PSSIBILITIES OF T AND F APPLICATIONS OF FUZZY LOGIC FOR DECISION MAKING IN REAL LIFE

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ABSTRACT

The phrase fuzzy refers to unclear or ambiguous things. We may encounter situations in real life where we are unable to determine if a choice is correct or incorrect. Fuzzy logic provides very valuable flexibility for reasoning at that point. We might also evaluate the uncertainties of any situation after taking into account all the information provided, using the fuzzy logic technique to solve a problem. Then it makes the best choice feasible given the input received. The FL technique mimics how humans make decisions by taking into account all of the potential outcomes between the digital values T and F.

INTRODUCTION

Since the 1920s, researchers have researched fuzzy logic. Professor Lotfi Zadeh of UC Berkeley in California coined the phrase "fuzzy logic" in 1965. He noted that traditional computer logic was unable to manipulate data that represented ambiguous or subjective human notions. Fuzzy logic has been used in a variety of domains, including AI and control theory. It was created so that the computer could distinguish between data that is neither true (T) nor untrue (F) anything like the way we think in our heads similar to a little darkness, some brightness, etc.

Characteristics of Fuzzy Logic
a.   Flexible and easy to implement machine learning technique
b.   Helps you to mimic the logic of human thought
c.   Logic may have two values true or false which represent two possible solutions
d.   Highly suitable method for uncertain or approximate reasoning
e.   Fuzzy logic views inference as a action of propagating elastic constraints
f.   Fuzzy logic allows you to build nonlinear functions of arbitrary complexity.

Fuzzy Logic vs. Probability
Fuzzy Logic
Fuzzy: Tom's degree of membership within the set of old people is 0.90.
Fuzzy logic takes truth degrees as a mathematical basis on the model of the vagueness phenomenon.
Crisp vs. Fuzzy
Crisp
In Crisp logic law of Excluded Middle and Non- In the fuzzy logic law of Excluded Middle and
Contradiction may or may not hold   Non- Contradiction hold
Classical Set vs. Fuzzy set Theory
Classical Set
Classes of objects with sharp boundaries.
A classical set is defined by crisp boundaries, i.e., there is clarity about the location of the set boundaries. objects do not have sharp boundaries.

Fuzzy Logic Architecture

Fuzzy Logic architecture has four main parts as mentioned below:

Rule Base:

It contains all the rules and the if-then conditions offered by the experts to control the decision-making system. The fuzzy theory provides various methods for the design and tuning of fuzzy controllers. This updates significantly reduce the number of the fuzzy set of rules.

Fuzzification

Fuzzification step helps to convert inputs. It helps you to convert, crisp numbers into fuzzy sets. Crisp inputs measured by sensors and passed into the control system for further processing. Like Room temperature, pressure, etc.

Inference Engine:

It helps you to compare the degree of match between fuzzy input and the rules. Based on the % match, it determines which rules need implement according to the given input field. After this, the applied rules are combined to develop the control actions.

Defuzzification:

Finally the Defuzzification process is performed to convert the fuzzy sets into a crisp value. There are many types of techniques available, so you need to select it which is best suited when it is used with an expert system.
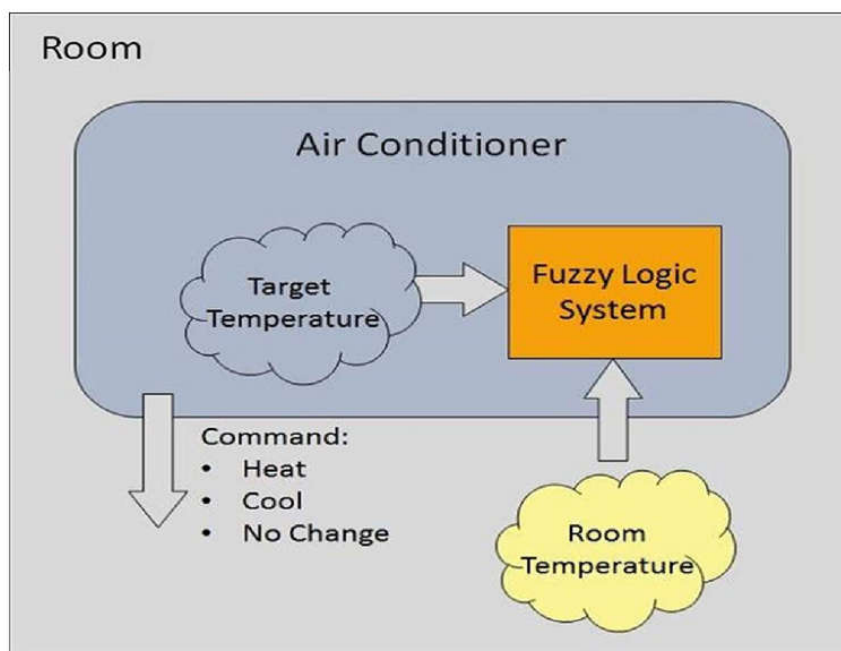
Fuzzy Logic System

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

ALGORITHM

  a. write linguistic Variables and terms (start)
  b. Construct membership functions for given data. (start)
  c. Construct knowledge base of rules (start)

d. Convert crisp set into fuzzy data sets using membership functions. (fuzzification)
e. Calculate rules in the rule base. (Inference Engine)
f. Compare results from each rule. (Inference Engine)
g. Convert output data into non-fuzzy values. (defuzzification)

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 are linguistic terms.
Temperature (T) = {very-cold, cold, warm, very-warm, hot}
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
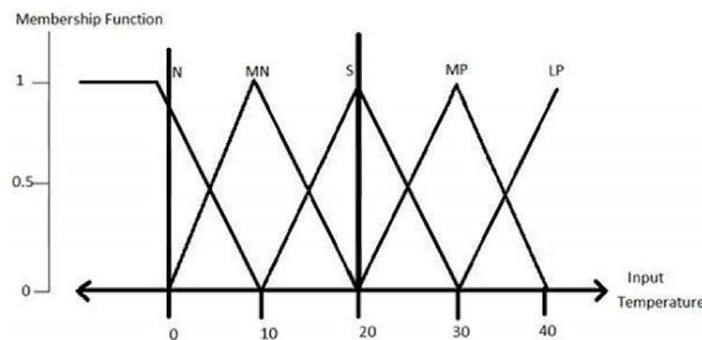
The membership functions of temperature variable are as shown in figure

Step3 − Construct knowledge base rules
Create a table 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

Construct 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 | No_Change |

Step 4 − Obtain fuzzy value

The operations used for OR and AND are Maximum and Minimum respectively. Compare all results of evaluation to form a final result. This result is a fuzzy value.

Step 5 − Perform defuzzification

Defuzzification is then performed according to membership function value for output variable.
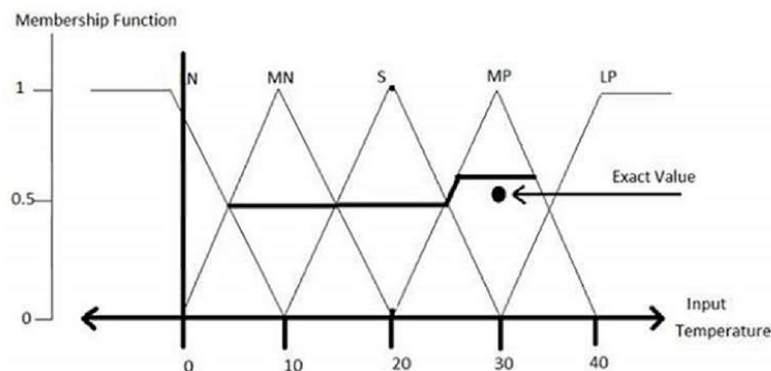
Application Areas of Fuzzy Logic

The Below given table shows how famous companies using fuzzy logic in their products.

Product	Company	Fuzzy Logic
Anti-lock brakes	Nissan	Use fuzzy logic to controls brakes in hazardous cases
		depend on car speed, acceleration, wheel speed, and acceleration
Auto transmission	NOK/Nissan	Fuzzy logic is used to control the fuel injection and
		ignition based on throttle setting, cooling water temperature, RPM, etc.
Auto engine	Honda, Nissan	Use to select geat based on engine load, driving style, and road conditions.
Copy machine	Canon laser printer	Using for adjusting drum voltage based on picture density, humidity, and temperature.
Cruise control	Nissan, Isuzu, Mitsubishi	Use it to adjusts throttle setting to set car speed and acceleration
Dishwasher	Matsushita	strategies based depend upon the number of dishes and the

Elevator control Fujitec, Mitsubishi		Use it to reduce waiting for time-based on passenger
	Electric, Toshiba	traffic
Golf diagnostic system	Maruman Golf	Selects golf club based on golfer's swing and physique.
Fitness management	Omron	Fuzzy rules implied by them to check the fitness of their employees.
Kiln control	Nippon Steel	Mixes cement
Microwave oven	Mitsubishi Chemical	Sets lunes power and cooking strategy
Palmtop computer	Hitachi, Sharp, Sanyo, Toshiba	Recognizes handwritten Kanji characters

Advantages of Fuzzy Logic System
a. The structure of Fuzzy Logic Systems is easy and understandable
b. Fuzzy logic is widely used for commercial and practical purposes
c. It may not offer accurate reasoning, but the only acceptable reasoning
d. It helps you to deal with the uncertainty in engineering
e. Mostly robust as no precise inputs required
f. It can be programmed to in the situation when feedback sensor stops working
g. It can easily be modified to improve or alter system performance inexpensive sensors can be used which helps you to keep the overall system cost and complexity low s
h. It provides a most effective solution to complex issues

CONCLUSION

A versatile and simple machine learning technique is fuzzy logic. Probability is a mathematical model of ignorance, but fuzzy logic uses truth degrees as a mathematical foundation on the concept of ambiguity. Fuzzy logic has applications in the areas of auto transmission, fitness management, golf diagnostic system, dishwasher, copy machine, and air conditioning system. You can control machinery and consumer goods with the use of fuzzy logic.

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