

In [2]:

```
# ATTENTION: Please do not alter any of the provided code in the exercise. Only c  
# ATTENTION: Please do not add or remove any cells in the exercise. The grader w  
# ATTENTION: Please use the provided epoch values when training.  
  
# Import all the necessary files!  
import os  
import tensorflow as tf  
from tensorflow.keras import layers  
from tensorflow.keras import Model  
from os import getcwd
```

```
In [3]: path_inception = f"{getcwd()}/../tmp2/inception_v3_weights_tf_dim_ordering_tf_key_format

# Import the inception model
from tensorflow.keras.applications.inception_v3 import InceptionV3

# Create an instance of the inception model from the local pre-trained weights
local_weights_file = path_inception

pre_trained_model = InceptionV3(
    input_shape=(150, 150, 3),
    include_top=False,
    weights=None
)

pre_trained_model.load_weights(local_weights_file)

# Make all the layers in the pre-trained model non-trainable
for layer in pre_trained_model.layers:
    layer.trainable=False

# Print the model summary
pre_trained_model.summary()

# Expected Output is extremely large, but should end with:

#batch_normalization_v1_281 (Batch Normalization) (None, 3, 3, 192) 576 conv2d_281[0][0]
#
#activation_273 (Activation) (None, 3, 3, 320) 0 batch_normalization_v1_281[0][0]
#
#mixed9_1 (Concatenate) (None, 3, 3, 768) 0 activation_275[0][0]
#
#
#concatenate_5 (Concatenate) (None, 3, 3, 768) 0 activation_279[0][0]
#
#activation_281 (Activation) (None, 3, 3, 192) 0 batch_normalization_v1_281[0][0]
#
#mixed10 (Concatenate) (None, 3, 3, 2048) 0 activation_273[0][0]
#
#
#
#
#Total params: 21,802,784
#Trainable params: 0
#Non-trainable params: 21,802,784
```

[0]

batch_normalization_43 (Batch Normalization) (None, 7, 7, 192) 576 conv2d_43[0][0]

batch_normalization_48 (Batch Normalization) (None, 7, 7, 192) 576 conv2d_48[0][0]

batch_normalization_49 (BatchNo (None, 7, 7, 192)	576	conv2d_49[0][0]
activation_40 (Activation) (None, 7, 7, 192)	0	batch_normalization_40[0][0]
activation_43 (Activation) (None, 7, 7, 192)	0	batch_normalization_43[0][0]

```
In [4]: last_layer = pre_trained_model.get_layer('mixed7')
print('last layer output shape: ', last_layer.output_shape)
last_output = last_layer.output
```

```
# Expected Output:
# ('last layer output shape: ', (None, 7, 7, 768))
```

```
last layer output shape: (None, 7, 7, 768)
```

```
In [5]: # Define a Callback class that stops training once accuracy reaches 97.0%
class myCallback(tf.keras.callbacks.Callback):
    def on_epoch_end(self, epoch, logs={}):
        if(logs.get('acc')>0.97):
            print("\nReached 97.0% accuracy so cancelling training!")
            self.model.stop_training = True
```

In [6]: `from tensorflow.keras.optimizers import RMSprop`

```
# Flatten the output layer to 1 dimension
x = layers.Flatten()(last_output)
# Add a fully connected layer with 1,024 hidden units and ReLU activation
x = layers.Dense(1024, activation='relu')(x)
# Add a dropout rate of 0.2
x = layers.Dropout(0.2)(x)
# Add a final sigmoid layer for classification
x = layers.Dense(1, activation='sigmoid')(x)

model = Model(pre_trained_model.input, x)

model.compile(optimizer = RMSprop(lr=0.0001),
              loss = 'binary_crossentropy',
              metrics = ['acc'])

model.summary()
```

Expected output will be large. Last few lines should be:

<i># mixed7 (Concatenate)</i>	<i>(None, 7, 7, 768)</i>	<i>0</i>	<i>activation_248</i>
<i>#</i>			<i>activation_251</i>
<i>#</i>			<i>activation_256</i>
<i>#</i>			<i>activation_257</i>
<i>#</i>			<i>activation_258</i>
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```
In [7]: # Get the Horse or Human dataset
path_horse_or_human = f"{getcwd()}/../tmp2/horse-or-human.zip"
# Get the Horse or Human Validation dataset
path_validation_horse_or_human = f"{getcwd()}/../tmp2/validation-horse-or-human.zip"
from tensorflow.keras.preprocessing.image import ImageDataGenerator

import os
import zipfile
import shutil

shutil.rmtree('/tmp')
local_zip = path_horse_or_human
zip_ref = zipfile.ZipFile(local_zip, 'r')
zip_ref.extractall('/tmp/training')
zip_ref.close()

local_zip = path_validation_horse_or_human
zip_ref = zipfile.ZipFile(local_zip, 'r')
zip_ref.extractall('/tmp/validation')
zip_ref.close()
```

```
In [8]: # Define our example directories and files
train_dir = '/tmp/training'
validation_dir = '/tmp/validation'

train_horses_dir = os.path.join(train_dir, "horses")
train_humans_dir = os.path.join(train_dir, "humans")
validation_horses_dir = os.path.join(validation_dir, "horses")
validation_humans_dir = os.path.join(validation_dir, "humans")

train_horses_fnames = os.listdir(train_horses_dir)
train_humans_fnames = os.listdir(train_humans_dir)
validation_horses_fnames = os.listdir(validation_horses_dir)
validation_humans_fnames = os.listdir(validation_humans_dir)

print(len(train_horses_fnames))
print(len(train_humans_fnames))
print(len(validation_horses_fnames))
print(len(validation_humans_fnames))

# Expected Output:
# 500
# 527
# 128
# 128
```

```
500
527
128
128
```

```
In [9]: # Add our data-augmentation parameters to ImageDataGenerator
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,
    fill_mode='nearest'
)

# Note that the validation data should not be augmented!
test_datagen = ImageDataGenerator(rescale=1/255)

# Flow training images in batches of 20 using train_datagen generator
train_generator = train_datagen.flow_from_directory(
    train_dir,
    target_size=(150, 150),
    batch_size=20,
    class_mode='binary'
)

# Flow validation images in batches of 20 using test_datagen generator
validation_generator = test_datagen.flow_from_directory(
    validation_dir,
    target_size=(150, 150),
    batch_size=20,
    class_mode='binary'
)

# Expected Output:
# Found 1027 images belonging to 2 classes.
# Found 256 images belonging to 2 classes.
```

```
Found 1027 images belonging to 2 classes.
Found 256 images belonging to 2 classes.
```

In [10]: *# Run this and see how many epochs it should take before the callback
fires, and stops training at 97% accuracy*

```
callbacks = myCallback()
history = model.fit_generator(
    train_generator,
    epochs=3,
    validation_data=validation_generator,
    verbose=1,
    callbacks=[callbacks]
)
```

Epoch 1/3

52/52 [=====] - 52s 1s/step - loss: 0.2500 - acc: 0.89
48 - val_loss: 0.0061 - val_acc: 1.0000

Epoch 2/3

52/52 [=====] - 44s 850ms/step - loss: 0.1073 - acc:
0.9620 - val_loss: 4.7177e-04 - val_acc: 1.0000

Epoch 3/3

51/52 [=====>.] - ETA: 0s - loss: 0.0685 - acc: 0.9752
Reached 97.0% accuracy so cancelling training!

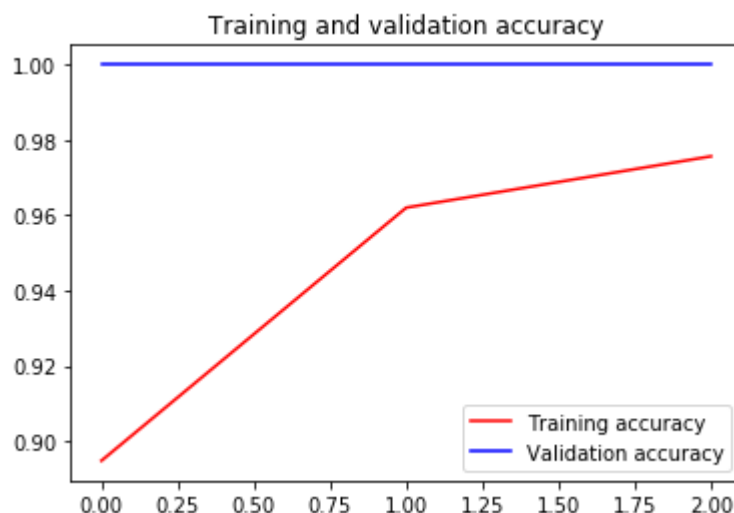
52/52 [=====] - 46s 879ms/step - loss: 0.0672 - acc:
0.9757 - val_loss: 1.1070e-04 - val_acc: 1.0000

```
In [11]: %matplotlib inline
import matplotlib.pyplot as plt
acc = history.history['acc']
val_acc = history.history['val_acc']
loss = history.history['loss']
val_loss = history.history['val_loss']

epochs = range(len(acc))

plt.plot(epochs, acc, 'r', label='Training accuracy')
plt.plot(epochs, val_acc, 'b', label='Validation accuracy')
plt.title('Training and validation accuracy')
plt.legend(loc=0)
plt.figure()

plt.show()
```



<Figure size 432x288 with 0 Axes>

Submission Instructions

```
In [ ]: # Now click the 'Submit Assignment' button above.
```

When you're done or would like to take a break, please run the two cells below to save your work and close the Notebook. This will free up resources for your fellow learners.

```
In [ ]: %%javascript
<!-- Save the notebook -->
IPython.notebook.save_checkpoint();
```



```
In [ ]: %%javascript
        IPython.notebook.session.delete();
        window.onbeforeunload = null
        setTimeout(function() { window.close(); }, 1000);
```