Genetic Algorithm & Fuzzy Logic

Semester-5

Practical - 9

Name: Shivam Tawari

Roll no: A-58

Aim: Implementation of fuzzy rules.

Theory:

What is Fuzzy Logic Rules?

It is a known fact that a human being is always comfortable making conversations in natural language. The representation of human knowledge can be done with the help of following natural language expression –

IF antecedent THEN consequent

The expression as stated above is referred to as the Fuzzy IF-THEN rule base.

Canonical Form Following is the canonical form of Fuzzy Logic Rule Base –

Rule 1 – *If condition C1, then restriction R1*

Rule 2 – *If condition C1, then restriction R2*

Rule n – *If condition C1, then restriction Rn*

Interpretations of Fuzzy IF-THEN Rules

Fuzzy IF-THEN Rules can be interpreted in the following four forms –

Assignment Statements

These kinds of statements use "=" (equal to sign) for the purpose of assignment. They are of the following form −

a = hello

climate = summer

Conditional Statements

These kinds of statements use the "IF-THEN" rule base form for the purpose of condition. They are of the following form −

IF temperature is high THEN Climate is hot

IF food is fresh THEN eat.

Unconditional Statements

They are of the following form −

GOTO 10

turn the Fan off

Linguistic Variable

We have studied that fuzzy logic uses linguistic variables which are the words or sentences in a natural language. For example, if we say temperature, it is a linguistic variable; the values of which are very hot or cold, slightly hot or cold, very warm, slightly warm, etc. The words very, slightly are the linguistic hedges.

Code and Output:

```
bp_high = skfuzzy.sigmf(bp, 100, 0.2)

[2]
    a = plt.plot(bp, bp_low, label='low')
    b = plt.plot(bp, bp_normal, label='normal')
    c = plt.plot(bp, bp_high, label='high')
    plt.title('BP comparisons')
    plt.legend()
    plt.xlabel('BP')
    plt.ylabel('Membership')
    plt.show()
```
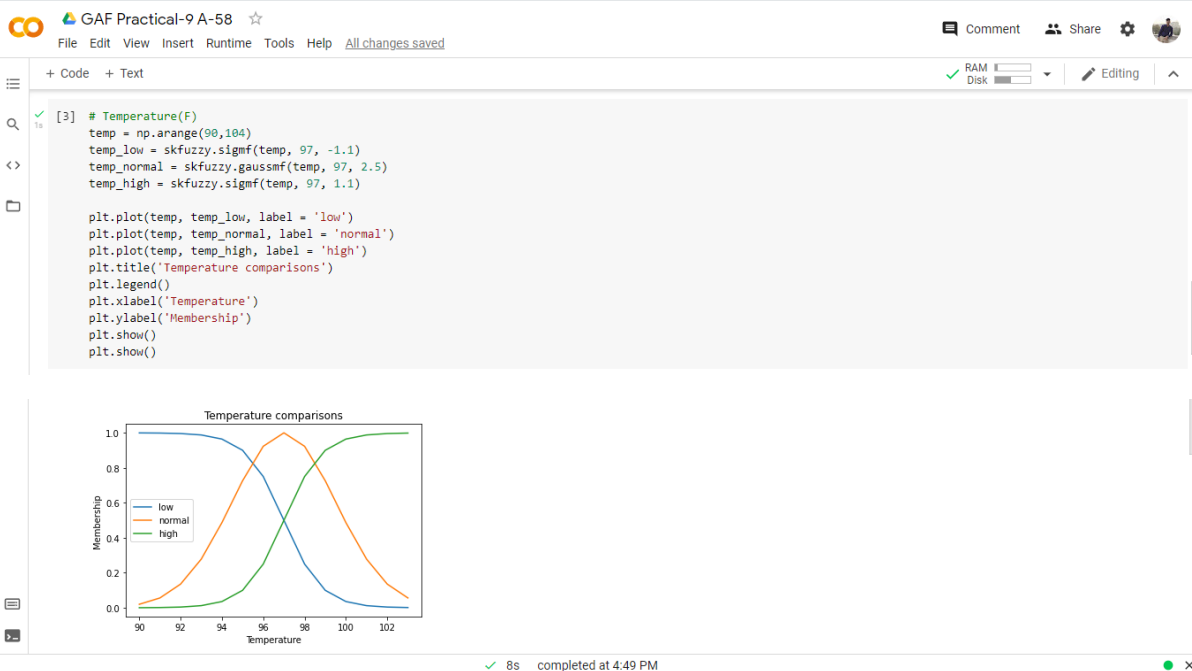


```
[3]  # Temperature(F)
```

✓ 8s   completed at 4:49 PM   ● ✕

☁ GAF Practical-9 A-58 ☆
File Edit View Insert Runtime Tools Help   All changes saved

Comment   Share ⚙

+ Code + Text

RAM
Disk   ▾   ✏ Editing   ∧

```
[3]  # Temperature(F)
     temp = np.arange(90,104)
     temp_low = skfuzzy.sigmf(temp, 97, -1.1)
     temp_normal = skfuzzy.gaussmf(temp, 97, 2.5)
     temp_high = skfuzzy.sigmf(temp, 97, 1.1)

     plt.plot(temp, temp_low, label = 'low')
     plt.plot(temp, temp_normal, label = 'normal')
     plt.plot(temp, temp_high, label = 'high')
     plt.title('Temperature comparisons')
     plt.legend()
     plt.xlabel('Temperature')
     plt.ylabel('Membership')
     plt.show()
     plt.show()
```


✓ 8s   completed at 4:49 PM   ● ✕

☁ GAF Practical-9 A-58 ☆
File Edit View Insert Runtime Tools Help   All changes saved

Comment   Share ⚙

+ Code + Text

RAM
Disk   ▾   ✏ Editing   ∧

```
[4]  def health(temperature, blood_pressure):

         temp_low = skfuzzy.sigmf(temperature, 97, -1.1)
         temp_normal = skfuzzy.gaussmf(temperature, 97, 2.5)
         temp_high = skfuzzy.sigmf(temperature, 97, 1.1)

         temp_cond = ''

         if temp_low > temp_normal and temp_low > temp_high:
             temp_cond = 'low'
         elif temp_normal > temp_low and temp_normal > temp_high:
             temp_cond = 'normal'
         elif temp_high > temp_low and temp_high > temp_normal:
             temp_cond = 'high'

         bp_low = skfuzzy.sigmf(blood_pressure, 100, -0.2)
         bp_normal = skfuzzy.gaussmf(blood_pressure, 100, 20)
         bp_high = skfuzzy.sigmf(blood_pressure, 100, 0.2)

         bp_cond = ''

         if bp_low > bp_normal and bp_low > bp_high:
             bp_cond = 'low'
         elif bp_normal > bp_low and bp_normal > bp_high:
             bp_cond = 'normal'
         elif bp_high > bp_low and bp_high > bp_normal:
             bp_cond = 'high'
```

✓ 8s   completed at 4:49 PM   ● ✕

```
[ ]  temp = float(input("Enter the temperature: "))
     bp = float(input("Enter the blood pressure: "))

     print('The health is :', health(temp, bp))

     Enter the temperature: 101
     Enter the blood pressure: 144
     The health is : Poor
```

Conclusion: Hence, Implementation of fuzzy rules has been successfully.