Original data

import libraries

```
from keras.layers import Input, Lambda, Dense, Flatten
from keras.models import Model
from keras.applications.vgg16 import VGG16
from keras.applications.vgg16 import preprocess_input
from keras.preprocessing import image
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
import numpy as np
from glob import glob
import matplotlib.pyplot as plt

import warnings
warnings.filterwarnings("ignore", category=FutureWarning)
```

```
import keras
```

```
IMAGE_SIZE = [224, 224]
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
!ls '/content/drive'
```

```
MyDrive
```

dataset path

```
#Give dataset path
train_path = "/content/drive/MyDrive/vgg16/men_women/train"
test_path = "/content/drive/MyDrive/vgg16/men_women/test"
```

```
from PIL import Image
import os
from IPython.display import display
from IPython.display import Image as _Imgdis
# creating a object
```

```
folder = train_path+'/men500'
```

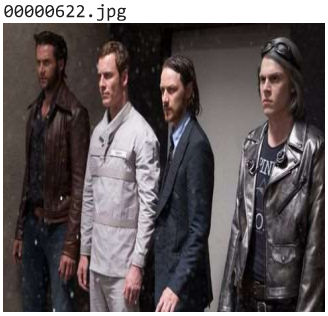
```
onlybenignfiles = [f for f in os.listdir(folder) if os.path.isfile(os.path.join(folder, f))]
print("Working with {0} images".format(len(onlybenignfiles)))
print("Image examples: ")
```

```
for i in range(10,20):
    print(onlybenignfiles[i])
    display(_Imgdis(filename=folder + "/" + onlybenignfiles[i], width=240, height=240))
```

```
Working with 500 images
Image examples:
00000800.jpg
```

```
00000563.jpg
```

```
00000622.jpg
```



```
vgg = VGG16(input_shape=IMAGE_SIZE + [3], weights='imagenet', include_top=False)
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/vgg16/vgg16_weights_tf_dim_ordering_tf_kernels_notop.
58889256/58889256 [==============================] - 3s 0us/step
```

```
vgg.input
```

```
<KerasTensor: shape=(None, 224, 224, 3) dtype=float32 (created by layer 'input_1')>
```

```
for layer in vgg.layers:
  layer.trainable = False


x = Flatten()(vgg.output)
num_classes = 2
prediction = Dense(num_classes, activation='softmax')(x)
model = Model(inputs=vgg.input, outputs=prediction)
model.summary()
```

```
Model: "model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_1 (InputLayer)        [(None, 224, 224, 3)]     0

 block1_conv1 (Conv2D)       (None, 224, 224, 64)      1792

 block1_conv2 (Conv2D)       (None, 224, 224, 64)      36928

 block1_pool (MaxPooling2D)  (None, 112, 112, 64)      0

 block2_conv1 (Conv2D)       (None, 112, 112, 128)     73856

 block2_conv2 (Conv2D)       (None, 112, 112, 128)     147584
```

```
block2_pool (MaxPooling2D)  (None, 56, 56, 128)       0

block3_conv1 (Conv2D)       (None, 56, 56, 256)       295168

block3_conv2 (Conv2D)       (None, 56, 56, 256)       590080

block3_conv3 (Conv2D)       (None, 56, 56, 256)       590080

block3_pool (MaxPooling2D)  (None, 28, 28, 256)       0

block4_conv1 (Conv2D)       (None, 28, 28, 512)       1180160

block4_conv2 (Conv2D)       (None, 28, 28, 512)       2359808

block4_conv3 (Conv2D)       (None, 28, 28, 512)       2359808

block4_pool (MaxPooling2D)  (None, 14, 14, 512)       0

block5_conv1 (Conv2D)       (None, 14, 14, 512)       2359808

block5_conv2 (Conv2D)       (None, 14, 14, 512)       2359808

block5_conv3 (Conv2D)       (None, 14, 14, 512)       2359808

block5_pool (MaxPooling2D)  (None, 7, 7, 512)         0

flatten (Flatten)           (None, 25088)             0

dense (Dense)               (None, 2)                 50178

=================================================================
Total params: 14,764,866
Trainable params: 50,178
Non-trainable params: 14,714,688
_________________________________________________________________
```

```
from keras import optimizers


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


train_datagen = ImageDataGenerator(
    preprocessing_function=preprocess_input,
    )


test_datagen = ImageDataGenerator(
    preprocessing_function=preprocess_input,
   )


train_set = train_datagen.flow_from_directory(train_path,
                                              target_size = (224, 224),
                                              batch_size = 32,
                                              class_mode = 'categorical')
```

```
Found 995 images belonging to 2 classes.
```

```
test_set = test_datagen.flow_from_directory(test_path,
                                            target_size = (224, 224),
                                            batch_size = 32,
                                            class_mode = 'categorical')
```

```
Found 259 images belonging to 2 classes.
```

training the model

```
from keras.callbacks import ModelCheckpoint



checkpoint = ModelCheckpoint(filepath='/content/drive/MyDrive/vgg16_evaluation/mymodel.h5',
                             verbose=2, save_best_only=True)
```

```
callbacks = [checkpoint]

start = datetime.now()

model_history=model.fit(
  train_set,
  validation_data=test_set,
  epochs=10,
  # steps_per_epoch=30,
  # validation_steps=32,
    callbacks=callbacks ,verbose=2)
```

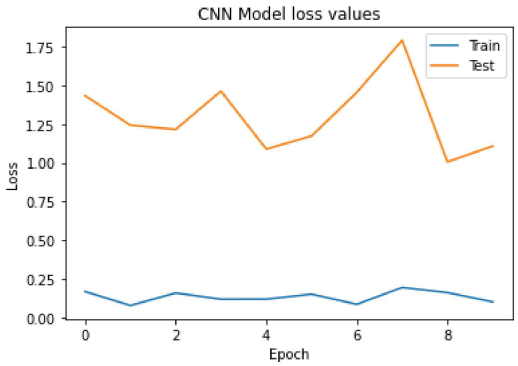
```
Epoch 1/10

Epoch 1: val_loss improved from inf to 1.43363, saving model to /content/drive/MyDrive/vgg16_evaluation/mymodel.h5
32/32 - 30s - loss: 0.1683 - accuracy: 0.9980 - val_loss: 1.4336 - val_accuracy: 0.9151 - 30s/epoch - 949ms/step
Epoch 2/10

Epoch 2: val_loss improved from 1.43363 to 1.24293, saving model to /content/drive/MyDrive/vgg16_evaluation/mymodel.h5
32/32 - 27s - loss: 0.0784 - accuracy: 0.9990 - val_loss: 1.2429 - val_accuracy: 0.9305 - 27s/epoch - 852ms/step
Epoch 3/10

Epoch 3: val_loss improved from 1.24293 to 1.21557, saving model to /content/drive/MyDrive/vgg16_evaluation/mymodel.h5
32/32 - 36s - loss: 0.1590 - accuracy: 0.9980 - val_loss: 1.2156 - val_accuracy: 0.9305 - 36s/epoch - 1s/step
Epoch 4/10

Epoch 4: val_loss did not improve from 1.21557
32/32 - 27s - loss: 0.1189 - accuracy: 0.9990 - val_loss: 1.4634 - val_accuracy: 0.9151 - 27s/epoch - 846ms/step
Epoch 5/10

Epoch 5: val_loss improved from 1.21557 to 1.08849, saving model to /content/drive/MyDrive/vgg16_evaluation/mymodel.h5
32/32 - 29s - loss: 0.1194 - accuracy: 0.9990 - val_loss: 1.0885 - val_accuracy: 0.9421 - 29s/epoch - 916ms/step
Epoch 6/10

Epoch 6: val_loss did not improve from 1.08849
32/32 - 26s - loss: 0.1514 - accuracy: 0.9990 - val_loss: 1.1731 - val_accuracy: 0.9498 - 26s/epoch - 822ms/step
Epoch 7/10

Epoch 7: val_loss did not improve from 1.08849
32/32 - 25s - loss: 0.0861 - accuracy: 0.9970 - val_loss: 1.4554 - val_accuracy: 0.9228 - 25s/epoch - 772ms/step
Epoch 8/10

Epoch 8: val_loss did not improve from 1.08849
32/32 - 26s - loss: 0.1951 - accuracy: 0.9980 - val_loss: 1.7916 - val_accuracy: 0.9112 - 26s/epoch - 810ms/step
Epoch 9/10

Epoch 9: val_loss improved from 1.08849 to 1.00591, saving model to /content/drive/MyDrive/vgg16_evaluation/mymodel.h5
32/32 - 26s - loss: 0.1616 - accuracy: 0.9990 - val_loss: 1.0059 - val_accuracy: 0.9498 - 26s/epoch - 806ms/step
Epoch 10/10

Epoch 10: val_loss did not improve from 1.00591
32/32 - 25s - loss: 0.1018 - accuracy: 0.9990 - val_loss: 1.1080 - val_accuracy: 0.9459 - 25s/epoch - 766ms/step
Training completed in time:  0:05:29.508975
```

```
model_history.history
```

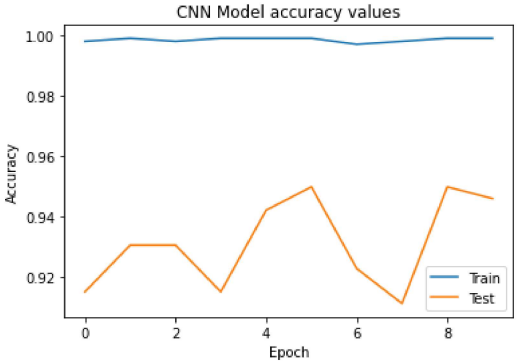
```
{'loss': [0.1682899296283722,
  0.07838954031467438,
  0.15904904901981354,
  0.11891869455575943,
  0.11940443515777588,
  0.15138235688209534,
  0.08607212454080582,
  0.19511447846889496,
  0.1615639328956604,
  0.10182344913482666],
 'accuracy': [0.9979899525642395,
  0.9989949464797974,
  0.9979899525642395,
  0.9989949464797974,
  0.9989949464797974,
  0.9989949464797974,
  0.9969848990440369,
  0.9979899525642395,
  0.9989949464797974,
  0.9989949464797974],
 'val_loss': [1.4336315393447876,
  1.2429298162460327,
```

```
        1.215573787689209,
        1.4633790254592896,
        1.088494062423706,
        1.1730585098266602,
        1.4554328918457031,
        1.7915524244308472,
        1.0059056282043457,
        1.1079607009887695],
       'val_accuracy': [0.915057897567749,
        0.9305019378662109,
        0.9305019378662109,
        0.915057897567749,
        0.9420849680900574,
        0.9498069286346436,
        0.92277991771698,
        0.9111968874931335,
        0.9498069286346436,
        0.9459459185600281]}
```

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



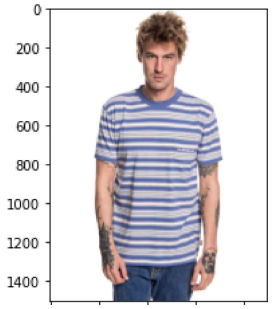

```
_# Plot training & validation loss values
plt.plot(model_history.history['accuracy'])
plt.plot(model_history.history['val_accuracy'])
plt.title('CNN Model accuracy values')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['Train', 'Test'], loc='lower right')
plt.show()
```



Testing the model

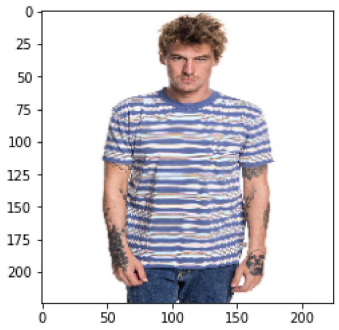
```
img = plt.imread("/content/drive/MyDrive/vgg16/men_women/test/men130/00000001.jpg")
plt.imshow(img)
```

```
<matplotlib.image.AxesImage at 0x7f60acbedfa0>
```




```
import tensorflow as tf
from keras.preprocessing import image


img = tf.keras.utils.load_img("/content/drive/MyDrive/vgg16/men_women/test/men130/00000001.jpg",target_size=(224,224))
img = np.asarray(img)
plt.imshow(img)
img = np.expand_dims(img, axis=0)
from keras.models import load_model
saved_model = load_model('/content/drive/MyDrive/vgg16_evaluation/mymodel.h5')

output = saved_model.predict(img)
if output[0][0] > output[0][1]:
    print("men")
else:
    print('women')
```

```
1/1 [==============================] - 1s 814ms/step
men
```

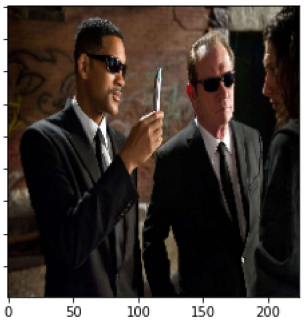



```
def predict_img(img):
  img = tf.keras.utils.load_img(img,target_size=(224,224))
  img = np.asarray(img)
  plt.imshow(img)
  img = np.expand_dims(img, axis=0)
  from keras.models import load_model
  saved_model = load_model('/content/drive/MyDrive/vgg16_evaluation/mymodel.h5')

  output = saved_model.predict(img)
  if output[0][0] > output[0][1]:
      print("men")
  else:
      print('women')


predict_img("/content/drive/MyDrive/vgg16/men_women/test1/test1/women/00001315.jpg")
```

```
WARNING:tensorflow:6 out of the last 6 calls to <function Model.make_predict_funct
1/1 [==============================] - 0s 116ms/step
women
```

```
predict_img("/content/drive/MyDrive/vgg16/men_women/test1/test1/men/00000408.jpg")
```

```
1/1 [==============================] - 0s 113ms/step
men
```



For Augmented Dataset

The data augmentation is done with different code and the augmented images are saved differently(apart from original dataset). So in the following code we are considering only augmented images not original images. (Augmented code is shared with this file)

import librarires

```
import keras
from keras.layers import Input, Lambda, Dense, Flatten
from keras.models import Model
from keras.applications.vgg16 import VGG16
from keras.applications.vgg16 import preprocess_input
from keras.preprocessing import image
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
import numpy as np
from glob import glob
import matplotlib.pyplot as plt

import warnings
warnings.filterwarnings("ignore", category=FutureWarning)


IMAGE_SIZE = [224, 224]
```

dataset path(for augmented images)

```
train_path = "/content/drive/MyDrive/vgg16/men_women/Augmented_dataset/train"
test_path = "/content/drive/MyDrive/vgg16/men_women/Augmented_dataset/test"
```

Augmented image examples

```
from PIL import Image
import os
from IPython.display import display
from IPython.display import Image as _Imgdis
# creating a object


folder = train_path+'/men'


onlybenignfiles = [f for f in os.listdir(folder) if os.path.isfile(os.path.join(folder, f))]
print("Working with {0} images".format(len(onlybenignfiles)))
print("Image examples: ")
```

```
for i in range(10,20):
    print(onlybenignfiles[i])
    display(_Imgdis(filename=folder + "/" + onlybenignfiles[i], width=240, height=240))
```

```
vgg = VGG16(input_shape=IMAGE_SIZE + [3], weights='imagenet', include_top=False)
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/vgg16/vgg16_weights_tf_dim_ordering_tf_kernels_notop.
58889256/58889256 [==============================] - 3s 0us/step
```

```
vgg.input
```

```
<KerasTensor: shape=(None, 224, 224, 3) dtype=float32 (created by layer 'input_1')>
```

```
for layer in vgg.layers:
  layer.trainable = False
```

```
x = Flatten()(vgg.output)
num_classes = 2
prediction = Dense(num_classes, activation='softmax')(x)
```

```
model = Model(inputs=vgg.input, outputs=prediction)
model.summary()
```

```
Model: "model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_1 (InputLayer)        [(None, 224, 224, 3)]     0

 block1_conv1 (Conv2D)       (None, 224, 224, 64)      1792

 block1_conv2 (Conv2D)       (None, 224, 224, 64)      36928

 block1_pool (MaxPooling2D)  (None, 112, 112, 64)      0

 block2_conv1 (Conv2D)       (None, 112, 112, 128)     73856

 block2_conv2 (Conv2D)       (None, 112, 112, 128)     147584

 block2_pool (MaxPooling2D)  (None, 56, 56, 128)       0

 block3_conv1 (Conv2D)       (None, 56, 56, 256)       295168

 block3_conv2 (Conv2D)       (None, 56, 56, 256)       590080

 block3_conv3 (Conv2D)       (None, 56, 56, 256)       590080

 block3_pool (MaxPooling2D)  (None, 28, 28, 256)       0

 block4_conv1 (Conv2D)       (None, 28, 28, 512)       1180160

 block4_conv2 (Conv2D)       (None, 28, 28, 512)       2359808

 block4_conv3 (Conv2D)       (None, 28, 28, 512)       2359808

 block4_pool (MaxPooling2D)  (None, 14, 14, 512)       0

 block5_conv1 (Conv2D)       (None, 14, 14, 512)       2359808

 block5_conv2 (Conv2D)       (None, 14, 14, 512)       2359808

 block5_conv3 (Conv2D)       (None, 14, 14, 512)       2359808

 block5_pool (MaxPooling2D)  (None, 7, 7, 512)         0

 flatten (Flatten)           (None, 25088)             0

 dense (Dense)               (None, 2)                 50178

=================================================================
Total params: 14,764,866
Trainable params: 50,178
Non-trainable params: 14,714,688
_________________________________________________________________
```

```
from keras import optimizers


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


train_datagen = ImageDataGenerator(
    preprocessing_function=preprocess_input,
    )


test_datagen = ImageDataGenerator(
    preprocessing_function=preprocess_input,
   )


train_set = train_datagen.flow_from_directory(train_path,
                                              target_size = (224, 224),
                                              batch_size = 32,
                                              class_mode = 'categorical')
```

```
Found 949 images belonging to 2 classes.
```

```
test_set = test_datagen.flow_from_directory(test_path,
                                            target_size = (224, 224),
```

```
                                        batch_size = 32,
                                        class_mode = 'categorical')
```

```
Found 260 images belonging to 2 classes.
```

```
from keras.callbacks import ModelCheckpoint
```

```
checkpoint = ModelCheckpoint(filepath='/content/drive/MyDrive/vgg16_evaluation/vgg16_Augmented.h5',
                             verbose=2, save_best_only=True)

callbacks = [checkpoint]

start = datetime.now()

model_history=model.fit(
  train_set,
  validation_data=test_set,
  epochs=10,
  # steps_per_epoch=30,
  # validation_steps=32,
    callbacks=callbacks ,verbose=2)
```

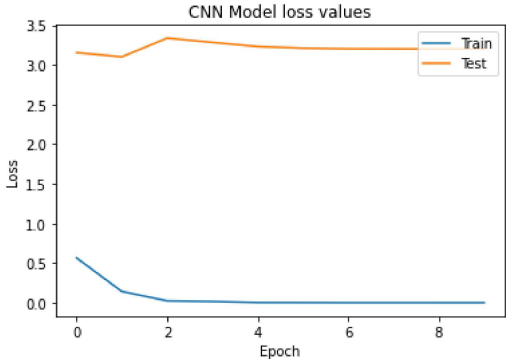
```
Epoch 1/10

Epoch 1: val_loss improved from inf to 3.15409, saving model to /content/drive/MyDrive/vgg16_evaluation/vgg16_Augmented.h5
30/30 - 18s - loss: 0.5643 - accuracy: 0.9579 - val_loss: 3.1541 - val_accuracy: 0.7692 - 18s/epoch - 590ms/step
Epoch 2/10

Epoch 2: val_loss improved from 3.15409 to 3.10146, saving model to /content/drive/MyDrive/vgg16_evaluation/vgg16_Augmented.h5
30/30 - 18s - loss: 0.1411 - accuracy: 0.9874 - val_loss: 3.1015 - val_accuracy: 0.7692 - 18s/epoch - 603ms/step
Epoch 3/10

Epoch 3: val_loss did not improve from 3.10146
30/30 - 20s - loss: 0.0230 - accuracy: 0.9989 - val_loss: 3.3371 - val_accuracy: 0.7654 - 20s/epoch - 679ms/step
Epoch 4/10

Epoch 4: val_loss did not improve from 3.10146
30/30 - 16s - loss: 0.0154 - accuracy: 1.0000 - val_loss: 3.2833 - val_accuracy: 0.7769 - 16s/epoch - 545ms/step
Epoch 5/10

Epoch 5: val_loss did not improve from 3.10146
30/30 - 16s - loss: 0.0014 - accuracy: 1.0000 - val_loss: 3.2312 - val_accuracy: 0.7692 - 16s/epoch - 543ms/step
Epoch 6/10

Epoch 6: val_loss did not improve from 3.10146
30/30 - 16s - loss: 0.0011 - accuracy: 1.0000 - val_loss: 3.2112 - val_accuracy: 0.7769 - 16s/epoch - 536ms/step
Epoch 7/10

Epoch 7: val_loss did not improve from 3.10146
30/30 - 16s - loss: 6.0736e-05 - accuracy: 1.0000 - val_loss: 3.2032 - val_accuracy: 0.7731 - 16s/epoch - 537ms/step
Epoch 8/10

Epoch 8: val_loss did not improve from 3.10146
30/30 - 16s - loss: 4.8455e-05 - accuracy: 1.0000 - val_loss: 3.2020 - val_accuracy: 0.7731 - 16s/epoch - 535ms/step
Epoch 9/10

Epoch 9: val_loss did not improve from 3.10146
30/30 - 16s - loss: 4.1059e-05 - accuracy: 1.0000 - val_loss: 3.2013 - val_accuracy: 0.7731 - 16s/epoch - 538ms/step
Epoch 10/10

Epoch 10: val_loss did not improve from 3.10146
30/30 - 16s - loss: 3.6654e-05 - accuracy: 1.0000 - val_loss: 3.2008 - val_accuracy: 0.7731 - 16s/epoch - 534ms/step
```

```
model_history.history
```

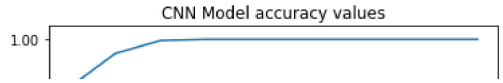
```
{'loss': [0.564281165599823,
  0.14114993810653687,
  0.022950368002057076,
  0.015424290671944618,
  0.001445319503545761,
  0.001145491492934525,
  6.073633267078549e-05,
  4.845533112529665e-05,
  4.105871994397603e-05,
```

```
 3.6654080759035423e-05],
'accuracy': [0.9578503966331482,
 0.98735511302948,
 0.9989462494850159,
 1.0,
 1.0,
 1.0,
 1.0,
 1.0,
 1.0,
 1.0],
'val_loss': [3.154093027114868,
 3.1014645099639893,
 3.3371238708496094,
 3.2832515239715576,
 3.231226682662964,
 3.211181402206421,
 3.203233480453491,
 3.2019853591918945,
 3.2012991905212402,
 3.200820207595825],
'val_accuracy': [0.7692307829856873,
 0.7692307829856873,
 0.7653846144676208,
 0.7769230604171753,
 0.7692307829856873,
 0.7769230604171753,
 0.7730769515037537,
 0.7730769515037537,
 0.7730769515037537,
 0.7730769515037537]}
```

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




```
_# Plot training & validation loss values
plt.plot(model_history.history['accuracy'])
plt.plot(model_history.history['val_accuracy'])
plt.title('CNN Model accuracy values')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['Train', 'Test'], loc='lower right')
plt.show()
```

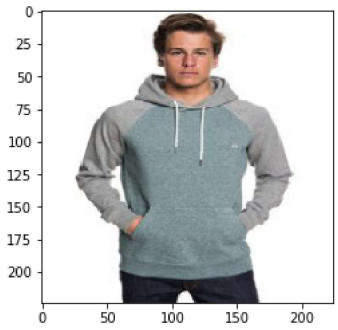



```
import tensorflow as tf
from keras.preprocessing import image
```

```
def predict_img(img):
  img = tf.keras.utils.load_img(img,target_size=(224,224))
  img = np.asarray(img)
  plt.imshow(img)
  img = np.expand_dims(img, axis=0)
  from keras.models import load_model
  saved_model = load_model('/content/drive/MyDrive/vgg16_evaluation/vgg16_Augmented.h5')

  output = saved_model.predict(img)
  if output[0][0] > output[0][1]:
      print("men")
  else:
      print('women')
```

```
predict_img("/content/drive/MyDrive/vgg16/men_women/test1/test1/men/00000399.jpg")
```

```
1/1 [==============================] - 0s 120ms/step
men
```



```
predict_img("/content/drive/MyDrive/vgg16/men_women/test1/test1/women/00001318.jpg")
```

```
1/1 [==============================] - 0s 123ms/step
women
```