

# PROJETO FUZZY

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**1**

# **OUTPUT DO ERRO**



**FUZZY LOGIC**

$$\text{ERRO} = \text{SP} - \text{SAÍDA}$$

<i>SP</i>	<i>ERRO (-) = SP - (-10)</i>	<i>ERRO (+) = SP - (10)</i>
-2	8	-12
-6	4	-16
-8	2	-18



FUZZY LOGIC

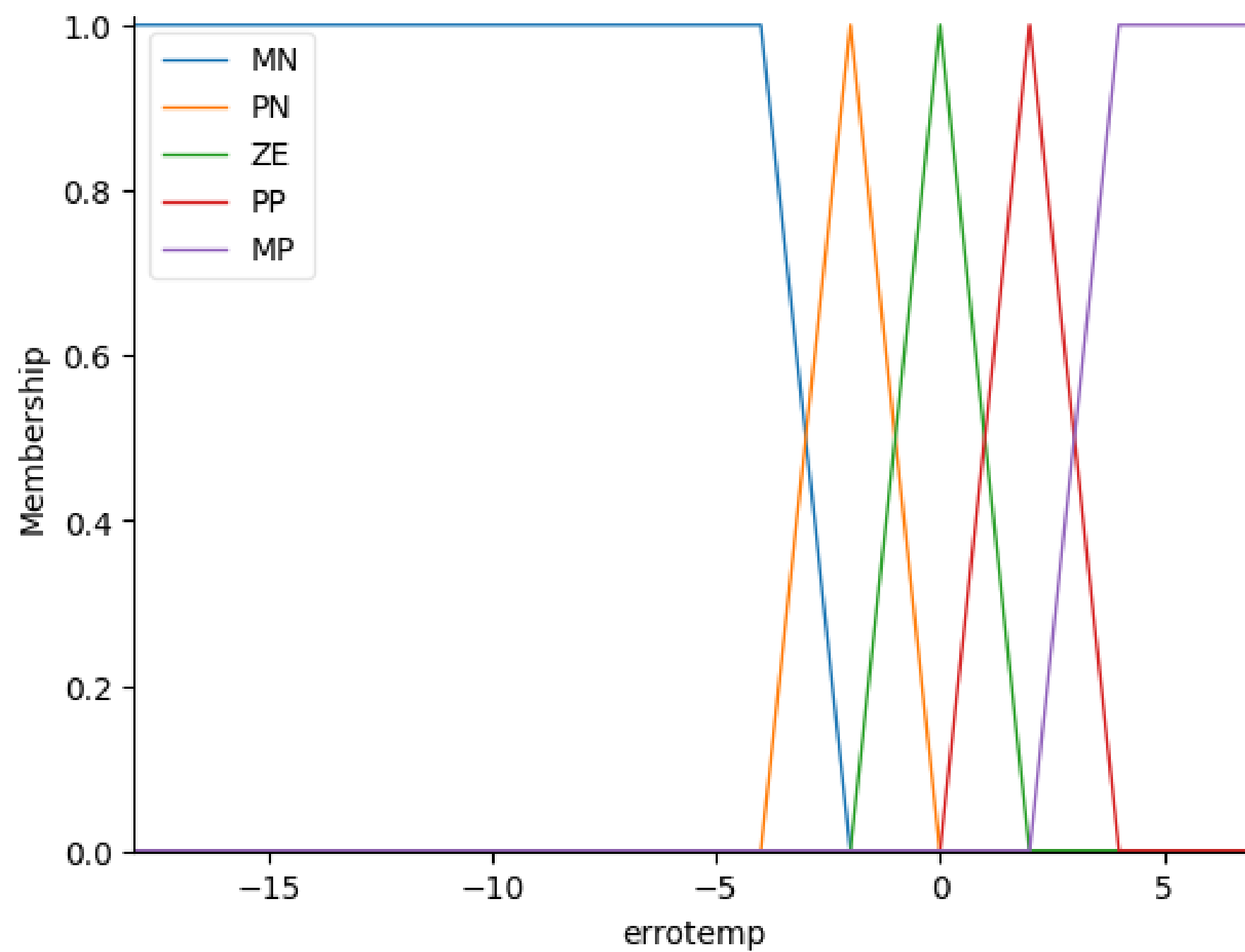
```
import numpy as np
import skfuzzy as fuzz
import paho.mqtt.client as mqtt
from skfuzzy import control as ctrl
import time
import requests

# New Antecedent/Consequent objects hold universe variables and membership
# functions
errottemp = ctrl.Antecedent(np.arange(-18, 9, 1), 'errottemp')
varerrottemp = ctrl.Antecedent(np.arange(-1, 1.01, 0.01), 'varerrottemp')
aquecedor = ctrl.Consequent(np.arange(0, 101, 1), 'aquecedor')

# Custom membership functions can be built interactively with a familiar,
# Pythonic API
errottemp['MN'] = fuzz.trapmf(errottemp.universe, [-18, -18, -4, -2])
errottemp['PN'] = fuzz.trimf(errottemp.universe, [-4, -2, 0])
errottemp['ZE'] = fuzz.trimf(errottemp.universe, [-2, 0, 2])
errottemp['PP'] = fuzz.trimf(errottemp.universe, [0, 2, 4])
errottemp['MP'] = fuzz.trapmf(errottemp.universe, [2, 4, 8, 8])
# You can see how these look with .view()
errottemp.view()
```



**FUZZY LOGIC**



**FUZZY LOGIC**

**2**

# **OUTPUT DO ΔERRO**

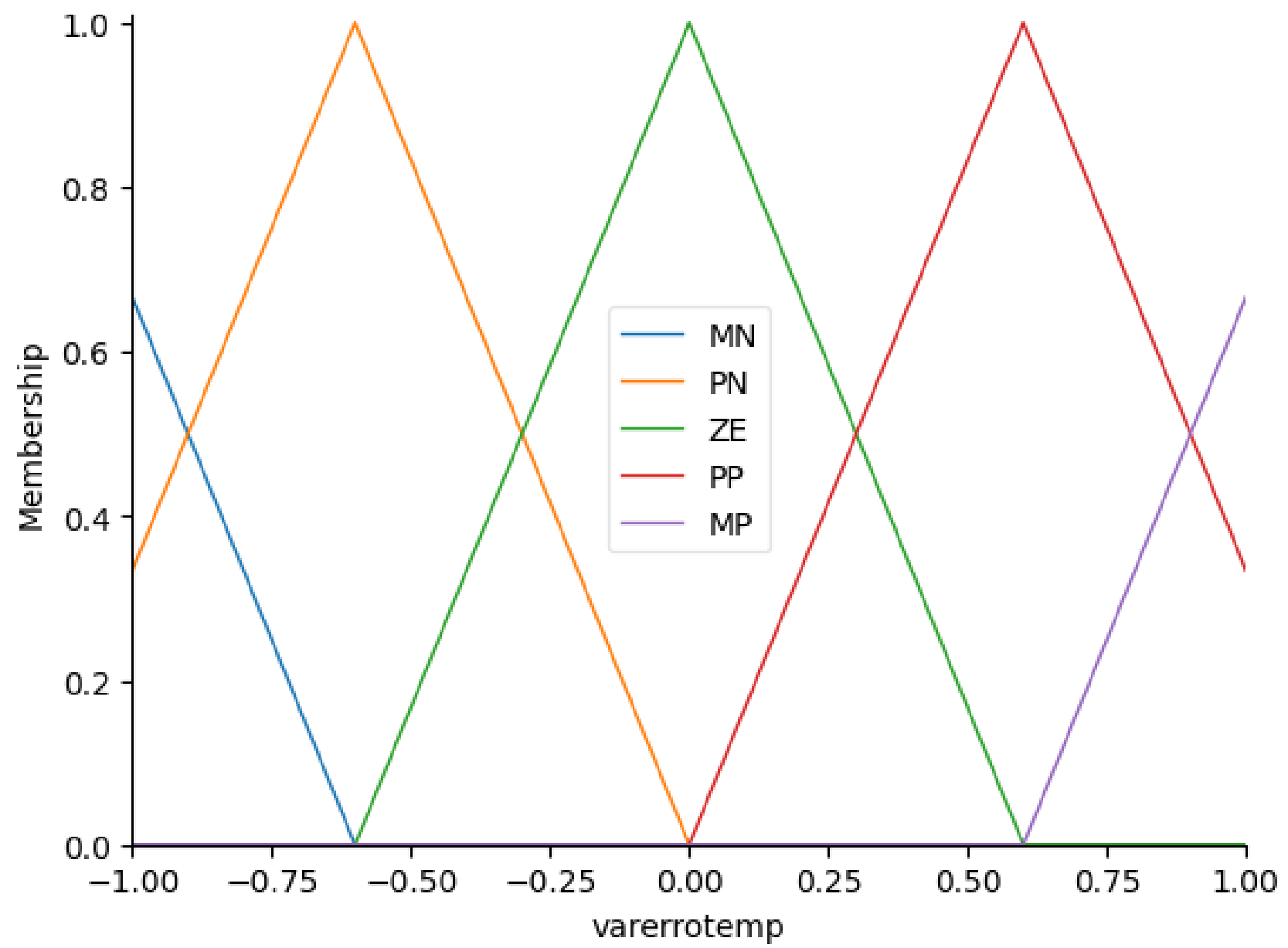


**FUZZY LOGIC**

```
varerrottemp['MN'] = fuzz.trapmf(varerrottemp.universe, [-4, -4, -1.2, -0.6])
varerrottemp['PN'] = fuzz.trimf(varerrottemp.universe, [-1.2, -0.6, 0])
varerrottemp['ZE'] = fuzz.trimf(varerrottemp.universe, [-0.6, 0, 0.6])
varerrottemp['PP'] = fuzz.trimf(varerrottemp.universe, [0, 0.6, 1.2])
varerrottemp['MP'] = fuzz.trapmf(varerrottemp.universe, [0.6, 1.2, 4, 4])
# You can see how these look with .view()
varerrottemp.view()
```



**FUZZY LOGIC**



**FUZZY LOGIC**



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# **SAÍDA DO SISTEMA**

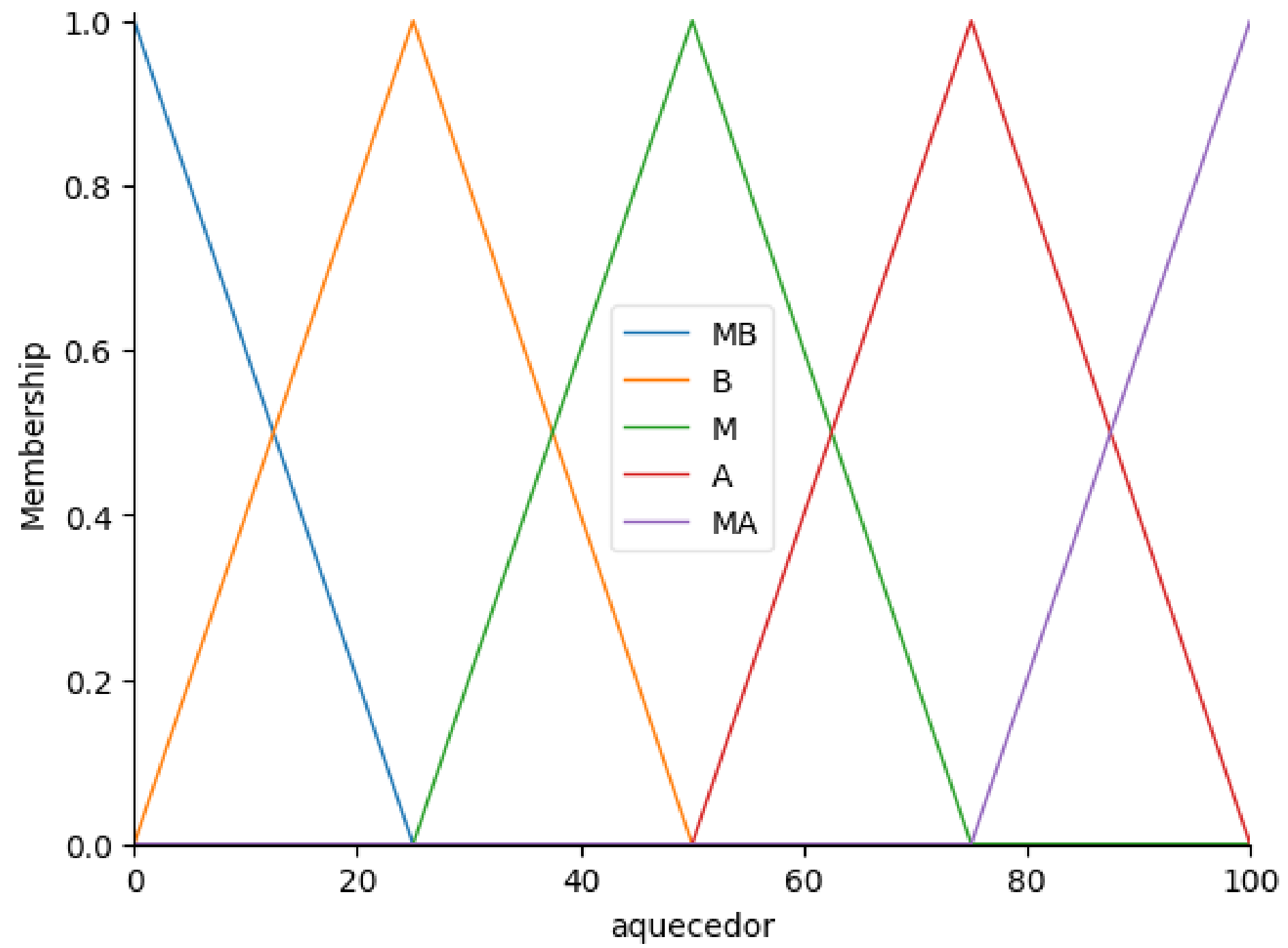


**FUZZY LOGIC**

```
aquecedor['MB'] = fuzz.trimf(aquecedor.universe, [0,0,25])  
aquecedor['B'] = fuzz.trimf(aquecedor.universe, [0,25,50])  
aquecedor['M'] = fuzz.trimf(aquecedor.universe, [25, 50, 75])  
aquecedor['A'] = fuzz.trimf(aquecedor.universe, [50, 75, 100])  
aquecedor['MA'] = fuzz.trimf(aquecedor.universe, [75, 100, 100])  
aquecedor.view()
```



**FUZZY LOGIC**



**FUZZY LOGIC**

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# **TABELA DE REGRAS DO SISTEMA**



**FUZZY LOGIC**

```
regra1 = ctrl.Rule(errotemp['MN'] & varerrotemp['MN'], aquecedor['MA'])
regra2 = ctrl.Rule(errotemp['PN'] & varerrotemp['MN'], aquecedor['MA'])
regra3 = ctrl.Rule(errotemp['ZE'] & varerrotemp['MN'], aquecedor['A'])
regra4 = ctrl.Rule(errotemp['PP'] & varerrotemp['MN'], aquecedor['M'])
regra5 = ctrl.Rule(errotemp['MP'] & varerrotemp['MN'], aquecedor['B'])
regra6 = ctrl.Rule(errotemp['MN'] & varerrotemp['PN'], aquecedor['MA'])
regra7 = ctrl.Rule(errotemp['PN'] & varerrotemp['PN'], aquecedor['A'])
regra8 = ctrl.Rule(errotemp['ZE'] & varerrotemp['PN'], aquecedor['M'])
regra9 = ctrl.Rule(errotemp['PP'] & varerrotemp['PN'], aquecedor['M'])
regra10 = ctrl.Rule(errotemp['MP'] & varerrotemp['PN'], aquecedor['B'])
regra11 = ctrl.Rule(errotemp['MN'] & varerrotemp['ZE'], aquecedor['MA'])
regra12 = ctrl.Rule(errotemp['PN'] & varerrotemp['ZE'], aquecedor['A'])
regra13 = ctrl.Rule(errotemp['ZE'] & varerrotemp['ZE'], aquecedor['M'])
regra14 = ctrl.Rule(errotemp['PP'] & varerrotemp['ZE'], aquecedor['M'])
regra15 = ctrl.Rule(errotemp['MP'] & varerrotemp['ZE'], aquecedor['B'])
regra16 = ctrl.Rule(errotemp['MN'] & varerrotemp['PP'], aquecedor['A'])
regra17 = ctrl.Rule(errotemp['PN'] & varerrotemp['PP'], aquecedor['M'])
regra18 = ctrl.Rule(errotemp['ZE'] & varerrotemp['PP'], aquecedor['M'])
regra19 = ctrl.Rule(errotemp['PP'] & varerrotemp['PP'], aquecedor['B'])
regra20 = ctrl.Rule(errotemp['MP'] & varerrotemp['PP'], aquecedor['MB'])
regra21 = ctrl.Rule(errotemp['MN'] & varerrotemp['MP'], aquecedor['A'])
regra22 = ctrl.Rule(errotemp['PN'] & varerrotemp['MP'], aquecedor['M'])
regra23 = ctrl.Rule(errotemp['ZE'] & varerrotemp['MP'], aquecedor['M'])
regra24 = ctrl.Rule(errotemp['PP'] & varerrotemp['MP'], aquecedor['MB'])
regra25 = ctrl.Rule(errotemp['MP'] & varerrotemp['MP'], aquecedor['MB'])
```



**FUZZY LOGIC**

# REGRAS

		ERROTEMP				
VARERROTEMP	-	MN	PN	ZE	PP	MP
	MN	MA	MA	A	M	B
	PN	MA	A	M	M	B
	ZE	MA	A	M	B	MB
	PP	A	M	M	B	MB
	MP	A	M	B	MB	MB

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# **EXECUÇÃO DAS REGRAS DO SISTEMA**



**FUZZY LOGIC**

```
aquecedor_ctrl = ctrl.ControlSystem([regra1,  
regra2, regra3,regra4,regra5,regra6, regra7,  
    regra8,regra9,regra10,regra11, regra12,  
regra13,regra14,regra15,regra16, regra17,  
regra18,regra19,regra20,regra21, regra22,  
    regra23,regra24,regra25])
```

```
    potencia =  
ctrl.ControlSystemSimulation(aquecedor_ctrl)
```



**FUZZY LOGIC**



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# **MOSTRANDO OS RESULTADOS**



**FUZZY LOGIC**

# FIM

**Muito Obrigado!**



**FUZZY LOGIC**