In [1]:

```
import pandas as ppd
import numpy as np
import matplotlib.pyplot as plt

import seaborn as sns
import cv2
plt.style.use('ggplot')
from sklearn.model_selection import train_test_split



rows = 128
cols = 128

import os, shutil
```

In [3]:

```
source_data_dir = "D:\tyres"
```

In [17]:

```
try:
    os.mkdir( "D:\tyres\training_set\good")
    os.mkdir("D:\tyres\training_set\defective" )
    os.mkdir( "D:\tyres\validation_set\good")
    os.mkdir("D:\tyres\validation_set\defective" )
except:
    pass
```

In [18]:

```
if os.listdir(r"D:\tyres\training_set\good")==" ":
    # if folder contains no picture start copying

    for file in ["good.{}.jpg".format(i) for i in range(800)]:
        shutil.copyfile(os.path,join(source_data_dir,file),os.path.join(r"D:\tyres\train

    for file in ["Defective.{}.jpg".format(i) for i in range(800)]:
        shutil.copyfile(os.path,join(source_data_dir,file),os.path.join(r"D:\tyres\train

    for file in ["good.{}.jpg".format(i) for i in range(800,1200)]:
        shutil.copyfile(os.path,join(source_data_dir,file),os.path.join(r"D:\tyres\valid

    for file in ["Defective.{}.jpg".format(i) for i in range(800,1200)]:
        shutil.copyfile(os.path,join(source_data_dir,file),os.path.join(r"D:\tyres\valid
```

Data Pre-processing

In [19]:

```
from keras.layers import Conv2D,MaxPooling2D, Flatten, Dense
from tensorflow.python.keras.layers import Conv2D, MaxPooling2D, Dropout, Flatten, Dense
#tf.keras.layers.MaxPool2D
from keras import models
#from keras.layers import Conv2D
from tensorflow.keras.layers import Conv2D

model = models.Sequential()
model.add(Conv2D(32,(3,3), activation ='relu', input_shape = (rows, cols , 3)))
model.add(MaxPooling2D((2,2)))

model.add(Conv2D(64,(3,3),activation = 'relu'))
model.add(MaxPooling2D((2,2)))

model.add(Conv2D(64,(3,3),activation = 'relu'))
model.add(MaxPooling2D((2,2)))
model.add(Flatten())
model.add(Dense(512,activation ='relu'))
model.add(Dense(1,activation ='sigmoid'))
model.summary()
```

```
Model: "sequential_2"
_________________________________________________________________
 Layer (type)                Output Shape              Param #   
=================================================================
 conv2d_6 (Conv2D)           (None, 126, 126, 32)      896       
                                                                 
 module_wrapper_12 (ModuleW  (None, 63, 63, 32)        0         
 rapper)                                                         
                                                                 
 conv2d_7 (Conv2D)           (None, 61, 61, 64)        18496     
                                                                 
 module_wrapper_13 (ModuleW  (None, 30, 30, 64)        0         
 rapper)                                                         
                                                                 
 conv2d_8 (Conv2D)           (None, 28, 28, 64)        36928     
                                                                 
 module_wrapper_14 (ModuleW  (None, 14, 14, 64)        0         
 rapper)                                                         
                                                                 
 module_wrapper_15 (ModuleW  (None, 12544)             0         
 rapper)                                                         
                                                                 
 module_wrapper_16 (ModuleW  (None, 512)               6423040   
 rapper)                                                         
                                                                 
 module_wrapper_17 (ModuleW  (None, 1)                 513       
 rapper)                                                         
                                                                 
=================================================================
Total params: 6479873 (24.72 MB)
Trainable params: 6479873 (24.72 MB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

In [20]:

```
from keras import optimizers
#from tensorflow.keras import optimizers
model.compile(loss='binary_crossentropy',
             optimizer = optimizers.RMSprop(learning_rate=1e-4),
              #optimizer = keras.optimizers.legacy.RMSprop(lr = 1e-4),
             metrics = ['acc'])
```

In [21]:

```
from keras.preprocessing.image import ImageDataGenerator

xtrain_datagen = ImageDataGenerator(rescale = 1./255) # THIS SCALE IT TO BE between 0 an
xval_datagen = ImageDataGenerator(rescale = 1./255)

train_datagen = xtrain_datagen.flow_from_directory(r"D:\tyres\training_set",
                                                target_size = (rows,cols),
                                                batch_size = 40,
                                                class_mode = 'binary')

val_datagen = xval_datagen.flow_from_directory(r"D:\tyres\validation_set",
                                                target_size = (rows,cols),
                                                batch_size = 40,
                                                class_mode = 'binary')
```

```
Found 1856 images belonging to 2 classes.
Found 881 images belonging to 2 classes.
```

In [24]:

```
epochs = 30 # 30

h = model.fit(train_datagen,
                      # steps_per_epoch = 60 ,# remove this part if you get Warning: you
                       epochs =  epochs,
                       validation_data = val_datagen,
                      # validation_steps = 50  # remove this part if you get Warning: yo
             )


#clear_output()  # clears consoke output
```

```
Epoch 1/30
47/47 [==============================] - 154s 3s/step - loss: 0.6396 - acc: 0.6439 - val
_loss: 0.6741 - val_acc: 0.6232
Epoch 2/30
47/47 [==============================] - 174s 4s/step - loss: 0.6093 - acc: 0.6692 - val
_loss: 0.6227 - val_acc: 0.6039
Epoch 3/30
47/47 [==============================] - 152s 3s/step - loss: 0.5883 - acc: 0.6821 - val
_loss: 0.6167 - val_acc: 0.6595
Epoch 4/30
47/47 [==============================] - 182s 4s/step - loss: 0.5744 - acc: 0.7042 - val
_loss: 0.5842 - val_acc: 0.6754
Epoch 5/30
47/47 [==============================] - 160s 3s/step - loss: 0.5620 - acc: 0.7074 - val
_loss: 0.5975 - val_acc: 0.6390
Epoch 6/30
47/47 [==============================] - 159s 3s/step - loss: 0.5536 - acc: 0.7231 - val
_loss: 0.5848 - val_acc: 0.6436
Epoch 7/30
47/47 [==============================] - 155s 3s/step - loss: 0.5385 - acc: 0.7301 - val
_loss: 0.5499 - val_acc: 0.6958
Epoch 8/30
47/47 [==============================] - 152s 3s/step - loss: 0.5347 - acc: 0.7231 - val
_loss: 0.5412 - val_acc: 0.7072
Epoch 9/30
47/47 [==============================] - 158s 3s/step - loss: 0.5245 - acc: 0.7317 - val
_loss: 0.5293 - val_acc: 0.7605
Epoch 10/30
47/47 [==============================] - 152s 3s/step - loss: 0.5142 - acc: 0.7581 - val
_loss: 0.5252 - val_acc: 0.7162
Epoch 11/30
47/47 [==============================] - 160s 3s/step - loss: 0.5020 - acc: 0.7608 - val
_loss: 0.5110 - val_acc: 0.7662
Epoch 12/30
47/47 [==============================] - 157s 3s/step - loss: 0.4973 - acc: 0.7667 - val
_loss: 0.5384 - val_acc: 0.6822
Epoch 13/30
47/47 [==============================] - 157s 3s/step - loss: 0.4906 - acc: 0.7662 - val
_loss: 0.4791 - val_acc: 0.7991
Epoch 14/30
47/47 [==============================] - 157s 3s/step - loss: 0.4854 - acc: 0.7672 - val
_loss: 0.4602 - val_acc: 0.8093
Epoch 15/30
47/47 [==============================] - 158s 3s/step - loss: 0.4737 - acc: 0.7812 - val
_loss: 0.4432 - val_acc: 0.8161
Epoch 16/30
47/47 [==============================] - 157s 3s/step - loss: 0.4570 - acc: 0.7775 - val
_loss: 0.5294 - val_acc: 0.6686
Epoch 17/30
47/47 [==============================] - 158s 3s/step - loss: 0.4488 - acc: 0.7947 - val
_loss: 0.4313 - val_acc: 0.7980
Epoch 18/30
47/47 [==============================] - 158s 3s/step - loss: 0.4401 - acc: 0.8060 - val
_loss: 0.4885 - val_acc: 0.7106
Epoch 19/30
47/47 [==============================] - 157s 3s/step - loss: 0.4273 - acc: 0.8001 - val
_loss: 0.5075 - val_acc: 0.6867
Epoch 20/30
47/47 [==============================] - 157s 3s/step - loss: 0.4172 - acc: 0.8055 - val
_loss: 0.3943 - val_acc: 0.8320
Epoch 21/30
47/47 [==============================] - 158s 3s/step - loss: 0.4003 - acc: 0.8190 - val
_loss: 0.3756 - val_acc: 0.8649
Epoch 22/30
```

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```
47/47 [==============================] - 158s 3s/step - loss: 0.3969 - acc: 0.8211 - val
_loss: 0.3902 - val_acc: 0.8218
Epoch 23/30
47/47 [==============================] - 158s 3s/step - loss: 0.3797 - acc: 0.8270 - val
_loss: 0.3521 - val_acc: 0.8854
Epoch 24/30
47/47 [==============================] - 157s 3s/step - loss: 0.3790 - acc: 0.8421 - val
_loss: 0.3397 - val_acc: 0.8717
Epoch 25/30
47/47 [==============================] - 158s 3s/step - loss: 0.3596 - acc: 0.8416 - val
_loss: 0.3442 - val_acc: 0.8899
Epoch 26/30
47/47 [==============================] - 157s 3s/step - loss: 0.3411 - acc: 0.8615 - val
_loss: 0.3305 - val_acc: 0.9001
Epoch 27/30
47/47 [==============================] - 158s 3s/step - loss: 0.3362 - acc: 0.8594 - val
_loss: 0.3027 - val_acc: 0.8967
Epoch 28/30
47/47 [==============================] - 157s 3s/step - loss: 0.3301 - acc: 0.8572 - val
_loss: 0.3574 - val_acc: 0.8184
Epoch 29/30
47/47 [==============================] - 158s 3s/step - loss: 0.3099 - acc: 0.8761 - val
_loss: 0.2975 - val_acc: 0.8774
Epoch 30/30
47/47 [==============================] - 157s 3s/step - loss: 0.3119 - acc: 0.8718 - val
_loss: 0.2703 - val_acc: 0.9092
```

In [26]:

```
acc =h.history['acc']
val_acc = h.history['val_acc']

loss = h.history['loss']
val_loss = h.history['val_loss']



epochs = range(1, len(acc)+1)


plt.plot(epochs , acc, 'bo',label = 'Training acc')
plt.plot(epochs , val_acc, 'g',label = 'validation acc')
plt.title('TRAINING AND VALIDATION ACCURACY')
plt.legend()




plt.figure()


plt.plot(epochs , loss, 'bo',label = 'Training loss')
plt.plot(epochs , val_loss, 'g',label = 'validation loss')
plt.title('TRAINING AND VALIDATION LOSS')
plt.legend()
plt.show()
```

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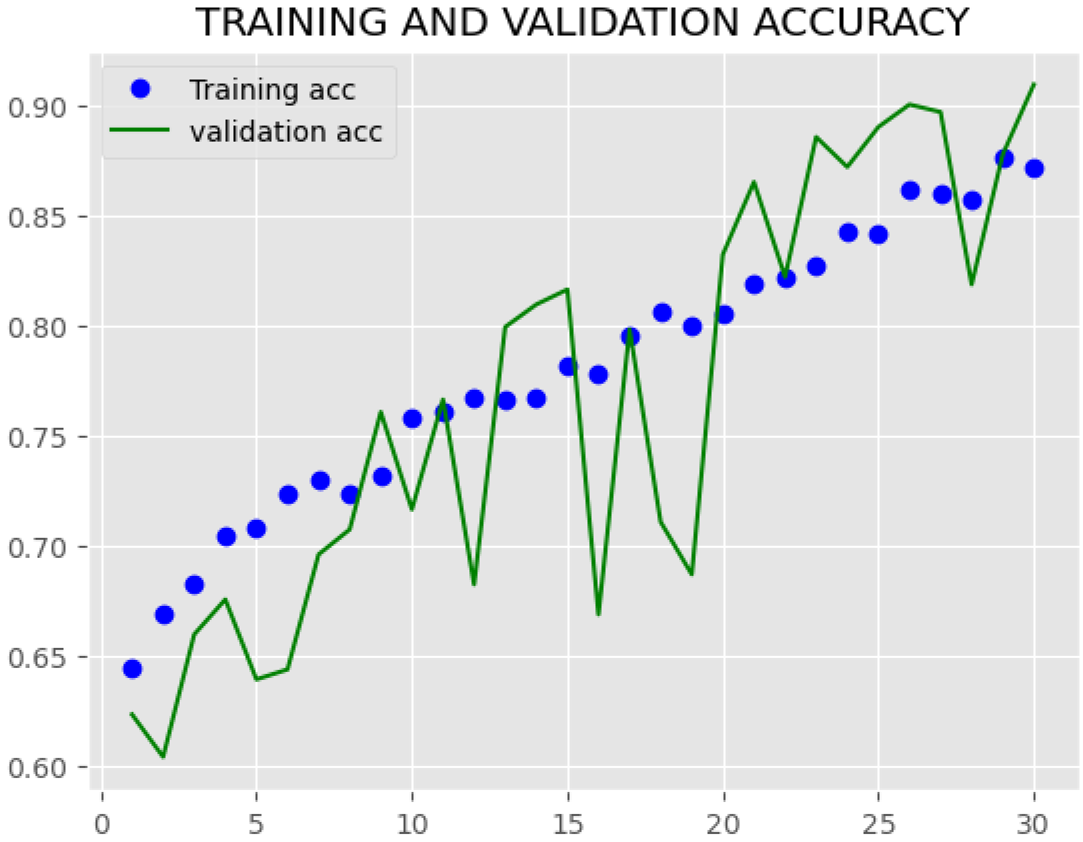

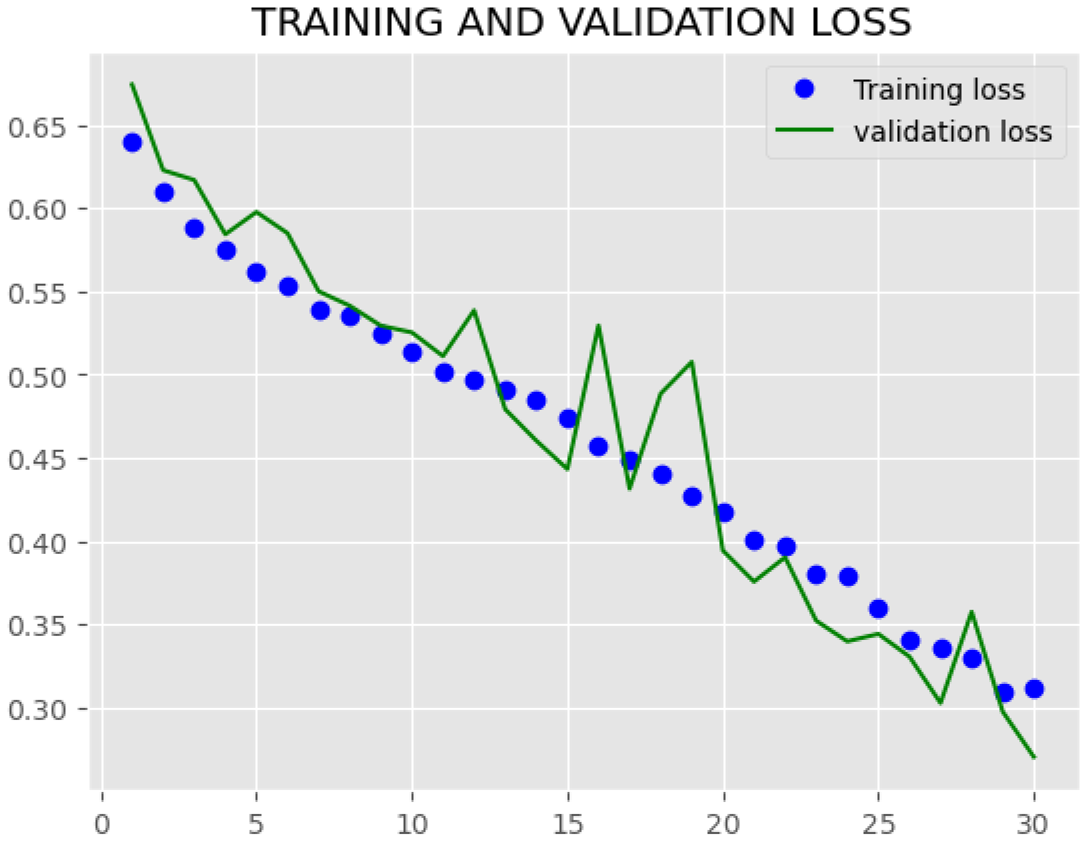

```
In [ ]:
```

```
In [ ]:
```

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