

gender-and-age-detection

April 11, 2025

1 Install Modules

```
[2]: %pip install opencv-python
      %pip install pandas
      %pip install numpy
      %pip install matplotlib
      %pip install seaborn
      %pip install pydot
      %pip install graphviz
      %pip install tensorflow
      %pip install keras
```

Requirement already satisfied: opencv-python in /opt/conda/lib/python3.10/site-packages (4.8.0.76)

Requirement already satisfied: numpy>=1.21.2 in /opt/conda/lib/python3.10/site-packages (from opencv-python) (1.23.5)

Note: you may need to restart the kernel to use updated packages.

Requirement already satisfied: pandas in /opt/conda/lib/python3.10/site-packages (2.0.2)

Requirement already satisfied: python-dateutil>=2.8.2 in /opt/conda/lib/python3.10/site-packages (from pandas) (2.8.2)

Requirement already satisfied: pytz>=2020.1 in /opt/conda/lib/python3.10/site-packages (from pandas) (2023.3)

Requirement already satisfied: tzdata>=2022.1 in /opt/conda/lib/python3.10/site-packages (from pandas) (2023.3)

Requirement already satisfied: numpy>=1.21.0 in /opt/conda/lib/python3.10/site-packages (from pandas) (1.23.5)

Requirement already satisfied: six>=1.5 in /opt/conda/lib/python3.10/site-packages (from python-dateutil>=2.8.2->pandas) (1.16.0)

Note: you may need to restart the kernel to use updated packages.

Requirement already satisfied: numpy in /opt/conda/lib/python3.10/site-packages (1.23.5)

Note: you may need to restart the kernel to use updated packages.

Requirement already satisfied: matplotlib in /opt/conda/lib/python3.10/site-packages (3.7.2)

Requirement already satisfied: contourpy>=1.0.1 in /opt/conda/lib/python3.10/site-packages (from matplotlib) (1.1.0)

Requirement already satisfied: cycycler>=0.10 in /opt/conda/lib/python3.10/site-

packages (from matplotlib) (0.11.0)
 Requirement already satisfied: fonttools>=4.22.0 in
 /opt/conda/lib/python3.10/site-packages (from matplotlib) (4.40.0)
 Requirement already satisfied: kiwisolver>=1.0.1 in
 /opt/conda/lib/python3.10/site-packages (from matplotlib) (1.4.4)
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 Requirement already satisfied: packaging>=20.0 in
 /opt/conda/lib/python3.10/site-packages (from matplotlib) (21.3)
 Requirement already satisfied: pillow>=6.2.0 in /opt/conda/lib/python3.10/site-
 packages (from matplotlib) (9.5.0)
 Requirement already satisfied: pyparsing<3.1,>=2.3.1 in
 /opt/conda/lib/python3.10/site-packages (from matplotlib) (3.0.9)
 Requirement already satisfied: python-dateutil>=2.7 in
 /opt/conda/lib/python3.10/site-packages (from matplotlib) (2.8.2)
 Requirement already satisfied: six>=1.5 in /opt/conda/lib/python3.10/site-
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 Requirement already satisfied: seaborn in /opt/conda/lib/python3.10/site-
 packages (0.12.2)
 Requirement already satisfied: numpy!=1.24.0,>=1.17 in
 /opt/conda/lib/python3.10/site-packages (from seaborn) (1.23.5)
 Requirement already satisfied: pandas>=0.25 in /opt/conda/lib/python3.10/site-
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 Requirement already satisfied: matplotlib!=3.6.1,>=3.1 in
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 Requirement already satisfied: contourpy>=1.0.1 in
 /opt/conda/lib/python3.10/site-packages (from matplotlib!=3.6.1,>=3.1->seaborn)
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 Requirement already satisfied: fonttools>=4.22.0 in
 /opt/conda/lib/python3.10/site-packages (from matplotlib!=3.6.1,>=3.1->seaborn)
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 Requirement already satisfied: kiwisolver>=1.0.1 in
 /opt/conda/lib/python3.10/site-packages (from matplotlib!=3.6.1,>=3.1->seaborn)
 (1.4.4)
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 /opt/conda/lib/python3.10/site-packages (from matplotlib!=3.6.1,>=3.1->seaborn)
 (21.3)
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 Requirement already satisfied: pyparsing<3.1,>=2.3.1 in
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 (3.0.9)
 Requirement already satisfied: python-dateutil>=2.7 in
 /opt/conda/lib/python3.10/site-packages (from matplotlib!=3.6.1,>=3.1->seaborn)
 (2.8.2)

Requirement already satisfied: pytz>=2020.1 in /opt/conda/lib/python3.10/site-packages (from pandas>=0.25->seaborn) (2023.3)

Requirement already satisfied: tzdata>=2022.1 in /opt/conda/lib/python3.10/site-packages (from pandas>=0.25->seaborn) (2023.3)

Requirement already satisfied: six>=1.5 in /opt/conda/lib/python3.10/site-packages (from python-dateutil>=2.7->matplotlib!=3.6.1,>=3.1->seaborn) (1.16.0)

Note: you may need to restart the kernel to use updated packages.

Requirement already satisfied: pydot in /opt/conda/lib/python3.10/site-packages (1.4.2)

Requirement already satisfied: pyparsing>=2.1.4 in /opt/conda/lib/python3.10/site-packages (from pydot) (3.0.9)

Note: you may need to restart the kernel to use updated packages.

Requirement already satisfied: graphviz in /opt/conda/lib/python3.10/site-packages (0.20.1)

Note: you may need to restart the kernel to use updated packages.

Requirement already satisfied: tensorflow in /opt/conda/lib/python3.10/site-packages (2.12.0)

Requirement already satisfied: absl-py>=1.0.0 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (1.4.0)

Requirement already satisfied: astunparse>=1.6.0 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (1.6.3)

Requirement already satisfied: flatbuffers>=2.0 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (23.5.26)

Requirement already satisfied: gast<=0.4.0,>=0.2.1 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (0.4.0)

Requirement already satisfied: google-pasta>=0.1.1 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (0.2.0)

Requirement already satisfied: grpcio<2.0,>=1.24.3 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (1.51.1)

Requirement already satisfied: h5py>=2.9.0 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (3.9.0)

Requirement already satisfied: jax>=0.3.15 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (0.4.13)

Requirement already satisfied: keras<2.13,>=2.12.0 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (2.12.0)

Requirement already satisfied: libclang>=13.0.0 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (16.0.0)

Requirement already satisfied: numpy<1.24,>=1.22 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (1.23.5)

Requirement already satisfied: opt-einsum>=2.3.2 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (3.3.0)

Requirement already satisfied: packaging in /opt/conda/lib/python3.10/site-packages (from tensorflow) (21.3)

Requirement already satisfied: protobuf!=4.21.0,!4.21.1,!4.21.2,!4.21.3,!4.21.4,!4.21.5,<5.0.0dev,>=3.20.3 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (3.20.3)

Requirement already satisfied: setuptools in /opt/conda/lib/python3.10/site-packages (from tensorflow) (68.0.0)

Requirement already satisfied: six>=1.12.0 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (1.16.0)

Requirement already satisfied: tensorboard<2.13,>=2.12 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (2.12.3)

Requirement already satisfied: tensorflow-estimator<2.13,>=2.12.0 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (2.12.0)

Requirement already satisfied: termcolor>=1.1.0 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (2.3.0)

Requirement already satisfied: typing-extensions>=3.6.6 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (4.6.3)

Requirement already satisfied: wrapt<1.15,>=1.11.0 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (1.14.1)

Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /opt/conda/lib/python3.10/site-packages (from tensorflow) (0.32.0)

Requirement already satisfied: wheel<1.0,>=0.23.0 in /opt/conda/lib/python3.10/site-packages (from astunparse>=1.6.0->tensorflow) (0.40.0)

Requirement already satisfied: ml-dtypes>=0.1.0 in /opt/conda/lib/python3.10/site-packages (from jax>=0.3.15->tensorflow) (0.2.0)

Requirement already satisfied: scipy>=1.7 in /opt/conda/lib/python3.10/site-packages (from jax>=0.3.15->tensorflow) (1.11.2)

Requirement already satisfied: google-auth<3,>=1.6.3 in /opt/conda/lib/python3.10/site-packages (from tensorboard<2.13,>=2.12->tensorflow) (2.20.0)

Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in /opt/conda/lib/python3.10/site-packages (from tensorboard<2.13,>=2.12->tensorflow) (1.0.0)

Requirement already satisfied: markdown>=2.6.8 in /opt/conda/lib/python3.10/site-packages (from tensorboard<2.13,>=2.12->tensorflow) (3.4.3)

Requirement already satisfied: requests<3,>=2.21.0 in /opt/conda/lib/python3.10/site-packages (from tensorboard<2.13,>=2.12->tensorflow) (2.31.0)

Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in /opt/conda/lib/python3.10/site-packages (from tensorboard<2.13,>=2.12->tensorflow) (0.7.1)

Requirement already satisfied: werkzeug>=1.0.1 in /opt/conda/lib/python3.10/site-packages (from tensorboard<2.13,>=2.12->tensorflow) (2.3.7)

Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in /opt/conda/lib/python3.10/site-packages (from packaging->tensorflow) (3.0.9)

Requirement already satisfied: cachetools<6.0,>=2.0.0 in /opt/conda/lib/python3.10/site-packages (from google-auth<3,>=1.6.3->tensorboard<2.13,>=2.12->tensorflow) (4.2.4)

Requirement already satisfied: pyasn1-modules>=0.2.1 in /opt/conda/lib/python3.10/site-packages (from google-auth<3,>=1.6.3->tensorboard<2.13,>=2.12->tensorflow) (0.2.7)

Requirement already satisfied: rsa<5,>=3.1.4 in /opt/conda/lib/python3.10/site-

packages (from google-auth<3,>=1.6.3->tensorboard<2.13,>=2.12->tensorflow) (4.9)
Requirement already satisfied: urllib3<2.0 in /opt/conda/lib/python3.10/site-packages (from google-auth<3,>=1.6.3->tensorboard<2.13,>=2.12->tensorflow) (1.26.15)
Requirement already satisfied: requests-oauthlib>=0.7.0 in /opt/conda/lib/python3.10/site-packages (from google-auth-oauthlib<1.1,>=0.5->tensorboard<2.13,>=2.12->tensorflow) (1.3.1)
Requirement already satisfied: charset-normalizer<4,>=2 in /opt/conda/lib/python3.10/site-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=2.12->tensorflow) (3.1.0)
Requirement already satisfied: idna<4,>=2.5 in /opt/conda/lib/python3.10/site-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=2.12->tensorflow) (3.4)
Requirement already satisfied: certifi>=2017.4.17 in /opt/conda/lib/python3.10/site-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=2.12->tensorflow) (2023.7.22)
Requirement already satisfied: MarkupSafe>=2.1.1 in /opt/conda/lib/python3.10/site-packages (from werkzeug>=1.0.1->tensorboard<2.13,>=2.12->tensorflow) (2.1.3)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in /opt/conda/lib/python3.10/site-packages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->tensorboard<2.13,>=2.12->tensorflow) (0.4.8)
Requirement already satisfied: oauthlib>=3.0.0 in /opt/conda/lib/python3.10/site-packages (from requests-oauthlib>=0.7.0->google-auth-oauthlib<1.1,>=0.5->tensorboard<2.13,>=2.12->tensorflow) (3.2.2)
Note: you may need to restart the kernel to use updated packages.
Requirement already satisfied: keras in /opt/conda/lib/python3.10/site-packages (2.12.0)
Note: you may need to restart the kernel to use updated packages.

```
[1]: import pandas as pd
import numpy as np
import os
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
from tqdm.notebook import tqdm
warnings.filterwarnings('ignore')
%matplotlib inline

import tensorflow as tf
from tensorflow.keras.preprocessing.image import load_img # Use tf.keras.
↳preprocessing.image
from keras.models import Sequential, Model
from keras.layers import Dense, Conv2D, Dropout, Flatten, MaxPooling2D, Input
```

/opt/conda/lib/python3.10/site-packages/scipy/__init__.py:146: UserWarning: A NumPy version >=1.16.5 and <1.23.0 is required for this version of SciPy (detected version 1.23.5)

```
warnings.warn(f"A NumPy version >={np_minversion} and <{np_maxversion}")
```

1.1 Load the Dataset

```
[2]: BASE_DIR = '../input/utkface-new/UTKFace/'
```

```
[3]: # labels - age, gender, ethnicity
image_paths = []
age_labels = []
gender_labels = []

for filename in tqdm(os.listdir(BASE_DIR)):
    image_path = os.path.join(BASE_DIR, filename)
    temp = filename.split('_')
    age = int(temp[0])
    gender = int(temp[1])
    image_paths.append(image_path)
    age_labels.append(age)
    gender_labels.append(gender)
```

```
0%|          | 0/23708 [00:00<?, ?it/s]
```

```
[4]: # convert to dataframe
df = pd.DataFrame()
df['image'], df['age'], df['gender'] = image_paths, age_labels, gender_labels
df.head()
```

```
[4]:
```

	image	age	gender
0	../input/utkface-new/UTKFace/26_0_2_2017010402...	26	0
1	../input/utkface-new/UTKFace/22_1_1_2017011223...	22	1
2	../input/utkface-new/UTKFace/21_1_3_2017010500...	21	1
3	../input/utkface-new/UTKFace/28_0_0_2017011718...	28	0
4	../input/utkface-new/UTKFace/17_1_4_2017010322...	17	1

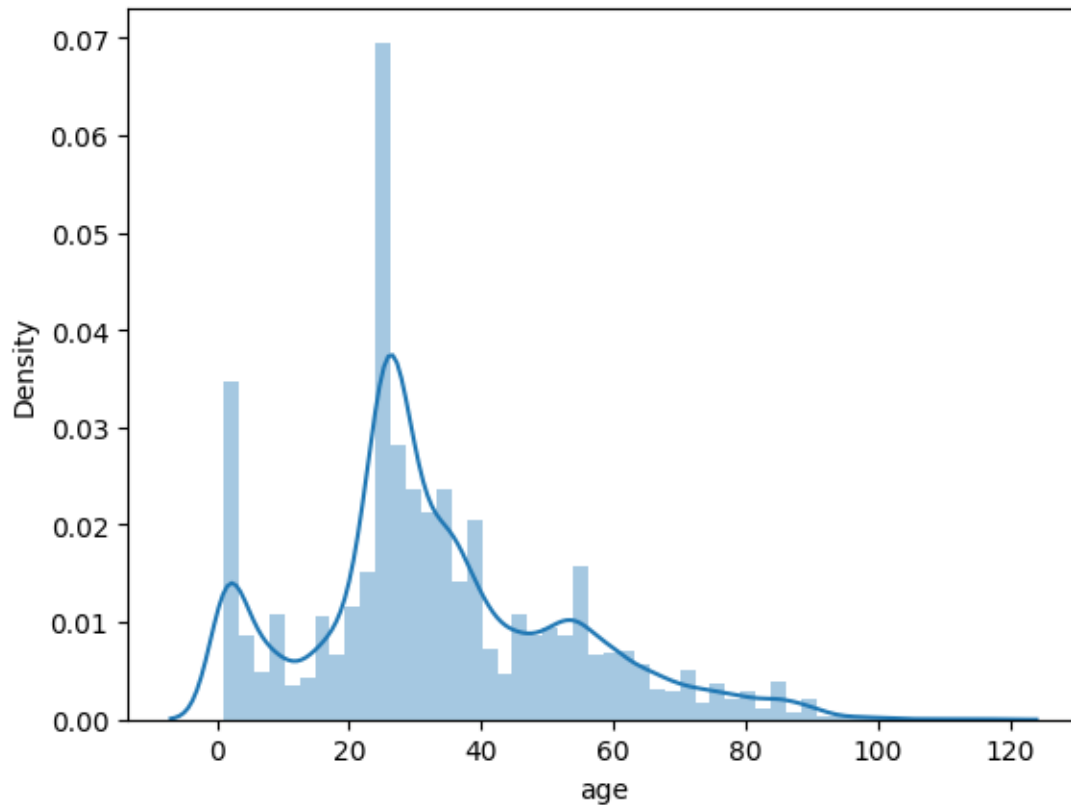
```
[5]: # map labels for gender
gender_dict = {0:'Male', 1:'Female'}
```

```
[25]: from PIL import Image
img = Image.open(df['image'][10])
plt.axis('off')
plt.imshow(img);
```



```
[7]: sns.distplot(df['age'])
```

```
[7]: <Axes: xlabel='age', ylabel='Density'>
```

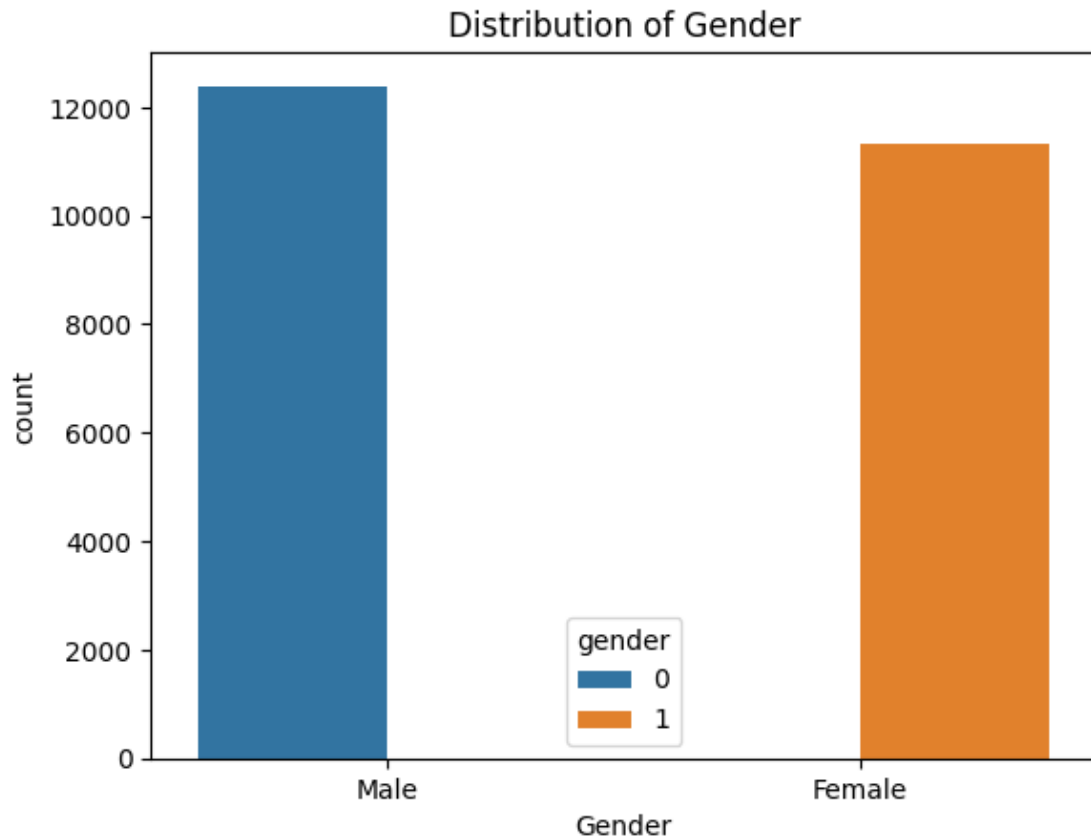


```
[8]: # This line of code is not working it is only showing the total number of
      ↪ images in a form
      # of a single column. So i used the updated code below.
      # sns.countplot(df['gender'])

      # Read the usage of hue in below code for future reference
      # By adding the hue='gender' parameter to sns.countplot, it will separate the
      ↪ bars
      # by gender (0 for Male, 1 for Female) and display them in different colors.

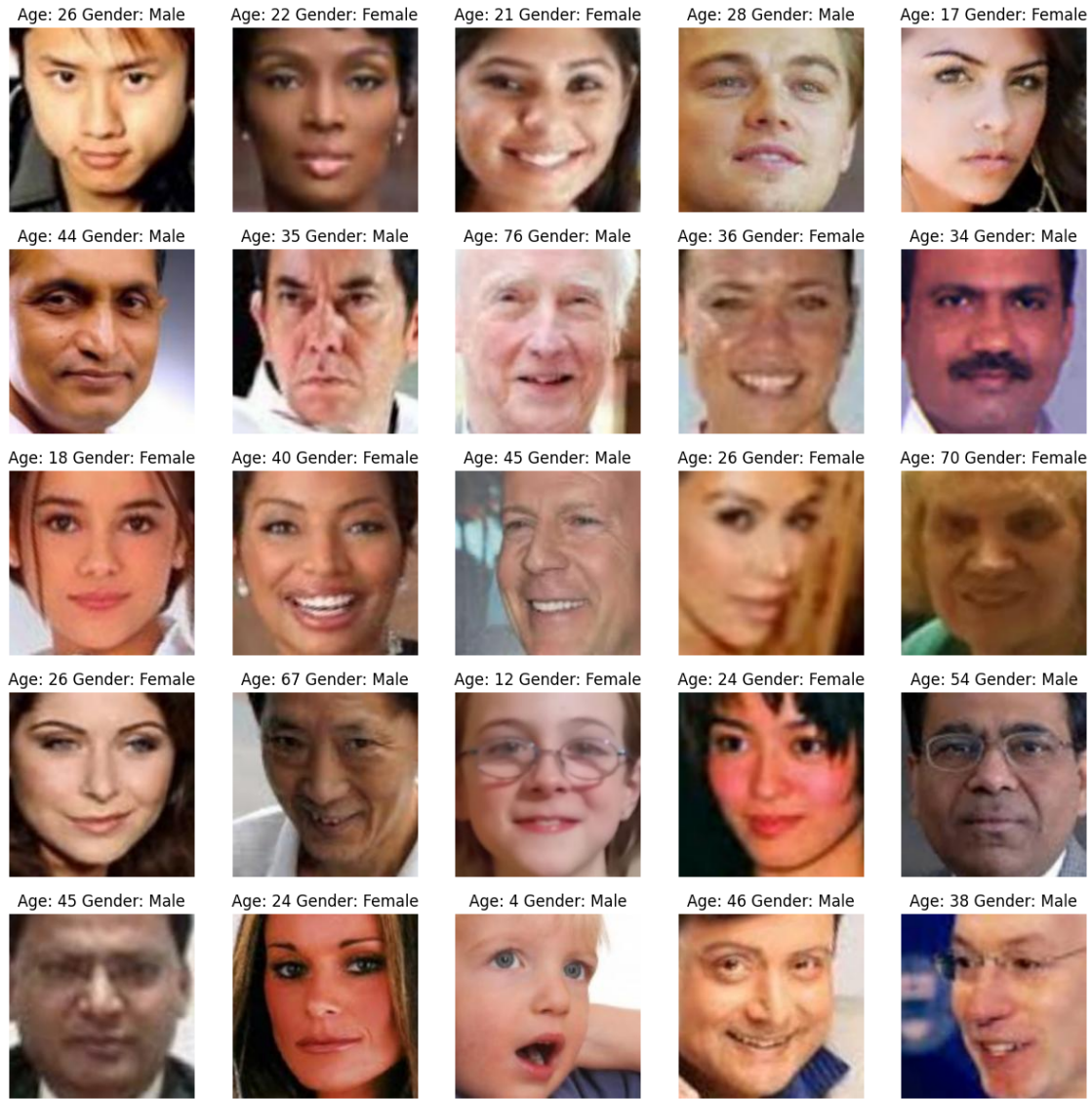
      sns.countplot(x='gender', data=df, hue='gender')
      plt.xlabel("Gender")
      plt.xticks([0, 1], labels=["Male", "Female"])
      plt.title("Distribution of Gender")
```

```
[8]: Text(0.5, 1.0, 'Distribution of Gender')
```

```
[9]: # to display grid of images
plt.figure(figsize=(15, 15))
files = df.iloc[0:25]

for index, file, age, gender in files.itertuples():
    plt.subplot(5, 5, index+1)
    img = load_img(file)
    img = np.array(img)
    plt.imshow(img)
    plt.title(f"Age: {age} Gender: {gender_dict[gender]}")
    plt.axis('off')
```



1.2 Feature Extraction

```
[10]: def extract_features(images):
    features = []
    for image in tqdm(images):
        img = load_img(image, grayscale=True)
        img = img.resize((128, 128), Image.ANTIALIAS)
        img = np.array(img)
        features.append(img)

    features = np.array(features)
    # ignore this step if using RGB
```

```
features = features.reshape(len(features), 128, 128, 1)
return features
```

```
[11]: X = extract_features(df['image'])
```

```
0%|          | 0/23708 [00:00<?, ?it/s]
```

```
[12]: X.shape
```

```
[12]: (23708, 128, 128, 1)
```

```
[13]: # normalize the images
X = X/255.0
```

```
[14]: y_gender = np.array(df['gender'])
y_age = np.array(df['age'])
```

```
[15]: input_shape = (128, 128, 1)
```

1.3 Model Creation

```
[16]: inputs = Input((input_shape))
# convolutional layers
conv_1 = Conv2D(32, kernel_size=(3, 3), activation='relu') (inputs)
maxp_1 = MaxPooling2D(pool_size=(2, 2)) (conv_1)
conv_2 = Conv2D(64, kernel_size=(3, 3), activation='relu') (maxp_1)
maxp_2 = MaxPooling2D(pool_size=(2, 2)) (conv_2)
conv_3 = Conv2D(128, kernel_size=(3, 3), activation='relu') (maxp_2)
maxp_3 = MaxPooling2D(pool_size=(2, 2)) (conv_3)
conv_4 = Conv2D(256, kernel_size=(3, 3), activation='relu') (maxp_3)
maxp_4 = MaxPooling2D(pool_size=(2, 2)) (conv_4)

flatten = Flatten() (maxp_4)

# fully connected layers
dense_1 = Dense(256, activation='relu') (flatten)
dense_2 = Dense(256, activation='relu') (flatten)

dropout_1 = Dropout(0.3) (dense_1)
dropout_2 = Dropout(0.3) (dense_2)

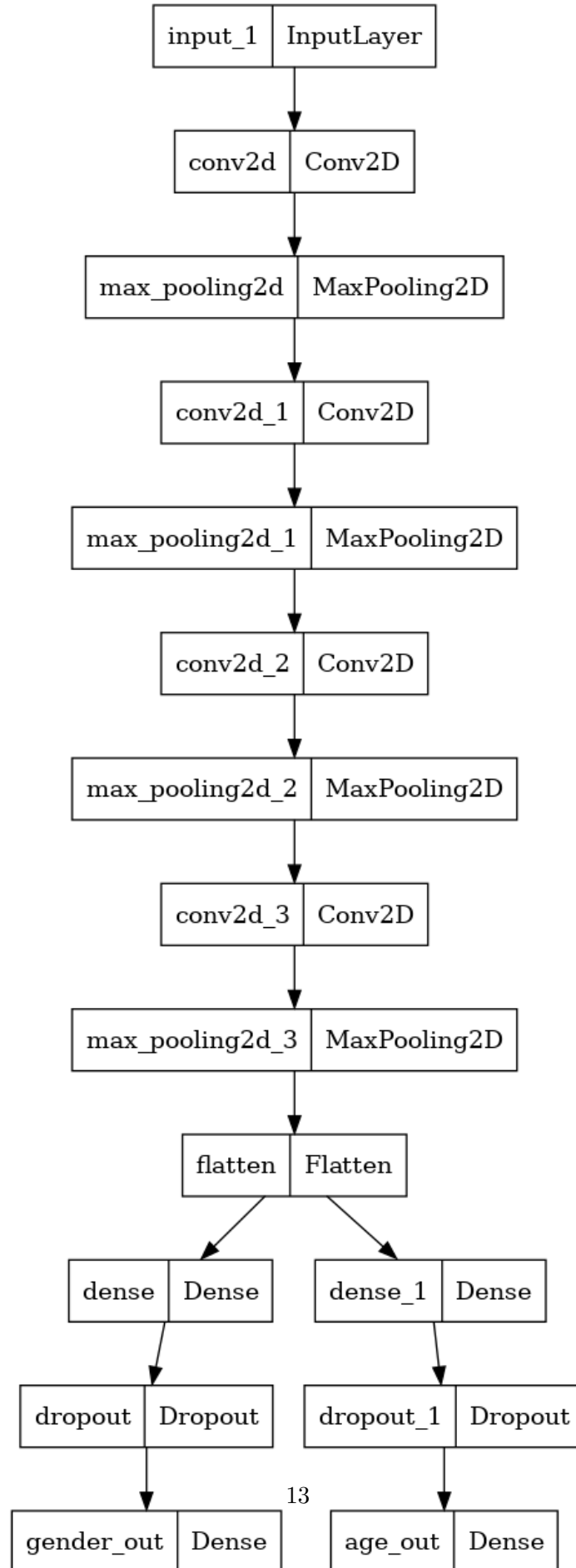
output_1 = Dense(1, activation='sigmoid', name='gender_out') (dropout_1)
output_2 = Dense(1, activation='relu', name='age_out') (dropout_2)

model = Model(inputs=[inputs], outputs=[output_1, output_2])
```

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

```
[18]: # plot the model  
from tensorflow.keras.utils import plot_model  
plot_model(model)
```

[18]:



```
[19]: # train model
history = model.fit(x=X, y=[y_gender, y_age], batch_size=32, epochs=30,
                    validation_split=0.2)
```

Epoch 1/30

593/593 [=====] - 25s 21ms/step - loss: 15.3149 -
gender_out_loss: 0.6748 - age_out_loss: 14.6402 - gender_out_accuracy: 0.5999 -
age_out_accuracy: 0.0476 - val_loss: 13.0185 - val_gender_out_loss: 0.5370 -
val_age_out_loss: 12.4815 - val_gender_out_accuracy: 0.7273 -
val_age_out_accuracy: 0.0394

Epoch 2/30

593/593 [=====] - 11s 19ms/step - loss: 11.1110 -
gender_out_loss: 0.4776 - age_out_loss: 10.6334 - gender_out_accuracy: 0.7697 -
age_out_accuracy: 0.0284 - val_loss: 9.4736 - val_gender_out_loss: 0.4306 -
val_age_out_loss: 9.0430 - val_gender_out_accuracy: 0.8013 -
val_age_out_accuracy: 0.0154

Epoch 3/30

593/593 [=====] - 11s 19ms/step - loss: 9.5563 -
gender_out_loss: 0.3977 - age_out_loss: 9.1586 - gender_out_accuracy: 0.8136 -
age_out_accuracy: 0.0159 - val_loss: 8.6304 - val_gender_out_loss: 0.3534 -
val_age_out_loss: 8.2770 - val_gender_out_accuracy: 0.8397 -
val_age_out_accuracy: 0.0105

Epoch 4/30

593/593 [=====] - 11s 19ms/step - loss: 8.5816 -
gender_out_loss: 0.3449 - age_out_loss: 8.2368 - gender_out_accuracy: 0.8426 -
age_out_accuracy: 0.0122 - val_loss: 8.4899 - val_gender_out_loss: 0.3333 -
val_age_out_loss: 8.1566 - val_gender_out_accuracy: 0.8372 -
val_age_out_accuracy: 0.0070

Epoch 5/30

593/593 [=====] - 11s 18ms/step - loss: 7.9002 -
gender_out_loss: 0.3125 - age_out_loss: 7.5877 - gender_out_accuracy: 0.8555 -
age_out_accuracy: 0.0096 - val_loss: 7.3850 - val_gender_out_loss: 0.3187 -
val_age_out_loss: 7.0663 - val_gender_out_accuracy: 0.8663 -
val_age_out_accuracy: 0.0091

Epoch 6/30

593/593 [=====] - 12s 20ms/step - loss: 7.5394 -
gender_out_loss: 0.2911 - age_out_loss: 7.2483 - gender_out_accuracy: 0.8711 -
age_out_accuracy: 0.0094 - val_loss: 7.2500 - val_gender_out_loss: 0.2942 -
val_age_out_loss: 6.9559 - val_gender_out_accuracy: 0.8739 -
val_age_out_accuracy: 0.0067

Epoch 7/30

593/593 [=====] - 11s 18ms/step - loss: 7.1528 -
gender_out_loss: 0.2784 - age_out_loss: 6.8744 - gender_out_accuracy: 0.8776 -
age_out_accuracy: 0.0087 - val_loss: 7.8145 - val_gender_out_loss: 0.2707 -
val_age_out_loss: 7.5439 - val_gender_out_accuracy: 0.8815 -

val_age_out_accuracy: 0.0055
Epoch 8/30
593/593 [=====] - 11s 19ms/step - loss: 6.9654 -
gender_out_loss: 0.2589 - age_out_loss: 6.7065 - gender_out_accuracy: 0.8863 -
age_out_accuracy: 0.0084 - val_loss: 7.2427 - val_gender_out_loss: 0.2779 -
val_age_out_loss: 6.9649 - val_gender_out_accuracy: 0.8817 -
val_age_out_accuracy: 0.0038
Epoch 9/30
593/593 [=====] - 11s 19ms/step - loss: 6.6096 -
gender_out_loss: 0.2490 - age_out_loss: 6.3607 - gender_out_accuracy: 0.8920 -
age_out_accuracy: 0.0067 - val_loss: 7.6145 - val_gender_out_loss: 0.2615 -
val_age_out_loss: 7.3530 - val_gender_out_accuracy: 0.8887 -
val_age_out_accuracy: 0.0049
Epoch 10/30
593/593 [=====] - 11s 19ms/step - loss: 6.3424 -
gender_out_loss: 0.2342 - age_out_loss: 6.1082 - gender_out_accuracy: 0.8993 -
age_out_accuracy: 0.0075 - val_loss: 6.8519 - val_gender_out_loss: 0.2631 -
val_age_out_loss: 6.5889 - val_gender_out_accuracy: 0.8849 -
val_age_out_accuracy: 0.0038
Epoch 11/30
593/593 [=====] - 11s 19ms/step - loss: 6.0887 -
gender_out_loss: 0.2243 - age_out_loss: 5.8644 - gender_out_accuracy: 0.9025 -
age_out_accuracy: 0.0061 - val_loss: 6.8296 - val_gender_out_loss: 0.2609 -
val_age_out_loss: 6.5687 - val_gender_out_accuracy: 0.8912 -
val_age_out_accuracy: 0.0051
Epoch 12/30
593/593 [=====] - 11s 19ms/step - loss: 5.8805 -
gender_out_loss: 0.2127 - age_out_loss: 5.6678 - gender_out_accuracy: 0.9091 -
age_out_accuracy: 0.0063 - val_loss: 6.8389 - val_gender_out_loss: 0.2578 -
val_age_out_loss: 6.5811 - val_gender_out_accuracy: 0.8874 -
val_age_out_accuracy: 0.0038
Epoch 13/30
593/593 [=====] - 11s 19ms/step - loss: 5.6329 -
gender_out_loss: 0.2008 - age_out_loss: 5.4322 - gender_out_accuracy: 0.9172 -
age_out_accuracy: 0.0065 - val_loss: 6.7650 - val_gender_out_loss: 0.2749 -
val_age_out_loss: 6.4901 - val_gender_out_accuracy: 0.8806 -
val_age_out_accuracy: 0.0042
Epoch 14/30
593/593 [=====] - 12s 20ms/step - loss: 5.5173 -
gender_out_loss: 0.1945 - age_out_loss: 5.3228 - gender_out_accuracy: 0.9178 -
age_out_accuracy: 0.0064 - val_loss: 6.7859 - val_gender_out_loss: 0.2525 -
val_age_out_loss: 6.5334 - val_gender_out_accuracy: 0.8908 -
val_age_out_accuracy: 0.0023
Epoch 15/30
593/593 [=====] - 11s 19ms/step - loss: 5.3792 -
gender_out_loss: 0.1807 - age_out_loss: 5.1986 - gender_out_accuracy: 0.9243 -
age_out_accuracy: 0.0057 - val_loss: 6.7218 - val_gender_out_loss: 0.2672 -
val_age_out_loss: 6.4546 - val_gender_out_accuracy: 0.8939 -

val_age_out_accuracy: 0.0040

Epoch 16/30

593/593 [=====] - 11s 19ms/step - loss: 5.1514 -
gender_out_loss: 0.1701 - age_out_loss: 4.9813 - gender_out_accuracy: 0.9310 -
age_out_accuracy: 0.0053 - val_loss: 6.9818 - val_gender_out_loss: 0.2757 -
val_age_out_loss: 6.7061 - val_gender_out_accuracy: 0.8893 -
val_age_out_accuracy: 0.0032

Epoch 17/30

593/593 [=====] - 11s 19ms/step - loss: 5.0442 -
gender_out_loss: 0.1636 - age_out_loss: 4.8806 - gender_out_accuracy: 0.9326 -
age_out_accuracy: 0.0058 - val_loss: 6.8968 - val_gender_out_loss: 0.2777 -
val_age_out_loss: 6.6191 - val_gender_out_accuracy: 0.8832 -
val_age_out_accuracy: 0.0044

Epoch 18/30

593/593 [=====] - 11s 19ms/step - loss: 4.8921 -
gender_out_loss: 0.1557 - age_out_loss: 4.7363 - gender_out_accuracy: 0.9367 -
age_out_accuracy: 0.0060 - val_loss: 7.0129 - val_gender_out_loss: 0.2804 -
val_age_out_loss: 6.7325 - val_gender_out_accuracy: 0.8887 -
val_age_out_accuracy: 0.0046

Epoch 19/30

593/593 [=====] - 11s 19ms/step - loss: 4.7872 -
gender_out_loss: 0.1465 - age_out_loss: 4.6406 - gender_out_accuracy: 0.9429 -
age_out_accuracy: 0.0062 - val_loss: 6.9136 - val_gender_out_loss: 0.2832 -
val_age_out_loss: 6.6304 - val_gender_out_accuracy: 0.8872 -
val_age_out_accuracy: 0.0049

Epoch 20/30

593/593 [=====] - 11s 19ms/step - loss: 4.6335 -
gender_out_loss: 0.1334 - age_out_loss: 4.5001 - gender_out_accuracy: 0.9460 -
age_out_accuracy: 0.0076 - val_loss: 6.9305 - val_gender_out_loss: 0.3056 -
val_age_out_loss: 6.6249 - val_gender_out_accuracy: 0.8880 -
val_age_out_accuracy: 0.0061

Epoch 21/30

593/593 [=====] - 11s 19ms/step - loss: 4.5393 -
gender_out_loss: 0.1273 - age_out_loss: 4.4120 - gender_out_accuracy: 0.9488 -
age_out_accuracy: 0.0083 - val_loss: 6.8502 - val_gender_out_loss: 0.3047 -
val_age_out_loss: 6.5455 - val_gender_out_accuracy: 0.8804 -
val_age_out_accuracy: 0.0091

Epoch 22/30

593/593 [=====] - 11s 18ms/step - loss: 4.3865 -
gender_out_loss: 0.1222 - age_out_loss: 4.2643 - gender_out_accuracy: 0.9511 -
age_out_accuracy: 0.0098 - val_loss: 6.8959 - val_gender_out_loss: 0.3685 -
val_age_out_loss: 6.5275 - val_gender_out_accuracy: 0.8817 -
val_age_out_accuracy: 0.0078

Epoch 23/30

593/593 [=====] - 12s 20ms/step - loss: 4.3326 -
gender_out_loss: 0.1145 - age_out_loss: 4.2181 - gender_out_accuracy: 0.9536 -
age_out_accuracy: 0.0149 - val_loss: 7.3191 - val_gender_out_loss: 0.3126 -
val_age_out_loss: 7.0065 - val_gender_out_accuracy: 0.8878 -


```

val_age_out_accuracy: 0.0099
Epoch 24/30
593/593 [=====] - 11s 19ms/step - loss: 4.2218 -
gender_out_loss: 0.1090 - age_out_loss: 4.1128 - gender_out_accuracy: 0.9546 -
age_out_accuracy: 0.0209 - val_loss: 6.9357 - val_gender_out_loss: 0.3510 -
val_age_out_loss: 6.5846 - val_gender_out_accuracy: 0.8846 -
val_age_out_accuracy: 0.0291
Epoch 25/30
593/593 [=====] - 11s 19ms/step - loss: 4.2507 -
gender_out_loss: 0.1035 - age_out_loss: 4.1472 - gender_out_accuracy: 0.9569 -
age_out_accuracy: 0.0222 - val_loss: 7.0294 - val_gender_out_loss: 0.4417 -
val_age_out_loss: 6.5877 - val_gender_out_accuracy: 0.8821 -
val_age_out_accuracy: 0.0179
Epoch 26/30
593/593 [=====] - 11s 19ms/step - loss: 4.0607 -
gender_out_loss: 0.0997 - age_out_loss: 3.9610 - gender_out_accuracy: 0.9594 -
age_out_accuracy: 0.0274 - val_loss: 6.9872 - val_gender_out_loss: 0.3825 -
val_age_out_loss: 6.6047 - val_gender_out_accuracy: 0.8857 -
val_age_out_accuracy: 0.0255
Epoch 27/30
593/593 [=====] - 11s 19ms/step - loss: 4.0060 -
gender_out_loss: 0.0906 - age_out_loss: 3.9155 - gender_out_accuracy: 0.9639 -
age_out_accuracy: 0.0334 - val_loss: 6.9073 - val_gender_out_loss: 0.3711 -
val_age_out_loss: 6.5362 - val_gender_out_accuracy: 0.8834 -
val_age_out_accuracy: 0.0257
Epoch 28/30
593/593 [=====] - 12s 20ms/step - loss: 3.9119 -
gender_out_loss: 0.0873 - age_out_loss: 3.8246 - gender_out_accuracy: 0.9645 -
age_out_accuracy: 0.0282 - val_loss: 7.1981 - val_gender_out_loss: 0.4189 -
val_age_out_loss: 6.7792 - val_gender_out_accuracy: 0.8842 -
val_age_out_accuracy: 0.0238
Epoch 29/30
593/593 [=====] - 11s 19ms/step - loss: 3.8396 -
gender_out_loss: 0.0821 - age_out_loss: 3.7575 - gender_out_accuracy: 0.9660 -
age_out_accuracy: 0.0312 - val_loss: 6.9846 - val_gender_out_loss: 0.4160 -
val_age_out_loss: 6.5686 - val_gender_out_accuracy: 0.8836 -
val_age_out_accuracy: 0.0329
Epoch 30/30
593/593 [=====] - 12s 20ms/step - loss: 3.7756 -
gender_out_loss: 0.0817 - age_out_loss: 3.6939 - gender_out_accuracy: 0.9655 -
age_out_accuracy: 0.0346 - val_loss: 7.0667 - val_gender_out_loss: 0.4255 -
val_age_out_loss: 6.6412 - val_gender_out_accuracy: 0.8842 -
val_age_out_accuracy: 0.0375

```

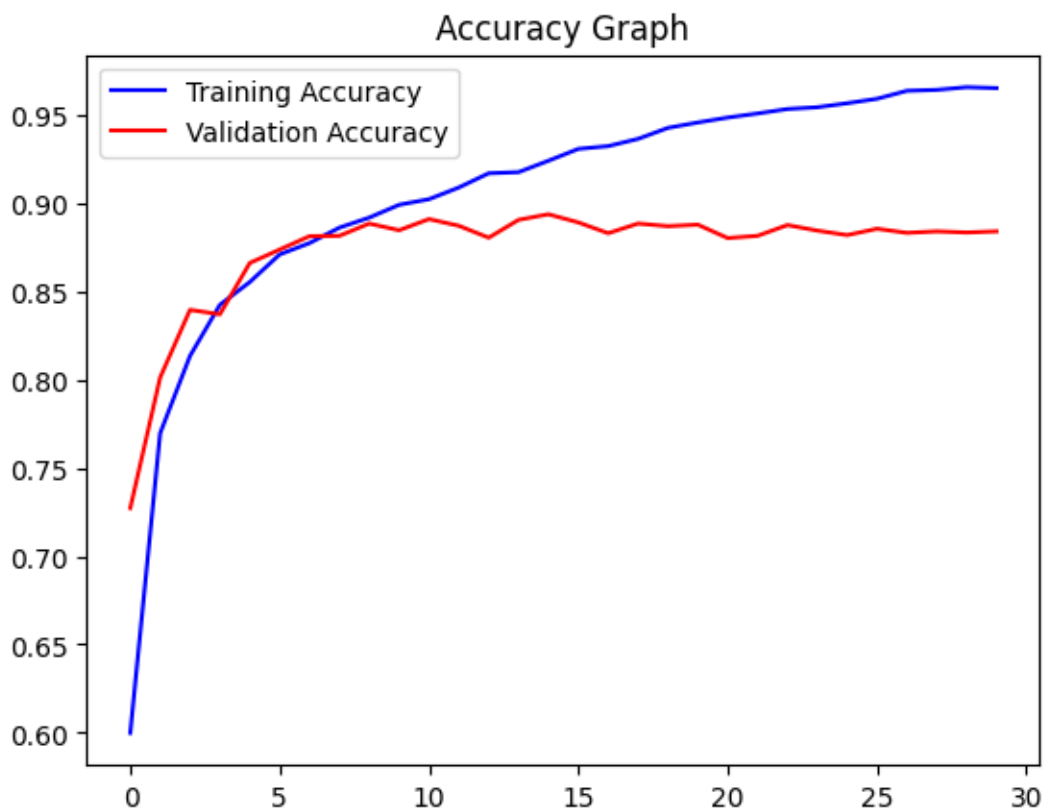
1.4 Plot the Results

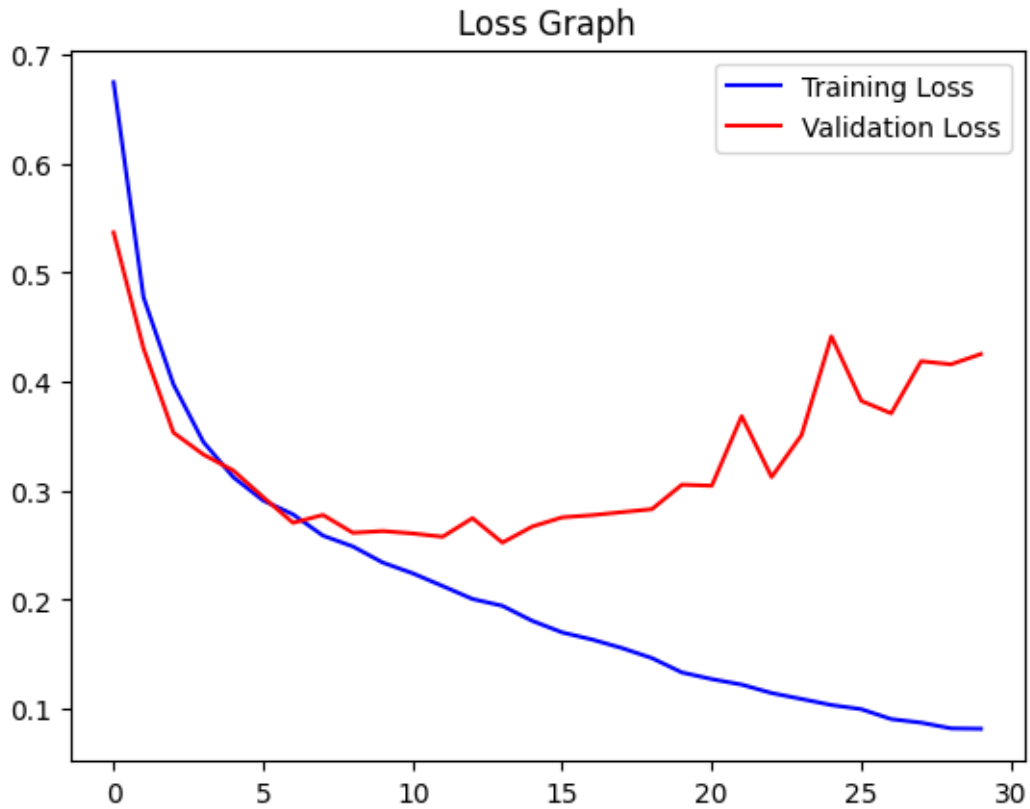
```
[20]: # plot results for gender
acc = history.history['gender_out_accuracy']
val_acc = history.history['val_gender_out_accuracy']
epochs = range(len(acc))

plt.plot(epochs, acc, 'b', label='Training Accuracy')
plt.plot(epochs, val_acc, 'r', label='Validation Accuracy')
plt.title('Accuracy Graph')
plt.legend()
plt.figure()

loss = history.history['gender_out_loss']
val_loss = history.history['val_gender_out_loss']

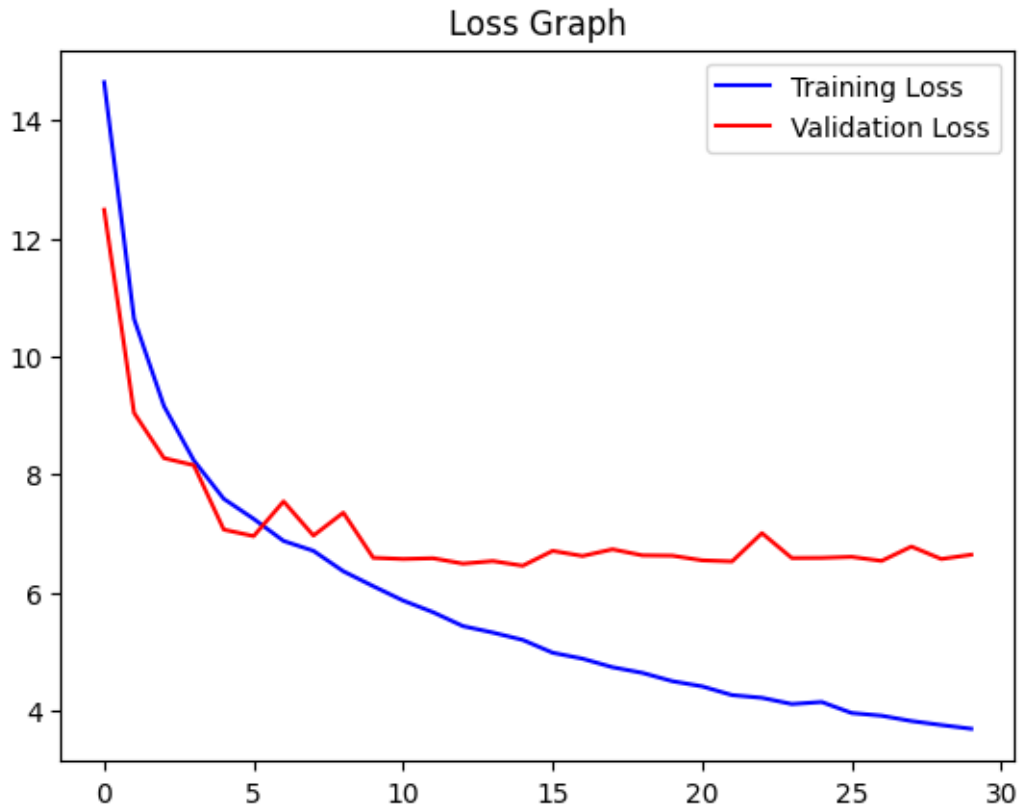
plt.plot(epochs, loss, 'b', label='Training Loss')
plt.plot(epochs, val_loss, 'r', label='Validation Loss')
plt.title('Loss Graph')
plt.legend()
plt.show()
```





```
[21]: # plot results for age
loss = history.history['age_out_loss']
val_loss = history.history['val_age_out_loss']
epochs = range(len(loss))

plt.plot(epochs, loss, 'b', label='Training Loss')
plt.plot(epochs, val_loss, 'r', label='Validation Loss')
plt.title('Loss Graph')
plt.legend()
plt.show()
```



```
[26]: image_index = 10
print("Original Gender:", gender_dict[y_gender[image_index]], "Original Age:", y_age[image_index])
# predict from model
pred = model.predict(X[image_index].reshape(1, 128, 128, 1))
pred_gender = gender_dict[round(pred[0][0][0])]
pred_age = round(pred[1][0][0])
print("Predicted Gender:", pred_gender, "Predicted Age:", pred_age)
plt.axis('off')
plt.imshow(X[image_index].reshape(128, 128), cmap='gray');
```

```
Original Gender: Female Original Age: 18
1/1 [=====] - 0s 19ms/step
Predicted Gender: Female Predicted Age: 17
```



```
[27]: image_index = 300
print("Original Gender:", gender_dict[y_gender[image_index]], "Original Age:", y_age[image_index])
# predict from model
pred = model.predict(X[image_index].reshape(1, 128, 128, 1))
pred_gender = gender_dict[round(pred[0][0][0])]
pred_age = round(pred[1][0][0])
print("Predicted Gender:", pred_gender, "Predicted Age:", pred_age)
plt.axis('off')
plt.imshow(X[image_index].reshape(128, 128), cmap='gray');
```

Original Gender: Male Original Age: 21

1/1 [=====] - 0s 20ms/step

Predicted Gender: Male Predicted Age: 22



```
[30]: image_index = 2500
print("Original Gender:", gender_dict[y_gender[image_index]], "Original Age:", y_age[image_index])
# predict from model
pred = model.predict(X[image_index].reshape(1, 128, 128, 1))
pred_gender = gender_dict[round(pred[0][0][0])]
pred_age = round(pred[1][0][0])
print("Predicted Gender:", pred_gender, "Predicted Age:", pred_age)
plt.axis('off')
plt.imshow(X[image_index].reshape(128, 128), cmap='gray');
```

Original Gender: Male Original Age: 56

1/1 [=====] - 0s 20ms/step

Predicted Gender: Male Predicted Age: 56



```
[31]: image_index = 2567
print("Original Gender:", gender_dict[y_gender[image_index]], "Original Age:", y_age[image_index])
# predict from model
pred = model.predict(X[image_index].reshape(1, 128, 128, 1))
pred_gender = gender_dict[round(pred[0][0][0])]
pred_age = round(pred[1][0][0])
print("Predicted Gender:", pred_gender, "Predicted Age:", pred_age)
plt.axis('off')
plt.imshow(X[image_index].reshape(128, 128), cmap='gray');
```

```
Original Gender: Female Original Age: 10
1/1 [=====] - 0s 20ms/step
Predicted Gender: Female Predicted Age: 10
```



```
[34]: image_index = 1577
print("Original Gender:", gender_dict[y_gender[image_index]], "Original Age:", y_age[image_index])
# predict from model
pred = model.predict(X[image_index].reshape(1, 128, 128, 1))
pred_gender = gender_dict[round(pred[0][0][0])]
pred_age = round(pred[1][0][0])
print("Predicted Gender:", pred_gender, "Predicted Age:", pred_age)
plt.axis('off')
plt.imshow(X[image_index].reshape(128, 128), cmap='gray');
```

```
Original Gender: Female Original Age: 26
1/1 [=====] - 0s 27ms/step
Predicted Gender: Female Predicted Age: 26
```