

# “Zadeh”, Master of Fuzzy Logic

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In 1965 **Lotfi Zadeh**, published his famous paper "**Fuzzy sets**". Zadeh extended the work on possibility theory into a formal system of mathematical logic, and introduced a new concept for applying natural language terms. This new logic for representing fuzzy terms was called **fuzzy logic** and Zadeh became the master of fuzzy logic. Fuzzy logic is a set of mathematical principles for knowledge representation base on degrees of membership. Unlike two-valued Boolean logic, fuzzy logic is multi-valued. Fuzzy logic uses the continuum of logic values between 0 (completely false) and 1 (completely true). Instead of just false and true, it employs that things can be partly true and partly false at the same time. In fact, if  $X$  be the universe set and its elements be denoted as  $x$ , then in the classical set theory, crisp set  $A$  of  $X$  is defined as function  $f_A(x)$  called the characteristic function

of  $A$ ,  $f_A(x): X \rightarrow \{0,1\}$ , where  $f_A(x) = \begin{cases} 1, & x \in A \\ 0, & x \notin A \end{cases}$ . This set maps universe  $X$  to a set of two

elements. For any element  $x$  of universe  $X$ , characteristic function  $f_A(x)$  is equal to 1, if  $x$  is an element of set  $A$ , and is equal to 0, if  $x$  is not an element of  $A$ . In the fuzzy theory, fuzzy set  $A$  of universe  $X$  is defined by function  $\mu_A(x)$  called the *membership function* of set  $A$ ,  $\mu_A(x): X \rightarrow [0,1]$ , where  $\mu_A(x) = 1$  if  $x$  is totally in  $A$ ,  $\mu_A(x) = 0$  if  $x$  is not in  $A$ ,  $0 < \mu_A(x) < 1$  if  $x$  is partly in  $A$ . This set allows a continuum of possible choices. For any element  $x$  of universe  $X$ , membership function  $\mu_A(x)$  equals the degree to which  $x$  is an element of set  $A$ . This degree, a value between 0 and 1, represents the degree of membership of element  $x$  in set  $A$ .