design and implement a feedforward neural network featuring multiple layers and assess its performance on a given dataset. develop an algorithm to construct and train the nural network followed by a comprehensive evaluation of its effectiveness in handling the provided dataset

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pip install tensorflow
```

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```

```
import tensorflow as tf
from tensorflow.keras import layers, models
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score

# Load and preprocess the dataset (MNIST as an example)
mnist = tf.keras.datasets.mnist
(train_images, train_labels), (test_images, test_labels) = mnist.load_data()
train_images, test_images = train_images / 255.0, test_images / 255.0

# Split the dataset into training and validation sets
train_images, val_images, train_labels, val_labels = train_test_split(
    train_images, train_labels, test_size=0.1, random_state=42
)

# Build the neural network model
model = models.Sequential([
    layers.Flatten(input_shape=(28, 28)),  # Flatten the 28x28 images
    layers.Dense(128, activation='relu'),
    layers.Dense(64, activation='relu'),
    layers.Dense(10, activation='softmax')  # Output layer with 10 classes for digits 0-9
])

# Compile the model
model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])

# Train the model
history = model.fit(train_images, train_labels, epochs=10, validation_data=(val_images, val_labels))

# Evaluate the model on the test set
test_loss, test_accuracy = model.evaluate(test_images, test_labels)
```

```
print(f'Test Accuracy: {test_accuracy}')

# Plot training history
plt.plot(history.history['accuracy'], label='Training Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()
plt.show()
```

```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/mnist.npz
11490434/11490434 [==============================] - 0s 0us/step
Epoch 1/10
1688/1688 [==============================] - 8s 4ms/step - loss: 0.2556 - accuracy: 0.9249 - val_loss: 0.1503 - val_accuracy: 0.9560
Epoch 2/10
1688/1688 [==============================] - 9s 6ms/step - loss: 0.1094 - accuracy: 0.9665 - val_loss: 0.0961 - val_accuracy: 0.9693
Epoch 3/10
1688/1688 [==============================] - 8s 5ms/step - loss: 0.0764 - accuracy: 0.9763 - val_loss: 0.0891 - val_accuracy: 0.9733
Epoch 4/10
1688/1688 [==============================] - 8s 5ms/step - loss: 0.0562 - accuracy: 0.9824 - val_loss: 0.1015 - val_accuracy: 0.9706
Epoch 5/10
1688/1688 [==============================] - 9s 5ms/step - loss: 0.0466 - accuracy: 0.9847 - val_loss: 0.0684 - val_accuracy: 0.9813
Epoch 6/10
1688/1688 [==============================] - 7s 4ms/step - loss: 0.0360 - accuracy: 0.9878 - val_loss: 0.0809 - val_accuracy: 0.9798
Epoch 7/10
1688/1688 [==============================] - 9s 5ms/step - loss: 0.0305 - accuracy: 0.9900 - val_loss: 0.0772 - val_accuracy: 0.9818
Epoch 8/10
1688/1688 [==============================] - 7s 4ms/step - loss: 0.0256 - accuracy: 0.9912 - val_loss: 0.0846 - val_accuracy: 0.9773
Epoch 9/10
1688/1688 [==============================] - 9s 5ms/step - loss: 0.0213 - accuracy: 0.9926 - val_loss: 0.0885 - val_accuracy: 0.9783
Epoch 10/10
1688/1688 [==============================] - 8s 4ms/step - loss: 0.0189 - accuracy: 0.9936 - val_loss: 0.0827 - val_accuracy: 0.9807
313/313 [==============================] - 1s 2ms/step - loss: 0.0862 - accuracy: 0.9783
Test Accuracy: 0.9782999753952026
```