

```
In [23]: import os, shutil
from pathlib import Path
from keras import layers
from keras import models
from keras.utils import to_categorical
from keras import optimizers
import matplotlib.pyplot as plt
import numpy as np
from keras.preprocessing.image import ImageDataGenerator
from keras.preprocessing import image

current_dir = Path(os.getcwd()).absolute()
original_dataset_dir = current_dir.joinpath('kaggle_data')
original_train_dir = original_dataset_dir.joinpath('train')
original_test_dir = original_dataset_dir.joinpath('test1')

train_dir = current_dir.joinpath('train')
train_dir.mkdir(parents=True, exist_ok=True)
validation_dir = current_dir.joinpath('validation')
validation_dir.mkdir(parents=True, exist_ok=True)
test_dir = current_dir.joinpath('test')
test_dir.mkdir(parents=True, exist_ok=True)
train_cats_dir = train_dir.joinpath('cats')
train_cats_dir.mkdir(parents=True, exist_ok=True)

train_dogs_dir = train_dir.joinpath('dogs')
train_dogs_dir.mkdir(parents=True, exist_ok=True)

validation_cats_dir = validation_dir.joinpath('cats')
validation_cats_dir.mkdir(parents=True, exist_ok=True)

validation_dogs_dir = validation_dir.joinpath('dogs')
validation_dogs_dir.mkdir(parents=True, exist_ok=True)

test_cats_dir = test_dir.joinpath('cats')
test_cats_dir.mkdir(parents=True, exist_ok=True)

test_dogs_dir = test_dir.joinpath('dogs')
test_dogs_dir.mkdir(parents=True, exist_ok=True)
```

```
In [24]: fnames = ['cat.{}.jpg'.format(i) for i in range(1000)]
for fname in fnames:
    src = original_train_dir.joinpath(fname)
    dst = train_cats_dir.joinpath(fname)
    shutil.copyfile(src, dst)

fnames = ['cat.{}.jpg'.format(i) for i in range(1000, 1500)]
for fname in fnames:
    src = original_train_dir.joinpath(fname)
    dst = validation_cats_dir.joinpath(fname)
    shutil.copyfile(src, dst)

fnames = ['cat.{}.jpg'.format(i) for i in range(1500, 2000)]
for fname in fnames:
    src = original_train_dir.joinpath(fname)
    dst = test_cats_dir.joinpath(fname)
    shutil.copyfile(src, dst)

fnames = ['dog.{}.jpg'.format(i) for i in range(1000)]
for fname in fnames:
    src = original_train_dir.joinpath(fname)
    dst = train_dogs_dir.joinpath(fname)
    shutil.copyfile(src, dst)

fnames = ['dog.{}.jpg'.format(i) for i in range(1000, 1500)]
for fname in fnames:
    src = original_train_dir.joinpath(fname)
    dst = validation_dogs_dir.joinpath(fname)
    shutil.copyfile(src, dst)

fnames = ['dog.{}.jpg'.format(i) for i in range(1500, 2000)]
for fname in fnames:
    src = original_train_dir.joinpath(fname)
    dst = test_dogs_dir.joinpath(fname)
    shutil.copyfile(src, dst)
```

```
In [25]: print('total train cat images:', len(os.listdir(train_cats_dir)))
print('total train dog images:', len(os.listdir(train_dogs_dir)))
print('total validation cat images:', len(os.listdir(validation_cats_dir)))
print('total validation dog images:', len(os.listdir(validation_dogs_dir)))
print('total test cat images:', len(os.listdir(test_cats_dir)))
print('total test dog images:', len(os.listdir(test_dogs_dir)))
```

```
total train cat images: 1000
total train dog images: 1000
total validation cat images: 500
total validation dog images: 500
total test cat images: 500
total test dog images: 500
```

```
In [26]: model = models.Sequential()
model.add(layers.Conv2D(32, (3, 3), activation = 'relu', input_shape = (150, 150, 3)))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation = 'relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(128, (3, 3), activation = 'relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(128, (3, 3), activation = 'relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Flatten())
model.add(layers.Dense(512, activation = 'relu'))
model.add(layers.Dense(1, activation = 'sigmoid'))
```

```
In [27]: model.summary()
```

Model: "sequential_2"

Layer (type)	Output Shape	Param #
<hr/>		
conv2d_8 (Conv2D)	(None, 148, 148, 32)	896
<hr/>		
max_pooling2d_8 (MaxPooling2D)	(None, 74, 74, 32)	0
<hr/>		
conv2d_9 (Conv2D)	(None, 72, 72, 64)	18496
<hr/>		
max_pooling2d_9 (MaxPooling2D)	(None, 36, 36, 64)	0
<hr/>		
conv2d_10 (Conv2D)	(None, 34, 34, 128)	73856
<hr/>		
max_pooling2d_10 (MaxPooling2D)	(None, 17, 17, 128)	0
<hr/>		
conv2d_11 (Conv2D)	(None, 15, 15, 128)	147584
<hr/>		
max_pooling2d_11 (MaxPooling2D)	(None, 7, 7, 128)	0
<hr/>		
flatten_2 (Flatten)	(None, 6272)	0
<hr/>		
dense_4 (Dense)	(None, 512)	3211776
<hr/>		
dense_5 (Dense)	(None, 1)	513
<hr/>		
Total params: 3,453,121		
Trainable params: 3,453,121		
Non-trainable params: 0		

```
In [28]: model.compile(loss = 'binary_crossentropy', optimizer = optimizers.RMSprop(lr = 1e-4), metrics = ['acc'])
```

```
In [29]: train_datagen = ImageDataGenerator(rescale=1./255)
test_datagen = ImageDataGenerator(rescale=1./255)

train_generator = train_datagen.flow_from_directory(
    train_dir,
    target_size = (150, 150),
    batch_size = 20,
    class_mode = 'binary')
```

Found 2000 images belonging to 2 classes.

```
In [30]: validation_generator = test_datagen.flow_from_directory(
    validation_dir,
    target_size = (150, 150),
    batch_size = 20,
    class_mode = 'binary')
```

Found 1000 images belonging to 2 classes.

```
In [31]: for data_batch, labels_batch in train_generator:
    print('data batch shape:', data_batch.shape)
    print('labels batch shape:', labels_batch.shape)
    break
```

data batch shape: (20, 150, 150, 3)
labels batch shape: (20,)

```
In [32]: history = model.fit_generator(  
    train_generator,  
    steps_per_epoch = 100,  
    epochs = 30,  
    validation_data = validation_generator,  
    validation_steps = 50)  
  
model.save('cats_and_dogs_small_1.h5')
```

```
Epoch 1/30
100/100 [=====] - 22s 221ms/step - loss: 0.6931 - ac
c: 0.5225 - val_loss: 0.6796 - val_acc: 0.5790
Epoch 2/30
100/100 [=====] - 20s 204ms/step - loss: 0.6657 - ac
c: 0.5950 - val_loss: 0.6536 - val_acc: 0.6110
Epoch 3/30
100/100 [=====] - 21s 207ms/step - loss: 0.6350 - ac
c: 0.6330 - val_loss: 0.6240 - val_acc: 0.6620
Epoch 4/30
100/100 [=====] - 21s 208ms/step - loss: 0.5916 - ac
c: 0.6850 - val_loss: 0.5874 - val_acc: 0.6790
Epoch 5/30
100/100 [=====] - 21s 207ms/step - loss: 0.5502 - ac
c: 0.7280 - val_loss: 0.5726 - val_acc: 0.6840
Epoch 6/30
100/100 [=====] - 21s 207ms/step - loss: 0.5254 - ac
c: 0.7330 - val_loss: 0.5663 - val_acc: 0.6930
Epoch 7/30
100/100 [=====] - 21s 208ms/step - loss: 0.5059 - ac
c: 0.7505 - val_loss: 0.5840 - val_acc: 0.6830
Epoch 8/30
100/100 [=====] - 21s 207ms/step - loss: 0.4851 - ac
c: 0.7560 - val_loss: 0.5618 - val_acc: 0.7040
Epoch 9/30
100/100 [=====] - 20s 205ms/step - loss: 0.4466 - ac
c: 0.7840 - val_loss: 0.5450 - val_acc: 0.7210
Epoch 10/30
100/100 [=====] - 21s 207ms/step - loss: 0.4299 - ac
c: 0.8050 - val_loss: 0.5501 - val_acc: 0.7160
Epoch 11/30
100/100 [=====] - 21s 210ms/step - loss: 0.4074 - ac
c: 0.8245 - val_loss: 0.5735 - val_acc: 0.7080
Epoch 12/30
100/100 [=====] - 21s 205ms/step - loss: 0.3893 - ac
c: 0.8210 - val_loss: 0.5774 - val_acc: 0.7090
Epoch 13/30
100/100 [=====] - 21s 207ms/step - loss: 0.3737 - ac
c: 0.8315 - val_loss: 0.5843 - val_acc: 0.7100
Epoch 14/30
100/100 [=====] - 21s 208ms/step - loss: 0.3502 - ac
c: 0.8525 - val_loss: 0.5529 - val_acc: 0.7330
Epoch 15/30
100/100 [=====] - 21s 209ms/step - loss: 0.3280 - ac
c: 0.8565 - val_loss: 0.5732 - val_acc: 0.7270
Epoch 16/30
100/100 [=====] - 21s 207ms/step - loss: 0.3101 - ac
c: 0.8785 - val_loss: 0.5588 - val_acc: 0.7360
Epoch 17/30
100/100 [=====] - 21s 209ms/step - loss: 0.2826 - ac
c: 0.8910 - val_loss: 0.7275 - val_acc: 0.7010
Epoch 18/30
100/100 [=====] - 20s 205ms/step - loss: 0.2705 - ac
c: 0.8925 - val_loss: 0.5988 - val_acc: 0.7370
Epoch 19/30
100/100 [=====] - 20s 205ms/step - loss: 0.2493 - ac
c: 0.9010 - val_loss: 0.6082 - val_acc: 0.7260
```

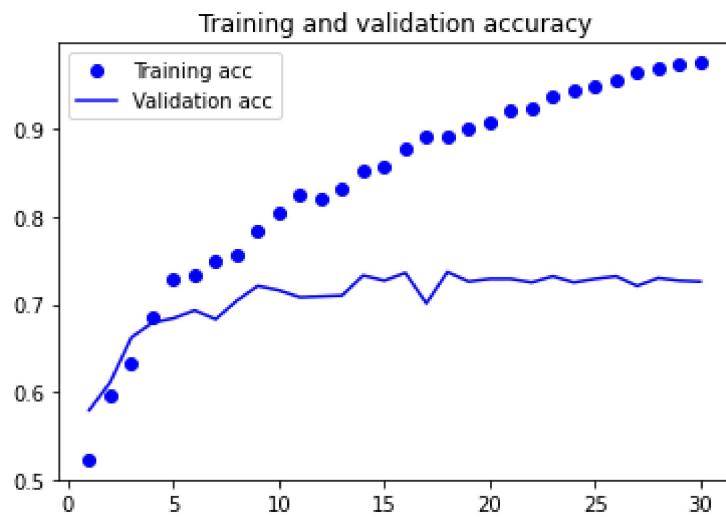
```
Epoch 20/30
100/100 [=====] - 21s 207ms/step - loss: 0.2307 - ac
c: 0.9080 - val_loss: 0.6174 - val_acc: 0.7290
Epoch 21/30
100/100 [=====] - 21s 207ms/step - loss: 0.2125 - ac
c: 0.9225 - val_loss: 0.6171 - val_acc: 0.7290
Epoch 22/30
100/100 [=====] - 21s 207ms/step - loss: 0.1971 - ac
c: 0.9230 - val_loss: 0.6181 - val_acc: 0.7250
Epoch 23/30
100/100 [=====] - 21s 207ms/step - loss: 0.1823 - ac
c: 0.9370 - val_loss: 0.6650 - val_acc: 0.7320
Epoch 24/30
100/100 [=====] - 21s 206ms/step - loss: 0.1576 - ac
c: 0.9455 - val_loss: 0.6859 - val_acc: 0.7250
Epoch 25/30
100/100 [=====] - 21s 205ms/step - loss: 0.1517 - ac
c: 0.9480 - val_loss: 0.7068 - val_acc: 0.7290
Epoch 26/30
100/100 [=====] - 21s 209ms/step - loss: 0.1341 - ac
c: 0.9560 - val_loss: 0.7325 - val_acc: 0.7320
Epoch 27/30
100/100 [=====] - 21s 207ms/step - loss: 0.1111 - ac
c: 0.9655 - val_loss: 0.7793 - val_acc: 0.7210
Epoch 28/30
100/100 [=====] - 20s 204ms/step - loss: 0.0974 - ac
c: 0.9700 - val_loss: 0.8379 - val_acc: 0.7300
Epoch 29/30
100/100 [=====] - 21s 205ms/step - loss: 0.0880 - ac
c: 0.9750 - val_loss: 0.8109 - val_acc: 0.7270
Epoch 30/30
100/100 [=====] - 20s 204ms/step - loss: 0.0801 - ac
c: 0.9760 - val_loss: 0.8108 - val_acc: 0.7260
```

```
In [33]: acc = history.history['acc']
val_acc = history.history['val_acc']
loss = history.history['loss']
val_loss = history.history['val_loss']

epochs = range(1, len(acc)+1)

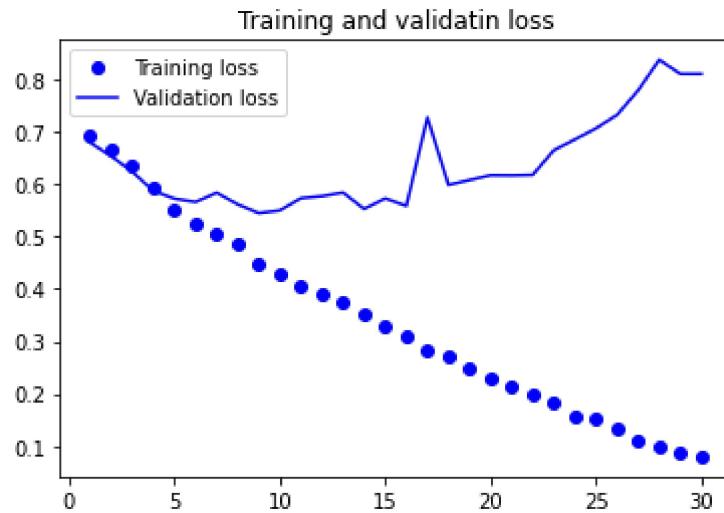
plt.plot(epochs, acc, 'bo', label = 'Training acc')
plt.plot(epochs, val_acc, 'b', label = 'Validation acc')
plt.title('Training and validation accuracy')
plt.legend()
plt.figure()
```

Out[33]: <Figure size 432x288 with 0 Axes>



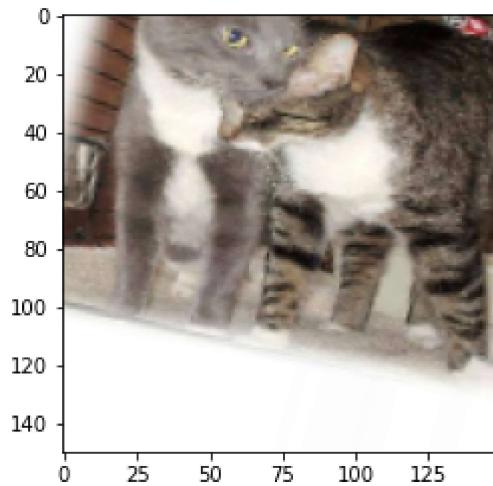
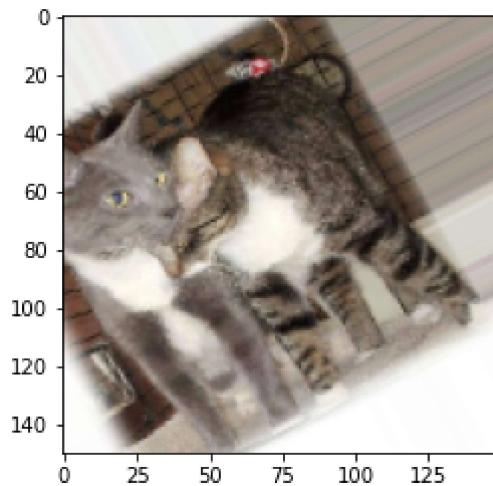
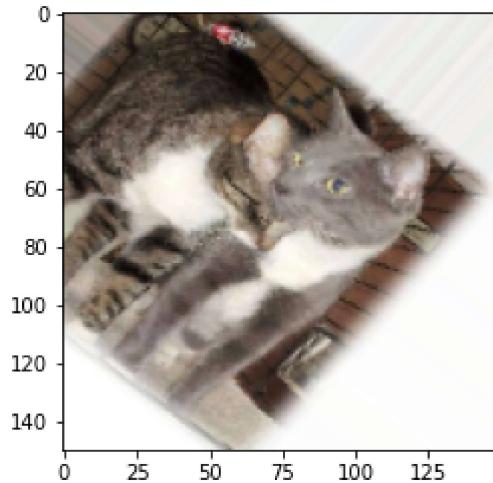
<Figure size 432x288 with 0 Axes>

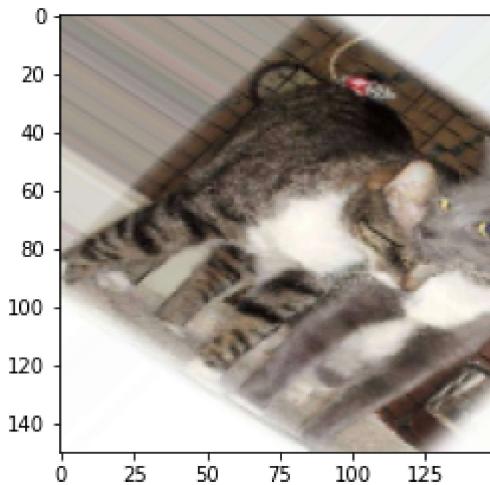
```
In [34]: plt.plot(epochs, loss, 'bo', label = 'Training loss')
plt.plot(epochs, val_loss, 'b', label = 'Validation loss')
plt.title('Training and validation loss')
plt.legend()
plt.show()
```



```
In [35]: datagen = 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,
    fill_mode = 'nearest')
```

```
In [36]: fnames = [train_cats_dir.joinpath(fname) for fname in os.listdir(train_cats_dir)]  
  
img_path = fnames[3]  
  
img = image.load_img(img_path, target_size = (150, 150))  
  
x = image.img_to_array(img)  
  
x = x.reshape((1,) + x.shape)  
  
i = 0  
for batch in datagen.flow(x, batch_size = 1):  
    plt.figure(i)  
    imgplot = plt.imshow(image.array_to_img(batch[0]))  
    i += 1  
    if i % 4 == 0:  
        break  
plt.show()
```





```
In [37]: model = models.Sequential()
model.add(layers.Conv2D(32, (3, 3), activation = 'relu', input_shape = (150, 150, 3)))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation = 'relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(128, (3, 3), activation = 'relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(128, (3, 3), activation = 'relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Flatten())
model.add(layers.Dropout(0.5))
model.add(layers.Dense(512, activation = 'relu'))
model.add(layers.Dense(1, activation = 'sigmoid'))

model.compile(loss = 'binary_crossentropy', optimizer = optimizers.RMSprop(lr = 1e-4), metrics = ['acc'])
```

```
In [53]: train_datagen = ImageDataGenerator(  
    rescale = 1./255,  
    rotation_range = 40,  
    width_shift_range = 0.2,  
    height_shift_range = 0.2,  
    shear_range = 0.2,  
    zoom_range = 0.2,  
    horizontal_flip = True,)  
  
test_datagen = ImageDataGenerator(rescale = 1./255)  
  
train_generator = train_datagen.flow_from_directory(  
    train_dir,  
    target_size = (150, 150),  
    batch_size = 32,  
    class_mode = 'binary')  
  
validation_generator = train_datagen.flow_from_directory(  
    validation_dir,  
    target_size = (150, 150),  
    batch_size = 32,  
    class_mode = 'binary')  
  
history = model.fit_generator(  
    train_generator,  
    steps_per_epoch = 62,  
    epochs = 100,  
    validation_data = validation_generator,  
    validation_steps = 50)
```

```
Found 2000 images belonging to 2 classes.
Found 1000 images belonging to 2 classes.
Epoch 1/100
62/62 [=====] - ETA: 0s - loss: 0.5994 - acc: 0.6819
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 456ms/step - loss: 0.5994 - acc: 0.6819 - val_loss: 0.5895 - val_acc: 0.6790
Epoch 2/100
62/62 [=====] - ETA: 0s - loss: 0.5977 - acc: 0.6778
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 453ms/step - loss: 0.5977 - acc: 0.6778 - val_loss: 0.6153 - val_acc: 0.6540
Epoch 3/100
62/62 [=====] - ETA: 0s - loss: 0.5990 - acc: 0.6789
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 455ms/step - loss: 0.5990 - acc: 0.6789 - val_loss: 0.5852 - val_acc: 0.6770
Epoch 4/100
62/62 [=====] - ETA: 0s - loss: 0.5908 - acc: 0.6885
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.5908 - acc: 0.6885 - val_loss: 0.6046 - val_acc: 0.6900
Epoch 5/100
62/62 [=====] - ETA: 0s - loss: 0.5910 - acc: 0.6784
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 456ms/step - loss: 0.5910 - acc: 0.6784 - val_loss: 0.5686 - val_acc: 0.6840
Epoch 6/100
62/62 [=====] - ETA: 0s - loss: 0.5795 - acc: 0.6961
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.5795 - acc: 0.6961 - val_loss: 0.5877 - val_acc: 0.6780
Epoch 7/100
62/62 [=====] - ETA: 0s - loss: 0.5788 - acc: 0.6982
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 456ms/step - loss: 0.5788 - acc:
```

```
0.6982 - val_loss: 0.5846 - val_acc: 0.6740
Epoch 8/100
62/62 [=====] - ETA: 0s - loss: 0.5764 - acc: 0.6997
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 460ms/step - loss: 0.5764 - acc: 0.6997 - val_loss: 0.5923 - val_acc: 0.6830
Epoch 9/100
62/62 [=====] - ETA: 0s - loss: 0.5711 - acc: 0.6977
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 455ms/step - loss: 0.5711 - acc: 0.6977 - val_loss: 0.5837 - val_acc: 0.6860
Epoch 10/100
62/62 [=====] - ETA: 0s - loss: 0.5586 - acc: 0.7124
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 455ms/step - loss: 0.5586 - acc: 0.7124 - val_loss: 0.5526 - val_acc: 0.7130
Epoch 11/100
62/62 [=====] - ETA: 0s - loss: 0.5558 - acc: 0.7124
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 454ms/step - loss: 0.5558 - acc: 0.7124 - val_loss: 0.6287 - val_acc: 0.6640
Epoch 12/100
62/62 [=====] - ETA: 0s - loss: 0.5511 - acc: 0.7241
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.5511 - acc: 0.7241 - val_loss: 0.6329 - val_acc: 0.6680
Epoch 13/100
62/62 [=====] - ETA: 0s - loss: 0.5567 - acc: 0.7043
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 459ms/step - loss: 0.5567 - acc: 0.7043 - val_loss: 0.5618 - val_acc: 0.6970
Epoch 14/100
62/62 [=====] - ETA: 0s - loss: 0.5383 - acc: 0.7231
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.5383 - acc: 0.7231 - val_loss: 0.5532 - val_acc: 0.7150
```

```
Epoch 15/100
62/62 [=====] - ETA: 0s - loss: 0.5430 - acc: 0.7246
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 454ms/step - loss: 0.5430 - acc: 0.7246 - val_loss: 0.5895 - val_acc: 0.6900
Epoch 16/100
62/62 [=====] - ETA: 0s - loss: 0.5380 - acc: 0.7292
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.5380 - acc: 0.7292 - val_loss: 0.5840 - val_acc: 0.6880
Epoch 17/100
62/62 [=====] - ETA: 0s - loss: 0.5428 - acc: 0.7215
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.5428 - acc: 0.7215 - val_loss: 0.6372 - val_acc: 0.6630
Epoch 18/100
62/62 [=====] - ETA: 0s - loss: 0.5456 - acc: 0.7175
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 456ms/step - loss: 0.5456 - acc: 0.7175 - val_loss: 0.5422 - val_acc: 0.7270
Epoch 19/100
62/62 [=====] - ETA: 0s - loss: 0.5361 - acc: 0.7327
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 456ms/step - loss: 0.5361 - acc: 0.7327 - val_loss: 0.5466 - val_acc: 0.7110
Epoch 20/100
62/62 [=====] - ETA: 0s - loss: 0.5412 - acc: 0.7221
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.5412 - acc: 0.7221 - val_loss: 0.5443 - val_acc: 0.7130
Epoch 21/100
62/62 [=====] - ETA: 0s - loss: 0.5367 - acc: 0.7348
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 456ms/step - loss: 0.5367 - acc: 0.7348 - val_loss: 0.5495 - val_acc: 0.7130
Epoch 22/100
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62/62 [=====] - ETA: 0s - loss: 0.5258 - acc: 0.7444
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 456ms/step - loss: 0.5258 - acc: 0.7444 - val_loss: 0.5236 - val_acc: 0.7290
Epoch 23/100
62/62 [=====] - ETA: 0s - loss: 0.5249 - acc: 0.7393
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 456ms/step - loss: 0.5249 - acc: 0.7393 - val_loss: 0.5317 - val_acc: 0.7150
Epoch 24/100
62/62 [=====] - ETA: 0s - loss: 0.5164 - acc: 0.7449
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 456ms/step - loss: 0.5164 - acc: 0.7449 - val_loss: 0.5286 - val_acc: 0.7210
Epoch 25/100
62/62 [=====] - ETA: 0s - loss: 0.5190 - acc: 0.7337
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 454ms/step - loss: 0.5190 - acc: 0.7337 - val_loss: 0.5563 - val_acc: 0.6990
Epoch 26/100
62/62 [=====] - ETA: 0s - loss: 0.5332 - acc: 0.7368
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 454ms/step - loss: 0.5332 - acc: 0.7368 - val_loss: 0.5237 - val_acc: 0.7270
Epoch 27/100
62/62 [=====] - ETA: 0s - loss: 0.5054 - acc: 0.7551
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 459ms/step - loss: 0.5054 - acc: 0.7551 - val_loss: 0.5762 - val_acc: 0.7020
Epoch 28/100
62/62 [=====] - ETA: 0s - loss: 0.5112 - acc: 0.7409
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 453ms/step - loss: 0.5112 - acc: 0.7409 - val_loss: 0.5068 - val_acc: 0.7520
Epoch 29/100
62/62 [=====] - ETA: 0s - loss: 0.5086 - acc: 0.7525
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WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 454ms/step - loss: 0.5086 - acc: 0.7525 - val_loss: 0.5188 - val_acc: 0.7560  
Epoch 30/100  
62/62 [=====] - ETA: 0s - loss: 0.5076 - acc: 0.7470  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 454ms/step - loss: 0.5076 - acc: 0.7470 - val_loss: 0.5327 - val_acc: 0.7240  
Epoch 31/100  
62/62 [=====] - ETA: 0s - loss: 0.5010 - acc: 0.7525  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 454ms/step - loss: 0.5010 - acc: 0.7525 - val_loss: 0.5085 - val_acc: 0.7500  
Epoch 32/100  
62/62 [=====] - ETA: 0s - loss: 0.5052 - acc: 0.7612  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 453ms/step - loss: 0.5052 - acc: 0.7612 - val_loss: 0.5285 - val_acc: 0.7390  
Epoch 33/100  
62/62 [=====] - ETA: 0s - loss: 0.4929 - acc: 0.7617  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 457ms/step - loss: 0.4929 - acc: 0.7617 - val_loss: 0.5632 - val_acc: 0.7070  
Epoch 34/100  
62/62 [=====] - ETA: 0s - loss: 0.5049 - acc: 0.7510  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 455ms/step - loss: 0.5049 - acc: 0.7510 - val_loss: 0.5198 - val_acc: 0.7260  
Epoch 35/100  
62/62 [=====] - ETA: 0s - loss: 0.4934 - acc: 0.7642  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 455ms/step - loss: 0.4934 - acc: 0.7642 - val_loss: 0.5282 - val_acc: 0.7230  
Epoch 36/100  
62/62 [=====] - ETA: 0s - loss: 0.4809 - acc: 0.7729  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make su
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re that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 453ms/step - loss: 0.4809 - acc: 0.7729 - val_loss: 0.5222 - val_acc: 0.7380
Epoch 37/100

62/62 [=====] - ETA: 0s - loss: 0.4818 - acc: 0.7683
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 456ms/step - loss: 0.4818 - acc: 0.7683 - val_loss: 0.4988 - val_acc: 0.7550
Epoch 38/100

62/62 [=====] - ETA: 0s - loss: 0.4821 - acc: 0.7622
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 455ms/step - loss: 0.4821 - acc: 0.7622 - val_loss: 0.6015 - val_acc: 0.7000
Epoch 39/100

62/62 [=====] - ETA: 0s - loss: 0.4851 - acc: 0.7637
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 457ms/step - loss: 0.4851 - acc: 0.7637 - val_loss: 0.5418 - val_acc: 0.7280
Epoch 40/100

62/62 [=====] - ETA: 0s - loss: 0.4810 - acc: 0.7637
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 456ms/step - loss: 0.4810 - acc: 0.7637 - val_loss: 0.5088 - val_acc: 0.7320
Epoch 41/100

62/62 [=====] - ETA: 0s - loss: 0.4782 - acc: 0.7754
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 455ms/step - loss: 0.4782 - acc: 0.7754 - val_loss: 0.5045 - val_acc: 0.7380
Epoch 42/100

62/62 [=====] - ETA: 0s - loss: 0.4661 - acc: 0.7795
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 457ms/step - loss: 0.4661 - acc: 0.7795 - val_loss: 0.5019 - val_acc: 0.7720
Epoch 43/100

62/62 [=====] - ETA: 0s - loss: 0.4770 - acc: 0.7703
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

ochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 454ms/step - loss: 0.4770 - acc: 0.7703 - val_loss: 0.5493 - val_acc: 0.7070
Epoch 44/100

62/62 [=====] - ETA: 0s - loss: 0.4678 - acc: 0.7815
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 457ms/step - loss: 0.4678 - acc: 0.7815 - val_loss: 0.5199 - val_acc: 0.7380
Epoch 45/100

62/62 [=====] - ETA: 0s - loss: 0.4751 - acc: 0.7729
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 455ms/step - loss: 0.4751 - acc: 0.7729 - val_loss: 0.5519 - val_acc: 0.7240
Epoch 46/100

62/62 [=====] - ETA: 0s - loss: 0.4703 - acc: 0.7693
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 454ms/step - loss: 0.4703 - acc: 0.7693 - val_loss: 0.5163 - val_acc: 0.7220
Epoch 47/100

62/62 [=====] - ETA: 0s - loss: 0.4699 - acc: 0.7774
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 454ms/step - loss: 0.4699 - acc: 0.7774 - val_loss: 0.5121 - val_acc: 0.7520
Epoch 48/100

62/62 [=====] - ETA: 0s - loss: 0.4720 - acc: 0.7683
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 454ms/step - loss: 0.4720 - acc: 0.7683 - val_loss: 0.5234 - val_acc: 0.7230
Epoch 49/100

62/62 [=====] - ETA: 0s - loss: 0.4649 - acc: 0.7764
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 457ms/step - loss: 0.4649 - acc: 0.7764 - val_loss: 0.5125 - val_acc: 0.7350
Epoch 50/100

62/62 [=====] - ETA: 0s - loss: 0.4534 - acc: 0.7861
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() fu

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unction when building your dataset.  
62/62 [=====] - 28s 453ms/step - loss: 0.4534 - acc: 0.7861 - val_loss: 0.4897 - val_acc: 0.7480  
Epoch 51/100  
62/62 [=====] - ETA: 0s - loss: 0.4601 - acc: 0.7840  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 453ms/step - loss: 0.4601 - acc: 0.7840 - val_loss: 0.5254 - val_acc: 0.7460  
Epoch 52/100  
62/62 [=====] - ETA: 0s - loss: 0.4647 - acc: 0.7790  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 459ms/step - loss: 0.4647 - acc: 0.7790 - val_loss: 0.4860 - val_acc: 0.7600  
Epoch 53/100  
62/62 [=====] - ETA: 0s - loss: 0.4475 - acc: 0.7927  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 456ms/step - loss: 0.4475 - acc: 0.7927 - val_loss: 0.4839 - val_acc: 0.7730  
Epoch 54/100  
62/62 [=====] - ETA: 0s - loss: 0.4714 - acc: 0.7754  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 458ms/step - loss: 0.4714 - acc: 0.7754 - val_loss: 0.4583 - val_acc: 0.7770  
Epoch 55/100  
62/62 [=====] - ETA: 0s - loss: 0.4501 - acc: 0.7947  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 457ms/step - loss: 0.4501 - acc: 0.7947 - val_loss: 0.4719 - val_acc: 0.7630  
Epoch 56/100  
62/62 [=====] - ETA: 0s - loss: 0.4559 - acc: 0.7800  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 455ms/step - loss: 0.4559 - acc: 0.7800 - val_loss: 0.4904 - val_acc: 0.7550  
Epoch 57/100  
62/62 [=====] - ETA: 0s - loss: 0.4527 - acc: 0.7846  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
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62/62 [=====] - 28s 458ms/step - loss: 0.4527 - acc: 0.7846 - val_loss: 0.5005 - val_acc: 0.7500
Epoch 58/100
62/62 [=====] - ETA: 0s - loss: 0.4487 - acc: 0.7901
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.4487 - acc: 0.7901 - val_loss: 0.5079 - val_acc: 0.7480
Epoch 59/100
62/62 [=====] - ETA: 0s - loss: 0.4412 - acc: 0.7901
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 455ms/step - loss: 0.4412 - acc: 0.7901 - val_loss: 0.4854 - val_acc: 0.7550
Epoch 60/100
62/62 [=====] - ETA: 0s - loss: 0.4404 - acc: 0.7939
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.4404 - acc: 0.7939 - val_loss: 0.5392 - val_acc: 0.7480
Epoch 61/100
62/62 [=====] - ETA: 0s - loss: 0.4469 - acc: 0.7779
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 455ms/step - loss: 0.4469 - acc: 0.7779 - val_loss: 0.4769 - val_acc: 0.7750
Epoch 62/100
62/62 [=====] - ETA: 0s - loss: 0.4483 - acc: 0.7912
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 458ms/step - loss: 0.4483 - acc: 0.7912 - val_loss: 0.4912 - val_acc: 0.7760
Epoch 63/100
62/62 [=====] - ETA: 0s - loss: 0.4588 - acc: 0.7795
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 458ms/step - loss: 0.4588 - acc: 0.7795 - val_loss: 0.4797 - val_acc: 0.7590
Epoch 64/100
62/62 [=====] - ETA: 0s - loss: 0.4350 - acc: 0.8013
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 454ms/step - loss: 0.4350 - acc:
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0.8013 - val_loss: 0.4940 - val_acc: 0.7720
Epoch 65/100
62/62 [=====] - ETA: 0s - loss: 0.4461 - acc: 0.7973
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 458ms/step - loss: 0.4461 - acc: 0.7973 - val_loss: 0.5012 - val_acc: 0.7390
Epoch 66/100
62/62 [=====] - ETA: 0s - loss: 0.4424 - acc: 0.7907
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.4424 - acc: 0.7907 - val_loss: 0.5071 - val_acc: 0.7440
Epoch 67/100
62/62 [=====] - ETA: 0s - loss: 0.4486 - acc: 0.7785
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 459ms/step - loss: 0.4486 - acc: 0.7785 - val_loss: 0.4758 - val_acc: 0.7700
Epoch 68/100
62/62 [=====] - ETA: 0s - loss: 0.4361 - acc: 0.7957
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 453ms/step - loss: 0.4361 - acc: 0.7957 - val_loss: 0.4983 - val_acc: 0.7560
Epoch 69/100
62/62 [=====] - ETA: 0s - loss: 0.4459 - acc: 0.7947
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 455ms/step - loss: 0.4459 - acc: 0.7947 - val_loss: 0.4839 - val_acc: 0.7530
Epoch 70/100
62/62 [=====] - ETA: 0s - loss: 0.4347 - acc: 0.8018
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.4347 - acc: 0.8018 - val_loss: 0.4925 - val_acc: 0.7500
Epoch 71/100
62/62 [=====] - ETA: 0s - loss: 0.4277 - acc: 0.7947
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 456ms/step - loss: 0.4277 - acc: 0.7947 - val_loss: 0.5187 - val_acc: 0.7500
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Epoch 72/100
62/62 [=====] - ETA: 0s - loss: 0.4289 - acc: 0.7912
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 456ms/step - loss: 0.4289 - acc: 0.7912 - val_loss: 0.4724 - val_acc: 0.7890
Epoch 73/100
62/62 [=====] - ETA: 0s - loss: 0.4090 - acc: 0.8095
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.4090 - acc: 0.8095 - val_loss: 0.5048 - val_acc: 0.7680
Epoch 74/100
62/62 [=====] - ETA: 0s - loss: 0.4185 - acc: 0.8110
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.4185 - acc: 0.8110 - val_loss: 0.5868 - val_acc: 0.7140
Epoch 75/100
62/62 [=====] - ETA: 0s - loss: 0.4247 - acc: 0.8003
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 455ms/step - loss: 0.4247 - acc: 0.8003 - val_loss: 0.5162 - val_acc: 0.7410
Epoch 76/100
62/62 [=====] - ETA: 0s - loss: 0.4396 - acc: 0.7957
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.4396 - acc: 0.7957 - val_loss: 0.5033 - val_acc: 0.7650
Epoch 77/100
62/62 [=====] - ETA: 0s - loss: 0.4248 - acc: 0.8064
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 458ms/step - loss: 0.4248 - acc: 0.8064 - val_loss: 0.5044 - val_acc: 0.7600
Epoch 78/100
62/62 [=====] - ETA: 0s - loss: 0.4278 - acc: 0.8130
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.4278 - acc: 0.8130 - val_loss: 0.4881 - val_acc: 0.7620
Epoch 79/100
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62/62 [=====] - ETA: 0s - loss: 0.4278 - acc: 0.7978
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.4278 - acc: 0.7978 - val_loss: 0.4655 - val_acc: 0.7750
Epoch 80/100
62/62 [=====] - ETA: 0s - loss: 0.4075 - acc: 0.8145
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.4075 - acc: 0.8145 - val_loss: 0.4723 - val_acc: 0.7710
Epoch 81/100
62/62 [=====] - ETA: 0s - loss: 0.4184 - acc: 0.8059
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 457ms/step - loss: 0.4184 - acc: 0.8059 - val_loss: 0.4896 - val_acc: 0.7700
Epoch 82/100
62/62 [=====] - ETA: 0s - loss: 0.4032 - acc: 0.8161
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 455ms/step - loss: 0.4032 - acc: 0.8161 - val_loss: 0.5150 - val_acc: 0.7640
Epoch 83/100
62/62 [=====] - ETA: 0s - loss: 0.4027 - acc: 0.8237
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 456ms/step - loss: 0.4027 - acc: 0.8237 - val_loss: 0.4718 - val_acc: 0.7630
Epoch 84/100
62/62 [=====] - ETA: 0s - loss: 0.4120 - acc: 0.8140
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 28s 460ms/step - loss: 0.4120 - acc: 0.8140 - val_loss: 0.4642 - val_acc: 0.7800
Epoch 85/100
62/62 [=====] - ETA: 0s - loss: 0.4113 - acc: 0.8100
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.
62/62 [=====] - 29s 466ms/step - loss: 0.4113 - acc: 0.8100 - val_loss: 0.4869 - val_acc: 0.7630
Epoch 86/100
62/62 [=====] - ETA: 0s - loss: 0.3983 - acc: 0.8145
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WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 455ms/step - loss: 0.3983 - acc: 0.8145 - val_loss: 0.4896 - val_acc: 0.7720  
Epoch 87/100  
62/62 [=====] - ETA: 0s - loss: 0.4053 - acc: 0.8257  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 457ms/step - loss: 0.4053 - acc: 0.8257 - val_loss: 0.4872 - val_acc: 0.7750  
Epoch 88/100  
62/62 [=====] - ETA: 0s - loss: 0.4099 - acc: 0.8028  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 456ms/step - loss: 0.4099 - acc: 0.8028 - val_loss: 0.4531 - val_acc: 0.8000  
Epoch 89/100  
62/62 [=====] - ETA: 0s - loss: 0.4164 - acc: 0.8064  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 454ms/step - loss: 0.4164 - acc: 0.8064 - val_loss: 0.5301 - val_acc: 0.7350  
Epoch 90/100  
62/62 [=====] - ETA: 0s - loss: 0.3999 - acc: 0.8074  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 458ms/step - loss: 0.3999 - acc: 0.8074 - val_loss: 0.4612 - val_acc: 0.7870  
Epoch 91/100  
62/62 [=====] - ETA: 0s - loss: 0.4101 - acc: 0.8120  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 457ms/step - loss: 0.4101 - acc: 0.8120 - val_loss: 0.4631 - val_acc: 0.7770  
Epoch 92/100  
62/62 [=====] - ETA: 0s - loss: 0.4080 - acc: 0.8181  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.  
62/62 [=====] - 28s 456ms/step - loss: 0.4080 - acc: 0.8181 - val_loss: 0.4636 - val_acc: 0.7880  
Epoch 93/100  
62/62 [=====] - ETA: 0s - loss: 0.3935 - acc: 0.8262  
WARNING:tensorflow:Your input ran out of data; interrupting training. Make su
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re that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 458ms/step - loss: 0.3935 - acc: 0.8262 - val_loss: 0.4950 - val_acc: 0.7640
Epoch 94/100

62/62 [=====] - ETA: 0s - loss: 0.3938 - acc: 0.8242
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 458ms/step - loss: 0.3938 - acc: 0.8242 - val_loss: 0.4690 - val_acc: 0.7710
Epoch 95/100

62/62 [=====] - ETA: 0s - loss: 0.4045 - acc: 0.8105
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 457ms/step - loss: 0.4045 - acc: 0.8105 - val_loss: 0.4665 - val_acc: 0.7750
Epoch 96/100

62/62 [=====] - ETA: 0s - loss: 0.3968 - acc: 0.8333
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 455ms/step - loss: 0.3968 - acc: 0.8333 - val_loss: 0.4613 - val_acc: 0.7710
Epoch 97/100

62/62 [=====] - ETA: 0s - loss: 0.3936 - acc: 0.8186
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 455ms/step - loss: 0.3936 - acc: 0.8186 - val_loss: 0.4671 - val_acc: 0.7840
Epoch 98/100

62/62 [=====] - ETA: 0s - loss: 0.3908 - acc: 0.8252
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 458ms/step - loss: 0.3908 - acc: 0.8252 - val_loss: 0.4916 - val_acc: 0.7740
Epoch 99/100

62/62 [=====] - ETA: 0s - loss: 0.4138 - acc: 0.8064
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

62/62 [=====] - 28s 458ms/step - loss: 0.4138 - acc: 0.8064 - val_loss: 0.4461 - val_acc: 0.7920
Epoch 100/100

62/62 [=====] - ETA: 0s - loss: 0.3907 - acc: 0.8186
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

ochs` batches (in this case, 50 batches). You may need to use the repeat() function when building your dataset.

```
62/62 [=====] - 28s 456ms/step - loss: 0.3907 - acc: 0.8186 - val_loss: 0.4634 - val_acc: 0.7830
```

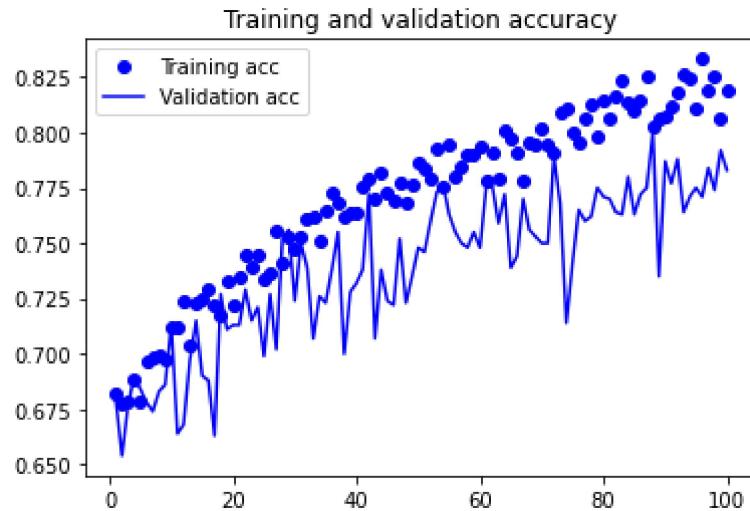
```
In [55]: model.save('cats_and_dogs_small_2.h5')
```

```
In [56]: acc = history.history['acc']
val_acc = history.history['val_acc']
loss = history.history['loss']
val_loss = history.history['val_loss']

epochs = range(1, len(acc)+1)

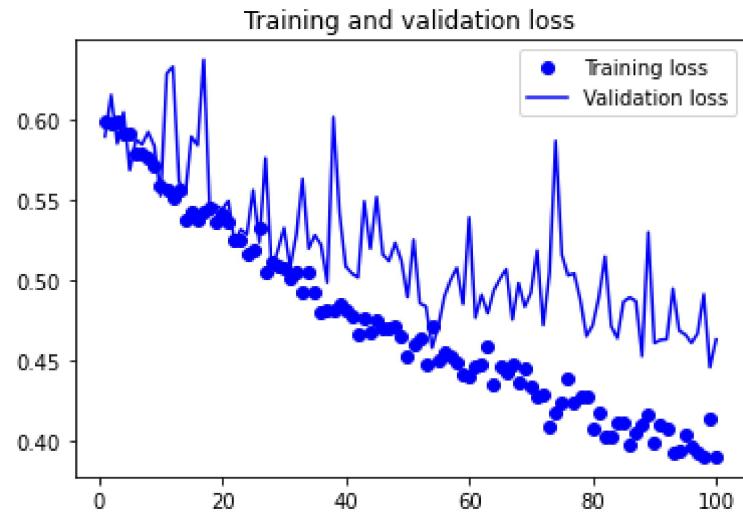
plt.plot(epochs, acc, 'bo', label = 'Training acc')
plt.plot(epochs, val_acc, 'b', label = 'Validation acc')
plt.title('Training and validation accuracy')
plt.legend()
plt.figure()
```

```
Out[56]: <Figure size 432x288 with 0 Axes>
```



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

```
In [58]: plt.plot(epochs, loss, 'bo', label = 'Training loss')
plt.plot(epochs, val_loss, 'b', label = 'Validation loss')
plt.title('Training and validation loss')
plt.legend()
plt.show()
```



```
In [ ]:
```