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```
Requirement already satisfied: numpy~=1.19.2 in /srv/conda/envs/notebook/lib/python3.6/site-packages (from tensorflow) (1.19.5)
Collecting protobuf>=3.9.2
  Downloading protobuf-3.17.3-cp36-cp36m-manylinux2_5_x86_64.manylinux1_x86_64.whl (1.0 MB)
|████████████████████████████████████████| 1.0 MB 49.5 MB/s eta 0:00:01
Collecting tensorboard~=2.6
  Downloading tensorboard-2.6.0-py3-none-any.whl (5.6 MB)
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Requirement already satisfied: wheel~=0.35 in /srv/conda/envs/notebook/lib/python3.6/site-packages (from tensorflow) (0.36.2)
Collecting astunparse~=1.6.3
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Collecting absl-py~=0.10
  Downloading absl_py-0.13.0-py3-none-any.whl (132 kB)
|████████████████████████████████████████| 132 kB 9.2 MB/s eta 0:00:01
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  Downloading flatbuffers-1.12-py2.py3-none-any.whl (15 kB)
Collecting wrapt~=1.12.1
  Downloading wrapt-1.12.1.tar.gz (27 kB)
Collecting clang~=5.0
  Downloading clang-5.0.tar.gz (30 kB)
Collecting gast==0.4.0
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Collecting keras~=2.6
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|████████████████████████████████████████| 1.3 MB 35.0 MB/s eta 0:00:01
Collecting tensorflow-estimator~=2.6
  Downloading tensorflow_estimator-2.6.0-py2.py3-none-any.whl (462 kB)
|████████████████████████████████████████| 462 kB 27.3 MB/s eta 0:00:01
Collecting grpcio<2.0,>=1.37.0
  Downloading grpcio-1.39.0-cp36-cp36m-manylinux2014_x86_64.whl (4.3 MB)
|████████████████████████████████████████| 4.3 MB 51.3 MB/s eta 0:00:01
Collecting google-pasta~=0.2
  Downloading google_pasta-0.2.0-py3-none-any.whl (57 kB)
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Collecting opt-einsum~=3.3.0
  Downloading opt_einsum-3.3.0-py3-none-any.whl (65 kB)
|████████████████████████████████████████| 65 kB 4.3 MB/s eta 0:00:01
Collecting cached-property
  Downloading cached_property-1.5.2-py2.py3-none-any.whl (7.6 kB)
Collecting tensorboard-data-server<0.7.0,>=0.6.0
  Downloading tensorboard_data_server-0.6.1-py3-none-manylinux2010_x86_64.whl (4.9 MB)
|████████████████████████████████████████| 4.9 MB 37.4 MB/s eta 0:00:01
Requirement already satisfied: requests<3,>=2.21.0 in /srv/conda/envs/notebook/lib/python3.6/site-packages (from tensorboard~=2.6->tensorflow) (2.25.1)
Collecting google-auth<2,>=1.6.3
  Downloading google_auth-1.35.0-py2.py3-none-any.whl (152 kB)
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Collecting tensorboard-plugin-wit>=1.6.0
  Downloading tensorboard_plugin_wit-1.8.0-py3-none-any.whl (781 kB)
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Collecting markdown>=2.6.8
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Collecting werkzeug>=0.11.15
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Requirement already satisfied: setuptools>=41.0.0 in /srv/conda/envs/notebook/lib/python3.6/site-packages (from tensorboard~=2.6->tensorflow) (49.6.0.post20210108)
Collecting pyasn1-modules>=0.2.1
  Downloading pyasn1_modules-0.2.8-py2.py3-none-any.whl (155 kB)
|████████████████████████████████████████| 155 kB 43.3 MB/s eta 0:00:01
Collecting cachetools<5.0,>=2.0.0
  Downloading cachetools-4.2.2-py3-none-any.whl (11 kB)
Collecting rsa<5,>=3.1.4
  Downloading rsa-4.7.2-py3-none-any.whl (34 kB)
Collecting requests-oauthlib>=0.7.0
```



In [74]:

```
pwd
```

Out[74]:

```
 '/home/jovyan/binder'
```

In [75]:

```
training_set = train_datagen.flow_from_directory('/home/jovyan/binder/facemask_detection/
training_set',
                                                target_size = (64, 64),
                                                batch_size = 32,
                                                class_mode = 'binary')
```

Found 4360 images belonging to 2 classes.

In [87]:

```
test_datagen = ImageDataGenerator(rescale = 1./255)
test_set = test_datagen.flow_from_directory('/home/jovyan/binder/facemask_detection/test_
set',
                                            target_size = (64, 64),
                                            batch_size = 32,
                                            class_mode = 'binary')
```

Found 1191 images belonging to 2 classes.

## CNN

In [78]:

```
cnn = tf.keras.models.Sequential()
```

In [79]:

```
cnn.add(tf.keras.layers.Conv2D(filters=32, kernel_size=3, activation='relu', input_shape
=[64, 64, 3]))
```

In [80]:

```
cnn.add(tf.keras.layers.MaxPool2D(pool_size=2, strides=2))
```

In [81]:

```
cnn.add(tf.keras.layers.Conv2D(filters=32, kernel_size=3, activation='relu'))
cnn.add(tf.keras.layers.MaxPool2D(pool_size=2, strides=2))
```

In [82]:

```
cnn.add(tf.keras.layers.Flatten())
```

In [83]:

```
cnn.add(tf.keras.layers.Dense(units=128, activation='relu'))
```

In [84]:

```
cnn.add(tf.keras.layers.Dense(units=1, activation='sigmoid'))
```

## Training and Compiling

In [85]:

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

In [88]:

```
cnn.fit(x = training_set, validation_data = test_set, epochs = 4)
```

Epoch 1/4

44/137 [=====>.....] - ETA: 45s - loss: 0.4821 - accuracy: 0.7990

/srv/conda/envs/notebook/lib/python3.6/site-packages/PIL/Image.py:963: UserWarning: Palette images with Transparency expressed in bytes should be converted to RGBA images  
"Palette images with Transparency expressed in bytes should be "

137/137 [=====] - 68s 492ms/step - loss: 0.3484 - accuracy: 0.8683 - val\_loss: 0.2364 - val\_accuracy: 0.9102

Epoch 2/4

137/137 [=====] - 70s 508ms/step - loss: 0.2439 - accuracy: 0.9083 - val\_loss: 0.2156 - val\_accuracy: 0.9211

Epoch 3/4

137/137 [=====] - 68s 493ms/step - loss: 0.2289 - accuracy: 0.9151 - val\_loss: 0.1949 - val\_accuracy: 0.9421

Epoch 4/4

137/137 [=====] - 66s 485ms/step - loss: 0.2027 - accuracy: 0.9243 - val\_loss: 0.1443 - val\_accuracy: 0.9513

Out[88]:

<keras.callbacks.History at 0x7f199ce89160>

In [105]:

```
import numpy as np
from keras.preprocessing import image
test_image = image.load_img('/home/jovyan/binder/facemask_detection/single_prediction/with_mask_647.jpg', target_size = (64, 64))
test_image = image.img_to_array(test_image)
test_image = np.expand_dims(test_image, axis = 0)
result = cnn.predict(test_image)
training_set.class_indices
if result[0][0] == 1:
    prediction = 'without mask'
else:
    prediction = 'with mask'
```

In [106]:

```
print(prediction)
```

with mask

In [107]:

```
import numpy as np
from keras.preprocessing import image
test_image = image.load_img('/home/jovyan/binder/facemask_detection/single_prediction/checkbox_4.jpg', target_size = (64, 64))
test_image = image.img_to_array(test_image)
test_image = np.expand_dims(test_image, axis = 0)
result = cnn.predict(test_image)
training_set.class_indices
if result[0][0] == 1:
    prediction = 'without mask'
else:
    prediction = 'with mask'
```

In [108]:

```
print(prediction)
```

without mask

In [ ]:

