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Mini Project 3 Deep Learning
Colorizing Old B&W Images: color old black and white images to colorful images given by the user.
Use 4 different colors
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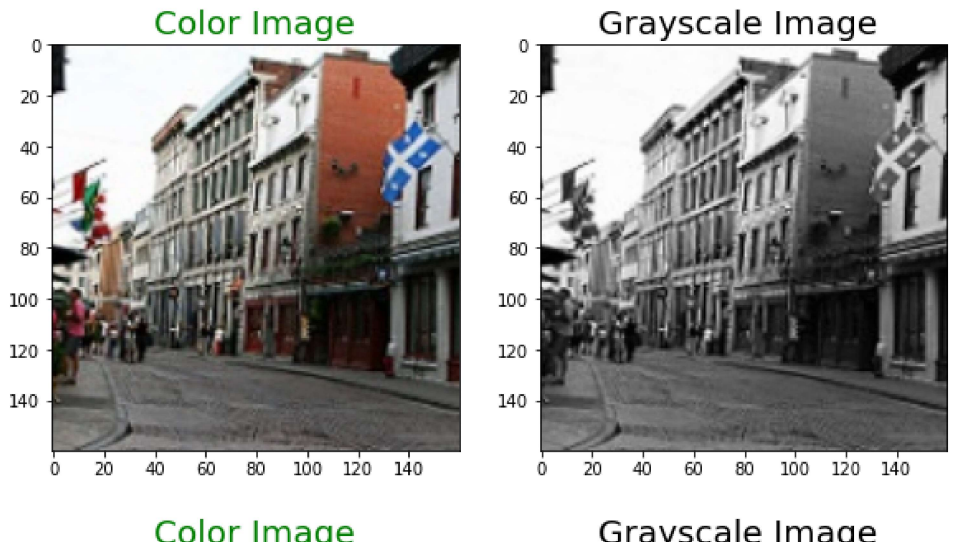
In [1]:
```
import numpy as np
import tensorflow as tf
import keras
import cv2
from keras.layers import MaxPool2D,Conv2D,UpSampling2D,Input,Dropout
from keras.models import Sequential
from keras.preprocessing.image import img_to_array
import os
from tqdm import tqdm
import re
import matplotlib.pyplot as plt
```

In [2]:
```
def sorted_alphanumeric(data):
    convert = lambda text: int(text) if text.isdigit() else text.lower()
    alphanum_key = lambda key: [convert(c) for c in re.split('([0-9]+)',key)]
    return sorted(data,key = alphanum_key)
# defining the size of the image
SIZE = 160
color_img = []
path = '../input/landscape-image-colorization/landscape Images/color'
files = os.listdir(path)
files = sorted_alphanumeric(files)
for i in tqdm(files):
    if i == '6000.jpg':
        break
    else:
        img = cv2.imread(path + '/'+i,1)
        # open cv reads images in BGR format so we have to convert it to RGB
        img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
        #resizing image
        img = cv2.resize(img, (SIZE, SIZE))
        img = img.astype('float32') / 255.0
        color_img.append(img_to_array(img))


gray_img = []
path = '../input/landscape-image-colorization/landscape Images/gray'
files = os.listdir(path)
files = sorted_alphanumeric(files)
for i in tqdm(files):
     if i == '6000.jpg':
        break
     else:
        img = cv2.imread(path + '/'+i,1)

        #resizing image
        img = cv2.resize(img, (SIZE, SIZE))
        img = img.astype('float32') / 255.0
        gray_img.append(img_to_array(img))
```

```
 84%|████████▍ | 6000/7129 [00:35<00:06, 171.07it/s]
 84%|████████▍ | 6000/7129 [00:31<00:05, 191.33it/s]
```

In [3]:
```
def plot_images(color,grayscale):
    plt.figure(figsize=(15,15))
    plt.subplot(1,3,1)
    plt.title('Color Image', color = 'green', fontsize = 20)
    plt.imshow(color)
    plt.subplot(1,3,2)
    plt.title('Grayscale Image ', color = 'black', fontsize = 20)
    plt.imshow(grayscale)

    plt.show()
```

In [4]:
```
for i in range(3,10):
     plot_images(color_img[i],gray_img[i])
```



Color Image Grayscale Image

In [5]:
```
train_gray_image = gray_img[:5500]
train_color_image = color_img[:5500]

test_gray_image = gray_img[5500:]
test_color_image = color_img[5500:]
# reshaping
train_g = np.reshape(train_gray_image,(len(train_gray_image),SIZE,SIZE,3))
train_c = np.reshape(train_color_image, (len(train_color_image),SIZE,SIZE,3))
print('Train color image shape:',train_c.shape)


test_gray_image = np.reshape(test_gray_image,(len(test_gray_image),SIZE,SIZE,3))
test_color_image = np.reshape(test_color_image, (len(test_color_image),SIZE,SIZE,3))
print('Test color image shape',test_color_image.shape)
```

```
Train color image shape: (5500, 160, 160, 3)
Test color image shape (500, 160, 160, 3)
```

In [6]:
```
from keras import layers
def down(filters , kernel_size, apply_batch_normalization = True):
    downsample = tf.keras.models.Sequential()
    downsample.add(layers.Conv2D(filters,kernel_size,padding = 'same', strides = 2))
    if apply_batch_normalization:
        downsample.add(layers.BatchNormalization())
    downsample.add(keras.layers.LeakyReLU())
    return downsample


def up(filters, kernel_size, dropout = False):
    upsample = tf.keras.models.Sequential()
    upsample.add(layers.Conv2DTranspose(filters, kernel_size,padding = 'same', strides = 2))
    if dropout:
        upsample.dropout(0.2)
    upsample.add(keras.layers.LeakyReLU())
    return upsample
```

In [7]:
```
def model():
    inputs = layers.Input(shape= [160,160,3])
    d1 = down(128,(3,3),False)(inputs)
    d2 = down(128,(3,3),False)(d1)
    d3 = down(256,(3,3),True)(d2)
    d4 = down(512,(3,3),True)(d3)

    d5 = down(512,(3,3),True)(d4)
    #upsampling
    u1 = up(512,(3,3),False)(d5)
    u1 = layers.concatenate([u1,d4])
    u2 = up(256,(3,3),False)(u1)
    u2 = layers.concatenate([u2,d3])
    u3 = up(128,(3,3),False)(u2)
    u3 = layers.concatenate([u3,d2])
    u4 = up(128,(3,3),False)(u3)
    u4 = layers.concatenate([u4,d1])
    u5 = up(3,(3,3),False)(u4)
    u5 = layers.concatenate([u5,inputs])
    output = layers.Conv2D(3,(2,2),strides = 1, padding = 'same')(u5)
    return tf.keras.Model(inputs=inputs, outputs=output)
```

In [8]:
```
model = model()
model.summary()
```

```
Model: "functional_1"
_________________________________________________________________________________________________
Layer (type)                 Output Shape              Param #     Connected to
=================================================================================================
input_1 (InputLayer)         [(None, 160, 160, 3) 0
_________________________________________________________________________________________________
sequential (Sequential)      (None, 80, 80, 128)  3584        input_1[0][0]
_________________________________________________________________________________________________
sequential_1 (Sequential)    (None, 40, 40, 128)  147584      sequential[0][0]
_________________________________________________________________________________________________
sequential_2 (Sequential)    (None, 20, 20, 256)  296192      sequential_1[0][0]
_________________________________________________________________________________________________
sequential_3 (Sequential)    (None, 10, 10, 512)  1182208     sequential_2[0][0]
_________________________________________________________________________________________________
sequential_4 (Sequential)    (None, 5, 5, 512)    2361856     sequential_3[0][0]
_________________________________________________________________________________________________
sequential_5 (Sequential)    (None, 10, 10, 512)  2359808     sequential_4[0][0]
_________________________________________________________________________________________________
concatenate (Concatenate)    (None, 10, 10, 1024) 0           sequential_5[0][0]
                                                              sequential_3[0][0]
_________________________________________________________________________________________________
sequential_6 (Sequential)    (None, 20, 20, 256)  2359552     concatenate[0][0]
_________________________________________________________________________________________________
concatenate_1 (Concatenate)  (None, 20, 20, 512)  0           sequential_6[0][0]
                                                              sequential_2[0][0]
_________________________________________________________________________________________________
sequential_7 (Sequential)    (None, 40, 40, 128)  589952      concatenate_1[0][0]
_________________________________________________________________________________________________
concatenate_2 (Concatenate)  (None, 40, 40, 256)  0           sequential_7[0][0]
                                                              sequential_1[0][0]
_________________________________________________________________________________________________
sequential_8 (Sequential)    (None, 80, 80, 128)  295040      concatenate_2[0][0]
_________________________________________________________________________________________________
concatenate_3 (Concatenate)  (None, 80, 80, 256)  0           sequential_8[0][0]
                                                              sequential[0][0]
_________________________________________________________________________________________________
sequential_9 (Sequential)    (None, 160, 160, 3)  6915        concatenate_3[0][0]
_________________________________________________________________________________________________
concatenate_4 (Concatenate)  (None, 160, 160, 6)  0           sequential_9[0][0]
                                                              input_1[0][0]
_________________________________________________________________________________________________
conv2d_5 (Conv2D)            (None, 160, 160, 3)  75          concatenate_4[0][0]
=================================================================================================
Total params: 9,602,766
Trainable params: 9,600,206
Non-trainable params: 2,560
_________________________________________________________________________________________________
```

In [14]:
```
model.compile(optimizer = tf.keras.optimizers.Adam(learning_rate = 0.001), loss = 'mean_absolute_erro
              metrics = ['acc'])

model.fit(train_g, train_c, epochs = 50,batch_size = 50,verbose = 0)
```

Out[14]:
```
<tensorflow.python.keras.callbacks.History at 0x7f61200d27d0>
```

In [15]:
```
model.evaluate(test_gray_image,test_color_image)
```

```
16/16 [==============================] - 1s 38ms/step - loss: 0.0481 - acc: 0.5307
```

Out[15]:
```
[0.04813535511493683, 0.5306968092918396]
```

In [17]:
```
def plot_images(color,grayscale,predicted):
    plt.figure(figsize=(15,15))
    plt.subplot(1,3,1)
    plt.title('Color Image', color = 'green', fontsize = 20)
    plt.imshow(color)
    plt.subplot(1,3,2)
    plt.title('Grayscale Image ', color = 'black', fontsize = 20)
    plt.imshow(grayscale)
    plt.subplot(1,3,3)
    plt.title('Predicted Image ', color = 'Red', fontsize = 20)
    plt.imshow(predicted)

    plt.show()

for i in range(50,58):
    predicted = np.clip(model.predict(test_gray_image[i].reshape(1,SIZE, SIZE,3)),0.0,1.0).reshape(SI
    plot_images(test_color_image[i],test_gray_image[i],predicted)
```