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

```
import zipfile
zip_ref = zipfile.ZipFile('/content/drive/MyDrive/Deep Learning/DogsNCats.zip', 'r')
zip_ref.extractall('/content')
zip_ref.close()
```

```
#importing libraries
import tensorflow as tf
from tensorflow import keras
from keras import Sequential
from keras.layers import Dense,Conv2D,MaxPooling2D,Flatten,BatchNormalization,Dropout
```

Data preprocessing

```
train_ds =keras.utils.image_dataset_from_directory(
    directory = '/content/DogsNCats/train',
    labels = 'inferred',
    label_mode = 'int',
    batch_size = 32,
    image_size = (256,256)
)

validation_ds = keras.utils.image_dataset_from_directory(
    directory = '/content/DogsNCats/validation',
    labels = 'inferred',
    label_mode = 'int',
    batch_size = 32,
    image_size = (256,256)
)
```

```
Found 2171 files belonging to 2 classes.
Found 829 files belonging to 2 classes.
```

normalizing

```
#normalize
def process(image, label):
  image = tf.cast(image/255. ,tf.float32)
  return image, label

train_ds = train_ds.map(process)
validation_ds = validation_ds.map(process)
```

Model Selection and training

Creating the CNN model

```
# create CNN model

model = Sequential()

model.add(Conv2D(32,kernel_size=(3,3),padding='valid',activation='relu',input_shape=(256,256,3)))
model.add(MaxPooling2D(pool_size=(2,2),strides=2,padding='valid'))

model.add(Conv2D(64,kernel_size=(3,3),padding='valid',activation='relu'))
model.add(MaxPooling2D(pool_size=(2,2),strides=2,padding='valid'))

model.add(Conv2D(128,kernel_size=(3,3),padding='valid',activation='relu'))
model.add(MaxPooling2D(pool_size=(2,2),strides=2,padding='valid'))

model.add(Flatten())
```

```
model.add(Dense(128,activation='relu'))
model.add(Dense(64,activation='relu'))
model.add(Dense(1,activation='sigmoid'))
```

```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 254, 254, 32)      896

 max_pooling2d (MaxPooling2D  (None, 127, 127, 32)     0
 )

 conv2d_1 (Conv2D)           (None, 125, 125, 64)      18496

 max_pooling2d_1 (MaxPooling  (None, 62, 62, 64)       0
 2D)

 conv2d_2 (Conv2D)           (None, 60, 60, 128)       73856

 max_pooling2d_2 (MaxPooling  (None, 30, 30, 128)      0
 2D)

 flatten (Flatten)           (None, 115200)            0

 dense (Dense)               (None, 128)               14745728

 dense_1 (Dense)             (None, 64)                8256

 dense_2 (Dense)             (None, 1)                 65

=================================================================
Total params: 14,847,297
Trainable params: 14,847,297
Non-trainable params: 0
_________________________________________________________________
```

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

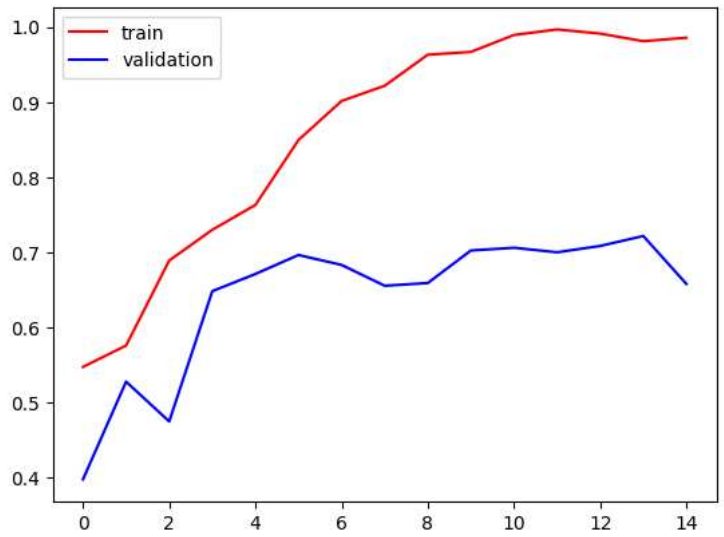
```
history = model.fit(train_ds, epochs=15, validation_data = validation_ds)
```

```
Epoch 1/15
68/68 [==============================] - 23s 205ms/step - loss: 0.7416 - accuracy: 0.5468 - val_loss: 0.7972 - val_accuracy: 0.3969
Epoch 2/15
68/68 [==============================] - 8s 106ms/step - loss: 0.6747 - accuracy: 0.5753 - val_loss: 0.6805 - val_accuracy: 0.5271
Epoch 3/15
68/68 [==============================] - 7s 90ms/step - loss: 0.5961 - accuracy: 0.6886 - val_loss: 0.9827 - val_accuracy: 0.4741
Epoch 4/15
68/68 [==============================] - 8s 115ms/step - loss: 0.5386 - accuracy: 0.7296 - val_loss: 0.6482 - val_accuracy: 0.6478
Epoch 5/15
68/68 [==============================] - 6s 90ms/step - loss: 0.4892 - accuracy: 0.7628 - val_loss: 0.7107 - val_accuracy: 0.6707
Epoch 6/15
68/68 [==============================] - 8s 114ms/step - loss: 0.3363 - accuracy: 0.8494 - val_loss: 0.8032 - val_accuracy: 0.6960
Epoch 7/15
68/68 [==============================] - 8s 106ms/step - loss: 0.2417 - accuracy: 0.9014 - val_loss: 0.9161 - val_accuracy: 0.6828
Epoch 8/15
68/68 [==============================] - 8s 107ms/step - loss: 0.1845 - accuracy: 0.9217 - val_loss: 1.2605 - val_accuracy: 0.6550
Epoch 9/15
68/68 [==============================] - 8s 112ms/step - loss: 0.1001 - accuracy: 0.9632 - val_loss: 1.8861 - val_accuracy: 0.6586
Epoch 10/15
68/68 [==============================] - 8s 107ms/step - loss: 0.0879 - accuracy: 0.9668 - val_loss: 1.4187 - val_accuracy: 0.7021
Epoch 11/15
68/68 [==============================] - 9s 127ms/step - loss: 0.0315 - accuracy: 0.9894 - val_loss: 1.8407 - val_accuracy: 0.7057
Epoch 12/15
68/68 [==============================] - 10s 145ms/step - loss: 0.0116 - accuracy: 0.9968 - val_loss: 2.2902 - val_accuracy: 0.6996
Epoch 13/15
68/68 [==============================] - 8s 106ms/step - loss: 0.0270 - accuracy: 0.9912 - val_loss: 1.7177 - val_accuracy: 0.7081
Epoch 14/15
68/68 [==============================] - 9s 128ms/step - loss: 0.0541 - accuracy: 0.9811 - val_loss: 2.0408 - val_accuracy: 0.7214
Epoch 15/15
68/68 [==============================] - 7s 105ms/step - loss: 0.0512 - accuracy: 0.9857 - val_loss: 1.9153 - val_accuracy: 0.6574
```

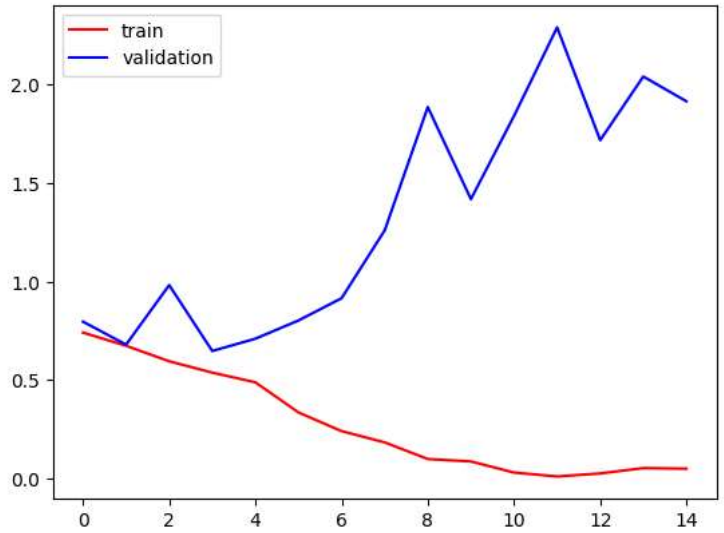
```
import matplotlib.pyplot as plt

plt.plot(history.history['accuracy'], color='red', label = 'train')
```

```
plt.plot(history.history['val_accuracy'], color='blue', label='validation')
plt.legend()
plt.show()
```




```
plt.plot(history.history['loss'], color='red', label = 'train')
plt.plot(history.history['val_loss'], color='blue', label='validation')
plt.legend()
plt.show()
```



ways to reduce overfiting:

- add more data
- data augmentation
- l1, l2 regularization
- batch normalization
- dropout

Batch Normalization and dropout

```
# create CNN model

model = Sequential()

model.add(Conv2D(32,kernel_size=(3,3),padding='valid',activation='relu',input_shape=(256,256,3)))
model.add(BatchNormalization())
```

```
model.add(MaxPooling2D(pool_size=(2,2),strides=2,padding='valid'))

model.add(Conv2D(64,kernel_size=(3,3),padding='valid',activation='relu'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2),strides=2,padding='valid'))

model.add(Conv2D(128,kernel_size=(3,3),padding='valid',activation='relu'))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size=(2,2),strides=2,padding='valid'))

model.add(Flatten())

model.add(Dense(128,activation='relu'))
model.add(Dropout(0.1))
model.add(Dense(64,activation='relu'))
model.add(Dropout(0.1))
model.add(Dense(1,activation='sigmoid'))
```

```
model.summary()
```

```
Model: "sequential_2"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_6 (Conv2D)           (None, 254, 254, 32)      896

 batch_normalization_3 (Batc  (None, 254, 254, 32)     128
 hNormalization)

 max_pooling2d_6 (MaxPooling  (None, 127, 127, 32)     0
 2D)

 conv2d_7 (Conv2D)           (None, 125, 125, 64)      18496

 batch_normalization_4 (Batc  (None, 125, 125, 64)     256
 hNormalization)

 max_pooling2d_7 (MaxPooling  (None, 62, 62, 64)       0
 2D)

 conv2d_8 (Conv2D)           (None, 60, 60, 128)       73856

 batch_normalization_5 (Batc  (None, 60, 60, 128)      512
 hNormalization)

 max_pooling2d_8 (MaxPooling  (None, 30, 30, 128)      0
 2D)

 flatten_2 (Flatten)         (None, 115200)            0

 dense_6 (Dense)             (None, 128)               14745728

 dropout_2 (Dropout)         (None, 128)               0

 dense_7 (Dense)             (None, 64)                8256

 dropout_3 (Dropout)         (None, 64)                0

 dense_8 (Dense)             (None, 1)                 65

=================================================================
Total params: 14,848,193
Trainable params: 14,847,745
Non-trainable params: 448
_________________________________________________________________
```

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

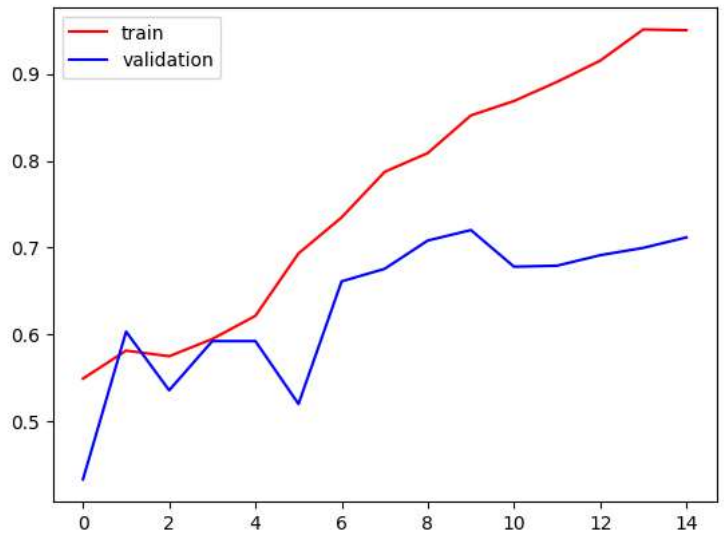
```
history = model.fit(train_ds, epochs=15, validation_data = validation_ds)
```

```
Epoch 1/15
68/68 [==============================] - 12s 127ms/step - loss: 4.9238 - accuracy: 0.5491 - val_loss: 8.1851 - val_accuracy: 0.4331
Epoch 2/15
68/68 [==============================] - 9s 129ms/step - loss: 2.3095 - accuracy: 0.5813 - val_loss: 9.9701 - val_accuracy: 0.6031
Epoch 3/15
68/68 [==============================] - 8s 112ms/step - loss: 1.2487 - accuracy: 0.5749 - val_loss: 1.4024 - val_accuracy: 0.5356
Epoch 4/15
```

```
68/68 [==============================] - 9s 116ms/step - loss: 1.0509 - accuracy: 0.5947 - val_loss: 1.0247 - val_accuracy: 0.5923
Epoch 5/15
68/68 [==============================] - 10s 138ms/step - loss: 0.8082 - accuracy: 0.6214 - val_loss: 1.0102 - val_accuracy: 0.5923
Epoch 6/15
68/68 [==============================] - 9s 128ms/step - loss: 0.6395 - accuracy: 0.6932 - val_loss: 0.7884 - val_accuracy: 0.5199
Epoch 7/15
68/68 [==============================] - 9s 128ms/step - loss: 0.5472 - accuracy: 0.7347 - val_loss: 0.6379 - val_accuracy: 0.6610
Epoch 8/15
68/68 [==============================] - 9s 126ms/step - loss: 0.4806 - accuracy: 0.7872 - val_loss: 0.7122 - val_accuracy: 0.6755
Epoch 9/15
68/68 [==============================] - 12s 168ms/step - loss: 0.4413 - accuracy: 0.8088 - val_loss: 0.6571 - val_accuracy: 0.7081
Epoch 10/15
68/68 [==============================] - 9s 129ms/step - loss: 0.3350 - accuracy: 0.8521 - val_loss: 0.6973 - val_accuracy: 0.7201
Epoch 11/15
68/68 [==============================] - 9s 128ms/step - loss: 0.3074 - accuracy: 0.8687 - val_loss: 0.6488 - val_accuracy: 0.6779
Epoch 12/15
68/68 [==============================] - 10s 136ms/step - loss: 0.2739 - accuracy: 0.8908 - val_loss: 0.7076 - val_accuracy: 0.6791
Epoch 13/15
68/68 [==============================] - 9s 121ms/step - loss: 0.2190 - accuracy: 0.9152 - val_loss: 0.7889 - val_accuracy: 0.6912
Epoch 14/15
68/68 [==============================] - 8s 112ms/step - loss: 0.1327 - accuracy: 0.9512 - val_loss: 0.9872 - val_accuracy: 0.6996
Epoch 15/15
68/68 [==============================] - 9s 129ms/step - loss: 0.1339 - accuracy: 0.9503 - val_loss: 1.0129 - val_accuracy: 0.7117
```

```
import matplotlib.pyplot as plt

plt.plot(history.history['accuracy'], color='red', label = 'train')
plt.plot(history.history['val_accuracy'], color='blue', label='validation')
plt.legend()
plt.show()
```




```
plt.plot(history.history['loss'], color='red', label = 'train')
plt.plot(history.history['val_loss'], color='blue', label='validation')
plt.legend()
plt.show()
```

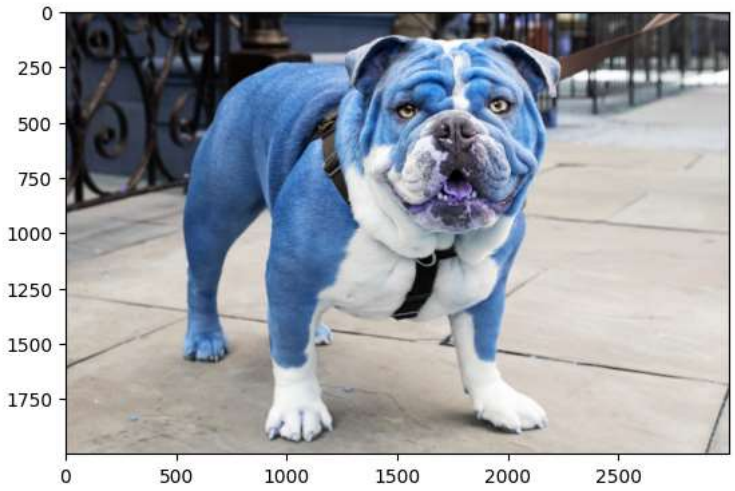
test case1

```
1 import cv2
```

```
1 test_img = cv2.imread('/content/dog.jpg')
```

```
1 plt.imshow(test_img)
```

```
<matplotlib.image.AxesImage at 0x7f1b044e5310>
```




```
1 test_img.shape
```

```
(1999, 3000, 3)
```

```
1 test_img = cv2.resize(test_img, (256, 256))
```

```
1 test_input = test_img.reshape((1,256,256,3))
```

```
1 model.predict(test_input)
```

```
1/1 [==============================] - 0s 19ms/step
array([[1.]], dtype=float32)
```

```
1 test = model.predict(test_input)
2 test = test > 0.5
3
4 if (test == 0):
5   pred = 'cat'
6 else:
7   pred = 'dog'
8
9 print('our model says its a :', pred)
```

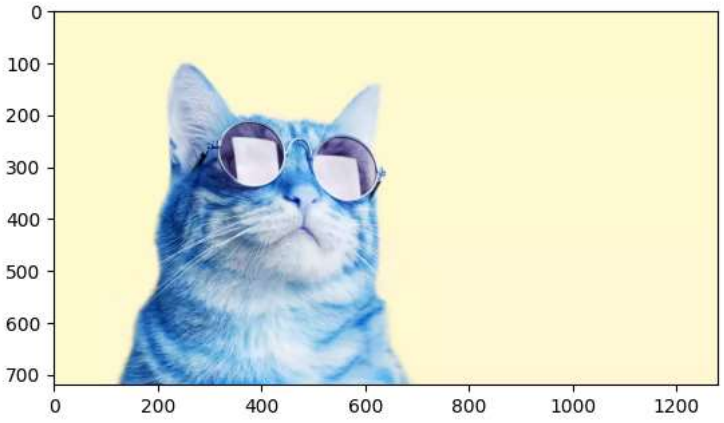
```
1/1 [==============================] - 0s 24ms/step
our model says its a : dog
```

test case2

```
1 test_img = cv2.imread('/content/cat.jpg')
```

```
1 plt.imshow(test_img)
```

```
<matplotlib.image.AxesImage at 0x7f1b0471db80>
```




```
1 test_img.shape
```

```
(720, 1280, 3)
```

```
1 test_img = cv2.resize(test_img, (256, 256))
```

```
1 test_input = test_img.reshape((1,256,256,3))
```

```
1 model.predict(test_input)
```

```
1/1 [==============================] - 0s 92ms/step
array([[0.]], dtype=float32)
```

```
1 #model.predict(test_input)
2 test = model.predict(test_input)
3 test = test > 0.5
4
5 if (test == 0):
6   pred = 'cat'
7 else:
8   pred = 'dog'
9
10 print('our model says it a :', pred)
```

```
1/1 [==============================] - 0s 173ms/step
our model says it a : cat
```

```
1
```