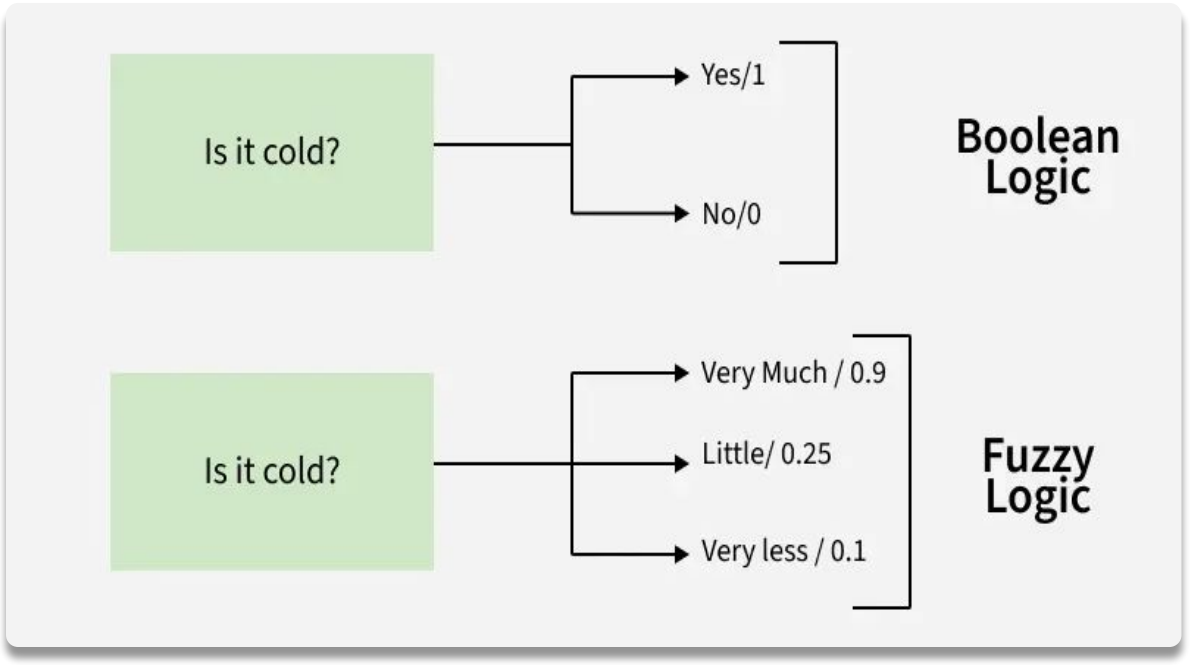
FUZZY LOGIC

ARTIFICIAL INTELLIGENCE

FACULTY OF EMERGING SCIENCES & TECHNOLOGY

Fuzzy Logic – Introduction

- A method to handle uncertainty where things are not clear.
- Classical logic = only True (1) or False (0)
- Real life often has uncertainty (values between 0 and 1)
- Introduced by Lotfi Zadeh (1965)
- Example: Temperature 30°C → partly Cold (0.6), partly Hot (0.4)
- Analogy: Cricket player's performance can be 70% good, 30% bad



Characteristics of Fuzzy Logic

Deals with vagueness & uncertainty

- Works where boundaries are not clear.
- Example: "Tall person." How tall is tall?

Works with degrees of truth (0 to 1)

- Truth values range between 0 and 1 (not just 0 or 1).

Uses linguistic variables (low, medium, high)

- Example: Fan speed = {slow, medium, fast}.

Closer to human reasoning

- Humans often say "maybe, almost, quite, fairly" → fuzzy logic captures this.

Rule-based system using IF-THEN rules

- Example Rule: IF temperature is high THEN fan speed is fast

Fuzzy Sets

- A **fuzzy set** is a set where **each element has a degree of membership** between 0 and 1.
- Classical set: element is IN (1) or OUT (0)
- Fuzzy set: element can belong partly (0 to 1)

- Example: Let's define a fuzzy set Fuzzy set = 'Hot Day'
  - 25°C → 0.2 hot
  - 35°C → 0.7 hot
  - 45°C → 1.0 hot

- Analogy: In a cricket stadium: "crowd is loud." Classical set = either loud or not loud. Fuzzy set = crowd can be 0.3 loud, 0.6 loud, or 1.0 loud.

Membership Functions

1. **Triangular:** Shaped like a triangle.
   - Example: "Warm temperature" = low at 20°C, highest at 30°C, low again at 40°C.
2. **Trapezoidal:** Like a flat top rectangle.
   - Example: "Comfortable temperature" = fully comfortable between 25°C and 30°C, partly comfortable between 20–25 and 30–35.
3. **Gaussian (Bell Curve):** Smooth curve like a bell.
   - Example: "Normal height of students."

Example: Fan Speed Control

- Input: Room Temperature
- Output: Fan Speed

- Fuzzy Sets:
- • Temperature: Cold, Warm, Hot
- • Fan Speed: Slow, Medium, Fast

- Rules:
- 1. IF Temp is Cold THEN Speed = Slow
- 2. IF Temp is Warm THEN Speed = Medium
- 3. IF Temp is Hot THEN Speed = Fast

- If Temp = 30°C → partly Warm (0.6), partly Hot (0.4)
- Result: 60% Medium + 40% Fast

Applications of Fuzzy Logic

- Air conditioners & washing machines
- Car braking systems (ABS)
- Medical diagnosis systems
- Stock market predictions
- Weather forecasting