VGG19

```
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras.datasets import mnist
from tensorflow.keras.models import Model
from tensorflow.keras.layers import Dense, Flatten, Input
from tensorflow.keras.applications import VGG19
import matplotlib.pyplot as plt
import numpy as np


# Load the MNIST dataset
(x_train, y_train), (x_test, y_test) = mnist.load_data()


# Preprocess the data
x_train = x_train.reshape(-1, 28, 28, 1)
x_test = x_test.reshape(-1, 28, 28, 1)
x_train = x_train.astype('float32')
x_test = x_test.astype('float32')
x_train /= 255
x_test /= 255


# Convert class vectors to binary class matrices
y_train = keras.utils.to_categorical(y_train)
y_test = keras.utils.to_categorical(y_test)


# Load pre-trained VGG19 model without the top (classification) layers
base_model = VGG19(weights='imagenet', include_top=False, input_shape=(48, 48, 3))
```

```
    Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/vgg19/vgg19_weights_tf_dim_ordering_tf_kernels_no
    80134624/80134624 [==============================] - 114s 1us/step
```

```
# Freeze the pre-trained layers
for layer in base_model.layers:
    layer.trainable = False


# Add new classification layers
x = Flatten()(base_model.output)
x = Dense(1024, activation='relu')(x)
predictions = Dense(10, activation='softmax')(x)


# Create a new model
model = Model(inputs=base_model.input, outputs=predictions)


# Reshape the images to fit VGG input dimensions
x_train_vgg = tf.image.grayscale_to_rgb(tf.image.resize(x_train, (48, 48)))
x_test_vgg = tf.image.grayscale_to_rgb(tf.image.resize(x_test, (48, 48)))


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


# Train the model
history = model.fit(x_train_vgg, y_train, epochs=3, batch_size=50, validation_data=(x_test_vgg, y_test))
```

```
    Epoch 1/3
    1200/1200 [==============================] - 296s 246ms/step - loss: 0.2271 - accuracy: 0.9316 - val_loss: 0.1175 - val_accuracy: 0
    Epoch 2/3
    1200/1200 [==============================] - 291s 242ms/step - loss: 0.1075 - accuracy: 0.9656 - val_loss: 0.0916 - val_accuracy: 0
    Epoch 3/3
    1200/1200 [==============================] - 285s 238ms/step - loss: 0.0897 - accuracy: 0.9712 - val_loss: 0.0906 - val_accuracy: 0
```

```
model.save("C:/Users/csconda1/Documents/325-Bhagavath/modelvgg19_model_epoch3")
```

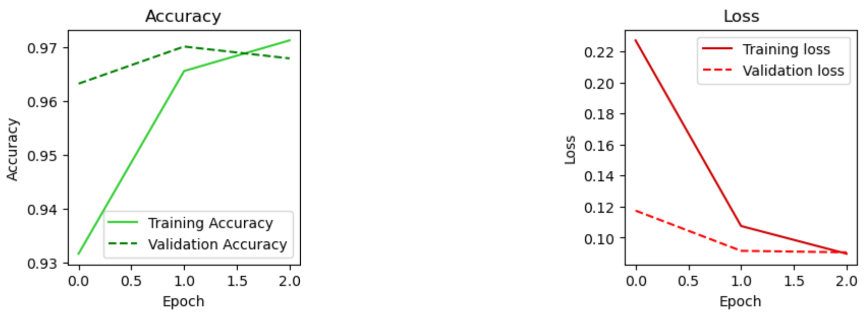
```
    INFO:tensorflow:Assets written to: C:/Users/csconda1/Documents/325-Bhagavath/modelvgg19_model_epoch3\assets
    INFO:tensorflow:Assets written to: C:/Users/csconda1/Documents/325-Bhagavath/modelvgg19_model_epoch3\assets
```

```
test_loss, test_accuracy = model.evaluate(x_test_vgg, y_test)
print("Test accuracy:", test_accuracy)
```

```
    313/313 [==============================] - 43s 137ms/step - loss: 0.0906 - accuracy: 0.9679
    Test accuracy: 0.9678999781608582
```

```
# Plot the training and validation loss
plt.figure(figsize=(10,3))
plt.subplot(1,3,1)
plt.title('Accuracy')
plt.plot(history.history['accuracy'],label='Training Accuracy',color='limegreen')
plt.plot(history.history['val_accuracy'],label='Validation Accuracy',color='green', linestyle='dashed')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()

plt.subplot(1,3,3)
plt.title('Loss')
plt.plot(history.history['loss'], label='Training loss', color='#cc0000',)
plt.plot(history.history['val_loss'], label='Validation loss',color = "#ff0000", linestyle = 'dashed')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()
plt.show()
```

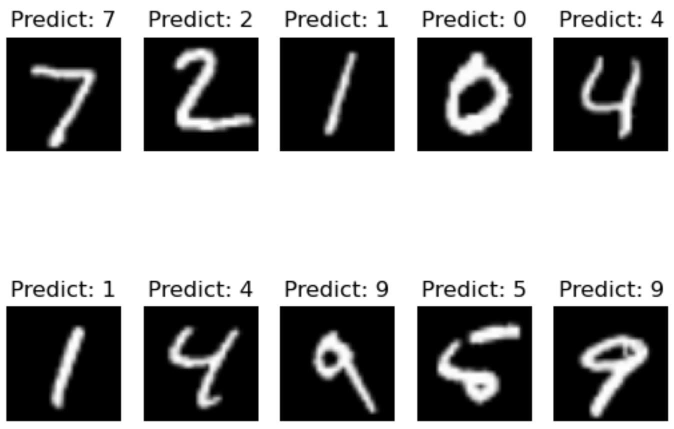


```
# Load some test images
test_images = x_test_vgg[:10]

# Make predictions on the test images
predictions = model.predict(test_images)
```

```
    1/1 [==============================] - 0s 191ms/step
```

```
# Plot the test images and their predictions
for i in range(len(test_images)):
    plt.subplot(2, 5, i + 1)
    plt.imshow(test_images[i], cmap='gray')
    plt.title(f"Predict: {np.argmax(predictions[i])}")
    plt.axis('off')
plt.show()
```


Predict: 7
Predict: 2
Predict: 1
Predict: 0
Predict: 4
Predict: 1
Predict: 4
Predict: 9
Predict: 5
Predict: 9