```
import numpy as np
import pandas as pd
from keras.preprocessing.image import ImageDataGenerator,load_img
from tensorflow.keras.utils import to_categorical
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
import random
import os
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
    Mounted at /content/drive
```

```
Image_Width=128
Image_Height=128
Image_Size=(Image_Width,Image_Height)
Image_Channels=3
```

```
from keras.models import Sequential
from keras.layers import Conv2D,MaxPooling2D,\
     Dropout,Flatten,Dense,Activation,\
     BatchNormalization

model=Sequential()

model.add(Conv2D(32,(3,3),activation='relu',input_shape=(Image_Width,Image_Height,Imag
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Dropout(0.25))

model.add(Conv2D(64,(3,3),activation='relu'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Dropout(0.25))

model.add(Conv2D(128,(3,3),activation='relu'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Dropout(0.25))

model.add(Flatten())
model.add(Dense(512,activation='relu'))
model.add(BatchNormalization())
model.add(Dropout(0.5))
model.add(Dense(2,activation='softmax'))

model.compile(loss='categorical_crossentropy',
    optimizer='rmsprop',metrics=['accuracy'])
```

```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #   
=================================================================
 conv2d (Conv2D)             (None, 126, 126, 32)      896       
                                                                 
 batch_normalization (BatchN  (None, 126, 126, 32)     128       
 ormalization)                                                   
                                                                 
 max_pooling2d (MaxPooling2D  (None, 63, 63, 32)       0         
 )                                                               
                                                                 
 dropout (Dropout)           (None, 63, 63, 32)        0         
                                                                 
 conv2d_1 (Conv2D)           (None, 61, 61, 64)        18496     
                                                                 
 batch_normalization_1 (Batc  (None, 61, 61, 64)       256       
 hNormalization)                                                 
                                                                 
 max_pooling2d_1 (MaxPooling  (None, 30, 30, 64)       0         
 2D)                                                             
                                                                 
 dropout_1 (Dropout)         (None, 30, 30, 64)        0         
                                                                 
 conv2d_2 (Conv2D)           (None, 28, 28, 128)       73856     
                                                                 
 batch_normalization_2 (Batc  (None, 28, 28, 128)      512       
 hNormalization)                                                 
                                                                 
 max_pooling2d_2 (MaxPooling  (None, 14, 14, 128)      0         
 2D)                                                             
                                                                 
 dropout_2 (Dropout)         (None, 14, 14, 128)       0         
                                                                 
 flatten (Flatten)           (None, 25088)             0         
                                                                 
 dense (Dense)               (None, 512)               12845568  
                                                                 
 batch_normalization_3 (Batc  (None, 512)              2048      
 hNormalization)                                                 
                                                                 
 dropout_3 (Dropout)         (None, 512)               0         
                                                                 
 dense_1 (Dense)             (None, 2)                 1026      
                                                                 
=================================================================
Total params: 12,942,786
Trainable params: 12,941,314
Non-trainable params: 1,472
_________________________________________________________________
```

```
from keras.callbacks import EarlyStopping, ReduceLROnPlateau
earlystop = EarlyStopping(patience = 10)
learning_rate_reduction = ReduceLROnPlateau(monitor = 'val_acc',patience = 2,verbose =
callbacks = [earlystop,learning_rate_reduction]
```

```
#!unzip /content/drive/MyDrive/Dog_breed.zip
#!unzip /content/drive/MyDrive/cat_breed.zip
```

```
df_full = pd.read_csv('/content/drive/MyDrive/df_full_cats_dogs.csv')
```

```
df_full = df_full.drop(['Labels'], axis=1)
df_full
```

```
       Unnamed: 0                                     Imagepath  Animal
    0           0    /content/train/b9f96dd0c9f3dc7e755d9b8cbb124f3...       1
    1           1   /content/train/f706682a30021cc74cd9416dac25e94...       1
    2           2     /content/train/8f3e10fab6ea57479f91a5c6efc1135...       1
    3           3  /content/train/65a3a8d1011f95e937d77e3a79700da...       1
    4           4  /content/train/324759773574e9bd6d6ba9c58e1550f...       1
   ...        ...                                                  ...     ...
56192       45970   /content/cat_breed/American Bobtail/22833651_3...       0
56193       45971   /content/cat_breed/American Bobtail/18490404_4...       0
56194       45972   /content/cat_breed/American Bobtail/37275567_1...       0
56195       45973   /content/cat_breed/American Bobtail/20529323_4...       0
56196       45974   /content/cat_breed/American Bobtail/44719213_3...       0

56197 rows × 3 columns
```

```
df = df_full[['Imagepath','Animal']].copy()
```

```
df
```

	Imagepath	Animal
0	/content/train/b9f96dd0c9f3dc7e755d9b8cbb124f3...	1
1	/content/train/f706682a30021cc74cd9416dac25e94...	1
2	/content/train/8f3e10fab6ea57479f91a5c6efc1135...	1
3	/content/train/65a3a8d1011f95e937d77e3a79700da...	1
4	/content/train/324759773574e9bd6d6ba9c58e1550f...	1
...	...	...
56192	/content/cat_breed/American Bobtail/22833651_3...	0

```
df["Animal"] = df["Animal"].replace({0:'cat',1:'dog'})
train_df,validate_df = train_test_split(df,test_size=0.20,
  random_state=42)

train_df = train_df.reset_index(drop=True)
validate_df = validate_df.reset_index(drop=True)

total_train=train_df.shape[0]
total_validate=validate_df.shape[0]
batch_size=15


train_datagen = ImageDataGenerator(rotation_range=15,
                                rescale=1./255,
                                shear_range=0.1,
                                zoom_range=0.2,
                                horizontal_flip=True,
                                width_shift_range=0.1,
                                height_shift_range=0.1
                                )

train_generator = train_datagen.flow_from_dataframe(train_df,
                                                 x_col='Imagepath',y_col='Animal',
                                                 target_size=Image_Size,
                                                 class_mode='categorical',
                                                 batch_size=batch_size)

validation_datagen = ImageDataGenerator(rescale=1./255)
validation_generator = validation_datagen.flow_from_dataframe(
    validate_df,
    x_col='Imagepath',
    y_col='Animal',
    target_size=Image_Size,
    class_mode='categorical',
    batch_size=batch_size
)
```

```
test_datagen = ImageDataGenerator(rotation_range=15,
                                rescale=1./255,
                                shear_range=0.1,
                                zoom_range=0.2,
                                horizontal_flip=True,
                                width_shift_range=0.1,
                                height_shift_range=0.1)

test_generator = train_datagen.flow_from_dataframe(train_df,
                                                 x_col='Imagepath',y_col='Animal',
                                                 target_size=Image_Size,
                                                 class_mode='categorical',
                                                 batch_size=batch_size)
```

```
Found 44957 validated image filenames belonging to 2 classes.
Found 11240 validated image filenames belonging to 2 classes.
Found 44957 validated image filenames belonging to 2 classes.
```

```
epochs=10
history = model.fit_generator(
    train_generator,
    epochs=epochs,
    validation_data=validation_generator,
    validation_steps=total_validate//batch_size,
    steps_per_epoch=total_train//batch_size,
    callbacks=callbacks
)
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:8: UserWarning: `Mo

Epoch 1/10
2997/2997 [==============================] - ETA: 0s - loss: 0.3825 - accuracy:
2997/2997 [==============================] - 385s 123ms/step - loss: 0.3825 - ac
Epoch 2/10
2997/2997 [==============================] - ETA: 0s - loss: 0.2664 - accuracy:
2997/2997 [==============================] - 355s 119ms/step - loss: 0.2664 - ac
Epoch 3/10
2997/2997 [==============================] - ETA: 0s - loss: 0.2396 - accuracy:
2997/2997 [==============================] - 345s 115ms/step - loss: 0.2396 - ac
Epoch 4/10
2997/2997 [==============================] - ETA: 0s - loss: 0.2198 - accuracy:
2997/2997 [==============================] - 347s 116ms/step - loss: 0.2198 - ac
Epoch 5/10
2997/2997 [==============================] - ETA: 0s - loss: 0.2044 - accuracy:
2997/2997 [==============================] - 359s 120ms/step - loss: 0.2044 - ac
Epoch 6/10
2997/2997 [==============================] - ETA: 0s - loss: 0.1931 - accuracy:
2997/2997 [==============================] - 357s 119ms/step - loss: 0.1931 - ac
Epoch 7/10
2997/2997 [==============================] - ETA: 0s - loss: 0.1851 - accuracy:
2997/2997 [==============================] - 363s 121ms/step - loss: 0.1851 - ac
Epoch 8/10
2997/2997 [==============================] - ETA: 0s - loss: 0.1859 - accuracy:
```

```
2997/2997 [==============================] - 359s 120ms/step - loss: 0.1859 - ac
Epoch 9/10
2997/2997 [==============================] - ETA: 0s - loss: 0.1809 - accuracy:
2997/2997 [==============================] - 358s 119ms/step - loss: 0.1809 - ac
Epoch 10/10
2997/2997 [==============================] - ETA: 0s - loss: 0.1787 - accuracy:
2997/2997 [==============================] - 350s 117ms/step - loss: 0.1787 - ac
```

LOADING THE MODEL & SAVING THE MODEL

```
from keras.models import model_from_json
model_cat_vs_dog_json = model.to_json()
with open("/content/drive/MyDrive/model_cat_vs_dog1.json", "w") as json_file:
    json_file.write(model_cat_vs_dog_json)
# serialize weights to HDF5
model.save_weights("/content/drive/MyDrive/model_cat_vs_dog1.h5")
print("Saved model to disk")

'''
LOADING THE WEIGHTS OF THE DEEP LEARNING NETWORK
# load json and create model
json_file = open('model_cat.json', 'r')
loaded_model_json = json_file.read()
json_file.close()
loaded_model = model_from_json(loaded_model_json)
# load weights into new model
loaded_model.load_weights("model.h5")
print("Loaded model from disk")
'''
```

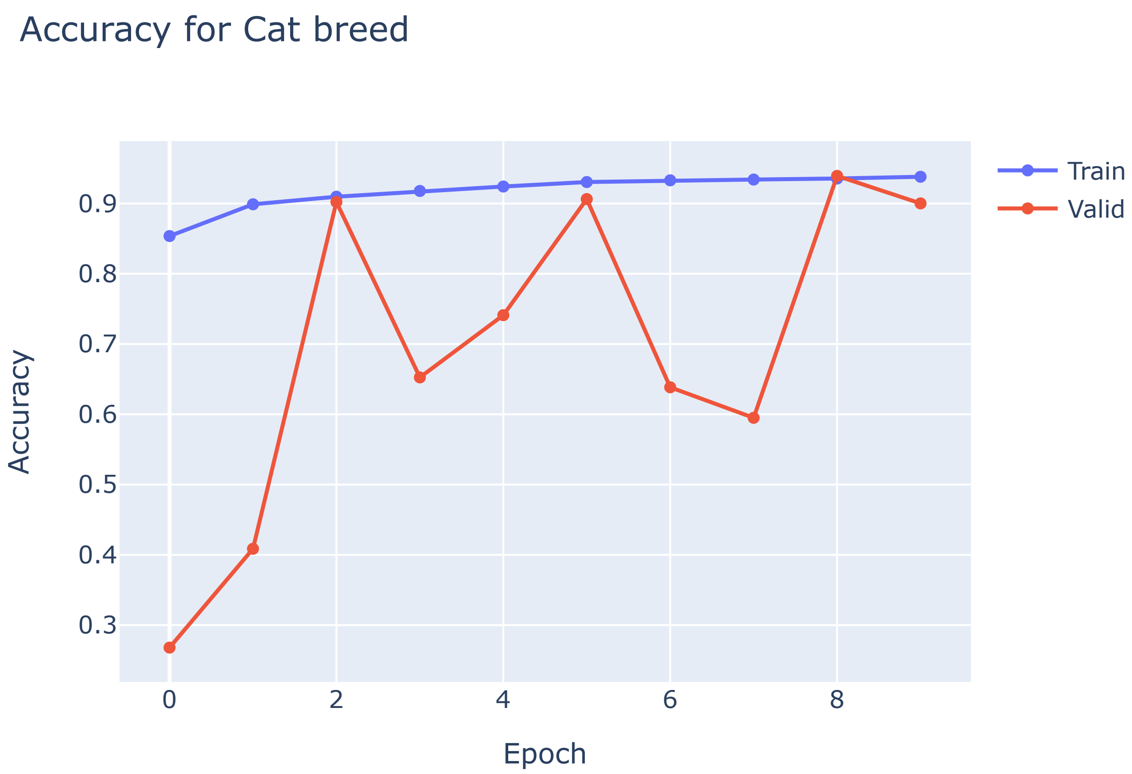
```
Saved model to disk
'\nLOADING THE WEIGHTS OF THE DEEP LEARNING NETWORK\n# load json and create mode
l\njson_file = open(\'model_cat.json\', \'r\')\nloaded_model_json = json_file.re
ad()\njson_file.close()\nloaded_model = model_from_json(loaded_model_json)\n# lo
```

LOADING THE HISTORY & SAVING THE HISTORY

```
#SAVING THE HISTORY

np.save('/content/drive/MyDrive/my_history_cat_dog.npy',history.history)

#Loading the history

#history=np.load('/content/drive/MyDrive/my_history_cat_dog.npy',allow_pickle='TRUE').
```

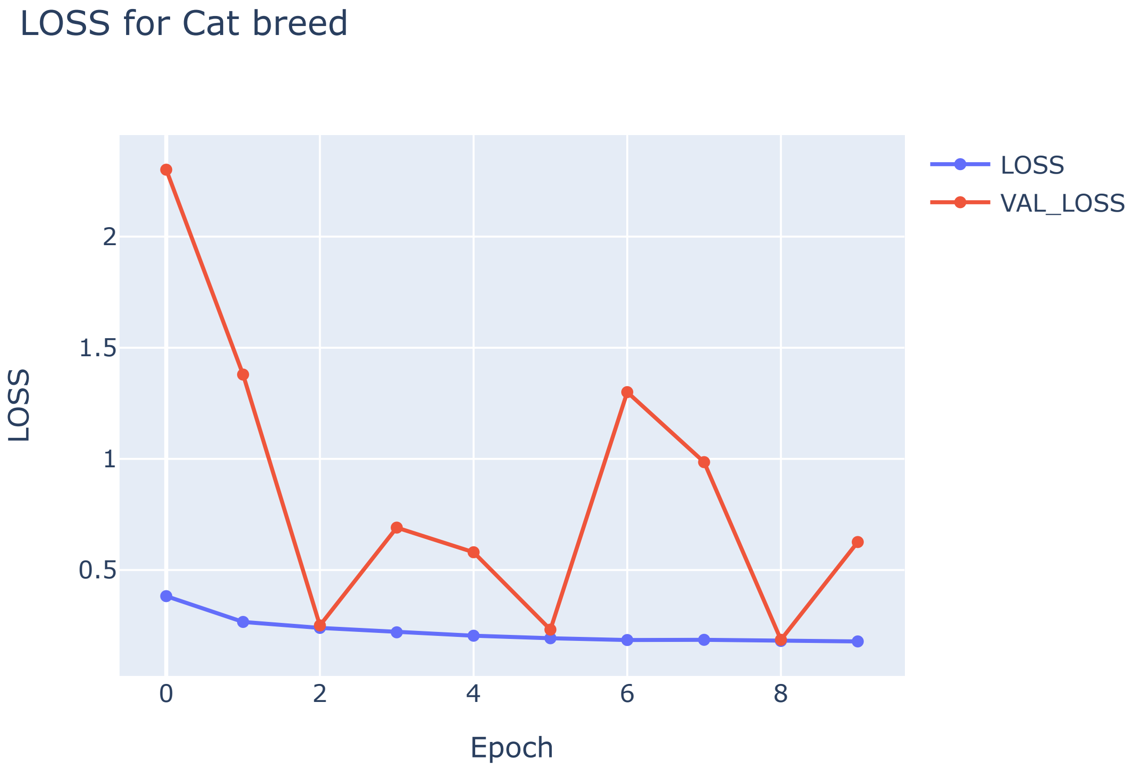
ACCURACY VISUALIZATION

```
import plotly.graph_objects as go
from IPython.display import display, Image
plt.clf()
fig = go.Figure()
fig.add_trace(go.Scatter(
                    y=history.history['accuracy'],
                    name='Train'))

fig.add_trace(go.Scatter(
                    y=history.history['val_accuracy'],
                    name='Valid'))


fig.update_layout(height=450,
                  width=600,
                  title='Accuracy for Cat breed',
                  xaxis_title='Epoch',
                  yaxis_title='Accuracy')

fig.show()
```



```
<Figure size 432x288 with 0 Axes>
```

```
plt.clf()
fig = go.Figure()
fig.add_trace(go.Scatter(
                    y=history.history['loss'],
                    name='LOSS'))

fig.add_trace(go.Scatter(
                    y=history.history['val_loss'],
                    name='VAL_LOSS'))


fig.update_layout(height=450,
                  width=600,
                  title='LOSS for Cat breed',
                  xaxis_title='Epoch',
                  yaxis_title='LOSS')


fig.show()
```



```
<Figure size 432x288 with 0 Axes>
```

```
df
```

	Imagepath	Animal
0	/content/train/b9f96dd0c9f3dc7e755d9b8cbb124f3...	dog
1	/content/train/f706682a30021cc74cd9416dac25e94...	dog
2	/content/train/8f3e10fab6ea57479f91a5c6efc1135...	dog
3	/content/train/65a3a8d1011f95e937d77e3a79700da...	dog
4	/content/train/324759773574e9bd6d6ba9c58e1550f...	dog
...	...	...
56192	/content/cat_breed/American Bobtail/22833651_3...	cat
56193	/content/cat_breed/American Bobtail/18490404_4...	cat
56194	/content/cat_breed/American Bobtail/37275567_1...	cat
56195	/content/cat_breed/American Bobtail/20529323_4...	cat
56196	/content/cat_breed/American Bobtail/44719213_3...	cat

56197 rows × 2 columns

```
train_df,test_df = train_test_split(df,test_size=0.10,
  random_state=15)
```

```
test_df
```

	Imagepath	Animal
43550	/content/cat_breed/Torbie/29322321_9800.jpg	cat
17193	/content/cat_breed/Tabby/46127685_8568.jpg	cat
29112	/content/cat_breed/Dilute Tortoiseshell/304766...	cat
18622	/content/cat_breed/Tabby/46514657_22856.jpg	cat
28251	/content/cat_breed/Dilute Tortoiseshell/459674...	cat
...	...	...
53751	/content/cat_breed/Manx/40124344_2161.jpg	cat
14398	/content/cat_breed/Ragdoll/22093596_7239.jpg	cat
41368	/content/cat_breed/Dilute Calico/33591660_6473...	cat
9127	/content/train/1d114c4409c9cba464f762b11ce47d5...	dog
4249	/content/train/8daabe9ded307c802b5f84492bc14d6...	dog

5620 rows × 2 columns

```
train_df
```

	Imagepath	Animal
49524	/content/cat_breed/Siamese/45998080_3612.jpg	cat
7846	/content/train/339b364c38154241070ef70a6769fbe...	dog
31399	/content/cat_breed/Tuxedo/46460970_28737.jpg	cat
30183	/content/cat_breed/Snowshoe/34323435_3656.jpg	cat
21331	/content/cat_breed/Bengal/42656471_1704.jpg	cat
...	...	...
49015	/content/cat_breed/Tiger/42774684_4228.jpg	cat
2693	/content/train/19a8c1698819d382c3ead14bdc1a360...	dog
8076	/content/train/4b47fe23fa6972002789b8c68cdf739...	dog
52981	/content/cat_breed/Manx/41140776_1985.jpg	cat
7624	/content/train/dfc362b94e5653a508ceaf63d6b1ffa...	dog

50577 rows × 2 columns

```
nb_samples = test_df.shape[0]
nb_samples
```

```
5620
```

```
test_generator = test_datagen.flow_from_dataframe(test_df,
                                                  x_col='Imagepath',y_col='Animal',
                                                  target_size=Image_Size,
                                                  class_mode='categorical',
                                                  batch_size=batch_size)
```

```
Found 5620 validated image filenames belonging to 2 classes.
```

```
predict = model.predict_generator(test_generator, steps=np.ceil(nb_samples/batch_size
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: UserWarning:

`Model.predict_generator` is deprecated and will be removed in a future version.
```

```
test_df['category'] = np.argmax(predict, axis=-1)
```

```
label_map = dict((v,k) for k,v in train_generator.class_indices.items())
```

```
test_df['category'] = test_df['category'].replace(label_map)

test_df['category'] = test_df['category'].replace({ 'dog': 1, 'cat': 0 })
```

```
test_df
```

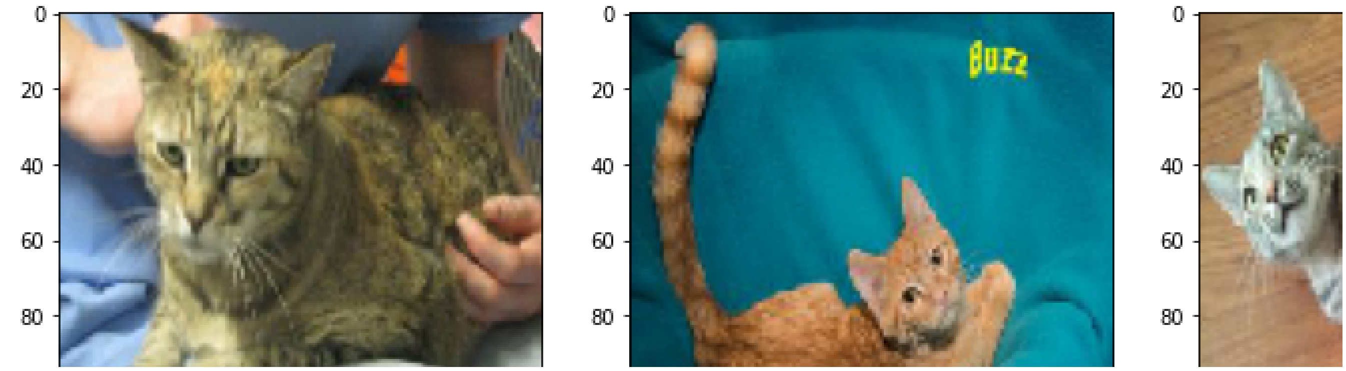
	Imagepath	Animal	category
43550	/content/cat_breed/Torbie/29322321_9800.jpg	cat	0
17193	/content/cat_breed/Tabby/46127685_8568.jpg	cat	0
29112	/content/cat_breed/Dilute Tortoiseshell/304766...	cat	0
18622	/content/cat_breed/Tabby/46514657_22856.jpg	cat	0
28251	/content/cat_breed/Dilute Tortoiseshell/459674...	cat	0
...	...	...	...
53751	/content/cat_breed/Manx/40124344_2161.jpg	cat	0
14398	/content/cat_breed/Ragdoll/22093596_7239.jpg	cat	0
41368	/content/cat_breed/Dilute Calico/33591660_6473...	cat	0
9127	/content/train/1d114c4409c9cba464f762b11ce47d5...	dog	0
4249	/content/train/8daabe9ded307c802b5f84492bc14d6...	dog	0

5620 rows × 3 columns

```
sample_test = test_df.head(18)
sample_test = sample_test.reset_index(drop=True)
sample_test.head()
```

	Imagepath	Animal	category
0	/content/cat_breed/Torbie/29322321_9800.jpg	cat	0
1	/content/cat_breed/Tabby/46127685_8568.jpg	cat	0
2	/content/cat_breed/Dilute Tortoiseshell/304766...	cat	0
3	/content/cat_breed/Tabby/46514657_22856.jpg	cat	0
4	/content/cat_breed/Dilute Tortoiseshell/459674...	cat	0

```
sample_test = test_df.head(18)
sample_test = sample_test.reset_index(drop=True)
sample_test.head()
plt.figure(figsize=(12, 24))
for index, row in sample_test.iterrows():
    filename = row['Imagepath']
    category = row['category']
    img = load_img(filename, target_size=Image_Size)
    plt.subplot(6, 3, index+1)
    plt.imshow(img)
    plt.xlabel(row['Animal'] + '(' + "{}".format(category) + ')' )
plt.tight_layout()
plt.show()
```



```
test_df["Animal"].replace({"cat": 0,'dog': 1}, inplace = True)
```

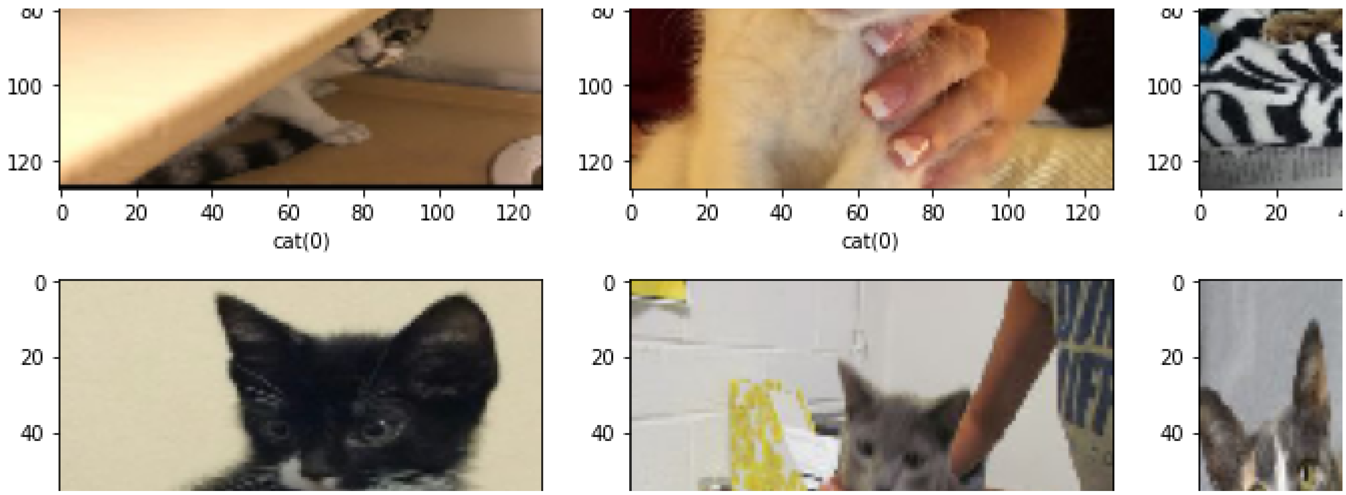
```
from sklearn.metrics import classification_report,confusion_matrix
cr_dog_cat = classification_report(test_df["Animal"], test_df["category"])
```

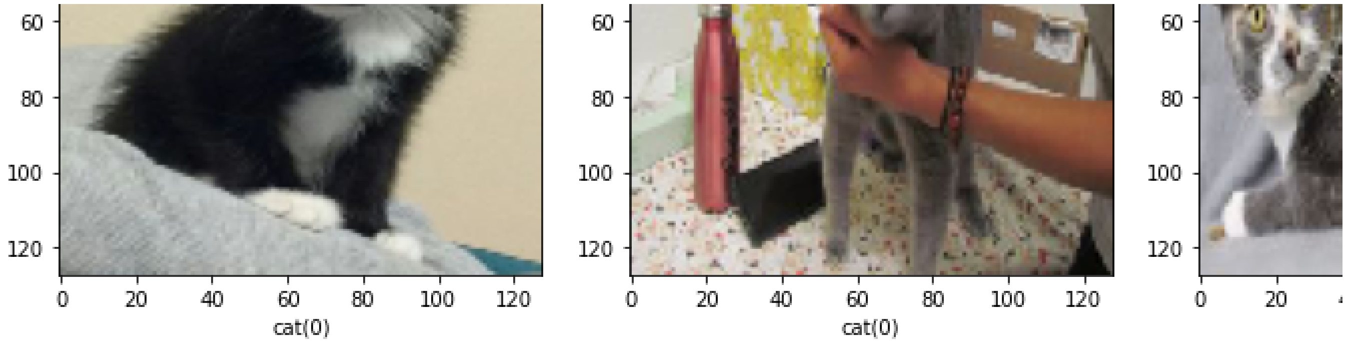
```
print(cr_dog_cat)
```

```
              precision    recall  f1-score   support

           0       0.81      0.87      0.84      4578
           1       0.16      0.11      0.13      1042

    accuracy                           0.73      5620
   macro avg       0.49      0.49      0.49      5620
weighted avg       0.69      0.73      0.71      5620
```

```
from sklearn.metrics import classification_report,confusion_matrix
confusion_matrix(test_df["Animal"], test_df["category"])
```

```
array([[3974,  604],
       [ 923,  119]])
```




60
80
100
120
0 20 40 60 80 100 120
cat(0)
60
80
100
120
0 20 40 60 80 100 120
cat(0)
60
80
100
120
0 20