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Gender Identification Problem

In this tutorial we will go through all the phases of Machine Learning keeping in view the example of Gender Identification.

Step 1: Importing the Libraries

In [1]:

```
import re
import string
import scipy
import pickle
import numpy as np
import pandas as pd
from sklearn.feature_extraction.text import *
from sklearn.preprocessing import LabelEncoder
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import BernoulliNB
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import LinearSVC
from sklearn.metrics import accuracy_score
from prettytable import PrettyTable
from astropy.table import Table, Column
%matplotlib inline
import warnings
warnings.filterwarnings('ignore')
```

Step 2 : Read, Understand and Pre Process Train/ Test Data

Step 2.1 : Read the Data

In [2]:

```
data1 = pd.read_csv('train.csv')
data2 = pd.read_csv('test.csv')
```

Step 2.2 : Understand the Data

Train Data Set

In [3]:

```
print('Train Dataset:\n')
Matrix = pd.DataFrame(data1)
Matrix
```

```
Train Dataset:
```

Out[3]:

	height	weight	hair	beard	scarf	gender
0	180.3000	196	Bald	Yes	No	Male

	height	weight	hair	beard	scarf	gender
1	170.0000	120	Long	No	No	Female
2	178.5000	200	Short	No	No	Male
3	163.4000	110	Medium	No	Yes	Female
4	175.2222	220	Short	Yes	No	Male
5	165.0000	150	Medium	No	Yes	Female

In [4]:

```
print('\nTrain Dataset Columns:\n')
print( data1.columns)
print('\nNumber of instances in Train set')
print('\nTrain instances: ' + str(data1.index.max() + 1))
```

```
Train Dataset Columns:

Index(['height', 'weight', 'hair', 'beard', 'scarf', 'gender'], dtype='object')

Number of instances in Train set

Train instances: 6
```

Test DataSet

In [5]:

```
print('Test Dataset:\n')
Matrix = pd.DataFrame(data2)
Matrix
```

```
Test Dataset:
```

Out[5]:

	height	weight	hair	beard	scarf	gender
0	179.1	185	Long	Yes	No	Male
1	160.5	130	Short	No	No	Female
2	177.8	160	Bald	No	No	Male
3	161.1	100	Medium	No	No	Female

In [6]:

```
print('\nTest Dataset Columns:\n')
print( data2.columns)
print('\nNumber of instances in Test set')
print('\nTest instances: ' + str(data2.index.max() + 1))
```

```
Test Dataset Columns:

Index(['height', 'weight', 'hair', 'beard', 'scarf', 'gender'], dtype='object')

Number of instances in Test set

Test instances: 4
```

In [7]:

```
print('Train Instances having label \'Male\':\n')

print(data1.loc[data1['gender'] == 'Male'])
```

```
Train Instances having label 'Male':
     height  weight    hair beard scarf gender
0  180.3000     196    Bald   Yes    No   Male
2  178.5000     200   Short    No    No   Male
4  175.2222     220   Short   Yes    No   Male
```

In [8]:

```
print('Train Instances having label \'Female\':\n')

print(data1.loc[data1['gender'] == 'Female'])
```

```
Train Instances having label 'Female':

   height  weight    hair beard scarf  gender
1   170.0     120    Long    No    No  Female
3   163.4     110  Medium    No   Yes  Female
5   165.0     150  Medium    No   Yes  Female
```

In [9]:

```
print('Test Instances having label \'Male\':\n')

print(data2.loc[data2['gender'] == 'Male'])
```

```
Test Instances having label 'Male':

   height  weight  hair beard scarf gender
0   179.1     185  Long   Yes    No   Male
2   177.8     160  Bald    No    No   Male
```

In [10]:

```
print('Test Instances having label \'Female\':\n')

print(data2.loc[data2['gender'] == 'Female'])
```

```
Test Instances having label 'Female':

   height  weight    hair beard scarf  gender
1   160.5     130   Short    No    No  Female
3   161.1     100  Medium    No    No  Female
```

Graphs Are Easy !!

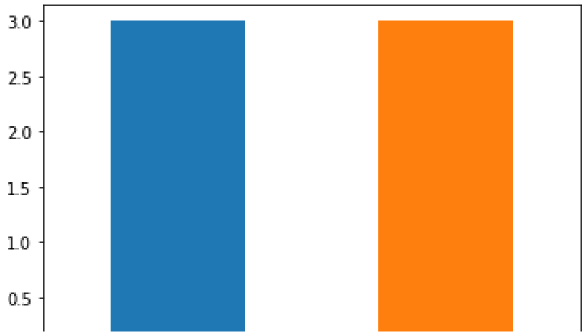
In [11]:

```
print('Total number of \'Males\' and \'Females\' in Train Dataset: ')
data1['gender'].value_counts().plot(kind='bar')
```

```
Total number of 'Males' and 'Females' in Train Dataset:
```

Out[11]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x23b206a2fd0>
```



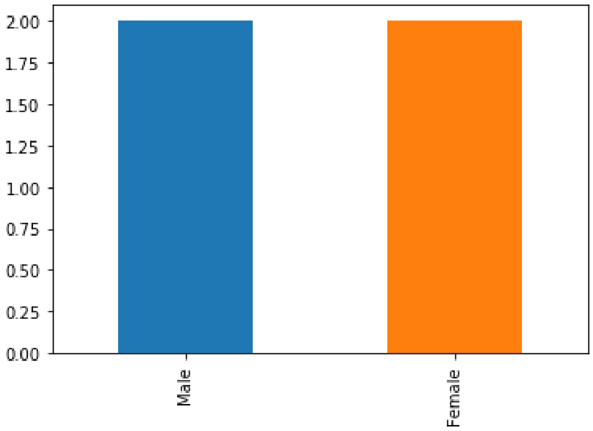
In [12]:

```
print('Total number of \'Males\' and \'Females\' in Test Dataset: ')
data2['gender'].value_counts().plot(kind='bar')
```

```
Total number of 'Males' and 'Females' in Test Dataset:
```

Out[12]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x23b2078a9b0>
```



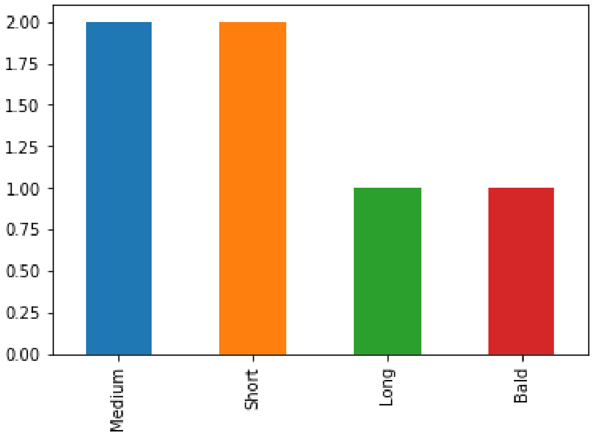
In [13]:

```
print('Number of people having various hair length in Train Dataset: ')
data1['hair'].value_counts().plot(kind='bar')
```

```
Number of people having various hair length in Train Dataset:
```

Out[13]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x23b20a1a7b8>
```



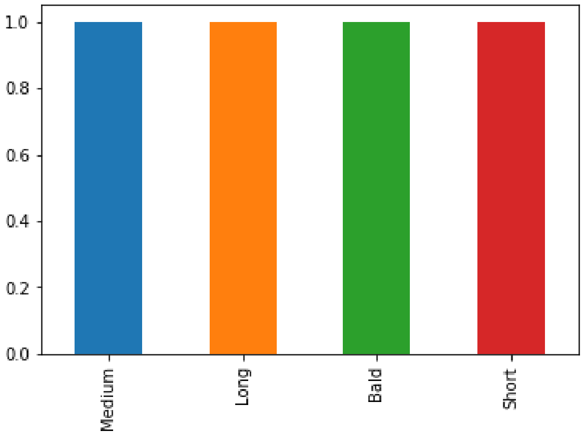
In [14]:

```
print('Number of people having various hair length in Test Dataset: ')
data2['hair'].value_counts().plot(kind='bar')
```

```
Number of people having various hair length in Test Dataset:
```

Out[14]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x23b20ae52e8>
```



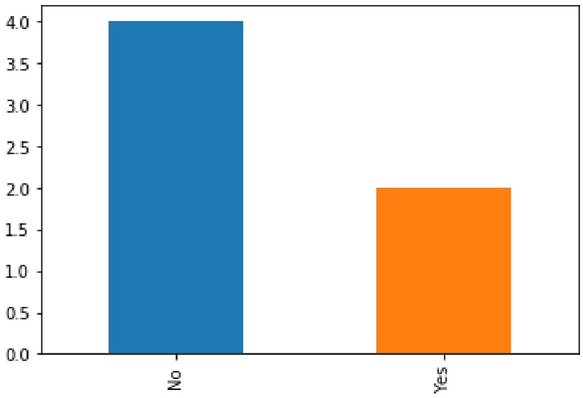
In [15]:

```
print('Number of people have/haven\'t beard in Train Dataset: ')
data1['beard'].value_counts().plot(kind='bar')
```

```
Number of people have/haven't beard in Train Dataset:
```

Out[15]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x23b20b39f28>
```



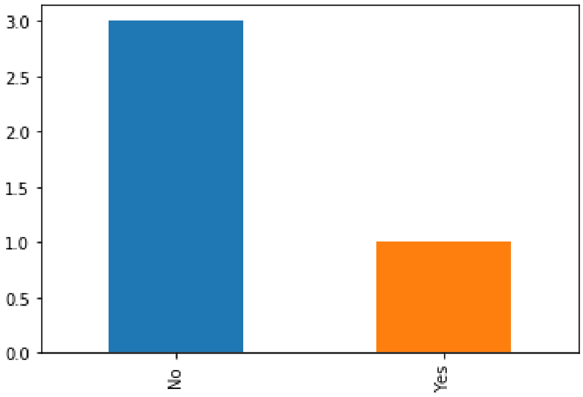
In [16]:

```
print('Number of people have/haven\'t beard in Test Dataset: ')
data2['beard'].value_counts().plot(kind='bar')
```

```
Number of people have/haven't beard in Test Dataset:
```

Out[16]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x23b20b93048>
```



Step: 2.3 Pre Process Data

Step: 2.3 Pre Process Data

In [17]:

```
print('Train Data before pre-processing:\n')

Matrix = pd.DataFrame(data1)
Matrix
```

```
Train Data before pre-processing:
```

Out[17]:

	height	weight	hair	beard	scarf	gender
0	180.3000	196	Bald	Yes	No	Male
1	170.0000	120	Long	No	No	Female
2	178.5000	200	Short	No	No	Male
3	163.4000	110	Medium	No	Yes	Female
4	175.2222	220	Short	Yes	No	Male
5	165.0000	150	Medium	No	Yes	Female

In [18]:

```
print('\nTrain Data after pre-processing: \n')
data1 = data1.round(2)

Matrix = pd.DataFrame(data1)
Matrix
```

```
Train Data after pre-processing:
```

Out[18]:

	height	weight	hair	beard	scarf	gender
0	180.30	196	Bald	Yes	No	Male
1	170.00	120	Long	No	No	Female
2	178.50	200	Short	No	No	Male
3	163.40	110	Medium	No	Yes	Female
4	175.22	220	Short	Yes	No	Male
5	165.00	150	Medium	No	Yes	Female

Step 3 : Label Encoding for Train/ Test Data

In [19]:

```
enc_hair = LabelEncoder()
enc_hair.fit(data1['hair'])

enc_beard = LabelEncoder()
enc_beard.fit(data1['beard'])

enc_scarf = LabelEncoder()
enc_scarf.fit(data1['scarf'])

enc_gender = LabelEncoder()
enc_gender.fit(data1['gender'])

TEMPdata1 = data1.copy()
```

In [20]:

In [20]:

```
print('Gender Attribute Encoding in Train Dataset: \n')
temp_var = {'gender': data1['gender'], 'encoded_gender': enc_gender.transform(data1['gender'])}
data1['gender'] = enc_gender.transform(data1['gender'])
print(pd.DataFrame(temp_var))
```

```
Gender Attribute Encoding in Train Dataset:

   gender  encoded_gender
0    Male               1
1  Female               0
2    Male               1
3  Female               0
4    Male               1
5  Female               0
```

In [21]:

```
print('Scarf Attribute Encoding in Train Dataset: \n')
temp_var = {'scarf': data1['scarf'], 'encoded_scarf': enc_scarf.transform(data1['scarf'])}
data1['scarf'] = enc_scarf.transform(data1['scarf'])
print(pd.DataFrame(temp_var))
```

```
Scarf Attribute Encoding in Train Dataset:

  scarf  encoded_scarf
0    No              0
1    No              0
2    No              0
3   Yes              1
4    No              0
5   Yes              1
```

In [22]:

```
print('Beard Attribute Encoding in Train Dataset: \n')
temp_var = {'beard': data1['beard'], 'encoded_beard': enc_beard.transform(data1['beard'])}
data1['beard'] = enc_beard.transform(data1['beard'])
print(pd.DataFrame(temp_var))
```

```
Beard Attribute Encoding in Train Dataset:

  beard  encoded_beard
0   Yes              1
1    No              0
2    No              0
3    No              0
4   Yes              1
5    No              0
```

In [23]:

```
print('Hair Attribute Encoding in Train Dataset: \n')
temp_var = {'hair': data1['hair'], 'encoded_hair': enc_hair.transform(data1['hair'])}
data1['hair'] = enc_hair.transform(data1['hair'])
print(pd.DataFrame(temp_var))
```

```
Hair Attribute Encoding in Train Dataset:

     hair  encoded_hair
0    Bald             0
1    Long             1
2   Short             3
3  Medium             2
4   Short             3
5  Medium             2
```

In [24]:

```
print('Original Train Data: \n')
```

```
Matrix = pd.DataFrame(TEMPdata1)
Matrix
```

```
Original Train Data:
```

Out[24]:

	height	weight	hair	beard	scarf	gender
0	180.30	196	Bald	Yes	No	Male
1	170.00	120	Long	No	No	Female
2	178.50	200	Short	No	No	Male
3	163.40	110	Medium	No	Yes	Female
4	175.22	220	Short	Yes	No	Male
5	165.00	150	Medium	No	Yes	Female

In [25]:

```
print('\nTrain Data After Label Encoding: \n ')

Matrix = pd.DataFrame(data1)
Matrix
```

```
Train Data After Label Encoding:
```

Out[25]:

	height	weight	hair	beard	scarf	gender
0	180.30	196	0	1	0	1
1	170.00	120	1	0	0	0
2	178.50	200	3	0	0	1
3	163.40	110	2	0	1	0
4	175.22	220	3	1	0	1
5	165.00	150	2	0	1	0

In [26]:

```
TEMPdata2 = data2.copy()

data2['hair'] = enc_hair.transform(data2['hair'])
data2['scarf'] = enc_scarf.transform(data2['scarf'])
data2['beard'] = enc_beard.transform(data2['beard'])
data2['gender'] = enc_gender.transform(data2['gender'])
```

In [27]:

```
print('Original Test Data:\n ')

Matrix = pd.DataFrame(TEMPdata2)
Matrix
```

```
Original Test Data:
```

Out[27]:

	height	weight	hair	beard	scarf	gender
0	179.1	185	Long	Yes	No	Male
1	160.5	130	Short	No	No	Female

	height	weight	hair	beard	scarf	gender
2	177.8	160	Bald	No	No	Male
3	161.1	100	Medium	No	No	Female

In [28]:

```
print('\nTest Data After Label Encoding: \n')

Matrix = pd.DataFrame(data2)
Matrix
```

```
Test Data After Label Encoding:
```

Out[28]:

	height	weight	hair	beard	scarf	gender
0	179.1	185	1	1	0	1
1	160.5	130	3	0	0	0
2	177.8	160	0	0	0	1
3	161.1	100	2	0	0	0

Step 4 : Features Extraction

The features are already extracted for this example.

Step 5 : Train ML Algorithms using Train Data

In [29]:

```
logistic_regression = LogisticRegression()
random_forest = RandomForestClassifier()
linear_svc = LinearSVC()
bernoulli_nb = BernoulliNB()
```

In [30]:

```
print('Parameters and their values:\n')
print(logistic_regression.fit(data1.iloc[0:6, 0:5], data1.iloc[0:6, 5]))
```

```
Parameters and their values:

LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
          intercept_scaling=1, max_iter=100, multi_class='ovr', n_jobs=1,
          penalty='l2', random_state=None, solver='liblinear', tol=0.0001,
          verbose=0, warm_start=False)
```

In [31]:

```
print('Parameters and their values:\n')
print(random_forest.fit(data1.iloc[0:6, 0:5], data1.iloc[0:6, 5]))
```

```
Parameters and their values:

RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
            max_depth=None, max_features='auto', max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, n_estimators=10, n_jobs=1,
            oob_score=False, random_state=None, verbose=0,
            warm_start=False)
```

In [32]:

```
print('Parameters and their values:\n')
print(linear_svc.fit(data1.iloc[0:6, 0:5], data1.iloc[0:6, 5]))
```

```
Parameters and their values:

LinearSVC(C=1.0, class_weight=None, dual=True, fit_intercept=True,
     intercept_scaling=1, loss='squared_hinge', max_iter=1000,
     multi_class='ovr', penalty='l2', random_state=None, tol=0.0001,
     verbose=0)
```

In [33]:

```
print('Parameters and their values:\n')
print(bernoulli_nb.fit(data1.iloc[0:6, 0:5], data1.iloc[0:6, 5]))
```

```
Parameters and their values:

BernoulliNB(alpha=1.0, binarize=0.0, class_prior=None, fit_prior=True)
```

Step 6: Evaluate ML Algorithms using Test Data

In [34]:

```
predict_logistic_regression = logistic_regression.predict(data2.iloc[0:6, 0:5])
print('Prediction using Logistic Regression: \n')
temp_frame = pd.DataFrame({'predicted_gender':
enc_gender.inverse_transform(predict_logistic_regression)})
print(pd.concat([TEMPdata2, temp_frame], axis=1))
print('\nAccuracy Score = ' + str(accuracy_score(data2.iloc[0:6, 5], predict_logistic_regression)))
```

```
Prediction using Logistic Regression:

   height  weight    hair beard scarf  gender predicted_gender
0   179.1     185    Long   Yes    No    Male             Male
1   160.5     130   Short    No    No  Female           Female
2   177.8     160    Bald    No    No    Male           Female
3   161.1     100  Medium    No    No  Female           Female

Accuracy Score = 0.75
```

In [35]:

```
predict_random_forest = random_forest.predict(data2.iloc[0:6, 0:5])
print('Prediction using Random Forest Classifier:\n')
temp_frame = pd.DataFrame({'predicted_gender': enc_gender.inverse_transform(predict_random_forest)
})
print(pd.concat([TEMPdata2, temp_frame], axis=1))
print('\nAccuracy Score = ' + str(accuracy_score(data2.iloc[0:6, 5], predict_random_forest)))
```

```
Prediction using Random Forest Classifier:

   height  weight    hair beard scarf  gender predicted_gender
0   179.1     185    Long   Yes    No    Male             Male
1   160.5     130   Short    No    No  Female           Female
2   177.8     160    Bald    No    No    Male             Male
3   161.1     100  Medium    No    No  Female           Female

Accuracy Score = 1.0
```

In [36]:

```
predict_linear_svc = linear_svc.predict(data2.iloc[0:6, 0:5])
print('Prediction using LinearSVC:\n')
temp_frame = pd.DataFrame({'predicted_gender': enc_gender.inverse_transform(predict_linear_svc)})

print(pd.concat([TEMPdata2, temp_frame], axis=1))
print('\nAccuracy Score = ' + str(accuracy_score(data2.iloc[0:6, 5], predict_linear_svc)))
```

```
Prediction using LinearSVC:

   height  weight    hair beard scarf  gender predicted_gender
0   179.1     185    Long   Yes    No    Male             Male
1   160.5     130   Short    No    No  Female           Female
2   177.8     160    Bald    No    No    Male           Female
3   161.1     100  Medium    No    No  Female           Female

Accuracy Score = 0.75
```

In [37]:

```
predict_bernoulli_nb = bernoulli_nb.predict(data2.iloc[0:6, 0:5])
print('Prediction using BernoulliNB:\n')
temp_frame = pd.DataFrame({'predicted_gender': enc_gender.inverse_transform(predict_bernoulli_nb)}
)
print(pd.concat([TEMPdata2, temp_frame], axis=1))
print('\nAccuracy Score = ' + str(accuracy_score(data2.iloc[0:6, 5], predict_bernoulli_nb)))
```

```
Prediction using BernoulliNB:

   height  weight    hair beard scarf  gender predicted_gender
0   179.1     185    Long   Yes    No    Male             Male
1   160.5     130   Short    No    No  Female           Female
2   177.8     160    Bald    No    No    Male             Male
3   161.1     100  Medium    No    No  Female           Female

Accuracy Score = 1.0
```

Step 7 : Selection of Best Model

In [38]:

```
pretty_table = PrettyTable()
pretty_table.field_names = ['Model', 'Accuracy']
pretty_table.add_row(['LogisticRegression', accuracy_score(data2.iloc[0:6, 5],
predict_logistic_regression)])
pretty_table.add_row(['RandomForestClassifier', accuracy_score(data2.iloc[0:6, 5], predict_random_f
orest)])
pretty_table.add_row(['LinearSVC', accuracy_score(data2.iloc[0:6, 5], predict_linear_svc)])
pretty_table.add_row(['BernoulliNB', accuracy_score(data2.iloc[0:6, 5], predict_bernoulli_nb)])

print('Detailed Performance of all the Models.')
print('=======================================')
print(pretty_table)

pretty_table = PrettyTable()
pretty_table.field_names = ['Model', 'Accuracy']
pretty_table.add_row(['RandomForestClassifier', accuracy_score(data2.iloc[0:6, 5], predict_random_f
orest)])

print('\nBest Model.')
print('=======================================')
print(pretty_table)
```

```
Detailed Performance of all the Models.
=======================================
+------------------------+----------+
|         Model          | Accuracy |
+------------------------+----------+
|   LogisticRegression   |   0.75   |
| RandomForestClassifier |   1.0    |
|       LinearSVC        |   0.75   |
|      BernoulliNB       |   1.0    |
+------------------------+----------+

Best Model.
=======================================
+------------------------+----------+
|         Model          | Accuracy |
+------------------------+----------+
| RandomForestClassifier |   1.0    |
+------------------------+----------+
```

Step 8 : Application Phase

Step 8.1 : Combine Data (Train + Test)

In [39]:

```
print('Train Features in form of DataFrame: \n')

Matrix = pd.DataFrame(data1)
Matrix
```

```
Train Features in form of DataFrame:
```

Out[39]:

	height	weight	hair	beard	scarf	gender
0	180.30	196	0	1	0	1
1	170.00	120	1	0	0	0
2	178.50	200	3	0	0	1
3	163.40	110	2	0	1	0
4	175.22	220	3	1	0	1
5	165.00	150	2	0	1	0

In [40]:

```
print('Test Features in form of DataFrame: \n')
print(data2)
```

```
Test Features in form of DataFrame:

   height  weight  hair  beard  scarf  gender
0   179.1     185     1      1      0       1
1   160.5     130     3      0      0       0
2   177.8     160     0      0      0       1
3   161.1     100     2      0      0       0
```

In [41]:

```
print('All features in form of data frame\n')
data3 = pd.concat([data1, data2])

Matrix = pd.DataFrame(data3)
Matrix
```

```
All features in form of data frame
```

Out[41]:

	height	weight	hair	beard	scarf	gender
0	180.30	196	0	1	0	1
1	170.00	120	1	0	0	0
2	178.50	200	3	0	0	1
3	163.40	110	2	0	1	0
4	175.22	220	3	1	0	1

	height	weight	hair	beard	scarf	gender
5	165.00	150	2	0	1	0
0	179.10	185	1	1	0	1
1	160.50	130	3	0	0	0
2	177.80	160	0	0	0	1
3	161.10	100	2	0	0	0

Step 8.2 : Train Best Model on All data

In [42]:

```
random_forest.fit(data3.iloc[0:6, 0:5], data3.iloc[0:6, 5])
```

Out[42]:

```
RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
            max_depth=None, max_features='auto', max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, n_estimators=10, n_jobs=1,
            oob_score=False, random_state=None, verbose=0,
            warm_start=False)
```

Step 9: Make predictions on Unseen Data

Step 9.1 : Load The Model

Step 9.2 : Take input from User

In [43]:

```
height = float(input('Please enter your Height here (centimeter): '))
weight = int(input('Please enter your Weight here(kg): '))
hair = input('Please enter your hair Length here (Bald/Long/Medium/Short): ')
beard = input('Do you have beard? (Yes/No): ')
scarf = input('Do you have Scarf? (Yes/No): ')
```

```
Please enter your Height here (centimeter): 170
Please enter your Weight here(kg): 120
Please enter your hair Length here (Bald/Long/Medium/Short): Long
Do you have beard? (Yes/No): No
Do you have Scarf? (Yes/No): No
```

Step 9.3 : Convert Input into feature vector

In [44]:

```
InsertedData = pd.DataFrame({'height': [height], 'weight': [weight], 'hair': [hair], 'beard': [bear
d], 'scarf': [scarf]})

print('\nUser input in Actual DataFrame form: ')
feature_vector = pd.DataFrame(InsertedData)
feature_vector
```

```
User input in Actual DataFrame form:
```

Out[44]:

	height	weight	hair	beard	scarf
0	170.0	120	Long	No	No

In [45]:

```
feature_vector['hair'] = enc_hair.transform(feature_vector['hair'])
feature_vector['beard'] = enc_beard.transform(feature_vector['beard'])
feature_vector['scarf'] = enc_scarf.fit_transform(feature_vector['scarf'])
print('User input in Encoded DataFame form: ')
feature_vector = pd.DataFrame(InsertedData)
feature_vector
```

```
User input in Encoded DataFame form:
```

Out[45]:

	height	weight	hair	beard	scarf
0	170.0	120	1	0	0

Step 9.4 : Apply Trained Model on Feature Vector

In [46]:

```
predict = random_forest.predict(feature_vector)
print('Prediction: ' + str(enc_gender.inverse_transform(predict)[0]))
```

```
Prediction: Female
```