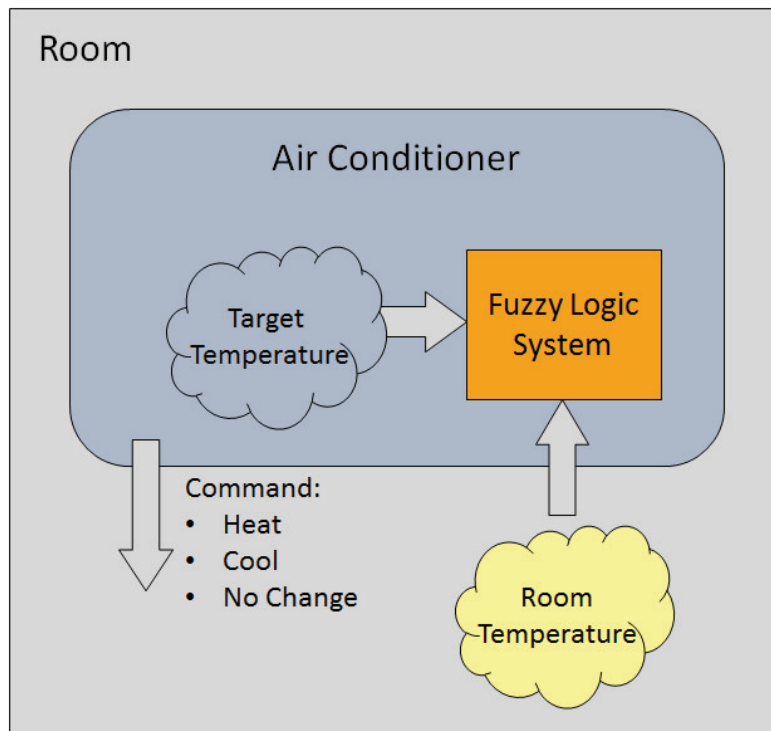


## Example of a Fuzzy Logic System

Let us consider an air conditioning system with 5-level fuzzy logic system. This system adjusts the temperature of air conditioner by comparing the room temperature and the target temperature value.



### Algorithm

1. Define linguistic Variables and terms (start)
2. Construct membership functions for them. (start)
3. Construct knowledge base of rules (start)
4. Convert crisp data into fuzzy data sets using membership functions (fuzzification)
5. Evaluate rules in the rule base (interface engine)
6. Combine results from each rule (interface engine)
7. Convert output data into non-fuzzy values. (defuzzification)

### Development

#### Step 1: Define linguistic variables and terms

Linguistic variables are input and output variables in the form of simple words or sentences. For room temperature, cold, warm, hot, etc., are linguistic terms.

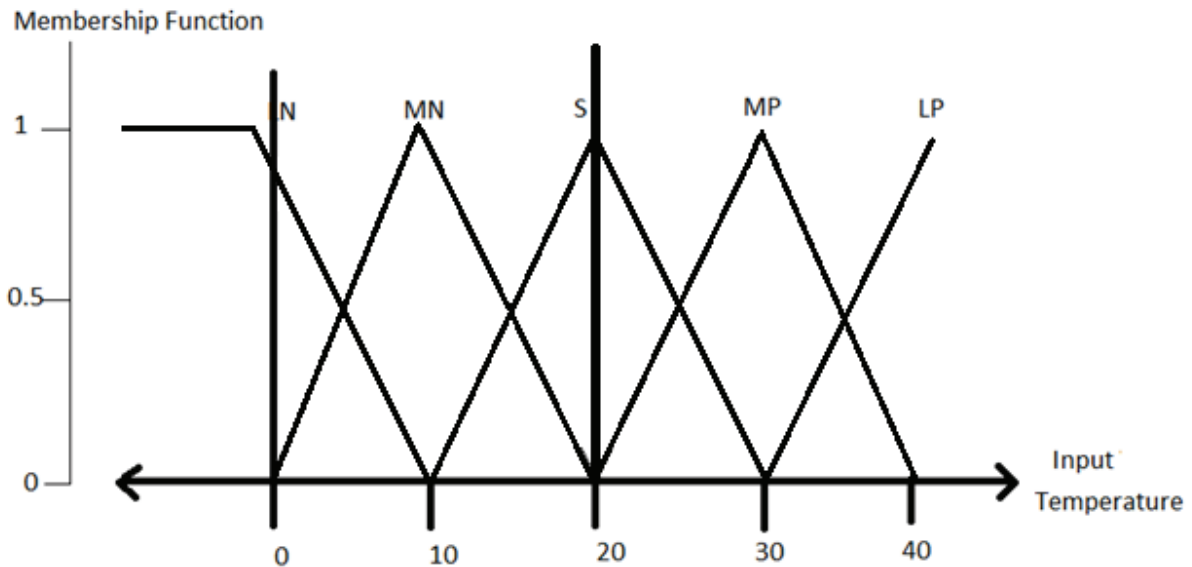
Temperature (t) = {very-cold, cold, warm, very-warm, hot}

## Artificial Intelligence for Beginners

Every member of this set is a linguistic term and it can cover some portion of overall temperature values.

### Step 2: Construct membership functions for them

The membership functions of temperature variable are as shown:



### Step3: Construct knowledge base rules

Create a matrix of room temperature values versus target temperature values that an air conditioning system is expected to provide.

RoomTemp/Target	Very_Cold	Cold	Warm	Hot	Very_Hot
Very_Cold	No_Change	Heat	Heat	Heat	Heat
Cold	Cool	No_Change	Heat	Heat	Heat
Warm	Cool	Cool	No_Change	Heat	Heat
Hot	Cool	Cool	Cool	No_Change	Heat
Very_Hot	Cool	Cool	Cool	Cool	No_Change

Build a set of rules into the knowledge base in the form of IF-THEN-ELSE structures.

Sr. No.	Condition	Action
1	IF temperature=(Cold OR Very_Cold) AND target=Warm THEN	HEAT

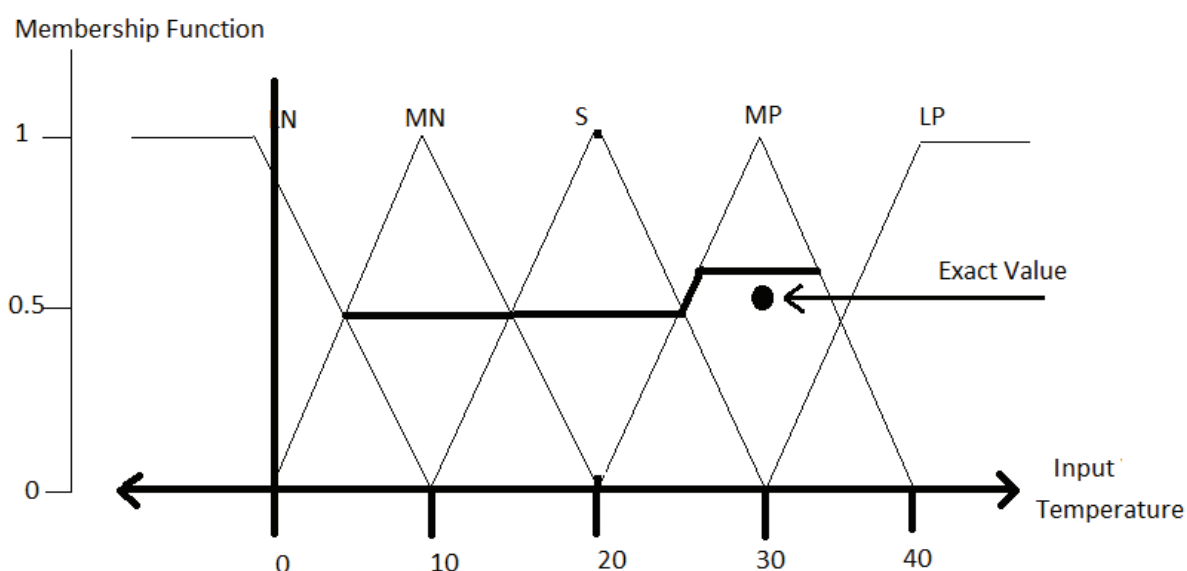
2	IF temperature=(Hot OR Very_Hot) AND target=Warm THEN	COOL
3	IF (temperature=Warm) AND (target=Warm) THEN	NOCHANGE

### Step5

Fuzzy set operations perform evaluation of rules. The operations used for OR and AND are Max and Min respectively. All results of evaluation are combined to form a final result. This result is a fuzzy value.

### Step 6

Defuzzification is then performed according to membership function for output variable.



## Application Areas of Fuzzy Logic

The key application areas of fuzzy logic are as given:

### Automotive Systems

- Automatic Gearboxes
- Four-Wheel Steering
- Vehicle environment control

### Consumer Electronics

- Hi-Fi Systems

- Photocopiers
- Still and Video Cameras
- Television

### **Domestic Goods**

- Microwave Ovens
- Refrigerators
- Toasters
- Vacuum Cleaners
- Washing Machines

### **Environment Control**

- Air Conditioners/Dryers/Heaters
- Humidifiers

## **Advantages of FLSs**

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- Mathematical concepts within fuzzy reasoning are very simple.
- You can modify a FIS by just adding or deleting rules due to flexibility of fuzzy logic.
- Fuzzy logic Systems can take imprecise, distorted, noisy input information.
- FLSs are easy to construct and understand.
- Fuzzy logic is a solution to complex problems in all fields of life, including medicine, as it resembles human reasoning and decision making.

## **Disadvantages of FLSs**

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- There is no systematic approach to fuzzy system designing.
- They are understandable only when simple.
- They are suitable for the problems which do not need high accuracy.