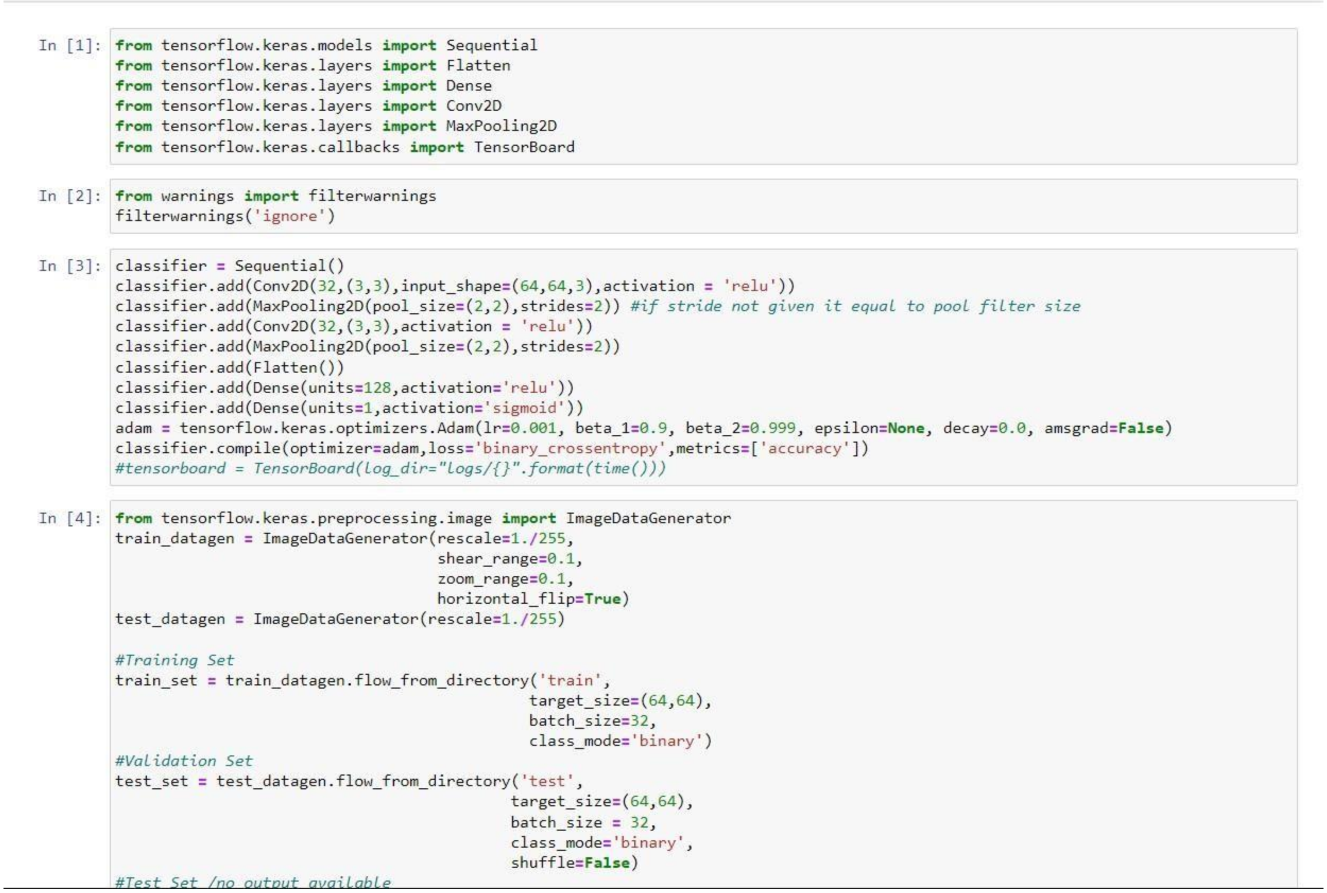
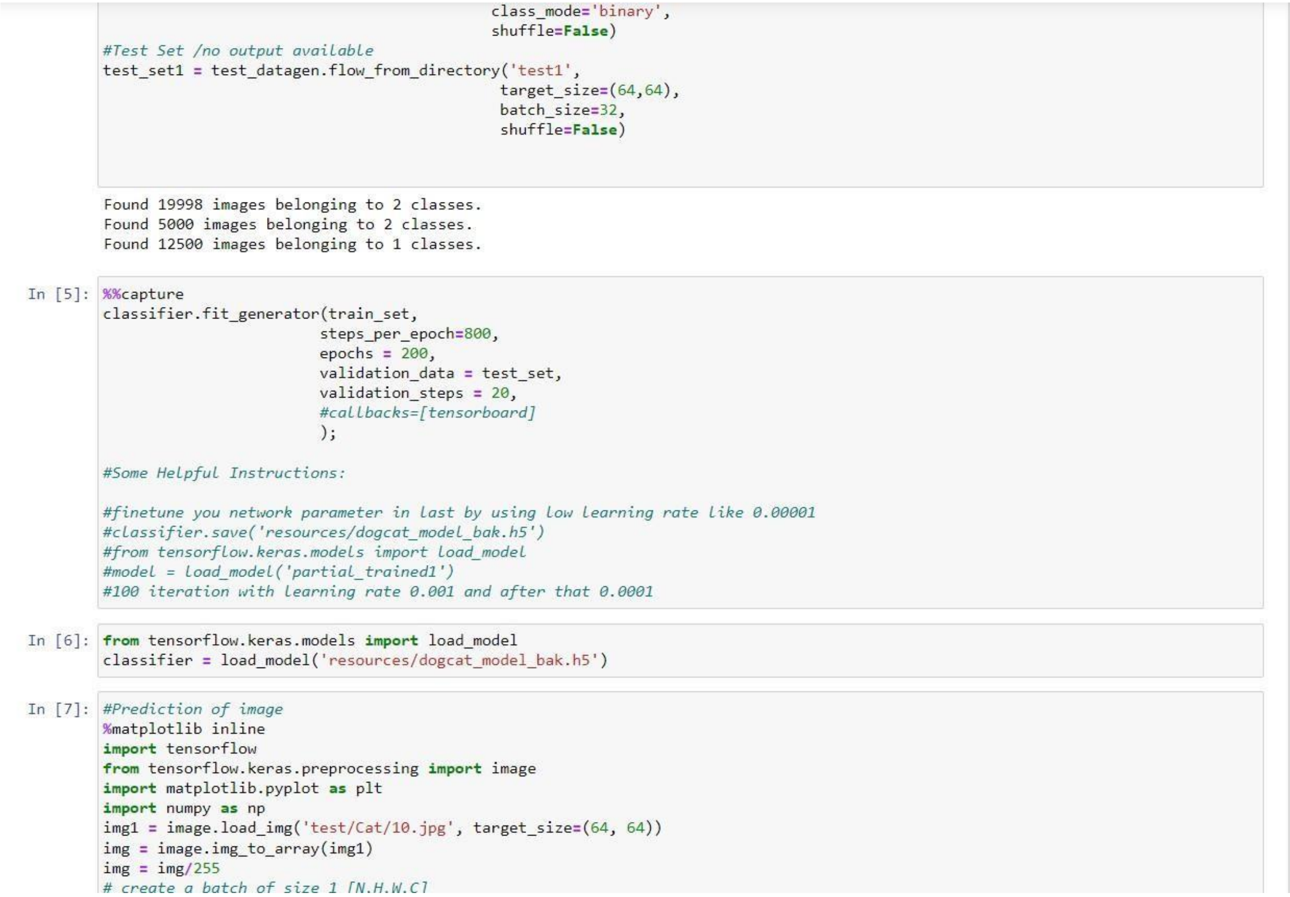


In [1]:
```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Flatten
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import Conv2D
from tensorflow.keras.layers import MaxPooling2D
from tensorflow.keras.callbacks import TensorBoard
```

In [2]:
```
from warnings import filterwarnings
filterwarnings('ignore')
```

In [3]:
```
classifier = Sequential()
classifier.add(Conv2D(32,(3,3),input_shape=(64,64,3),activation = 'relu'))
classifier.add(MaxPooling2D(pool_size=(2,2),strides=2)) #if stride not given it equal to pool filter size
classifier.add(Conv2D(32,(3,3),activation = 'relu'))
classifier.add(MaxPooling2D(pool_size=(2,2),strides=2))
classifier.add(Flatten())
classifier.add(Dense(units=128,activation='relu'))
classifier.add(Dense(units=1,activation='sigmoid'))
adam = tensorflow.keras.optimizers.Adam(lr=0.001, beta_1=0.9, beta_2=0.999, epsilon=None, decay=0.0, amsgrad=False)
classifier.compile(optimizer=adam,loss='binary_crossentropy',metrics=['accuracy'])
#tensorboard = TensorBoard(log_dir="logs/{}".format(time()))
```

In [4]:
```
from tensorflow.keras.preprocessing.image import ImageDataGenerator
train_datagen = ImageDataGenerator(rescale=1./255,
                                   shear_range=0.1,
                                   zoom_range=0.1,
                                   horizontal_flip=True)
test_datagen = ImageDataGenerator(rescale=1./255)

#Training Set
train_set = train_datagen.flow_from_directory('train',
                                             target_size=(64,64),
                                             batch_size=32,
                                             class_mode='binary')
#Validation Set
test_set = test_datagen.flow_from_directory('test',
                                           target_size=(64,64),
                                           batch_size = 32,
                                           class_mode='binary',
                                           shuffle=False)
#Test Set /no output available
```



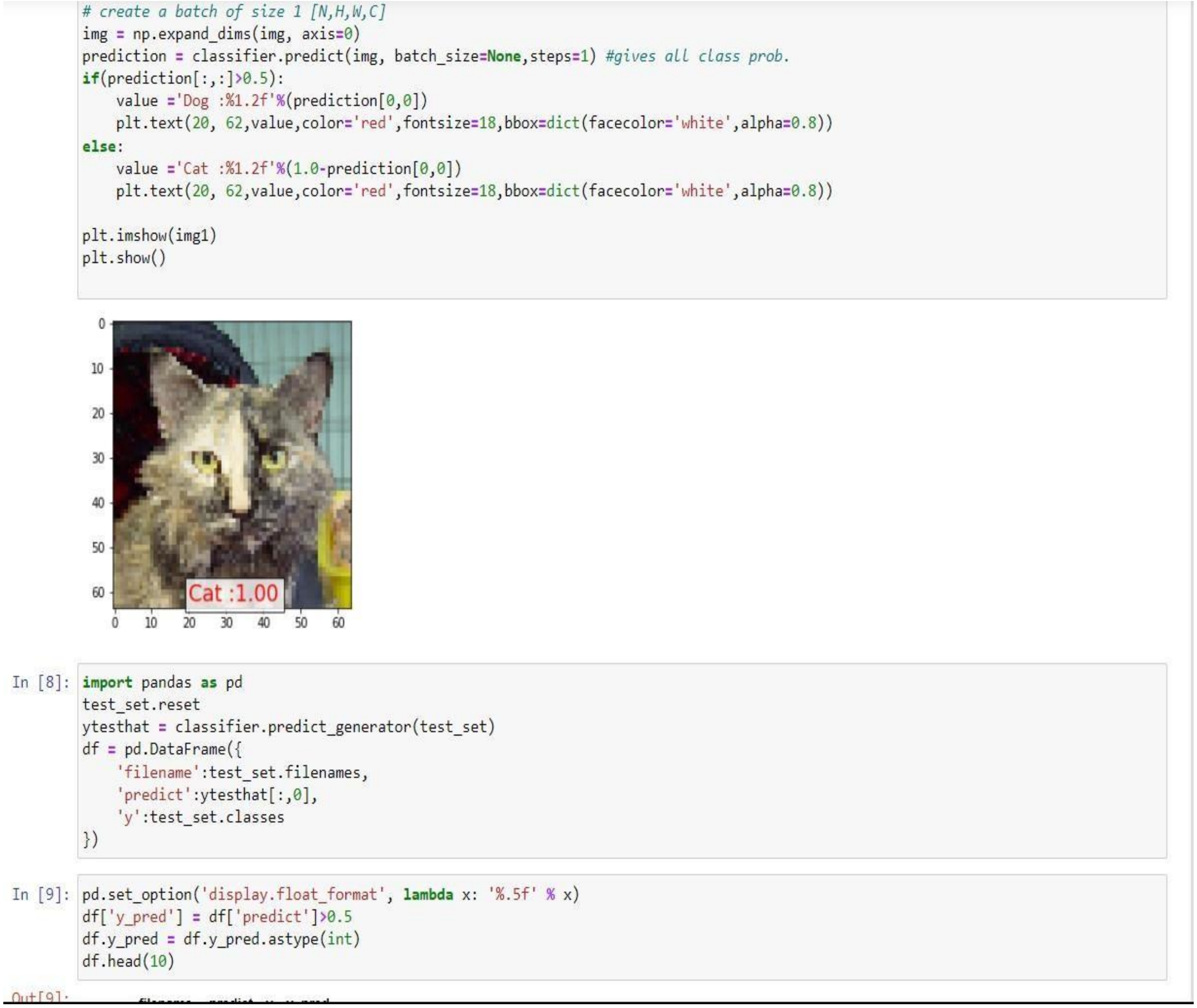
```
                                             class_mode='binary',
                                             shuffle=False)
#Test Set /no output available
test_set1 = test_datagen.flow_from_directory('test1',
                                              target_size=(64,64),
                                              batch_size=32,
                                              shuffle=False)
```

```
Found 19998 images belonging to 2 classes.
Found 5000 images belonging to 2 classes.
Found 12500 images belonging to 1 classes.
```

```
In [5]: %%capture
        classifier.fit_generator(train_set,
                                steps_per_epoch=800,
                                epochs = 200,
                                validation_data = test_set,
                                validation_steps = 20,
                                #callbacks=[tensorboard]
                                );

        #Some Helpful Instructions:

        #finetune you network parameter in last by using low learning rate like 0.00001
        #classifier.save('resources/dogcat_model_bak.h5')
        #from tensorflow.keras.models import load_model
        #model = load_model('partial_trained1')
        #100 iteration with learning rate 0.001 and after that 0.0001
```

```
In [6]: from tensorflow.keras.models import load_model
        classifier = load_model('resources/dogcat_model_bak.h5')
```

```
In [7]: #Prediction of image
        %matplotlib inline
        import tensorflow
        from tensorflow.keras.preprocessing import image
        import matplotlib.pyplot as plt
        import numpy as np
        img1 = image.load_img('test/Cat/10.jpg', target_size=(64, 64))
        img = image.img_to_array(img1)
        img = img/255
        # create a batch of size 1 [N,H,W,C]
```

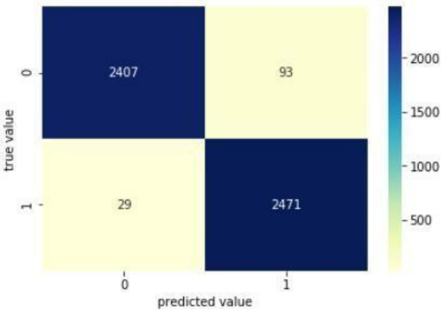


```
# create a batch of size 1 [N,H,W,C]
img = np.expand_dims(img, axis=0)
prediction = classifier.predict(img, batch_size=None,steps=1) #gives all class prob.
if(prediction[:,:]>0.5):
    value ='Dog :%1.2f'%(prediction[0,0])
    plt.text(20, 62,value,color='red',fontsize=18,bbox=dict(facecolor='white',alpha=0.8))
else:
    value ='Cat :%1.2f'%(1.0-prediction[0,0])
    plt.text(20, 62,value,color='red',fontsize=18,bbox=dict(facecolor='white',alpha=0.8))

plt.imshow(img1)
plt.show()
```

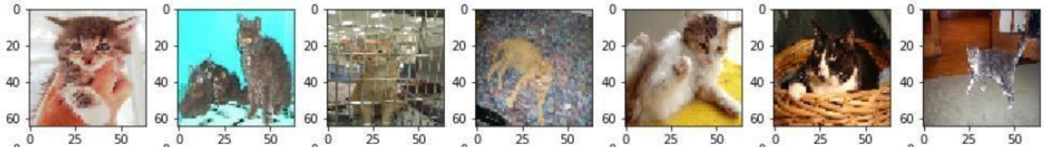
```
In [8]: import pandas as pd
        test_set.reset
        ytesthat = classifier.predict_generator(test_set)
        df = pd.DataFrame({
            'filename':test_set.filenames,
            'predict':ytesthat[:,0],
            'y':test_set.classes
        })
```

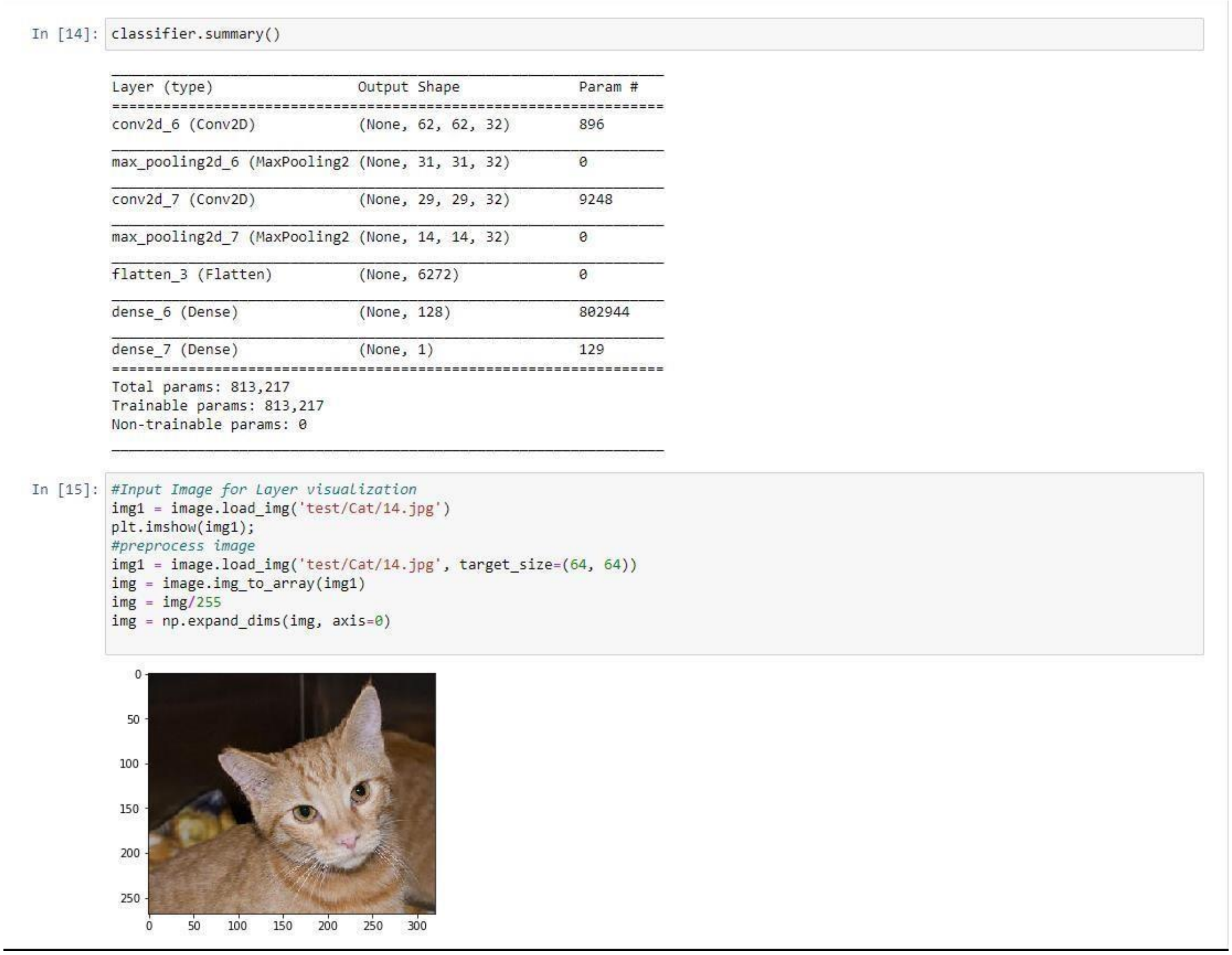
```
In [9]: pd.set_option('display.float_format', lambda x: '%.5f' % x)
        df['y_pred'] = df['predict']>0.5
        df.y_pred = df.y_pred.astype(int)
        df.head(10)
```

```
Out[9]:
```



In [12]:
```
#Some of Cat image misclassified as Dog.
import matplotlib.image as mpimg

CatasDog = df['filename'][(df.y==0)&(df.y_pred==1)]
fig=plt.figure(figsize=(15, 6))
columns = 7
rows = 3
for i in range(columns*rows):
    #img = mpimg.imread()
    img = image.load_img('test/'+CatasDog.iloc[i], target_size=(64, 64))
    fig.add_subplot(rows, columns, i+1)
    plt.imshow(img)

plt.show()
```

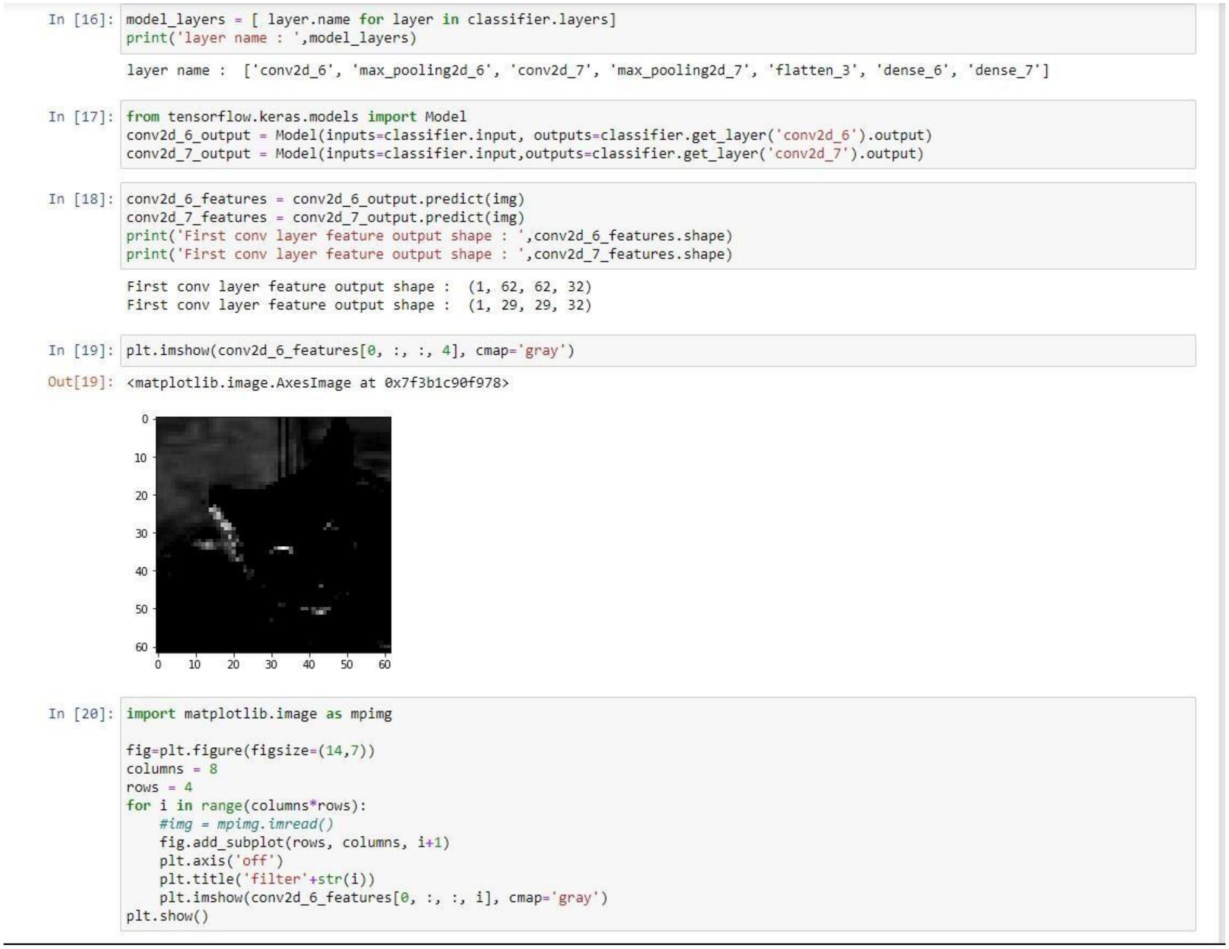




```
In [14]: classifier.summary()
```

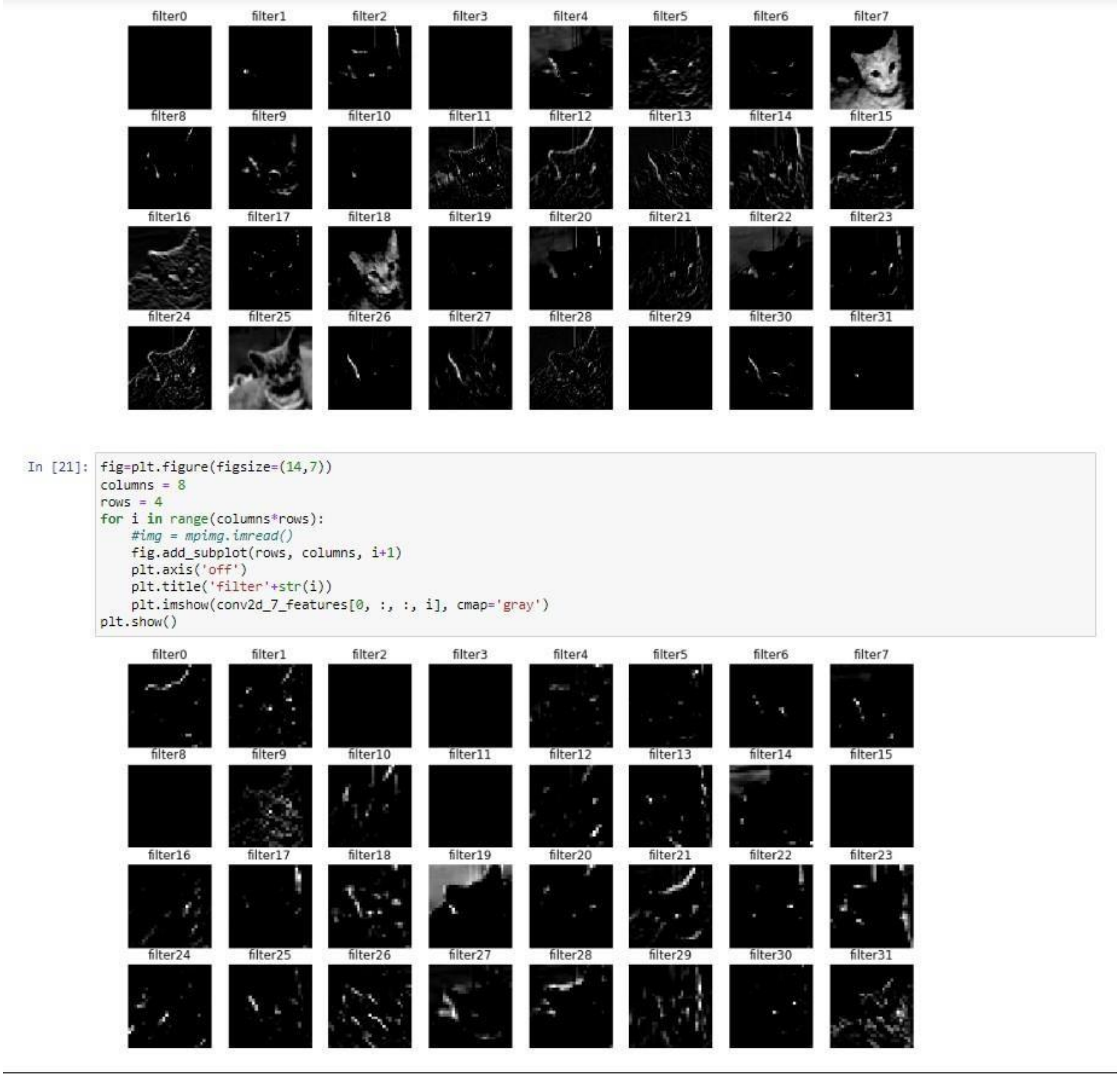
```
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
conv2d_6 (Conv2D)            (None, 62, 62, 32)        896       
_________________________________________________________________
max_pooling2d_6 (MaxPooling2 (None, 31, 31, 32)        0         
_________________________________________________________________
conv2d_7 (Conv2D)            (None, 29, 29, 32)        9248      
_________________________________________________________________
max_pooling2d_7 (MaxPooling2 (None, 14, 14, 32)        0         
_________________________________________________________________
flatten_3 (Flatten)          (None, 6272)              0         
_________________________________________________________________
dense_6 (Dense)              (None, 128)               802944    
_________________________________________________________________
dense_7 (Dense)              (None, 1)                 129       
=================================================================
Total params: 813,217
Trainable params: 813,217
Non-trainable params: 0
_________________________________________________________________
```

```
In [15]: #Input Image for Layer visualization
         img1 = image.load_img('test/Cat/14.jpg')
         plt.imshow(img1);
         #preprocess image
         img1 = image.load_img('test/Cat/14.jpg', target_size=(64, 64))
         img = image.img_to_array(img1)
         img = img/255
         img = np.expand_dims(img, axis=0)
```

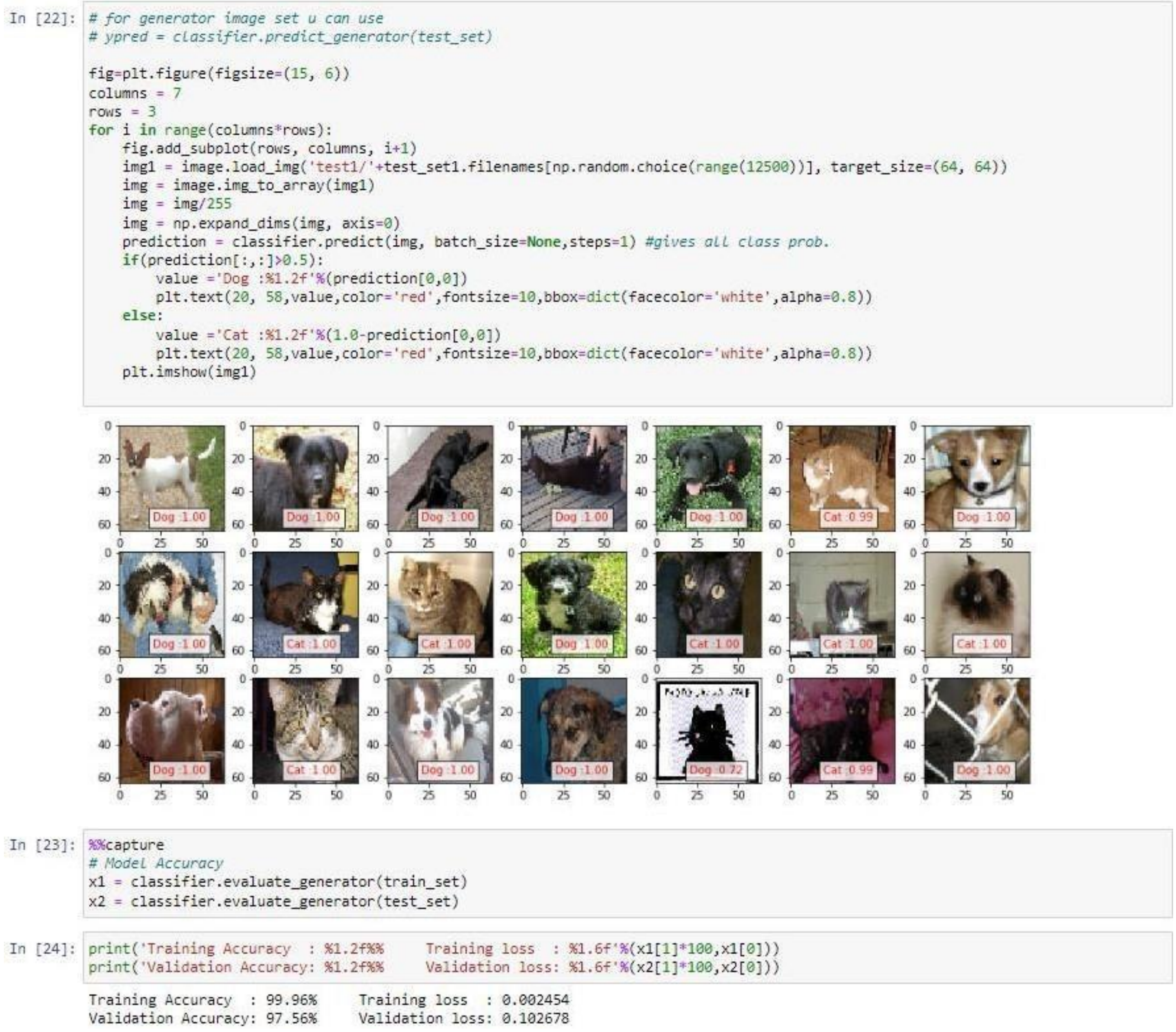


```
In [16]: model_layers = [ layer.name for layer in classifier.layers]
         print('layer name : ',model_layers)

         layer name :  ['conv2d_6', 'max_pooling2d_6', 'conv2d_7', 'max_pooling2d_7', 'flatten_3', 'dense_6', 'dense_7']

In [17]: from tensorflow.keras.models import Model
         conv2d_6_output = Model(inputs=classifier.input, outputs=classifier.get_layer('conv2d_6').output)
         conv2d_7_output = Model(inputs=classifier.input,outputs=classifier.get_layer('conv2d_7').output)

In [18]: conv2d_6_features = conv2d_6_output.predict(img)
         conv2d_7_features = conv2d_7_output.predict(img)
         print('First conv layer feature output shape : ',conv2d_6_features.shape)
         print('First conv layer feature output shape : ',conv2d_7_features.shape)

         First conv layer feature output shape :  (1, 62, 62, 32)
         First conv layer feature output shape :  (1, 29, 29, 32)

In [19]: plt.imshow(conv2d_6_features[0, :, :, 4], cmap='gray')

Out[19]: <matplotlib.image.AxesImage at 0x7f3b1c90f978>
```

```
In [20]: import matplotlib.image as mpimg

         fig=plt.figure(figsize=(14,7))
         columns = 8
         rows = 4
         for i in range(columns*rows):
             #img = mpimg.imread()
             fig.add_subplot(rows, columns, i+1)
             plt.axis('off')
             plt.title('filter'+str(i))
             plt.imshow(conv2d_6_features[0, :, :, i], cmap='gray')
         plt.show()
```



```
In [21]: fig=plt.figure(figsize=(14,7))
         columns = 8
         rows = 4
         for i in range(columns*rows):
             #img = mpimg.imread()
             fig.add_subplot(rows, columns, i+1)
             plt.axis('off')
             plt.title('filter'+str(i))
             plt.imshow(conv2d_7_features[0, :, :, i], cmap='gray')
         plt.show()
```



```
In [22]: # for generator image set u can use
         # ypred = classifier.predict_generator(test_set)

         fig=plt.figure(figsize=(15, 6))
         columns = 7
         rows = 3
         for i in range(columns*rows):
             fig.add_subplot(rows, columns, i+1)
             img1 = image.load_img('test1/'+test_set1.filenames[np.random.choice(range(12500))], target_size=(64, 64))
             img = image.img_to_array(img1)
             img = img/255
             img = np.expand_dims(img, axis=0)
             prediction = classifier.predict(img, batch_size=None,steps=1) #gives all class prob.
             if(prediction[:,:]>0.5):
                 value ='Dog :%1.2f'%(prediction[0,0])
                 plt.text(20, 58,value,color='red',fontsize=10,bbox=dict(facecolor='white',alpha=0.8))
             else:
                 value ='Cat :%1.2f'%(1.0-prediction[0,0])
                 plt.text(20, 58,value,color='red',fontsize=10,bbox=dict(facecolor='white',alpha=0.8))
             plt.imshow(img1)
```

```
In [23]: %%capture
         # Model Accuracy
         x1 = classifier.evaluate_generator(train_set)
         x2 = classifier.evaluate_generator(test_set)
```

```
In [24]: print('Training Accuracy  : %1.2f%%     Training loss  : %1.6f'%(x1[1]*100,x1[0]))
         print('Validation Accuracy: %1.2f%%     Validation loss: %1.6f'%(x2[1]*100,x2[0]))

         Training Accuracy  : 99.96%     Training loss  : 0.002454
         Validation Accuracy: 97.56%     Validation loss: 0.102678
```

Conclusion

The Architecture and parameter used in this network are capable of producing accuracy of 97.56% on Validation Data which is pretty good.