jupyter Assignment 6._Transfer_Learning_with_VGG16_for_Flower_classification Last Checkpoint: 3 hours ago (autosaved) Logout

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Reference

https://www.youtube.com/watch?v=AwOlgOwaLI0

Imports

```
In [ ]: import tensorflow_datasets as tfds
        import tensorflow as tf
        from tensorflow.keras.utils import to_categorical
```

Load Data

Explore more about datset: https://www.tensorflow.org/datasets/catalog/tf_flowers

```
In [ ]: ## Loading images and labels
        (train_ds, train_labels), (test_ds, test_labels) = tfds.load("tf_flowers",
            split=["train[:70%]", "train[:30%]"], ## Train test split
            batch_size=-1,
            as_supervised=True,  # Include labels
        )
```

Image Preprocessing

```
In [ ]: ## check existing image size
        train_ds[0].shape

Out[6]: TensorShape([442, 1024, 3])
```

```
In [ ]: ## Resizing images
        train_ds = tf.image.resize(train_ds, (150, 150))
        test_ds = tf.image.resize(test_ds, (150, 150))
```

```
In [ ]: train_labels

Out[8]: <tf.Tensor: shape=(2569,), dtype=int64, numpy=array([2, 3, 3, ..., 0, 2, 0])>
```

```
In [ ]: ## Transforming labels to correct format
        train_labels = to_categorical(train_labels, num_classes=5)
        test_labels = to_categorical(test_labels, num_classes=5)
```

```
In [ ]: train_labels[0]

Out[10]: array([0., 0., 1., 0., 0.], dtype=float32)
```

Use Pretrained VGG16 Image Classification model

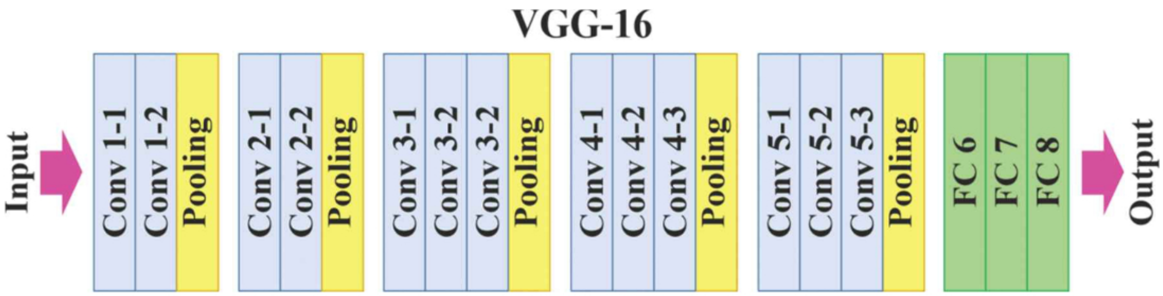
Load a pre-trained CNN model trained on a large dataset

```
In [ ]: from tensorflow.keras.applications.vgg16 import VGG16
        from tensorflow.keras.applications.vgg16 import preprocess_input
```

```
In [ ]: train_ds[0].shape

Out[12]: TensorShape([150, 150, 3])
```

```
In [ ]: ## Loading VGG16 model
        base_model = VGG16(weights="imagenet", include_top=False, input_shape=train_ds[0].shape)
```

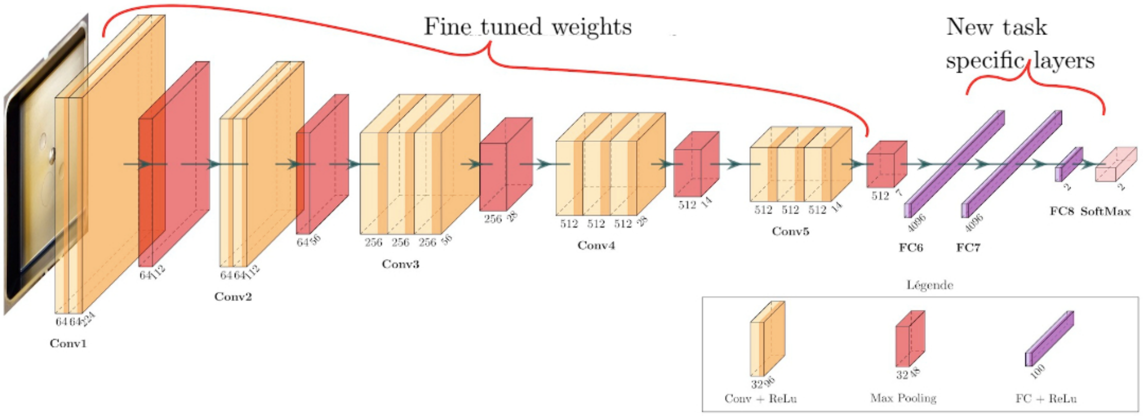


```
In [ ]: ## will not train base mode
        # Freeze Parameters in model's lower convolutional layers
        base_model.trainable = False
```

In [ ]:
```
## Preprocessing input
train_ds = preprocess_input(train_ds)
test_ds = preprocess_input(test_ds)
```

In [ ]:
```
## model details
base_model.summary()
```

```
Model: "vgg16"
_________________________________________________________________
 Layer (type)                Output Shape              Param #   
=================================================================
 input_1 (InputLayer)        [(None, 150, 150, 3)]     0         
                                                                 
 block1_conv1 (Conv2D)       (None, 150, 150, 64)      1792      
                                                                 
 block1_conv2 (Conv2D)       (None, 150, 150, 64)      36928     
                                                                 
 block1_pool (MaxPooling2D)  (None, 75, 75, 64)        0         
                                                                 
 block2_conv1 (Conv2D)       (None, 75, 75, 128)       73856     
                                                                 
 block2_conv2 (Conv2D)       (None, 75, 75, 128)       147584    
                                                                 
 block2_pool (MaxPooling2D)  (None, 37, 37, 128)       0         
                                                                 
 block3_conv1 (Conv2D)       (None, 37, 37, 256)       295168    
                                                                 
 block3_conv2 (Conv2D)       (None, 37, 37, 256)       590080    
                                                                 
 block3_conv3 (Conv2D)       (None, 37, 37, 256)       590080    
                                                                 
 block3_pool (MaxPooling2D)  (None, 18, 18, 256)       0         
                                                                 
 block4_conv1 (Conv2D)       (None, 18, 18, 512)       1180160   
                                                                 
 block4_conv2 (Conv2D)       (None, 18, 18, 512)       2359808   
                                                                 
 block4_conv3 (Conv2D)       (None, 18, 18, 512)       2359808   
                                                                 
 block4_pool (MaxPooling2D)  (None, 9, 9, 512)         0         
                                                                 
 block5_conv1 (Conv2D)       (None, 9, 9, 512)         2359808   
                                                                 
 block5_conv2 (Conv2D)       (None, 9, 9, 512)         2359808   
                                                                 
 block5_conv3 (Conv2D)       (None, 9, 9, 512)         2359808   
                                                                 
 block5_pool (MaxPooling2D)  (None, 4, 4, 512)         0         
                                                                 
=================================================================
Total params: 14,714,688
Trainable params: 0
Non-trainable params: 14,714,688
_________________________________________________________________
```



Add custom classifier with two dense layers of trainable parameters to model

In [ ]:
```
#add our layers on top of this model
from tensorflow.keras import layers, models

flatten_layer = layers.Flatten()
dense_layer_1 = layers.Dense(50, activation='relu')
dense_layer_2 = layers.Dense(20, activation='relu')
prediction_layer = layers.Dense(5, activation='softmax')


model = models.Sequential([
    base_model,
    flatten_layer,
    dense_layer_1,
    dense_layer_2,
    prediction_layer
])
```

Train classifier layers on training data available for task

```
In [ ]: from tensorflow.keras.callbacks import EarlyStopping

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

```
In [ ]: es = EarlyStopping(monitor='val_accuracy', mode='max', patience=5,  restore_best_weights=True)
```

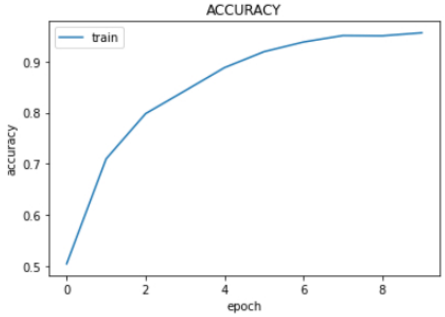
```
In [ ]: history=model.fit(train_ds, train_labels, epochs=50, validation_split=0.2, batch_size=32, callbacks=[es])
```

```
Epoch 1/50
65/65 [==============================] - 20s 126ms/step - loss: 1.6295 - accuracy: 0.5041 - val_loss: 1.1216 - val_ac
curacy: 0.5759
Epoch 2/50
65/65 [==============================] - 6s 98ms/step - loss: 0.7803 - accuracy: 0.7095 - val_loss: 1.0138 - val_accu
racy: 0.6401
Epoch 3/50
65/65 [==============================] - 6s 98ms/step - loss: 0.5985 - accuracy: 0.7981 - val_loss: 0.8845 - val_accu
racy: 0.6984
Epoch 4/50
65/65 [==============================] - 6s 98ms/step - loss: 0.4167 - accuracy: 0.8428 - val_loss: 1.0356 - val_accu
racy: 0.6848
Epoch 5/50
65/65 [==============================] - 6s 99ms/step - loss: 0.3029 - accuracy: 0.8881 - val_loss: 0.9954 - val_accu
racy: 0.7296
Epoch 6/50
65/65 [==============================] - 6s 99ms/step - loss: 0.2083 - accuracy: 0.9192 - val_loss: 1.0856 - val_accu
racy: 0.7218
Epoch 7/50
65/65 [==============================] - 6s 100ms/step - loss: 0.1784 - accuracy: 0.9382 - val_loss: 1.0919 - val_acc
uracy: 0.7257
Epoch 8/50
65/65 [==============================] - 6s 100ms/step - loss: 0.1407 - accuracy: 0.9509 - val_loss: 1.0710 - val_acc
uracy: 0.7296
Epoch 9/50
65/65 [==============================] - 7s 100ms/step - loss: 0.1475 - accuracy: 0.9504 - val_loss: 1.1085 - val_acc
uracy: 0.7023
Epoch 10/50
65/65 [==============================] - 7s 101ms/step - loss: 0.1193 - accuracy: 0.9562 - val_loss: 1.1981 - val_acc
uracy: 0.7179
```

```
In [ ]: los,accurac=model.evaluate(test_ds,test_labels)
        print("Loss: ",los,"Accuracy: ", accurac)
```

```
35/35 [==============================] - 3s 78ms/step - loss: 0.1735 - accuracy: 0.9391
Loss:  0.17345084249973297 Accuracy:  0.9391462206840515
```

```
In [ ]: import matplotlib.pyplot as plt
        plt.plot(history.history['accuracy'])
        plt.title('ACCURACY')
        plt.ylabel('accuracy')
        plt.xlabel('epoch')
        plt.legend(['train'],loc='upper left')
        plt.show()
```



```
In [ ]: import numpy as np
        import pandas as pd
        y_pred = model.predict(test_ds)
        y_classes = [np.argmax(element) for element in y_pred]
        #to_categorical(y_classes, num_classes=5)
        #to_categorical(test_labels, num_classes=5)
        print(y_classes[:10])
        print("\nTest")
        print(test_labels[:10])
```

```
35/35 [==============================] - 3s 77ms/step
[2, 3, 3, 4, 3, 0, 1, 0, 0, 2]

Test
[[0. 0. 1. 0. 0.]
 [0. 0. 0. 1. 0.]
 [0. 0. 0. 1. 0.]
 [0. 0. 0. 0. 1.]
 [0. 0. 0. 1. 0.]
 [1. 0. 0. 0. 0.]
 [1. 0. 0. 0. 0.]
 [1. 0. 0. 0. 0.]
 [1. 0. 0. 0. 0.]
 [0. 1. 0. 0. 0.]]
```