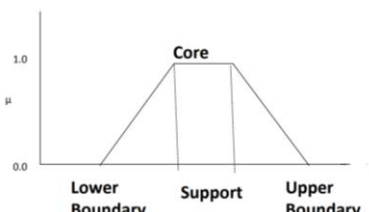


1. Support in fuzzy sets:

a. The support of a fuzzy set is the set of all elements in the universal set that have a non-zero membership degree in the fuzzy set.
b. It is the closure of the set of elements that have a non-zero membership degree.
c. The support of a fuzzy set can be defined as the intersection of all alpha cuts of the fuzzy set that have a non-zero value.
d. Support(A) is set of all points x in X such that {(x| μA (x) > 0 }
e. Fuzzy set whose support is a single point in X with μA (x) =1 is called fuzzy singleton

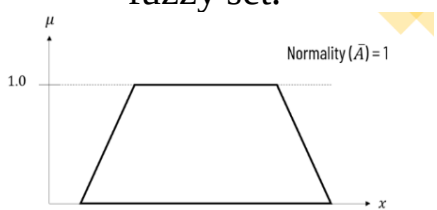
2. **Core in fuzzy sets:**

a. The core of a fuzzy set is the set of all elements in the universal set that have a membership degree of 1 in the fuzzy set.
b. It is the crisp subset of the fuzzy set, where the membership degree is maximum.
c. The core is a subset of the support, and the larger the core, the more compact the fuzzy set.
d. core(A) is set of all points x in X such that {(x| μA (x) =1 }

3. **Boundary in fuzzy sets**:

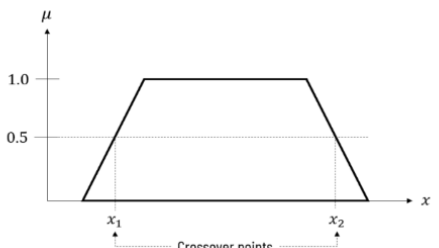
a. The boundary of a fuzzy set is the set of all elements in the universal set that have a membership degree of 0.5 in the fuzzy set.
b. It is the fuzzy subset of the fuzzy set, where the membership degree is midway between 0 and 1.
c. The boundary separates the fuzzy set from its complement in the universal set.
d. $1>\mu\tilde{A}(y)>0$

4. **Normality in fuzzy sets**:
   a. Normality is a property of a fuzzy set that indicates how well it fits a crisp set.
   b. A fuzzy set is said to be normal if its core is equal to the corresponding crisp set.
   c. The degree of normality is the membership degree of the core in the fuzzy set.

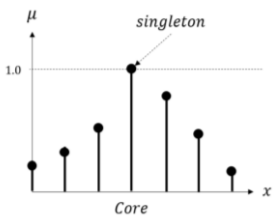


5. **Crossover points in fuzzy sets:**

a. Crossover points are the points at which two or more fuzzy sets have the same membership degree.
b. They are important for decision-making in fuzzy logic because they represent the points of ambiguity or uncertainty.
c. Crossover points can be used to determine the membership degree of an element in multiple fuzzy sets.



6. **Fuzzy singleton in fuzzy sets**:

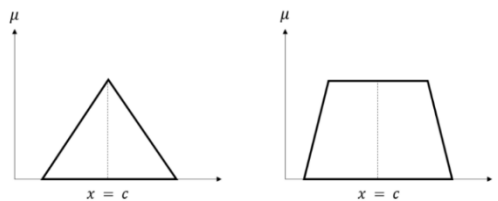


a. A fuzzy singleton is a fuzzy set that has a membership degree of 1 for a single element in the universal set and 0 for all other elements.

b. It is a special case of a fuzzy set that represents a crisp value.

c. Fuzzy singleton can be used to represent uncertain or vague value.

7. **Symmetry in fuzzy sets**:



a. Symmetry is a property of a fuzzy set that indicates how balanced the membership degrees are on either side of the center of the fuzzy set.

b. A fuzzy set is symmetric if the membership degrees are mirror images of each other across the center of the fuzzy set.

8. **Alpha cut in fuzzy sets**:
    a. An alpha cut is a crisp subset of a fuzzy set that contains all elements in the universal set that have a membership degree greater than or equal to a given threshold value.
    b. Alpha cuts are important for converting fuzzy sets into crisp sets for decision-making.
    c. The degree of alpha cut is the threshold value, and it determines the level of granularity of the crisp set.

Application of Fuzzy Logic

It is used in the aerospace field for altitude control of spacecraft and satellites. It has been used in the automotive system for speed control, traffic control. It is used for decision-making support systems and personal valuation in the large company business. It has application in the chemical industry for controlling the pH, drying, chemical distillation process. Fuzzy logic is used in Natural language processing and various intensive applications in Artificial Intelligence.
Fuzzy logic is extensively used in modern control systems such as expert systems.

Probabilistic reasoning

In this technique, we use the probability or the concept of probability which will help us to indicate and identify the uncertainty of the value. In this approach what we do, we combine the probability theory or concept with the logic to handle the uncertainty of the value. Like we have so many examples in the real world also like the things will happen or not we are not sure about it. We can use Probabilistic reasoning in the below three cases provided; a) When we are trying to do an experiment, and something happened like an unknown error. b) When we are not sure about uncertain outcomes. c) when we have predicates too large to handle.

Genetic Algorithms

Genetic Algorithm (GA) is a search-based optimization technique based on the principles of Genetics and Natural Selection. It is frequently used to solve optimization problems, in research, and in machine learning. Genetic algorithms simulate the process of natural selection which means those species who can adapt to changes in their environment are able to survive and reproduce and go to next generation. Optimization is the process of making something better. In any process, we have a set of inputs and a set of outputs. This makes genetic algorithms attractive for use in solving optimization problems.

Applications of GA's

Optimization – Genetic Algorithms are most used in optimization problems. It generates solutions to optimization problems using techniques inspired by natural evolution, such as inheritance, mutation, selection, and crossover.
Economics – GAs are also used to characterize various economic models like the cobweb model, game theory equilibrium resolution, asset pricing, etc.
Parallelization – GAs also have very good parallel capabilities and prove to be very effective means in solving certain problems, and also provide a good area for research.
Image Processing – GAs are used for various digital image processing (DIP) tasks
as well like dense pixel matching.

Hybrid System

A Hybrid system is an intelligent system that is framed by combining at least two intelligent technologies like Fuzzy Logic, Neural networks, Genetic algorithms, reinforcement learning, etc. The combination of different techniques in one computational model makes these systems possess an extended range of capabilities. These systems are capable of reasoning and learning in an uncertain and imprecise environment. These systems can provide human-like expertise like domain knowledge, adaptation in noisy environments, etc.

Neuro-Fuzzy Hybrid System

The Neuro-fuzzy system is based on fuzzy system which is trained based on the working of neural network theory. The learning process operates only on the local information and causes only local changes in the underlying fuzzy system. A neuro-fuzzy system can be seen as a 3-layer feedforward neural network. The first layer represents input variables, the middle (hidden) layer represents fuzzy rules and the third layer represents output variables.

Neuro-Genetic

A Neuro Genetic hybrid system is a system that combines Neural networks and a Genetic algorithm. A Neuro Genetic hybrid system is a system that combines Neural networks: which are capable to learn various tasks from examples, classify objects and establish relations between them, and a Genetic algorithm: which serves important search and optimization techniques. Genetic algorithms can be used to improve the performance of Neural Networks and they can be used to decide the connection weights of the inputs. These algorithms can also be used for topology selection and training networks.

Fuzzy-Genetic

A Fuzzy Genetic Hybrid System is developed to use fuzzy logic-based techniques for improving and modeling Genetic algorithms and vice-versa. A Fuzzy Genetic Hybrid System is developed to use fuzzy logic-based techniques for improving and modeling Genetic algorithms and vice-versa. Genetic algorithm has proved to be a robust and efficient tool to perform tasks like generation of the fuzzy rule base, generation of membership function, etc.