Worksheet 3

```
# Example usage for MCP_Neurons_AND function
X1 = [0, 0, 1, 1]
X2 = [0, 1, 0, 1]
T = 2  # Threshold value

# Call the MCP_Neurons_AND function
result = MCP_Neurons_AND(X1, X2, T)

# Print the result
print(f"Output of AND gate for inputs {X1} and {X2} with threshold {T}: {result}")
```

```
Output of AND gate for inputs [0, 0, 1, 1] and [0, 1, 0, 1] with threshold 2: [0, 0, 0, 1]
```

```
    assert len(X1) == len(X2)

    state_neuron = []

    for x1, x2 in zip(X1, X2):
        sum_inputs = x1 + x2
        state_neuron.append(1 if sum_inputs >= T else 0)

    return state_neuron
```

```
# Example usage for MCP_Neurons_OR function
X1 = [0, 0, 1, 1]
X2 = [0, 1, 0, 1]
T = 1  # Threshold value for OR gate

# Call the MCP_Neurons_OR function
result_or = MCP_Neurons_OR(X1, X2, T)

# Print the result
print(f"Output of OR gate for inputs {X1} and {X2} with threshold {T}: {result_or}")
```

```
Output of OR gate for inputs [0, 0, 1, 1] and [0, 1, 0, 1] with threshold 1: [0, 1, 1, 1]
```

Step 1: Load the Dataset

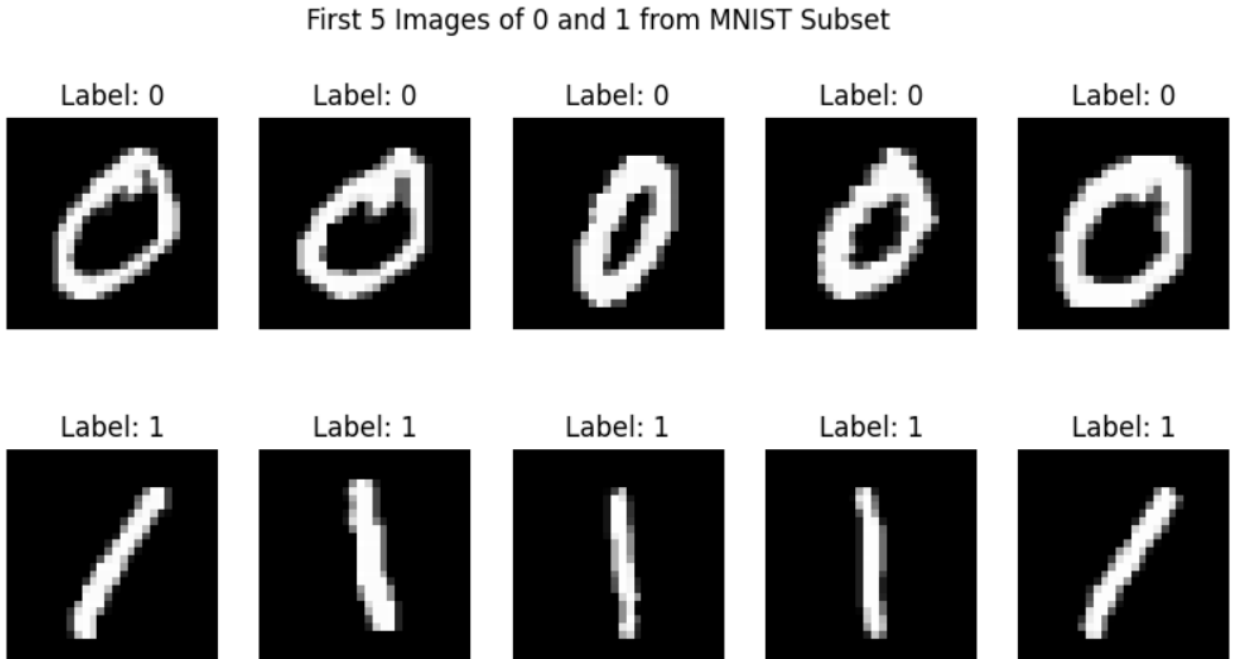
```
[5] from google.colab import drive
    drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

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


# Load the dataset
df_0_1 = pd.read_csv("/content/drive/MyDrive/Week3WorkshopAI/mnist_dataset.csv")  # Add the correct file path if necessary

# Extract features and labels
X = df_0_1.drop(columns=["label"]).values  # 784 pixels
y = df_0_1["label"].values  # Labels (0 or 1)

# Check the shape of the features and labels
print("Feature matrix shape:", X.shape)
print("Label vector shape:", y.shape)
```

```
Feature matrix shape: (60000, 784)
Label vector shape: (60000,)
```

```python
# Separate images for label 0 and label 1
images_0 = X[y == 0]  # Get all images with label 0
images_1 = X[y == 1]  # Get all images with label 1

fig, axes = plt.subplots(2, 5, figsize=(10, 5))

# Check if the arrays have the required amount of data
if len(images_0) < 5 or len(images_1) < 5:
    print("Error: Not enough images in images_0 or images_1 to plot 5 images.")
else:
    for i in range(5):
        # Plot digit 0
        axes[0, i].imshow(images_0[i].reshape(28, 28), cmap="gray")
        axes[0, i].set_title("Label: 0")
        axes[0, i].axis("off")
        # Plot digit 1
        axes[1, i].imshow(images_1[i].reshape(28, 28), cmap="gray")
        axes[1, i].set_title("Label: 1")
        axes[1, i].axis("off")
    plt.suptitle("First 5 Images of 0 and 1 from MNIST Subset")
    plt.show()
```

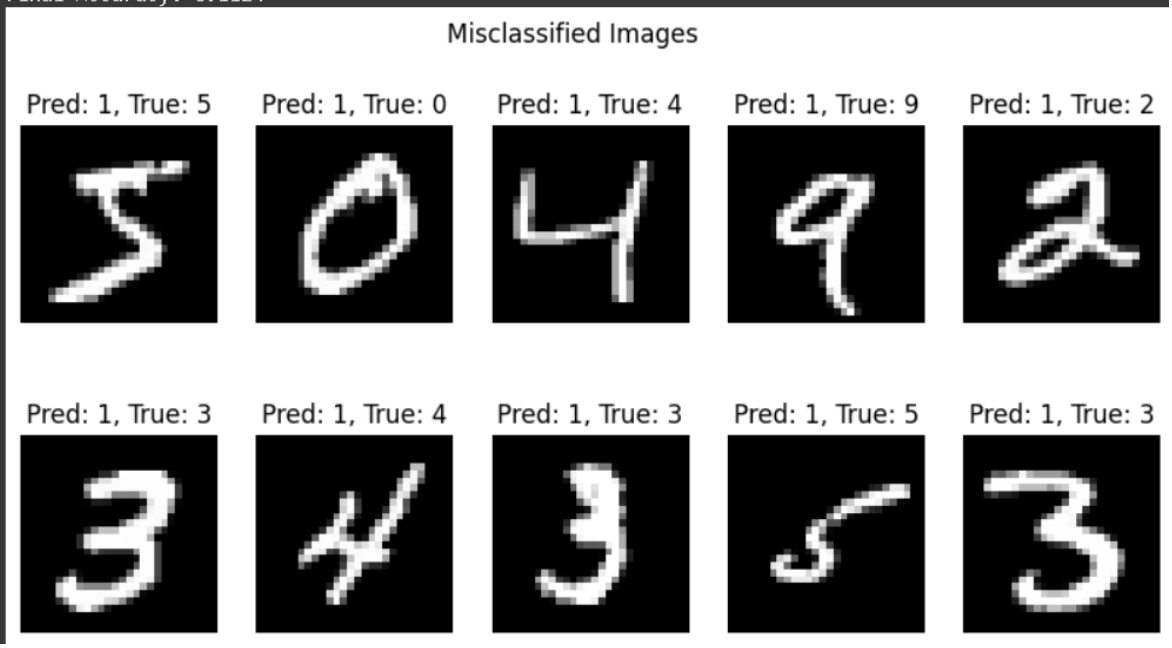


```
[12] # After training the model with the perceptron_learning_algorithm
     weights, bias, accuracy = train_perceptron(X, y, weights, bias)

     # Evaluate the model using the new function
     print("The Final Accuracy is: ", accuracy)
```

```
The Final Accuracy is:  0.11236666666666667
```

```
# Get predictions for all data points
predictions = np.dot(X, weights) + bias
y_pred = np.where(predictions >= 0, 1, 0)

# Calculate final accuracy
final_accuracy = np.mean(y_pred == y)
print(f"Final Accuracy: {final_accuracy:.4f}")

# Step 5: Visualize Misclassified Images
misclassified_idx = np.where(y_pred != y)[0]
if len(misclassified_idx) > 0:
    fig, axes = plt.subplots(2, 5, figsize=(10, 5))
    for ax, idx in zip(axes.flat, misclassified_idx[:10]):  # Show 10 misclassified images
        ax.imshow(X[idx].reshape(28, 28), cmap="gray")
        ax.set_title(f"Pred: {y_pred[idx]}, True: {y[idx]}")
        ax.axis("off")
    plt.suptitle("Misclassified Images")
    plt.show()
else:
    print("All images were correctly classified!")
```

```
Final Accuracy: 0.1124
```



```python
predictions = np.dot(X, weights) + bias
y_pred = np.where(predictions >= 0, 1, 0)

final_accuracy = np.mean(y_pred == y)
print(f"Final Accuracy: {final_accuracy:.4f}")

classified_idx = np.where(y_pred == y)[0]

if len(classified_idx) > 0:
    fig, axes = plt.subplots(2, 5, figsize=(10, 5))
    for ax, idx in zip(axes.flat, classified_idx[:10]):
        ax.imshow(X[idx].reshape(28, 28), cmap="gray")
        ax.set_title(f"Pred: {y_pred[idx]}, True: {y[idx]}")
        ax.axis("off")
    plt.suptitle("Correctly Classified Images")
    plt.show()
else:
    print("No images were correctly classified!")
```

```
Final Accuracy: 0.1124
```