EE655 HW3

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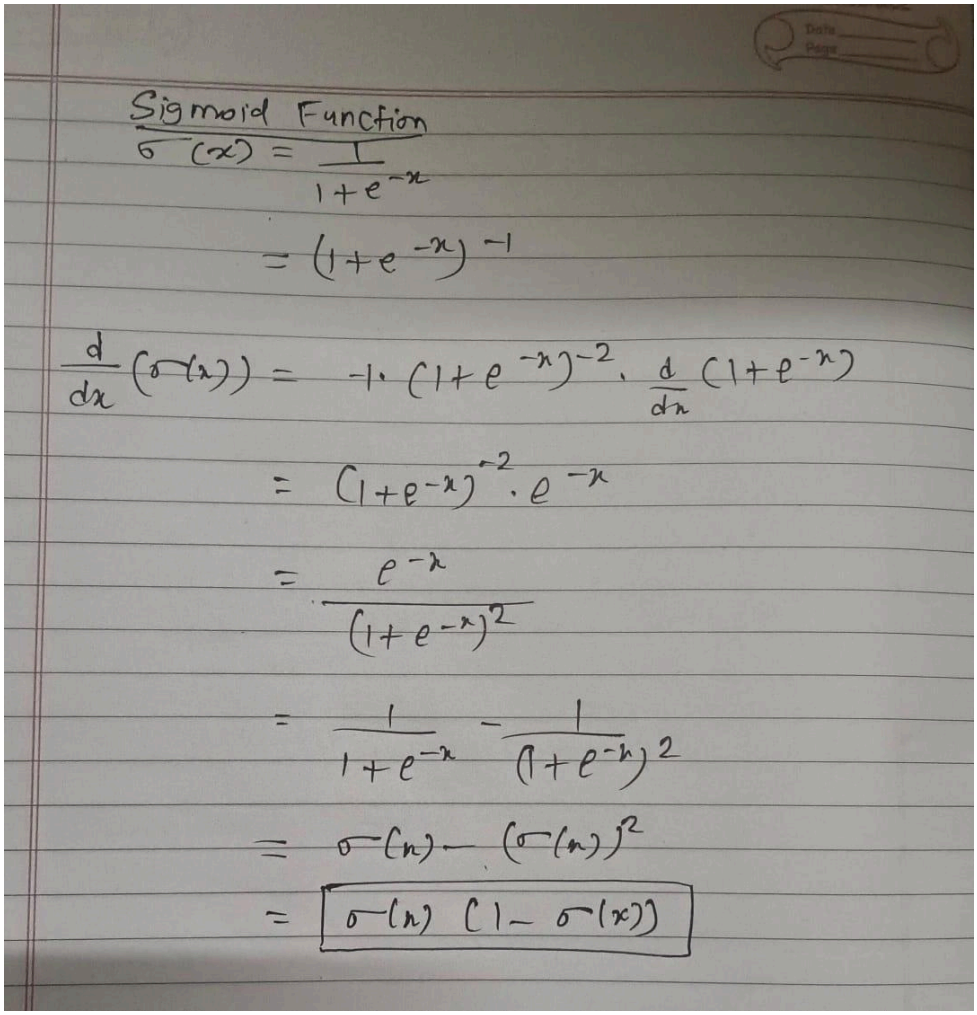
Proof:



Sigmoid Function

$$\sigma(x) = \frac{1}{1+e^{-x}}$$

$$= (1+e^{-x})^{-1}$$

$$\frac{d}{dx}(\sigma(x)) = -1 \cdot (1+e^{-x})^{-2} \cdot \frac{d}{dx}(1+e^{-x})$$

$$= (1+e^{-x})^{-2} \cdot e^{-x}$$

$$= \frac{e^{-x}}{(1+e^{-x})^2}$$

$$= \frac{1}{1+e^{-x}} - \frac{1}{(1+e^{-x})^2}$$

$$= \sigma(x) - (\sigma(x))^2$$

$$= \boxed{\sigma(x)\,(1-\sigma(x))}$$

Code:

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

def sigmo(x):
    return 1 / (1 + np.exp(-x))

def derivative(x):
    sigmoidx = sigmo(x)
    return sigmoidx * (1 - sigmoidx)

x_values = np.linspace(-10, 10, 800)

sigmoid_values = sigmo(x_values)
derivative_values = derivative(x_values)

plt.figure(figsize=(8, 5))
plt.plot(x_values, sigmoid_values, label="Sigmoid Function", color='blue')
plt.plot(x_values, derivative_values, label="Sigmoid Derivative", color='red', linestyle='dashed')
plt.legend()
plt.xlabel("x")
plt.ylabel("Value")
plt.title("Sigmoid Function and its Derivative")
plt.grid()
plt.show()
```

Output: