Assignment 3 - Building CNN model for classification of flowers

```
#Loading dataset into notebook via google drive
from google.colab import drive
drive.mount('/content/drive')
```

```
---------------------------------------------------------------------------
MessageError                              Traceback (most recent call last)
<ipython-input-1-70d5a717f842> in <module>
      1 #Loading dataset into notebook via google drive
      2 from google.colab import drive
----> 3 drive.mount('/content/drive')

                              3 frames
/usr/local/lib/python3.7/dist-packages/google/colab/_message.py in
read_reply_from_input(message_id, timeout_sec)
    100         reply.get('colab_msg_id') == message_id):
    101       if 'error' in reply:
--> 102         raise MessageError(reply['error'])
    103       return reply.get('data', None)
    104

MessageError: Error: credential propagation was unsuccessful
```

SEARCH STACK OVERFLOW

```
#Unzipping the dataset
!unzip '/content/drive/MyDrive/Flowers-Dataset.zip'
```

Data Augmentation

```
#Importing libraries
from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

```
#Data Augmentation on training data
train_data = ImageDataGenerator(rescale=1./255,
                                   zoom_range=0.2,
                                   horizontal_flip=True)
```

```
#Data Augmentation on testing data
test_data = ImageDataGenerator(rescale=1./255)
```

```
#Downloading split-folders module to split the data into train and test datasets
! pip install split-folders[full]
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/
Requirement already satisfied: split-folders[full] in /usr/local/lib/python3.7/dist-
Requirement already satisfied: tqdm in /usr/local/lib/python3.7/dist-packages (from
```

```
#Splitting the data into train and test datas
import splitfolders
input_folder='/content/flowers'
splitfolders.ratio(input_folder,output="dataset",seed=42,ratio=(.8,.2,.0),group_prefix=No
```

```
Copying files: 4317 files [00:01, 3854.01 files/s]
```

```
#Listing the directories with each file in it
!ls -laRh dataset/
```

```
dataset/:
total 20K
drwxr-xr-x 5 root root 4.0K Oct  9 05:44 .
drwxr-xr-x 1 root root 4.0K Oct  9 06:24 ..
drwxr-xr-x 7 root root 4.0K Oct  9 05:44 test
drwxr-xr-x 7 root root 4.0K Oct  9 05:44 train
drwxr-xr-x 7 root root 4.0K Oct  9 05:44 val

dataset/test:
total 28K
drwxr-xr-x 7 root root 4.0K Oct  9 05:44 .
drwxr-xr-x 5 root root 4.0K Oct  9 05:44 ..
drwxr-xr-x 2 root root 4.0K Oct  9 05:44 daisy
drwxr-xr-x 2 root root 4.0K Oct  9 05:44 dandelion
drwxr-xr-x 2 root root 4.0K Oct  9 05:44 rose
drwxr-xr-x 2 root root 4.0K Oct  9 05:44 sunflower
drwxr-xr-x 2 root root 4.0K Oct  9 05:44 tulip

dataset/test/daisy:
total 36K
drwxr-xr-x 2 root root 4.0K Oct  9 05:44 .
drwxr-xr-x 7 root root 4.0K Oct  9 05:44 ..
-rw-r--r-- 1 root root  25K Jul 16  2021 6864242336_0d12713fe5_n.jpg

dataset/test/dandelion:
total 72K
drwxr-xr-x 2 root root 4.0K Oct  9 05:44 .
drwxr-xr-x 7 root root 4.0K Oct  9 05:44 ..
-rw-r--r-- 1 root root  61K Jul 16  2021 17619402434_15b2ec2d79.jpg

dataset/test/rose:
total 120K
drwxr-xr-x 2 root root 4.0K Oct  9 05:44 .
drwxr-xr-x 7 root root 4.0K Oct  9 05:44 ..
-rw-r--r-- 1 root root 111K Jul 16  2021 7419966772_d6c1c22a81.jpg

dataset/test/sunflower:
total 28K
drwxr-xr-x 2 root root 4.0K Oct  9 05:44 .
```

```
drwxr-xr-x 7 root root 4.0K Oct  9 05:44 ..
-rw-r--r-- 1 root root  18K Jul 16  2021 8433716268_8b7b4083bc_n.jpg

dataset/test/tulip:
total 132K
drwxr-xr-x 2 root root 4.0K Oct  9 05:44 .
drwxr-xr-x 7 root root 4.0K Oct  9 05:44 ..
-rw-r--r-- 1 root root 121K Jul 16  2021 471298577_cc7558bcf1.jpg

dataset/train:
total 196K
drwxr-xr-x 7 root root 4.0K Oct  9 05:44 .
drwxr-xr-x 5 root root 4.0K Oct  9 05:44 ..
drwxr-xr-x 2 root root  36K Oct  9 05:44 daisy
drwxr-xr-x 2 root root  44K Oct  9 05:44 dandelion
drwxr-xr-x 2 root root  36K Oct  9 05:44 rose
drwxr-xr-x 2 root root  36K Oct  9 05:44 sunflower
drwxr-xr-x 2 root root  36K Oct  9 05:44 tulip
```

```
train_dataset = train_data.flow_from_directory(r"/content/dataset/train",
                                           target_size=(180,180),
                                           class_mode='categorical')
```

```
Found 3452 images belonging to 5 classes.
```

```
#Here val is same as test. Since we use split-folders module, it calls both test
#and validate. We shall consider validate as test
test_dataset = test_data.flow_from_directory(r"/content/dataset/val",
                                           target_size=(180,180),
                                           class_mode='categorical')
```

```
Found 860 images belonging to 5 classes.
```

Model Creation

```
#Importing libraries
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Convolution2D, MaxPooling2D, Flatten, Dense
```

```
model = Sequential()
model.add(Convolution2D(32,(3,3),activation='relu',input_shape=(180,180,3)))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Flatten())
model.add(Dense(300,activation='relu'))
model.add(Dense(150,activation='relu'))
model.add(Dense(5,activation='softmax'))
model.summary()
```

```
Model: "sequential_4"
_________________________________________________________________
 Layer (type)                Output Shape              Param #   
=================================================================
 conv2d_7 (Conv2D)           (None, 178, 178, 32)      896       
                                                                 
 max_pooling2d_7 (MaxPooling  (None, 89, 89, 32)       0         
 2D)                                                             
                                                                 
 flatten_4 (Flatten)         (None, 253472)            0         
                                                                 
 dense_12 (Dense)            (None, 300)               76041900  
                                                                 
 dense_13 (Dense)            (None, 150)               45150     
                                                                 
 dense_14 (Dense)            (None, 5)                 755       
                                                                 
=================================================================
Total params: 76,088,701
Trainable params: 76,088,701
Non-trainable params: 0
_________________________________________________________________
```

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

```
#Training the model
y = model.fit_generator(train_dataset,
                        steps_per_epoch=108,
                        epochs=15,
                        validation_data=test_dataset,
                        validation_steps=27)
```

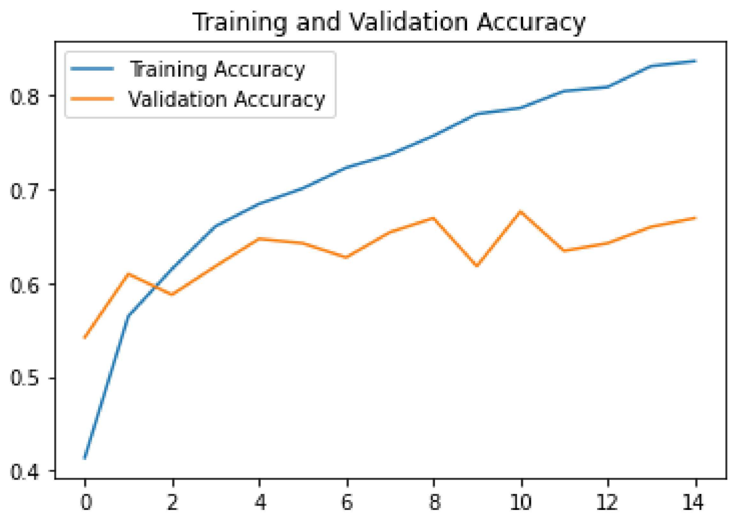
```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:6: UserWarning: `Model.

Epoch 1/15
108/108 [==============================] - 37s 339ms/step - loss: 3.6573 - accuracy:
Epoch 2/15
108/108 [==============================] - 31s 285ms/step - loss: 1.0961 - accuracy:
Epoch 3/15
108/108 [==============================] - 32s 292ms/step - loss: 0.9918 - accuracy:
Epoch 4/15
108/108 [==============================] - 31s 286ms/step - loss: 0.8913 - accuracy:
Epoch 5/15
108/108 [==============================] - 31s 284ms/step - loss: 0.8535 - accuracy:
Epoch 6/15
108/108 [==============================] - 31s 286ms/step - loss: 0.7828 - accuracy:
Epoch 7/15
108/108 [==============================] - 31s 283ms/step - loss: 0.7305 - accuracy:
Epoch 8/15
108/108 [==============================] - 31s 284ms/step - loss: 0.6856 - accuracy:
Epoch 9/15
```

```
108/108 [==============================] - 31s 287ms/step - loss: 0.6502 - accuracy:
Epoch 10/15
108/108 [==============================] - 31s 283ms/step - loss: 0.5963 - accuracy:
Epoch 11/15
108/108 [==============================] - 31s 284ms/step - loss: 0.5824 - accuracy:
Epoch 12/15
108/108 [==============================] - 31s 285ms/step - loss: 0.5350 - accuracy:
Epoch 13/15
108/108 [==============================] - 31s 288ms/step - loss: 0.5064 - accuracy:
Epoch 14/15
108/108 [==============================] - 31s 287ms/step - loss: 0.4853 - accuracy:
Epoch 15/15
108/108 [==============================] - 31s 286ms/step - loss: 0.4660 - accuracy:
```

Plotting the accuracy during training and validation

```
import matplotlib.pyplot as plt
epochs = range(0,15)
plt.plot(epochs, y.history['accuracy'], label='Training Accuracy')
plt.plot(epochs, y.history['val_accuracy'], label='Validation Accuracy')
plt.legend()
plt.title('Training and Validation Accuracy')
plt.show()
```



```
model.save('flower_classification.h5')
```

Testing the model

```
from tensorflow.keras.preprocessing import image
import numpy as np
```

```
#Installing pillow to resize image
! pip install pillow
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/
Requirement already satisfied: pillow in /usr/local/lib/python3.7/dist-packages (7.1
```

```
from PIL import Image
im = Image.open('/content/dataset/test/daisy/6864242336_0d12713fe5_n.jpg')
im = im.resize((180,180))
xp = image.img_to_array(im)
xp= np.expand_dims(xp,axis=0)
pred = np.argmax(model.predict(xp))
op = ['daisy','dandelion','rose','sunflower','tulip']
op[pred]
```

```
'daisy'
```

```
i = Image.open('/content/dataset/train/sunflower/10386525005_fd0b7d6c55_n.jpg')
i = i.resize((180,180))
x = image.img_to_array(i)
x = np.expand_dims(x,axis=0)
pred = np.argmax(model.predict(x))
op[pred]
```

```
'sunflower'
```

```
train_dataset.class_indices
```

```
{'daisy': 0, 'dandelion': 1, 'rose': 2, 'sunflower': 3, 'tulip': 4}
```

Model Tuning

```
from tensorflow.keras.callbacks import EarlyStopping, ReduceLROnPlateau
earlystop1 = EarlyStopping(monitor='val_accuracy',
                           patience=5)

l_r = ReduceLROnPlateau(monitor='val_accuaracy',
                       factor=0.5,
                       min_lr=0.00001)

callback = [earlystop1,l_r]
```

```
model.fit_generator(train_dataset,
                    steps_per_epoch=len(train_dataset),
                    epochs=100,
                   callbacks=callback,
                   validation_data=test_dataset,
                   validation_steps=len(test_dataset))
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:6: UserWarning: `Model.

Epoch 1/100
108/108 [==============================] - ETA: 0s - loss: 0.2885 - accuracy: 0.9015
108/108 [==============================] - 34s 312ms/step - loss: 0.2885 - accuracy:
Epoch 2/100
108/108 [==============================] - ETA: 0s - loss: 0.2885 - accuracy: 0.9053
108/108 [==============================] - 33s 309ms/step - loss: 0.2885 - accuracy:
Epoch 3/100
108/108 [==============================] - ETA: 0s - loss: 0.2834 - accuracy: 0.8975
108/108 [==============================] - 31s 283ms/step - loss: 0.2834 - accuracy:
Epoch 4/100
108/108 [==============================] - ETA: 0s - loss: 0.2972 - accuracy: 0.8975
108/108 [==============================] - 31s 291ms/step - loss: 0.2972 - accuracy:
Epoch 5/100
108/108 [==============================] - ETA: 0s - loss: 0.2264 - accuracy: 0.9235
108/108 [==============================] - 34s 313ms/step - loss: 0.2264 - accuracy:
Epoch 6/100
108/108 [==============================] - ETA: 0s - loss: 0.2217 - accuracy: 0.9261
108/108 [==============================] - 33s 301ms/step - loss: 0.2217 - accuracy:
<keras.callbacks.History at 0x7f5b84400410>
```

```
img1 = Image.open('/content/dataset/test/rose/7419966772_d6c1c22a81.jpg')
img1 = img1.resize((180,180))
x_1= image.img_to_array(i)
x_= np.expand_dims(x,axis=0)
pred_x = np.argmax(model.predict(x))
op[pred_x]
```

```
'rose'
```

```
model.save('flower_classification_tuned.h5')
```