# APPLICATION OF FUZZY LOGIC

# WHAT IS FUZZY LOGIC?

- Fuzzy Logic (FL) is a method of reasoning that resembles human reasoning. The approach of FL imitates the way of decision making in humans that involves all intermediate possibilities between digital values YES and NO.

- The conventional logic block that a computer can understand takes precise input and produces a definite output as TRUE or FALSE, which is equivalent to human's YES or NO.

# What is Fuzzy Logic?

**Fuzzy logic is a form of many-valued logic; it deals with reasoning that is approximate rather than fixed and exact. In contrast with traditional logic theory, where binary sets have two-valued logic: true or false, fuzzy logic variables may have a truth value that ranges in degree**

**between 0 and 1**

# What is Fuzzy Logic?

**Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false. Furthermore, when linguistic variables are used, these degrees may be managed by specific functions.**

# Fuzzy Logic began

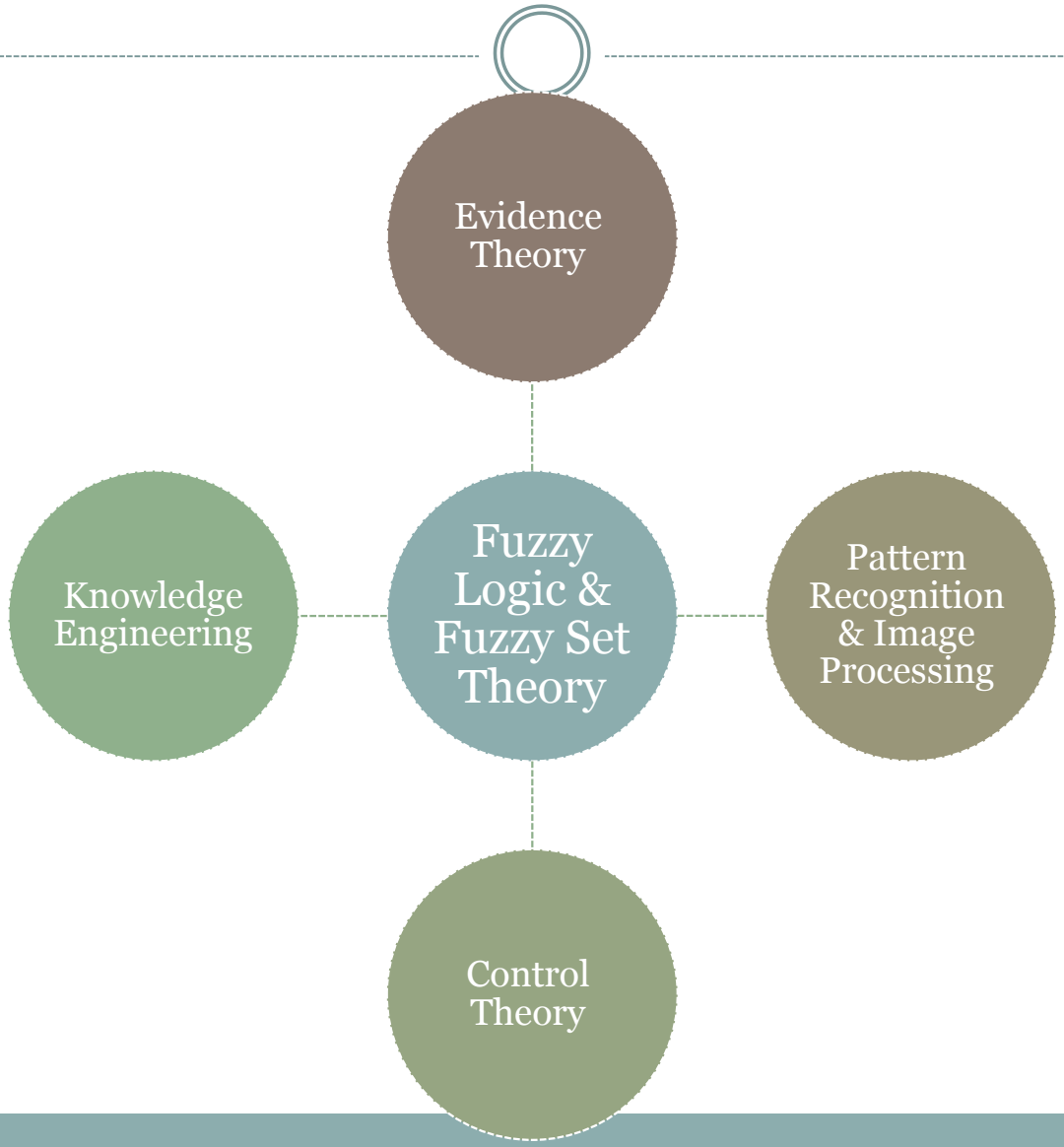
**Fuzzy logic began with the 1965 proposal of fuzzy set theory by Lotfi Zadeh Fuzzy logic has been applied to many fields, from control theory to artificial intelligence**

- Lotfi A. Zadeh, a professor of UC Berkeley in California, soon to be known as the founder of fuzzy logic observed that conventional computer logic was incapable of manipulating data representing subjective or vague human ideas such as "an attractive person" .

- Fuzzy logic, hence was designed to allow computers to determine the distinctions among data with shades of gray, similar to the process of human reasoning.

- This theory proposed making the membership function (or the values False and True) operate over the range of real numbers [0.0, 1.0]. Fuzzy logic was now introduced to the world.

# Some Related Fields



Rules :-

- Fuzzy logic usually uses IF-THEN rules, or constructs that
are equivalent.

-IF *variable* IS *property* THEN *action*

*Example:-*

A simple temperature regulator that uses a fan might look like this:

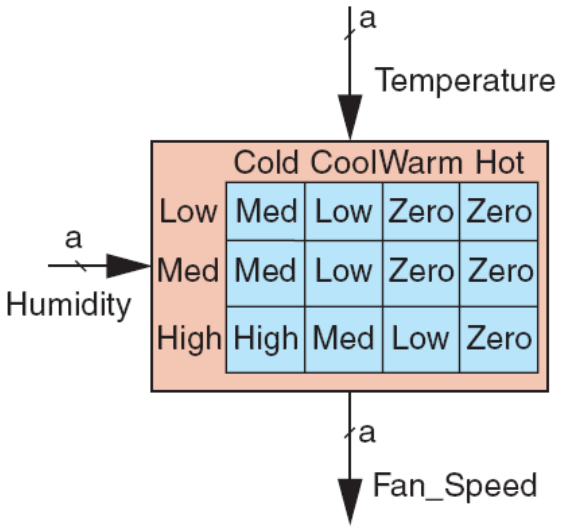
IF temperature IS very cold THEN stop fan
IF temperature IS cold THEN turn down fan
IF temperature IS normal THEN maintain level
IF temperature IS hot THEN speed up fan

# FUZZY LOGIC IN CONTROL SYSTEMS

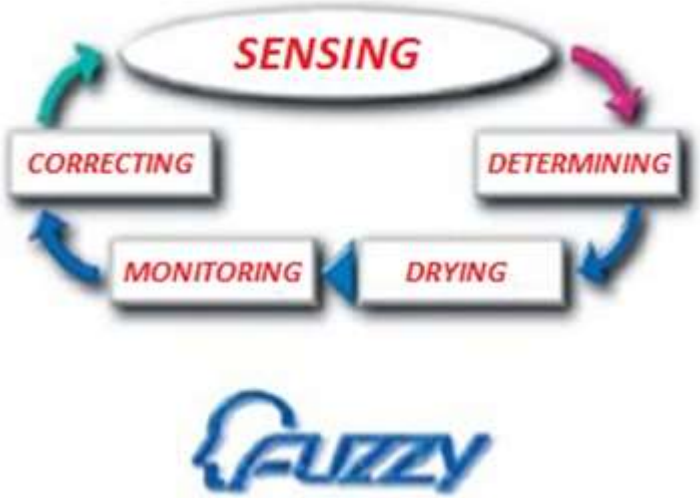
- Fuzzy Logic provides a more efficient and resourceful way to solve Control Systems.
- Some Examples
  - Temperature Controller
  - Anti – Lock Break System ( ABS )

# TEMPERATURE CONTROLLER

- The problem
  - Change the speed of a heater fan, based off the room temperature and humidity.
- A temperature control system has four settings
  - Cold, Cool, Warm, and Hot
- Humidity can be defined by:
  - Low, Medium, and High
- Using this we can define the fuzzy set.



# Fuzzy Logic in a Washing Machine




- **Fuzzy logic** washing machines are gaining popularity. These machines offer the advantages of **performance**, **productivity**, **simplicity**, **productivity**, and **less cost**. Sensors continually monitor varying conditions inside the machine and accordingly adjust operations for the best wash results. As there is no standard for fuzzy logic, different machines perform in different manners.

- Fuzzy logic controls the washing process, **water intake**, **water temperature**, **wash time**, **rinse performance**, and **spin speed**. This optimizes the life span of the washing machine.

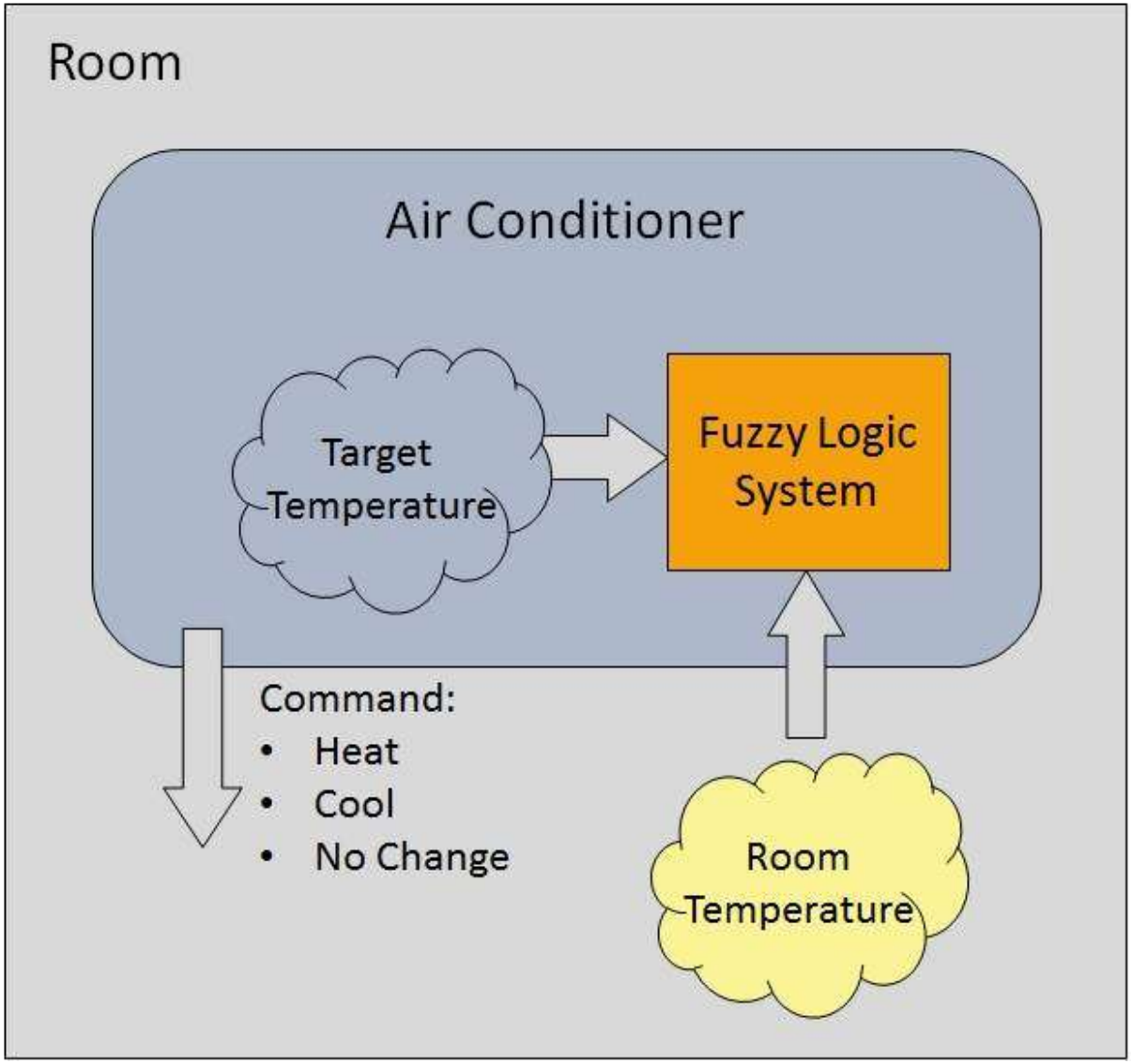
- Machines even learn from **past experience**, **memorizing programs** and adjusting them to **minimize running costs**.

- Most fuzzy logic machines feature '**one touch control**'. Equipped with energy saving features .

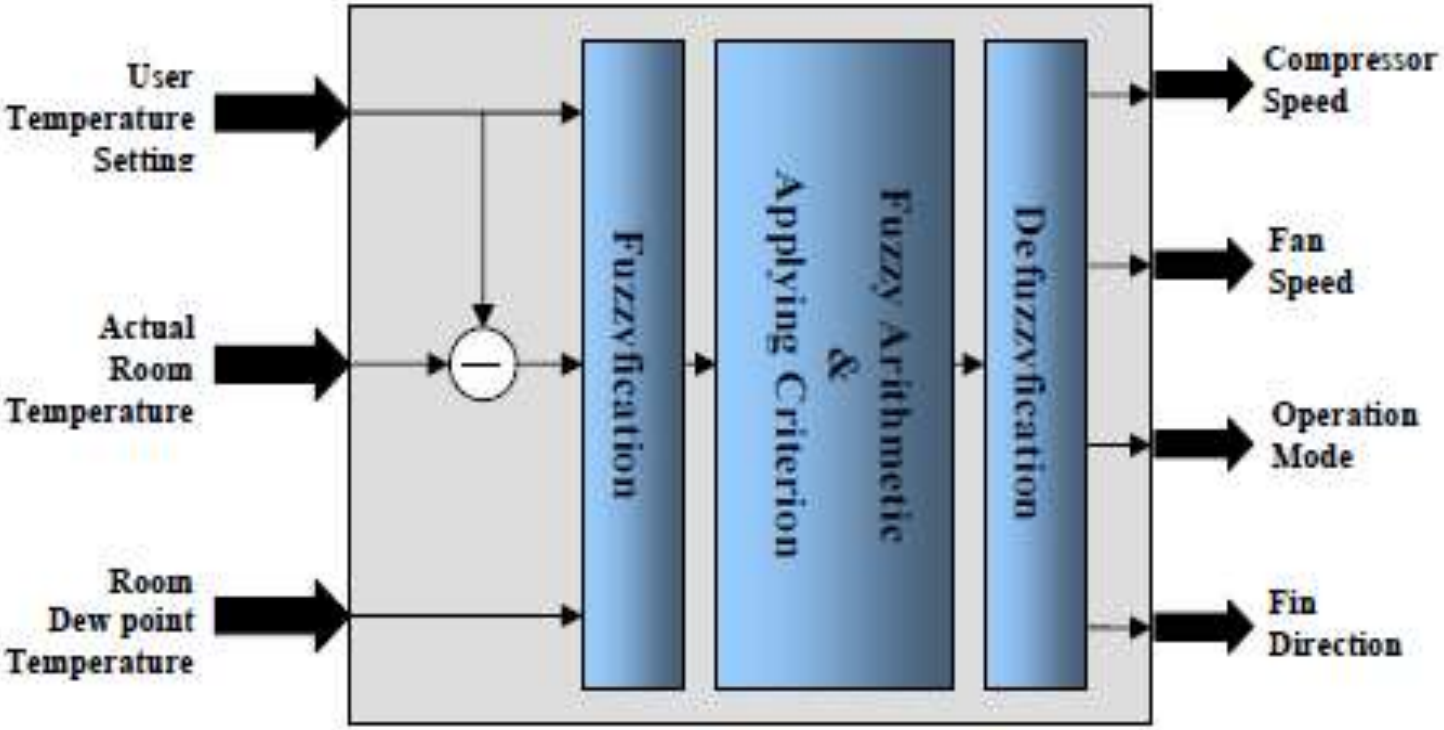
- The **fuzzy logic** checks for the extent of dirt and grease, the amount of soap and water to add, direction of spin, and so on.

- The machine rebalances washing load to ensure correct spinning. Else, it reduces spinning speed if an imbalance is detected. Even distribution of washing load reduces spinning noise. **Neurofuzzy logic** incorporates optical sensors to sense the dirt in water and a **fabric sensor** to detect the type of fabric and accordingly adjust wash cycle.

# Air Conditioner

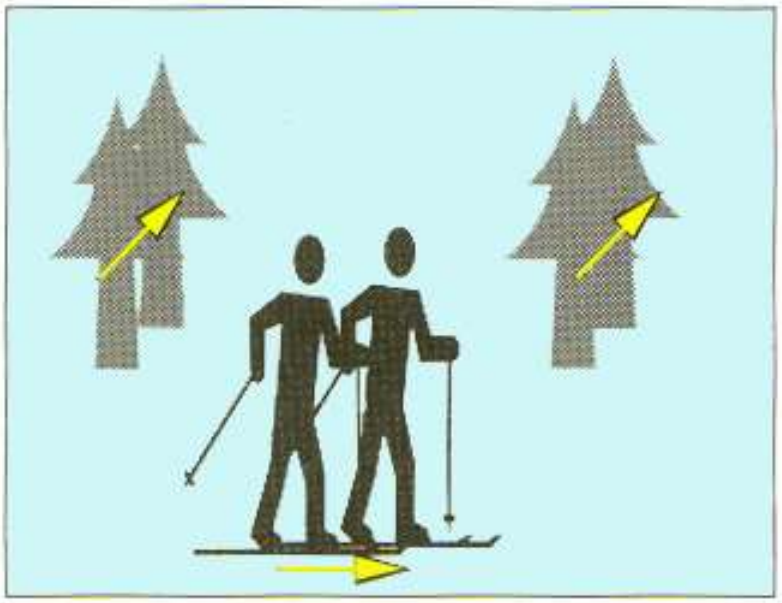


# Block diagram for Controller :-



# Fuzzy Logic Applications

**Image Stabilization via Fuzzy Logic**



**"If all motion vectors are almost parallel and their time differential is small, then the hand jittering is detected and the direction of the hand movement is in the direction of the moving vectors".**

# Fuzzy Logic Applications

- Aerospace
  - Altitude control of spacecraft, satellite altitude control, flow and mixture regulation in aircraft deiceing vehicles.
- Automotive
  - Trainable fuzzy systems for idle speed control, shift scheduling method for automatic transmission, intelligent highway systems, traffic control, improving efficiency of automatic transmissions

# Fuzzy Logic Applications

- Business
  - Decision-making support systems, personnel evaluation in a large company
- Chemical Industry
  - Control of pH, drying, chemical distillation processes, polymer extrusion production, a coke oven gas cooling plant

# Fuzzy Logic Applications

- Defense
  - Underwater target recognition, automatic target recognition of thermal infrared images, naval decision support aids, control of a hypervelocity interceptor, fuzzy set modeling of NATO decision making.
- Electronics
  - Control of automatic exposure in video cameras, humidity in a clean room, air conditioning systems, washing machine timing, microwave ovens, vacuum cleaners.

# Fuzzy Logic Applications

- Financial
  - Banknote transfer control, fund management, stock market predictions.
- Industrial
  - Cement kiln controls heat exchanger control, activated sludge wastewater treatment process control, water purification plant control, quantitative pattern analysis for industrial quality assurance, control of constraint satisfaction problems in structural design, control of water purification plants

# Fuzzy Logic Applications

- Manufacturing
  - Optimization of cheese production.
- Marine
  - Autopilot for ships, optimal route selection, control of autonomous underwater vehicles, ship steering.
- Medical
  - Medical diagnostic support system, control of arterial pressure during anesthesia, multivariable control of anesthesia, modeling of neuropathological findings in Alzheimer's patients, radiology diagnoses, fuzzy inference diagnosis of diabetes and prostate cancer.

# Fuzzy Logic Applications

- Mining and Metal Processing
  - Sinter plant control, decision making in metal forming.
- Robotics
  - Fuzzy control for flexible-link manipulators, robot arm control.
- Securities
  - Decision systems for securities trading.

# Fuzzy Logic Applications

- Signal Processing and Telecommunications
  - Adaptive filter for nonlinear channel equalization control of broadband noise
- Transportation
  - Automatic underground train operation, train schedule control, railway acceleration, braking, and stopping