```
!pip install kaggle
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Requirement already satisfied: kaggle in /usr/local/lib/python3.10/dist-packages (1.5.13)
Requirement already satisfied: six>=1.10 in /usr/local/lib/python3.10/dist-packages (from kaggle) (1.16.0)
Requirement already satisfied: certifi in /usr/local/lib/python3.10/dist-packages (from kaggle) (2022.12.7)
Requirement already satisfied: python-dateutil in /usr/local/lib/python3.10/dist-packages (from kaggle) (2.8.2)
Requirement already satisfied: requests in /usr/local/lib/python3.10/dist-packages (from kaggle) (2.27.1)
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packages (from kaggle) (4.65.0)
Requirement already satisfied: python-slugify in /usr/local/lib/python3.10/dist-packages (from kaggle) (8.0.1)
Requirement already satisfied: urllib3 in /usr/local/lib/python3.10/dist-packages (from kaggle) (1.26.15)
Requirement already satisfied: text-unidecode>=1.3 in /usr/local/lib/python3.10/dist-packages (from python-slugify->kaggle) (1.3)
Requirement already satisfied: charset-normalizer~=2.0.0 in /usr/local/lib/python3.10/dist-packages (from requests->kaggle) (2.0.12)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests->kaggle) (3.4)
```

```
# configuring the path of Kaggle.json file
!mkdir -p ~/.kaggle
!cp kaggle.json ~/.kaggle/
!chmod 600 ~/.kaggle/kaggle.json
```

Importing Face Mask Dataset

```
# API to fetch the dataset from Kaggle
!kaggle datasets download -d omkargurav/face-mask-dataset
```

```
face-mask-dataset.zip: Skipping, found more recently modified local copy (use --force to force download)
```

```
# extracting the compessed Dataset
from zipfile import ZipFile
dataset = '/content/face-mask-dataset.zip'

with ZipFile(dataset,'r') as zip:
  zip.extractall()
  print('The dataset is extracted')
```

```
The dataset is extracted
```

```
!ls
```

```
Carithers-Pediatrics_Face-Mask-Facts-for-Kids.jpeg   kaggle.json
data                                                'no mask celebrity.jpg'
face-3.jpg                                           sample_data
face-mask-dataset.zip
```

Importing the Dependencies

```
import os
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
import cv2
from google.colab.patches import cv2_imshow
from PIL import Image
from sklearn.model_selection import train_test_split
```

```
with_mask_files = os.listdir('/content/data/with_mask')
print(with_mask_files[0:5])
print(with_mask_files[-5:])
```

```
['with_mask_33.jpg', 'with_mask_3669.jpg', 'with_mask_3059.jpg', 'with_mask_2950.jpg', 'with_mask_1187.jpg']
['with_mask_312.jpg', 'with_mask_3087.jpg', 'with_mask_2835.jpg', 'with_mask_568.jpg', 'with_mask_2171.jpg']
```

```
without_mask_files = os.listdir('/content/data/without_mask')
print(without_mask_files[0:5])
print(without_mask_files[-5:])
```

```
['without_mask_3325.jpg', 'without_mask_877.jpg', 'without_mask_672.jpg', 'without_mask_1853.jpg', 'without_mask_2742.jpg']
['without_mask_2925.jpg', 'without_mask_2233.jpg', 'without_mask_1473.jpg', 'without_mask_3354.jpg', 'without_mask_3479.jpg']
```

```
print('Number of with mask images:', len(with_mask_files))
print('Number of without mask images:', len(without_mask_files))
```

```
Number of with mask images: 3725
Number of without mask images: 3828
```

Creating Labels for the two class of Images

with mask --> 1

without mask --> 0

```
# create the labels

with_mask_labels = [1]*3725

without_mask_labels = [0]*3828


print(with_mask_labels[0:5])

print(without_mask_labels[0:5])
```

```
[1, 1, 1, 1, 1]
[0, 0, 0, 0, 0]
```

```
print(len(with_mask_labels))
print(len(without_mask_labels))
```

```
3725
3828
```

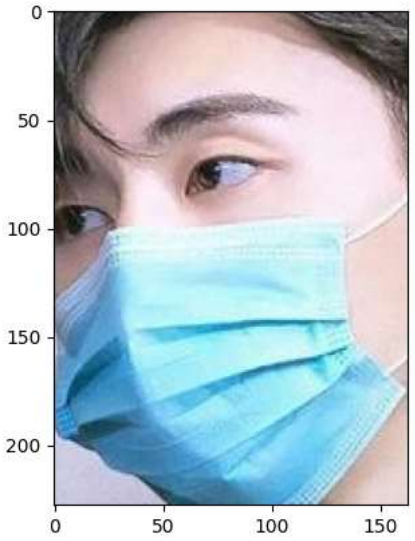
```
labels = with_mask_labels + without_mask_labels

print(len(labels))
print(labels[0:5])
print(labels[-5:])
```

```
7553
[1, 1, 1, 1, 1]
[0, 0, 0, 0, 0]
```

Displaying the Images

```
# displaying with mask image
img = mpimg.imread('/content/data/with_mask/with_mask_1545.jpg')
imgplot = plt.imshow(img)
plt.show()
```



```
# displaying without mask image
img = mpimg.imread('/content/data/without_mask/without_mask_2925.jpg')
imgplot = plt.imshow(img)
plt.show()
```

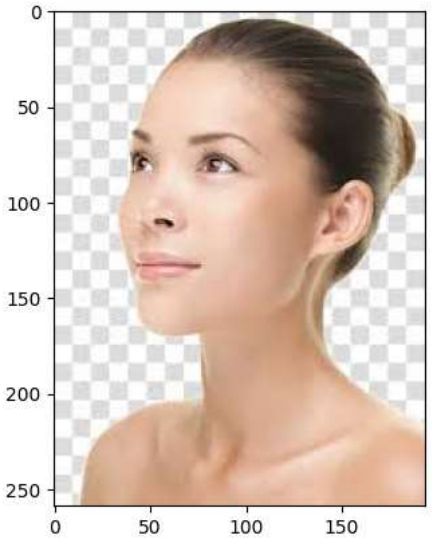


Image Processing

1. Resize the Images
2. Convert the images to numpy arrays

```
# convert images to numpy arrays+

with_mask_path = '/content/data/with_mask/'

data = []

for img_file in with_mask_files:

  image = Image.open(with_mask_path + img_file)
  image = image.resize((128,128))
  image = image.convert('RGB')
  image = np.array(image)
  data.append(image)



without_mask_path = '/content/data/without_mask/'


for img_file in without_mask_files:

  image = Image.open(without_mask_path + img_file)
  image = image.resize((128,128))
  image = image.convert('RGB')
  image = np.array(image)
  data.append(image)
```

```
/usr/local/lib/python3.10/dist-packages/PIL/Image.py:975: UserWarning: Palette images with Transparency expressed in bytes should be cor
  warnings.warn(
```

```
type(data)
```

```
list
```

```
len(data)
```

```
7553
```

```
data[0]
```

```
array([[[169, 168, 182],
        [169, 169, 182],
        [168, 170, 183],
        ...,
        [ 83,  70,  80],
        [ 87,  76,  86],
        [ 91,  78,  88]],

       [[167, 166, 180],
        [167, 167, 180],
        [166, 168, 181],
        ...,
        [ 80,  66,  76],
        [ 83,  70,  80],
        [ 84,  71,  81]],

       [[163, 162, 176],
        [164, 163, 177],
        [164, 165, 178],
        ...,
        [ 77,  61,  72],
        [ 78,  64,  74],
        [ 77,  64,  74]],

       ...,

       [[182, 173, 168],
        [182, 173, 168],
        [181, 172, 167],
        ...,
        [125,  97,  94],
        [128, 100,  97],
        [130, 102,  99]],

       [[182, 173, 168],
        [182, 173, 168],
        [181, 172, 167],
        ...,
        [127,  99,  96],
        [129, 101,  98],
        [130, 102,  99]],

       [[182, 173, 168],
        [182, 173, 168],
        [181, 172, 167],
        ...,
        [128, 100,  97],
        [129, 101,  98],
        [130, 102,  98]]], dtype=uint8)
```

```
type(data[0])
```

```
numpy.ndarray
```

```
data[0].shape
```

```
(128, 128, 3)
```

```
# converting image list and label list to numpy arrays

X = np.array(data)
Y = np.array(labels)
```

```
type(X)
```

```
numpy.ndarray
```

```
type(Y)
```

```
numpy.ndarray
```

```
print(X.shape)
print(Y.shape)
```

```
(7553, 128, 128, 3)
(7553,)
```

```
print(Y)
```

```
[1 1 1 ... 0 0 0]
```

Train Test Split

```
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.2, random_state=2)
```

```
print(X.shape, X_train.shape, X_test.shape)
```

```
(7553, 128, 128, 3) (6042, 128, 128, 3) (1511, 128, 128, 3)
```

```
# scaling the data

X_train_scaled = X_train/255

X_test_scaled = X_test/255
```

```
X_train[0]
```

```
array([[[181, 167, 154],
        [182, 168, 155],
        [184, 170, 157],
        ...,
        [208, 206, 181],
        [202, 198, 169],
        [194, 189, 159]],

       [[181, 167, 154],
        [183, 169, 156],
        [184, 170, 157],
        ...,
        [208, 206, 181],
        [202, 198, 168],
        [194, 189, 159]],

       [[182, 168, 155],
        [183, 169, 156],
        [185, 171, 158],
        ...,
        [208, 206, 181],
        [201, 198, 168],
        [193, 188, 158]],

       ...,

       [[ 12,  16,  17],
        [  9,  14,  14],
        [  5,  12,  12],
        ...,
        [109, 121, 114],
        [133, 144, 135],
        [133, 147, 137]],

       [[ 11,  15,  16],
        [  8,  13,  14],
        [  4,  11,  10],
        ...,
        [111, 123, 115],
        [133, 145, 135],
        [133, 147, 137]],

       [[ 11,  15,  16],
        [  8,  13,  14],
        [  4,  11,  10],
        ...,
        [111, 123, 116],
        [133, 145, 135],
        [133, 147, 137]]], dtype=uint8)
```

```
X_train_scaled[0]
```

```
array([[[0.70980392, 0.65490196, 0.60392157],
        [0.71372549, 0.65882353, 0.60784314],
        [0.72156863, 0.66666667, 0.61568627],
        ...,
```

```
        [0.81568627, 0.80784314, 0.70980392],
        [0.79215686, 0.77647059, 0.6627451 ],
        [0.76078431, 0.74117647, 0.62352941]],

       [[0.70980392, 0.65490196, 0.60392157],
        [0.71764706, 0.6627451 , 0.61176471],
        [0.72156863, 0.66666667, 0.61568627],
        ...,
        [0.81568627, 0.80784314, 0.70980392],
        [0.79215686, 0.77647059, 0.65882353],
        [0.76078431, 0.74117647, 0.62352941]],

       [[0.71372549, 0.65882353, 0.60784314],
        [0.71764706, 0.6627451 , 0.61176471],
        [0.7254902 , 0.67058824, 0.61960784],
        ...,
        [0.81568627, 0.80784314, 0.70980392],
        [0.78823529, 0.77647059, 0.65882353],
        [0.75686275, 0.7372549 , 0.61960784]],

       ...,

       [[0.04705882, 0.0627451 , 0.06666667],
        [0.03529412, 0.05490196, 0.05490196],
        [0.01960784, 0.04705882, 0.04705882],
        ...,
        [0.42745098, 0.4745098 , 0.44705882],
        [0.52156863, 0.56470588, 0.52941176],
        [0.52156863, 0.57647059, 0.5372549 ]],

       [[0.04313725, 0.05882353, 0.0627451 ],
        [0.03137255, 0.05098039, 0.05490196],
        [0.01568627, 0.04313725, 0.03921569],
        ...,
        [0.43529412, 0.48235294, 0.45098039],
        [0.52156863, 0.56862745, 0.52941176],
        [0.52156863, 0.57647059, 0.5372549 ]],

       [[0.04313725, 0.05882353, 0.0627451 ],
        [0.03137255, 0.05098039, 0.05490196],
        [0.01568627, 0.04313725, 0.03921569],
        ...,
        [0.43529412, 0.48235294, 0.45490196],
        [0.52156863, 0.56862745, 0.52941176],
        [0.52156863, 0.57647059, 0.5372549 ]]])
```

Building a Convolutional Neural Networks (CNN)

```
import tensorflow as tf
from tensorflow import keras


num_of_classes = 2

model = keras.Sequential()

model.add(keras.layers.Conv2D(32, kernel_size=(3,3), activation='relu', input_shape=(128,128,3)))
model.add(keras.layers.MaxPooling2D(pool_size=(2,2)))


model.add(keras.layers.Conv2D(64, kernel_size=(3,3), activation='relu'))
model.add(keras.layers.MaxPooling2D(pool_size=(2,2)))

model.add(keras.layers.Flatten())

model.add(keras.layers.Dense(128, activation='relu'))
model.add(keras.layers.Dropout(0.5))

model.add(keras.layers.Dense(64, activation='relu'))
model.add(keras.layers.Dropout(0.5))


model.add(keras.layers.Dense(num_of_classes, activation='sigmoid'))


# compile the neural network
model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['acc'])
```

```
# training the neural network
history = model.fit(X_train_scaled, Y_train, validation_split=0.1, epochs=5)
```

```
Epoch 1/5
170/170 [==============================] - 15s 23ms/step - loss: 0.4951 - acc: 0.7758 - val_loss: 0.2923 - val_acc: 0.8760
Epoch 2/5
170/170 [==============================] - 3s 17ms/step - loss: 0.2908 - acc: 0.8841 - val_loss: 0.2976 - val_acc: 0.8860
Epoch 3/5
170/170 [==============================] - 3s 17ms/step - loss: 0.2416 - acc: 0.9080 - val_loss: 0.2443 - val_acc: 0.9008
Epoch 4/5
170/170 [==============================] - 4s 21ms/step - loss: 0.2036 - acc: 0.9220 - val_loss: 0.2384 - val_acc: 0.9058
Epoch 5/5
170/170 [==============================] - 3s 20ms/step - loss: 0.1704 - acc: 0.9319 - val_loss: 0.2554 - val_acc: 0.9058
```

Model Evaluation

```
loss, accuracy = model.evaluate(X_test_scaled, Y_test)
print('Test Accuracy =', accuracy)
```

```
48/48 [==============================] - 0s 9ms/step - loss: 0.2249 - acc: 0.9067
Test Accuracy = 0.9066843390464783
```

```
h = history

# plot the loss value
plt.plot(h.history['loss'], label='train loss')
plt.plot(h.history['val_loss'], label='validation loss')
plt.legend()
plt.show()

# plot the accuracy value
plt.plot(h.history['acc'], label='train accuracy')
plt.plot(h.history['val_acc'], label='validation accuracy')
plt.legend()
plt.show()
```

Predictive System

```
input_image_path = input('Path of the image to be predicted: ')

input_image = cv2.imread(input_image_path)

cv2_imshow(input_image)

input_image_resized = cv2.resize(input_image, (128,128))

input_image_scaled = input_image_resized/255

input_image_reshaped = np.reshape(input_image_scaled, [1,128,128,3])

input_prediction = model.predict(input_image_reshaped)

print(input_prediction)


input_pred_label = np.argmax(input_prediction)

print(input_pred_label)


if input_pred_label == 1:

  print('The person in the image is wearing a mask')

else:

  print('The person in the image is not wearing a mask')
```

```
Path of the image to be predicted: /content/Carithers-Pediatrics_Face-Mask-Facts-f
```

```
1/1 [==============================] - 0s 33ms/step
[[0.49155238 0.52961123]]
1
The person in the image is wearing a mask
```