convnet2

January 23, 2020

[4]:
```
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D
from tensorflow.keras.layers import Activation, Dropout, Flatten, Dense
from tensorflow.keras import backend as K
from tensorflow.keras.utils import plot_model
import matplotlib.pyplot as plt
import tensorflow as tf

tf.config.threading.set_inter_op_parallelism_threads(6)
tf.config.threading.set_intra_op_parallelism_threads(2)
```

[5]:
```
# dimensions of our images.
img_width, img_height = 224, 224

train_data_dir = '/home/user/     /convnets/transfer-learning-keras/dataset/
 ↪training'
validation_data_dir = '/home/user/     /convnets/transfer-learning-keras/
 ↪dataset/validation'
nb_train_samples = 3000
nb_validation_samples = 1000
epochs = 50
batch_size = 20

if K.image_data_format() == 'channels_first':
    input_shape = (3, img_width, img_height)
else:
    input_shape = (img_width, img_height, 3)

model = Sequential()
model.add(Conv2D(32, (3, 3), input_shape=input_shape))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Conv2D(32, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
```

```
model.add(Conv2D(64, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Flatten())
model.add(Dense(64))
model.add(Activation('relu'))
model.add(Dropout(0.5))
model.add(Dense(1))
model.add(Activation('sigmoid'))

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

# this is the augmentation configuration we will use for training
train_datagen = ImageDataGenerator(
    rescale=1. / 255,
    shear_range=0.2,
    zoom_range=0.2,
    horizontal_flip=True)

# this is the augmentation configuration we will use for testing:
# only rescaling
test_datagen = ImageDataGenerator(rescale=1. / 255)

train_generator = train_datagen.flow_from_directory(
    train_data_dir,
    target_size=(img_width, img_height),
    batch_size=batch_size,
    class_mode='binary')

validation_generator = test_datagen.flow_from_directory(
    validation_data_dir,
    target_size=(img_width, img_height),
    batch_size=batch_size,
    class_mode='binary')

history = model.fit_generator(
    train_generator,
    steps_per_epoch=nb_train_samples // batch_size,
    epochs=epochs,
    validation_data=validation_generator,
    validation_steps=nb_validation_samples // batch_size)
```

```
Found 3000 images belonging to 2 classes.
```

```
Found 1000 images belonging to 2 classes.
Epoch 1/50
149/150 [============================>.] - ETA: 0s - loss: 0.5575 - acc:
0.7225Epoch 1/50
150/150 [==============================] - 63s 420ms/step - loss: 0.5561 - acc:
0.7233 - val_loss: 0.4194 - val_acc: 0.8290
Epoch 2/50
149/150 [============================>.] - ETA: 0s - loss: 0.4257 - acc:
0.8134Epoch 1/50
150/150 [==============================] - 60s 399ms/step - loss: 0.4252 - acc:
0.8137 - val_loss: 0.3527 - val_acc: 0.8540
Epoch 3/50
149/150 [============================>.] - ETA: 0s - loss: 0.3953 - acc:
0.8265Epoch 1/50
150/150 [==============================] - 59s 395ms/step - loss: 0.3951 - acc:
0.8267 - val_loss: 0.3728 - val_acc: 0.8320
Epoch 4/50
149/150 [============================>.] - ETA: 0s - loss: 0.3556 - acc:
0.8534Epoch 1/50
150/150 [==============================] - 60s 400ms/step - loss: 0.3551 - acc:
0.8540 - val_loss: 0.2872 - val_acc: 0.8900
Epoch 5/50
149/150 [============================>.] - ETA: 0s - loss: 0.3310 - acc:
0.8745Epoch 1/50
150/150 [==============================] - 59s 396ms/step - loss: 0.3301 - acc:
0.8750 - val_loss: 0.2611 - val_acc: 0.8840
Epoch 6/50
149/150 [============================>.] - ETA: 0s - loss: 0.2920 - acc:
0.8859Epoch 1/50
150/150 [==============================] - 59s 395ms/step - loss: 0.2914 - acc:
0.8860 - val_loss: 0.2923 - val_acc: 0.8860
Epoch 7/50
149/150 [============================>.] - ETA: 0s - loss: 0.2840 - acc:
0.8886Epoch 1/50
150/150 [==============================] - 59s 396ms/step - loss: 0.2845 - acc:
0.8883 - val_loss: 0.3222 - val_acc: 0.8900
Epoch 8/50
149/150 [============================>.] - ETA: 0s - loss: 0.2850 - acc:
0.8946Epoch 1/50
150/150 [==============================] - 60s 397ms/step - loss: 0.2864 - acc:
0.8933 - val_loss: 0.2681 - val_acc: 0.9010
Epoch 9/50
149/150 [============================>.] - ETA: 0s - loss: 0.2413 - acc:
0.9050Epoch 1/50
150/150 [==============================] - 59s 396ms/step - loss: 0.2420 - acc:
0.9047 - val_loss: 0.2389 - val_acc: 0.9100
Epoch 10/50
149/150 [============================>.] - ETA: 0s - loss: 0.2441 - acc:
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0.9101Epoch 1/50
150/150 [==============================] - 59s 394ms/step - loss: 0.2459 - acc:
0.9090 - val_loss: 0.2186 - val_acc: 0.9240
Epoch 11/50
149/150 [============================>.] - ETA: 0s - loss: 0.2425 - acc:
0.9044Epoch 1/50
150/150 [==============================] - 58s 388ms/step - loss: 0.2422 - acc:
0.9043 - val_loss: 0.3002 - val_acc: 0.8930
Epoch 12/50
149/150 [============================>.] - ETA: 0s - loss: 0.2247 - acc:
0.9117Epoch 1/50
150/150 [==============================] - 58s 388ms/step - loss: 0.2242 - acc:
0.9120 - val_loss: 0.3620 - val_acc: 0.8800
Epoch 13/50
149/150 [============================>.] - ETA: 0s - loss: 0.2311 - acc:
0.9128Epoch 1/50
150/150 [==============================] - 58s 385ms/step - loss: 0.2305 - acc:
0.9130 - val_loss: 0.3167 - val_acc: 0.8860
Epoch 14/50
149/150 [============================>.] - ETA: 0s - loss: 0.2230 - acc:
0.9131Epoch 1/50
150/150 [==============================] - 58s 387ms/step - loss: 0.2253 - acc:
0.9127 - val_loss: 0.2302 - val_acc: 0.9200
Epoch 15/50
149/150 [============================>.] - ETA: 0s - loss: 0.1990 - acc:
0.9232Epoch 1/50
150/150 [==============================] - 58s 387ms/step - loss: 0.1982 - acc:
0.9237 - val_loss: 0.2627 - val_acc: 0.9150
Epoch 16/50
149/150 [============================>.] - ETA: 0s - loss: 0.2170 - acc:
0.9168Epoch 1/50
150/150 [==============================] - 59s 390ms/step - loss: 0.2176 - acc:
0.9167 - val_loss: 0.2113 - val_acc: 0.9150
Epoch 17/50
149/150 [============================>.] - ETA: 0s - loss: 0.2009 - acc:
0.9245Epoch 1/50
150/150 [==============================] - 60s 402ms/step - loss: 0.2011 - acc:
0.9243 - val_loss: 0.2977 - val_acc: 0.8970
Epoch 18/50
149/150 [============================>.] - ETA: 0s - loss: 0.1748 - acc:
0.9295Epoch 1/50
150/150 [==============================] - 61s 405ms/step - loss: 0.1740 - acc:
0.9300 - val_loss: 0.2578 - val_acc: 0.9150
Epoch 19/50
149/150 [============================>.] - ETA: 0s - loss: 0.1812 - acc:
0.9272Epoch 1/50
150/150 [==============================] - 60s 403ms/step - loss: 0.1807 - acc:
0.9273 - val_loss: 0.2436 - val_acc: 0.9200
```

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Epoch 20/50
149/150 [============================>.] - ETA: 0s - loss: 0.1675 - acc:
0.9336Epoch 1/50
150/150 [==============================] - 61s 404ms/step - loss: 0.1673 - acc:
0.9337 - val_loss: 0.2474 - val_acc: 0.9150
Epoch 21/50
149/150 [============================>.] - ETA: 0s - loss: 0.1583 - acc:
0.9362Epoch 1/50
150/150 [==============================] - 61s 405ms/step - loss: 0.1590 - acc:
0.9357 - val_loss: 0.2596 - val_acc: 0.9050
Epoch 22/50
149/150 [============================>.] - ETA: 0s - loss: 0.1381 - acc:
0.9436Epoch 1/50
150/150 [==============================] - 60s 400ms/step - loss: 0.1374 - acc:
0.9440 - val_loss: 0.4166 - val_acc: 0.8900
Epoch 23/50
149/150 [============================>.] - ETA: 0s - loss: 0.1460 - acc:
0.9403Epoch 1/50
150/150 [==============================] - 60s 400ms/step - loss: 0.1461 - acc:
0.9403 - val_loss: 0.2354 - val_acc: 0.9220
Epoch 24/50
149/150 [============================>.] - ETA: 0s - loss: 0.1610 - acc:
0.9342Epoch 1/50
150/150 [==============================] - 60s 403ms/step - loss: 0.1608 - acc:
0.9343 - val_loss: 0.2911 - val_acc: 0.9090
Epoch 25/50
149/150 [============================>.] - ETA: 0s - loss: 0.1631 - acc:
0.9315Epoch 1/50
150/150 [==============================] - 60s 401ms/step - loss: 0.1623 - acc:
0.9320 - val_loss: 0.2106 - val_acc: 0.9180
Epoch 26/50
149/150 [============================>.] - ETA: 0s - loss: 0.1324 - acc:
0.9440Epoch 1/50
150/150 [==============================] - 60s 402ms/step - loss: 0.1319 - acc:
0.9443 - val_loss: 0.2939 - val_acc: 0.9140
Epoch 27/50
149/150 [============================>.] - ETA: 0s - loss: 0.1442 - acc:
0.9423Epoch 1/50
150/150 [==============================] - 60s 399ms/step - loss: 0.1453 - acc:
0.9420 - val_loss: 0.4655 - val_acc: 0.8930
Epoch 28/50
149/150 [============================>.] - ETA: 0s - loss: 0.1381 - acc:
0.9483Epoch 1/50
150/150 [==============================] - 60s 398ms/step - loss: 0.1376 - acc:
0.9487 - val_loss: 0.2794 - val_acc: 0.9150
Epoch 29/50
149/150 [============================>.] - ETA: 0s - loss: 0.1468 - acc:
0.9493Epoch 1/50
```

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150/150 [==============================] - 61s 403ms/step - loss: 0.1470 - acc:
0.9487 - val_loss: 0.3009 - val_acc: 0.9200
Epoch 30/50
149/150 [============================>.] - ETA: 0s - loss: 0.1226 - acc:
0.9523Epoch 1/50
150/150 [==============================] - 62s 410ms/step - loss: 0.1220 - acc:
0.9527 - val_loss: 0.2905 - val_acc: 0.9170
Epoch 31/50
149/150 [============================>.] - ETA: 0s - loss: 0.1045 - acc:
0.9564Epoch 1/50
150/150 [==============================] - 61s 408ms/step - loss: 0.1045 - acc:
0.9560 - val_loss: 0.4743 - val_acc: 0.8950
Epoch 32/50
149/150 [============================>.] - ETA: 0s - loss: 0.1236 - acc:
0.9534Epoch 1/50
150/150 [==============================] - 61s 407ms/step - loss: 0.1243 - acc:
0.9530 - val_loss: 0.2692 - val_acc: 0.9120
Epoch 33/50
149/150 [============================>.] - ETA: 0s - loss: 0.1175 - acc:
0.9530Epoch 1/50
150/150 [==============================] - 61s 406ms/step - loss: 0.1167 - acc:
0.9533 - val_loss: 0.4117 - val_acc: 0.9060
Epoch 34/50
149/150 [============================>.] - ETA: 0s - loss: 0.1163 - acc:
0.9540Epoch 1/50
150/150 [==============================] - 60s 401ms/step - loss: 0.1160 - acc:
0.9540 - val_loss: 0.4887 - val_acc: 0.8890
Epoch 35/50
149/150 [============================>.] - ETA: 0s - loss: 0.0980 - acc:
0.9624Epoch 1/50
150/150 [==============================] - 60s 400ms/step - loss: 0.0979 - acc:
0.9623 - val_loss: 0.3495 - val_acc: 0.9100
Epoch 36/50
149/150 [============================>.] - ETA: 0s - loss: 0.1298 - acc:
0.9493Epoch 1/50
150/150 [==============================] - 60s 399ms/step - loss: 0.1291 - acc:
0.9497 - val_loss: 0.3363 - val_acc: 0.9220
Epoch 37/50
149/150 [============================>.] - ETA: 0s - loss: 0.1035 - acc:
0.9560Epoch 1/50
150/150 [==============================] - 60s 403ms/step - loss: 0.1029 - acc:
0.9563 - val_loss: 0.3539 - val_acc: 0.9270
Epoch 38/50
149/150 [============================>.] - ETA: 0s - loss: 0.1165 - acc:
0.9523Epoch 1/50
150/150 [==============================] - 61s 404ms/step - loss: 0.1160 - acc:
0.9527 - val_loss: 0.3751 - val_acc: 0.9170
Epoch 39/50
```

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149/150 [============================>.] - ETA: 0s - loss: 0.0940 - acc:
0.9601Epoch 1/50
150/150 [==============================] - 61s 403ms/step - loss: 0.0959 - acc:
0.9597 - val_loss: 0.2836 - val_acc: 0.9270
Epoch 40/50
149/150 [============================>.] - ETA: 0s - loss: 0.0985 - acc:
0.9621Epoch 1/50
150/150 [==============================] - 61s 404ms/step - loss: 0.0980 - acc:
0.9623 - val_loss: 0.4612 - val_acc: 0.9140
Epoch 41/50
149/150 [============================>.] - ETA: 0s - loss: 0.0955 - acc:
0.9621Epoch 1/50
150/150 [==============================] - 60s 403ms/step - loss: 0.0953 - acc:
0.9620 - val_loss: 0.3774 - val_acc: 0.9150
Epoch 42/50
149/150 [============================>.] - ETA: 0s - loss: 0.0985 - acc:
0.9648Epoch 1/50
150/150 [==============================] - 62s 415ms/step - loss: 0.0990 - acc:
0.9643 - val_loss: 0.3927 - val_acc: 0.9160
Epoch 43/50
149/150 [============================>.] - ETA: 0s - loss: 0.0898 - acc:
0.9628Epoch 1/50
150/150 [==============================] - 60s 398ms/step - loss: 0.0893 - acc:
0.9630 - val_loss: 0.3437 - val_acc: 0.9180
Epoch 44/50
149/150 [============================>.] - ETA: 0s - loss: 0.1085 - acc:
0.9557Epoch 1/50
150/150 [==============================] - 68s 456ms/step - loss: 0.1080 - acc:
0.9560 - val_loss: 0.2439 - val_acc: 0.9290
Epoch 45/50
149/150 [============================>.] - ETA: 0s - loss: 0.0805 - acc:
0.9715Epoch 1/50
150/150 [==============================] - 73s 485ms/step - loss: 0.0813 - acc:
0.9713 - val_loss: 0.3927 - val_acc: 0.9230
Epoch 46/50
149/150 [============================>.] - ETA: 0s - loss: 0.0856 - acc:
0.9668Epoch 1/50
150/150 [==============================] - 72s 483ms/step - loss: 0.0867 - acc:
0.9667 - val_loss: 0.4648 - val_acc: 0.9210
Epoch 47/50
149/150 [============================>.] - ETA: 0s - loss: 0.0831 - acc:
0.9661Epoch 1/50
150/150 [==============================] - 73s 485ms/step - loss: 0.0827 - acc:
0.9663 - val_loss: 0.4244 - val_acc: 0.9190
Epoch 48/50
149/150 [============================>.] - ETA: 0s - loss: 0.0709 - acc:
0.9742Epoch 1/50
150/150 [==============================] - 74s 494ms/step - loss: 0.0713 - acc:
```

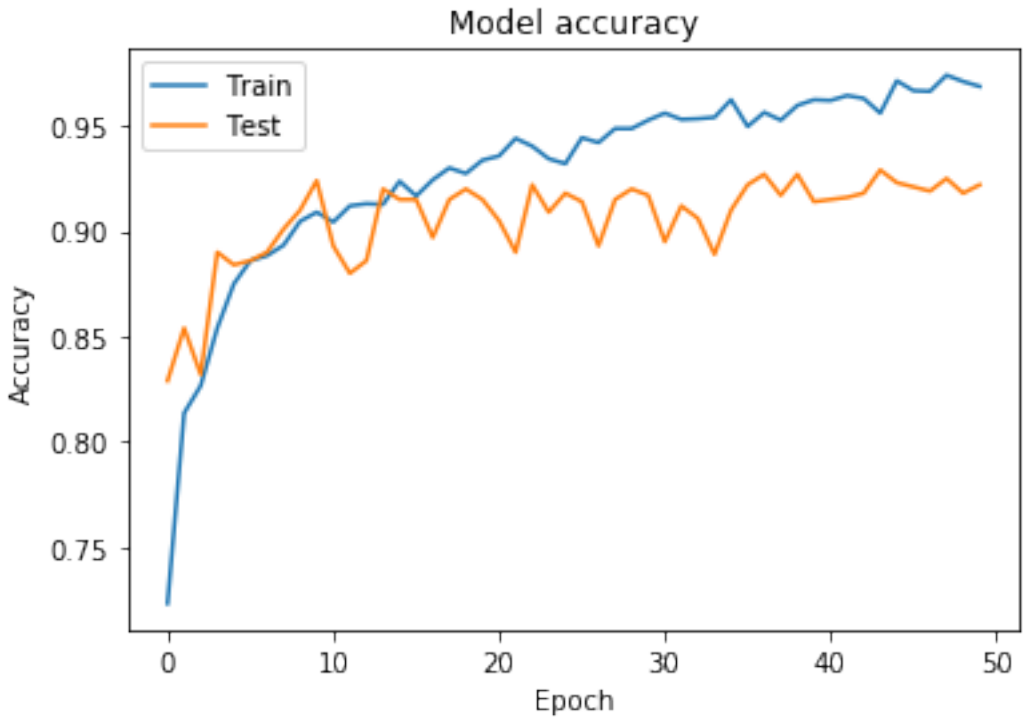
```
0.9740 - val_loss: 0.3774 - val_acc: 0.9250
Epoch 49/50
149/150 [============================>.] - ETA: 0s - loss: 0.0710 - acc:
0.9711Epoch 1/50
150/150 [==============================] - 72s 483ms/step - loss: 0.0712 - acc:
0.9710 - val_loss: 0.3528 - val_acc: 0.9180
Epoch 50/50
149/150 [============================>.] - ETA: 0s - loss: 0.0995 - acc:
0.9685Epoch 1/50
150/150 [==============================] - 73s 487ms/step - loss: 0.0990 - acc:
0.9687 - val_loss: 0.3235 - val_acc: 0.9220
```

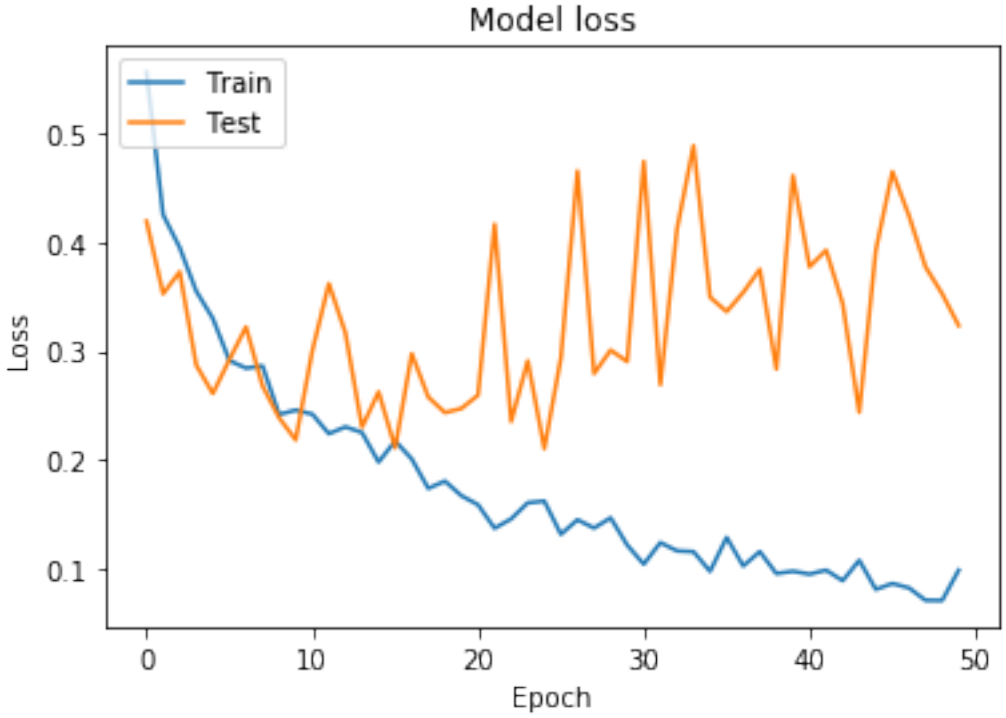
[6]:
```
model.save('/home/user/models/simple/conv_two_class.h5')
```

[7]:
```
plot_model(model, to_file='model.png')
plot_model(model, to_file='model.png')
    # Plot training & validation accuracy values
plt.plot(history.history['acc'])
plt.plot(history.history['val_acc'])
plt.title('Model accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['Train', 'Test'], loc='upper left')
plt.show()

    # Plot training & validation loss values
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('Model loss')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend(['Train', 'Test'], loc='upper left')
plt.show()
```

```
Failed to import pydot. You must install pydot and graphviz for `pydotprint` to
work.
Failed to import pydot. You must install pydot and graphviz for `pydotprint` to
work.
```


Model accuracy
Train
Test
Accuracy
0.95
0.90
0.85
0.80
0.75
0
10
20
30
40
50
Epoch


Model loss
Train
Test
Loss
0.5
0.4
0.3
0.2
0.1
0
10
20
30
40
50
Epoch

[ ]: