Foundation of Data Engineering

Functions to Plot

1 Activation Functions

1.1 Sigmoid Function

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

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

def sigmoid_derivative(x):
    s = sigmoid(x)
    return s * (1 - s)

x = np.linspace(-10, 10, 1000)
y_sigmoid = sigmoid(x)
y_derivative = sigmoid_derivative(x)

plt.figure(figsize=(10, 5))
plt.subplot(1, 2, 1)
plt.plot(x, y_sigmoid, label="Sigmoid", color='green')
plt.title("Sigmoid Function")
plt.xlabel("x")
plt.ylabel("sigma(x)")
plt.grid(True)
plt.legend()

plt.subplot(1, 2, 2)
plt.plot(x, y_derivative, label="Sigmoid Derivative", color='orange')
plt.title("Derivative of Sigmoid")
plt.xlabel("x")
plt.ylabel("d(sigma)/dx")
plt.grid(True)
plt.legend()

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

Listing 1: Sigmoid function and its derivative

Output:

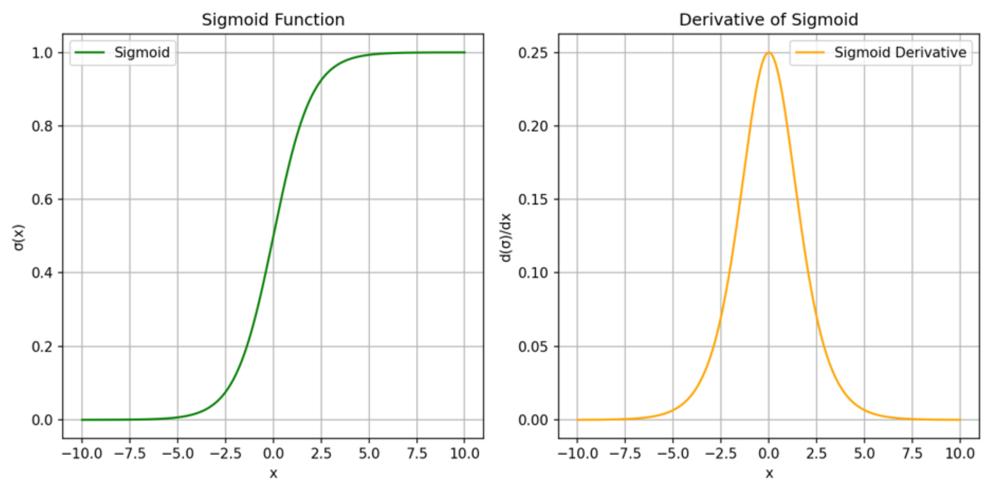

Figure 1: Sigmoid function and its derivative

1.2 ReLU Function

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

def relu(x):
    return np.maximum(0, x)

def relu_derivative(x):
    return np.where(x > 0, 1, 0)

x = np.linspace(-10, 10, 1000)
y_relu = relu(x)
y_derivative = relu_derivative(x)

plt.figure(figsize=(10, 5))
plt.subplot(1, 2, 1)
plt.plot(x, y_relu, label="ReLU", color='blue')
plt.title("ReLU Function")
plt.xlabel("x")
plt.ylabel("ReLU(x)")
plt.grid(True)
plt.legend()

plt.subplot(1, 2, 2)
plt.plot(x, y_derivative, label="ReLU Derivative", color='red')
plt.title("Derivative of ReLU")
plt.xlabel("x")
plt.ylabel("d(ReLU)/dx")
plt.grid(True)
plt.legend()

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

Listing 2: ReLU function and its derivative

Output:

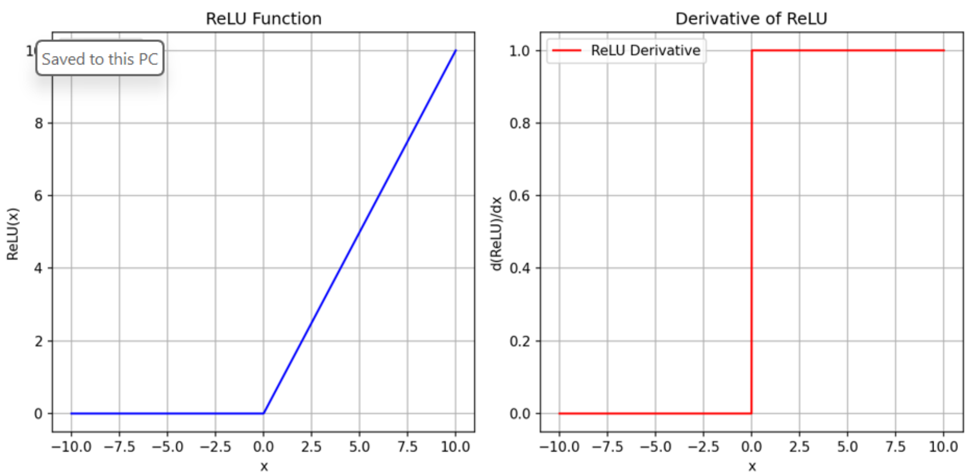

Figure 2: ReLU function and its derivative

1.3 Tanh Function

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

def tanh(x):
    return np.tanh(x)

def tanh_derivative(x):
    return 1 - np.tanh(x)**2

x = np.linspace(-10, 10, 1000)
y_tanh = tanh(x)
y_derivative = tanh_derivative(x)

plt.figure(figsize=(10, 5))
plt.subplot(1, 2, 1)
plt.plot(x, y_tanh, label="Tanh", color='purple')
plt.title("Tanh Function")
plt.xlabel("x")
plt.ylabel("tanh(x)")
plt.grid(True)
plt.legend()

plt.subplot(1, 2, 2)
plt.plot(x, y_derivative, label="Tanh Derivative", color='brown')
plt.title("Derivative of Tanh")
plt.xlabel("x")
plt.ylabel("d(tanh)/dx")
plt.grid(True)
plt.legend()

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

Listing 3: Tanh function and its derivative

Output:

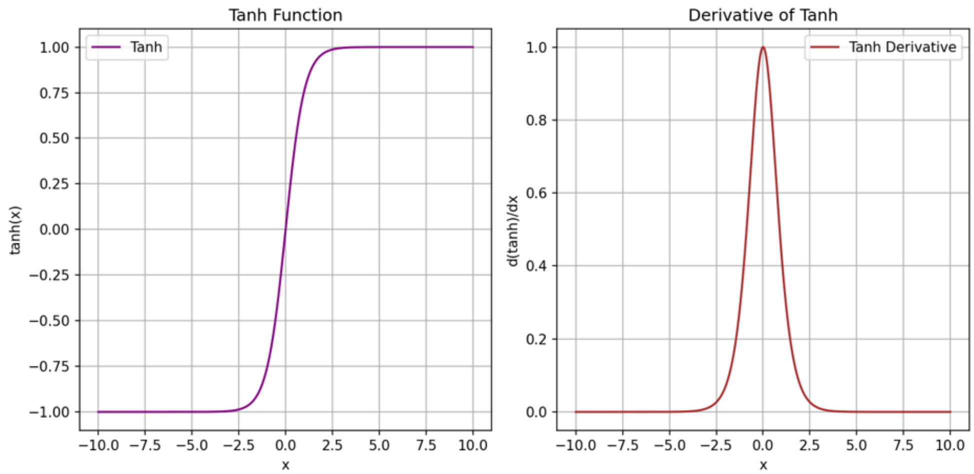

Figure 3: Tanh function and its derivative

2 Basic Functions

2.1 $f(x) = e^{-x}$

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

def f(x):
    return np.exp(-x)

def f_derivative(x):
    return -np.exp(-x)

x = np.linspace(-5, 5, 500)
y = f(x)
y_prime = f_derivative(x)

plt.figure(figsize=(10, 5))
plt.plot(x, y, label=r'$f(x) = e^{-x}$', color='blue')
plt.plot(x, y_prime, label=r"$f'(x) = -e^{-x}$", color='red', linestyle='--')
plt.title("Function and Derivative: $f(x) = e^{-x}$")
plt.xlabel("x")
plt.ylabel("y")
plt.axhline(0, color='black', linewidth=0.5)
plt.axvline(0, color='black', linewidth=0.5)
plt.grid(True)
plt.legend()
plt.tight_layout()
plt.show()
```

Listing 4: $f(x) = e^{-x}$ and its derivative

Output:

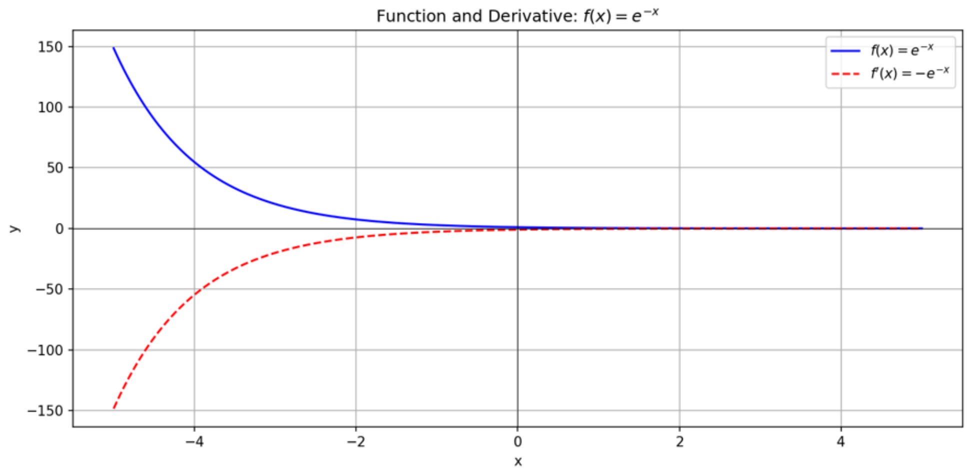

Figure 4: $f(x) = e^{-x}$ function and its derivative

2.2 $f(x) = e^{-|x|}$

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

def f(x):
    return np.exp(-np.abs(x))

def f_derivative(x):
    return np.where(x > 0, -np.exp(-x), np.where(x < 0, np.exp(x), 0))

x = np.linspace(-5, 5, 1000)
y = f(x)
y_prime = f_derivative(x)

plt.figure(figsize=(10, 5))
plt.plot(x, y, label=r'$f(x) = e^{-|x|}$', color='blue')
plt.plot(x, y_prime, label=r"$f'(x)$", color='orange', linestyle='--')
plt.title("Function and Derivative: $f(x) = e^{-|x|}$")
plt.xlabel("x")
plt.ylabel("y")
plt.grid(True)
plt.axhline(0, color='black', linewidth=0.5)
plt.axvline(0, color='black', linewidth=0.5)
plt.legend()
plt.tight_layout()
plt.show()
```

Listing 5: $f(x) = e^{-|x|}$ and its derivative

Output:

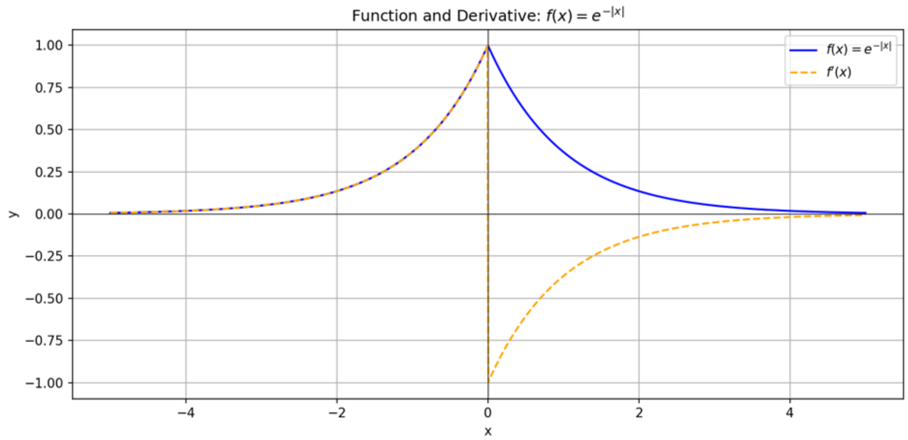

Figure 5: $f(x) = e^{-|x|}$ function and its derivative

2.3 $f(x) = e^{-x^2}$

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

def f(x):
    return np.exp(-x**2)

def f_derivative(x):
    return -2 * x * np.exp(-x**2)

x = np.linspace(-3, 3, 500)
y = f(x)
y_prime = f_derivative(x)

plt.figure(figsize=(10, 5))
plt.plot(x, y, label=r'$f(x) = e^{-x^2}$', color='blue')
plt.plot(x, y_prime, label=r"$f'(x) = -2x e^{-x^2}$", color='red', linestyle='--')
plt.title("Function and Derivative: $f(x) = e^{-x^2}$")
plt.xlabel("x")
plt.ylabel("y")
plt.grid(True)
plt.axhline(0, color='black', linewidth=0.5)
plt.axvline(0, color='black', linewidth=0.5)
plt.legend()
plt.tight_layout()
plt.show()
```

Listing 6: $f(x) = e^{-x^2}$ and its derivative

Output:

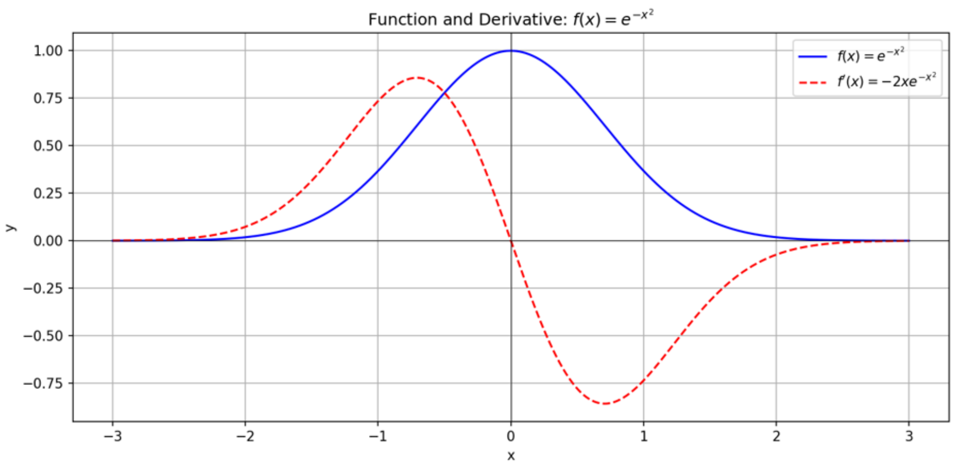

Figure 6: $f(x) = e^{-x^2}$ function and its derivative

Submitted By

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