In [1]:

```
import numpy as np
import pandas as pd
from keras.preprocessing.image import ImageDataGenerator, load_img
from keras.utils import to_categorical
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
import random
import os
print(os.listdir("/Users/ShantanuOjha/Downloads/dogs-vs-cats"))
```

```
['model2nd.h5', '.DS_Store', 'sampleSubmission.csv', 'with saved w
eights.ipynb', 'Untitled.ipynb', 'test1', '10th sep-Copy1.ipynb',
'Desktop', '10th sep.ipynb', 'test1.zip', 'train', 'model.h5', 'mo
del1st.h5', '.ipynb_checkpoints', 'train.zip']
```

In [2]:

```
FAST_RUN = False
IMAGE_WIDTH=128
IMAGE_HEIGHT=128
IMAGE_SIZE=(IMAGE_WIDTH, IMAGE_HEIGHT)
IMAGE_CHANNELS=3
```

In [3]:

```
filenames = os.listdir("/Users/ShantanuOjha/Downloads/dogs-vs-cats/
train")
categories = []
for filename in filenames:
    category = filename.split('.')[0]
    if category == 'dog':
        categories.append(1)
    else:
        categories.append(0)

df = pd.DataFrame({
    'filename': filenames,
    'category': categories
})
```

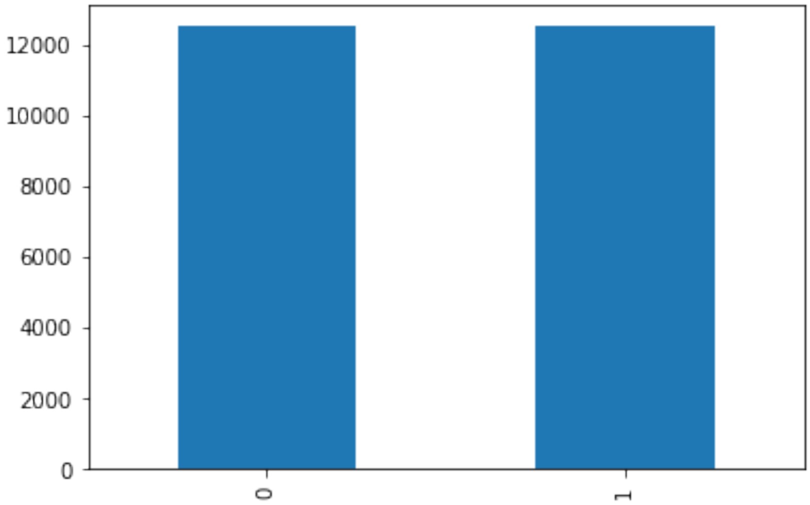
In [4]:
```
df.head(10)
```

Out[4]:

	filename	category
0	dog.8011.jpg	1
1	cat5,471.jpg	0
2	dog.7322.jpg	1
3	cat4,662.jpg	0
4	cat7,979.jpg	0
5	cat1,055.jpg	0
6	dog.1753.jpg	1
7	cat3,385.jpg	0
8	cat2,196.jpg	0
9	dog.5535.jpg	1

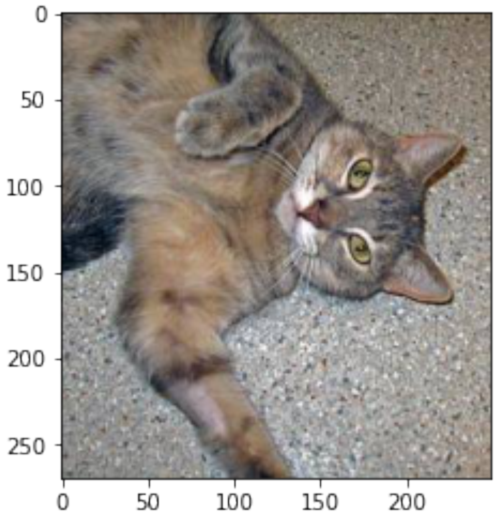
In [5]:
```
df['category'].value_counts().plot.bar()
```

Out[5]:
```
<AxesSubplot:>
```



In [6]:
```
sample = random.choice(df.filename)
image = load_img("/Users/ShantanuOjha/Downloads/dogs-vs-cats/train/
"+sample)
plt.imshow(image)
```

Out[6]:
```
<matplotlib.image.AxesImage at 0x155cda8e0>
```



In [7]:

```
from keras.models import Sequential
from keras.layers import Conv2D, MaxPooling2D, Dropout, Flatten, De
nse, Activation, BatchNormalization

model = Sequential()

model.add(Conv2D(32, (3, 3), activation='relu', input_shape=(IMAGE_
WIDTH, IMAGE_HEIGHT, IMAGE_CHANNELS)))
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')) # 2 because we have cat a
nd dog classes

model.compile(loss='binary_crossentropy', optimizer='rmsprop', metr
ics=['accuracy'])

model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
conv2d (Conv2D)              (None, 126, 126, 32)      896       
_________________________________________________________________
batch_normalization (BatchNo (None, 126, 126, 32)      128       
_________________________________________________________________
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 (Batch (None, 61, 61, 64)        256       
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 30, 30, 64)        0         
_________________________________________________________________
dropout_1 (Dropout)          (None, 30, 30, 64)        0         
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 28, 28, 128)       73856     
_________________________________________________________________
batch_normalization_2 (Batch (None, 28, 28, 128)       512       
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 14, 14, 128)       0         
_________________________________________________________________
dropout_2 (Dropout)          (None, 14, 14, 128)       0         
_________________________________________________________________
flatten (Flatten)            (None, 25088)             0         
_________________________________________________________________
dense (Dense)                (None, 512)               12845568  
_________________________________________________________________
batch_normalization_3 (Batch (None, 512)               2048      
_________________________________________________________________
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
_________________________________________________________________
```

In [8]:

```
from keras.callbacks import EarlyStopping, ReduceLROnPlateau
```

In [11]:

```
earlystop = EarlyStopping(patience=10)
```

```
In [12]: learning_rate_reduction = ReduceLROnPlateau(monitor='val_accuracy',
                                                     patience=2,
                                                     verbose=1,
                                                     factor=0.5,
                                                     min_lr=0.00001)
```

```
In [13]: callbacks = [earlystop, learning_rate_reduction]
```

```
In [14]: df["category"] = df["category"].replace({0: 'cat', 1: 'dog'})
```

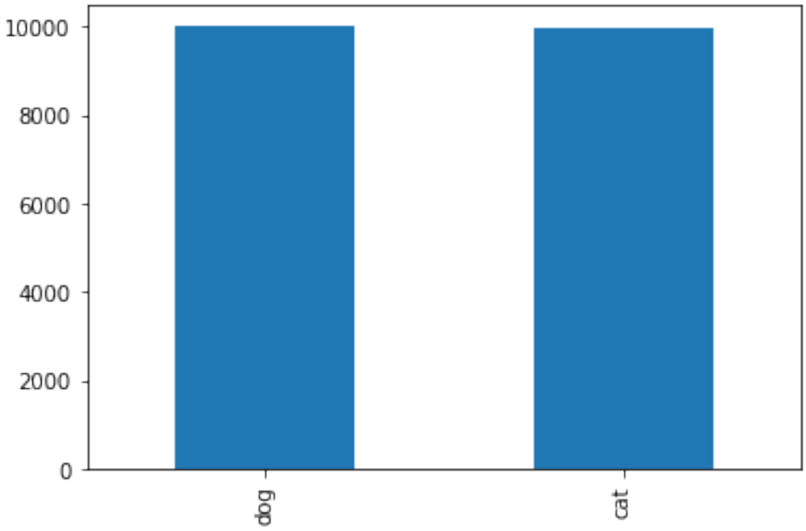
```
In [15]: df.head()
         df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 25001 entries, 0 to 25000
Data columns (total 2 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   filename  25001 non-null  object
 1   category  25001 non-null  object
dtypes: object(2)
memory usage: 390.8+ KB
```

```
In [16]: 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)
```

```
In [17]: train_df['category'].value_counts().plot.bar()
```

```
Out[17]: <AxesSubplot:>
```

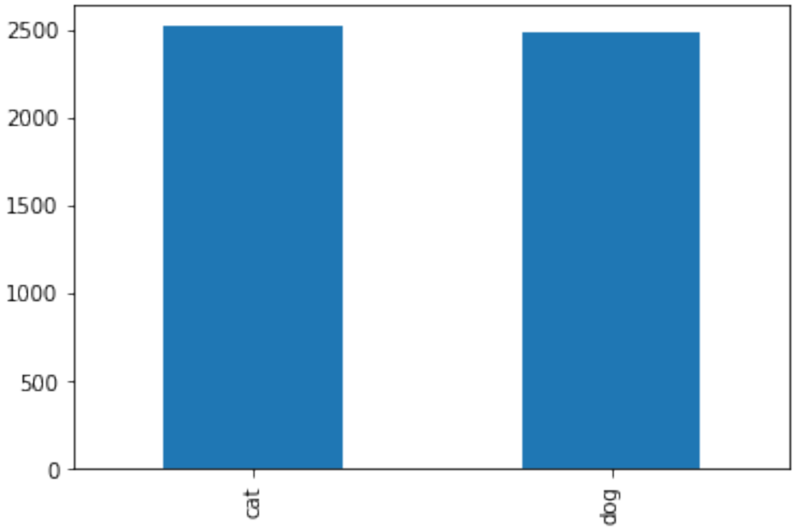


In [18]:

```
validate_df['category'].value_counts().plot.bar()
```

Out[18]:

```
<AxesSubplot:>
```



In [19]:

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

In [20]:

```
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,
    "/Users/ShantanuOjha/Downloads/dogs-vs-cats/train/",
    x_col='filename',
    y_col='category',
    target_size=IMAGE_SIZE,
    class_mode='categorical',
    batch_size=batch_size
)
```

```
Found 19999 validated image filenames belonging to 2 classes.

/usr/local/lib/python3.8/site-packages/keras_preprocessing/image/d
ataframe_iterator.py:279: UserWarning: Found 1 invalid image filen
ame(s) in x_col="filename". These filename(s) will be ignored.
  warnings.warn(
```

In [21]:

```
validation_datagen = ImageDataGenerator(rescale=1./255)
validation_generator = validation_datagen.flow_from_dataframe(
    validate_df,
    "/Users/ShantanuOjha/Downloads/dogs-vs-cats/train/",
    x_col='filename',
    y_col='category',
    target_size=IMAGE_SIZE,
    class_mode='categorical',
    batch_size=batch_size
)
```

```
Found 5001 validated image filenames belonging to 2 classes.
```

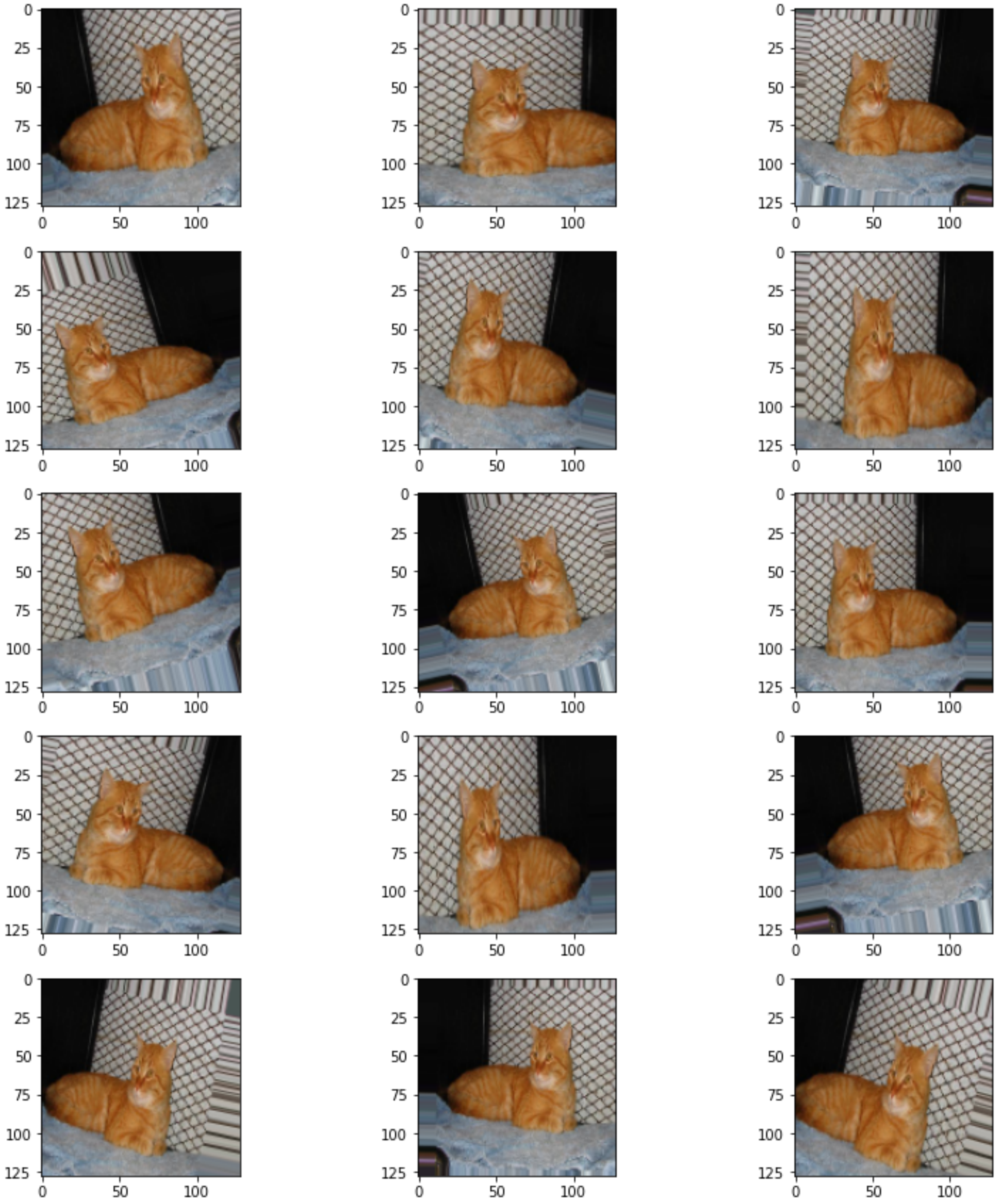
In [22]:

```
example_df = train_df.sample(n=1).reset_index(drop=True)
example_generator = train_datagen.flow_from_dataframe(
    example_df,
    "/Users/ShantanuOjha/Downloads/dogs-vs-cats/train/",
    x_col='filename',
    y_col='category',
    target_size=IMAGE_SIZE,
    class_mode='categorical'
)
```

```
Found 1 validated image filenames belonging to 1 classes.
```

In [23]:

```
plt.figure(figsize=(12, 12))
for i in range(0, 15):
    plt.subplot(5, 3, i+1)
    for X_batch, Y_batch in example_generator:
        image = X_batch[0]
        plt.imshow(image)
        break
plt.tight_layout()
plt.show()
```



In [24]:

```
epochs=3 if FAST_RUN else 15
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
)
```

```
WARNING:tensorflow:From <ipython-input-24-677267c34070>:2: Model.f
it_generator (from tensorflow.python.keras.engine.training) is dep
```

```
recated and will be removed in a future version.
Instructions for updating:
Please use Model.fit, which supports generators.
Epoch 1/15
1333/1333 [==============================] - 474s 356ms/step - los
s: 0.7369 - accuracy: 0.6366 - val_loss: 0.5573 - val_accuracy: 0.
7227
Epoch 2/15
1333/1333 [==============================] - 484s 363ms/step - los
s: 0.5534 - accuracy: 0.7260 - val_loss: 0.5087 - val_accuracy: 0.
7568
Epoch 3/15
1333/1333 [==============================] - 452s 339ms/step - los
s: 0.5044 - accuracy: 0.7600 - val_loss: 0.5302 - val_accuracy: 0.
7536
Epoch 4/15
1333/1333 [==============================] - 459s 344ms/step - los
s: 0.4766 - accuracy: 0.7789 - val_loss: 0.4059 - val_accuracy: 0.
8210
Epoch 5/15
1333/1333 [==============================] - 458s 344ms/step - los
s: 0.4419 - accuracy: 0.7989 - val_loss: 0.6858 - val_accuracy: 0.
6104
Epoch 6/15
1333/1333 [==============================] - ETA: 0s - loss: 0.424
7 - accuracy: 0.8058
Epoch 00006: ReduceLROnPlateau reducing learning rate to 0.0005000
000237487257.
1333/1333 [==============================] - 481s 361ms/step - los
s: 0.4247 - accuracy: 0.8058 - val_loss: 3.1594 - val_accuracy: 0.
5664
Epoch 7/15
1333/1333 [==============================] - 476s 357ms/step - los
s: 0.3784 - accuracy: 0.8319 - val_loss: 0.4203 - val_accuracy: 0.
8250
Epoch 8/15
1333/1333 [==============================] - 472s 354ms/step - los
s: 0.3587 - accuracy: 0.8435 - val_loss: 0.3671 - val_accuracy: 0.
8402
Epoch 9/15
1333/1333 [==============================] - 465s 349ms/step - los
s: 0.3536 - accuracy: 0.8462 - val_loss: 0.4260 - val_accuracy: 0.
8070
Epoch 10/15
1333/1333 [==============================] - 492s 369ms/step - los
s: 0.3369 - accuracy: 0.8515 - val_loss: 0.2879 - val_accuracy: 0.
8859
Epoch 11/15
1333/1333 [==============================] - 487s 366ms/step - los
s: 0.3426 - accuracy: 0.8536 - val_loss: 0.2426 - val_accuracy: 0.
9075
Epoch 12/15
1333/1333 [==============================] - 474s 356ms/step - los
```

```
s: 0.3263 - accuracy: 0.8600 - val_loss: 0.3331 - val_accuracy: 0.
8617
Epoch 13/15
1333/1333 [==============================] - 460s 345ms/step - los
s: 0.3222 - accuracy: 0.8616 - val_loss: 0.2301 - val_accuracy: 0.
9089
Epoch 14/15
1333/1333 [==============================] - 458s 343ms/step - los
s: 0.3234 - accuracy: 0.8631 - val_loss: 0.3103 - val_accuracy: 0.
8681
Epoch 15/15
1333/1333 [==============================] - ETA: 0s - loss: 0.320
1 - accuracy: 0.8635
Epoch 00015: ReduceLROnPlateau reducing learning rate to 0.0002500
000118743628.
1333/1333 [==============================] - 466s 350ms/step - los
s: 0.3201 - accuracy: 0.8635 - val_loss: 0.3208 - val_accuracy: 0.
8747
```

In [25]:

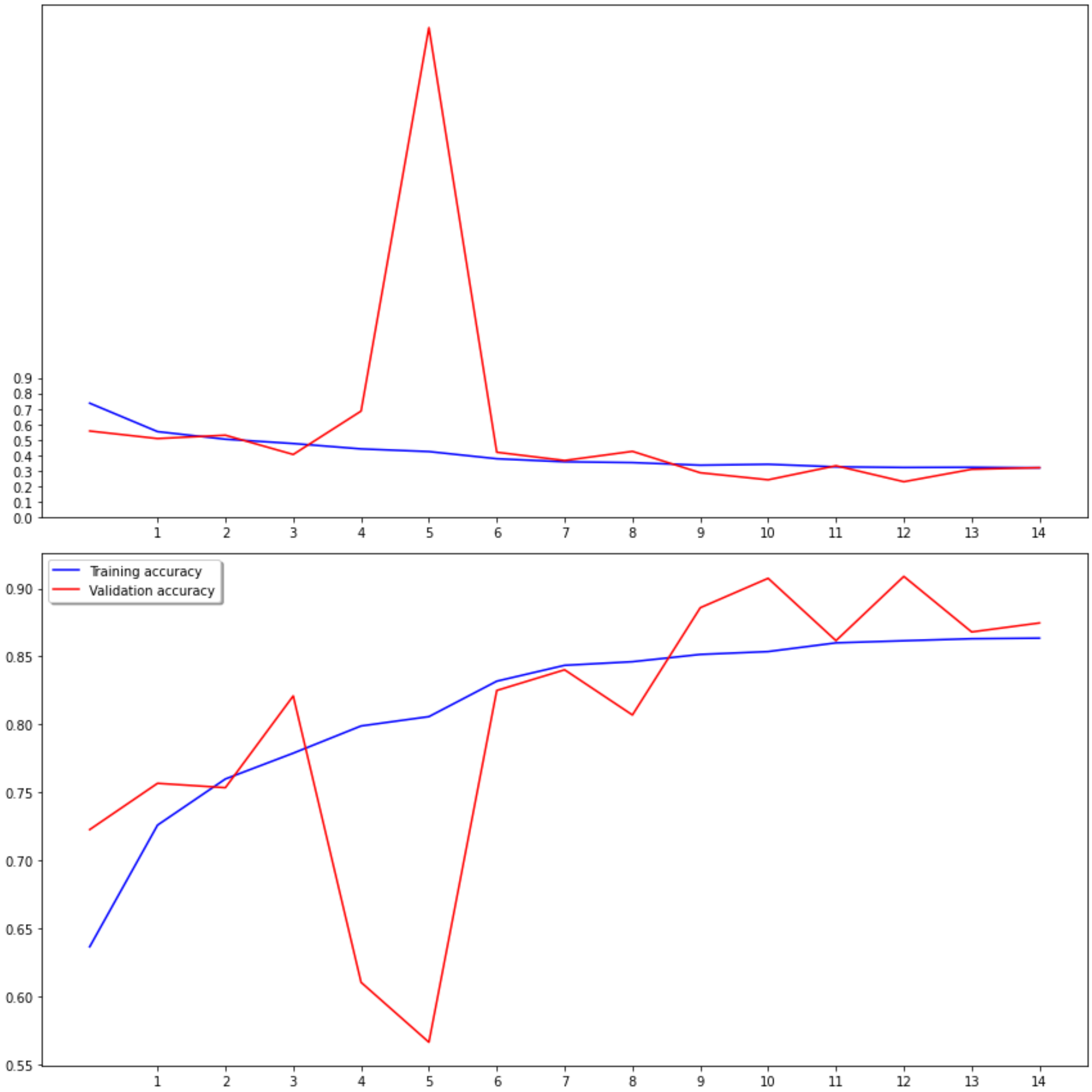
```
model.save_weights("binarymodel.h5")
```

In [26]:

```
fig, (ax1, ax2) = plt.subplots(2, 1, figsize=(12, 12))
ax1.plot(history.history['loss'], color='b', label="Training loss")
ax1.plot(history.history['val_loss'], color='r', label="validation
loss")
ax1.set_xticks(np.arange(1, epochs, 1))
ax1.set_yticks(np.arange(0, 1, 0.1))

ax2.plot(history.history['accuracy'], color='b', label="Training ac
curacy")
ax2.plot(history.history['val_accuracy'], color='r',label="Validati
on accuracy")
ax2.set_xticks(np.arange(1, epochs, 1))

legend = plt.legend(loc='best', shadow=True)
plt.tight_layout()
plt.show()
```



In [27]:

```
test_filenames = os.listdir("/Users/ShantanuOjha/Downloads/dogs-vs-cats/test1")
test_df = pd.DataFrame({
    'filename': test_filenames
})
nb_samples = test_df.shape[0]
```

In [28]:
```
test_gen = ImageDataGenerator(rescale=1./255)
test_generator = test_gen.flow_from_dataframe(
    test_df,
    "/Users/ShantanuOjha/Downloads/dogs-vs-cats/test1",
    x_col='filename',
    y_col=None,
    class_mode=None,
    target_size=IMAGE_SIZE,
    batch_size=batch_size,
    shuffle=False
)
```

```
Found 12500 validated image filenames.
```

In [37]:
```
predict = model.predict(test_generator, steps=np.ceil(nb_samples/ba
tch_size))
```

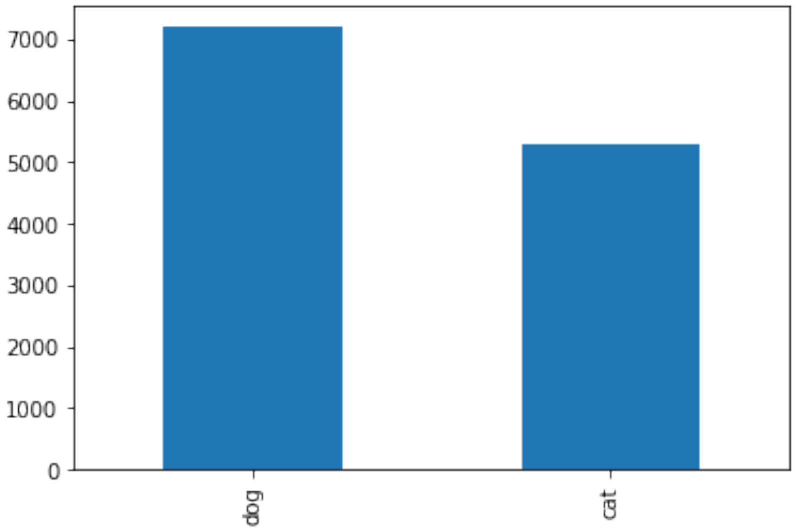
In [38]:
```
test_df['category'] = np.argmax(predict, axis=-1)
```

In [39]:
```
label_map = dict((v,k) for k,v in train_generator.class_indices.ite
ms())
test_df['category'] = test_df['category'].replace(label_map)
```

In [54]:
```
#test_df['category'] = test_df['category'].replace({ 'dog': 1, 'cat
': 0 })
```

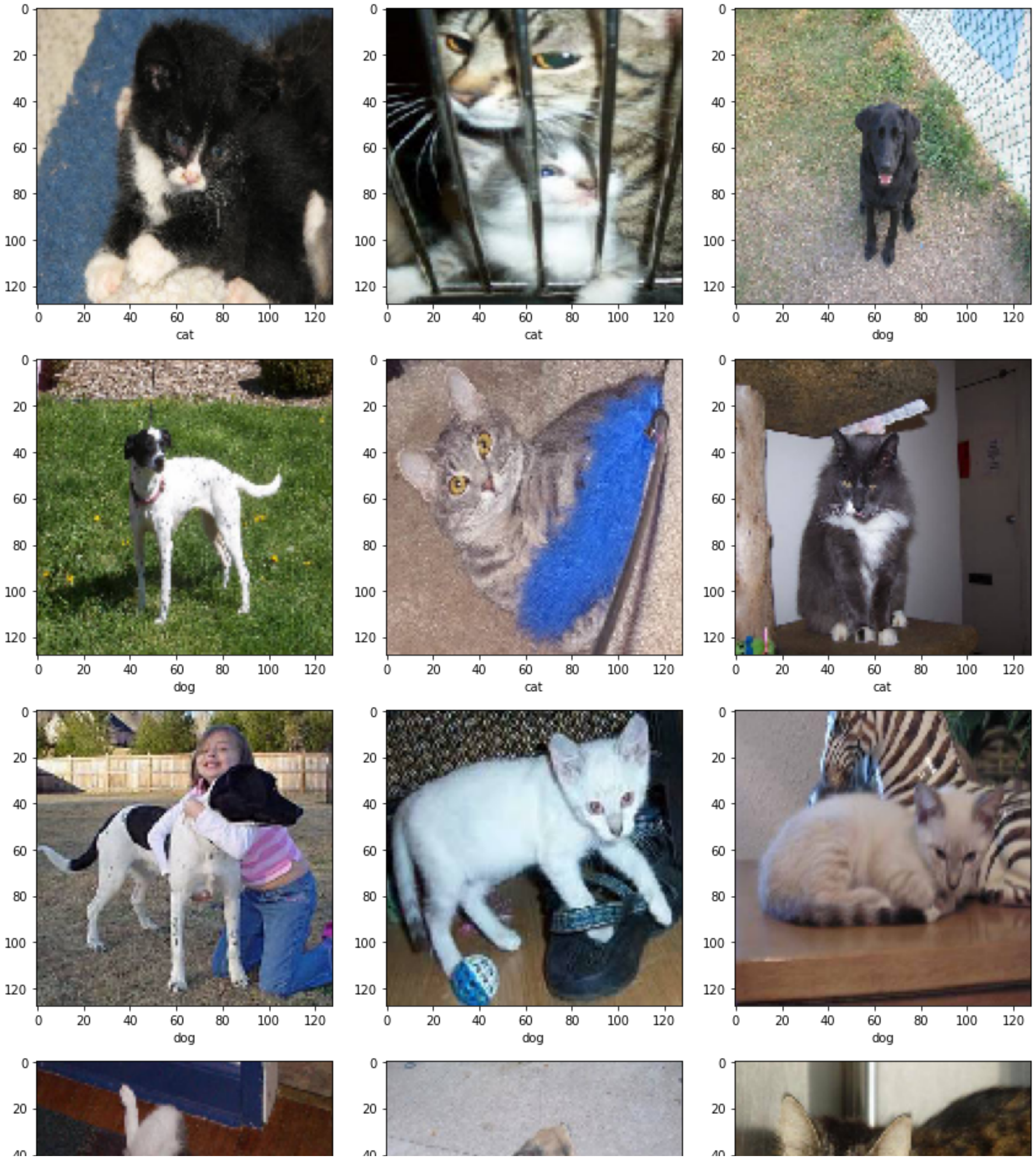
In [40]:
```
test_df['category'].value_counts().plot.bar()
```

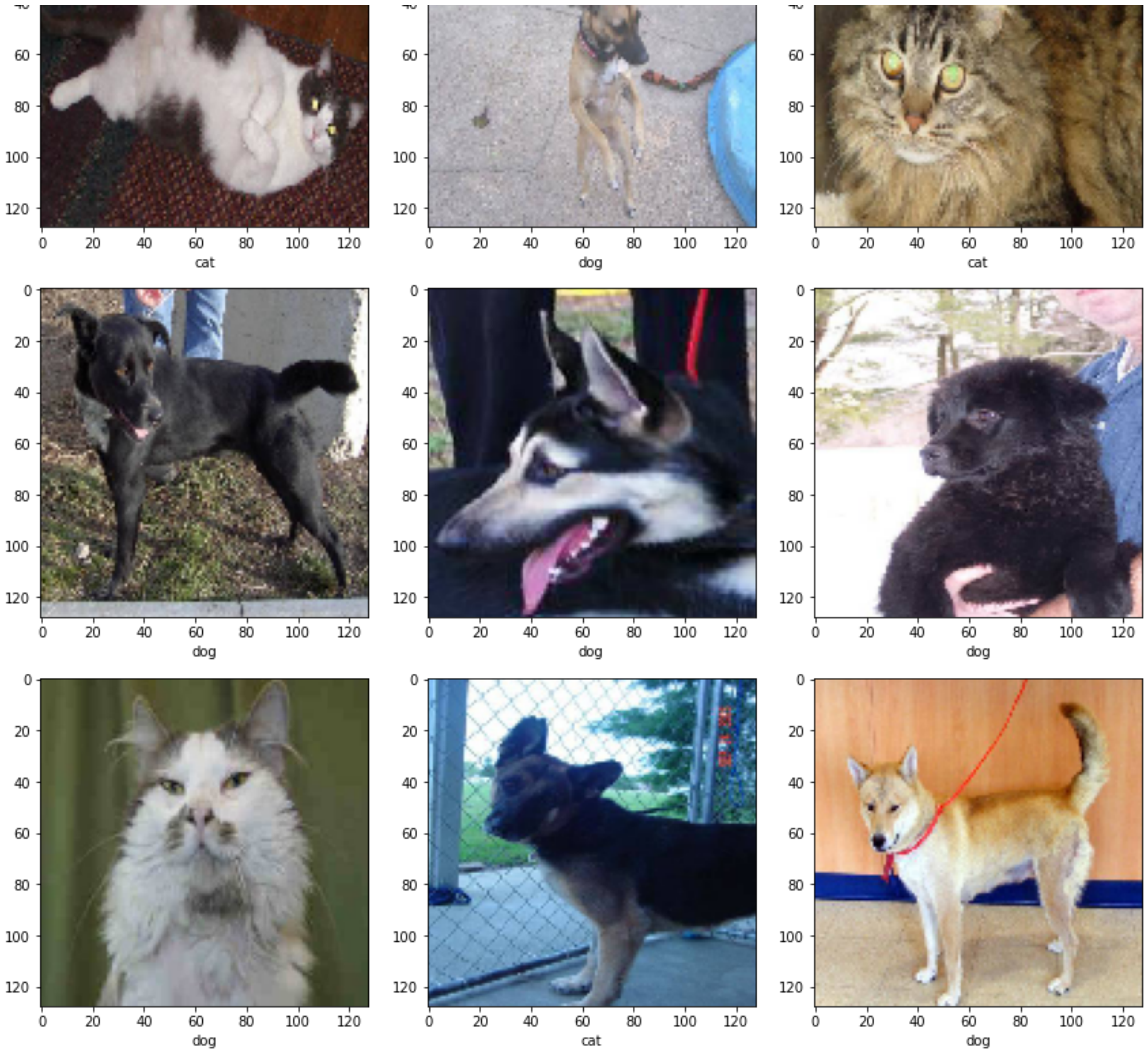
Out[40]:
```
<AxesSubplot:>
```



In [41]:

```
sample_test = test_df.head(18)
sample_test.head()
plt.figure(figsize=(12, 24))
output=1
for index, row in sample_test.iterrows():
    filename = row['filename']
    category = row['category']
    img = load_img("/Users/ShantanuOjha/Downloads/dogs-vs-cats/test
1/"+filename, target_size=IMAGE_SIZE)
    plt.subplot(6, 3, output)
    output=output+1
    plt.imshow(img)
    plt.xlabel( "{}".format(category)  )
plt.tight_layout()
plt.show()
```





In [43]:
```
#model.summary()

from keras.preprocessing.image import load_img
```

In [68]:
```
img = load_img('/Users/ShantanuOjha/Downloads/q.jpg',target_size=(128,128,3))
```

In [73]:
```
img = np.reshape(img,[1,128,128,3])
```

In [88]:
```
result=model.predict(img)
```

In [90]:
```
result.size
```

Out[90]:
```
2
```

In [91]:
```
result=np.argmax(result, axis=-1)
```

In [92]:

```
result.size
```

Out[92]:

```
1
```

In [93]:

```
result
```

Out[93]:

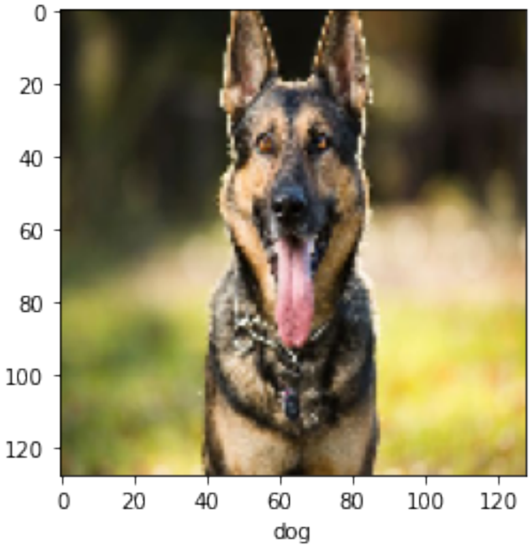
```
array([1])
```

In [112]:

```
plt.subplot(1,1,1)
plt.imshow(load_img('/Users/ShantanuOjha/Downloads/q.jpg',target_si
ze=(128,128)))
if result[0]==1:
    cord="dog"
else:
    cord="cat"
plt.xlabel("{}".format(cord))
```

Out[112]:

```
Text(0.5, 0, 'dog')
```

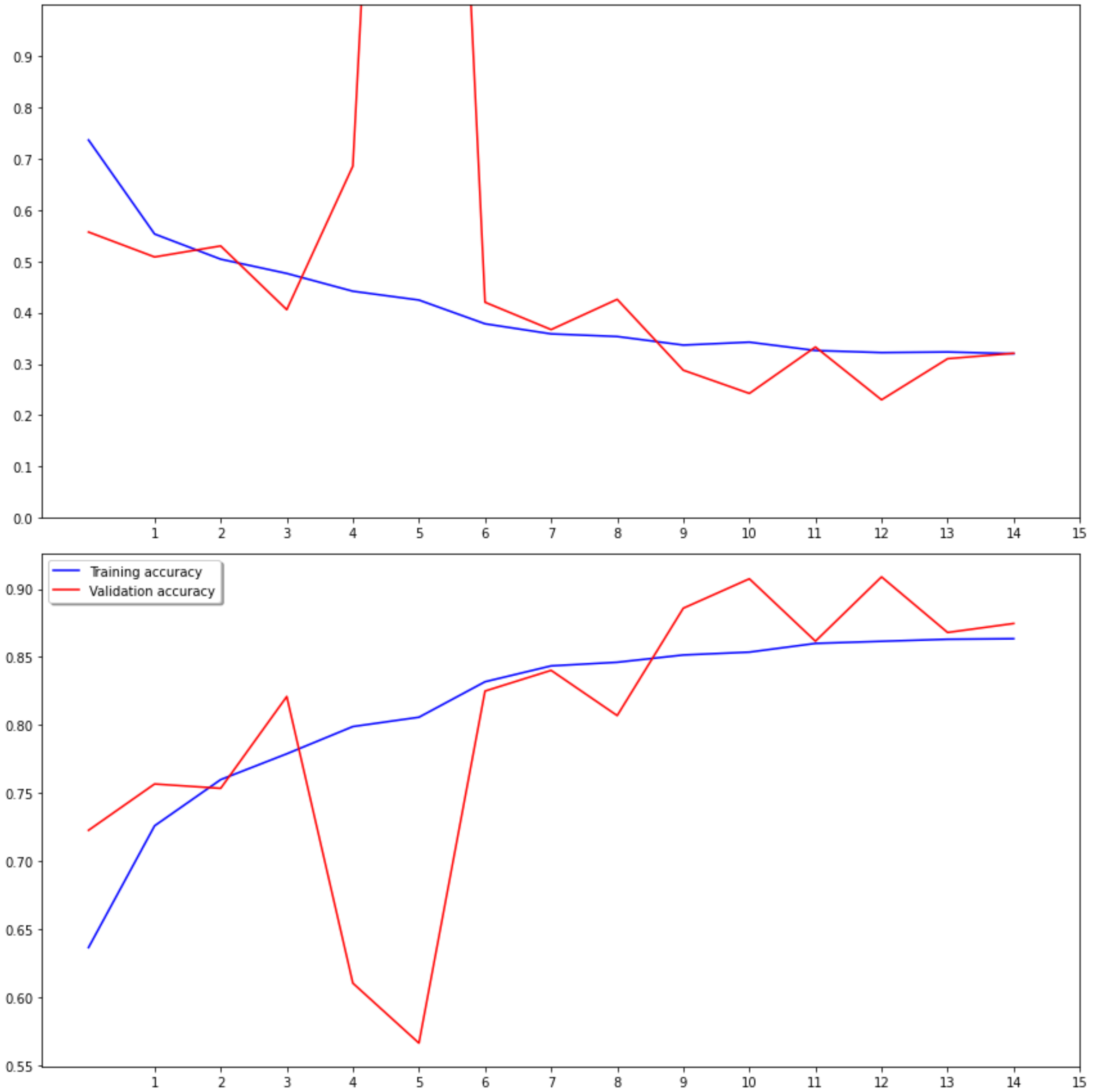


In [132]:

```
fig, (ax1, ax2) = plt.subplots(2, 1, figsize=(12, 12))
ax1.plot(history.history['loss'], color='b', label="Training loss")
ax1.plot(history.history['val_loss'], color='r', label="validation loss")
ax1.set_xticks(np.arange(1, epochs+1, 1))
ax1.set_yticks(np.arange(0, 1, 0.1))
ax1.axis(ymin=0,ymax=1)

ax2.plot(history.history['accuracy'], color='b', label="Training accuracy")
ax2.plot(history.history['val_accuracy'], color='r',label="Validation accuracy")
ax2.set_xticks(np.arange(1, epochs+1, 1))

legend = plt.legend(loc='best', shadow=True)
plt.tight_layout()
plt.show()
```



```
In [134]: type(history.history)

Out[134]: dict
```

```
In [135]: np.save('history.npy', history.history)
```

```
In [137]: read_dictionary = np.load('history.npy',allow_pickle='TRUE').item()
```

```
In [139]: type(read_dictionary)

Out[139]: dict
```

```
In [ ]:
```