Properties of Membership function in fuzzy logic

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Abstract:

In recent years lot of research is carried on fuzzy logic. Fuzzy membership functions represent similarities of objects to ambiguous properties. All the information represented by a fuzzy set is contained within the membership function. This chapter summaries some methods to develop membership functions, briefly discusses the process of fuzzification (making crisp sets into fuzzy sets), and illustrates a few defuzzification (reducing fuzzy sets into singleton scalar values) methods.

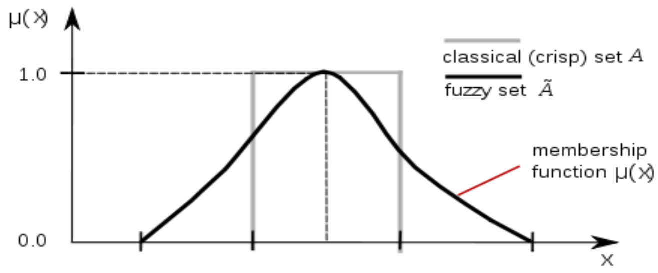
History:

Membership functions were introduced by Zadeh in the first paper on fuzzy sets (1965). Zadeh, in his theory of fuzzy sets, proposed using a membership function (with a range covering the interval (0,1)) operating on the domain of all possible values.

Following are important points relating to the membership function:

- Membership functions characterize fuzziness (i.e., all the information in fuzzy set), whether the elements in fuzzy sets are discrete or continuous.
- Membership functions can be defined as a technique to solve practical problems by experience.
- Membership functions are represented by graphical forms.

Definition of membership function: For any set X, a membership function on X is any function from X to the real unit interval [0,1]. Membership functions on represent fuzzy subset of X. The membership function which represents a fuzzy set $\overline{A}$ is usually denoted by μ_A.For an element x of X, the value $\mu_A(x)$ is called the membership degree of $x$in the fuzzy set $\overline{A}$. The membership degree $\mu_A(x)$ quantifies the grade of membership of the element x to the fuzzy set $\overline{A}$. The value 0 means that $x$is not a member of the fuzzy set; the value 1 means that is fully a member of the fuzzy set. The values between 0 and 1 characterize fuzzy members, which belong to the fuzzy set only partially.



Membership function of a fuzzy set

The usual membership functions with values in [0, 1] are then called [0, 1]-valued membership functions.

Mathematical Notation:

- We have already studied that a fuzzy set $\tilde{A}$ in the universe of information U can be defined as a set of ordered pairs and it can be represented mathematically as − $A = \{(y, \mu_A(y)) \mid y \in U\}$
- Here $\mu A(\bullet) =$ membership function of $\overline{A}$; this assumes values in the range from 0 to 1, i.e $\mu A(\bullet) \in [0,1]$ .The membership function $\mu A(\bullet)$ maps U to the membership space M.
- The dot $(\bullet)$ in the membership function described above, represents the element in a fuzzy set; whether it is discrete or continuous.

There are different forms of membership functions such as:

1. Triangular.
2. Trapezoidal.
3. Piecewise linear.
4. Gaussian.
5. Singleton

Properties of Membership Function:

A normal fuzzy set is one whose membership function has at least one element x in the universe whose membership value is unity. For fuzzy sets where one and only one element has a membership equal to one, this element is typically referred to as the prototype of the set, or the prototypical element. From fig.(A) that figure illustrates typical normal and subnormal fuzzy sets..

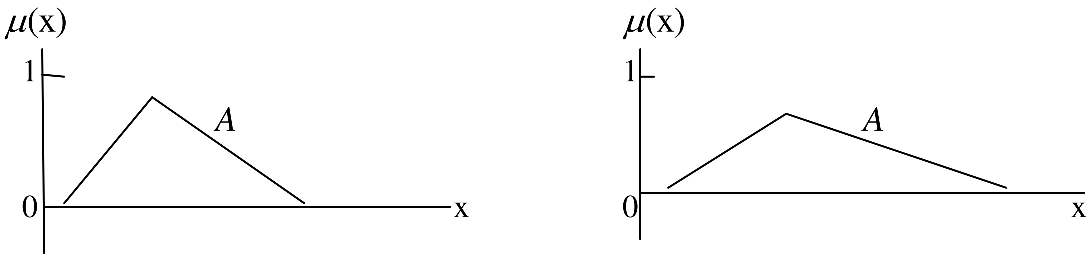


Fig.(A)

A convex fuzzy set is described by a membership function whose membership values are strictly monotonically increasing, or whose membership values are strictly monotonically decreasing, or whose membership values are strictly monotonically increasing then strictly monotonically decreasing with increasing values for elements in the universe. Said another way, if, for any elements x, y, and z in a fuzzy set A, the relation x<y<z implies that $\mu_A(y) \geq \min[\mu_A(x), \mu_A(z)]$, (1)

then A is said to be a convex fuzzy set [Ross, 1995], From Fig(B) shows a typical convex fuzzy set and a typical non convex fuzzy set.

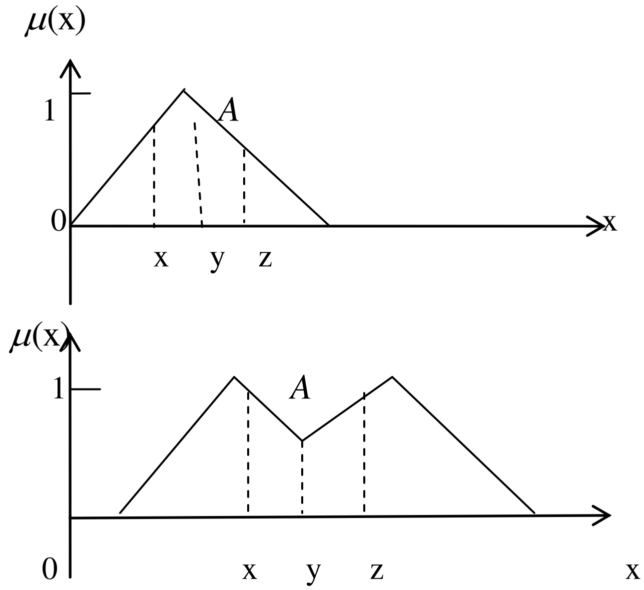


Fig.(B)

A special property of two convex fuzzy sets, say A and B is that the intersection of these two convex fuzzy sets is also a convex fuzzy set, as shown in Fig.(C) That is, for A and B,which are both convex, $A \cap B$ is also convex

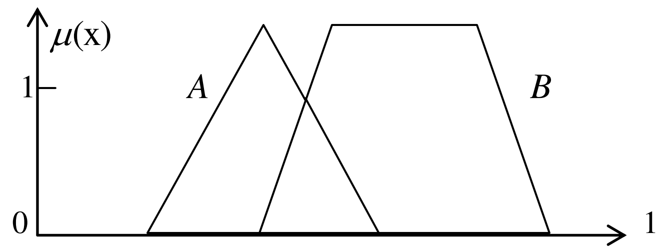


Fig.(C)

Conclusion:

In this paper ,we have learned methods of membership functions and its prperties.The proposed approach can significantly reduce the time and effort needed to develop a fuzzy expert system .Based on membership functions and fuzzy. This work has been successfully demonstrated effect of various membership functions , different types of membership functions were explained. We took different properties. An attempt has been made to show how the membership functions used in fuzzy logic.

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