In [0]:

```
import os
import glob
import math
import numpy as np
from keras import optimizers
from keras import applications
from keras.models import Model
from keras.layers import Flatten, Dense, Dropout, Input
from keras.preprocessing.image import ImageDataGenerator
from keras.callbacks import EarlyStopping, ModelCheckpoint
```

```
Using TensorFlow backend.
```

In [0]:

```
# 数据集
train_dir = '../input/flower_data/flower_data/train'  # 训练集/Training set
validation_dir = '../input/flower_data/flower_data/valid'  # 验证集/Verification set
img_size = (224, 224)  # 图片大小/size of picture
```

In [0]:

```
classes = sorted([o for o in os.listdir(train_dir)])  # 根据文件名分类/Classified by file name
```

In [0]:

```
# 定义模型/Defining model
base_model = applications.VGG16(weights='imagenet', include_top=False, input_tensor=Input(shape=img
_size + (3,)),
                                classes=len(classes))

for layer in base_model.layers:
    layer.trainable = False

x = base_model.output
x = Flatten()(x)
x = Dense(4096, activation='relu')(x)
x = Dropout(0.6)(x)  # Droupout 0.6
x = Dense(4096, activation='relu')(x)
x = Dropout(0.6)(x)
predictions = Dense(len(classes), activation='softmax')(x)

model = Model(input=base_model.input, output=predictions)

model.compile(loss='categorical_crossentropy', optimizer=optimizers.Adam(lr=1e-5),
metrics=['accuracy'])
print(model.summary())
```

```
Downloading data from https://github.com/fchollet/deep-learning-
models/releases/download/v0.1/vgg16_weights_tf_dim_ordering_tf_kernels_notop.h5
58892288/58889256 [==============================] - 1s 0us/step
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_1 (InputLayer)         (None, 224, 224, 3)       0
_________________________________________________________________
block1_conv1 (Conv2D)        (None, 224, 224, 64)      1792
_________________________________________________________________
block1_conv2 (Conv2D)        (None, 224, 224, 64)      36928
_________________________________________________________________
block1_pool (MaxPooling2D)   (None, 112, 112, 64)      0
_________________________________________________________________
block2_conv1 (Conv2D)        (None, 112, 112, 128)     73856
_________________________________________________________________
block2_conv2 (Conv2D)        (None, 112, 112, 128)     147584
_________________________________________________________________
block2_pool (MaxPooling2D)   (None, 56, 56, 128)       0
```

```
_________________________________________________________________
block3_conv1 (Conv2D)        (None, 56, 56, 256)       295168
_________________________________________________________________
block3_conv2 (Conv2D)        (None, 56, 56, 256)       590080
_________________________________________________________________
block3_conv3 (Conv2D)        (None, 56, 56, 256)       590080
_________________________________________________________________
block3_pool (MaxPooling2D)   (None, 28, 28, 256)       0
_________________________________________________________________
block4_conv1 (Conv2D)        (None, 28, 28, 512)       1180160
_________________________________________________________________
block4_conv2 (Conv2D)        (None, 28, 28, 512)       2359808
_________________________________________________________________
block4_conv3 (Conv2D)        (None, 28, 28, 512)       2359808
_________________________________________________________________
block4_pool (MaxPooling2D)   (None, 14, 14, 512)       0
_________________________________________________________________
block5_conv1 (Conv2D)        (None, 14, 14, 512)       2359808
_________________________________________________________________
block5_conv2 (Conv2D)        (None, 14, 14, 512)       2359808
_________________________________________________________________
block5_conv3 (Conv2D)        (None, 14, 14, 512)       2359808
_________________________________________________________________
block5_pool (MaxPooling2D)   (None, 7, 7, 512)         0
_________________________________________________________________
flatten_1 (Flatten)          (None, 25088)             0
_________________________________________________________________
dense_1 (Dense)              (None, 4096)              102764544
_________________________________________________________________
dropout_1 (Dropout)          (None, 4096)              0
_________________________________________________________________
dense_2 (Dense)              (None, 4096)              16781312
_________________________________________________________________
dropout_2 (Dropout)          (None, 4096)              0
_________________________________________________________________
dense_3 (Dense)              (None, 102)               417894
=================================================================
Total params: 134,678,438
Trainable params: 119,963,750
Non-trainable params: 14,714,688
_________________________________________________________________
None
```

```
/opt/conda/lib/python3.6/site-packages/ipykernel_launcher.py:16: UserWarning: Update your `Model` call to the Keras 2 API: `Model(inputs=Tensor("in..., outputs=Tensor("de...)`
  app.launch_new_instance()
```

In [0]:

```
#数据增强/Data enhancement
train_datagen = ImageDataGenerator(rotation_range=30., shear_range=0.2, zoom_range=0.2,
                                   horizontal_flip=True)  # 30°内随机旋转，0.2几率应用错切，0.2几率缩放p部，水平随机旋转一半图像/Random rotation within 30°, 0.2 chance to apply miscut, 0.2 probability to scale inside, horizontal random rotation half image
train_data = train_datagen.flow_from_directory(train_dir, target_size=img_size, classes=classes)

validation_datagen = ImageDataGenerator()  # 用于验证，无需数据增强/For verification, no data enhancement required
validation_data = validation_datagen.flow_from_directory(validation_dir, target_size=img_size,
                                                         classes=classes)
```

```
Found 6552 images belonging to 102 classes.
Found 818 images belonging to 102 classes.
```

In [0]:

```
early_stopping = EarlyStopping(verbose=1, patience=30, monitor='val_acc')
model_checkpoint = ModelCheckpoint(filepath='102flowersmodel.h5', verbose=1, save_best_only=True, monitor='val_acc')
callbacks = [early_stopping, model_checkpoint]
nb_epoch = 80  # 迭代次数/Number of iterations
batch_size = 32  # 批量大小/Batch size
hist = model.fit_generator(train_data, steps_per_epoch=nb_train_samples / float(batch_size), epochs=nb_epoch,
                           validation_data=validation_data, validation_steps=nb_validation_samples / float
```

```
                    validation_data=validation_data, validation_steps=nb_validation_samples / float
(batch_size),
                    callbacks=callbacks)

print('Training is finished!')
```

```
Epoch 1/80
205/204 [==============================] - 142s 691ms/step - loss: 15.5404 - acc: 0.0159 -
val_loss: 14.8518 - val_acc: 0.0391

Epoch 00001: val_acc improved from -inf to 0.03912, saving model to 102flowersmodel.h5
Epoch 2/80
205/204 [==============================] - 99s 482ms/step - loss: 15.0355 - acc: 0.0432 -
val_loss: 14.1272 - val_acc: 0.0868

Epoch 00002: val_acc improved from 0.03912 to 0.08680, saving model to 102flowersmodel.h5
Epoch 3/80
205/204 [==============================] - 100s 488ms/step - loss: 14.6194 - acc: 0.0670 -
val_loss: 13.6192 - val_acc: 0.1149

Epoch 00003: val_acc improved from 0.08680 to 0.11491, saving model to 102flowersmodel.h5
Epoch 4/80
205/204 [==============================] - 99s 485ms/step - loss: 14.1506 - acc: 0.0938 -
val_loss: 13.2720 - val_acc: 0.1491

Epoch 00004: val_acc improved from 0.11491 to 0.14914, saving model to 102flowersmodel.h5
Epoch 5/80
205/204 [==============================] - 99s 481ms/step - loss: 13.8324 - acc: 0.1113 -
val_loss: 12.8258 - val_acc: 0.1760

Epoch 00005: val_acc improved from 0.14914 to 0.17604, saving model to 102flowersmodel.h5
Epoch 6/80
205/204 [==============================] - 98s 480ms/step - loss: 13.6083 - acc: 0.1249 -
val_loss: 12.7355 - val_acc: 0.1809

Epoch 00006: val_acc improved from 0.17604 to 0.18093, saving model to 102flowersmodel.h5
Epoch 7/80
205/204 [==============================] - 99s 483ms/step - loss: 13.4460 - acc: 0.1353 -
val_loss: 12.3094 - val_acc: 0.2152

Epoch 00007: val_acc improved from 0.18093 to 0.21516, saving model to 102flowersmodel.h5
Epoch 8/80
205/204 [==============================] - 98s 480ms/step - loss: 13.2028 - acc: 0.1466 -
val_loss: 11.8620 - val_acc: 0.2298

Epoch 00008: val_acc improved from 0.21516 to 0.22983, saving model to 102flowersmodel.h5
Epoch 9/80
205/204 [==============================] - 98s 476ms/step - loss: 12.9454 - acc: 0.1615 -
val_loss: 11.5069 - val_acc: 0.2543

Epoch 00009: val_acc improved from 0.22983 to 0.25428, saving model to 102flowersmodel.h5
Epoch 10/80
205/204 [==============================] - 97s 475ms/step - loss: 12.6153 - acc: 0.1781 -
val_loss: 11.0554 - val_acc: 0.2836

Epoch 00010: val_acc improved from 0.25428 to 0.28362, saving model to 102flowersmodel.h5
Epoch 11/80
205/204 [==============================] - 97s 475ms/step - loss: 12.3001 - acc: 0.1953 -
val_loss: 10.8532 - val_acc: 0.3068

Epoch 00011: val_acc improved from 0.28362 to 0.30685, saving model to 102flowersmodel.h5
Epoch 12/80
205/204 [==============================] - 99s 484ms/step - loss: 12.0505 - acc: 0.2111 -
val_loss: 10.8694 - val_acc: 0.3068

Epoch 00012: val_acc improved from 0.30685 to 0.30685, saving model to 102flowersmodel.h5
Epoch 13/80
205/204 [==============================] - 99s 482ms/step - loss: 11.7673 - acc: 0.2252 -
val_loss: 10.6665 - val_acc: 0.3166

Epoch 00013: val_acc improved from 0.30685 to 0.31663, saving model to 102flowersmodel.h5
Epoch 14/80
205/204 [==============================] - 98s 479ms/step - loss: 11.5898 - acc: 0.2366 -
val_loss: 10.3773 - val_acc: 0.3276

Epoch 00014: val_acc improved from 0.31663 to 0.32763, saving model to 102flowersmodel.h5
Epoch 15/80
```

205/204 [==============================] - 98s 480ms/step - loss: 11.3110 - acc: 0.2522 -
val_loss: 9.8690 - val_acc: 0.3619

Epoch 00015: val_acc improved from 0.32763 to 0.36186, saving model to 102flowersmodel.h5
Epoch 16/80
205/204 [==============================] - 99s 482ms/step - loss: 11.1490 - acc: 0.2617 -
val_loss: 9.5500 - val_acc: 0.3802

Epoch 00016: val_acc improved from 0.36186 to 0.38020, saving model to 102flowersmodel.h5
Epoch 17/80
205/204 [==============================] - 98s 479ms/step - loss: 10.9429 - acc: 0.2729 -
val_loss: 9.1999 - val_acc: 0.3998

Epoch 00017: val_acc improved from 0.38020 to 0.39976, saving model to 102flowersmodel.h5
Epoch 18/80
205/204 [==============================] - 97s 475ms/step - loss: 10.6211 - acc: 0.2902 -
val_loss: 9.0715 - val_acc: 0.4071

Epoch 00018: val_acc improved from 0.39976 to 0.40709, saving model to 102flowersmodel.h5
Epoch 19/80
205/204 [==============================] - 98s 477ms/step - loss: 10.4407 - acc: 0.3026 -
val_loss: 8.8710 - val_acc: 0.4132

Epoch 00019: val_acc improved from 0.40709 to 0.41320, saving model to 102flowersmodel.h5
Epoch 20/80
205/204 [==============================] - 98s 478ms/step - loss: 10.2322 - acc: 0.3072 -
val_loss: 8.7711 - val_acc: 0.4169

Epoch 00020: val_acc improved from 0.41320 to 0.41687, saving model to 102flowersmodel.h5
Epoch 21/80
205/204 [==============================] - 98s 477ms/step - loss: 10.0087 - acc: 0.3256 -
val_loss: 8.3561 - val_acc: 0.4328

Epoch 00021: val_acc improved from 0.41687 to 0.43276, saving model to 102flowersmodel.h5
Epoch 22/80
205/204 [==============================] - 98s 480ms/step - loss: 9.7653 - acc: 0.3314 - val_loss:
8.1327 - val_acc: 0.4487

Epoch 00022: val_acc improved from 0.43276 to 0.44866, saving model to 102flowersmodel.h5
Epoch 23/80
205/204 [==============================] - 98s 477ms/step - loss: 9.6541 - acc: 0.3402 - val_loss:
7.9681 - val_acc: 0.4474

Epoch 00023: val_acc did not improve from 0.44866
Epoch 24/80
205/204 [==============================] - 97s 475ms/step - loss: 9.3998 - acc: 0.3555 - val_loss:
7.7900 - val_acc: 0.4523

Epoch 00024: val_acc improved from 0.44866 to 0.45232, saving model to 102flowersmodel.h5
Epoch 25/80
205/204 [==============================] - 97s 476ms/step - loss: 9.2767 - acc: 0.3579 - val_loss:
7.5722 - val_acc: 0.4645

Epoch 00025: val_acc improved from 0.45232 to 0.46455, saving model to 102flowersmodel.h5
Epoch 26/80
205/204 [==============================] - 98s 478ms/step - loss: 9.0261 - acc: 0.3741 - val_loss:
7.1722 - val_acc: 0.4853

Epoch 00026: val_acc improved from 0.46455 to 0.48533, saving model to 102flowersmodel.h5
Epoch 27/80
205/204 [==============================] - 97s 476ms/step - loss: 8.8279 - acc: 0.3775 - val_loss:
6.7417 - val_acc: 0.5012

Epoch 00027: val_acc improved from 0.48533 to 0.50122, saving model to 102flowersmodel.h5
Epoch 28/80
205/204 [==============================] - 98s 477ms/step - loss: 8.6561 - acc: 0.3836 - val_loss:
6.4603 - val_acc: 0.5147

Epoch 00028: val_acc improved from 0.50122 to 0.51467, saving model to 102flowersmodel.h5
Epoch 29/80
205/204 [==============================] - 98s 478ms/step - loss: 8.4198 - acc: 0.3925 - val_loss:
6.3185 - val_acc: 0.5196

Epoch 00029: val_acc improved from 0.51467 to 0.51956, saving model to 102flowersmodel.h5
Epoch 30/80
205/204 [==============================] - 97s 475ms/step - loss: 8.1587 - acc: 0.4050 - val_loss:
6.2075 - val_acc: 0.5416

```
Epoch 00030: val_acc improved from 0.51956 to 0.54156, saving model to 102flowersmodel.h5
Epoch 31/80
205/204 [==============================] - 98s 479ms/step - loss: 8.0566 - acc: 0.4114 - val_loss:
5.9478 - val_acc: 0.5526

Epoch 00031: val_acc improved from 0.54156 to 0.55257, saving model to 102flowersmodel.h5
Epoch 32/80
205/204 [==============================] - 98s 479ms/step - loss: 7.8168 - acc: 0.4181 - val_loss:
5.8651 - val_acc: 0.5599

Epoch 00032: val_acc improved from 0.55257 to 0.55990, saving model to 102flowersmodel.h5
Epoch 33/80
205/204 [==============================] - 97s 474ms/step - loss: 7.6114 - acc: 0.4288 - val_loss:
5.5715 - val_acc: 0.5746

Epoch 00033: val_acc improved from 0.55990 to 0.57457, saving model to 102flowersmodel.h5
Epoch 34/80
205/204 [==============================] - 97s 473ms/step - loss: 7.3979 - acc: 0.4341 - val_loss:
5.3026 - val_acc: 0.5770

Epoch 00034: val_acc improved from 0.57457 to 0.57702, saving model to 102flowersmodel.h5
Epoch 35/80
205/204 [==============================] - 97s 473ms/step - loss: 7.0898 - acc: 0.4550 - val_loss:
5.0702 - val_acc: 0.5892

Epoch 00035: val_acc improved from 0.57702 to 0.58924, saving model to 102flowersmodel.h5
Epoch 36/80
205/204 [==============================] - 97s 475ms/step - loss: 6.8173 - acc: 0.4646 - val_loss:
4.8418 - val_acc: 0.6002

Epoch 00036: val_acc improved from 0.58924 to 0.60024, saving model to 102flowersmodel.h5
Epoch 37/80
205/204 [==============================] - 97s 474ms/step - loss: 6.5905 - acc: 0.4737 - val_loss:
4.6374 - val_acc: 0.6271

Epoch 00037: val_acc improved from 0.60024 to 0.62714, saving model to 102flowersmodel.h5
Epoch 38/80
205/204 [==============================] - 97s 474ms/step - loss: 6.5084 - acc: 0.4711 - val_loss:
4.4852 - val_acc: 0.6333

Epoch 00038: val_acc improved from 0.62714 to 0.63325, saving model to 102flowersmodel.h5
Epoch 39/80
205/204 [==============================] - 97s 473ms/step - loss: 6.1511 - acc: 0.4919 - val_loss:
4.3485 - val_acc: 0.6394

Epoch 00039: val_acc improved from 0.63325 to 0.63936, saving model to 102flowersmodel.h5
Epoch 40/80
205/204 [==============================] - 97s 473ms/step - loss: 5.9503 - acc: 0.5054 - val_loss:
4.1950 - val_acc: 0.6418

Epoch 00040: val_acc improved from 0.63936 to 0.64181, saving model to 102flowersmodel.h5
Epoch 41/80
205/204 [==============================] - 98s 476ms/step - loss: 5.7553 - acc: 0.5096 - val_loss:
4.0238 - val_acc: 0.6516

Epoch 00041: val_acc improved from 0.64181 to 0.65159, saving model to 102flowersmodel.h5
Epoch 42/80
205/204 [==============================] - 97s 473ms/step - loss: 5.4875 - acc: 0.5202 - val_loss:
3.8453 - val_acc: 0.6516

Epoch 00042: val_acc improved from 0.65159 to 0.65159, saving model to 102flowersmodel.h5
Epoch 43/80
205/204 [==============================] - 97s 475ms/step - loss: 5.2436 - acc: 0.5329 - val_loss:
3.5167 - val_acc: 0.6626

Epoch 00043: val_acc improved from 0.65159 to 0.66259, saving model to 102flowersmodel.h5
Epoch 44/80
205/204 [==============================] - 98s 478ms/step - loss: 5.1618 - acc: 0.5297 - val_loss:
3.3585 - val_acc: 0.6809

Epoch 00044: val_acc improved from 0.66259 to 0.68093, saving model to 102flowersmodel.h5
Epoch 45/80
205/204 [==============================] - 97s 474ms/step - loss: 4.9963 - acc: 0.5354 - val_loss:
3.2810 - val_acc: 0.6858

Epoch 00045: val_acc improved from 0.68093 to 0.68582, saving model to 102flowersmodel.h5
```

Epoch 00045: val_acc improved from 0.68582 to 0.68582, saving model to 102flowersmodel.h5
Epoch 46/80
205/204 [==============================] - 97s 472ms/step - loss: 4.6114 - acc: 0.5531 - val_loss: 3.1445 - val_acc: 0.6956

Epoch 00046: val_acc improved from 0.68582 to 0.69560, saving model to 102flowersmodel.h5
Epoch 47/80
205/204 [==============================] - 98s 479ms/step - loss: 4.5729 - acc: 0.5524 - val_loss: 2.9075 - val_acc: 0.7029

Epoch 00047: val_acc improved from 0.69560 to 0.70293, saving model to 102flowersmodel.h5
Epoch 48/80
205/204 [==============================] - 97s 475ms/step - loss: 4.2608 - acc: 0.5627 - val_loss: 2.7060 - val_acc: 0.7115

Epoch 00048: val_acc improved from 0.70293 to 0.71149, saving model to 102flowersmodel.h5
Epoch 49/80
205/204 [==============================] - 97s 475ms/step - loss: 4.1526 - acc: 0.5680 - val_loss: 2.5807 - val_acc: 0.7164

Epoch 00049: val_acc improved from 0.71149 to 0.71638, saving model to 102flowersmodel.h5
Epoch 50/80
205/204 [==============================] - 98s 479ms/step - loss: 3.9508 - acc: 0.5744 - val_loss: 2.4988 - val_acc: 0.7152

Epoch 00050: val_acc did not improve from 0.71638
Epoch 51/80
205/204 [==============================] - 97s 474ms/step - loss: 3.8776 - acc: 0.5797 - val_loss: 2.3918 - val_acc: 0.7311

Epoch 00051: val_acc improved from 0.71638 to 0.73105, saving model to 102flowersmodel.h5
Epoch 52/80
205/204 [==============================] - 97s 475ms/step - loss: 3.7176 - acc: 0.5786 - val_loss: 2.3071 - val_acc: 0.7286

Epoch 00052: val_acc did not improve from 0.73105
Epoch 53/80
205/204 [==============================] - 98s 479ms/step - loss: 3.5122 - acc: 0.5962 - val_loss: 2.2345 - val_acc: 0.7286

Epoch 00053: val_acc did not improve from 0.73105
Epoch 54/80
205/204 [==============================] - 98s 476ms/step - loss: 3.3209 - acc: 0.5994 - val_loss: 2.1108 - val_acc: 0.7408

Epoch 00054: val_acc improved from 0.73105 to 0.74083, saving model to 102flowersmodel.h5
Epoch 55/80
205/204 [==============================] - 97s 474ms/step - loss: 3.1841 - acc: 0.6021 - val_loss: 2.0713 - val_acc: 0.7359

Epoch 00055: val_acc did not improve from 0.74083
Epoch 56/80
205/204 [==============================] - 98s 479ms/step - loss: 3.0697 - acc: 0.6064 - val_loss: 1.9834 - val_acc: 0.7445

Epoch 00056: val_acc improved from 0.74083 to 0.74450, saving model to 102flowersmodel.h5
Epoch 57/80
205/204 [==============================] - 98s 477ms/step - loss: 3.0522 - acc: 0.6134 - val_loss: 1.9440 - val_acc: 0.7469

Epoch 00057: val_acc improved from 0.74450 to 0.74694, saving model to 102flowersmodel.h5
Epoch 58/80
205/204 [==============================] - 97s 474ms/step - loss: 2.8836 - acc: 0.6221 - val_loss: 1.8426 - val_acc: 0.7518

Epoch 00058: val_acc improved from 0.74694 to 0.75183, saving model to 102flowersmodel.h5
Epoch 59/80
205/204 [==============================] - 99s 481ms/step - loss: 2.7801 - acc: 0.6222 - val_loss: 1.7987 - val_acc: 0.7616

Epoch 00059: val_acc improved from 0.75183 to 0.76161, saving model to 102flowersmodel.h5
Epoch 60/80
205/204 [==============================] - 98s 478ms/step - loss: 2.5963 - acc: 0.6405 - val_loss: 1.7582 - val_acc: 0.7604

Epoch 00060: val_acc did not improve from 0.76161
Epoch 61/80
205/204 [==============================] - 98s 476ms/step - loss: 2.5253 - acc: 0.6443 - val_loss:

205/204 [==============================] - 98s 476ms/step - loss: 2.5295 - acc: 0.6445 - val_loss:
1.6582 - val_acc: 0.7689

Epoch 00061: val_acc improved from 0.76161 to 0.76895, saving model to 102flowersmodel.h5
Epoch 62/80
205/204 [==============================] - 99s 481ms/step - loss: 2.4462 - acc: 0.6434 - val_loss:
1.5628 - val_acc: 0.7763

Epoch 00062: val_acc improved from 0.76895 to 0.77628, saving model to 102flowersmodel.h5
Epoch 63/80
205/204 [==============================] - 98s 479ms/step - loss: 2.3170 - acc: 0.6493 - val_loss:
1.4615 - val_acc: 0.7861

Epoch 00063: val_acc improved from 0.77628 to 0.78606, saving model to 102flowersmodel.h5
Epoch 64/80
205/204 [==============================] - 98s 478ms/step - loss: 2.2966 - acc: 0.6489 - val_loss:
1.2982 - val_acc: 0.7861

Epoch 00064: val_acc did not improve from 0.78606
Epoch 65/80
205/204 [==============================] - 99s 483ms/step - loss: 2.1653 - acc: 0.6579 - val_loss:
1.2616 - val_acc: 0.7983

Epoch 00065: val_acc improved from 0.78606 to 0.79829, saving model to 102flowersmodel.h5
Epoch 66/80
205/204 [==============================] - 98s 476ms/step - loss: 2.0578 - acc: 0.6722 - val_loss:
1.2278 - val_acc: 0.8020

Epoch 00066: val_acc improved from 0.79829 to 0.80196, saving model to 102flowersmodel.h5
Epoch 67/80
205/204 [==============================] - 98s 478ms/step - loss: 1.9695 - acc: 0.6799 - val_loss:
1.2290 - val_acc: 0.8056

Epoch 00067: val_acc improved from 0.80196 to 0.80562, saving model to 102flowersmodel.h5
Epoch 68/80
205/204 [==============================] - 99s 481ms/step - loss: 1.9299 - acc: 0.6906 - val_loss:
1.2266 - val_acc: 0.8056

Epoch 00068: val_acc did not improve from 0.80562
Epoch 69/80
205/204 [==============================] - 97s 475ms/step - loss: 1.9215 - acc: 0.6919 - val_loss:
1.1859 - val_acc: 0.8044

Epoch 00069: val_acc did not improve from 0.80562
Epoch 70/80
205/204 [==============================] - 97s 473ms/step - loss: 1.8238 - acc: 0.7044 - val_loss:
1.1864 - val_acc: 0.8007

Epoch 00070: val_acc did not improve from 0.80562
Epoch 71/80
205/204 [==============================] - 98s 476ms/step - loss: 1.7451 - acc: 0.7099 - val_loss:
1.1787 - val_acc: 0.8007

Epoch 00071: val_acc did not improve from 0.80562
Epoch 72/80
205/204 [==============================] - 97s 474ms/step - loss: 1.7269 - acc: 0.7149 - val_loss:
1.1663 - val_acc: 0.8093

Epoch 00072: val_acc improved from 0.80562 to 0.80929, saving model to 102flowersmodel.h5
Epoch 73/80
205/204 [==============================] - 97s 475ms/step - loss: 1.7196 - acc: 0.7130 - val_loss:
1.1415 - val_acc: 0.8056

Epoch 00073: val_acc did not improve from 0.80929
Epoch 74/80
205/204 [==============================] - 97s 475ms/step - loss: 1.5773 - acc: 0.7323 - val_loss:
1.1420 - val_acc: 0.8117

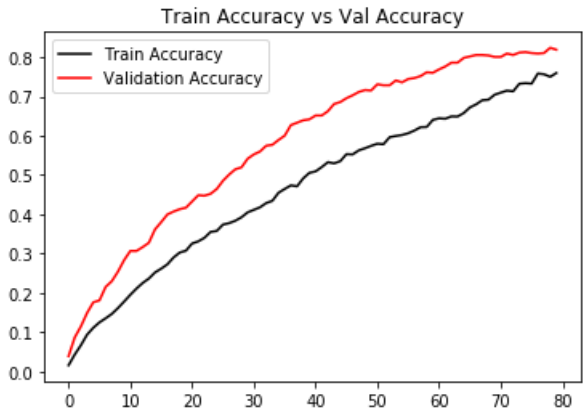
Epoch 00074: val_acc improved from 0.80929 to 0.81174, saving model to 102flowersmodel.h5
Epoch 75/80
205/204 [==============================] - 98s 480ms/step - loss: 1.6288 - acc: 0.7336 - val_loss:
1.1273 - val_acc: 0.8130

Epoch 00075: val_acc improved from 0.81174 to 0.81296, saving model to 102flowersmodel.h5
Epoch 76/80
205/204 [==============================] - 98s 477ms/step - loss: 1.5655 - acc: 0.7330 - val_loss:
1.1403 - val_acc: 0.8105

```
Epoch 00076: val_acc did not improve from 0.81296
Epoch 77/80
205/204 [==============================] - 97s 474ms/step - loss: 1.4227 - acc: 0.7584 - val_loss:
1.1186 - val_acc: 0.8093

Epoch 00077: val_acc did not improve from 0.81296
Epoch 78/80
205/204 [==============================] - 99s 481ms/step - loss: 1.4737 - acc: 0.7566 - val_loss:
1.1229 - val_acc: 0.8105

Epoch 00078: val_acc did not improve from 0.81296
Epoch 79/80
205/204 [==============================] - 98s 476ms/step - loss: 1.4806 - acc: 0.7499 - val_loss:
1.0944 - val_acc: 0.8240

Epoch 00079: val_acc improved from 0.81296 to 0.82396, saving model to 102flowersmodel.h5
Epoch 80/80
205/204 [==============================] - 98s 477ms/step - loss: 1.4363 - acc: 0.7599 - val_loss:
1.0475 - val_acc: 0.8191

Epoch 00080: val_acc did not improve from 0.82396
Training is finished!
```

In [0]:

```
#查看acc与val_acc相互关系/View the relationship between acc and val_acc
import matplotlib.pyplot as plt

plt.title('Train Accuracy vs Val Accuracy')
plt.plot(hist.history['acc'], label='Train Accuracy', color='black')
plt.plot(hist.history['val_acc'], label='Validation Accuracy', color='red')
plt.legend()
plt.show()
```



In [0]:

```
from keras.models import load_model
from keras.preprocessing import image
#加载模型/Load model
model = load_model('102flowersmodel.h5')
#将结果以（图片名，分类id）保存到data中/Save the result as (name,id) to data
data = []
path = '../input/flower_data/flower_data/test'
img_height, img_width = 224, 224
imgs = os.listdir(path)
for img in imgs:
    jpgfile = image.load_img(path=path+'/'+img, target_size=(img_height, img_width))
    jpgfile = image.img_to_array(jpgfile)
    jpgfile = jpgfile[None]
    result = model.predict(jpgfile)
    data.append([img,np.argsort(result[0])[-1]])
```

In [0]:

```
#导出csv文件/Export CSV file
import csv
import pandas as pd
```

```
import pandas as pd
df = pd.DataFrame(data, columns=['file_name', 'id'])
df.to_csv('submission.csv', index = False)
```

In [0]:

```
x = pd.read_csv('submission.csv')
x.head()
```

Out[0]:

	file_name	id
0	image_03989.jpg	43
1	image_06815.jpg	19
2	image_07696.jpg	99
3	image_02677.jpg	56
4	image_02055.jpg	81