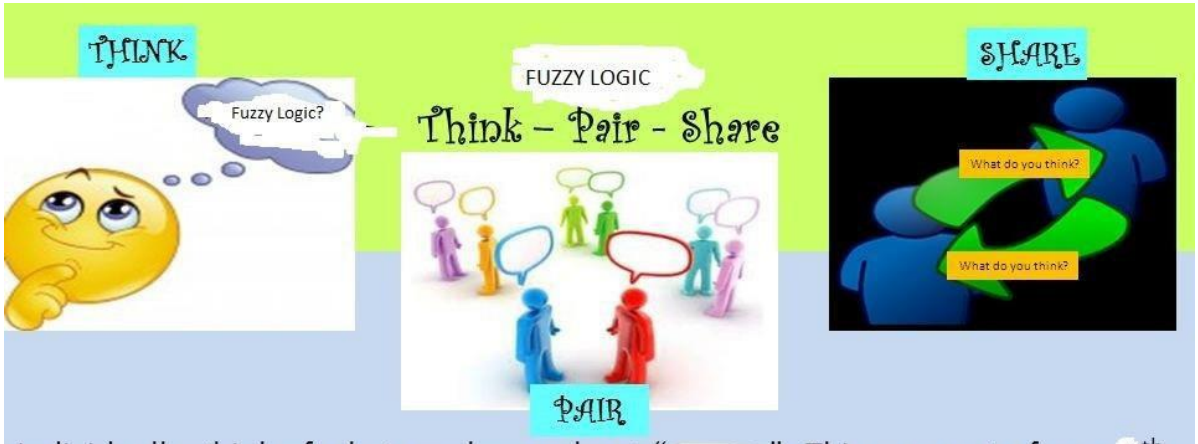
Department of Information Technology

IV B.TECH INFORMATION TECHNOLOGY II SEMESTER

Academic Year 2017-18 Sub: SOFT COMPUTING

Topic: Fuzzy Logic


February
Kids are Special
Hands
Left
Right



Individually, think of what you know about "fuzzy logic". This was part of your 8th Semester BTECH class. Write down what comes to mind when you think of "fuzzy logic" 5 - 7 minutes

Now pair up with a partner (or team) and share your thoughts and ideas. One person serve are the recorder and put these on the construction paper.
5 – 7 minutes

Each team will then share their information with the class. Tape the construction paper up for other students to see.

WHAT IS FUZZY LOGIC?

- Definition of fuzzy
  - Fuzzy – "not clear, distinct, or precise; blurred"
- Definition of fuzzy logic
  - A form of knowledge representation suitable for notions that cannot be defined precisely, but which depend upon their contexts.

Fuzzy Logic Vs Bivalued Logic

- Bivalued logic can have only two possible values as 0/1, yes/no, right/wrong etc
- Fuzzy logic can be multi valued. It can have relative values like yes, not, not so much, a little bit etc.

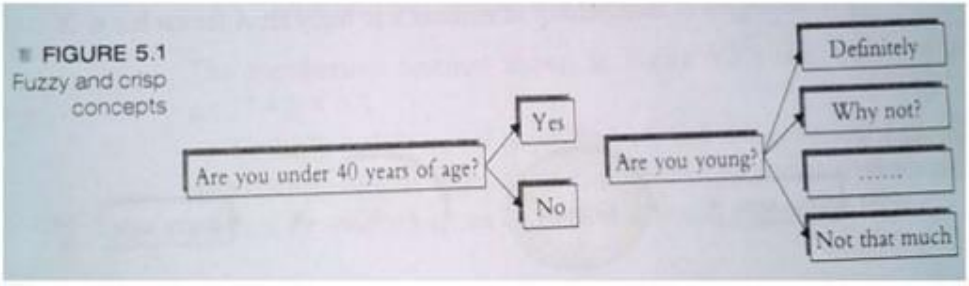
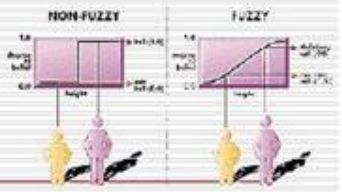


FIGURE 5.1
Fuzzy and crisp concepts

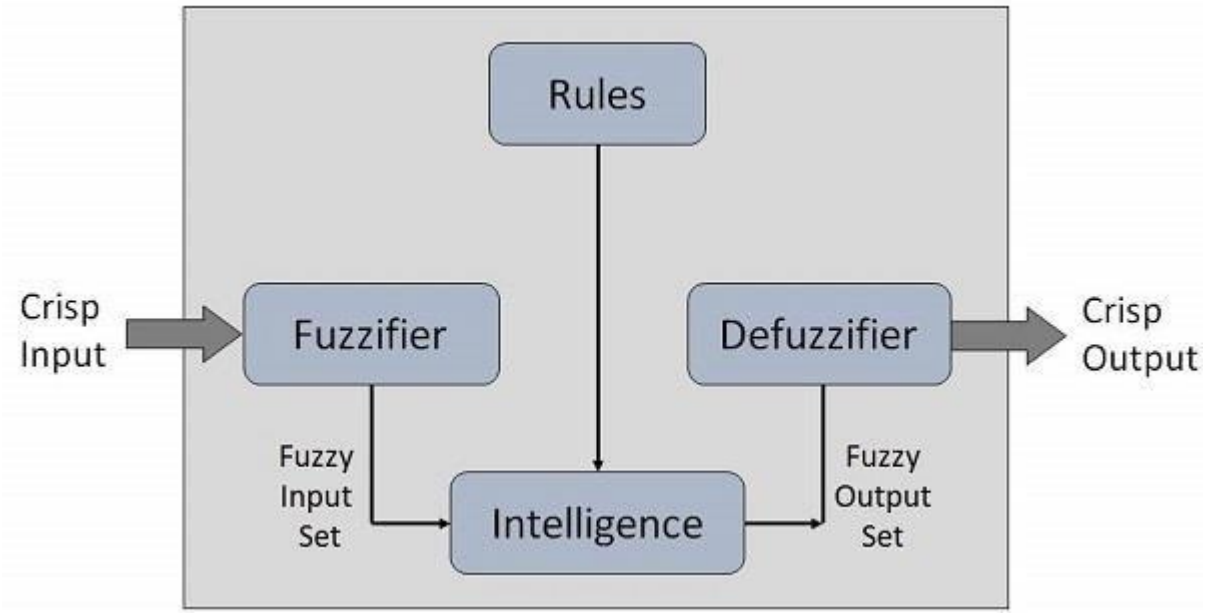
INTRODUCTION



- Fuzzy logic has rapidly become one of the most successful of today's technologies for developing sophisticated control systems. The reason for which is very simple.
- Fuzzy logic addresses such applications perfectly as it resembles human decision making with an ability to generate precise solutions from certain or approximate information.
- It fills an important gap in engineering design methods left vacant by purely mathematical approaches (e.g. linear control design), and purely logic-based approaches (e.g. expert systems) in system design.

Characteristics of Fuzzy Logic

- Exact reasoning is viewed as a limiting case of approximate reasoning
- Everything is a matter of degree
- Knowledge is interpreted as a collection of elastic or equivalently fuzzy constraints on a collection of variables
- Inference is viewed as a process of propagating elastic constraints
- Any logical system can be fuzzified



Simplified Fuzzy Logic Block Diagram

Fuzzification

The process of transforming crisp(bivalued) input values into linguistic values is called fuzzification

Steps of Fuzzification:

Step 1: Input values are translated into linguistic concepts, which are represented by fuzzy set.

Step 2: Membership functions are applied to the measurements, and the degree of membership is determined

Defuzzification

Defuzzification converts the fuzzy values into crisp (bivalued) value.

Example methods of defuzzification:

- **Max-membership method:** This method chooses the elements with maximum value
- **Centroid method:** This method find the centre point of the targeted fuzzy region by calculating the weighted mean of the output fuzzy region
- **Weighted average method:** Assigns weight to each membership function in the output by its respective maximum membership value

Membership Function

- Maps elements of a fuzzy set to real numbered values in the interval 0 to 1.
- The curve representing the mathematical function is a membership function that determines the degree of belonging of member x to the fuzzy set T.

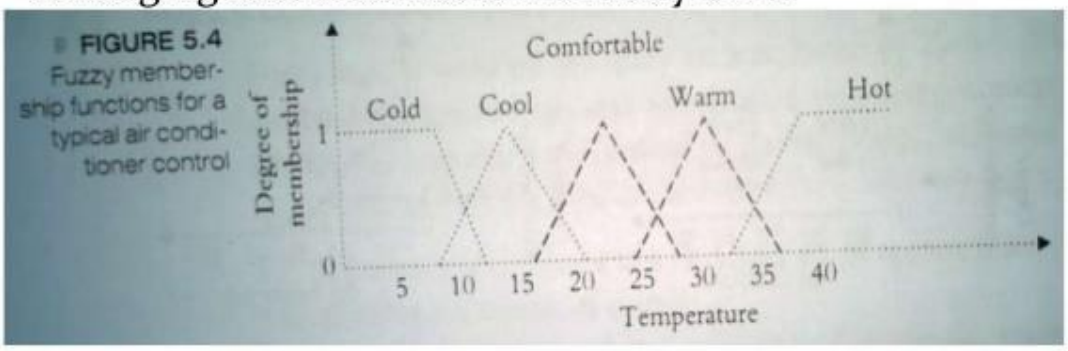
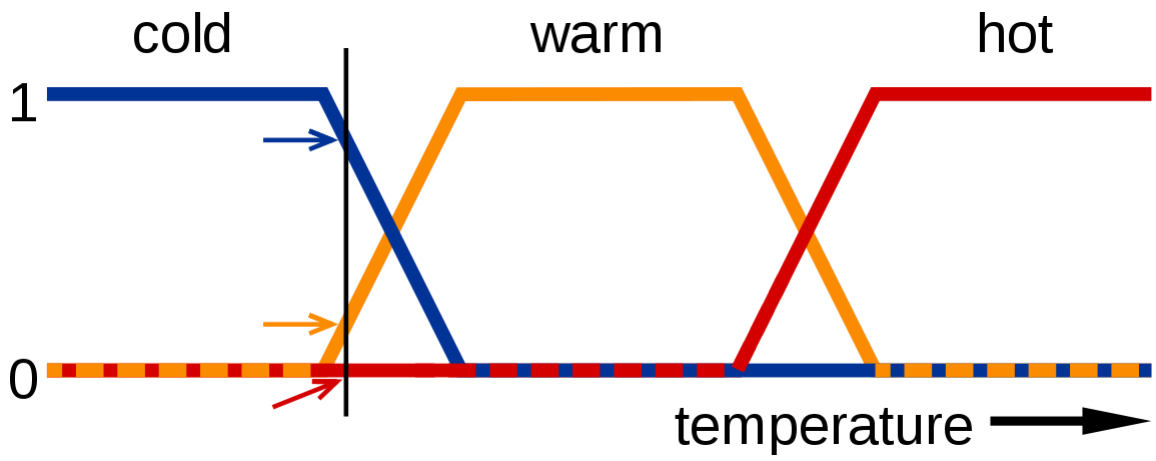


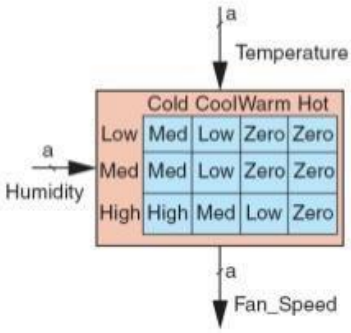
FIGURE 5.4 Fuzzy membership functions for a typical air conditioner control



FUZZY RULE PREPARATION

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 CONTROL:-

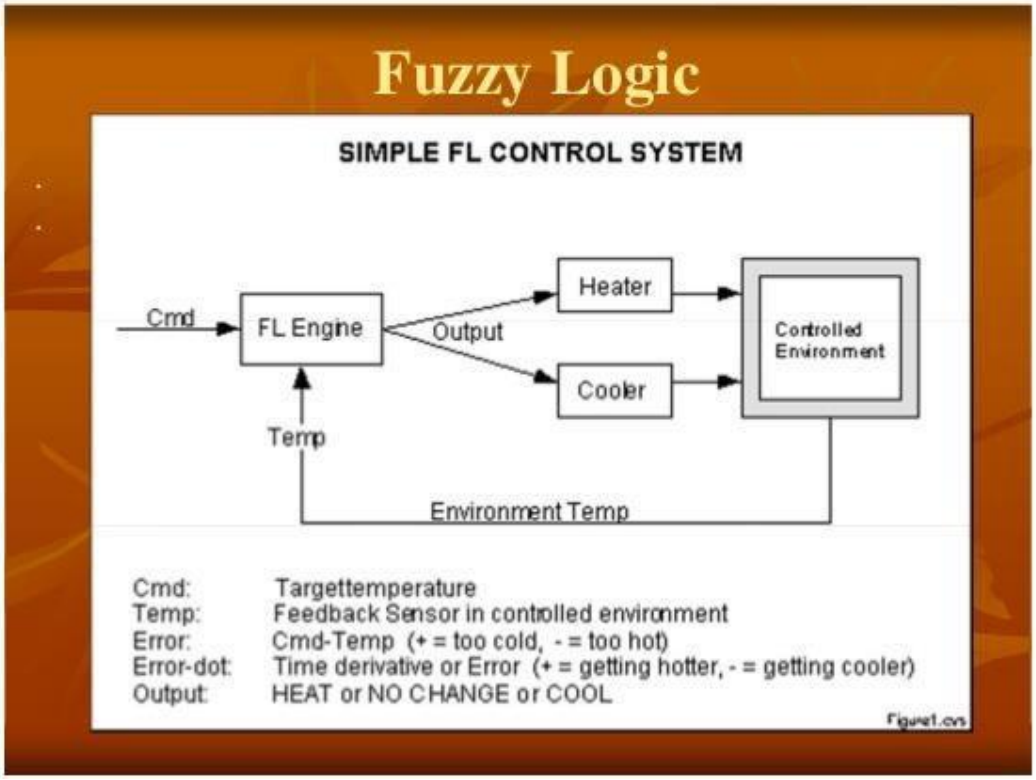
- Fuzzy control, which directly uses fuzzy rules is the most important application in fuzzy theory.
- Using a procedure originated by Ebrahim Mamdani in the late 70s, three steps are taken to create a fuzzy controlled machine:
- 1)Fuzzification(Using membership functions to graphically describe a situation)
- 2)Rule evaluation(Application of fuzzy rules)
- 3)Defuzzification(Obtaining the crisp or actual results)

WHY FUZZY CONTROL?

- Fuzzy Logic is a technique to embody human like thinking into a control system.
- A fuzzy controller is designed to emulate human deductive thinking, that is, the process people use to infer conclusions from what they know.
- Traditional control approach requires formal modeling of the physical reality.

- A **fuzzy control system** can also be described as based on fuzzy logic—a mathematical system that analyzes analog input values in terms of logical variables that take on continuous values between 0 and 1, in contrast to classical or digital logic, which operates on discrete values of either 1 or 0 (true or false respectively).

- Fuzzy logic is widely used in machine control.
- The term itself inspires a certain skepticism, sounding equivalent to "half-baked logic" or "bogus logic", but the "fuzzy" part does not refer to a lack of rigour in the method, rather to the fact that the logic involved can deal with fuzzy concepts—concepts that cannot be expressed as "true" or "false" but rather as "partially true".



Applications of Fuzzy Logic

- Automatic control system
- Prediction, diagnostic and advisory systems
- User interface and neural language processing
- Domestic appliances and embedded systems
- Soft computing and hybrid systems with artificial neural networks
- Very Large Scale Integrated circuits (VLSI) micro controller
- Fuzzy expert system and fuzzy inference