BSD2513 ARTIFICIAL INTELLIGENCE

LAB REPORT 5

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SECTION : 02G

Questions 1 : General Knowledge

Explain the architecture of fuzzy logic work in your own words. Give reference/s.

Fuzzy logic is a computational approach that deals with reasoning and decision-making in systems with uncertainty and imprecision. It was developed to handle problems that involve subjective or vague information by mimicking human reasoning processes. The architecture of fuzzy logic consists of several key components that work together to enable fuzzy reasoning.

The primary element is the Rule Base, which contains a variety of rules and membership functions that define the relationships between inputs and outputs. These rules frequently have an IF-THEN structure, where the IF part specifies the conditions or criteria based on the input variables, and the THEN part establishes the matching output values.

The Fuzzifier, the second important element, is in charge of converting precise inputs, also known as crisp inputs, into fuzzy sets. These fuzzily defined sets signify the degree of truth or membership with respect to particular requirements. The system successfully manages the ambiguity and uncertainty in the data using fuzzification, which promotes more flexible reasoning.

The third key component, the Inference Engine, orchestrates the selection of relevant rules depending on the current input values. To create a fuzzy output, it mixes the rule base with the fuzzy sets from the fuzzifier. The inference engine assesses how well each rule is satisfied using strategies like fuzzy matching and logical operations.

The Defuzzifier, the last component, has the job of turning the fuzzy output into a precise, explicit output that makes it easier for other systems to understand and use. Defuzzification includes remapping the fuzzy output to its original input space, and is frequently carried out using techniques like centroid defuzzification, which involves locating the fuzzy output's centre of mass.

In summary, fuzzy logic finds applications in various fields, including control systems, pattern recognition, decision-making, and artificial intelligence. It provides a flexible framework for handling imprecise and uncertain information, allowing systems to make decisions or perform actions based on approximate reasoning.

Reference:

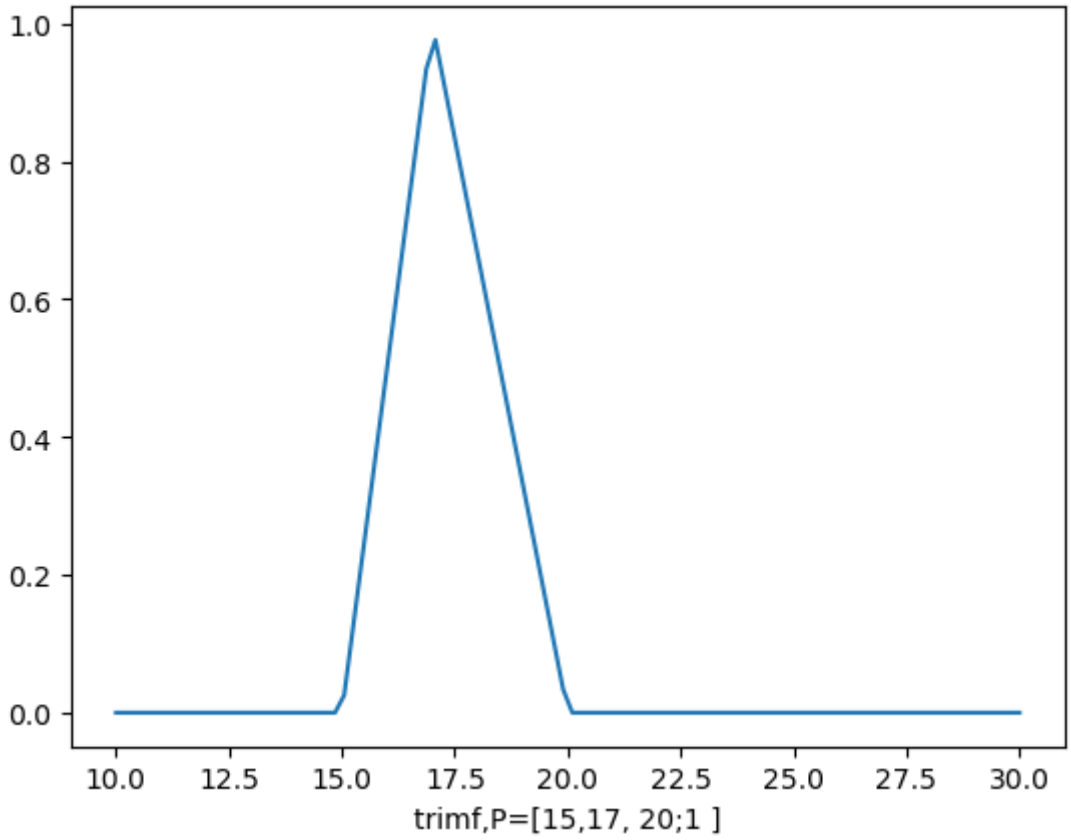
```
Klir, G. J., & Yuan, B. (1995). Fuzzy sets and fuzzy logic: theory and
applications. Prentice Hall.
https://vdoc.pub/documents/fuzzy-sets-and-fuzzy-logic-theory-and-applications-
4i0555h72g50
```


Question 2 Python: Image Recognition

1. Create simple codes for fuzzy numbers below and visualise them.

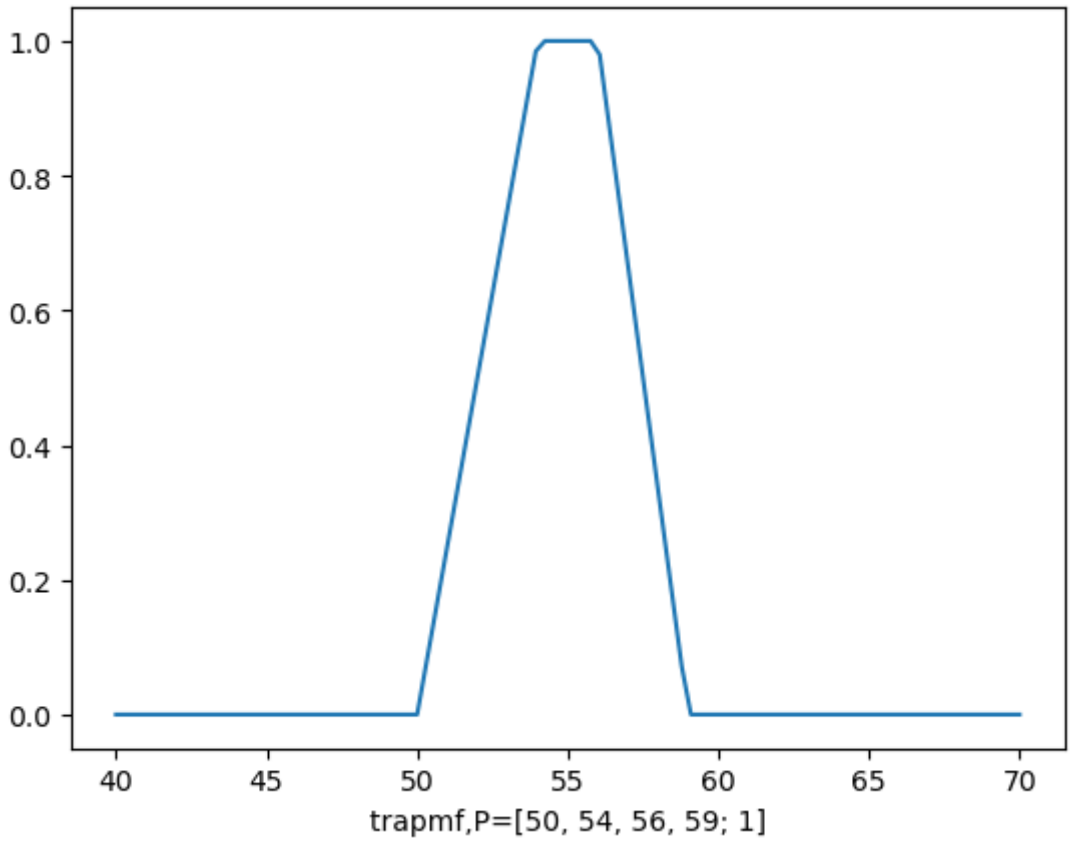
In [1]:

```
#a)

import numpy as np
from matplotlib.pyplot import *
from fuzzylab import *

x=np.linspace(10, 30, 100)  #101 is a peak of triangular point
y=trimf(x,[15,17,20])
plot(x,y)
xlabel('trimf,P=[15,17, 20;1 ]')
show()
```



In [2]:

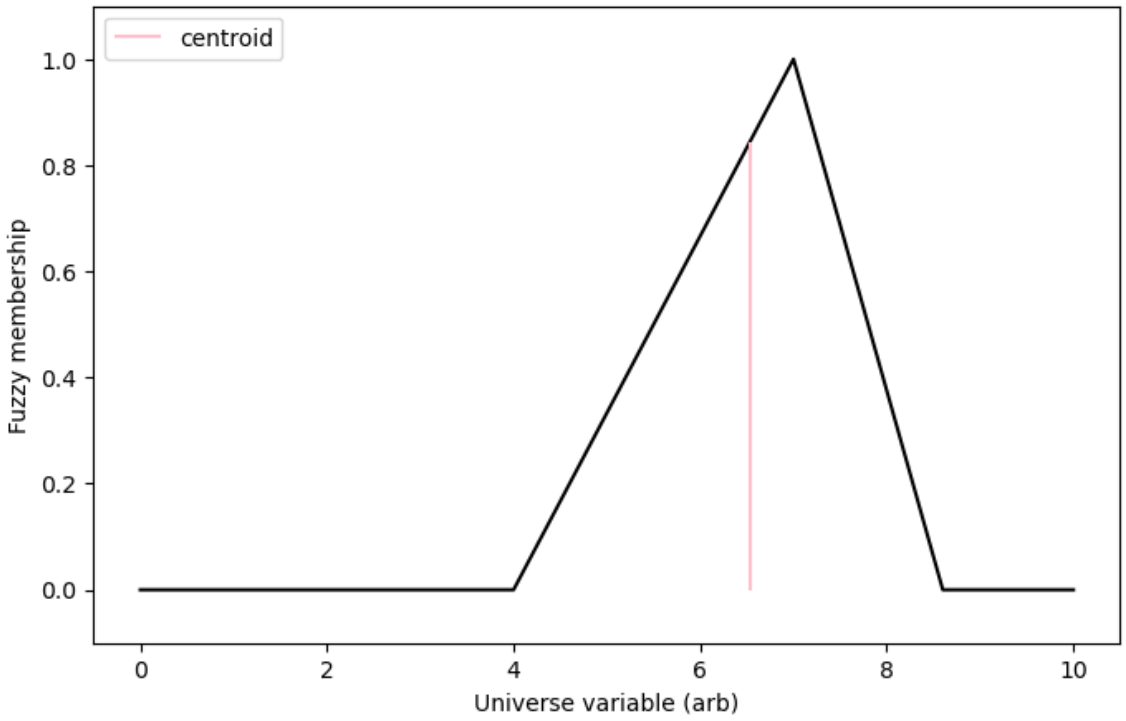
```
#b)

x=np.linspace(40, 70, 100)
y=trapmf(x,[50, 54, 56, 59])
plot(x,y)
xlabel('trapmf,P=[50, 54, 56, 59; 1]')
show()
```



2. Create simple codes for fuzzy numbers below and the defuzzification using centroid defuzzification method only. Plot the fuzzy numbers with the defuzzification results.

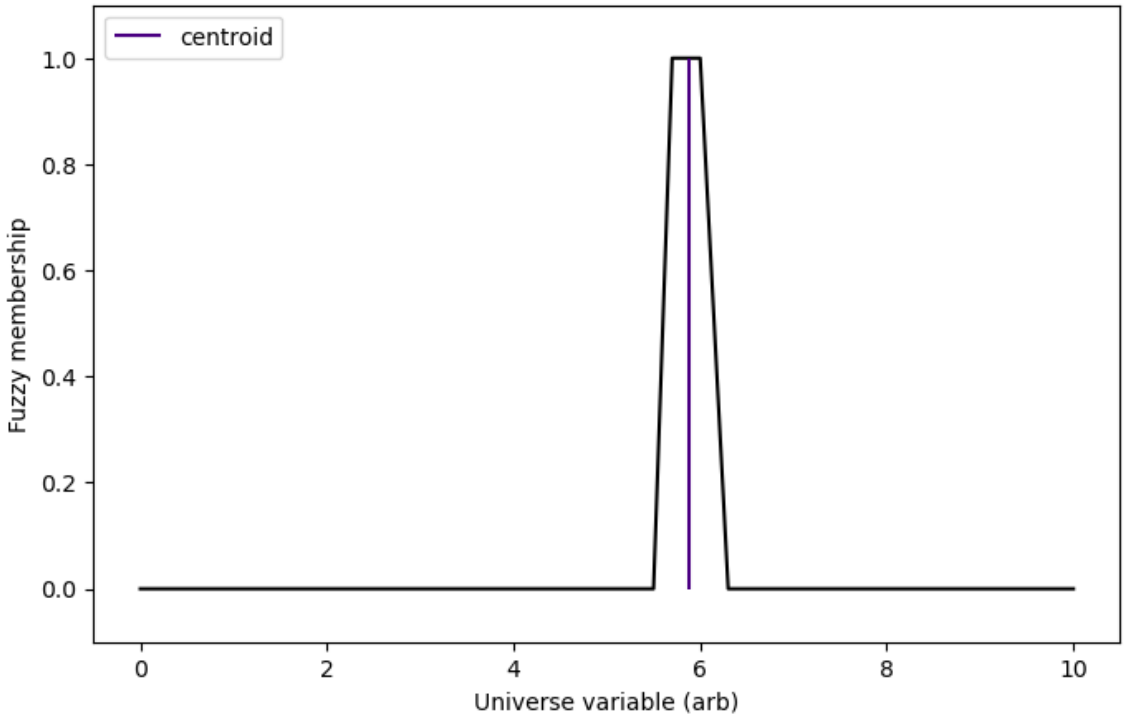
In [3]:

```
#a)

import numpy as np
import matplotlib.pyplot as plt
import skfuzzy as fuzz

x = np.arange(0, 10.05, 0.1)
mfx = fuzz.trimf(x, [4, 7, 8.6])


defuzz_centroid = fuzz.defuzz(x, mfx, 'centroid')


labels = ['centroid']
xvals = [defuzz_centroid]
colors = ['pink']
ymax = [fuzz.interp_membership(x, mfx, i) for i in xvals]


plt.figure(figsize=(8, 5))

plt.plot(x, mfx, 'k')
for xv, y, label, color in zip(xvals, ymax, labels, colors):
    plt.vlines(xv, 0, y, label=label, color=color)
plt.ylabel('Fuzzy membership')
plt.xlabel('Universe variable (arb)')
plt.ylim(-0.1, 1.1)
plt.legend(loc=2)

plt.show()
```



In [4]:

```
#b)

x = np.arange(0, 10.05, 0.1)
mfx = fuzz.trapmf(x, [5.5, 5.7, 6, 6.3])


defuzz_centroid = fuzz.defuzz(x, mfx, 'centroid')


labels = ['centroid']
xvals = [defuzz_centroid]
colors = ['indigo']
ymax = [fuzz.interp_membership(x, mfx, i) for i in xvals]


plt.figure(figsize=(8, 5))

plt.plot(x, mfx, 'k')
for xv, y, label, color in zip(xvals, ymax, labels, colors):
    plt.vlines(xv, 0, y, label=label, color=color)
plt.ylabel('Fuzzy membership')
plt.xlabel('Universe variable (arb)')
plt.ylim(-0.1, 1.1)
plt.legend(loc=2)

plt.show()
```



In [ ]:

```

```