

INTRODUCTION TO FUZZY MATHEMATICS

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LEARNING OBJECTIVES

Enable to understand the basic concepts of crisp set and fuzzy set, operations of fuzzy sets with examples.

Crisp Set:

Classical set theory also termed as crisp set theory was propounded by George Cantor in 1874-1897 , is fundamental to the study of fuzzy sets.

e.g: Does she have a pen? The answer of the above given question is definitely Yes or No, depending on the situation. If yes is assigned a value 1 and No is assigned a value 0, the outcome of the statement could have a 0 or 1.

Fuzzy Set:

A fuzzy set can be defined mathematically by assigning to each possible individual in the universe of discourse a value representing its grade membership in the fuzzy set.

e.g: a fuzzy set representing our concept of sunny might assign a degree of membership of 1 to a cloud cover of 0%, 0.8 to a cloud cover of 20%, 0.4 to a cloud cover of 30%, and 0 to a cloud cover of 75%.

Crisp Set vs Fuzzy Set

- Crisp set A is a mapping for the elements of S to the set $\{0,1\}$

$$A: S \rightarrow \{0,1\}$$

$$\mu_A(x) = 1 \quad \text{If } x \text{ is an element of set } A$$

$$\mu_A(x) = 0 \quad \text{If } x \text{ not an element of set } A$$

- Fuzzy set F is a mapping for the elements of S to the interval $[0,1]$

$$F: S \rightarrow [0,1]$$

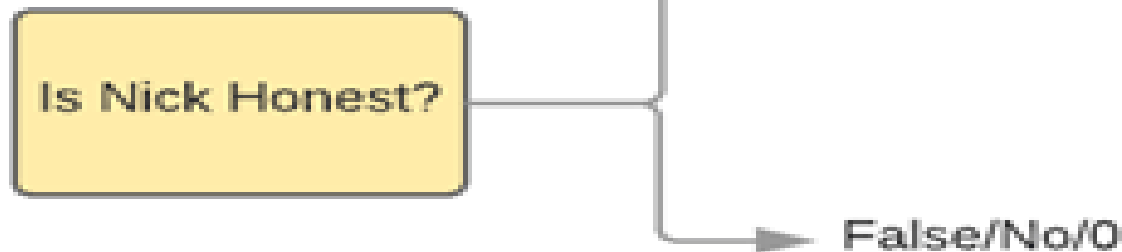
Characteristic function: $0 \leq \mu_F(x) \leq 1$

For 1 full membership and for 0 no membership

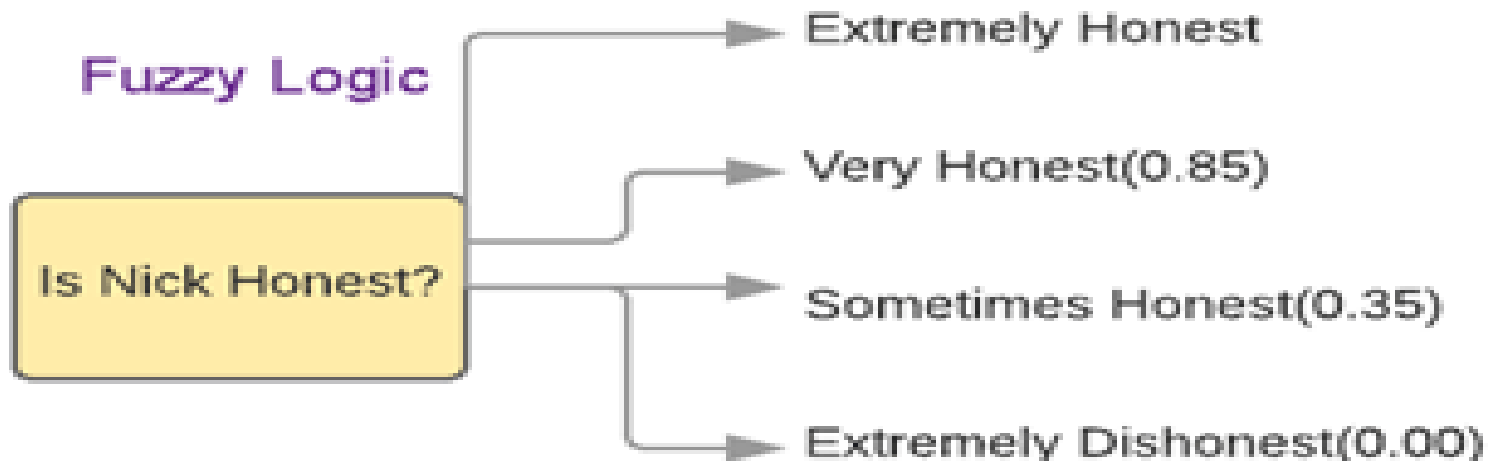
Anything between them called graded membership

FUZZY SET VS CRISP SET

Boolean Logic



Fuzzy Logic



Fuzzy Set Operation

Given X to be the universe of discourse and \tilde{A} and \tilde{B} to be fuzzy sets with $\mu_{\tilde{A}}(x)$ and $\mu_{\tilde{B}}(x)$ are their respective membership function, the fuzzy set operations are as follows:

Union:

$$\mu_{\tilde{A} \cup \tilde{B}}(x) = \max (\mu_{\tilde{A}}(x), \mu_{\tilde{B}}(x))$$

Intersection:

$$\mu_{\tilde{A} \cap \tilde{B}}(x) = \min (\mu_{\tilde{A}}(x), \mu_{\tilde{B}}(x))$$

Complement:

$$\mu_{\tilde{A}}(x) = 1 - \mu_A(x)$$

Example of Operations on Fuzzy Set (cntd.)

Universe $U = \{X_1, X_2, X_3\}$

Fuzzy sets $A = \{0.2/X_1, 0.7/X_2, 0.6/X_3\}$ and $B = \{0.7/X_1, 0.3/X_2, 0.5/X_3\}$

$$A \cup B = \{0.7/X_1, 0.7/X_2, 0.6/X_3\}$$

$$A \cap B = \{0.2/X_1, 0.3/X_2, 0.5/X_3\}$$

$$A^c = \{0.8/X_1, 0.3/X_2, 0.4/X_3\}$$

Thank You