Importing Libraries

```python
from glob import glob
import cv2
from PIL import Image
import numpy as np
from sklearn.model_selection import train_test_split
import tensorflow as tf
import keras
from tensorflow.keras.utils import normalize
from keras.models import Sequential
from keras.layers import Conv2D, MaxPooling2D
from keras.layers import Activation, Dropout, Flatten, Dense
from keras.models import load_model
from sklearn.metrics import multilabel_confusion_matrix,
classification_report, confusion_matrix
```

connecting with kaggle dir

```python
! pip install -q kaggle
from google.colab import files
files.upload()
```

```
<IPython.core.display.HTML object>

Saving kaggle.json to kaggle.json
```

```
{'kaggle.json':
b'{"username":"manu0589","key":"781270b7f9a8d0e147c626ae65786ce8"}'}
```

```python
! mkdir ~/.kaggle

! cp kaggle.json ~/.kaggle/

! chmod 600 ~/.kaggle/kaggle.json

!kaggle datasets download -d iarunava/cell-images-for-detecting-
malaria #download dataset from kaggle
```

```
Downloading cell-images-for-detecting-malaria.zip to /content
 99% 666M/675M [00:02<00:00, 167MB/s]
100% 675M/675M [00:02<00:00, 262MB/s]
```
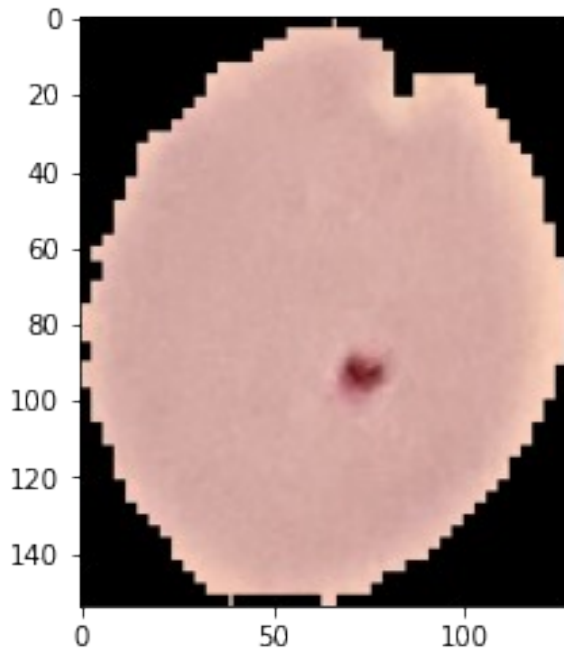
Downloading Data

```python
import os
zip_path = '/content/cell-images-for-detecting-malaria.zip'

from zipfile import ZipFile
with ZipFile(zip_path,'r') as zip:
  zip.extractall()
  print('Done')
```

Done

image visualization

```python
import matplotlib.pyplot as plt
im =
plt.imread('/content/cell_images/Parasitized/C33P1thinF_IMG_20150619_1
14756a_cell_180.png')
plt.imshow(im)
plt.show()
```



```python
%matplotlib inline
import os
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
train_parasitized_fnames =
os.listdir("/content/cell_images/Parasitized")
train_uninfected_fnames =
os.listdir("/content/cell_images/Uninfected")
nrows = 3
ncols = 3
pic_index = 0
pic_index += 4
next_para_pix = [os.path.join("/content/cell_images/Parasitized",
fname)
                 for fname in train_parasitized_fnames[pic_index-
4:pic_index]]
next_un_pix = [os.path.join("/content/cell_images/Uninfected", fname)
               for fname in train_uninfected_fnames[pic_index-
4:pic_index]]
fig=plt.gcf()
```

```
fig.set_size_inches(ncols*4,nrows*4)
for i, img_path in enumerate(next_para_pix+next_un_pix):
  sp = plt.subplot(nrows, ncols, i + 1)
  img = mpimg.imread(img_path)
  plt.imshow(img)
plt.show()
```
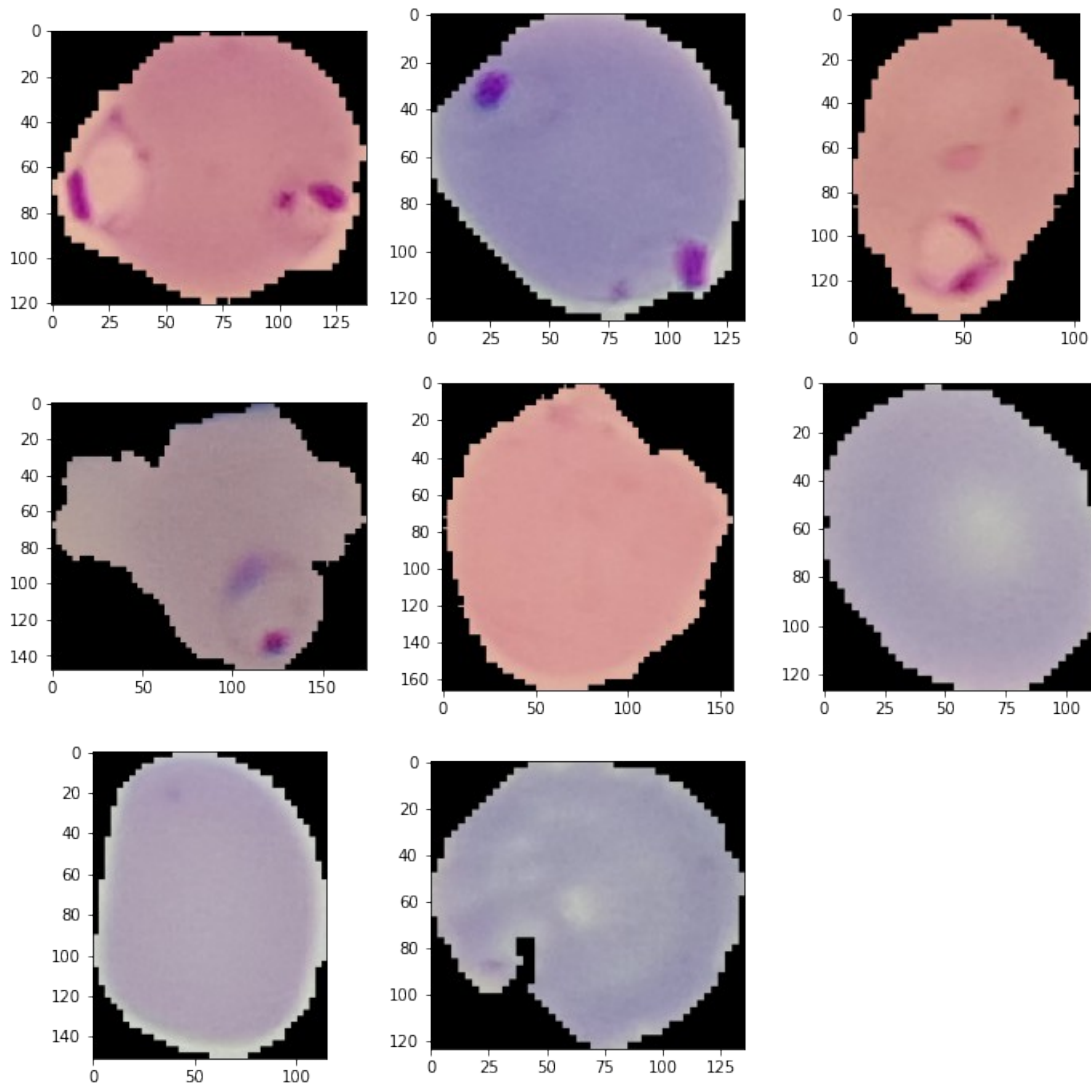

dividing data into train and test

```
image_directory = '/content/cell_images/'
SIZE = 80
dataset = []
label = []


parasitized_images = os.listdir(image_directory + 'Parasitized/')
for i, image_name in enumerate(parasitized_images):
```

```python
    if (image_name.split('.')[1] == 'png'):
        image = cv2.imread(image_directory + 'Parasitized/' +
image_name)
        image = Image.fromarray(image, 'RGB')
        image = image.resize((SIZE, SIZE))
        dataset.append(np.array(image))
        label.append(1)

uninfected_images = os.listdir(image_directory + 'Uninfected/')
for i, image_name in enumerate(uninfected_images):
    if (image_name.split('.')[1] == 'png'):
        image = cv2.imread(image_directory + 'Uninfected/' +
image_name)
        image = Image.fromarray(image, 'RGB')
        image = image.resize((SIZE, SIZE))
        dataset.append(np.array(image))
        label.append(0)
dataset = np.array(dataset)
label = np.array(label)
print("Dataset size is ", dataset.shape)
print("Label size is ", label.shape)
```

```
Dataset size is  (27558, 80, 80, 3)
Label size is  (27558,)
```

```python
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(dataset, label,
test_size = 0.30, random_state = 0)
print("Train size is ", X_train.shape)
print("Test size is ", X_test.shape)
print("Train size is ", y_train.shape)
print("Test size is ", y_test.shape)
```

```
Train size is  (19290, 80, 80, 3)
Test size is  (8268, 80, 80, 3)
Train size is  (19290,)
Test size is  (8268,)
```

```python
print(y_train)
```

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

```python
X_train[0].ndim
```

```
3
```

```python
n_classes = len(np.unique(y_train))
n_classes
```

```
2
```

```python
X_train = np.array(X_train, dtype="float") / 255.0
X_test = np.array(X_test, dtype="float") / 255.0

X_train.shape
```

```
(19290, 80, 80, 3)
```

```python
plt.imshow(X_train[100].squeeze())
```

```
<matplotlib.image.AxesImage at 0x7fac90c64590>
```
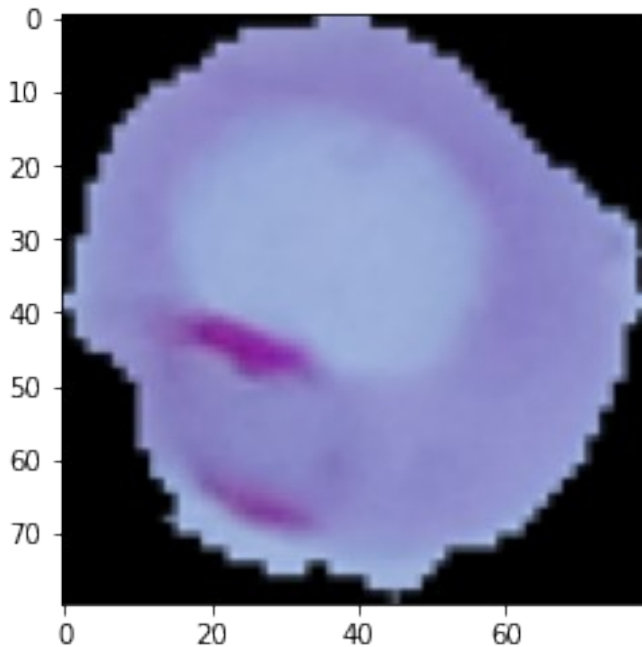

initializing cnn model

```python
tf.keras.backend.clear_session()

INPUT_SHAPE = (SIZE, SIZE, 3)

model = Sequential()
model.add(Conv2D(32, (3, 3), input_shape=INPUT_SHAPE))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Conv2D(32, (3, 3), kernel_initializer = 'he_uniform'))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Conv2D(64, (3, 3), kernel_initializer = 'he_uniform'))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Flatten())
```

```python
model.add(Dense(64))
model.add(Activation('relu'))
model.add(Dropout(0.5))

model.add(Dense(1))
model.add(Activation('sigmoid'))

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

print(model.summary())
```

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 78, 78, 32)	896
activation (Activation)	(None, 78, 78, 32)	0
max_pooling2d (MaxPooling2D)	(None, 39, 39, 32)	0
conv2d_1 (Conv2D)	(None, 37, 37, 32)	9248
activation_1 (Activation)	(None, 37, 37, 32)	0
max_pooling2d_1 (MaxPooling 2D)	(None, 18, 18, 32)	0
conv2d_2 (Conv2D)	(None, 16, 16, 64)	18496
activation_2 (Activation)	(None, 16, 16, 64)	0
max_pooling2d_2 (MaxPooling 2D)	(None, 8, 8, 64)	0
flatten (Flatten)	(None, 4096)	0
dense (Dense)	(None, 64)	262208
activation_3 (Activation)	(None, 64)	0
dropout (Dropout)	(None, 64)	0
dense_1 (Dense)	(None, 1)	65
activation_4 (Activation)	(None, 1)	0

```
Total params: 290,913
Trainable params: 290,913
Non-trainable params: 0
_____
None
```

training model

```python
history = model.fit(X_train,
                        y_train,
                        batch_size = 20,
                        verbose = 1,
                        epochs = 50,
                        validation_data=(X_test,y_test)
                    )
```

```
Epoch 1/50
965/965 [==============================] - 20s 9ms/step - loss: 0.3457
- accuracy: 0.8459 - val_loss: 0.1497 - val_accuracy: 0.9569
Epoch 2/50
965/965 [==============================] - 8s 8ms/step - loss: 0.1642
- accuracy: 0.9514 - val_loss: 0.1337 - val_accuracy: 0.9594
Epoch 3/50
965/965 [==============================] - 8s 8ms/step - loss: 0.1469
- accuracy: 0.9552 - val_loss: 0.1226 - val_accuracy: 0.9611
Epoch 4/50
965/965 [==============================] - 8s 8ms/step - loss: 0.1348
- accuracy: 0.9573 - val_loss: 0.1243 - val_accuracy: 0.9591
Epoch 5/50
965/965 [==============================] - 9s 9ms/step - loss: 0.1273
- accuracy: 0.9582 - val_loss: 0.1225 - val_accuracy: 0.9590
Epoch 6/50
965/965 [==============================] - 8s 9ms/step - loss: 0.1183
- accuracy: 0.9611 - val_loss: 0.1220 - val_accuracy: 0.9594
Epoch 7/50
965/965 [==============================] - 8s 8ms/step - loss: 0.1080
- accuracy: 0.9641 - val_loss: 0.1289 - val_accuracy: 0.9539
Epoch 8/50
965/965 [==============================] - 8s 8ms/step - loss: 0.1005
- accuracy: 0.9662 - val_loss: 0.1403 - val_accuracy: 0.9560
Epoch 9/50
965/965 [==============================] - 9s 9ms/step - loss: 0.0960
- accuracy: 0.9667 - val_loss: 0.1302 - val_accuracy: 0.9619
Epoch 10/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0866
- accuracy: 0.9697 - val_loss: 0.1526 - val_accuracy: 0.9494
Epoch 11/50
965/965 [==============================] - 9s 9ms/step - loss: 0.0834
- accuracy: 0.9715 - val_loss: 0.1500 - val_accuracy: 0.9584
Epoch 12/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0739
```

```
- accuracy: 0.9743 - val_loss: 0.1532 - val_accuracy: 0.9522
Epoch 13/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0682
- accuracy: 0.9759 - val_loss: 0.1514 - val_accuracy: 0.9566
Epoch 14/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0617
- accuracy: 0.9782 - val_loss: 0.1679 - val_accuracy: 0.9568
Epoch 15/50
965/965 [==============================] - 9s 9ms/step - loss: 0.0537
- accuracy: 0.9795 - val_loss: 0.2116 - val_accuracy: 0.9549
Epoch 16/50
965/965 [==============================] - 9s 9ms/step - loss: 0.0525
- accuracy: 0.9812 - val_loss: 0.1837 - val_accuracy: 0.9550
Epoch 17/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0471
- accuracy: 0.9832 - val_loss: 0.2066 - val_accuracy: 0.9566
Epoch 18/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0412
- accuracy: 0.9846 - val_loss: 0.2188 - val_accuracy: 0.9510
Epoch 19/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0383
- accuracy: 0.9854 - val_loss: 0.2415 - val_accuracy: 0.9516
Epoch 20/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0354
- accuracy: 0.9875 - val_loss: 0.2692 - val_accuracy: 0.9546
Epoch 21/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0374
- accuracy: 0.9862 - val_loss: 0.2909 - val_accuracy: 0.9517
Epoch 22/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0351
- accuracy: 0.9875 - val_loss: 0.2514 - val_accuracy: 0.9494
Epoch 23/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0298
- accuracy: 0.9894 - val_loss: 0.3059 - val_accuracy: 0.9579
Epoch 24/50
965/965 [==============================] - 9s 9ms/step - loss: 0.0301
- accuracy: 0.9900 - val_loss: 0.3196 - val_accuracy: 0.9534
Epoch 25/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0269
- accuracy: 0.9900 - val_loss: 0.3058 - val_accuracy: 0.9493
Epoch 26/50
965/965 [==============================] - 9s 9ms/step - loss: 0.0276
- accuracy: 0.9905 - val_loss: 0.3642 - val_accuracy: 0.9557
Epoch 27/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0232
- accuracy: 0.9926 - val_loss: 0.3600 - val_accuracy: 0.9555
Epoch 28/50
965/965 [==============================] - 9s 9ms/step - loss: 0.0270
- accuracy: 0.9905 - val_loss: 0.3431 - val_accuracy: 0.9561
Epoch 29/50
```

```
965/965 [==============================] - 9s 9ms/step - loss: 0.0229
- accuracy: 0.9924 - val_loss: 0.3624 - val_accuracy: 0.9478
Epoch 30/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0277
- accuracy: 0.9910 - val_loss: 0.2919 - val_accuracy: 0.9554
Epoch 31/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0247
- accuracy: 0.9918 - val_loss: 0.3578 - val_accuracy: 0.9462
Epoch 32/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0203
- accuracy: 0.9927 - val_loss: 0.4438 - val_accuracy: 0.9565
Epoch 33/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0229
- accuracy: 0.9921 - val_loss: 0.3723 - val_accuracy: 0.9560
Epoch 34/50
965/965 [==============================] - 9s 9ms/step - loss: 0.0243
- accuracy: 0.9916 - val_loss: 0.4800 - val_accuracy: 0.9565
Epoch 35/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0238
- accuracy: 0.9921 - val_loss: 0.4228 - val_accuracy: 0.9528
Epoch 36/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0163
- accuracy: 0.9944 - val_loss: 0.4147 - val_accuracy: 0.9538
Epoch 37/50
965/965 [==============================] - 9s 9ms/step - loss: 0.0182
- accuracy: 0.9935 - val_loss: 0.4869 - val_accuracy: 0.9515
Epoch 38/50
965/965 [==============================] - 9s 9ms/step - loss: 0.0252
- accuracy: 0.9928 - val_loss: 0.4316 - val_accuracy: 0.9551
Epoch 39/50
965/965 [==============================] - 9s 9ms/step - loss: 0.0211
- accuracy: 0.9931 - val_loss: 0.4276 - val_accuracy: 0.9510
Epoch 40/50
965/965 [==============================] - 7s 7ms/step - loss: 0.0175
- accuracy: 0.9936 - val_loss: 0.4254 - val_accuracy: 0.9534
Epoch 41/50
965/965 [==============================] - 7s 7ms/step - loss: 0.0128
- accuracy: 0.9957 - val_loss: 0.5078 - val_accuracy: 0.9550
Epoch 42/50
965/965 [==============================] - 7s 7ms/step - loss: 0.0240
- accuracy: 0.9933 - val_loss: 0.4328 - val_accuracy: 0.9561
Epoch 43/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0197
- accuracy: 0.9934 - val_loss: 0.4663 - val_accuracy: 0.9536
Epoch 44/50
965/965 [==============================] - 9s 9ms/step - loss: 0.0179
- accuracy: 0.9942 - val_loss: 0.4023 - val_accuracy: 0.9492
Epoch 45/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0169
- accuracy: 0.9936 - val_loss: 0.4432 - val_accuracy: 0.9555
```

```
Epoch 46/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0154
- accuracy: 0.9947 - val_loss: 0.4700 - val_accuracy: 0.9549
Epoch 47/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0158
- accuracy: 0.9947 - val_loss: 0.5214 - val_accuracy: 0.9566
Epoch 48/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0170
- accuracy: 0.9947 - val_loss: 0.5015 - val_accuracy: 0.9545
Epoch 49/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0133
- accuracy: 0.9958 - val_loss: 0.4736 - val_accuracy: 0.9533
Epoch 50/50
965/965 [==============================] - 8s 8ms/step - loss: 0.0201
- accuracy: 0.9939 - val_loss: 0.4996 - val_accuracy: 0.9551
```

```python
model.save('models/malaria_model_100epochs.h5')
```

visualization of training and validation loss and accuracy
```python
loss = history.history['loss']
val_loss = history.history['val_loss']
epochs = range(1, len(loss) + 1)
plt.plot(epochs, loss, 'y', label='Training loss')
plt.plot(epochs, val_loss, 'r', label='Validation loss')
plt.title('Training and validation loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend()
plt.show()


acc = history.history['accuracy']
val_acc = history.history['val_accuracy']
plt.plot(epochs, acc, 'y', label='Training acc')
plt.plot(epochs, val_acc, 'r', label='Validation acc')
plt.title('Training and validation accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()
plt.show()
```

Training and validation loss

Training and validation accuracy
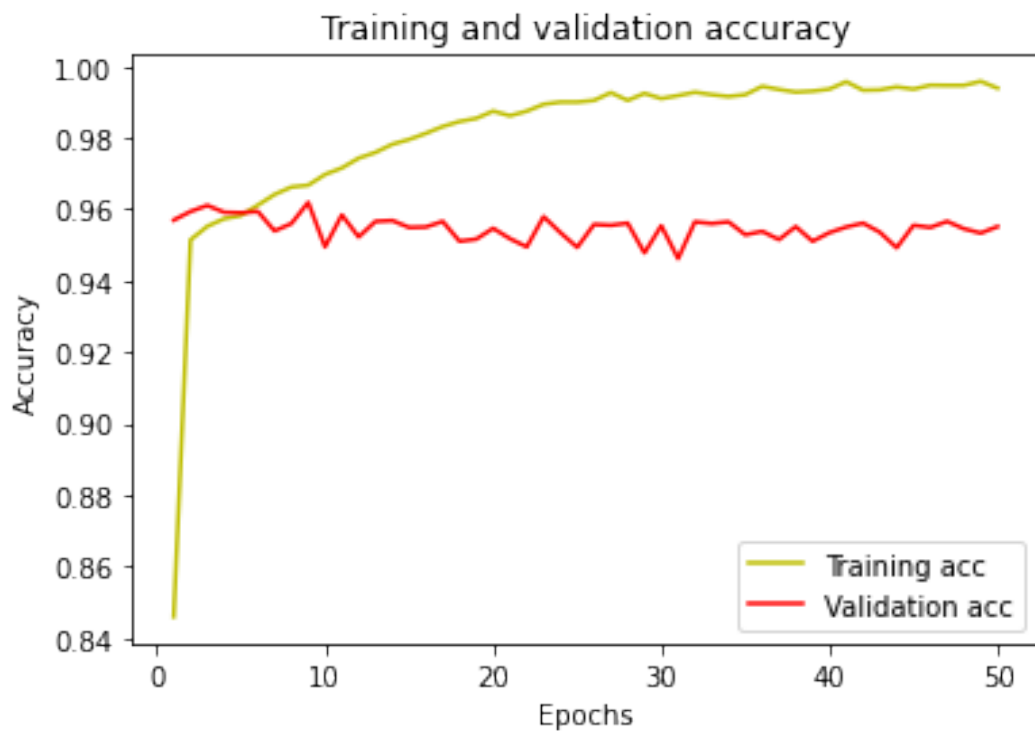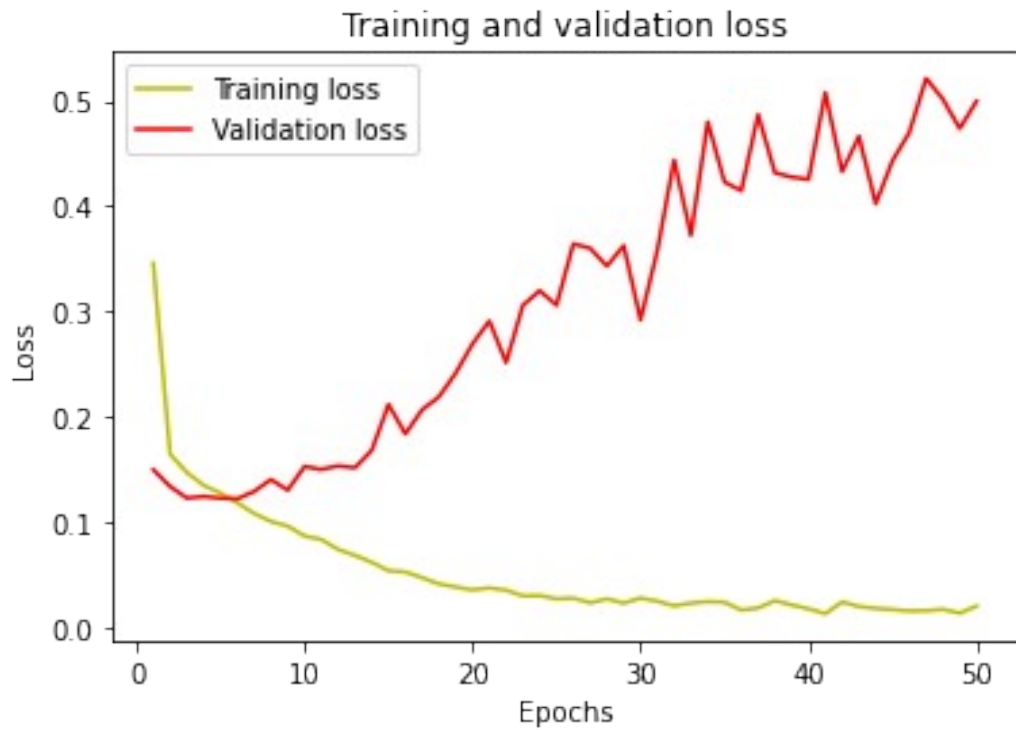
Testing Model

```
n=10  #Select the index of image to be loaded for testing
img = X_test[n]
plt.imshow(img)
```

```python
input_img = np.expand_dims(img, axis=0) #Expand dims so the input is
(num images, x, y, c)
print("The prediction for this image is: ", model.predict(input_img))
print("The actual label for this image is: ", y_test[n])
```

```
/usr/local/lib/python3.7/dist-packages/tensorflow/python/data/ops/
structured_function.py:265: UserWarning: Even though the
`tf.config.experimental_run_functions_eagerly` option is set, this
option does not apply to tf.data functions. To force eager execution
of tf.data functions, please use
`tf.data.experimental.enable_debug_mode()`.
  "Even though the `tf.config.experimental_run_functions_eagerly` "

The prediction for this image is:  [[3.0226164e-07 9.9999964e-01]]
The actual label for this image is:   1
```
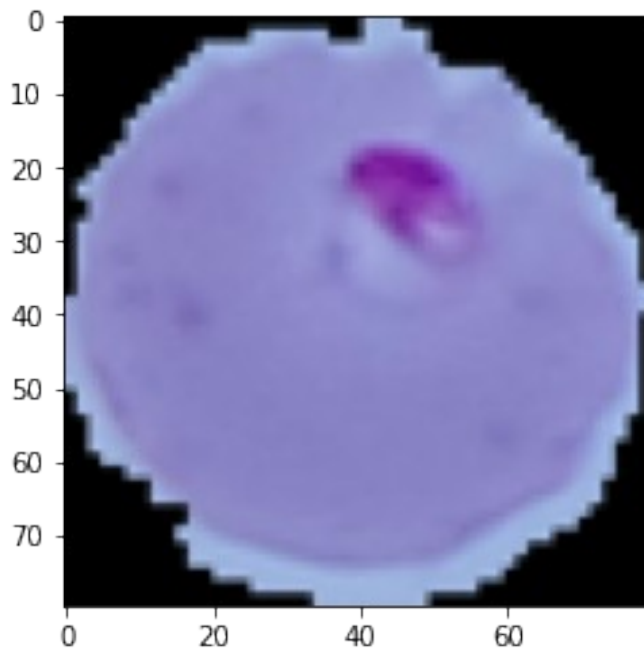


```python
from keras.models import load_model
```

Accuracy and Confusion matrix

```python
model = load_model('models/malaria_model_100epochs.h5')

_, acc = model.evaluate(X_test, y_test)
print("Accuracy = ", (acc * 100.0), "%")
```

```
259/259 [==============================] - 2s 6ms/step - loss: 0.4996
- accuracy: 0.9551
Accuracy =  95.51281929016113 %
```

```python
mythreshold=0.885
from sklearn.metrics import confusion_matrix
```

```
y_pred = (model.predict(X_test)>= mythreshold).astype(int)
cm=confusion_matrix(y_test, y_pred)
print(cm)
```

```
[[4034  140]
 [ 220 3874]]
```

Using Pretrained model Resnet50

```
image_directory = '/content/cell_images/'
SIZE = 80
image_data = []
label1 = []


parasitized_images = os.listdir(image_directory + 'Parasitized/')
for i, image_name in enumerate(parasitized_images):    #Remember
enumerate method adds a counter and returns the enumerate object

    if (image_name.split('.')[1] == 'png'):
        image = cv2.imread(image_directory + 'Parasitized/' +
image_name)
        image = Image.fromarray(image, 'RGB')
        image = image.resize((SIZE, SIZE))
        image_data.append(np.array(image))
        label1.append(1)

uninfected_images = os.listdir(image_directory + 'Uninfected/')
for i, image_name in enumerate(uninfected_images):
    if (image_name.split('.')[1] == 'png'):
        image = cv2.imread(image_directory + 'Uninfected/' +
image_name)
        image = Image.fromarray(image, 'RGB')
        image = image.resize((SIZE, SIZE))
        image_data.append(np.array(image))
        label1.append(0)

image_data = np.array(image_data)
label1 = np.array(label1)
print("Dataset size is ", image_data.shape)
print("Label size is ", label1.shape)
```

```
Dataset size is  (27558, 80, 80, 3)
Label size is  (27558,)
```

```
from sklearn.model_selection import train_test_split
x_train, x_test, Y_train, Y_test = train_test_split(image_data,
label1, test_size = 0.30, random_state = 0)
print("Train size is ", x_train.shape)
print("Test size is ", x_test.shape)
print("Train size is ", Y_train.shape)
print("Test size is ", Y_test.shape)
```

```
Train size is  (19290, 80, 80, 3)
Test size is  (8268, 80, 80, 3)
Train size is  (19290,)
Test size is  (8268,)

n_classes = len(np.unique(Y_train))
n_classes

2

Y_train_onehot = tf.keras.utils.to_categorical(Y_train, num_classes=
n_classes)
Y_test_onehot = tf.keras.utils.to_categorical(Y_test, num_classes=
n_classes)

Y_train_onehot.shape

(19290, 2)
```

Calling ResNet50 using weights imagenet

```python
tf.keras.backend.clear_session()
base = tf.keras.applications.ResNet50(
    include_top=False,
    weights="imagenet",
    input_tensor=None,
    input_shape=None,
    pooling=None,

)


base.summary()
```

```
Model: "resnet50"
_____
_____
 Layer (type)                   Output Shape          Param #
Connected to
==================================================================
===========================
 input_1 (InputLayer)           [(None, None, None,   0          []

                                 3)]



 conv1_pad (ZeroPadding2D)       (None, None, None,    0
['input_1[0][0]']
                                 3)
```

conv1_conv (Conv2D) ['conv1_pad[0][0]']	(None, None, None, 64)	9472
conv1_bn (BatchNormalization) ['conv1_conv[0][0]']	(None, None, None, 64)	256
conv1_relu (Activation) ['conv1_bn[0][0]']	(None, None, None, 64)	0
pool1_pad (ZeroPadding2D) ['conv1_relu[0][0]']	(None, None, None, 64)	0
pool1_pool (MaxPooling2D) ['pool1_pad[0][0]']	(None, None, None, 64)	0
conv2_block1_1_conv (Conv2D) ['pool1_pool[0][0]']	(None, None, None, 64)	4160
conv2_block1_1_bn (BatchNormal ['conv2_block1_1_conv[0][0]'] ization)	(None, None, None, 64)	256
conv2_block1_1_relu (Activatio ['conv2_block1_1_bn[0][0]'] n)	(None, None, None, 64)	0

conv2_block1_2_conv (Conv2D)	(None, None, None, 64)	36928	['conv2_block1_1_relu[0][0]']
conv2_block1_2_bn (BatchNormal ization)	(None, None, None, 64)	256	['conv2_block1_2_conv[0][0]']
conv2_block1_2_relu (Activatio n)	(None, None, None, 64)	0	['conv2_block1_2_bn[0][0]']
conv2_block1_0_conv (Conv2D)	(None, None, None, 256)	16640	['pool1_pool[0][0]']
conv2_block1_3_conv (Conv2D)	(None, None, None, 256)	16640	['conv2_block1_2_relu[0][0]']
conv2_block1_0_bn (BatchNormal ization)	(None, None, None, 256)	1024	['conv2_block1_0_conv[0][0]']
conv2_block1_3_bn (BatchNormal ization)	(None, None, None, 256)	1024	['conv2_block1_3_conv[0][0]']
conv2_block1_add (Add)	(None, None, None, 256)	0	['conv2_block1_0_bn[0][0]', 'conv2_block1_3_bn[0][0]']

```
 conv2_block1_out (Activation)   (None, None, None,     0
['conv2_block1_add[0][0]']
                                  256)


 conv2_block2_1_conv (Conv2D)    (None, None, None,   16448
['conv2_block1_out[0][0]']
                                  64)


 conv2_block2_1_bn (BatchNormal  (None, None, None,     256
['conv2_block2_1_conv[0][0]']
 ization)                         64)


 conv2_block2_1_relu (Activatio  (None, None, None,     0
['conv2_block2_1_bn[0][0]']
 n)                               64)


 conv2_block2_2_conv (Conv2D)    (None, None, None,   36928
['conv2_block2_1_relu[0][0]']
                                  64)


 conv2_block2_2_bn (BatchNormal  (None, None, None,     256
['conv2_block2_2_conv[0][0]']
 ization)                         64)


 conv2_block2_2_relu (Activatio  (None, None, None,     0
['conv2_block2_2_bn[0][0]']
 n)                               64)


 conv2_block2_3_conv (Conv2D)    (None, None, None,   16640
['conv2_block2_2_relu[0][0]']
                                  256)
```

```
conv2_block2_3_bn (BatchNormal  (None, None, None,    1024      ['conv2_block2_3_conv[0][0]']
 ization)                        256)


 conv2_block2_add (Add)          (None, None, None,    0         ['conv2_block1_out[0][0]',
                                 256)
                                                                 'conv2_block2_3_bn[0][0]']


 conv2_block2_out (Activation)   (None, None, None,    0         ['conv2_block2_add[0][0]']
                                 256)



 conv2_block3_1_conv (Conv2D)    (None, None, None,    16448     ['conv2_block2_out[0][0]']
                                 64)



 conv2_block3_1_bn (BatchNormal  (None, None, None,    256       ['conv2_block3_1_conv[0][0]']
 ization)                        64)



 conv2_block3_1_relu (Activatio  (None, None, None,    0         ['conv2_block3_1_bn[0][0]']
 n)                              64)



 conv2_block3_2_conv (Conv2D)    (None, None, None,    36928     ['conv2_block3_1_relu[0][0]']
                                 64)



 conv2_block3_2_bn (BatchNormal  (None, None, None,    256       ['conv2_block3_2_conv[0][0]']
 ization)                        64)
```

```
conv2_block3_2_relu (Activatio    (None, None, None,    0         ['conv2_block3_2_bn[0][0]']
n)                                64)


conv2_block3_3_conv (Conv2D)      (None, None, None,    16640     ['conv2_block3_2_relu[0][0]']
                                  256)


conv2_block3_3_bn (BatchNormal    (None, None, None,    1024      ['conv2_block3_3_conv[0][0]']
ization)                          256)


conv2_block3_add (Add)            (None, None, None,    0         ['conv2_block2_out[0][0]',
                                  256)

                                                                  'conv2_block3_3_bn[0][0]']


conv2_block3_out (Activation)     (None, None, None,    0         ['conv2_block3_add[0][0]']
                                  256)


conv3_block1_1_conv (Conv2D)      (None, None, None,    32896     ['conv2_block3_out[0][0]']
                                  128)


conv3_block1_1_bn (BatchNormal    (None, None, None,    512       ['conv3_block1_1_conv[0][0]']
ization)                          128)


conv3_block1_1_relu (Activatio    (None, None, None,    0         ['conv3_block1_1_bn[0][0]']
n)                                128)
```

conv3_block1_2_conv (Conv2D) ['conv3_block1_1_relu[0][0]']	(None, None, None, 128)	147584	
conv3_block1_2_bn (BatchNormal ['conv3_block1_2_conv[0][0]'] ization)	(None, None, None, 128)	512	
conv3_block1_2_relu (Activatio ['conv3_block1_2_bn[0][0]'] n)	(None, None, None, 128)	0	
conv3_block1_0_conv (Conv2D) ['conv2_block3_out[0][0]']	(None, None, None, 512)	131584	
conv3_block1_3_conv (Conv2D) ['conv3_block1_2_relu[0][0]']	(None, None, None, 512)	66048	
conv3_block1_0_bn (BatchNormal ['conv3_block1_0_conv[0][0]'] ization)	(None, None, None, 512)	2048	
conv3_block1_3_bn (BatchNormal ['conv3_block1_3_conv[0][0]'] ization)	(None, None, None, 512)	2048	
conv3_block1_add (Add) ['conv3_block1_0_bn[0][0]', 'conv3_block1_3_bn[0][0]']	(None, None, None, 512)	0	

```
conv3_block1_out (Activation)    (None, None, None,     0      ['conv3_block1_add[0][0]']
                                  512)


conv3_block2_1_conv (Conv2D)     (None, None, None,    65664   ['conv3_block1_out[0][0]']
                                  128)


conv3_block2_1_bn (BatchNormal   (None, None, None,     512    ['conv3_block2_1_conv[0][0]']
 ization)                         128)


conv3_block2_1_relu (Activatio   (None, None, None,     0      ['conv3_block2_1_bn[0][0]']
 n)                               128)


conv3_block2_2_conv (Conv2D)     (None, None, None,   147584   ['conv3_block2_1_relu[0][0]']
                                  128)


conv3_block2_2_bn (BatchNormal   (None, None, None,     512    ['conv3_block2_2_conv[0][0]']
 ization)                         128)


conv3_block2_2_relu (Activatio   (None, None, None,     0      ['conv3_block2_2_bn[0][0]']
 n)                               128)


conv3_block2_3_conv (Conv2D)     (None, None, None,    66048   ['conv3_block2_2_relu[0][0]']
                                  512)
```

```
 conv3_block2_3_bn (BatchNormal   (None, None, None,    2048
['conv3_block2_3_conv[0][0]']
 ization)                         512)


 conv3_block2_add (Add)           (None, None, None,    0
['conv3_block1_out[0][0]',
                                  512)
'conv3_block2_3_bn[0][0]']


 conv3_block2_out (Activation)    (None, None, None,    0
['conv3_block2_add[0][0]']
                                  512)


 conv3_block3_1_conv (Conv2D)     (None, None, None,    65664
['conv3_block2_out[0][0]']
                                  128)


 conv3_block3_1_bn (BatchNormal   (None, None, None,    512
['conv3_block3_1_conv[0][0]']
 ization)                         128)


 conv3_block3_1_relu (Activatio   (None, None, None,    0
['conv3_block3_1_bn[0][0]']
 n)                               128)


 conv3_block3_2_conv (Conv2D)     (None, None, None,    147584
['conv3_block3_1_relu[0][0]']
                                  128)


 conv3_block3_2_bn (BatchNormal   (None, None, None,    512
['conv3_block3_2_conv[0][0]']
 ization)                         128)
```

```
conv3_block3_2_relu (Activatio    (None, None, None,    0     ['conv3_block3_2_bn[0][0]']
 n)                                128)


conv3_block3_3_conv (Conv2D)      (None, None, None,    66048  ['conv3_block3_2_relu[0][0]']
                                   512)


conv3_block3_3_bn (BatchNormal    (None, None, None,    2048   ['conv3_block3_3_conv[0][0]']
 ization)                          512)


conv3_block3_add (Add)            (None, None, None,    0      ['conv3_block2_out[0][0]',
                                   512)
                                                               'conv3_block3_3_bn[0][0]']


conv3_block3_out (Activation)     (None, None, None,    0      ['conv3_block3_add[0][0]']
                                   512)


conv3_block4_1_conv (Conv2D)      (None, None, None,    65664  ['conv3_block3_out[0][0]']
                                   128)


conv3_block4_1_bn (BatchNormal    (None, None, None,    512    ['conv3_block4_1_conv[0][0]']
 ization)                          128)


conv3_block4_1_relu (Activatio    (None, None, None,    0      ['conv3_block4_1_bn[0][0]']
 n)                                128)
```

```
 conv3_block4_2_conv (Conv2D)    (None, None, None,    147584
['conv3_block4_1_relu[0][0]']
                                 128)


 conv3_block4_2_bn (BatchNormal  (None, None, None,     512
['conv3_block4_2_conv[0][0]']
 ization)                        128)


 conv3_block4_2_relu (Activatio  (None, None, None,      0
['conv3_block4_2_bn[0][0]']
 n)                              128)


 conv3_block4_3_conv (Conv2D)    (None, None, None,    66048
['conv3_block4_2_relu[0][0]']
                                 512)


 conv3_block4_3_bn (BatchNormal  (None, None, None,    2048
['conv3_block4_3_conv[0][0]']
 ization)                        512)


 conv3_block4_add (Add)          (None, None, None,      0
['conv3_block3_out[0][0]',
                                 512)
'conv3_block4_3_bn[0][0]']


 conv3_block4_out (Activation)   (None, None, None,      0
['conv3_block4_add[0][0]']
                                 512)


 conv4_block1_1_conv (Conv2D)    (None, None, None,    131328
['conv3_block4_out[0][0]']
                                 256)
```

```
 conv4_block1_1_bn (BatchNormal   (None, None, None,    1024    ['conv4_block1_1_conv[0][0]']
 ization)                         256)


 conv4_block1_1_relu (Activatio   (None, None, None,    0       ['conv4_block1_1_bn[0][0]']
 n)                               256)


 conv4_block1_2_conv (Conv2D)     (None, None, None,    590080  ['conv4_block1_1_relu[0][0]']
                                  256)


 conv4_block1_2_bn (BatchNormal   (None, None, None,    1024    ['conv4_block1_2_conv[0][0]']
 ization)                         256)


 conv4_block1_2_relu (Activatio   (None, None, None,    0       ['conv4_block1_2_bn[0][0]']
 n)                               256)


 conv4_block1_0_conv (Conv2D)     (None, None, None,    525312  ['conv3_block4_out[0][0]']
                                  1024)


 conv4_block1_3_conv (Conv2D)     (None, None, None,    263168  ['conv4_block1_2_relu[0][0]']
                                  1024)


 conv4_block1_0_bn (BatchNormal   (None, None, None,    4096    ['conv4_block1_0_conv[0][0]']
 ization)                         1024)
```

```
 conv4_block1_3_bn (BatchNormal   (None, None, None,    4096
['conv4_block1_3_conv[0][0]']
 ization)                         1024)


 conv4_block1_add (Add)           (None, None, None,    0
['conv4_block1_0_bn[0][0]',
                                  1024)

'conv4_block1_3_bn[0][0]']


 conv4_block1_out (Activation)    (None, None, None,    0
['conv4_block1_add[0][0]']

                                  1024)



 conv4_block2_1_conv (Conv2D)     (None, None, None,    262400
['conv4_block1_out[0][0]']

                                  256)



 conv4_block2_1_bn (BatchNormal   (None, None, None,    1024
['conv4_block2_1_conv[0][0]']
 ization)                         256)



 conv4_block2_1_relu (Activatio   (None, None, None,    0
['conv4_block2_1_bn[0][0]']
 n)                               256)



 conv4_block2_2_conv (Conv2D)     (None, None, None,    590080
['conv4_block2_1_relu[0][0]']

                                  256)



 conv4_block2_2_bn (BatchNormal   (None, None, None,    1024
['conv4_block2_2_conv[0][0]']
 ization)                         256)
```

```
 conv4_block2_2_relu (Activatio   (None, None, None,     0    ['conv4_block2_2_bn[0][0]']
                                   256)
 n)


 conv4_block2_3_conv (Conv2D)     (None, None, None,   263168   ['conv4_block2_2_relu[0][0]']
                                   1024)


 conv4_block2_3_bn (BatchNormal   (None, None, None,    4096    ['conv4_block2_3_conv[0][0]']
                                   1024)
 ization)


 conv4_block2_add (Add)           (None, None, None,     0     ['conv4_block1_out[0][0]',
                                   1024)
                                                               'conv4_block2_3_bn[0][0]']


 conv4_block2_out (Activation)    (None, None, None,     0     ['conv4_block2_add[0][0]']
                                   1024)


 conv4_block3_1_conv (Conv2D)     (None, None, None,   262400   ['conv4_block2_out[0][0]']
                                   256)


 conv4_block3_1_bn (BatchNormal   (None, None, None,    1024    ['conv4_block3_1_conv[0][0]']
                                   256)
 ization)


 conv4_block3_1_relu (Activatio   (None, None, None,     0    ['conv4_block3_1_bn[0][0]']
                                   256)
 n)
```

```
 conv4_block3_2_conv (Conv2D)    (None, None, None,    590080
['conv4_block3_1_relu[0][0]']
                                 256)


 conv4_block3_2_bn (BatchNormal  (None, None, None,    1024
['conv4_block3_2_conv[0][0]']
 ization)                        256)


 conv4_block3_2_relu (Activatio  (None, None, None,    0
['conv4_block3_2_bn[0][0]']
 n)                              256)


 conv4_block3_3_conv (Conv2D)    (None, None, None,    263168
['conv4_block3_2_relu[0][0]']
                                 1024)


 conv4_block3_3_bn (BatchNormal  (None, None, None,    4096
['conv4_block3_3_conv[0][0]']
 ization)                        1024)


 conv4_block3_add (Add)          (None, None, None,    0
['conv4_block2_out[0][0]',
                                 1024)

'conv4_block3_3_bn[0][0]']


 conv4_block3_out (Activation)   (None, None, None,    0
['conv4_block3_add[0][0]']
                                 1024)


 conv4_block4_1_conv (Conv2D)    (None, None, None,    262400
['conv4_block3_out[0][0]']
                                 256)
```

conv4_block4_1_bn (BatchNormal ['conv4_block4_1_conv[0][0]'] ization)	(None, None, None, 256)	1024	
conv4_block4_1_relu (Activatio ['conv4_block4_1_bn[0][0]'] n)	(None, None, None, 256)	0	
conv4_block4_2_conv (Conv2D) ['conv4_block4_1_relu[0][0]']	(None, None, None, 256)	590080	
conv4_block4_2_bn (BatchNormal ['conv4_block4_2_conv[0][0]'] ization)	(None, None, None, 256)	1024	
conv4_block4_2_relu (Activatio ['conv4_block4_2_bn[0][0]'] n)	(None, None, None, 256)	0	
conv4_block4_3_conv (Conv2D) ['conv4_block4_2_relu[0][0]']	(None, None, None, 1024)	263168	
conv4_block4_3_bn (BatchNormal ['conv4_block4_3_conv[0][0]'] ization)	(None, None, None, 1024)	4096	
conv4_block4_add (Add) ['conv4_block3_out[0][0]', 'conv4_block4_3_bn[0][0]']	(None, None, None, 1024)	0	

conv4_block4_out (Activation)	(None, None, None, 1024)	0	['conv4_block4_add[0][0]']
conv4_block5_1_conv (Conv2D)	(None, None, None, 256)	262400	['conv4_block4_out[0][0]']
conv4_block5_1_bn (BatchNormal ization)	(None, None, None, 256)	1024	['conv4_block5_1_conv[0][0]']
conv4_block5_1_relu (Activatio n)	(None, None, None, 256)	0	['conv4_block5_1_bn[0][0]']
conv4_block5_2_conv (Conv2D)	(None, None, None, 256)	590080	['conv4_block5_1_relu[0][0]']
conv4_block5_2_bn (BatchNormal ization)	(None, None, None, 256)	1024	['conv4_block5_2_conv[0][0]']
conv4_block5_2_relu (Activatio n)	(None, None, None, 256)	0	['conv4_block5_2_bn[0][0]']
conv4_block5_3_conv (Conv2D)	(None, None, None, 1024)	263168	['conv4_block5_2_relu[0][0]']

```
 conv4_block5_3_bn (BatchNormal  (None, None, None,    4096     ['conv4_block5_3_conv[0][0]']
 ization)                        1024)


 conv4_block5_add (Add)          (None, None, None,    0        ['conv4_block4_out[0][0]',
                                 1024)
                                                                 'conv4_block5_3_bn[0][0]']


 conv4_block5_out (Activation)   (None, None, None,    0        ['conv4_block5_add[0][0]']
                                 1024)


 conv4_block6_1_conv (Conv2D)    (None, None, None,    262400   ['conv4_block5_out[0][0]']
                                 256)


 conv4_block6_1_bn (BatchNormal  (None, None, None,    1024     ['conv4_block6_1_conv[0][0]']
 ization)                        256)


 conv4_block6_1_relu (Activatio  (None, None, None,    0        ['conv4_block6_1_bn[0][0]']
 n)                              256)


 conv4_block6_2_conv (Conv2D)    (None, None, None,    590080   ['conv4_block6_1_relu[0][0]']
                                 256)


 conv4_block6_2_bn (BatchNormal  (None, None, None,    1024     ['conv4_block6_2_conv[0][0]']
 ization)                        256)
```

```
 conv4_block6_2_relu (Activatio   (None, None, None,    0        ['conv4_block6_2_bn[0][0]']
 n)                                256)


 conv4_block6_3_conv (Conv2D)     (None, None, None,    263168   ['conv4_block6_2_relu[0][0]']

                                  1024)


 conv4_block6_3_bn (BatchNormal   (None, None, None,    4096     ['conv4_block6_3_conv[0][0]']
 ization)                         1024)


 conv4_block6_add (Add)           (None, None, None,    0        ['conv4_block5_out[0][0]',
                                  1024)

                                                                 'conv4_block6_3_bn[0][0]']


 conv4_block6_out (Activation)    (None, None, None,    0        ['conv4_block6_add[0][0]']
                                  1024)


 conv5_block1_1_conv (Conv2D)     (None, None, None,    524800   ['conv4_block6_out[0][0]']
                                  512)


 conv5_block1_1_bn (BatchNormal   (None, None, None,    2048     ['conv5_block1_1_conv[0][0]']
 ization)                         512)


 conv5_block1_1_relu (Activatio   (None, None, None,    0        ['conv5_block1_1_bn[0][0]']
 n)                                512)
```

conv5_block1_2_conv (Conv2D) ['conv5_block1_1_relu[0][0]']	(None, None, None, 512)	2359808
conv5_block1_2_bn (BatchNormal ['conv5_block1_2_conv[0][0]'] ization)	(None, None, None, 512)	2048
conv5_block1_2_relu (Activatio ['conv5_block1_2_bn[0][0]'] n)	(None, None, None, 512)	0
conv5_block1_0_conv (Conv2D) ['conv4_block6_out[0][0]']	(None, None, None, 2048)	2099200
conv5_block1_3_conv (Conv2D) ['conv5_block1_2_relu[0][0]']	(None, None, None, 2048)	1050624
conv5_block1_0_bn (BatchNormal ['conv5_block1_0_conv[0][0]'] ization)	(None, None, None, 2048)	8192
conv5_block1_3_bn (BatchNormal ['conv5_block1_3_conv[0][0]'] ization)	(None, None, None, 2048)	8192
conv5_block1_add (Add) ['conv5_block1_0_bn[0][0]', 'conv5_block1_3_bn[0][0]']	(None, None, None, 2048)	0

```
conv5_block1_out (Activation)   (None, None, None,      0    ['conv5_block1_add[0][0]']
                                 2048)


conv5_block2_1_conv (Conv2D)    (None, None, None,   1049088  ['conv5_block1_out[0][0]']
                                 512)


conv5_block2_1_bn (BatchNormal  (None, None, None,     2048   ['conv5_block2_1_conv[0][0]']
 ization)                        512)


conv5_block2_1_relu (Activatio  (None, None, None,      0     ['conv5_block2_1_bn[0][0]']
 n)                              512)


conv5_block2_2_conv (Conv2D)    (None, None, None,   2359808  ['conv5_block2_1_relu[0][0]']
                                 512)


conv5_block2_2_bn (BatchNormal  (None, None, None,     2048   ['conv5_block2_2_conv[0][0]']
 ization)                        512)


conv5_block2_2_relu (Activatio  (None, None, None,      0     ['conv5_block2_2_bn[0][0]']
 n)                              512)


conv5_block2_3_conv (Conv2D)    (None, None, None,   1050624  ['conv5_block2_2_relu[0][0]']
                                 2048)
```

```
 conv5_block2_3_bn (BatchNormal  (None, None, None,    8192    ['conv5_block2_3_conv[0][0]']
 ization)                        2048)


 conv5_block2_add (Add)          (None, None, None,    0       ['conv5_block1_out[0][0]',
                                 2048)

                                                               'conv5_block2_3_bn[0][0]']


 conv5_block2_out (Activation)   (None, None, None,    0       ['conv5_block2_add[0][0]']
                                 2048)



 conv5_block3_1_conv (Conv2D)    (None, None, None,    1049088  ['conv5_block2_out[0][0]']
                                 512)



 conv5_block3_1_bn (BatchNormal  (None, None, None,    2048    ['conv5_block3_1_conv[0][0]']
 ization)                        512)



 conv5_block3_1_relu (Activatio  (None, None, None,    0       ['conv5_block3_1_bn[0][0]']
 n)                              512)



 conv5_block3_2_conv (Conv2D)    (None, None, None,    2359808  ['conv5_block3_1_relu[0][0]']
                                 512)



 conv5_block3_2_bn (BatchNormal  (None, None, None,    2048    ['conv5_block3_2_conv[0][0]']
 ization)                        512)
```

```
 conv5_block3_2_relu (Activatio    (None, None, None,     0
['conv5_block3_2_bn[0][0]']
 n)                                512)


 conv5_block3_3_conv (Conv2D)      (None, None, None,     1050624
['conv5_block3_2_relu[0][0]']

                                   2048)


 conv5_block3_3_bn (BatchNormal    (None, None, None,     8192
['conv5_block3_3_conv[0][0]']
 ization)                          2048)


 conv5_block3_add (Add)            (None, None, None,     0
['conv5_block2_out[0][0]',

                                   2048)

'conv5_block3_3_bn[0][0]']


 conv5_block3_out (Activation)     (None, None, None,     0
['conv5_block3_add[0][0]']

                                   2048)


==================================================================
===========================
Total params: 23,587,712
Trainable params: 23,534,592
Non-trainable params: 53,120

_____
_____

base.trainable = False

base.summary()

Model: "resnet50"

_____
_____
 Layer (type)                     Output Shape           Param #
Connected to
==================================================================
```

```
===========================
 input_1 (InputLayer)           [(None, None, None,    0              []
                                  3)]


 conv1_pad (ZeroPadding2D)      (None, None, None,     0
                                                              ['input_1[0][0]']
                                 3)


 conv1_conv (Conv2D)            (None, None, None,     9472
                                                              ['conv1_pad[0][0]']
                                 64)


 conv1_bn (BatchNormalization)  (None, None, None,     256
                                                              ['conv1_conv[0][0]']
                                 64)


 conv1_relu (Activation)        (None, None, None,     0
                                                              ['conv1_bn[0][0]']
                                 64)


 pool1_pad (ZeroPadding2D)      (None, None, None,     0
                                                              ['conv1_relu[0][0]']
                                 64)


 pool1_pool (MaxPooling2D)      (None, None, None,     0
                                                              ['pool1_pad[0][0]']
                                 64)


 conv2_block1_1_conv (Conv2D)   (None, None, None,     4160
                                                              ['pool1_pool[0][0]']
                                 64)
```

```
 conv2_block1_1_bn (BatchNormal   (None, None, None,    256    ['conv2_block1_1_conv[0][0]']
 ization)                         64)


 conv2_block1_1_relu (Activatio   (None, None, None,    0      ['conv2_block1_1_bn[0][0]']
 n)                               64)


 conv2_block1_2_conv (Conv2D)     (None, None, None,    36928  ['conv2_block1_1_relu[0][0]']

                                  64)


 conv2_block1_2_bn (BatchNormal   (None, None, None,    256    ['conv2_block1_2_conv[0][0]']
 ization)                         64)


 conv2_block1_2_relu (Activatio   (None, None, None,    0      ['conv2_block1_2_bn[0][0]']
 n)                               64)


 conv2_block1_0_conv (Conv2D)     (None, None, None,    16640  ['pool1_pool[0][0]']

                                  256)


 conv2_block1_3_conv (Conv2D)     (None, None, None,    16640  ['conv2_block1_2_relu[0][0]']

                                  256)


 conv2_block1_0_bn (BatchNormal   (None, None, None,    1024   ['conv2_block1_0_conv[0][0]']
 ization)                         256)
```

```
conv2_block1_3_bn (BatchNormal  (None, None, None,    1024
['conv2_block1_3_conv[0][0]']
 ization)                        256)


 conv2_block1_add (Add)         (None, None, None,     0
['conv2_block1_0_bn[0][0]',
                                 256)

'conv2_block1_3_bn[0][0]']


 conv2_block1_out (Activation)  (None, None, None,     0
['conv2_block1_add[0][0]']
                                 256)



 conv2_block2_1_conv (Conv2D)   (None, None, None,    16448
['conv2_block1_out[0][0]']
                                 64)



 conv2_block2_1_bn (BatchNormal  (None, None, None,    256
['conv2_block2_1_conv[0][0]']
 ization)                        64)



 conv2_block2_1_relu (Activatio  (None, None, None,     0
['conv2_block2_1_bn[0][0]']
 n)                              64)



 conv2_block2_2_conv (Conv2D)   (None, None, None,    36928
['conv2_block2_1_relu[0][0]']
                                 64)



 conv2_block2_2_bn (BatchNormal  (None, None, None,    256
['conv2_block2_2_conv[0][0]']
 ization)                        64)
```

```
conv2_block2_2_relu (Activatio  (None, None, None,    0      ['conv2_block2_2_bn[0][0]']
 n)                             64)


conv2_block2_3_conv (Conv2D)    (None, None, None,    16640  ['conv2_block2_2_relu[0][0]']
                                256)


conv2_block2_3_bn (BatchNormal  (None, None, None,    1024   ['conv2_block2_3_conv[0][0]']
 ization)                       256)


conv2_block2_add (Add)          (None, None, None,    0      ['conv2_block1_out[0][0]',
                                256)
                                                             'conv2_block2_3_bn[0][0]']


conv2_block2_out (Activation)   (None, None, None,    0      ['conv2_block2_add[0][0]']
                                256)


conv2_block3_1_conv (Conv2D)    (None, None, None,    16448  ['conv2_block2_out[0][0]']
                                64)


conv2_block3_1_bn (BatchNormal  (None, None, None,    256    ['conv2_block3_1_conv[0][0]']
 ization)                       64)


conv2_block3_1_relu (Activatio  (None, None, None,    0      ['conv2_block3_1_bn[0][0]']
 n)                             64)
```

conv2_block3_2_conv (Conv2D) ['conv2_block3_1_relu[0][0]']	(None, None, None, 64)	36928
conv2_block3_2_bn (BatchNormal ['conv2_block3_2_conv[0][0]'] ization)	(None, None, None, 64)	256
conv2_block3_2_relu (Activatio ['conv2_block3_2_bn[0][0]'] n)	(None, None, None, 64)	0
conv2_block3_3_conv (Conv2D) ['conv2_block3_2_relu[0][0]']	(None, None, None, 256)	16640
conv2_block3_3_bn (BatchNormal ['conv2_block3_3_conv[0][0]'] ization)	(None, None, None, 256)	1024
conv2_block3_add (Add) ['conv2_block2_out[0][0]', 'conv2_block3_3_bn[0][0]']	(None, None, None, 256)	0
conv2_block3_out (Activation) ['conv2_block3_add[0][0]']	(None, None, None, 256)	0
conv3_block1_1_conv (Conv2D) ['conv2_block3_out[0][0]']	(None, None, None, 128)	32896

conv3_block1_1_bn (BatchNormal ['conv3_block1_1_conv[0][0]'] ization)	(None, None, None, 128)	512
conv3_block1_1_relu (Activatio ['conv3_block1_1_bn[0][0]'] n)	(None, None, None, 128)	0
conv3_block1_2_conv (Conv2D) ['conv3_block1_1_relu[0][0]']	(None, None, None, 128)	147584
conv3_block1_2_bn (BatchNormal ['conv3_block1_2_conv[0][0]'] ization)	(None, None, None, 128)	512
conv3_block1_2_relu (Activatio ['conv3_block1_2_bn[0][0]'] n)	(None, None, None, 128)	0
conv3_block1_0_conv (Conv2D) ['conv2_block3_out[0][0]']	(None, None, None, 512)	131584
conv3_block1_3_conv (Conv2D) ['conv3_block1_2_relu[0][0]']	(None, None, None, 512)	66048
conv3_block1_0_bn (BatchNormal ['conv3_block1_0_conv[0][0]'] ization)	(None, None, None, 512)	2048

```
 conv3_block1_3_bn (BatchNormal  (None, None, None,    2048      ['conv3_block1_3_conv[0][0]']
 ization)                        512)


 conv3_block1_add (Add)          (None, None, None,    0         ['conv3_block1_0_bn[0][0]',
                                 512)

                                                                 'conv3_block1_3_bn[0][0]']


 conv3_block1_out (Activation)   (None, None, None,    0         ['conv3_block1_add[0][0]']
                                 512)



 conv3_block2_1_conv (Conv2D)    (None, None, None,    65664     ['conv3_block1_out[0][0]']
                                 128)



 conv3_block2_1_bn (BatchNormal  (None, None, None,    512       ['conv3_block2_1_conv[0][0]']
 ization)                        128)



 conv3_block2_1_relu (Activatio  (None, None, None,    0         ['conv3_block2_1_bn[0][0]']
 n)                              128)



 conv3_block2_2_conv (Conv2D)    (None, None, None,    147584    ['conv3_block2_1_relu[0][0]']
                                 128)



 conv3_block2_2_bn (BatchNormal  (None, None, None,    512       ['conv3_block2_2_conv[0][0]']
 ization)                        128)
```

```
conv3_block2_2_relu (Activatio   (None, None, None,    0      ['conv3_block2_2_bn[0][0]']
 n)                               128)


conv3_block2_3_conv (Conv2D)     (None, None, None,    66048  ['conv3_block2_2_relu[0][0]']
                                  512)


conv3_block2_3_bn (BatchNormal   (None, None, None,    2048   ['conv3_block2_3_conv[0][0]']
 ization)                         512)


conv3_block2_add (Add)           (None, None, None,    0      ['conv3_block1_out[0][0]',
                                  512)
                                                              'conv3_block2_3_bn[0][0]']


conv3_block2_out (Activation)    (None, None, None,    0      ['conv3_block2_add[0][0]']
                                  512)


conv3_block3_1_conv (Conv2D)     (None, None, None,    65664  ['conv3_block2_out[0][0]']
                                  128)


conv3_block3_1_bn (BatchNormal   (None, None, None,    512    ['conv3_block3_1_conv[0][0]']
 ization)                         128)


conv3_block3_1_relu (Activatio   (None, None, None,    0      ['conv3_block3_1_bn[0][0]']
 n)                               128)
```

```
 conv3_block3_2_conv (Conv2D)    (None, None, None,    147584
['conv3_block3_1_relu[0][0]']
                                 128)


 conv3_block3_2_bn (BatchNormal  (None, None, None,    512
['conv3_block3_2_conv[0][0]']
 ization)                        128)


 conv3_block3_2_relu (Activatio  (None, None, None,    0
['conv3_block3_2_bn[0][0]']
 n)                              128)


 conv3_block3_3_conv (Conv2D)    (None, None, None,    66048
['conv3_block3_2_relu[0][0]']
                                 512)


 conv3_block3_3_bn (BatchNormal  (None, None, None,    2048
['conv3_block3_3_conv[0][0]']
 ization)                        512)


 conv3_block3_add (Add)          (None, None, None,    0
['conv3_block2_out[0][0]',
                                 512)

'conv3_block3_3_bn[0][0]']


 conv3_block3_out (Activation)   (None, None, None,    0
['conv3_block3_add[0][0]']
                                 512)


 conv3_block4_1_conv (Conv2D)    (None, None, None,    65664
['conv3_block3_out[0][0]']
                                 128)
```

conv3_block4_1_bn (BatchNormal ['conv3_block4_1_conv[0][0]'] ization)	(None, None, None, 128)	512
conv3_block4_1_relu (Activatio ['conv3_block4_1_bn[0][0]'] n)	(None, None, None, 128)	0
conv3_block4_2_conv (Conv2D) ['conv3_block4_1_relu[0][0]']	(None, None, None, 128)	147584
conv3_block4_2_bn (BatchNormal ['conv3_block4_2_conv[0][0]'] ization)	(None, None, None, 128)	512
conv3_block4_2_relu (Activatio ['conv3_block4_2_bn[0][0]'] n)	(None, None, None, 128)	0
conv3_block4_3_conv (Conv2D) ['conv3_block4_2_relu[0][0]']	(None, None, None, 512)	66048
conv3_block4_3_bn (BatchNormal ['conv3_block4_3_conv[0][0]'] ization)	(None, None, None, 512)	2048
conv3_block4_add (Add) ['conv3_block3_out[0][0]', 'conv3_block4_3_bn[0][0]']	(None, None, None, 512)	0

```
conv3_block4_out (Activation)   (None, None, None,     0      ['conv3_block4_add[0][0]']
                                 512)


conv4_block1_1_conv (Conv2D)    (None, None, None,   131328   ['conv3_block4_out[0][0]']
                                 256)


conv4_block1_1_bn (BatchNormal  (None, None, None,    1024    ['conv4_block1_1_conv[0][0]']
ization)                         256)


conv4_block1_1_relu (Activatio  (None, None, None,     0      ['conv4_block1_1_bn[0][0]']
n)                               256)


conv4_block1_2_conv (Conv2D)    (None, None, None,   590080   ['conv4_block1_1_relu[0][0]']
                                 256)


conv4_block1_2_bn (BatchNormal  (None, None, None,    1024    ['conv4_block1_2_conv[0][0]']
ization)                         256)


conv4_block1_2_relu (Activatio  (None, None, None,     0      ['conv4_block1_2_bn[0][0]']
n)                               256)


conv4_block1_0_conv (Conv2D)    (None, None, None,   525312   ['conv3_block4_out[0][0]']
                                 1024)
```

```
conv4_block1_3_conv (Conv2D)    (None, None, None,    263168
['conv4_block1_2_relu[0][0]']
                                 1024)


conv4_block1_0_bn (BatchNormal  (None, None, None,    4096
['conv4_block1_0_conv[0][0]']
 ization)                        1024)


conv4_block1_3_bn (BatchNormal  (None, None, None,    4096
['conv4_block1_3_conv[0][0]']
 ization)                        1024)


conv4_block1_add (Add)          (None, None, None,    0
['conv4_block1_0_bn[0][0]',
                                 1024)

'conv4_block1_3_bn[0][0]']


conv4_block1_out (Activation)   (None, None, None,    0
['conv4_block1_add[0][0]']
                                 1024)


conv4_block2_1_conv (Conv2D)    (None, None, None,    262400
['conv4_block1_out[0][0]']
                                 256)


conv4_block2_1_bn (BatchNormal  (None, None, None,    1024
['conv4_block2_1_conv[0][0]']
 ization)                        256)


conv4_block2_1_relu (Activatio  (None, None, None,    0
['conv4_block2_1_bn[0][0]']
 n)                              256)
```

```
 conv4_block2_2_conv (Conv2D)    (None, None, None,    590080
['conv4_block2_1_relu[0][0]']
                                 256)


 conv4_block2_2_bn (BatchNormal  (None, None, None,    1024
['conv4_block2_2_conv[0][0]']
 ization)                        256)


 conv4_block2_2_relu (Activatio  (None, None, None,    0
['conv4_block2_2_bn[0][0]']
 n)                              256)


 conv4_block2_3_conv (Conv2D)    (None, None, None,    263168
['conv4_block2_2_relu[0][0]']
                                 1024)


 conv4_block2_3_bn (BatchNormal  (None, None, None,    4096
['conv4_block2_3_conv[0][0]']
 ization)                        1024)


 conv4_block2_add (Add)          (None, None, None,    0
['conv4_block1_out[0][0]',
                                 1024)

'conv4_block2_3_bn[0][0]']


 conv4_block2_out (Activation)   (None, None, None,    0
['conv4_block2_add[0][0]']
                                 1024)


 conv4_block3_1_conv (Conv2D)    (None, None, None,    262400
['conv4_block2_out[0][0]']
                                 256)
```

conv4_block3_1_bn (BatchNormal ization)	(None, None, None, 256)	1024
['conv4_block3_1_conv[0][0]']		
conv4_block3_1_relu (Activatio n)	(None, None, None, 256)	0
['conv4_block3_1_bn[0][0]']		
conv4_block3_2_conv (Conv2D)	(None, None, None, 256)	590080
['conv4_block3_1_relu[0][0]']		
conv4_block3_2_bn (BatchNormal ization)	(None, None, None, 256)	1024
['conv4_block3_2_conv[0][0]']		
conv4_block3_2_relu (Activatio n)	(None, None, None, 256)	0
['conv4_block3_2_bn[0][0]']		
conv4_block3_3_conv (Conv2D)	(None, None, None, 1024)	263168
['conv4_block3_2_relu[0][0]']		
conv4_block3_3_bn (BatchNormal ization)	(None, None, None, 1024)	4096
['conv4_block3_3_conv[0][0]']		
conv4_block3_add (Add)	(None, None, None, 1024)	0
['conv4_block2_out[0][0]', 'conv4_block3_3_bn[0][0]']		

```
conv4_block3_out (Activation)   (None, None, None,    0
['conv4_block3_add[0][0]']
                                 1024)


conv4_block4_1_conv (Conv2D)    (None, None, None,    262400
['conv4_block3_out[0][0]']
                                 256)


conv4_block4_1_bn (BatchNormal  (None, None, None,    1024
['conv4_block4_1_conv[0][0]']
 ization)                        256)


conv4_block4_1_relu (Activatio  (None, None, None,    0
['conv4_block4_1_bn[0][0]']
 n)                              256)


conv4_block4_2_conv (Conv2D)    (None, None, None,    590080
['conv4_block4_1_relu[0][0]']
                                 256)


conv4_block4_2_bn (BatchNormal  (None, None, None,    1024
['conv4_block4_2_conv[0][0]']
 ization)                        256)


conv4_block4_2_relu (Activatio  (None, None, None,    0
['conv4_block4_2_bn[0][0]']
 n)                              256)


conv4_block4_3_conv (Conv2D)    (None, None, None,    263168
['conv4_block4_2_relu[0][0]']
                                 1024)
```

```
conv4_block4_3_bn (BatchNormal    (None, None, None,     4096    ['conv4_block4_3_conv[0][0]']
 ization)                          1024)


conv4_block4_add (Add)            (None, None, None,       0     ['conv4_block3_out[0][0]',
                                   1024)
                                                                 'conv4_block4_3_bn[0][0]']


conv4_block4_out (Activation)     (None, None, None,       0     ['conv4_block4_add[0][0]']
                                   1024)


conv4_block5_1_conv (Conv2D)      (None, None, None,     262400  ['conv4_block4_out[0][0]']
                                   256)


conv4_block5_1_bn (BatchNormal    (None, None, None,     1024    ['conv4_block5_1_conv[0][0]']
 ization)                          256)


conv4_block5_1_relu (Activatio    (None, None, None,       0     ['conv4_block5_1_bn[0][0]']
 n)                                256)


conv4_block5_2_conv (Conv2D)      (None, None, None,     590080  ['conv4_block5_1_relu[0][0]']
                                   256)


conv4_block5_2_bn (BatchNormal    (None, None, None,     1024    ['conv4_block5_2_conv[0][0]']
 ization)                          256)
```

```
 conv4_block5_2_relu (Activatio  (None, None, None,    0
['conv4_block5_2_bn[0][0]']
 n)                              256)


 conv4_block5_3_conv (Conv2D)    (None, None, None,    263168
['conv4_block5_2_relu[0][0]']
                                 1024)


 conv4_block5_3_bn (BatchNormal  (None, None, None,    4096
['conv4_block5_3_conv[0][0]']
 ization)                        1024)


 conv4_block5_add (Add)          (None, None, None,    0
['conv4_block4_out[0][0]',
                                 1024)

'conv4_block5_3_bn[0][0]']


 conv4_block5_out (Activation)   (None, None, None,    0
['conv4_block5_add[0][0]']
                                 1024)


 conv4_block6_1_conv (Conv2D)    (None, None, None,    262400
['conv4_block5_out[0][0]']
                                 256)


 conv4_block6_1_bn (BatchNormal  (None, None, None,    1024
['conv4_block6_1_conv[0][0]']
 ization)                        256)


 conv4_block6_1_relu (Activatio  (None, None, None,    0
['conv4_block6_1_bn[0][0]']
 n)                              256)
```

conv4_block6_2_conv (Conv2D) ['conv4_block6_1_relu[0][0]']	(None, None, None, 256)	590080
conv4_block6_2_bn (BatchNormal ['conv4_block6_2_conv[0][0]'] ization)	(None, None, None, 256)	1024
conv4_block6_2_relu (Activatio ['conv4_block6_2_bn[0][0]'] n)	(None, None, None, 256)	0
conv4_block6_3_conv (Conv2D) ['conv4_block6_2_relu[0][0]']	(None, None, None, 1024)	263168
conv4_block6_3_bn (BatchNormal ['conv4_block6_3_conv[0][0]'] ization)	(None, None, None, 1024)	4096
conv4_block6_add (Add) ['conv4_block5_out[0][0]', 'conv4_block6_3_bn[0][0]']	(None, None, None, 1024)	0
conv4_block6_out (Activation) ['conv4_block6_add[0][0]']	(None, None, None, 1024)	0
conv5_block1_1_conv (Conv2D) ['conv4_block6_out[0][0]']	(None, None, None, 512)	524800

conv5_block1_1_bn (BatchNormal ['conv5_block1_1_conv[0][0]'] ization)	(None, None, None, 512)	2048
conv5_block1_1_relu (Activatio ['conv5_block1_1_bn[0][0]'] n)	(None, None, None, 512)	0
conv5_block1_2_conv (Conv2D) ['conv5_block1_1_relu[0][0]']	(None, None, None, 512)	2359808
conv5_block1_2_bn (BatchNormal ['conv5_block1_2_conv[0][0]'] ization)	(None, None, None, 512)	2048
conv5_block1_2_relu (Activatio ['conv5_block1_2_bn[0][0]'] n)	(None, None, None, 512)	0
conv5_block1_0_conv (Conv2D) ['conv4_block6_out[0][0]']	(None, None, None, 2048)	2099200
conv5_block1_3_conv (Conv2D) ['conv5_block1_2_relu[0][0]']	(None, None, None, 2048)	1050624
conv5_block1_0_bn (BatchNormal ['conv5_block1_0_conv[0][0]'] ization)	(None, None, None, 2048)	8192

conv5_block1_3_bn (BatchNormal ['conv5_block1_3_conv[0][0]'] ization)	(None, None, None, 2048)	8192
conv5_block1_add (Add) ['conv5_block1_0_bn[0][0]', 'conv5_block1_3_bn[0][0]']	(None, None, None, 2048)	0
conv5_block1_out (Activation) ['conv5_block1_add[0][0]']	(None, None, None, 2048)	0
conv5_block2_1_conv (Conv2D) ['conv5_block1_out[0][0]']	(None, None, None, 512)	1049088
conv5_block2_1_bn (BatchNormal ['conv5_block2_1_conv[0][0]'] ization)	(None, None, None, 512)	2048
conv5_block2_1_relu (Activatio ['conv5_block2_1_bn[0][0]'] n)	(None, None, None, 512)	0
conv5_block2_2_conv (Conv2D) ['conv5_block2_1_relu[0][0]']	(None, None, None, 512)	2359808
conv5_block2_2_bn (BatchNormal ['conv5_block2_2_conv[0][0]'] ization)	(None, None, None, 512)	2048

```
conv5_block2_2_relu (Activatio    (None, None, None,      0    ['conv5_block2_2_bn[0][0]']
 n)                                512)


conv5_block2_3_conv (Conv2D)      (None, None, None,   1050624   ['conv5_block2_2_relu[0][0]']

                                  2048)


conv5_block2_3_bn (BatchNormal    (None, None, None,     8192    ['conv5_block2_3_conv[0][0]']
 ization)                         2048)


conv5_block2_add (Add)            (None, None, None,      0    ['conv5_block1_out[0][0]',
                                  2048)
                                                            'conv5_block2_3_bn[0][0]']


conv5_block2_out (Activation)     (None, None, None,      0    ['conv5_block2_add[0][0]']
                                  2048)


conv5_block3_1_conv (Conv2D)      (None, None, None,   1049088   ['conv5_block2_out[0][0]']
                                  512)


conv5_block3_1_bn (BatchNormal    (None, None, None,     2048    ['conv5_block3_1_conv[0][0]']
 ization)                         512)


conv5_block3_1_relu (Activatio    (None, None, None,      0    ['conv5_block3_1_bn[0][0]']
 n)                                512)
```

```
 conv5_block3_2_conv (Conv2D)    (None, None, None,    2359808
['conv5_block3_1_relu[0][0]']
                                 512)


 conv5_block3_2_bn (BatchNormal  (None, None, None,    2048
['conv5_block3_2_conv[0][0]']
 ization)                        512)


 conv5_block3_2_relu (Activatio  (None, None, None,    0
['conv5_block3_2_bn[0][0]']
 n)                              512)


 conv5_block3_3_conv (Conv2D)    (None, None, None,    1050624
['conv5_block3_2_relu[0][0]']
                                 2048)


 conv5_block3_3_bn (BatchNormal  (None, None, None,    8192
['conv5_block3_3_conv[0][0]']
 ization)                        2048)


 conv5_block3_add (Add)          (None, None, None,    0
['conv5_block2_out[0][0]',
                                 2048)

'conv5_block3_3_bn[0][0]']


 conv5_block3_out (Activation)   (None, None, None,    0
['conv5_block3_add[0][0]']
                                 2048)


===================================================================
===========================
Total params: 23,587,712
Trainable params: 0
Non-trainable params: 23,587,712
```

```python
inputs = keras.Input(shape=(80, 80, 3))
x = base(inputs, training=False)
x = keras.layers.GlobalAveragePooling2D()(x)
x = keras.layers.Dropout(0.2)(x)  # Regularize with dropout
out = tf.keras.layers.Dense(n_classes, activation='softmax')(x)
model = keras.Model(inputs, out)

model.summary()
```

Model: "model"

Layer (type)	Output Shape	Param #
input_2 (InputLayer)	[(None, 80, 80, 3)]	0
resnet50 (Functional)	(None, None, None, 2048)	23587712
global_average_pooling2d (G lobalAveragePooling2D)	(None, 2048)	0
dropout (Dropout)	(None, 2048)	0
dense (Dense)	(None, 2)	4098

Total params: 23,591,810
Trainable params: 4,098
Non-trainable params: 23,587,712

```python
model.compile(optimizer="adam", loss="binary_crossentropy",
metrics=["accuracy"])

model_checkpoint=tf.keras.callbacks.ModelCheckpoint('malaria_model_100
epochs_Resnet50.h5',

save_best_only=True,

monitor='val_accuracy',
                                                    mode='max',
                                                    verbose=1)

tf.config.experimental_run_functions_eagerly(True)
```

WARNING:tensorflow:From <ipython-input-17-bdb3352f611a>:1:
experimental_run_functions_eagerly (from
tensorflow.python.eager.def_function) is deprecated and will be
removed in a future version.

```
Instructions for updating:
Use `tf.config.run_functions_eagerly` instead of the experimental
version.

history = model.fit(x_train,
                          Y_train_onehot,
        steps_per_epoch=100,
        epochs=10,
        validation_data=(x_test,Y_test_onehot),
        validation_steps=50,
        verbose=2, callbacks=[model_checkpoint])
```

/usr/local/lib/python3.7/dist-packages/tensorflow/python/data/ops/
structured_function.py:265: UserWarning: Even though the
`tf.config.experimental_run_functions_eagerly` option is set, this
option does not apply to tf.data functions. To force eager execution
of tf.data functions, please use
`tf.data.experimental.enable_debug_mode()`.
  "Even though the `tf.config.experimental_run_functions_eagerly` "

Epoch 1/10

Epoch 1: val_accuracy improved from -inf to 0.88909, saving model to
malaria_model_100epochs_Resnet50.h5
100/100 - 36s - loss: 0.4260 - accuracy: 0.8394 - val_loss: 0.2796 -
val_accuracy: 0.8891 - 36s/epoch - 363ms/step
Epoch 2/10

Epoch 2: val_accuracy improved from 0.88909 to 0.89695, saving model
to malaria_model_100epochs_Resnet50.h5
100/100 - 33s - loss: 0.3113 - accuracy: 0.8773 - val_loss: 0.2520 -
val_accuracy: 0.8970 - 33s/epoch - 331ms/step
Epoch 3/10

Epoch 3: val_accuracy improved from 0.89695 to 0.90542, saving model
to malaria_model_100epochs_Resnet50.h5
100/100 - 34s - loss: 0.2777 - accuracy: 0.8918 - val_loss: 0.2426 -
val_accuracy: 0.9054 - 34s/epoch - 339ms/step
Epoch 4/10

Epoch 4: val_accuracy improved from 0.90542 to 0.90953, saving model
to malaria_model_100epochs_Resnet50.h5
100/100 - 34s - loss: 0.2602 - accuracy: 0.8980 - val_loss: 0.2286 -
val_accuracy: 0.9095 - 34s/epoch - 335ms/step
Epoch 5/10

Epoch 5: val_accuracy improved from 0.90953 to 0.91195, saving model
to malaria_model_100epochs_Resnet50.h5
100/100 - 33s - loss: 0.2457 - accuracy: 0.9028 - val_loss: 0.2218 -
val_accuracy: 0.9119 - 33s/epoch - 326ms/step

```
Epoch 6/10

Epoch 6: val_accuracy did not improve from 0.91195
100/100 - 33s - loss: 0.2425 - accuracy: 0.9038 - val_loss: 0.2448 -
val_accuracy: 0.9057 - 33s/epoch - 331ms/step
Epoch 7/10

Epoch 7: val_accuracy improved from 0.91195 to 0.91376, saving model
to malaria_model_100epochs_Resnet50.h5
100/100 - 33s - loss: 0.2369 - accuracy: 0.9062 - val_loss: 0.2152 -
val_accuracy: 0.9138 - 33s/epoch - 333ms/step
Epoch 8/10

Epoch 8: val_accuracy did not improve from 0.91376
100/100 - 33s - loss: 0.2308 - accuracy: 0.9098 - val_loss: 0.2133 -
val_accuracy: 0.9130 - 33s/epoch - 333ms/step
Epoch 9/10

Epoch 9: val_accuracy did not improve from 0.91376
100/100 - 33s - loss: 0.2257 - accuracy: 0.9097 - val_loss: 0.2155 -
val_accuracy: 0.9127 - 33s/epoch - 333ms/step
Epoch 10/10

Epoch 10: val_accuracy improved from 0.91376 to 0.91630, saving model
to malaria_model_100epochs_Resnet50.h5
100/100 - 36s - loss: 0.2249 - accuracy: 0.9092 - val_loss: 0.2110 -
val_accuracy: 0.9163 - 36s/epoch - 364ms/step

loss = history.history['loss']
val_loss = history.history['val_loss']
epochs = range(1, len(loss) + 1)
plt.plot(epochs, loss, 'y', label='Training loss')
plt.plot(epochs, val_loss, 'r', label='Validation loss')
plt.title('Training and validation loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend()
plt.show()


acc = history.history['accuracy']
val_acc = history.history['val_accuracy']
plt.plot(epochs, acc, 'y', label='Training acc')
plt.plot(epochs, val_acc, 'r', label='Validation acc')
plt.title('Training and validation accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()
plt.show()
```
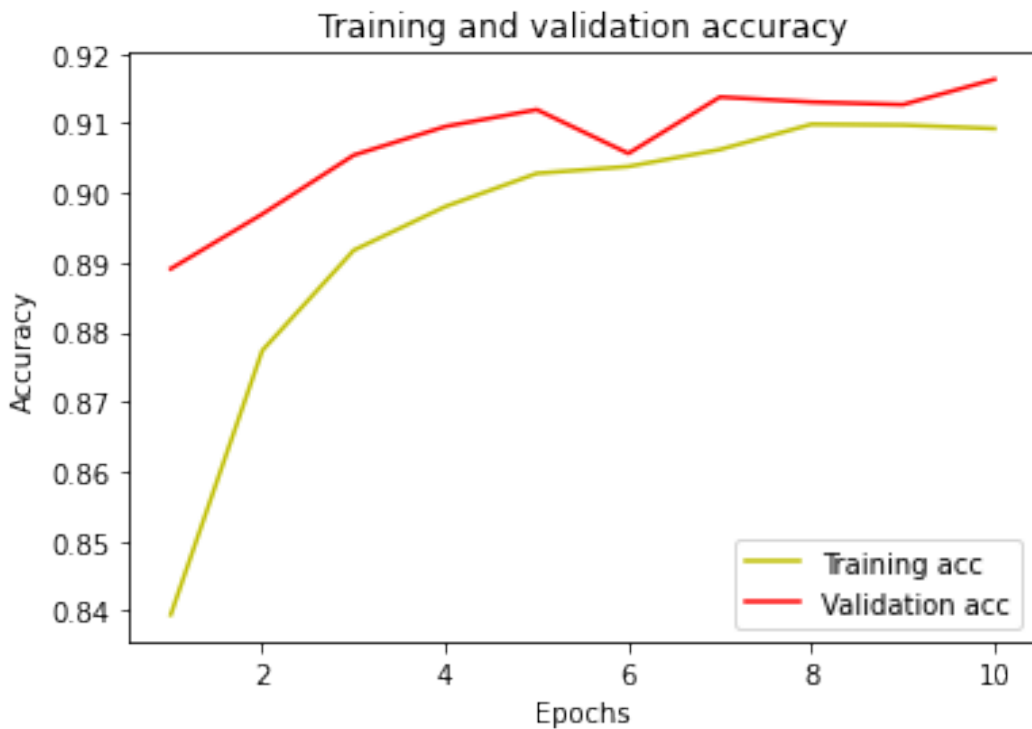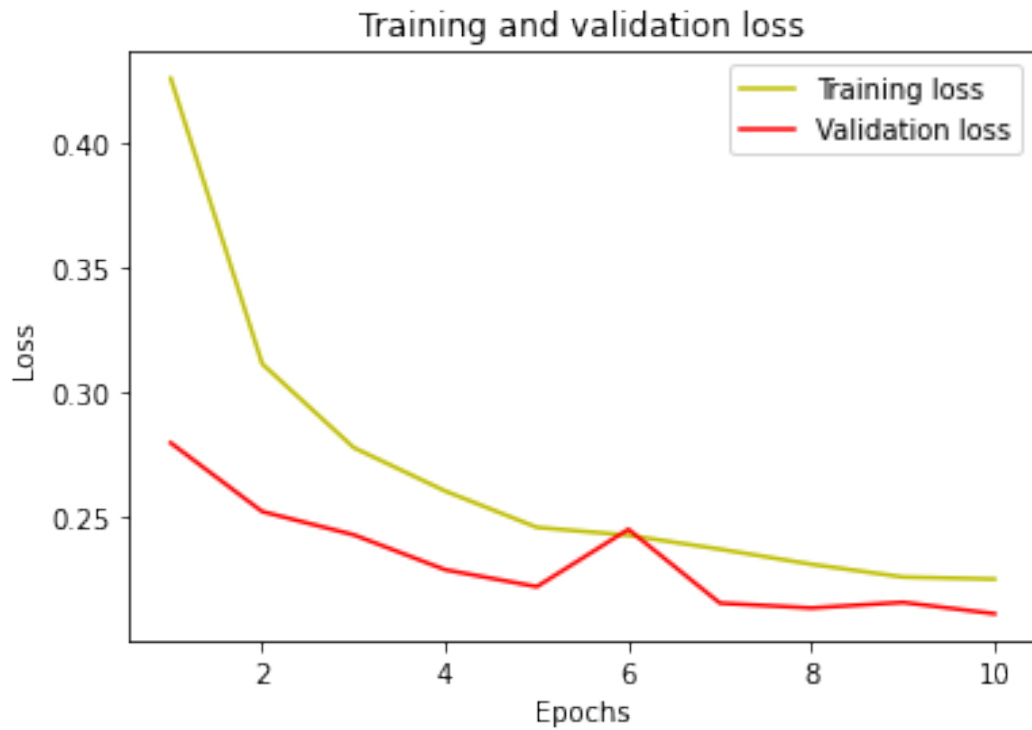
Training and validation loss

Training and validation accuracy


```python
n=52  #Select the index of image to be loaded for testing
img = x_test[n]
plt.imshow(img)
input_img = np.expand_dims(img, axis=0) #Expand dims so the input is
(num images, x, y, c)
```

```python
print("The prediction for this image is: ", model.predict(input_img))
print("The actual label for this image is: ", Y_test[n])
```

/usr/local/lib/python3.7/dist-packages/tensorflow/python/data/ops/
structured_function.py:265: UserWarning: Even though the
`tf.config.experimental_run_functions_eagerly` option is set, this
option does not apply to tf.data functions. To force eager execution
of tf.data functions, please use
`tf.data.experimental.enable_debug_mode()`.
  "Even though the `tf.config.experimental_run_functions_eagerly` "

The prediction for this image is: [[0.02093498 0.97906506]]
The actual label for this image is: 1
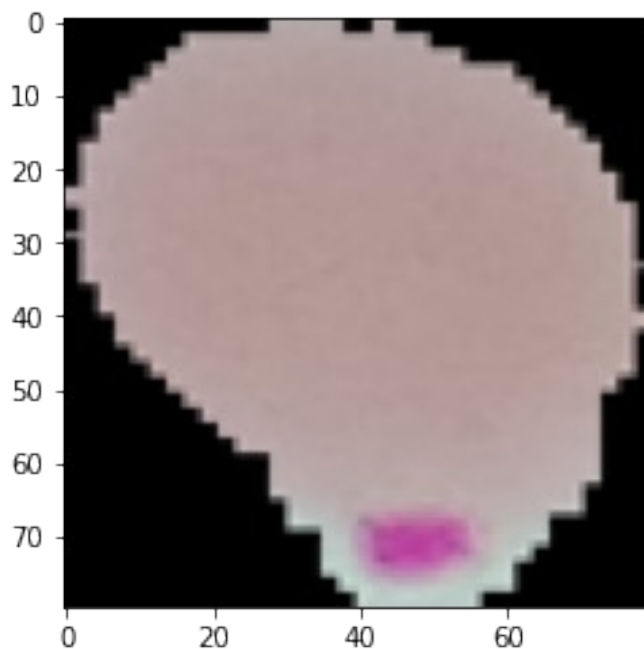

```python
model = load_model('/content/malaria_model_100epochs_Resnet50.h5')
```

#For 300 epochs, giving 82.5% accuracy

```python
_, acc = model.evaluate(x_test, Y_test_onehot)
print("Accuracy = ", (acc * 100.0), "%")
```

    1/259 [..............................] - ETA: 23s - loss: 0.2719 -
accuracy: 0.9375

/usr/local/lib/python3.7/dist-packages/tensorflow/python/data/ops/
structured_function.py:265: UserWarning: Even though the
`tf.config.experimental_run_functions_eagerly` option is set, this
option does not apply to tf.data functions. To force eager execution
of tf.data functions, please use

```
 `tf.data.experimental.enable_debug_mode()`.
   "Even though the `tf.config.experimental_run_functions_eagerly` "
```

```
259/259 [==============================] - 20s 77ms/step - loss:
0.2110 - accuracy: 0.9163
Accuracy =  91.6303813457489 %
```

```
mythreshold=0.885
from sklearn.metrics import confusion_matrix

y_pred = (model.predict(x_test)>= mythreshold).astype(int)

cm=multilabel_confusion_matrix(Y_test_onehot, y_pred)
print(cm)
```

```
/usr/local/lib/python3.7/dist-packages/tensorflow/python/data/ops/
structured_function.py:265: UserWarning: Even though the
`tf.config.experimental_run_functions_eagerly` option is set, this
option does not apply to tf.data functions. To force eager execution
of tf.data functions, please use
`tf.data.experimental.enable_debug_mode()`.
   "Even though the `tf.config.experimental_run_functions_eagerly` "
```

```
[[[3946  148]
  [ 708 3466]]

 [[4000  174]
  [ 615 3479]]]
```