RAMA UNIVERSITY

www.ramauniversity.ac.in

FACULTY OF EGINEERING AND TECHNOLOGY

Soft Computing

LECTURE -10

Umesh Kumar Gera
Assistant Professor
Computer Science & Engineering

OUTLINE

- Architecture of a Fuzzy Logic System
- Membership Function
- Triangular function
- Trapezoidal function
- Gaussian function
- Reference

Architecture Of FLS

Architecture of a Fuzzy Logic System

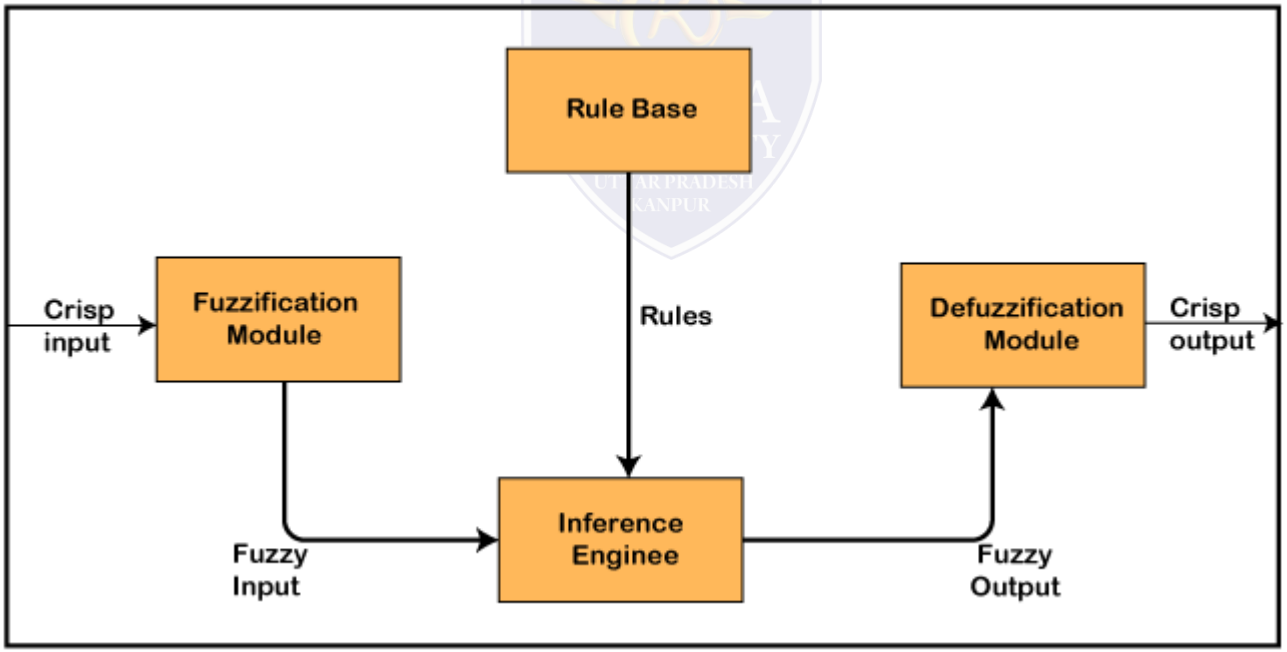
The architecture consists of the different four components which are given below.

•Rule Base

•Fuzzification

•Inference Engine

•Defuzzification



RULE BASE AND FUZZIFICATION

Rule Base

Rule Base is a component used for storing the set of rules and the If-Then conditions given by the experts are used for controlling the decision-making systems. There are so many updates that come in the Fuzzy theory recently, which offers effective methods for designing and tuning of fuzzy controllers. These updates or developments decreases the number of fuzzy set of rules.

Fuzzification

Fuzzification is a module or component for transforming the system inputs, i.e., it converts the crisp number into fuzzy steps. The crisp numbers are those inputs which are measured by the sensors and then Fuzzification passed them into the control systems for further processing. This component divides the input signals into following five states in any Fuzzy Logic system.

- ❑Large Positive (LP)
- ❑Medium Positive (MP)
- ❑Small (S)
- ❑Medium Negative (MN)
- ❑Large negative (LN)

INFERENCE AND DEFUZZIFICATION

Inference Engine

This component is a main component in any Fuzzy Logic system (FLS), because all the information is processed in the Inference Engine. It allows users to find the matching degree between the current fuzzy input and the rules. After the matching degree, this system determines which rule is to be added according to the given input field. When all rules are fired, then they are combined for developing the control actions.

Defuzzification

Defuzzification is a module or component, which takes the fuzzy set inputs generated by the Inference Engine, and then transforms them into a crisp value. It is the last step in the process of a fuzzy logic system. The crisp value is a type of value which is acceptable by the user. Various techniques are present to do this, but the user has to select the best one for reducing the errors.

MEMBERSHIP FUNCTION

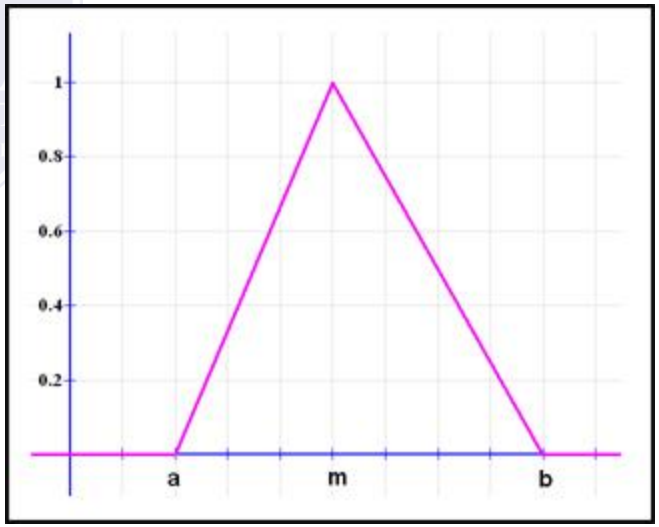
Membership Function

a membership function for a fuzzy set A on the universe of discourse X is defined as μ_A:X → [0,1], where each element of X is mapped to a value between 0 and 1. This value, called membership value or degree of membership, quantifies the grade of membership of the element in X to the fuzzy set A.

Triangular function:

defined by a lower limit **a**, an upper limit **b**, and a value **m**, where **a < m < b**.

$$\mu_A(x) = \begin{cases} 0, & x \le a \\ \dfrac{x-a}{m-a}, & a < x \le m \\ \dfrac{b-x}{b-m}, & m < x < b \\ 0, & x \ge b \end{cases}$$

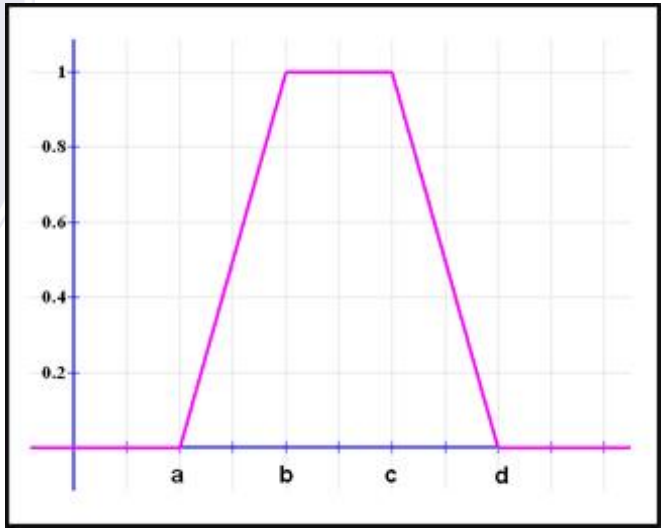


MEMBERSHIP FUNCTION

Trapezoidal function:

defined by a lower limit **a**, an upper limit **d**, a lower support limit **b**, and an upper support limit **c**, where **a < b < c < d**.

$$\mu_A(x) = \begin{cases} 0, & (x < a) \text{ or } (x > d) \\ \dfrac{x-a}{b-a}, & a \le x \le b \\ 1, & b \le x \le c \\ \dfrac{d-x}{d-c}, & c \le x \le d \end{cases}$$

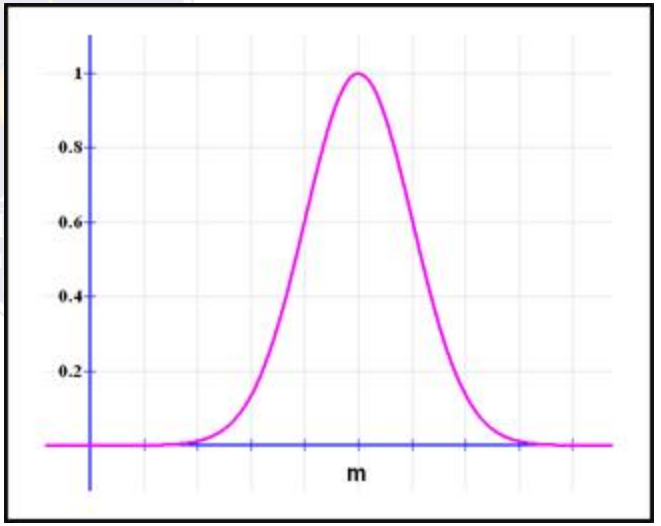


MEMBERSHIP FUNCTION

Gaussian function:

defined by a central value **m** and a standard deviation **k > 0**. The smaller k is, the narrower the “bell” is.

$$\mu_A(x) = e^{-\frac{(x-m)^2}{2k^2}}$$



MULTIPLE CHOICE QUESTION

1. Why is the XOR problem exceptionally interesting to neural network researchers?

a) Because it can be expressed in a way that allows you to use a neural network

b) Because it is complex binary operation that cannot be solved using neural networks

c) Because it can be solved by a single layer perceptron

d) Because it is the simplest linearly inseparable problem that exists.

2. What is back propagation?

a) It is another name given to the curvy function in the perceptron

b) It is the transmission of error back through the network to adjust the inputs

c) It is the transmission of error back through the network to allow weights to be adjusted so that the network can learn

d) None of the mentioned

3. Why are linearly separable problems of interest of neural network researchers?

a) Because they are the only class of problem that network can solve successfully

b) Because they are the only class of problem that Perceptron can solve successfully

c) Because they are the only mathematical functions that are continue

d) Because they are the only mathematical functions you can draw

4. Which of the following is not the promise of artificial neural network?

a) It can explain result

b) It can survive the failure of some nodes

c) It has inherent parallelism

d) It can handle noise

5. Neural Networks are complex _____ with many parameters.

a) Linear Functions

b) Nonlinear Functions

c) Discrete Functions

d) Exponential Functions

REFERENCES

- https://www.sanfoundry.com/neural-networks-questions-answers-backpropagation-algorithm/
- http://www.dma.fi.upm.es/recursos/aplicaciones/logica_borrosa/web/fuzzy_inferencia/funpert_en.htm#:~:text=Definition%3A%20a%20membership%20function%20for,to%20the%20fuzzy%20set%20A.