```
import keras
import numpy as np
import matplotlib.pyplot as plt
import tensorflow as tf
from keras.models import Sequential
from keras.layers import Dense,Dropout
from keras.utils import to_categorical
from keras.layers.convolutional import Conv2D # to add convolutional layers
from keras.layers.convolutional import MaxPooling2D # to add pooling layers
from keras.layers import Flatten # to flatten data for fully connected layers
import glob
import pandas as pd
from keras.optimizers import RMSprop, Adam
#activation=tf.keras.layers.LeakyReLU(alpha=0.05)
from keras.layers import LeakyReLU
from keras.callbacks import EarlyStopping


df_train = pd.DataFrame(columns=['class','dir','image_file'])
df_test = pd.DataFrame(columns=['class','dir','image_file'])

train_cats_dogs=list()
train_cats_dogs_class=list()
test_cats_dogs=list()
test_cats_dogs_class=list()
```

```
!unzip -q 'deeplearningwithkerasandtensorflow.zip'


!cd data
!ls
```

```
#Parse image files located in /data/*/*/*jpg and make train and  test csv.

for entry in glob.glob('./data/*/*/*jpg'):
  cats_dogs = entry
  if "/train" in cats_dogs:
    train_cats_dogs.append(cats_dogs)

    cats_dogs_dir = cats_dogs[0:cats_dogs.rfind('/')]
    cats_dogs_class = cats_dogs_dir[cats_dogs_dir.rfind('/')+1:]
    df_train.loc[df_train.shape[0]] = [cats_dogs_class, cats_dogs_dir, cats_dogs]


  if "/test" in cats_dogs:
    test_cats_dogs.append(cats_dogs)
    cats_dogs_dir = cats_dogs[0:cats_dogs.rfind('/')]
    cats_dogs_class = cats_dogs_dir[cats_dogs_dir.rfind('/')+1:]
    df_test.loc[df_test.shape[0]] = [cats_dogs_class, cats_dogs_dir, cats_dogs]

print(cats_dogs)
print('Total images: ', df_train.shape[0])
df_train.head()

print('Total images: ', df_test.shape[0])
df_test.head()

print(df_train.groupby(['class']).size())
print(df_test.groupby(['class']).size())

 #There are 40 train set and 20 test set
df_train.to_csv('data/train.csv',index=False)
df_test.to_csv('data/test.csv',index=False)
```

```
./data/test/cats/105.jpg
Total images:  40
Total images:  20
class
cats    20
dogs    20
dtype: int64
class
cats    10
dogs    10
dtype: int64
```

```
df_train.head()


img_size = 150
```

```
img_size = 150
img_depth = 3


class_names = df_train['class'].unique().tolist()


def batch_generator(df, batchsize, train_mode=True):

    img_generator= tf.keras.preprocessing.image.ImageDataGenerator(
      rotation_range=40,
      width_shift_range=0.2,
      height_shift_range=0.2,
      shear_range=0.2,
      zoom_range=0.2,
      horizontal_flip=True,
      rescale = 1./255,
      fill_mode='nearest',

      )

    while True:


        #Generate random numbers to pick images from dataset
        batch_nums = np.random.randint(0,df.shape[0],batchsize)

        #Initialize batch images array
batch_images = np.zeros((batchsize,img_size, img_size,img_depth))

#Initiate batch label array
batch_labels = np.zeros((batchsize, len(class_names)))

for i in range(batchsize):

    #Load image
    animal_image =  tf.keras.preprocessing.image.load_img(
                                                          df.loc[batch_nums[i]]['image_file'],
                                                          target_size=(img_size, img_size))
    #Convert to array
    animal_image = tf.keras.preprocessing.image.img_to_array(animal_image)

    if(train_mode):
        #Apply transform
        animal_image =  img_generator.random_transform(animal_image)


    #Get the class
    img_class = df.loc[batch_nums[i]]['class']
    #Conver class to number
    img_class = class_names.index(img_class)
    #Convert class to one hot encoding
    img_class = tf.keras.utils.to_categorical(img_class, num_classes=len(class_names))

    #Update batch images and class arrays
    batch_images[i] = animal_image
    batch_labels[i] = img_class

        yield batch_images, batch_labels


def convolutional_model():

    # create model
    model = Sequential()
    model.add(tf.keras.layers.BatchNormalization(input_shape=(img_size,img_size,3,)))

    #convolution layer 1
    model.add(Conv2D(32, (5, 5), activation='relu',))
    model.add(MaxPooling2D(pool_size=(2, 2),strides=2))
    #model.add(Dropout(0.4))
  #LeakyReLU(alpha=0.05)
    #convolution layer 2
    model.add(Conv2D(64,(5,5),activation='relu'),)
    model.add(MaxPooling2D(pool_size=(2, 2),strides=2))

    #Fully conected layer
    model.add(Flatten())

    model.add(Dense(32, activation='relu',))
    model.add(Dropout(0.4))
   #output layer with 2 output, softmax activation
    model.add(Dense(len(class_names), activation='softmax'))
   # model.add(Dense(len(class_names), activation='sigmoid'))
```

```
    return model



batchsize = 16
train_generator = batch_generator(df_train, batchsize=batchsize)
test_generator = batch_generator(df_test, batchsize=batchsize, train_mode=False)


df_train.shape[0]


df_test.shape[0]


# i have tried with different optimizer, batch no, epoch number, increase/decrease of img_generator
# i have triled using binary entropy and sigmoid
# val_accuracy is not consistant.
# Is it because of less dataset? if not please suggest to hadle overfitting


model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
batch_normalization_1 (Batch (None, 150, 150, 3)       12
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 146, 146, 32)      2432
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 73, 73, 32)        0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 69, 69, 64)        51264
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 34, 34, 64)        0
_________________________________________________________________
flatten_1 (Flatten)          (None, 73984)             0
_________________________________________________________________
dense_2 (Dense)              (None, 32)                2367520
_________________________________________________________________
dropout_1 (Dropout)          (None, 32)                0
_________________________________________________________________
dense_3 (Dense)              (None, 2)                 66
=================================================================
Total params: 2,421,294
Trainable params: 2,421,288
Non-trainable params: 6
_________________________________________________________________
```

```
model =convolutional_model()



#callbacks = myCallback()
model.compile('adam', loss='categorical_crossentropy',  metrics=["accuracy"])
#keras.optimizers.Adam(lr=1e-5)
#es = EarlyStopping(monitor='val_loss', mode='auto', verbose=1,)
history = model.fit(train_generator,
                    epochs=200,
                    steps_per_epoch= 8,
                    validation_data=test_generator,
                    validation_steps = 1,
        shuffle=True,)#callbacks=[callbacks])
```

```
Epoch 1/200
8/8 [==============================] - 1s 139ms/step - loss: 3.6884 - accuracy: 0.5000 - val_loss: 0.6629 - val_accuracy: 0.5625
Epoch 2/200
8/8 [==============================] - 1s 132ms/step - loss: 0.7175 - accuracy: 0.5312 - val_loss: 1.1468 - val_accuracy: 0.4375
Epoch 3/200
8/8 [==============================] - 1s 134ms/step - loss: 0.6924 - accuracy: 0.6172 - val_loss: 0.7036 - val_accuracy: 0.6250
Epoch 4/200
8/8 [==============================] - 1s 133ms/step - loss: 0.6733 - accuracy: 0.6016 - val_loss: 1.0219 - val_accuracy: 0.2500
Epoch 5/200
8/8 [==============================] - 1s 128ms/step - loss: 0.6890 - accuracy: 0.5469 - val_loss: 0.7538 - val_accuracy: 0.5000
Epoch 6/200
8/8 [==============================] - 1s 131ms/step - loss: 0.6449 - accuracy: 0.5703 - val_loss: 0.6484 - val_accuracy: 0.5000
Epoch 7/200
8/8 [==============================] - 1s 133ms/step - loss: 0.7315 - accuracy: 0.5938 - val_loss: 0.7835 - val_accuracy: 0.5000
Epoch 8/200
8/8 [==============================] - 1s 128ms/step - loss: 0.6694 - accuracy: 0.5703 - val_loss: 0.7087 - val_accuracy: 0.4375
Epoch 9/200
8/8 [==============================] - 1s 131ms/step - loss: 0.6470 - accuracy: 0.5938 - val_loss: 0.6790 - val_accuracy: 0.5625
Epoch 10/200
8/8 [==============================] - 1s 135ms/step - loss: 0.5960 - accuracy: 0.6562 - val_loss: 0.8846 - val_accuracy: 0.5625
Epoch 11/200
8/8 [==============================] - 1s 129ms/step - loss: 0.6194 - accuracy: 0.6016 - val_loss: 0.6753 - val_accuracy: 0.5625
Epoch 12/200
8/8 [==============================] - 1s 128ms/step - loss: 0.6001 - accuracy: 0.6562 - val_loss: 0.6928 - val_accuracy: 0.6875
Epoch 13/200
8/8 [==============================] - 1s 133ms/step - loss: 0.6220 - accuracy: 0.6094 - val_loss: 0.6008 - val_accuracy: 0.6250
Epoch 14/200
8/8 [==============================] - 1s 131ms/step - loss: 0.6198 - accuracy: 0.6875 - val_loss: 0.5862 - val_accuracy: 0.6875
Epoch 15/200
8/8 [==============================] - 1s 129ms/step - loss: 0.5887 - accuracy: 0.6484 - val_loss: 0.8248 - val_accuracy: 0.5000
Epoch 16/200
8/8 [==============================] - 1s 129ms/step - loss: 0.5851 - accuracy: 0.6641 - val_loss: 0.7149 - val_accuracy: 0.3125
Epoch 17/200
8/8 [==============================] - 1s 134ms/step - loss: 0.6089 - accuracy: 0.6172 - val_loss: 0.9461 - val_accuracy: 0.6250
Epoch 18/200
8/8 [==============================] - 1s 130ms/step - loss: 0.5475 - accuracy: 0.6953 - val_loss: 1.0005 - val_accuracy: 0.4375
Epoch 19/200
8/8 [==============================] - 1s 130ms/step - loss: 0.5579 - accuracy: 0.7188 - val_loss: 0.5650 - val_accuracy: 0.6250
Epoch 20/200
8/8 [==============================] - 1s 137ms/step - loss: 0.4928 - accuracy: 0.7266 - val_loss: 1.0613 - val_accuracy: 0.6250
Epoch 21/200
8/8 [==============================] - 1s 131ms/step - loss: 0.5106 - accuracy: 0.7344 - val_loss: 0.8784 - val_accuracy: 0.3750
Epoch 22/200
8/8 [==============================] - 1s 132ms/step - loss: 0.5171 - accuracy: 0.7344 - val_loss: 0.8704 - val_accuracy: 0.4375
Epoch 23/200
8/8 [==============================] - 1s 135ms/step - loss: 0.6419 - accuracy: 0.7344 - val_loss: 0.6891 - val_accuracy: 0.8125
Epoch 24/200
8/8 [==============================] - 1s 129ms/step - loss: 0.5685 - accuracy: 0.6562 - val_loss: 0.5689 - val_accuracy: 0.8125
Epoch 25/200
8/8 [==============================] - 1s 131ms/step - loss: 0.5393 - accuracy: 0.7109 - val_loss: 0.6005 - val_accuracy: 0.5000
Epoch 26/200
8/8 [==============================] - 1s 132ms/step - loss: 0.5784 - accuracy: 0.6562 - val_loss: 0.6642 - val_accuracy: 0.6250
Epoch 27/200
8/8 [==============================] - 1s 135ms/step - loss: 0.5534 - accuracy: 0.7031 - val_loss: 0.6985 - val_accuracy: 0.6250
Epoch 28/200
8/8 [==============================] - 1s 131ms/step - loss: 0.5507 - accuracy: 0.6641 - val_loss: 0.7575 - val_accuracy: 0.5625
Epoch 29/200
8/8 [==============================] - 1s 136ms/step - loss: 0.6360 - accuracy: 0.5859 - val_loss: 0.8393 - val_accuracy: 0.2500
Epoch 30/200
8/8 [==============================] - 1s 133ms/step - loss: 0.6270 - accuracy: 0.6250 - val_loss: 0.6487 - val_accuracy: 0.4375
Epoch 31/200
8/8 [==============================] - 1s 128ms/step - loss: 0.6396 - accuracy: 0.6094 - val_loss: 0.8463 - val_accuracy: 0.5625
Epoch 32/200
8/8 [==============================] - 1s 132ms/step - loss: 0.6132 - accuracy: 0.6797 - val_loss: 0.8150 - val_accuracy: 0.5625
Epoch 33/200
8/8 [==============================] - 1s 135ms/step - loss: 0.5759 - accuracy: 0.7109 - val_loss: 0.9135 - val_accuracy: 0.4375
Epoch 34/200
8/8 [==============================] - 1s 135ms/step - loss: 0.5316 - accuracy: 0.7578 - val_loss: 1.6810 - val_accuracy: 0.3125
Epoch 35/200
8/8 [==============================] - 1s 130ms/step - loss: 0.5729 - accuracy: 0.6094 - val_loss: 0.8371 - val_accuracy: 0.7500
Epoch 36/200
8/8 [==============================] - 1s 132ms/step - loss: 0.5200 - accuracy: 0.7109 - val_loss: 0.5925 - val_accuracy: 0.7500
Epoch 37/200
8/8 [==============================] - 1s 132ms/step - loss: 0.5058 - accuracy: 0.6875 - val_loss: 0.7220 - val_accuracy: 0.5000
Epoch 38/200
8/8 [==============================] - 1s 136ms/step - loss: 0.4820 - accuracy: 0.7500 - val_loss: 0.7710 - val_accuracy: 0.4375
Epoch 39/200
8/8 [==============================] - 1s 132ms/step - loss: 0.6095 - accuracy: 0.6484 - val_loss: 0.5627 - val_accuracy: 0.5000
Epoch 40/200
8/8 [==============================] - 1s 132ms/step - loss: 0.5368 - accuracy: 0.6797 - val_loss: 0.9271 - val_accuracy: 0.5000
Epoch 41/200
8/8 [==============================] - 1s 137ms/step - loss: 0.5939 - accuracy: 0.6641 - val_loss: 0.5318 - val_accuracy: 0.8750
Epoch 42/200
8/8 [==============================] - 1s 134ms/step - loss: 0.4589 - accuracy: 0.7422 - val_loss: 0.9444 - val_accuracy: 0.5625
Epoch 43/200
8/8 [==============================] - 1s 139ms/step - loss: 0.4618 - accuracy: 0.7422 - val_loss: 0.9979 - val_accuracy: 0.6875
Epoch 44/200
8/8 [==============================] - 1s 133ms/step - loss: 0.4362 - accuracy: 0.7578 - val_loss: 0.8936 - val_accuracy: 0.5625
Epoch 45/200
8/8 [==============================] - 1s 133ms/step - loss: 0.4375 - accuracy: 0.7578 - val_loss: 0.9706 - val_accuracy: 0.5000
Epoch 46/200
8/8 [==============================] - 1s 135ms/step - loss: 0.5036 - accuracy: 0.7500 - val_loss: 0.6497 - val_accuracy: 0.5625
```

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Epoch 47/200
8/8 [==============================] - 1s 134ms/step - loss: 0.4245 - accuracy: 0.7422 - val_loss: 0.5256 - val_accuracy: 0.7500
Epoch 48/200
8/8 [==============================] - 1s 129ms/step - loss: 0.4767 - accuracy: 0.7109 - val_loss: 0.5664 - val_accuracy: 0.7500
Epoch 49/200
8/8 [==============================] - 1s 149ms/step - loss: 0.4407 - accuracy: 0.7891 - val_loss: 1.6473 - val_accuracy: 0.2500
Epoch 50/200
8/8 [==============================] - 1s 139ms/step - loss: 0.4894 - accuracy: 0.7500 - val_loss: 0.9821 - val_accuracy: 0.5000
Epoch 51/200
8/8 [==============================] - 1s 136ms/step - loss: 0.4048 - accuracy: 0.7578 - val_loss: 2.3299 - val_accuracy: 0.3125
Epoch 52/200
8/8 [==============================] - 1s 138ms/step - loss: 0.4451 - accuracy: 0.7734 - val_loss: 1.4897 - val_accuracy: 0.3750
Epoch 53/200
8/8 [==============================] - 1s 134ms/step - loss: 0.4611 - accuracy: 0.7578 - val_loss: 0.7191 - val_accuracy: 0.5000
Epoch 54/200
8/8 [==============================] - 1s 142ms/step - loss: 0.4794 - accuracy: 0.7109 - val_loss: 0.6854 - val_accuracy: 0.6250
Epoch 55/200
8/8 [==============================] - 1s 141ms/step - loss: 0.4199 - accuracy: 0.7969 - val_loss: 0.8856 - val_accuracy: 0.6875
Epoch 56/200
8/8 [==============================] - 1s 138ms/step - loss: 0.4082 - accuracy: 0.7812 - val_loss: 1.3532 - val_accuracy: 0.6250
Epoch 57/200
8/8 [==============================] - 1s 135ms/step - loss: 0.4258 - accuracy: 0.7891 - val_loss: 1.5406 - val_accuracy: 0.5000
Epoch 58/200
8/8 [==============================] - 1s 136ms/step - loss: 0.4237 - accuracy: 0.7812 - val_loss: 0.9182 - val_accuracy: 0.5625
Epoch 59/200
8/8 [==============================] - 1s 131ms/step - loss: 0.3799 - accuracy: 0.7812 - val_loss: 0.5018 - val_accuracy: 0.6875
Epoch 60/200
8/8 [==============================] - 1s 139ms/step - loss: 0.4197 - accuracy: 0.7812 - val_loss: 0.3903 - val_accuracy: 0.7500
Epoch 61/200
8/8 [==============================] - 1s 132ms/step - loss: 0.4541 - accuracy: 0.7891 - val_loss: 1.5358 - val_accuracy: 0.6250
Epoch 62/200
8/8 [==============================] - 1s 132ms/step - loss: 0.5101 - accuracy: 0.6641 - val_loss: 0.7288 - val_accuracy: 0.5000
Epoch 63/200
8/8 [==============================] - 1s 135ms/step - loss: 0.4150 - accuracy: 0.8047 - val_loss: 0.6528 - val_accuracy: 0.8750
Epoch 64/200
8/8 [==============================] - 1s 130ms/step - loss: 0.4548 - accuracy: 0.7656 - val_loss: 1.4639 - val_accuracy: 0.6250
Epoch 65/200
8/8 [==============================] - 1s 132ms/step - loss: 0.5250 - accuracy: 0.7344 - val_loss: 0.5209 - val_accuracy: 0.6875
Epoch 66/200
8/8 [==============================] - 1s 135ms/step - loss: 0.4190 - accuracy: 0.7734 - val_loss: 0.7502 - val_accuracy: 0.6875
Epoch 67/200
8/8 [==============================] - 1s 130ms/step - loss: 0.3904 - accuracy: 0.8047 - val_loss: 1.3694 - val_accuracy: 0.2500
Epoch 68/200
8/8 [==============================] - 1s 129ms/step - loss: 0.3698 - accuracy: 0.8203 - val_loss: 1.1793 - val_accuracy: 0.6250
Epoch 69/200
8/8 [==============================] - 1s 135ms/step - loss: 0.3830 - accuracy: 0.7812 - val_loss: 0.2688 - val_accuracy: 0.8750
Epoch 70/200
8/8 [==============================] - 1s 131ms/step - loss: 0.3516 - accuracy: 0.8047 - val_loss: 0.8295 - val_accuracy: 0.5000
Epoch 71/200
8/8 [==============================] - 1s 129ms/step - loss: 0.4581 - accuracy: 0.7500 - val_loss: 0.5604 - val_accuracy: 0.6875
Epoch 72/200
8/8 [==============================] - 1s 136ms/step - loss: 0.3384 - accuracy: 0.8359 - val_loss: 1.6542 - val_accuracy: 0.5625
Epoch 73/200
8/8 [==============================] - 1s 131ms/step - loss: 0.3942 - accuracy: 0.8125 - val_loss: 0.5556 - val_accuracy: 0.6250
Epoch 74/200
8/8 [==============================] - 1s 135ms/step - loss: 0.4244 - accuracy: 0.7578 - val_loss: 1.8702 - val_accuracy: 0.4375
Epoch 75/200
8/8 [==============================] - 1s 140ms/step - loss: 0.3928 - accuracy: 0.7734 - val_loss: 0.8179 - val_accuracy: 0.6250
Epoch 76/200
8/8 [==============================] - 1s 135ms/step - loss: 0.3744 - accuracy: 0.8125 - val_loss: 0.8271 - val_accuracy: 0.6250
Epoch 77/200
8/8 [==============================] - 1s 133ms/step - loss: 0.4110 - accuracy: 0.7578 - val_loss: 0.6879 - val_accuracy: 0.7500
Epoch 78/200
8/8 [==============================] - 1s 135ms/step - loss: 0.3655 - accuracy: 0.7891 - val_loss: 0.5818 - val_accuracy: 0.8750
Epoch 79/200
8/8 [==============================] - 1s 129ms/step - loss: 0.4831 - accuracy: 0.7344 - val_loss: 1.5463 - val_accuracy: 0.5000
Epoch 80/200
8/8 [==============================] - 1s 130ms/step - loss: 0.4464 - accuracy: 0.7031 - val_loss: 0.6556 - val_accuracy: 0.5625
Epoch 81/200
8/8 [==============================] - 1s 132ms/step - loss: 0.3119 - accuracy: 0.8594 - val_loss: 1.0446 - val_accuracy: 0.5000
Epoch 82/200
8/8 [==============================] - 1s 132ms/step - loss: 0.4039 - accuracy: 0.7734 - val_loss: 1.0136 - val_accuracy: 0.6875
Epoch 83/200
8/8 [==============================] - 1s 129ms/step - loss: 0.3873 - accuracy: 0.7969 - val_loss: 1.8511 - val_accuracy: 0.3125
Epoch 84/200
8/8 [==============================] - 1s 129ms/step - loss: 0.4083 - accuracy: 0.8125 - val_loss: 1.0027 - val_accuracy: 0.6875
Epoch 85/200
8/8 [==============================] - 1s 133ms/step - loss: 0.3311 - accuracy: 0.7891 - val_loss: 0.3727 - val_accuracy: 0.9375
Epoch 86/200
8/8 [==============================] - 1s 129ms/step - loss: 0.3343 - accuracy: 0.8594 - val_loss: 0.7448 - val_accuracy: 0.6250
Epoch 87/200
8/8 [==============================] - 1s 131ms/step - loss: 0.4220 - accuracy: 0.7812 - val_loss: 0.9425 - val_accuracy: 0.6250
Epoch 88/200
8/8 [==============================] - 1s 128ms/step - loss: 0.3756 - accuracy: 0.8125 - val_loss: 0.8058 - val_accuracy: 0.7500
Epoch 89/200
8/8 [==============================] - 1s 134ms/step - loss: 0.3679 - accuracy: 0.8047 - val_loss: 0.4952 - val_accuracy: 0.6250
Epoch 90/200
8/8 [==============================] - 1s 129ms/step - loss: 0.3450 - accuracy: 0.8359 - val_loss: 1.2641 - val_accuracy: 0.5000
Epoch 91/200
8/8 [==============================] - 1s 131ms/step - loss: 0.3298 - accuracy: 0.8359 - val_loss: 1.4499 - val_accuracy: 0.5000
Epoch 92/200
8/8 [==============================] - 1s 134ms/step - loss: 0.4232 - accuracy: 0.8281 - val_loss: 0.9306 - val_accuracy: 0.6250
Epoch 93/200
```

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8/8 [==============================] - 1s 128ms/step - loss: 0.3948 - accuracy: 0.7812 - val_loss: 0.3004 - val_accuracy: 0.7500
Epoch 94/200
8/8 [==============================] - 1s 133ms/step - loss: 0.2814 - accuracy: 0.9062 - val_loss: 1.8863 - val_accuracy: 0.5625
Epoch 95/200
8/8 [==============================] - 1s 131ms/step - loss: 0.3244 - accuracy: 0.8281 - val_loss: 1.4308 - val_accuracy: 0.3750
Epoch 96/200
8/8 [==============================] - 1s 127ms/step - loss: 0.2743 - accuracy: 0.8594 - val_loss: 0.4187 - val_accuracy: 0.7500
Epoch 97/200
8/8 [==============================] - 1s 136ms/step - loss: 0.2565 - accuracy: 0.8594 - val_loss: 1.5824 - val_accuracy: 0.5625
Epoch 98/200
8/8 [==============================] - 1s 129ms/step - loss: 0.2316 - accuracy: 0.8672 - val_loss: 0.8380 - val_accuracy: 0.7500
Epoch 99/200
8/8 [==============================] - 1s 134ms/step - loss: 0.1957 - accuracy: 0.9219 - val_loss: 1.3148 - val_accuracy: 0.7500
Epoch 100/200
8/8 [==============================] - 1s 134ms/step - loss: 0.2929 - accuracy: 0.8516 - val_loss: 0.4691 - val_accuracy: 0.8125
Epoch 101/200
8/8 [==============================] - 1s 129ms/step - loss: 0.3863 - accuracy: 0.8516 - val_loss: 1.4135 - val_accuracy: 0.5000
Epoch 102/200
8/8 [==============================] - 1s 132ms/step - loss: 0.3652 - accuracy: 0.8750 - val_loss: 0.5644 - val_accuracy: 0.7500
Epoch 103/200
8/8 [==============================] - 1s 132ms/step - loss: 0.3936 - accuracy: 0.8047 - val_loss: 0.6771 - val_accuracy: 0.7500
Epoch 104/200
8/8 [==============================] - 1s 131ms/step - loss: 0.3177 - accuracy: 0.8906 - val_loss: 0.4698 - val_accuracy: 0.7500
Epoch 105/200
8/8 [==============================] - 1s 129ms/step - loss: 0.3180 - accuracy: 0.8516 - val_loss: 1.0470 - val_accuracy: 0.6875
Epoch 106/200
8/8 [==============================] - 1s 136ms/step - loss: 0.3173 - accuracy: 0.8359 - val_loss: 0.5946 - val_accuracy: 0.6250
Epoch 107/200
8/8 [==============================] - 1s 134ms/step - loss: 0.3261 - accuracy: 0.8359 - val_loss: 0.7139 - val_accuracy: 0.6250
Epoch 108/200
8/8 [==============================] - 1s 132ms/step - loss: 0.3076 - accuracy: 0.8594 - val_loss: 1.0648 - val_accuracy: 0.5625
Epoch 109/200
8/8 [==============================] - 1s 135ms/step - loss: 0.1800 - accuracy: 0.9375 - val_loss: 0.9758 - val_accuracy: 0.6875
Epoch 110/200
8/8 [==============================] - 1s 136ms/step - loss: 0.3447 - accuracy: 0.8281 - val_loss: 0.9163 - val_accuracy: 0.7500
Epoch 111/200
8/8 [==============================] - 1s 131ms/step - loss: 0.4690 - accuracy: 0.8750 - val_loss: 1.7629 - val_accuracy: 0.4375
Epoch 112/200
8/8 [==============================] - 1s 133ms/step - loss: 0.3170 - accuracy: 0.8438 - val_loss: 1.3464 - val_accuracy: 0.6250
Epoch 113/200
8/8 [==============================] - 1s 129ms/step - loss: 0.2625 - accuracy: 0.8750 - val_loss: 0.7165 - val_accuracy: 0.6875
Epoch 114/200
8/8 [==============================] - 1s 130ms/step - loss: 0.3885 - accuracy: 0.8672 - val_loss: 0.6718 - val_accuracy: 0.6875
Epoch 115/200
8/8 [==============================] - 1s 129ms/step - loss: 0.4006 - accuracy: 0.7734 - val_loss: 0.5801 - val_accuracy: 0.7500
Epoch 116/200
8/8 [==============================] - 1s 136ms/step - loss: 0.3312 - accuracy: 0.8906 - val_loss: 0.7138 - val_accuracy: 0.5625
Epoch 117/200
8/8 [==============================] - 1s 131ms/step - loss: 0.2952 - accuracy: 0.8516 - val_loss: 0.3971 - val_accuracy: 0.6875
Epoch 118/200
8/8 [==============================] - 1s 138ms/step - loss: 0.2565 - accuracy: 0.8750 - val_loss: 0.4709 - val_accuracy: 0.8750
Epoch 119/200
8/8 [==============================] - 1s 131ms/step - loss: 0.3226 - accuracy: 0.8516 - val_loss: 1.1264 - val_accuracy: 0.6875
Epoch 120/200
8/8 [==============================] - 1s 128ms/step - loss: 0.4045 - accuracy: 0.8438 - val_loss: 0.8315 - val_accuracy: 0.7500
Epoch 121/200
8/8 [==============================] - 1s 134ms/step - loss: 0.2736 - accuracy: 0.8984 - val_loss: 0.7547 - val_accuracy: 0.6250
Epoch 122/200
8/8 [==============================] - 1s 126ms/step - loss: 0.3306 - accuracy: 0.8594 - val_loss: 0.4273 - val_accuracy: 0.8750
Epoch 123/200
8/8 [==============================] - 1s 133ms/step - loss: 0.3930 - accuracy: 0.7969 - val_loss: 0.5994 - val_accuracy: 0.6875
Epoch 124/200
8/8 [==============================] - 1s 132ms/step - loss: 0.2800 - accuracy: 0.8828 - val_loss: 0.3298 - val_accuracy: 0.8125
Epoch 125/200
8/8 [==============================] - 1s 134ms/step - loss: 0.3229 - accuracy: 0.8359 - val_loss: 0.9184 - val_accuracy: 0.6250
Epoch 126/200
8/8 [==============================] - 1s 132ms/step - loss: 0.2769 - accuracy: 0.8750 - val_loss: 1.7777 - val_accuracy: 0.5625
Epoch 127/200
8/8 [==============================] - 1s 137ms/step - loss: 0.1875 - accuracy: 0.9297 - val_loss: 0.6301 - val_accuracy: 0.8125
Epoch 128/200
8/8 [==============================] - 1s 131ms/step - loss: 0.2174 - accuracy: 0.9219 - val_loss: 0.9039 - val_accuracy: 0.6875
Epoch 129/200
8/8 [==============================] - 1s 132ms/step - loss: 0.1935 - accuracy: 0.9141 - val_loss: 0.4633 - val_accuracy: 0.9375
Epoch 130/200
8/8 [==============================] - 1s 135ms/step - loss: 0.2067 - accuracy: 0.9141 - val_loss: 0.6769 - val_accuracy: 0.7500
Epoch 131/200
8/8 [==============================] - 1s 131ms/step - loss: 0.2832 - accuracy: 0.8750 - val_loss: 0.7071 - val_accuracy: 0.8750
Epoch 132/200
8/8 [==============================] - 1s 131ms/step - loss: 0.3140 - accuracy: 0.8828 - val_loss: 0.8862 - val_accuracy: 0.6250
Epoch 133/200
8/8 [==============================] - 1s 137ms/step - loss: 0.3002 - accuracy: 0.8516 - val_loss: 0.2693 - val_accuracy: 0.8750
Epoch 134/200
8/8 [==============================] - 1s 130ms/step - loss: 0.2254 - accuracy: 0.9375 - val_loss: 0.3749 - val_accuracy: 0.7500
Epoch 135/200
8/8 [==============================] - 1s 134ms/step - loss: 0.2247 - accuracy: 0.8828 - val_loss: 0.4629 - val_accuracy: 0.8125
Epoch 136/200
8/8 [==============================] - 1s 133ms/step - loss: 0.3221 - accuracy: 0.8750 - val_loss: 1.0526 - val_accuracy: 0.6250
Epoch 137/200
8/8 [==============================] - 1s 135ms/step - loss: 0.2253 - accuracy: 0.8750 - val_loss: 1.2163 - val_accuracy: 0.6875
Epoch 138/200
8/8 [==============================] - 1s 136ms/step - loss: 0.2326 - accuracy: 0.8828 - val_loss: 0.3594 - val_accuracy: 0.8125
Epoch 139/200
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8/8 [==============================] - 1s 132ms/step - loss: 0.2787 - accuracy: 0.8750 - val_loss: 0.3555 - val_accuracy: 0.8125
Epoch 140/200
8/8 [==============================] - 1s 134ms/step - loss: 0.1971 - accuracy: 0.9219 - val_loss: 0.5885 - val_accuracy: 0.5000
Epoch 141/200
8/8 [==============================] - 1s 133ms/step - loss: 0.2770 - accuracy: 0.9219 - val_loss: 0.4139 - val_accuracy: 0.7500
Epoch 142/200
8/8 [==============================] - 1s 125ms/step - loss: 0.2163 - accuracy: 0.9219 - val_loss: 0.8530 - val_accuracy: 0.5625
Epoch 143/200
8/8 [==============================] - 1s 129ms/step - loss: 0.2202 - accuracy: 0.9219 - val_loss: 1.6719 - val_accuracy: 0.6875
Epoch 144/200
8/8 [==============================] - 1s 136ms/step - loss: 0.2085 - accuracy: 0.8984 - val_loss: 0.6205 - val_accuracy: 0.7500
Epoch 145/200
8/8 [==============================] - 1s 128ms/step - loss: 0.2123 - accuracy: 0.9141 - val_loss: 1.1882 - val_accuracy: 0.5000
Epoch 146/200
8/8 [==============================] - 1s 131ms/step - loss: 0.2456 - accuracy: 0.8906 - val_loss: 0.1937 - val_accuracy: 0.9375
Epoch 147/200
8/8 [==============================] - 1s 130ms/step - loss: 0.2142 - accuracy: 0.9219 - val_loss: 0.3205 - val_accuracy: 0.7500
Epoch 148/200
8/8 [==============================] - 1s 133ms/step - loss: 0.1899 - accuracy: 0.9219 - val_loss: 0.6231 - val_accuracy: 0.8750
Epoch 149/200
8/8 [==============================] - 1s 131ms/step - loss: 0.1965 - accuracy: 0.9297 - val_loss: 1.2806 - val_accuracy: 0.7500
Epoch 150/200
8/8 [==============================] - 1s 135ms/step - loss: 0.2593 - accuracy: 0.8906 - val_loss: 0.5264 - val_accuracy: 0.6875
Epoch 151/200
8/8 [==============================] - 1s 138ms/step - loss: 0.1659 - accuracy: 0.9531 - val_loss: 0.4800 - val_accuracy: 0.8750
Epoch 152/200
8/8 [==============================] - 1s 131ms/step - loss: 0.1746 - accuracy: 0.9297 - val_loss: 1.0273 - val_accuracy: 0.7500
Epoch 153/200
8/8 [==============================] - 1s 135ms/step - loss: 0.2114 - accuracy: 0.8984 - val_loss: 0.2658 - val_accuracy: 0.8750
Epoch 154/200
8/8 [==============================] - 1s 134ms/step - loss: 0.2814 - accuracy: 0.8984 - val_loss: 1.0592 - val_accuracy: 0.6250
Epoch 155/200
8/8 [==============================] - 1s 131ms/step - loss: 0.1768 - accuracy: 0.9453 - val_loss: 1.6677 - val_accuracy: 0.5625
Epoch 156/200
8/8 [==============================] - 1s 136ms/step - loss: 0.2239 - accuracy: 0.8984 - val_loss: 0.4440 - val_accuracy: 0.8125
Epoch 157/200
8/8 [==============================] - 1s 133ms/step - loss: 0.1272 - accuracy: 0.9531 - val_loss: 0.2633 - val_accuracy: 0.8750
Epoch 158/200
8/8 [==============================] - 1s 135ms/step - loss: 0.1976 - accuracy: 0.9219 - val_loss: 0.7967 - val_accuracy: 0.6250
Epoch 159/200
8/8 [==============================] - 1s 131ms/step - loss: 0.1527 - accuracy: 0.9219 - val_loss: 0.1296 - val_accuracy: 0.8750
Epoch 160/200
8/8 [==============================] - 1s 132ms/step - loss: 0.1863 - accuracy: 0.9531 - val_loss: 1.0164 - val_accuracy: 0.6875
Epoch 161/200
8/8 [==============================] - 1s 136ms/step - loss: 0.2520 - accuracy: 0.9062 - val_loss: 1.2081 - val_accuracy: 0.8125
Epoch 162/200
8/8 [==============================] - 1s 131ms/step - loss: 0.4459 - accuracy: 0.7891 - val_loss: 0.7379 - val_accuracy: 0.6875
Epoch 163/200
8/8 [==============================] - 1s 131ms/step - loss: 0.2934 - accuracy: 0.8594 - val_loss: 1.1860 - val_accuracy: 0.5000
Epoch 164/200
8/8 [==============================] - 1s 134ms/step - loss: 0.3138 - accuracy: 0.8594 - val_loss: 0.6611 - val_accuracy: 0.6875
Epoch 165/200
8/8 [==============================] - 1s 135ms/step - loss: 0.3115 - accuracy: 0.8750 - val_loss: 0.6274 - val_accuracy: 0.7500
Epoch 166/200
8/8 [==============================] - 1s 137ms/step - loss: 0.2231 - accuracy: 0.8984 - val_loss: 1.6379 - val_accuracy: 0.6875
Epoch 167/200
8/8 [==============================] - 1s 138ms/step - loss: 0.3061 - accuracy: 0.8828 - val_loss: 0.3004 - val_accuracy: 0.9375
Epoch 168/200
8/8 [==============================] - 1s 131ms/step - loss: 0.3035 - accuracy: 0.8594 - val_loss: 0.4632 - val_accuracy: 0.6250
Epoch 169/200
8/8 [==============================] - 1s 139ms/step - loss: 0.2170 - accuracy: 0.8984 - val_loss: 2.0993 - val_accuracy: 0.5000
Epoch 170/200
8/8 [==============================] - 1s 133ms/step - loss: 0.2881 - accuracy: 0.9062 - val_loss: 0.2947 - val_accuracy: 0.9375
Epoch 171/200
8/8 [==============================] - 1s 140ms/step - loss: 0.1826 - accuracy: 0.9141 - val_loss: 0.6531 - val_accuracy: 0.7500
Epoch 172/200
8/8 [==============================] - 1s 134ms/step - loss: 0.2732 - accuracy: 0.8984 - val_loss: 0.3791 - val_accuracy: 0.8125
Epoch 173/200
8/8 [==============================] - 1s 131ms/step - loss: 0.2561 - accuracy: 0.8906 - val_loss: 0.4903 - val_accuracy: 0.9375
Epoch 174/200
8/8 [==============================] - 1s 139ms/step - loss: 0.2561 - accuracy: 0.8594 - val_loss: 0.3853 - val_accuracy: 0.8125
Epoch 175/200
8/8 [==============================] - 1s 131ms/step - loss: 0.3181 - accuracy: 0.9297 - val_loss: 1.2185 - val_accuracy: 0.6875
Epoch 176/200
8/8 [==============================] - 1s 138ms/step - loss: 0.1834 - accuracy: 0.9219 - val_loss: 1.1625 - val_accuracy: 0.7500
Epoch 177/200
8/8 [==============================] - 1s 135ms/step - loss: 0.2879 - accuracy: 0.8438 - val_loss: 0.4527 - val_accuracy: 0.8125
Epoch 178/200
8/8 [==============================] - 1s 135ms/step - loss: 0.3393 - accuracy: 0.8516 - val_loss: 0.2648 - val_accuracy: 0.8750
Epoch 179/200
8/8 [==============================] - 1s 135ms/step - loss: 0.1664 - accuracy: 0.9297 - val_loss: 0.0335 - val_accuracy: 1.0000
Epoch 180/200
8/8 [==============================] - 1s 132ms/step - loss: 0.1757 - accuracy: 0.9375 - val_loss: 0.2094 - val_accuracy: 0.8750
Epoch 181/200
8/8 [==============================] - 1s 133ms/step - loss: 0.1451 - accuracy: 0.9375 - val_loss: 0.6534 - val_accuracy: 0.7500
Epoch 182/200
8/8 [==============================] - 1s 132ms/step - loss: 0.2701 - accuracy: 0.8906 - val_loss: 0.5971 - val_accuracy: 0.8125
Epoch 183/200
8/8 [==============================] - 1s 136ms/step - loss: 0.1423 - accuracy: 0.9531 - val_loss: 1.3980 - val_accuracy: 0.7500
Epoch 184/200
8/8 [==============================] - 1s 132ms/step - loss: 0.1602 - accuracy: 0.9141 - val_loss: 0.9335 - val_accuracy: 0.8750
Epoch 185/200
8/8 [==============================] - 1s 133ms/step - loss: 0.1559 - accuracy: 0.9375 - val_loss: 1.2170 - val_accuracy: 0.8125
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Epoch 186/200
8/8 [==============================] - 1s 140ms/step - loss: 0.1728 - accuracy: 0.9141 - val_loss: 0.8080 - val_accuracy: 0.8125
Epoch 187/200
8/8 [==============================] - 1s 131ms/step - loss: 0.1156 - accuracy: 0.9766 - val_loss: 0.8432 - val_accuracy: 0.6250
Epoch 188/200
8/8 [==============================] - 1s 134ms/step - loss: 0.1344 - accuracy: 0.9375 - val_loss: 1.4441 - val_accuracy: 0.6250
Epoch 189/200
8/8 [==============================] - 1s 132ms/step - loss: 0.1259 - accuracy: 0.9531 - val_loss: 1.1543 - val_accuracy: 0.7500
Epoch 190/200
8/8 [==============================] - 1s 138ms/step - loss: 0.0895 - accuracy: 0.9688 - val_loss: 0.5715 - val_accuracy: 0.6875
Epoch 191/200
8/8 [==============================] - 1s 131ms/step - loss: 0.1269 - accuracy: 0.9453 - val_loss: 1.1043 - val_accuracy: 0.5625
Epoch 192/200
8/8 [==============================] - 1s 127ms/step - loss: 0.0929 - accuracy: 0.9688 - val_loss: 0.8887 - val_accuracy: 0.8750
Epoch 193/200
8/8 [==============================] - 1s 132ms/step - loss: 0.1102 - accuracy: 0.9609 - val_loss: 1.1979 - val_accuracy: 0.6875
Epoch 194/200
8/8 [==============================] - 1s 134ms/step - loss: 0.0859 - accuracy: 0.9766 - val_loss: 1.1828 - val_accuracy: 0.7500
Epoch 195/200
8/8 [==============================] - 1s 137ms/step - loss: 0.2109 - accuracy: 0.9297 - val_loss: 1.6794 - val_accuracy: 0.5625
Epoch 196/200
8/8 [==============================] - 1s 133ms/step - loss: 0.1580 - accuracy: 0.9219 - val_loss: 0.6461 - val_accuracy: 0.8125
Epoch 197/200
8/8 [==============================] - 1s 140ms/step - loss: 0.1520 - accuracy: 0.9375 - val_loss: 0.3739 - val_accuracy: 0.8125
Epoch 198/200
8/8 [==============================] - 1s 134ms/step - loss: 0.3425 - accuracy: 0.8750 - val_loss: 0.3879 - val_accuracy: 0.8125
Epoch 199/200
8/8 [==============================] - 1s 134ms/step - loss: 0.1973 - accuracy: 0.9141 - val_loss: 2.1893 - val_accuracy: 0.8125
Epoch 200/200
8/8 [==============================] - 1s 138ms/step - loss: 0.2548 - accuracy: 0.9062 - val_loss: 0.9422 - val_accuracy: 0.8125
```