Single Layer Perceptron

```
!pip install tensorflow
```

```
Requirement already satisfied: tensorflow in /usr/local/lib/python3.10/dist-packages (2.17.0)
Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.4.0)
Requirement already satisfied: astunparse>=1.6.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=24.3.25 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (24.3.25)
Requirement already satisfied: gast!=0.5.0,!=0.5.1,!=0.5.2,>=0.2.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.6.0)
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Requirement already satisfied: protobuf!=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!=4.21.4,!=4.21.5,<5.0.0dev,>=3.20.3 in /usr/local/lib/python
Requirement already satisfied: requests<3,>=2.21.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.32.3)
Requirement already satisfied: setuptools in /usr/local/lib/python3.10/dist-packages (from tensorflow) (71.0.4)
Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.16.0)
Requirement already satisfied: termcolor>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.5.0)
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Requirement already satisfied: tensorboard<2.18,>=2.17 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.17.0)
Requirement already satisfied: keras>=3.2.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.4.1)
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Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.18,>=2.17->tensorflow) (3.
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.18,>
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Requirement already satisfied: markdown-it-py>=2.2.0 in /usr/local/lib/python3.10/dist-packages (from rich->keras>=3.2.0->tensorflow) (3
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in /usr/local/lib/python3.10/dist-packages (from rich->keras>=3.2.0->tensorflow)
Requirement already satisfied: mdurl~=0.1 in /usr/local/lib/python3.10/dist-packages (from markdown-it-py>=2.2.0->rich->keras>=3.2.0->te
```

```
# Import necessary libraries
import numpy as np
import pandas as pd
import tensorflow as tf
import matplotlib.pyplot as plt
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
```

```
df = pd.read_csv("/content/titanic_cleaned.csv")
```

```
X = df.drop('Survived',axis=1)
y = df['Survived']
```

```
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.2,random_state=42)
```

```
X_train.shape
```

```
(712, 3)
```

```
X_test.shape
```

```
(179, 3)
```

```
y_train.shape
```

```
(712,)
```

```
y_test.shape
```

```
(179,)
```

```
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
```

```
model = Sequential([Dense(1, input_dim=X_train.shape[1], activation='sigmoid')])
```

```
/usr/local/lib/python3.10/dist-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argumen
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

```
model.compile(optimizer='adam', loss='binary_crossentropy', metrics=['accuracy'])
```

```
# Train the model
model.fit(X_train, y_train, epochs=100, batch_size=10, verbose=1)
```

```
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.7874 - loss: 0.4411
Epoch 73/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.8109 - loss: 0.4251
Epoch 74/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.7857 - loss: 0.4457
Epoch 75/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7857 - loss: 0.4665
Epoch 76/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.8005 - loss: 0.4517
Epoch 77/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7694 - loss: 0.4903
Epoch 78/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7694 - loss: 0.4935
Epoch 79/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.8048 - loss: 0.4444
Epoch 80/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.8061 - loss: 0.4464
Epoch 81/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7666 - loss: 0.4704
Epoch 82/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.7793 - loss: 0.4676
Epoch 83/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.7779 - loss: 0.4657
Epoch 84/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.7893 - loss: 0.4534
Epoch 85/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8144 - loss: 0.4454
Epoch 86/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.7650 - loss: 0.4899
Epoch 87/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.7831 - loss: 0.4611
Epoch 88/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.7719 - loss: 0.4975
Epoch 89/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.7917 - loss: 0.4498
Epoch 90/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.7938 - loss: 0.4673
Epoch 91/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.7957 - loss: 0.4452
Epoch 92/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.7725 - loss: 0.4714
Epoch 93/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8002 - loss: 0.4536
Epoch 94/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.7982 - loss: 0.4128
Epoch 95/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.7841 - loss: 0.4563
Epoch 96/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.7939 - loss: 0.4470
Epoch 97/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8129 - loss: 0.4280
Epoch 98/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.7833 - loss: 0.4763
Epoch 99/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8021 - loss: 0.4610
Epoch 100/100
72/72 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.7813 - loss: 0.4707
<keras.src.callbacks.history.History at 0x7adcbc3d4460>
```

```
# Evaluate the model on test data
loss, accuracy = model.evaluate(X_test, y_test)
print(f'Test Accuracy: {accuracy*100:.2f}%')
```

```
6/6 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.8217 - loss: 0.4159
Test Accuracy: 81.01%
```

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


class Perceptron:
    def __init__(self, weights, bias):
        self.weights = weights
        self.bias = bias

    def predict(self, inputs):
        # Calculate weighted sum
        z = np.dot(inputs, self.weights) + self.bias
        # Apply sigmoid activation function
        return sigmoid(z)


# Input for AND, OR gates (binary input pairs)
inputs = np.array([[0, 0], [0, 1], [1, 0], [1, 1]])


# Input for NOT gate (single binary input)
inputs_not = np.array([[0], [1]])


# AND gate weights and bias (both inputs need to be 1 to output 1)
weights_and = np.array([1, 1])
bias_and = 1 # Adjusting for threshold


# OR gate weights and bias (one input being 1 is enough for output 1)
weights_or = np.array([0, 1])
bias_or = 1  # Adjusting for threshold


# NOT gate weights and bias (single input)
weights_not = np.array([1])
bias_not = 1  # Adjusting for threshold


perceptron_and = Perceptron(weights_and, bias_and)
perceptron_or = Perceptron(weights_or, bias_or)
perceptron_not = Perceptron(weights_not, bias_not)


# AND gate results
print("AND Gate")
for x in inputs:
    output = perceptron_and.predict(x)
    print(f"Input: {x}, Output: {round(output)}")
```

```
AND Gate
Input: [0 0], Output: 0
Input: [0 1], Output: 0
Input: [1 0], Output: 0
Input: [1 1], Output: 1
```

```
# OR gate results
print("\nOR Gate")
for x in inputs:
    output = perceptron_or.predict(x)
    print(f"Input: {x}, Output: {round(output)}")
```

```

OR Gate
Input: [0 0], Output: 0
Input: [0 1], Output: 1
Input: [1 0], Output: 1
Input: [1 1], Output: 1
```

```
# NOT gate results
print("\nNOT Gate")
for x in inputs_not:
    output = perceptron_not.predict(x)
    print(f"Input: {x}, Output: {round(output)}")
```

```
NOT Gate
Input: [0], Output: 1
Input: [1], Output: 0
```

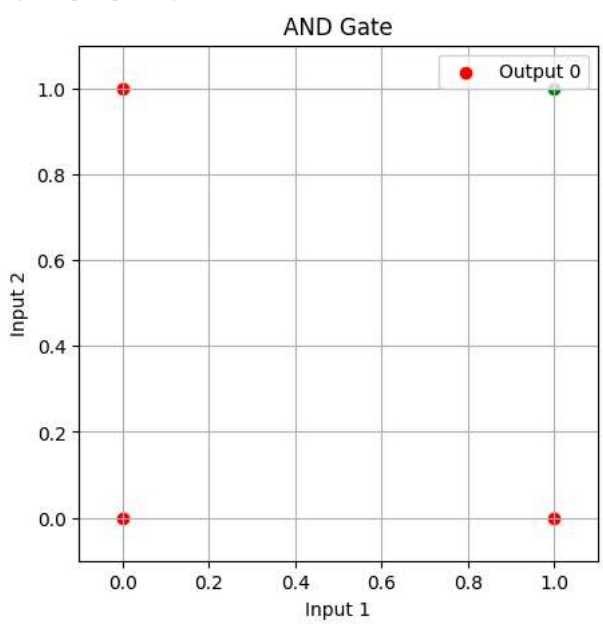
```
def plot_logic_gate(inputs, outputs, gate_name):
    # Define figure
    plt.figure(figsize=(5, 5))

    # Plot the points: Red for 0 output, Green for 1 output
    for i, point in enumerate(inputs):
        if outputs[i] == 0:
            plt.scatter(point[0], point[1] if len(point) > 1 else 0, color='red', label='Output 0' if i == 0 else "")
        else:
            plt.scatter(point[0], point[1] if len(point) > 1 else 0, color='green', label='Output 1' if i == 0 else "")

    # Set plot details
    plt.title(f'{gate_name} Gate')
    plt.xlabel('Input 1')
    if len(inputs[0]) > 1:
        plt.ylabel('Input 2')
    else:
        plt.yticks([0])
    plt.xlim(-0.1, 1.1)
    plt.ylim(-0.1, 1.1)
    plt.grid(True)
    plt.legend()
    plt.show()
```

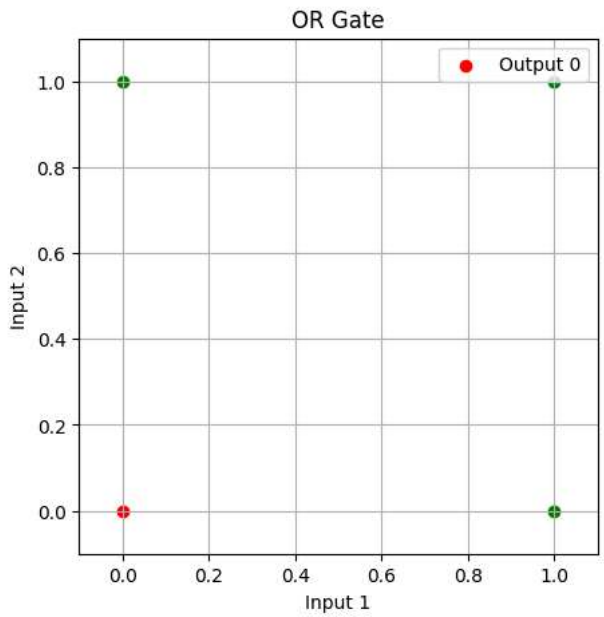
```
# AND Gate
print("AND Gate")
and_outputs = []
for x in inputs:
    output = round(perceptron_and.predict(x))
    and_outputs.append(output)
    print(f"Input: {x}, Output: {output}")
plot_logic_gate(inputs, and_outputs, "AND")
```

```
AND Gate
Input: [0 0], Output: 0
Input: [0 1], Output: 0
Input: [1 0], Output: 0
Input: [1 1], Output: 1
```



```
# OR Gate
print("\nOR Gate")
or_outputs = []
for x in inputs:
    output = round(perceptron_or.predict(x))
    or_outputs.append(output)
    print(f"Input: {x}, Output: {output}")
plot_logic_gate(inputs, or_outputs, "OR")
```

```
OR Gate
Input: [0 0], Output: 0
Input: [0 1], Output: 1
Input: [1 0], Output: 1
Input: [1 1], Output: 1
```




```
# NOT Gate
print("\nNOT Gate")
not_outputs = []
for x in inputs_not:
    output = round(perceptron_not.predict(x))
    not_outputs.append(output)
    print(f"Input: {x}, Output: {output}")
# For NOT gate, we only plot single input
plot_logic_gate(inputs_not, not_outputs, "NOT")
```

```
NOT Gate
Input: [0], Output: 1
Input: [1], Output: 0
```