knn

October 16, 2023

[7]:
```
# loading libraries
import pandas as pd
import seaborn as sns
import numpy as np
from matplotlib import pyplot as plt
```

[178]:
```
# importing dataset
df = pd.read_csv('weight-height.csv')
```

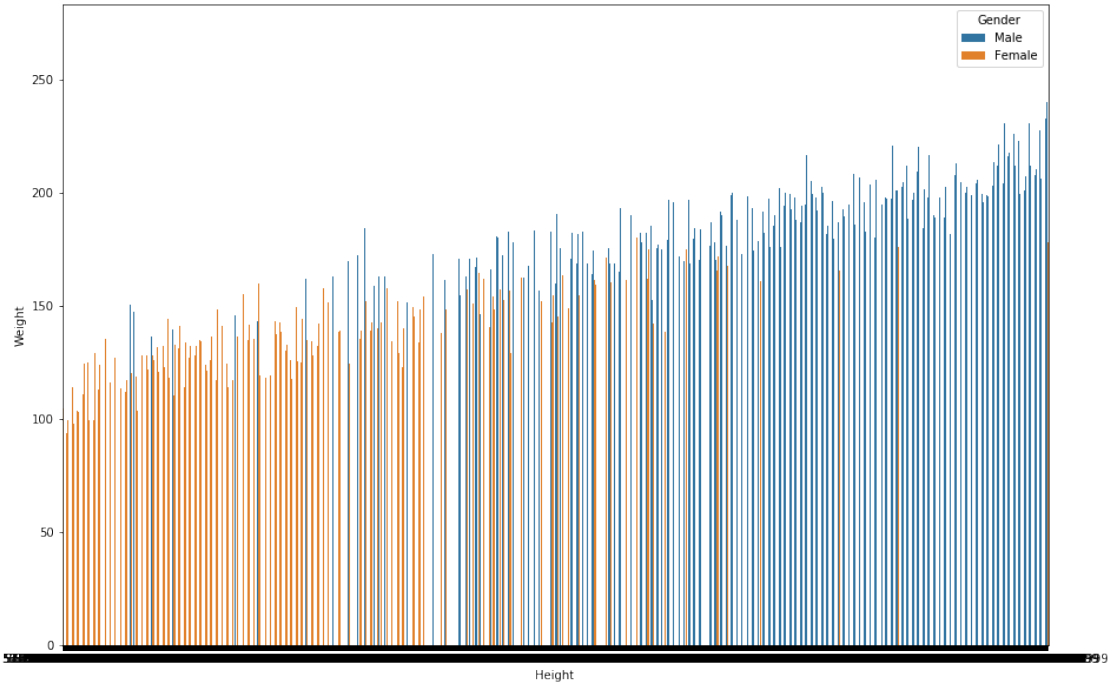
[179]:
```
df.head()
```

[179]:

	Gender	Height	Weight
0	Male	73.847017	241.893563
1	Male	68.781904	162.310473
2	Male	74.110105	212.740856
3	Male	71.730978	220.042470
4	Male	69.881796	206.349801

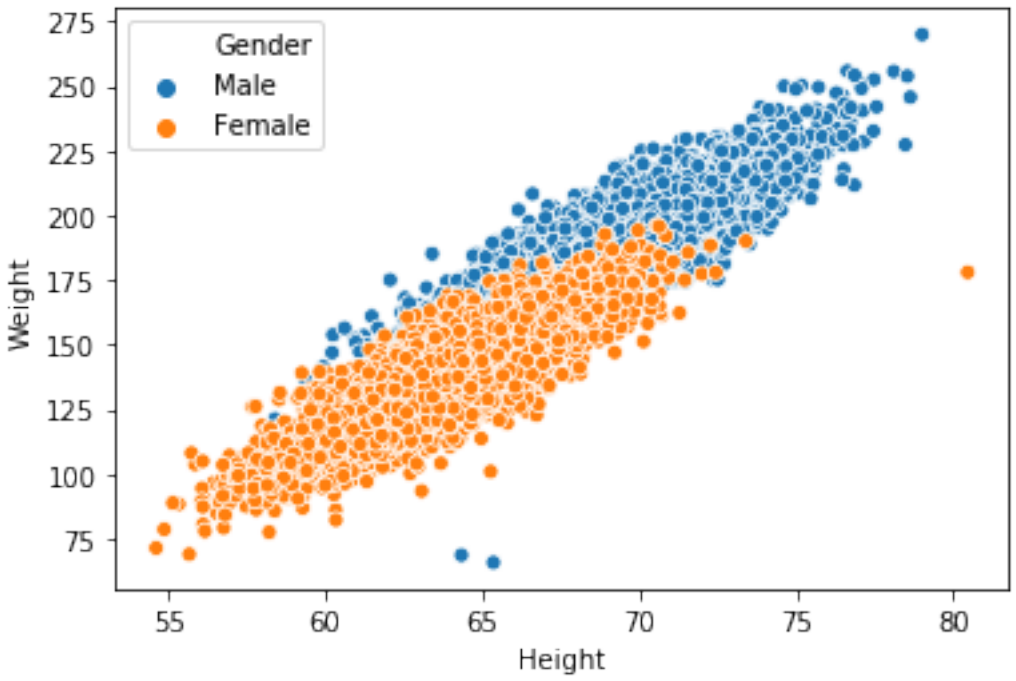
[34]:
```
# correlation between Gender based Height and Weight
plt.figure(figsize = (15,10))
sns.barplot(data=df, x='Height',y='Weight',hue='Gender')
```

[34]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1b74be1ac48>
```



[35]:
```
# correlation between Gender based Height and Weight
sns.scatterplot(
    data=df, x="Height", y="Weight", hue="Gender",
    sizes=(20, 200), legend="full"
)
```

[35]: <matplotlib.axes._subplots.AxesSubplot at 0x1b761028f88>



[122]:
```
# scaling and encoding libraries
from sklearn.preprocessing import MinMaxScaler,LabelEncoder
scaler = MinMaxScaler()
encoder = LabelEncoder()
```

[123]:
```
# Encoding and scaling data
from pandas.core.dtypes.common import is_numeric_dtype
for column in df.columns:
    if is_numeric_dtype(df[column]):
        df[column] = scaler.fit_transform(df[[column]])
        continue
    df[column] = encoder.fit_transform(df[column])
```

[124]:
```
df.head()
```

[124]:

	Gender	Height	Weight
0	1	0.744399	0.862415
1	1	0.548328	0.472703
2	1	0.754583	0.719657
3	1	0.662487	0.755412
4	1	0.590905	0.688360

[202]:
```
# Information about dataset
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8555 entries, 0 to 8554
Data columns (total 3 columns):
 #   Column  Non-Null Count  Dtype  
---  ------  --------------  -----  
 0   Gender  8555 non-null   object 
 1   Height  8555 non-null   float64
 2   Weight  8555 non-null   float64
dtypes: float64(2), object(1)
memory usage: 200.6+ KB
```

[126]:
```
# descriptive statistics
df.describe()
```

[126]:

	Gender	Height	Weight
count	8555.000000	8555.000000	8555.000000
mean	0.584454	0.471993	0.488972
std	0.492845	0.149090	0.156917
min	0.000000	0.000000	0.000000
25%	0.000000	0.361583	0.362847
50%	1.000000	0.478806	0.503118
75%	1.000000	0.580168	0.611559
max	1.000000	1.000000	1.000000

[127]:
```
x = df.drop('Weight',axis=1)
y = df.Weight
```

[128]:
```
x.head()
```

[128]:

	Gender	Height
0	1	0.744399
1	1	0.548328
2	1	0.754583
3	1	0.662487
4	1	0.590905

[129]:
```
y.head()
```

[129]:
```
0    0.862415
1    0.472703
2    0.719657
3    0.755412
4    0.688360
Name: Weight, dtype: float64
```

[18]:
```
# splitting data for testing and training
from sklearn.model_selection import train_test_split
```

```
xtrain,xtest,ytrain,ytest = train_test_split(x,y,train_size=.3)
```

[19]:
```
xtrain.head()
```

[19]:
```
      Gender    Height
3162       1  0.551467
140        1  0.551355
3047       1  0.576173
2063       1  0.516827
6639       0  0.314077
```

[20]:
```
ytrain.head()
```

[20]:
```
3162    0.618225
140     0.508188
3047    0.591625
2063    0.632553
6639    0.217728
Name: Weight, dtype: float64
```

0.1 Linear Regression

[21]:
```
from sklearn.linear_model import LinearRegression
lr = LinearRegression()
```

[22]:
```
lr.fit(xtrain,ytrain)
```

[22]:
```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=False)
```

[23]:
```
# predict for a set
lr.predict([[1.0,0.664220]])
```

[23]:
```
array([0.67291622])
```

0.1.1 Evaluation of Linear Regression

[24]:
```
# training accuracy
lr.score(xtrain,ytrain)
```

[24]:
```
0.9019340062547945
```

[25]:
```
# testing accuracy/ R squared Value
lr.score(xtest,ytest)
```

[25]:
```
0.8990340769523023
```

[26]:
```
from sklearn.metrics import mean_squared_error,mean_absolute_error,r2_score
```

[27]:
```
pred = lr.predict(xtest)
```

[28]:
```
# MSE
mean_squared_error(ytest,pred)
```

[28]: 0.002489382815066405

[29]:
```
# MAE
mean_absolute_error(ytest,pred)
```

[29]: 0.03936851330019256

[30]:
```
# coefficient of determination
r2_score(ytest,pred)
```

[30]: 0.8990340769523022

0.2 KNN Regressor

[63]:
```
from sklearn.neighbors import KNeighborsRegressor
knr = KNeighborsRegressor()
```

[64]:
```
knr.fit(xtrain,ytrain)
```

[64]:
```
KNeighborsRegressor(algorithm='auto', leaf_size=30, metric='minkowski',
                    metric_params=None, n_jobs=-1, n_neighbors=5, p=2,
                    weights='uniform')
```

[65]:
```
# predict for a set
knr.predict([[1,70]])
```

[65]: array([0.82395397])

0.2.1 Evaluation of KNN Regressor

[66]:
```
#Training Accuracy
knr.score(xtrain,ytrain)
```

[66]: 0.9211518734987775

[67]:
```
#Testing Accuracy
knr.score(xtest,ytest)
```

[67]: 0.8798623058445141

[68]:
```
from sklearn.metrics import mean_squared_error
```

[71]:
```
# prediction for testing dataset
pred = knr.predict(xtest)
pred
```

[71]:
```
array([0.40543375, 0.60259229, 0.48116714, …, 0.26152244, 0.49350545,
       0.60235419])
```

[74]:
```
# MSE
mean_squared_error(ytest,pred)
```

[74]:
```
0.002962075740456371
```

0.2.2 Tuning

[75]:
```
from sklearn.model_selection import RandomizedSearchCV
```

[96]:
```
n_neighbors = np.random.randint(5,100,50)
weights = ['uniform', 'distance']
params = {
    'n_neighbors': n_neighbors,
    'weights' : weights
}
```

[97]:
```
params
```

[97]:
```
{'n_neighbors': array([95, 60, 29, 18, 25, 69, 73,  8, 64, 36, 84, 54,  9, 85,
92, 45, 49,
        62, 64, 13, 87, 66, 20, 82, 66, 70, 18, 40, 75, 10, 50,  7, 37, 83,
        72, 94, 67, 31, 65, 26, 88, 84, 47, 16, 64, 92, 16, 51, 41, 62]),
 'weights': ['uniform', 'distance']}
```

[98]:
```
knr = KNeighborsRegressor(n_jobs=-1)
```

[102]:
```
rs = RandomizedSearchCV(knr,params)
```

[104]:
```
rs.fit(xtrain,ytrain)
```

[104]:
```
RandomizedSearchCV(cv=None, error_score=nan,
                   estimator=KNeighborsRegressor(algorithm='auto', leaf_size=30,
                                                 metric='minkowski',
                                                 metric_params=None, n_jobs=-1,
                                                 n_neighbors=5, p=2,
                                                 weights='uniform'),
                   iid='deprecated', n_iter=10, n_jobs=None,
                   param_distributions={'n_neighbors': array([95, 60, 29, 18,
```

```
25, 69, 73,  8, 64, 36, 84, 54,  9, 85, 92, 45, 49,
       62, 64, 13, 87, 66, 20, 82, 66, 70, 18, 40, 75, 10, 50,  7, 37, 83,
       72, 94, 67, 31, 65, 26, 88, 84, 47, 16, 64, 92, 16, 51, 41, 62]),
                                 'weights': ['uniform', 'distance']},
                   pre_dispatch='2*n_jobs', random_state=None, refit=True,
                   return_train_score=False, scoring=None, verbose=0)
```

[105]:
```
pd.DataFrame(rs.cv_results_)
```

[105]:
```
   mean_fit_time  std_fit_time  mean_score_time  std_score_time param_weights  \
0       0.010630      0.008940         0.017875        0.002932      distance
1       0.005000      0.000004         0.016996        0.002448      distance
2       0.005004      0.000001         0.014995        0.000001      distance
3       0.005000      0.000002         0.016284        0.001938       uniform
4       0.004998      0.000002         0.018000        0.002447       uniform
5       0.004999      0.000002         0.014999        0.000001       uniform
6       0.005000      0.000003         0.018143        0.002284      distance
7       0.004998      0.000004         0.016998        0.002450      distance
8       0.006001      0.002000         0.017996        0.002448       uniform
9       0.005597      0.001197         0.017116        0.002082       uniform

  param_n_neighbors                                      params  \
0                64  {'weights': 'distance', 'n_neighbors': 64}
1                64  {'weights': 'distance', 'n_neighbors': 64}
2                16  {'weights': 'distance', 'n_neighbors': 16}
3                62   {'weights': 'uniform', 'n_neighbors': 62}
4                94   {'weights': 'uniform', 'n_neighbors': 94}
5                20   {'weights': 'uniform', 'n_neighbors': 20}
6                82  {'weights': 'distance', 'n_neighbors': 82}
7                69  {'weights': 'distance', 'n_neighbors': 69}
8                83   {'weights': 'uniform', 'n_neighbors': 83}
9                69   {'weights': 'uniform', 'n_neighbors': 69}

   split0_test_score  split1_test_score  split2_test_score  split3_test_score  \
0           0.892928           0.886049           0.866592           0.882085
1           0.892928           0.886049           0.866592           0.882085
2           0.887581           0.881456           0.859843           0.873204
3           0.903305           0.895889           0.886012           0.900630
4           0.899619           0.891904           0.883906           0.899170
5           0.907338           0.894841           0.884607           0.895442
6           0.893086           0.886194           0.866974           0.882979
7           0.892973           0.886214           0.866687           0.882384
8           0.901136           0.893934           0.884919           0.899238
9           0.902578           0.895902           0.885692           0.899732

   split4_test_score  mean_test_score  std_test_score  rank_test_score
0           0.888025         0.883136        0.008979                8
```

1	0.888025	0.883136	0.008979	8
2	0.883025	0.877022	0.009766	10
3	0.898470	0.896861	0.005949	1
4	0.896548	0.894230	0.005845	5
5	0.901179	0.896682	0.007543	2
6	0.888266	0.883500	0.008891	6
7	0.888173	0.883286	0.008974	7
8	0.897559	0.895357	0.005732	4
9	0.898647	0.896510	0.005817	3

[106]:
```
rs.best_params_
```

[106]:
```
{'weights': 'uniform', 'n_neighbors': 62}
```

[108]:
```
nrs = rs.best_estimator_
nrs
```

[108]:
```
KNeighborsRegressor(algorithm='auto', leaf_size=30, metric='minkowski',
                    metric_params=None, n_jobs=-1, n_neighbors=62, p=2,
                    weights='uniform')
```

[109]:
```
nrs.fit(xtrain,ytrain)
```

[109]:
```
KNeighborsRegressor(algorithm='auto', leaf_size=30, metric='minkowski',
                    metric_params=None, n_jobs=-1, n_neighbors=62, p=2,
                    weights='uniform')
```

0.2.3 Evaluation

[114]:
```
nrs.score(xtrain,ytrain)
```

[114]:
```
0.9007895006820974
```

[110]:
```
nrs.score(xtest,ytest)
```

[110]:
```
0.8951833964672039
```

[111]:
```
from sklearn.metrics import mean_squared_error
```

[112]:
```
pred = nrs.predict(xtest)
```

[113]:
```
mean_squared_error(ytest,pred)
```

[113]:
```
0.0025843239351647854
```

[115]:
```
nrs.predict([[1,70]])
```

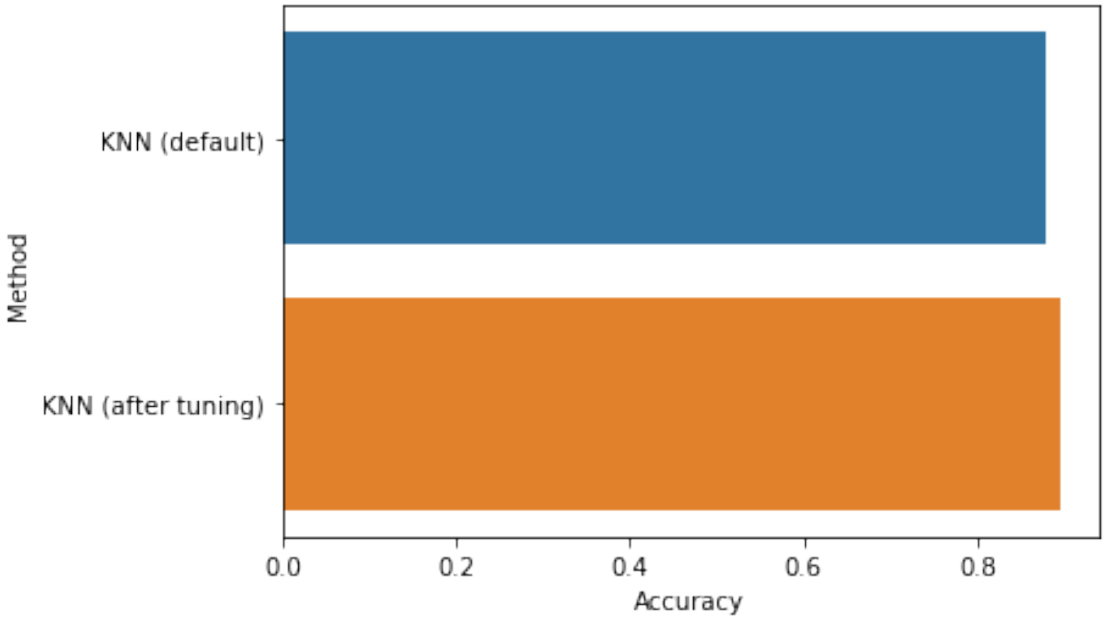
[115]:
```
array([0.77183087])
```

0.2.4 Comparison

[199]:
```
_df = pd.DataFrame([['KNN (default)',0.8798623058445141] , ['KNN (after␣
↪tuning)',0.8951833964672039]],columns=['Method','Accuracy'])
```

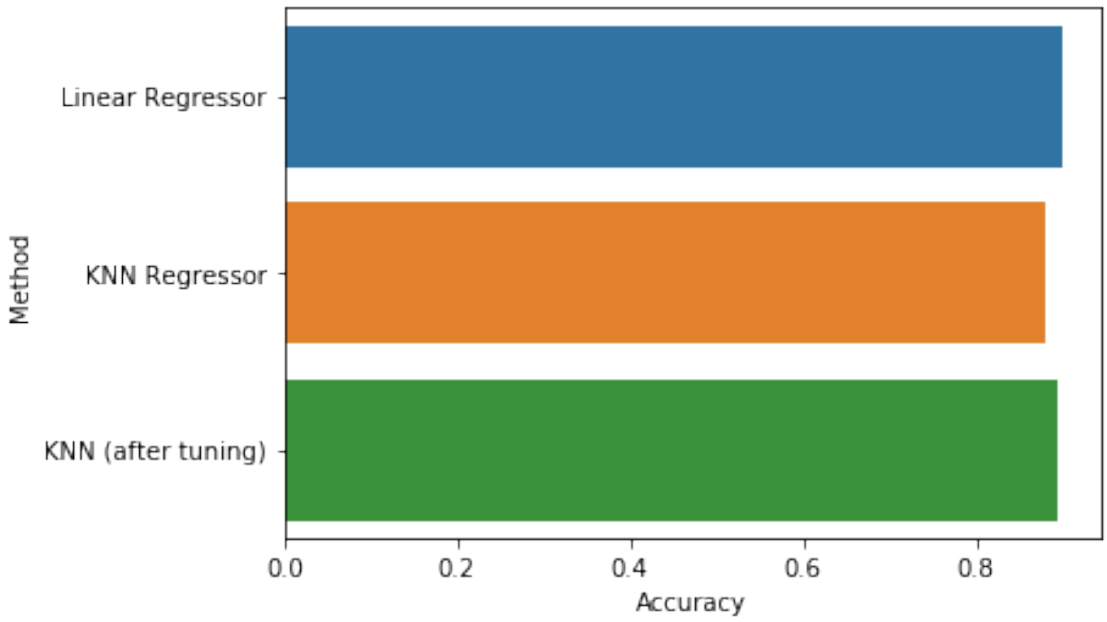
[200]:
```
sns.barplot(x='Accuracy',y='Method',data=_df)
```

[200]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1b77bcf1ac8>
```



[218]:
```
_df = pd.DataFrame([['Linear Regressor', 0.8990340769523023] , ['KNN␣
↪Regressor',0.8798623058445141],['KNN (after tuning)',0.8951833964672039]],␣
↪columns= ['Method','Accuracy'])
sns.barplot(x='Accuracy',y='Method',data=_df)
```

[218]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1b7223c8b88>
```



0.3 KNN Classifier

[130]:
```
# separating values
x = df.drop('Gender',axis=1)
y = df.Gender
```

[131]:
```
x
```

[131]:

	Height	Weight
0	0.744399	0.862415
1	0.548328	0.472703
2	0.754583	0.719657
3	0.662487	0.755412
4	0.590905	0.688360
…	…	…
8550	0.227115	0.219311
8551	0.340900	0.314097
8552	0.424540	0.441520
8553	0.495995	0.420638
8554	0.244064	0.320620

[8555 rows x 2 columns]

[132]:
```
y
```

[132]:
```
0       1
1       1
2       1
3       1
4       1
       ..
8550    0
8551    0
8552    0
8553    0
8554    0
Name: Gender, Length: 8555, dtype: int32
```

[134]:
```
# Splitting dataset for training and testing
from sklearn.model_selection import train_test_split
xtrain, xtest, ytrain, ytest = train_test_split(x,y,test_size=.
 ↪7,random_state=42)
```

[135]:
```
xtrain.head()
```

[135]:

	Height	Weight
1735	0.539772	0.590673
2823	0.431680	0.517239
6781	0.100096	0.186978
6336	0.393841	0.365413
2475	0.301345	0.385707

[138]:
```
xtest.head()
```

[138]:

	Height	Weight
6006	0.395995	0.410795
1197	0.552372	0.645720
2862	0.632773	0.552232
6497	0.314338	0.370027
2860	0.579146	0.634361

[140]:
```
from sklearn.neighbors import KNeighborsClassifier
knc = KNeighborsClassifier()
```

[141]:
```
knc.fit(xtrain,ytrain)
```

[141]:
```
KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='minkowski',
                     metric_params=None, n_jobs=None, n_neighbors=5, p=2,
                     weights='uniform')
```

0.3.1 Evaluation

[142]:
```
#training accuracy
knc.score(xtrain,ytrain)
```

[142]:
```
0.9275136399064692
```

[143]:
```
#testing accuracy
knc.score(xtest,ytest)
```

[143]:
```
0.9100016697278344
```

[144]:
```
pred = knc.predict(xtest)
```

[147]:
```
from sklearn.metrics import␣
↪accuracy_score,confusion_matrix,plot_roc_curve,classification_report
```

[203]:
```
# Accuracy
accuracy_score(ytest,pred)
```

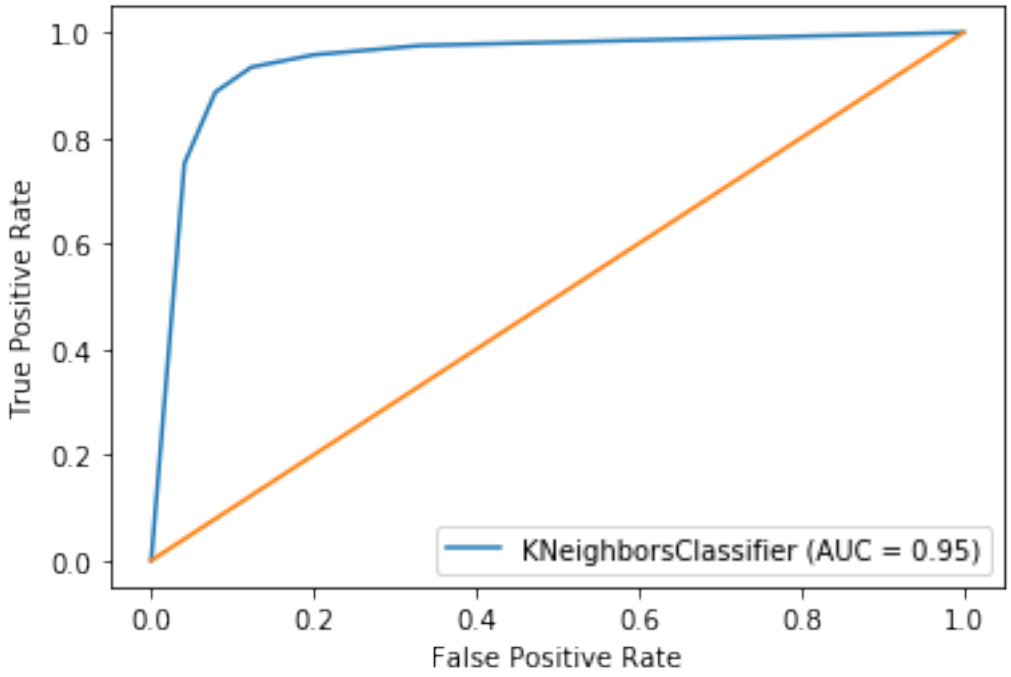
[203]:
```
0.9100016697278344
```

[148]:
```
confusion_matrix(ytest,pred)
```

[148]:
```
array([[2208,  311],
       [ 228, 3242]], dtype=int64)
```

[152]:
```
plot_roc_curve(knc,xtest,ytest)
plt.plot([0,1],[0,1])
```

[152]:
```
[<matplotlib.lines.Line2D at 0x1b777a7cb88>]
```



[149]:
```
print(classification_report(ytest,pred))
```

```
              precision    recall  f1-score   support

           0       0.91      0.88      0.89      2519
           1       0.91      0.93      0.92      3470

    accuracy                           0.91      5989
   macro avg       0.91      0.91      0.91      5989
weighted avg       0.91      0.91      0.91      5989
```

0.3.2 Tuning

[156]:
```
n_neighbors = np.random.randint(5,100,20)
weights = ['uniform', 'distance']
params = {
    'n_neighbors': n_neighbors,
    'weights':weights
}
```

[157]:
```
params
```

[157]:
```
{'n_neighbors': array([26, 42, 30, 65, 91, 56, 30, 64,  6, 11, 77, 88, 12, 79,
54, 63, 49,
```

```
        16, 84, 54]),
 'weights': ['uniform', 'distance']}
```

[153]:
```
from sklearn.model_selection import RandomizedSearchCV
```

[159]:
```
rsc =RandomizedSearchCV(KNeighborsClassifier(),params,n_jobs=-1)
```

[160]:
```
rsc.fit(xtrain,ytrain)
```

[160]:
```
RandomizedSearchCV(cv=None, error_score=nan,
                   estimator=KNeighborsClassifier(algorithm='auto',
                                                  leaf_size=30,
                                                  metric='minkowski',
                                                  metric_params=None,
                                                  n_jobs=None, n_neighbors=5,
                                                  p=2, weights='uniform'),
                   iid='deprecated', n_iter=10, n_jobs=-1,
                   param_distributions={'n_neighbors': array([26, 42, 30, 65,
91, 56, 30, 64,  6, 11, 77, 88, 12, 79, 54, 63, 49,
       16, 84, 54]),
                                        'weights': ['uniform', 'distance']},
                   pre_dispatch='2*n_jobs', random_state=None, refit=True,
                   return_train_score=False, scoring=None, verbose=0)
```

[161]:
```
# Best accuracy score
rsc.best_score_
```

[161]:
```
0.9185473411154346
```

[162]:
```
# Best parameters
rsc.best_params_
```

[162]:
```
{'weights': 'uniform', 'n_neighbors': 49}
```

[165]:
```
nrsc = rsc.best_estimator_
nrsc
```

[165]:
```
KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='minkowski',
                     metric_params=None, n_jobs=None, n_neighbors=49, p=2,
                     weights='uniform')
```

[166]:
```
nrsc.fit(xtrain,ytrain)
```

[166]:
```
KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='minkowski',
                     metric_params=None, n_jobs=None, n_neighbors=49, p=2,
                     weights='uniform')
```

[169]:
```
# Training Accuracy
nrsc.score(xtrain,ytrain)
```

[169]: 0.9189399844115355

[168]:
```
# Testing Accuracy
nrsc.score(xtest,ytest)
```

[168]: 0.9095007513775255

[167]:
```
# Prediction
pred = nrsc.predict(xtest)
```

[167]: array([0, 1, 1, …, 1, 0, 1])

[170]:
```
from sklearn.metrics import␣
↪accuracy_score,confusion_matrix,plot_roc_curve,classification_report
```

[171]:
```
# Accuracy
accuracy_score(ytest,pred)
```

[171]: 0.9100016697278344

[172]:
```
# Confusion Matrix
confusion_matrix(ytest,pred)
```

[172]:
```
array([[2208,  311],
       [ 228, 3242]], dtype=int64)
```

[174]:
```
# Classification Report
print(classification_report(ytest,pred))
```

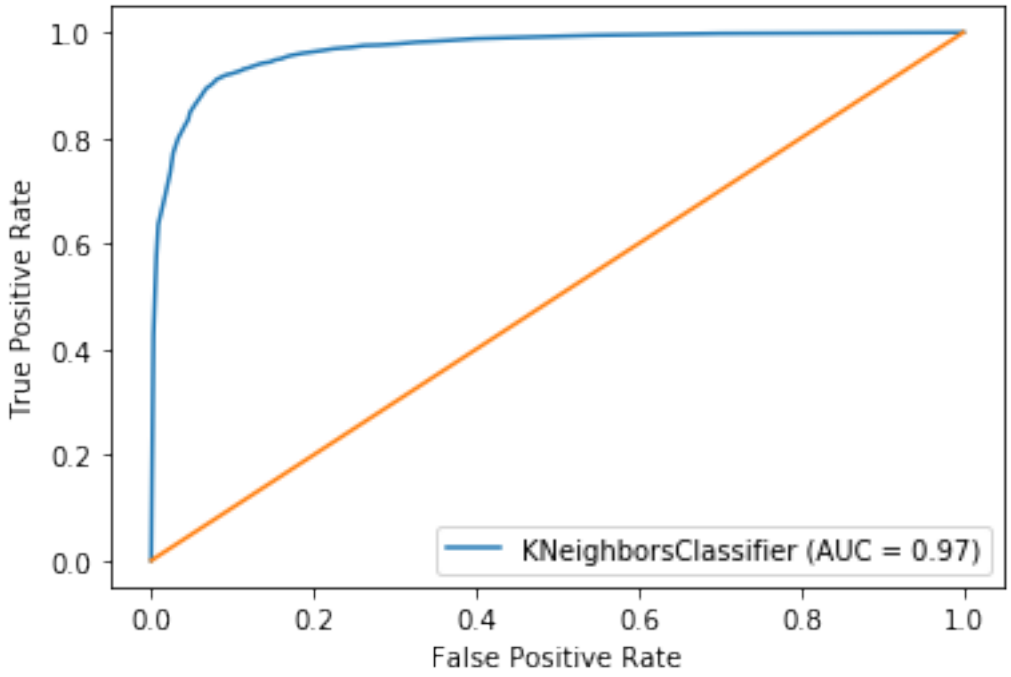
```
              precision    recall  f1-score   support

           0       0.91      0.88      0.89      2519
           1       0.91      0.93      0.92      3470

    accuracy                           0.91      5989
   macro avg       0.91      0.91      0.91      5989
weighted avg       0.91      0.91      0.91      5989
```

[177]:
```
# ROC AUC Plot
plot_roc_curve(nrsc,xtest,ytest)
plt.plot([0,1],[0,1])
```

[177]: [<matplotlib.lines.Line2D at 0x1b777536808>]

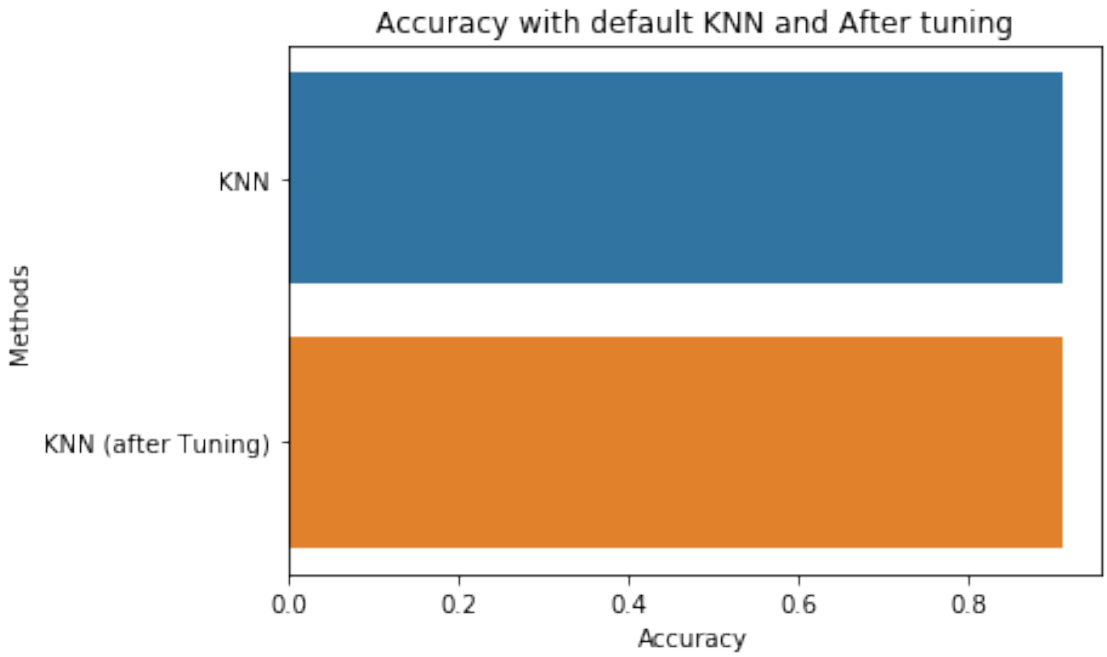


0.4 Comparison

[216]:
```
_temp_df = pd.DataFrame([['KNN',0.9100016697278344],['KNN (after Tuning)',0.
↪9095007513775255]],columns=['Methods','Accuracy'])
```

[219]:
```
sns.barplot(x='Accuracy',y='Methods',data=_temp_df)
# plt.xlabel("accuracy with default KNN and After tuning")
plt.title("Accuracy with default KNN and After tuning")
```

[219]:
```
Text(0.5, 1.0, 'Accuracy with default KNN and After tuning')
```


Accuracy with default KNN and After tuning
KNN
KNN (after Tuning)
Methods
0.0
0.2
0.4
0.6
0.8
Accuracy

[ ]: