

Experiment - 3.2

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Subject Name : Soft Computing

Subject Code: 20CSV-347_20AML-4

1.Aim/Overview of the Practical

Write a program to implement Fuzzy Control System: Tipping Problem.

2.Task to be done

- Learn about basic fuzzy control systems.
- Implement Tipping Problem using fuzzy control system using skfuzzy library in python

3. Program/ Code

```
import numpy as np
import skfuzzy as fuzz
from skfuzzy import control as ctrl

quality = ctrl.Antecedent(np.arange(0, 11, 1), 'quality')
service = ctrl.Antecedent(np.arange(0, 11, 1), 'service')
tip = ctrl.Consequent(np.arange(0, 26, 1), 'tip')

quality.automf(3)
service.automf(3)

tip['low'] = fuzz.trimf(tip.universe, [0, 0, 13])
tip['medium'] = fuzz.trimf(tip.universe, [0, 13, 25])
tip['high'] = fuzz.trimf(tip.universe, [13, 25, 25])

rule1 = ctrl.Rule(quality['poor'] | service['poor'], tip['low'])
rule2 = ctrl.Rule(service['average'], tip['medium'])
rule3 = ctrl.Rule(quality['good'] | service['good'], tip['high'])

tipping_ctrl = ctrl.ControlSystem([rule1, rule2, rule3])

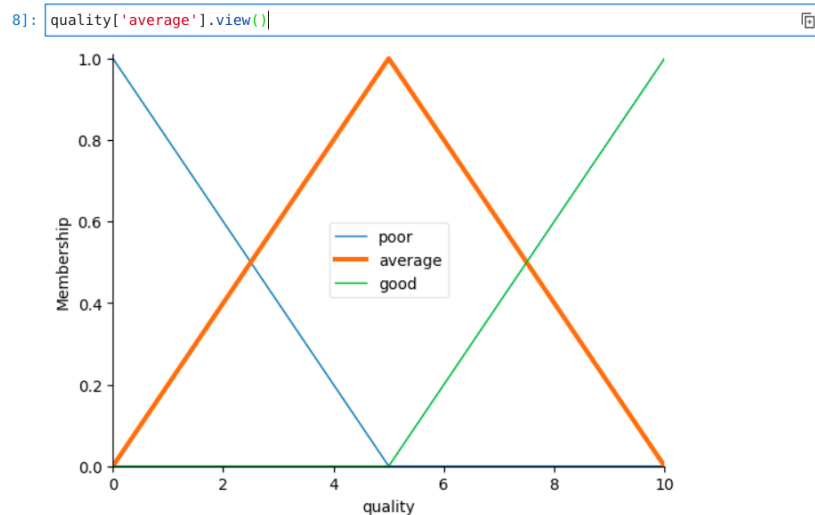
Pankaj_feed = ctrl.ControlSystemSimulation(tipping_ctrl)
```

```
Pankaj_feed.input['quality'] = 1
Pankaj_feed.input['service'] = 2
```

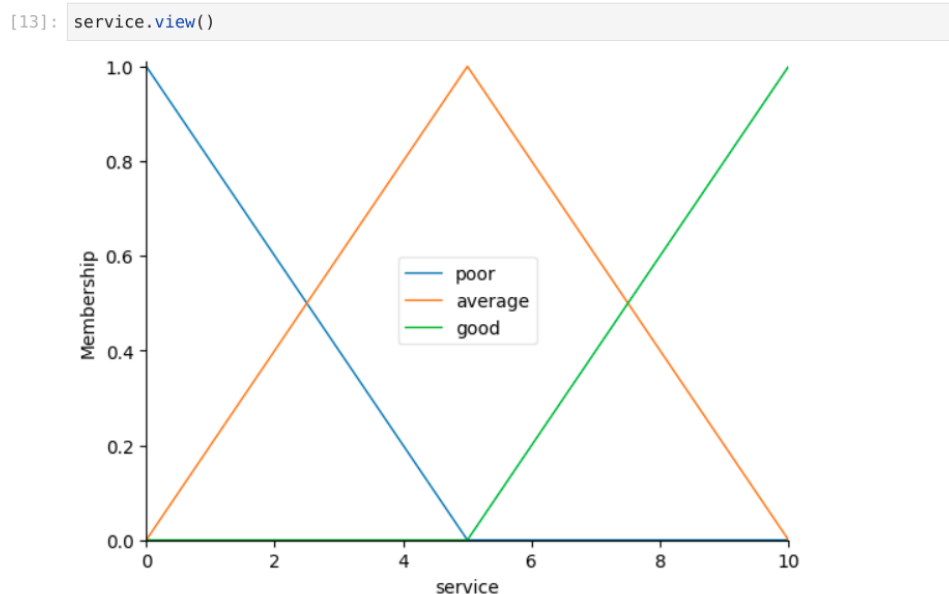
```
Pankaj_feed.compute()
Pankaj_feed.output['tip']
```

4. Output

Output 1: Representing the average quality view



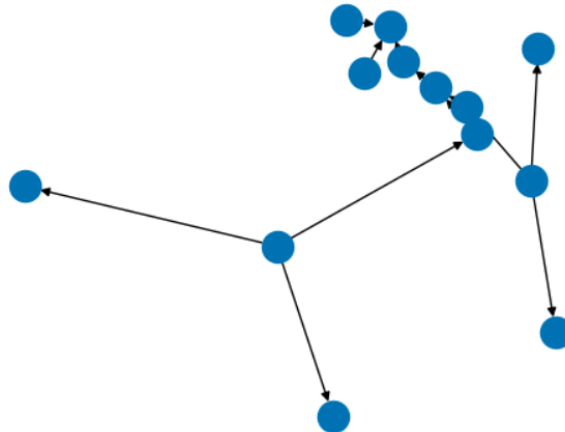
Output 2: Representing the common operation in fuzzy sets.



Output 3: Graph showing rule3 view

```
print(rule3.view())
```

(<Figure size 640x480 with 1 Axes>, <AxesSubplot:>)



Output 4: Based on the input given by the user, the calculated tip using rule1,rule2,rul3 the resulting output is shown below.

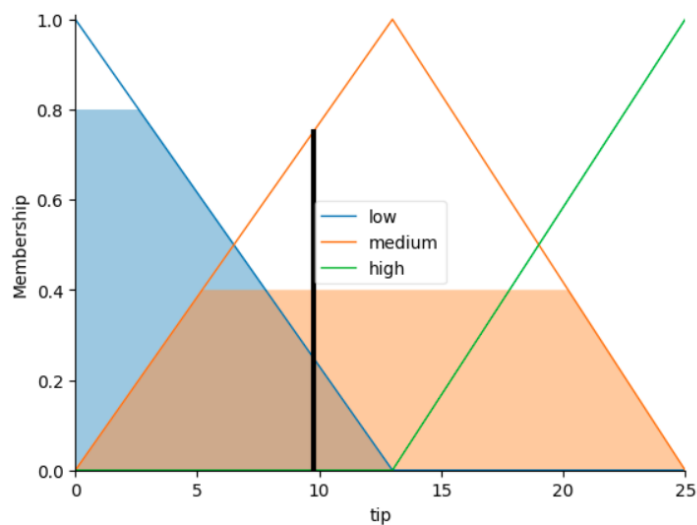
```
[28]: Pankaj_feed.input['quality'] = 1  
Pankaj_feed.input['service'] = 2
```

```
[29]: Pankaj_feed.compute()
```

```
[30]: Pankaj_feed.output['tip']
```

```
[30]: 9.746533923303831
```

```
[31]: tip.view(sim=Pankaj_feed)
```



5. Observation and Discussion

- In this experiment we have implemented a tipping problem using a fuzzy control system. When tipping, we consider the service and food quality, rated between 0 and 10. We have used this to leave a tip of between 0 and 25%.
- Antecedent:** If the antecedent of a rule has more than one part, the fuzzy operator is applied to obtain one number that represents the result of the rule antecedent.
- Consequent:** The consequent is reshaped using a function associated with the antecedent (a single number). The input for the implication process is a single number given by the antecedent, and the output is a fuzzy set. Implication is implemented for each rule.

6. Learning Outcomes

- Learned about fuzzy control system
- Learn to implement fuzzy control systems and implement fuzzy control system in python.

Evaluation Grid (To be created as per the SOP and Assessment guidelines by the faculty):

Sr No.	Parameters	Marks Obtained	Maximum Marks
1.			
2.			
3.			