NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
“IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE”

Faculty of Informatics and Computer Engineering

Department of Computer Engineering

Lab 2 Report

Modeling a Two-Variable Function with Fuzzy Logic and Studying Membership Function Shape Effects

Variant 12

Student, group IM-14
(group code)

in the educational and professional program

“**Software Engineering For Computer System”**

Specialty 121 "Computer Engineering"

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(position, academic degree, academic status, surname and initials)

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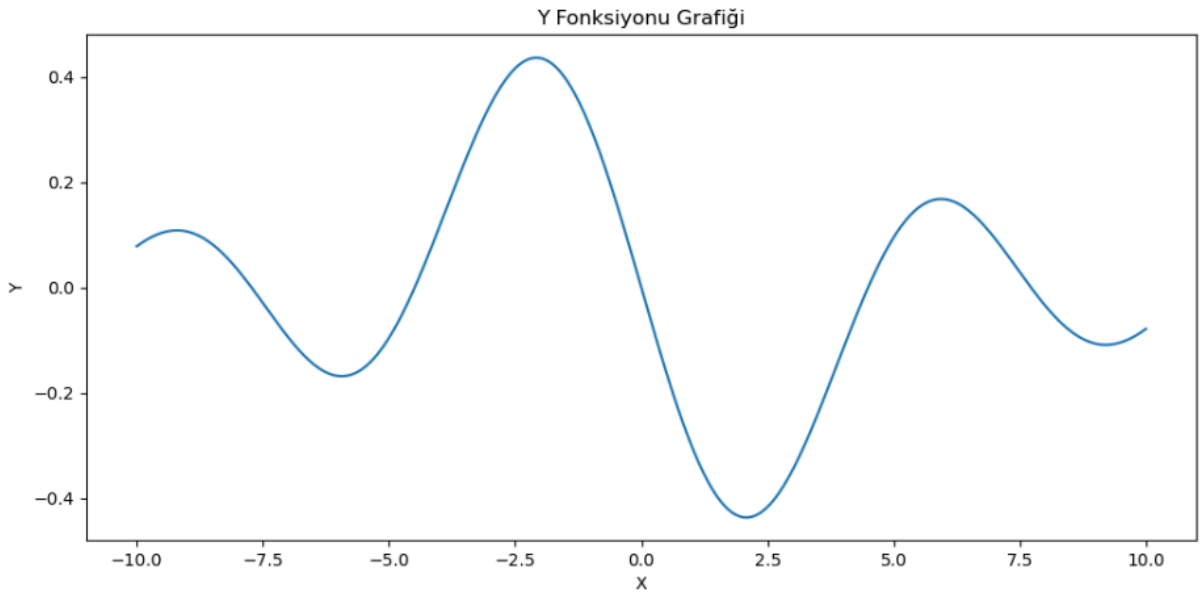
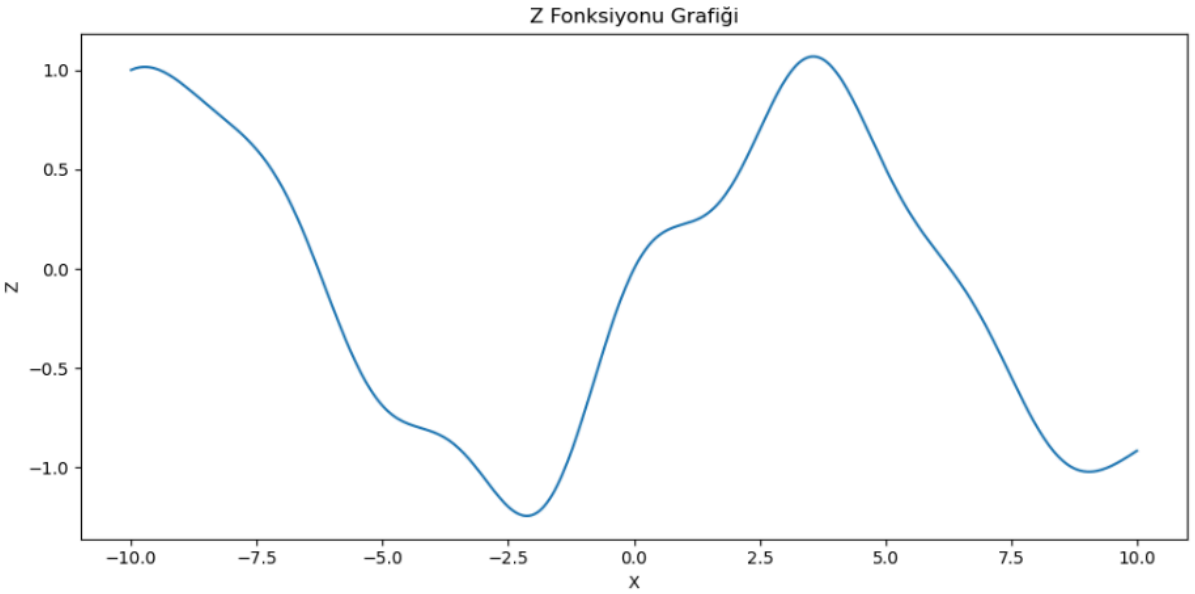
Modeling a function with two variables by means of fuzzy mathematics The purpose of the work: To model a function of two by means of fuzzy logic variables Conduct a study of the shape of the membership function on the quality of modeling.

12.	$y = \cos(x)/x - \sin(x)/x^2$ $z = \sin(x/2) + y \cdot \sin(x)$	12.	19.	7.

I derive the graph of the Y function:



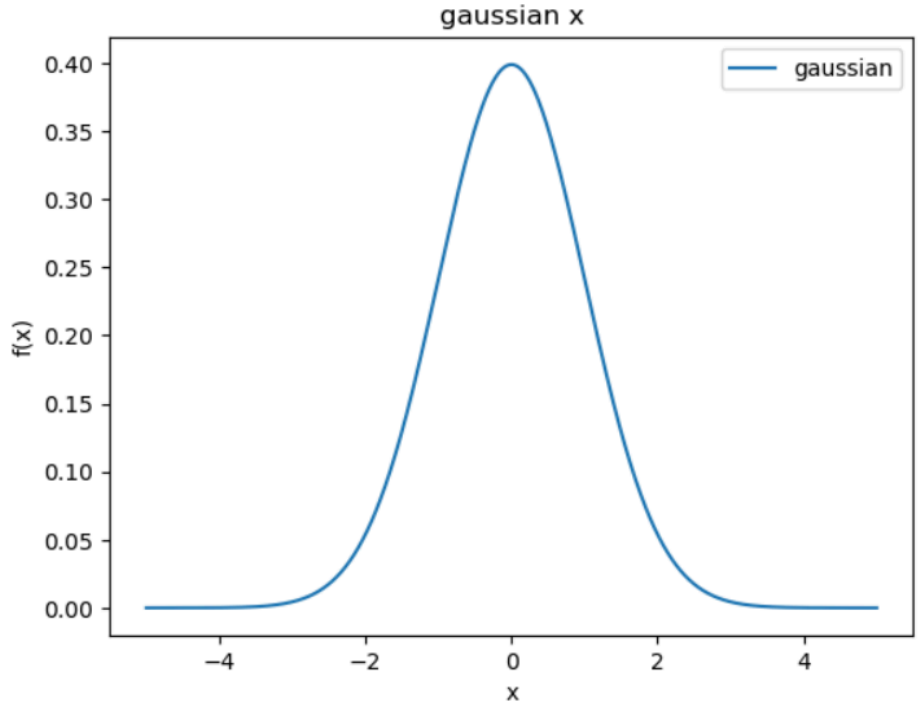
I derive the graph of the Z function:



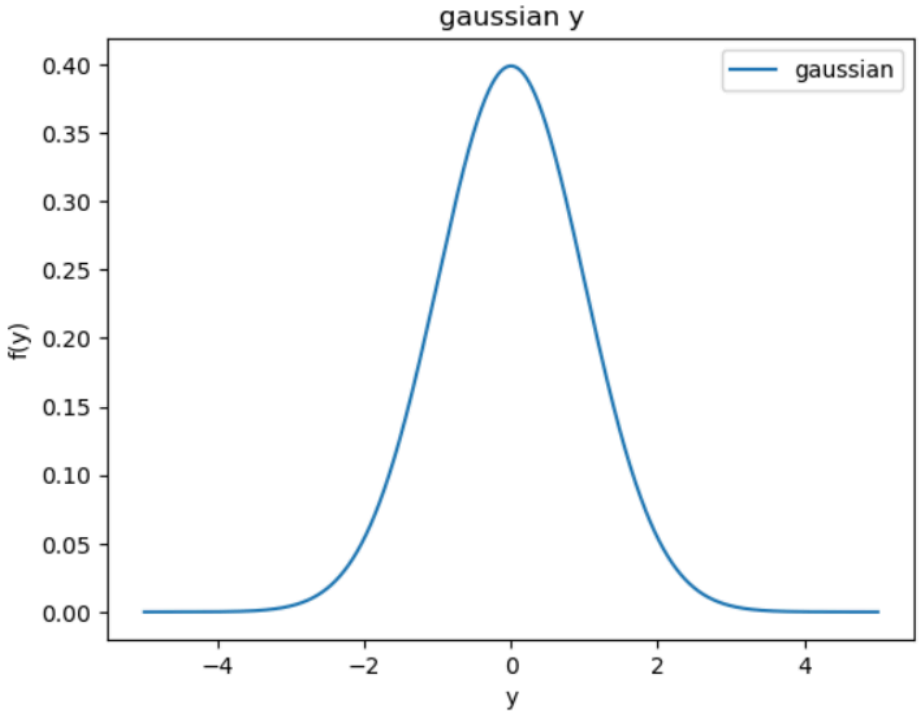
MY CODES:

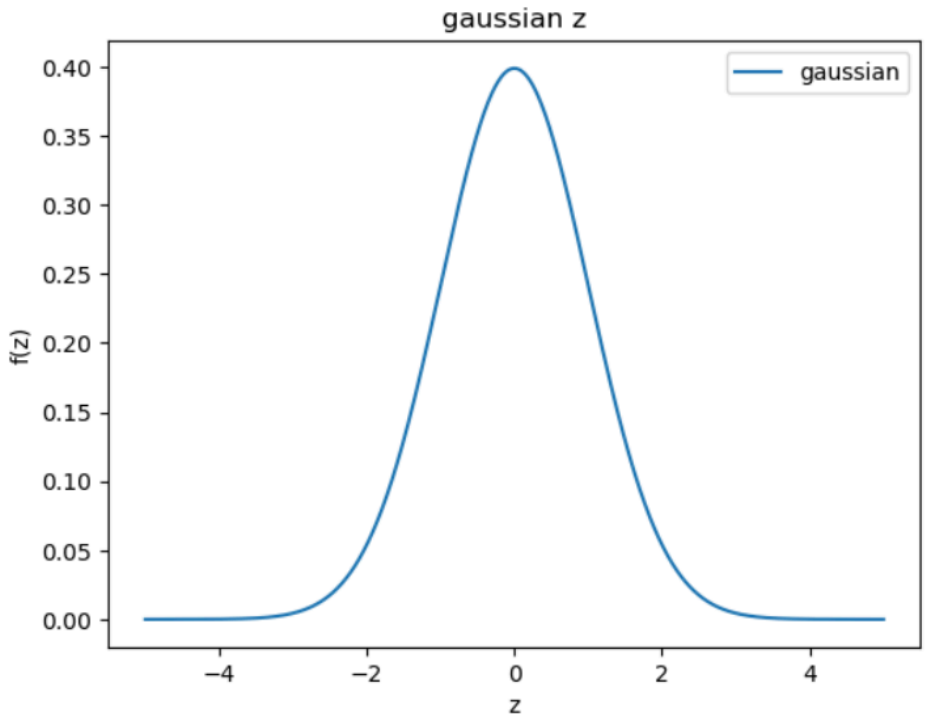
```
import numpy as np
import matplotlib.pyplot as plt

def y_func(x):
    return np.cos(x) / x - np.sin(x) / x**2

def z_func(x):
    y = y_func(x)
    return np.sin(x / 2) + y * np.sin(x)

x = np.linspace(-10, 10, 400)
y = y_func(x)
z = z_func(x)

plt.figure(figsize=(10, 10))

plt.subplot(2, 1, 1)
plt.plot(x, y)
plt.title('Y Fonksiyonu Grafiği')
plt.xlabel('X')
plt.ylabel('Y')

plt.subplot(2, 1, 2)
plt.plot(x, z)
plt.title('Z Fonksiyonu Grafiği')
plt.xlabel('X')
plt.ylabel('Z')

plt.tight_layout()
plt.show()
```

I derive the Gaussian member the variables



ship functions for.

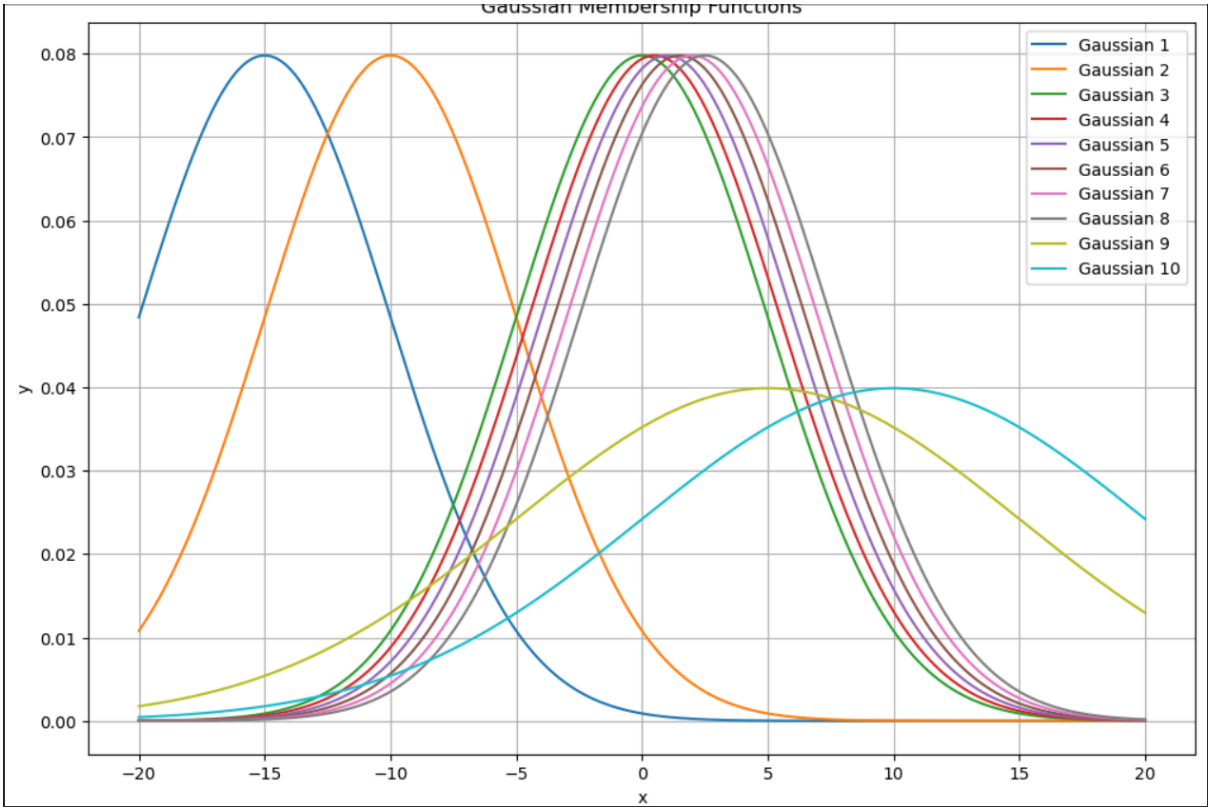




MY CODES:

```
import numpy as np
import matplotlib.pyplot as plt
from scipy.stats import norm

def plot_gaussian(x, y, x_label, y_label, title):
    plt.plot(x, y, label='gaussian')
    plt.xlabel(x_label)
    plt.ylabel(y_label)
    plt.title(title)
    plt.legend()
    plt.show()

# gaussians x, gaussians y, gaussians z
x = np.linspace(-5, 5, 1000)
y = np.linspace(-5, 5, 1000)
z = np.linspace(-5, 5, 1000)

plot_gaussian(x, norm.pdf(x, 0, 1), 'x', 'f(x)', 'gaussian x')
plot_gaussian(y, norm.pdf(y, 0, 1), 'y', 'f(y)', 'gaussian y')
plot_gaussian(z, norm.pdf(z, 0, 1), 'z', 'f(z)', 'gaussian z')
```

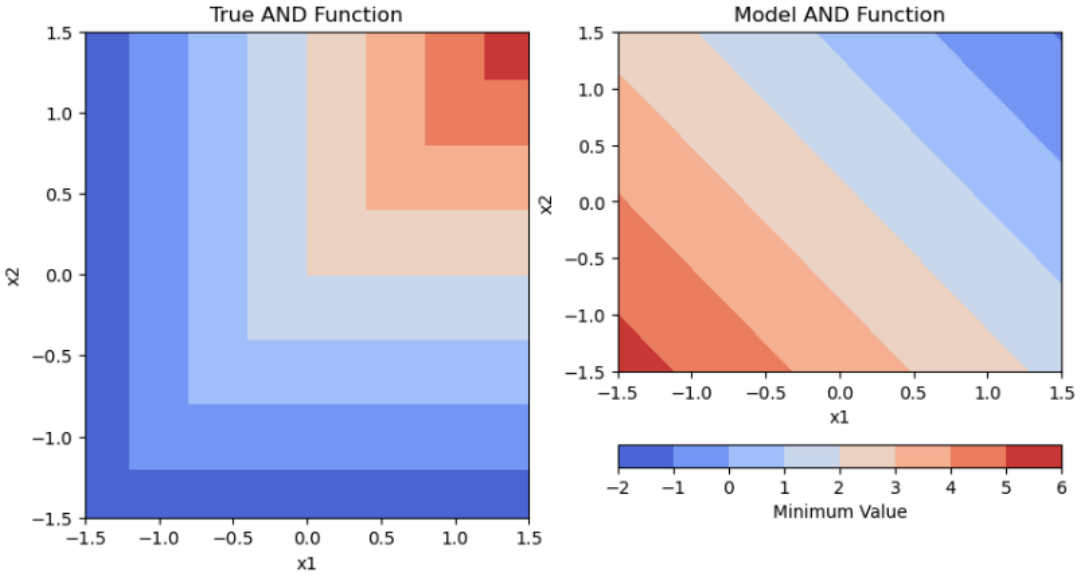
GUASSIAN MEMBERSHİP FUNCTİONS:



MY CODES:

```
import numpy as np
import matplotlib.pyplot as plt

def gaussian(x, mu, sigma):
    return (1 / (np.sqrt(2 * np.pi) * sigma)) * np.exp(-0.5 * np.power((x - mu) / sigma, 2))

x = np.linspace(-20, 20, 400)

mu = [-15, -10, 0, 0.5, 1, 1.5, 2, 2.5, 5, 10]
sigma = [5, 5, 5, 5, 5, 5, 5, 5, 10, 10]

plt.figure(figsize=(12, 8))
for i in range(len(mu)):
    y = gaussian(x, mu[i], sigma[i])
    plt.plot(x, y, label=f'Gaussian {i+1}')

plt.legend()
plt.xlabel('x')
plt.ylabel('y')
plt.title('Gaussian Membership Functions')
plt.grid(True)
plt.show()
```

True AND function and Model AND function:



MY CODES:

```
import numpy as np
import matplotlib.pyplot as plt

def and_func(x1, x2):
    return np.minimum(x1, x2)

def model_func(x1, x2):
    return (20*(1 - x1) + 15*(1 - x2))/16

x1_range = np.linspace(-1.5, 1.5, 1000)
x2_range = np.linspace(-1.5, 1.5, 1000)
X1, X2 = np.meshgrid(x1_range, x2_range)

Z1 = and_func(X1, X2)
Z2 = model_func(X1, X2)

plt.figure(figsize=(10, 5))

plt.subplot(121)
plt.contourf(X1, X2, Z1, cmap='coolwarm')
plt.xlabel('x1')
plt.ylabel('x2')
plt.title('True AND Function')

plt.subplot(122)
plt.contourf(X1, X2, Z2, cmap='coolwarm')
plt.xlabel('x1')
plt.ylabel('x2')
```

```
plt.title('Model AND Function')

# create a common colorbar for both subplots
cbar = plt.colorbar(label='Minimum Value', orientation='horizontal')

plt.show()
```