- Fuzzy set allows that objects belong to a set, or couples of objects belong to a relation to a given degree.
- It allows partial membership of an object to different classes and also takes into account the relative importance of each neighbor with repect to the test instances.
- A fuzzy set in X is an X -> [0,1] mapping, while a fuzzy relation in X is a fuzzy set in $X \times X$.
- For all y in X, the R-forest of y is the fuzzy set Ry which is defined by

  $Ry(x) = R(x,y)$

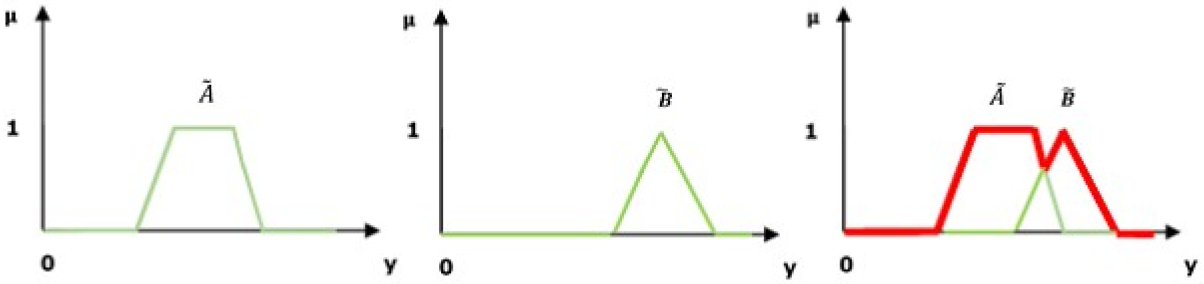
Operations of Fuzzy Set:

Having two fuzzy sets A and B , the universe of information U and an element y of the universe, the following relations express the union, intersection and complement operation on fuzzy sets.

1. Union / Fuzzy ‘OR’

   $\mu A^{\sim} \cup B^{\sim}(y) = \mu A^{\sim} \vee \mu B^{\sim} \quad ,\forall y \in U$

   Here $\vee$ represents the ‘max’ operation.

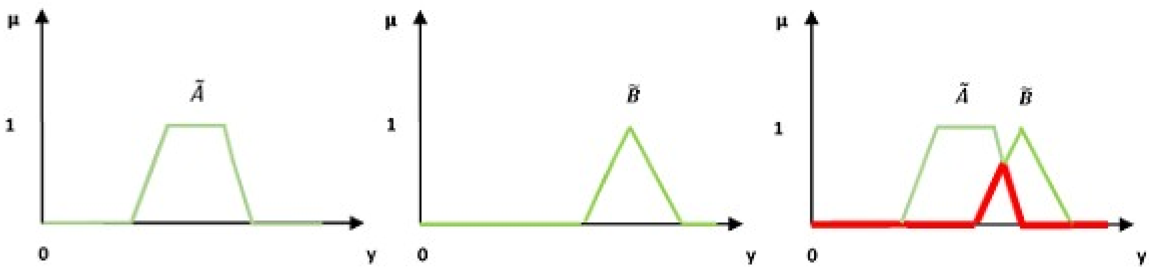


Fuzzy set $\tilde{A}$ Fuzzy set $\tilde{B}$ Union of two Fuzzy sets

2. Intersection / Fuzzy 'AND'

   $\mu_{\tilde{A}\cap\tilde{B}}(y) = \mu_{\tilde{A}} \wedge \mu_{\tilde{B}} \quad ,\forall y \in U$

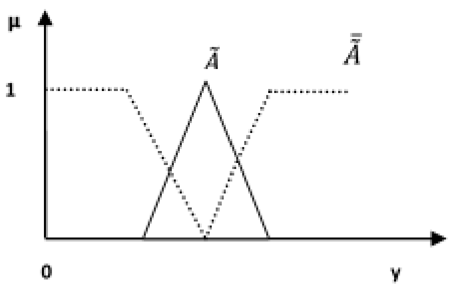
   Here $\wedge$ represents the 'min' operation.



Fuzzy set $\tilde{A}$ Fuzzy set $\tilde{B}$ Intersection of two Fuzzy sets

3. Complement / Fuzzy 'NOT'

   $\mu_{\tilde{A}} = 1 - \mu_{\tilde{A}}(y) \quad ,y \in U$



Complement of a fuzzy set

Properties of Fuzzy Set:

Having three fuzzy sets *A*, *B*, and *C*, the different properties of fuzzy sets are as follows.

1. Commutative Property

   $\tilde{A} \cup \tilde{B} = \tilde{B} \cup \tilde{A}$

   $\tilde{A} \cap \tilde{B} = \tilde{B} \cap \tilde{A}$

2. Associative Property

   $\tilde{A} \cup (\tilde{B} \cup \tilde{C}) = (\tilde{A} \cup \tilde{B}) \cup \tilde{C}$

   $\tilde{A} \cap (\tilde{B} \cap \tilde{C}) = (\tilde{A} \cap \tilde{B}) \cap \tilde{C}$

3. Distributive Property

   $\tilde{A} \cup (\tilde{B} \cap \tilde{C}) = (\tilde{A} \cup \tilde{B}) \cap (\tilde{A} \cup \tilde{C})$

   $\tilde{A} \cap (\tilde{B} \cup \tilde{C}) = (\tilde{A} \cap \tilde{B}) \cup (\tilde{A} \cap \tilde{C})$

Conclusion:

Thus, we successfully understood the concepts of fuzzy set and implemented different operations on the same.