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# CS156 (Introduction to AI), Fall 2021
# Term Project Report
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# References and sources:
# 1) Regression.Boston.ipynb (class file)
# 2) Train_validation_test_Iris.ipynb
# 3) importing datafile into google colab : https://stackoverfl
```

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# Project description/introduction text (the background informa

# Happiness is an important part of our well being. There are m
# factors that contributes to Happiness. We will closely looks 
# these factors and determine the roles they play in determinin
# the happiness score of a given country. I will use several ma
# learning algorithms to predict happiness score of various cou
# This is an interesting problem to solve because it gives us s
# insights into major factors that contributes to happiness of 
# Most of the data are numeric and we will be deadling with a r
# problem.
```

```
# Machine learning algorithm selected for this project

# LinerRegression: LinearRegression fits a linear model with co
# w = (w1, …, wp) to minimize the residual sum of squares betwe
# observed targets in the dataset, and the targets predicted by

# RandomForestRegressor: RFs train each tree independently, usi
# random sample of the data. This randomness helps to make the 
# more robust than a single decision tree, and less likely to o
# on the training data [1,2].

# GradientBoostingRegressor GBT build trees one at a time, wher
# new tree helps to correct errors made by previously trained t



# Dataset source

# Kaggle Dataset:  https://www.kaggle.com/unsdsn/world-happines
# Download 2019.csv file



# Solution:


import numpy as np
from google.colab import files

import pandas as pd
from sklearn.model_selection import train_test_split
import seaborn as sns
from sklearn.preprocessing import MinMaxScaler

from sklearn.ensemble import RandomForestRegressor
from sklearn.linear_model import LinearRegression
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.svm import SVR

from sklearn.metrics import mean_absolute_error,mean_squared_er

np.random.seed(42)





uploaded = files.upload()
print(uploaded)
```

Choose Files happiness_2019.csv

- **happiness_2019.csv**(text/csv) - 8822 bytes, last modified: 10/20/2021 - 100% done

```
Saving happiness_2019.csv to happiness_2019 (1).csv
```

```
df = pd.read_csv(io.BytesIO(uploaded['happiness_2019.csv']))
df = df.drop('Overall rank', 1)
df.head()
```

	Country or region	Score	GDP per capita	Social support	Healthy life expectancy	Freedom to make life choices	Generosity	Perce corr
0	Finland	7.769	1.340	1.587	0.986	0.596	0.153	
1	Denmark	7.600	1.383	1.573	0.996	0.592	0.252	
2	Norway	7.554	1.488	1.582	1.028	0.603	0.271	
3	Iceland	7.494	1.380	1.624	1.026	0.591	0.354	
4	Netherlands	7.488	1.396	1.522	0.999	0.557	0.322	

```
# checking if data contains null values
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 156 entries, 0 to 155
Data columns (total 8 columns):
 #   Column                        Non-Null Count  Dtype  
---  ------                        --------------  -----  
 0   Country or region             156 non-null    object 
 1   Score                         156 non-null    float64
 2   GDP per capita                156 non-null    float64
 3   Social support                156 non-null    float64
 4   Healthy life expectancy       156 non-null    float64
 5   Freedom to make life choices  156 non-null    float64
 6   Generosity                    156 non-null    float64
 7   Perceptions of corruption     156 non-null    float64
dtypes: float64(7), object(1)
memory usage: 9.9+ KB
```

```
X= df.loc[ : ,df.columns.difference(['id','Overall rank','Count
Y = df['Score']
class_names = ['GDP per capita', 'Social support', 'Healthy lif
          'Generosity','Perceptions of corruption']
```

```
X.head()
# Y.head()
```

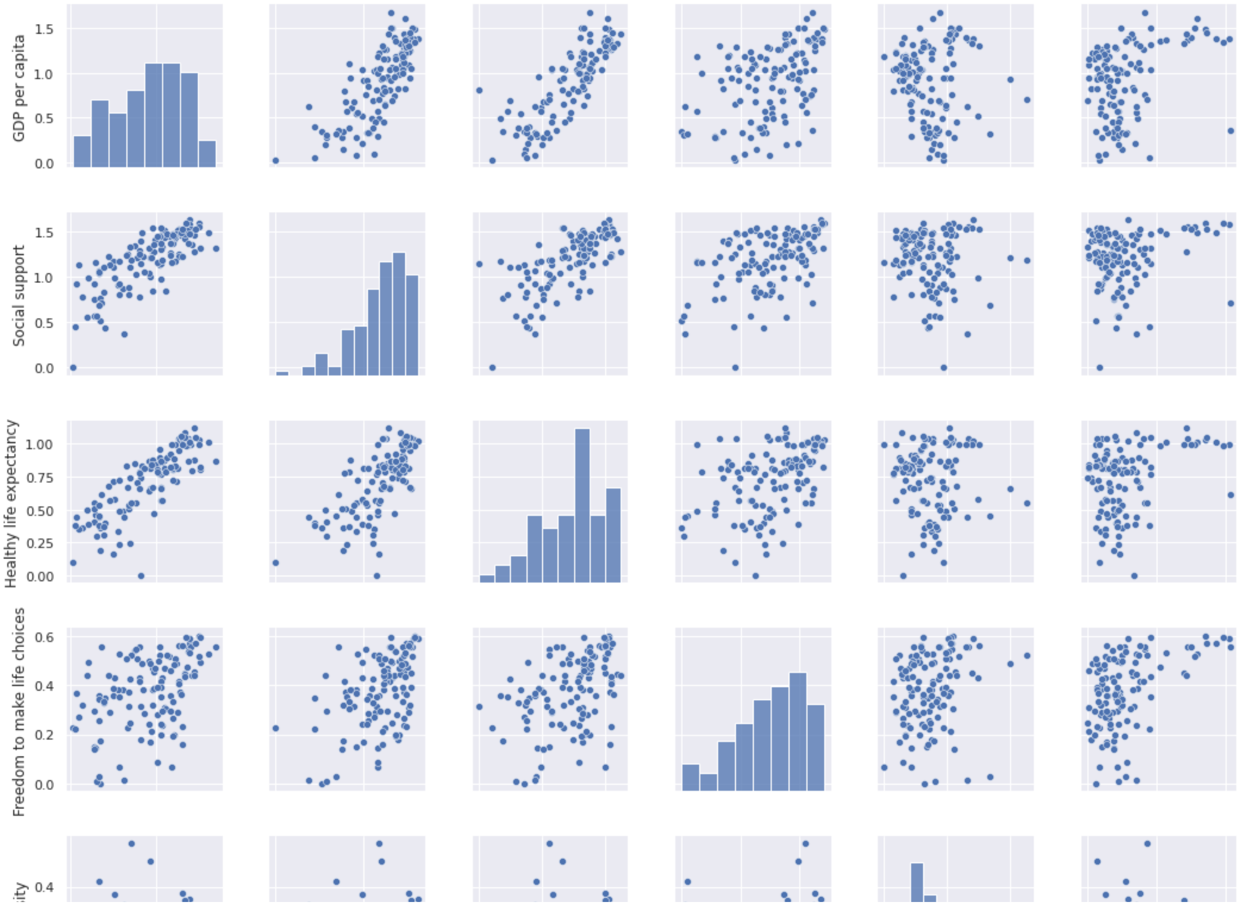
	Freedom to make life choices	GDP per capita	Generosity	Healthy life expectancy	Perceptions of corruption	Score	Social support
0	0.596	1.340	0.153	0.986	0.393	7.769	1.587
1	0.592	1.383	0.252	0.996	0.410	7.600	1.573
2	0.603	1.488	0.271	1.028	0.341	7.554	1.582
3	0.591	1.380	0.354	1.026	0.118	7.494	1.624

```
#  Break the data into the training and test datasets at 80/20
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_
X_train.shape, Y_train.shape, X_test.shape, Y_test.shape
```

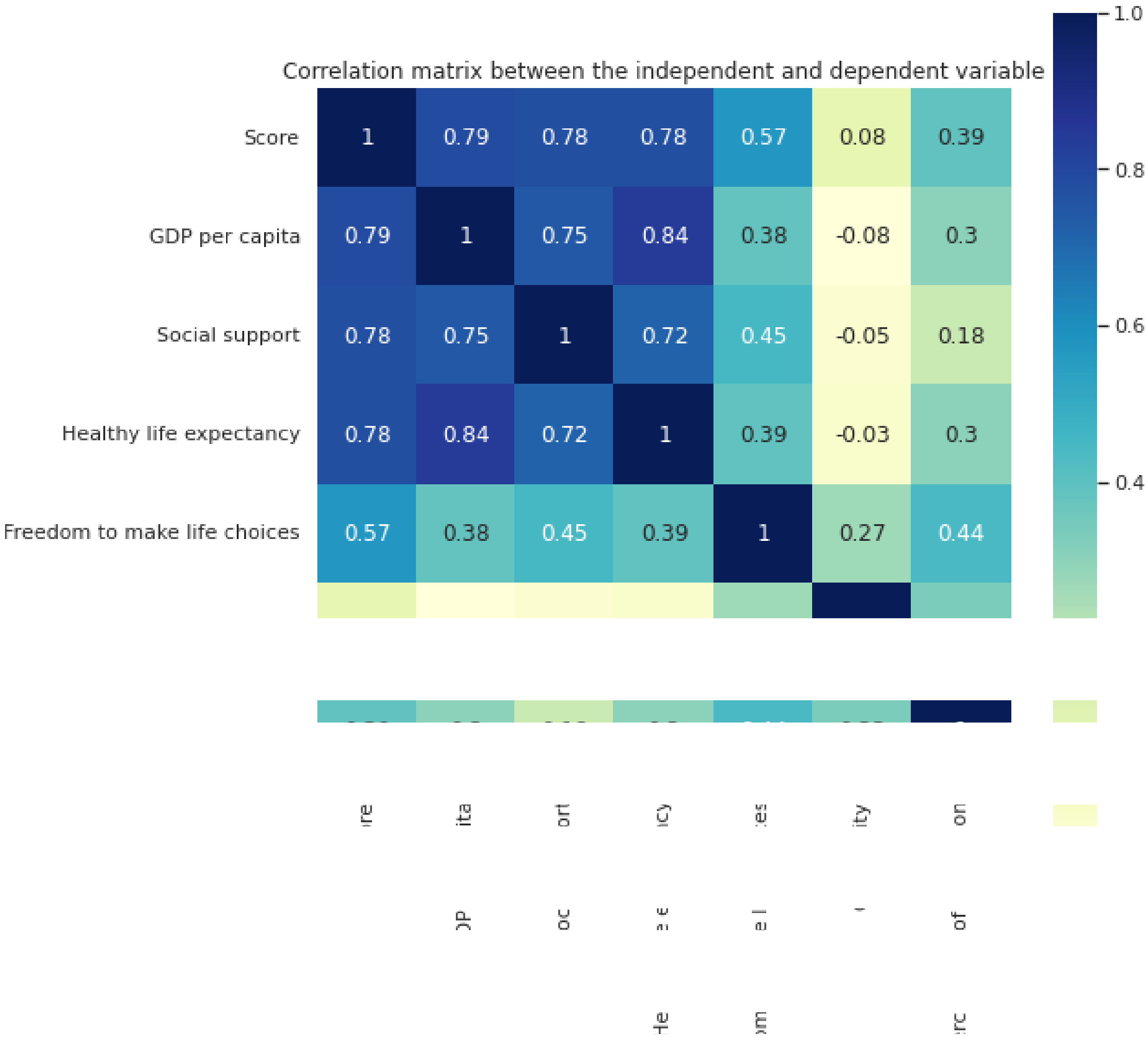
```
((124, 7), (124,), (32, 7), (32,))
```

```
# check to see what our training data looks like
train_df = pd.DataFrame(X_train,columns= class_names)
train_df['MEDV'] = Y_train
sns.pairplot(train_df, vars = class_names)
```

```
<seaborn.axisgrid.PairGrid at 0x7f5cc9858d90>
```



```
# correlation matrix between the independent variable
sns.set(rc={'figure.figsize': (8.5,8.5)})
sns.heatmap(df.corr().round(2), square=True, cmap='YlGnBu', ann
ax = plt.axes()
ax.set_title('Correlation matrix between the independent and de
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:4: MatplotlibD
  after removing the cwd from sys.path.
Text(0.5, 1.0, 'Correlation matrix between the independent and dependent va
```

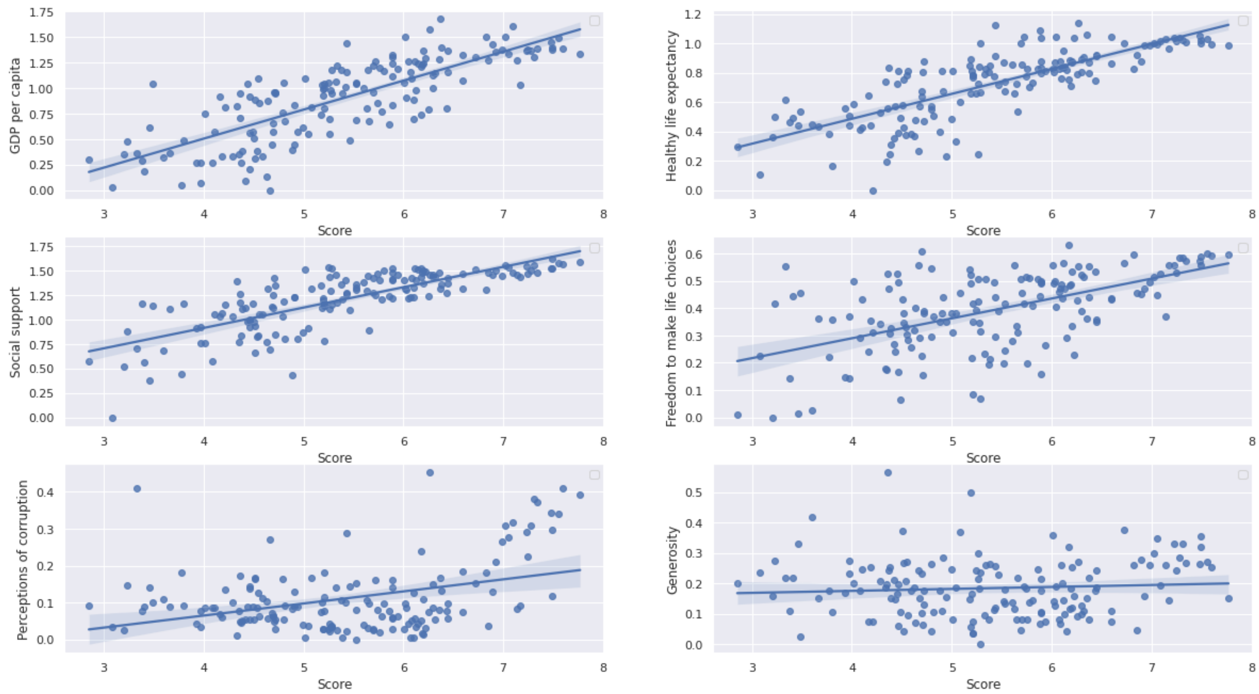


```
#  what are the fields that contribute most to higher happiness
cols=df.corr()['Score'].sort_values(ascending=False)
fig=plt.figure(figsize=(20,15))
plt.suptitle("Comparing features that contribute to happiness s
j=0
for i in cols.index[1:]:

    ax=plt.subplot(421+j)
    ax=sns.regplot(data=df, x='Score',y=i)
    ax.legend('')
    j=j+1
```

```
plt.legend('')
```

```
<matplotlib.legend.Legend at 0x7f5cc968f510>
```

Comparing features that contribute to happiness score



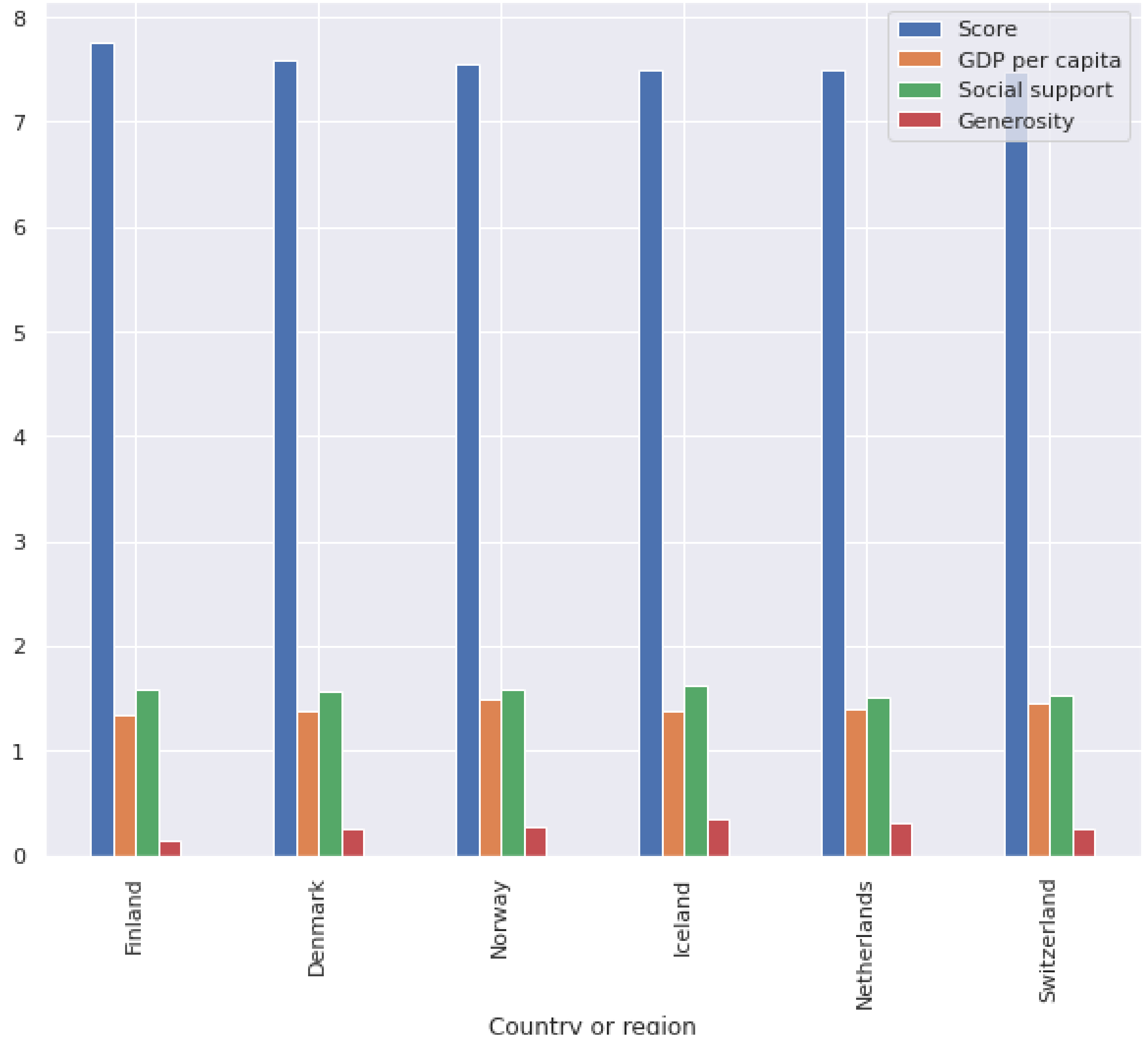
```
models=[LinearRegression(),
        RandomForestRegressor(),GradientBoostingRegressor()]

def create_model(model):
    mod=model
    mod.fit(X_train,Y_train)
    temp= mod.score(X_train,Y_train)

    pre=mod.predict(X_test)


    mean_absolute_err=mean_absolute_error(pre,Y_test)
    mean_square_err=mean_squared_error(pre,Y_test)
    root_mean_square_err=np.sqrt(mean_squared_error(pre,Y_test)
    cof_det=r2_score(Y_test,pre)

    print(mod)
    print("Score of the Model on training data: ", temp)
    print('Mean absolute error',mean_absolute_err)
    print('Mean squared error',mean_square_err)
    print('Root Mean squared error',root_mean_square_err)
    print('Coefficient of determination:',cof_det)
    print()
```

```
for i in models:
    create_model(i)
```

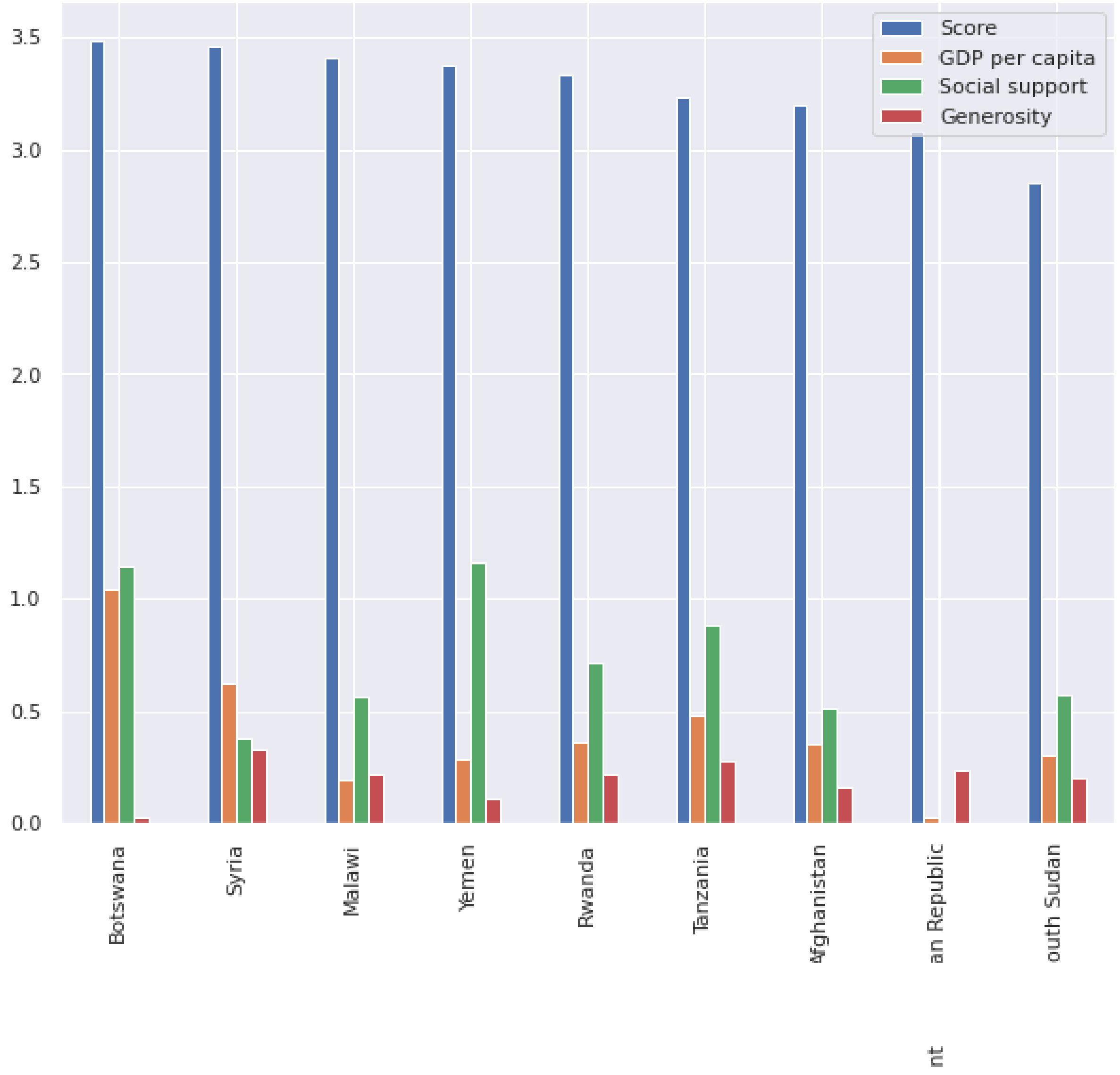
```
LinearRegression()
Score of the Model on training data:  1.0
Mean absolute error 2.3037127760972e-15
Mean squared error 6.582058177937817e-30
Root Mean squared error 2.5655522169579433e-15
Coefficient of determination: 1.0

RandomForestRegressor()
Score of the Model on training data:  0.9995937875192347
Mean absolute error 0.028754375
Mean squared error 0.0016603634687499824
Root Mean squared error 0.04074755782559223
Coefficient of determination: 0.9985978616372247

GradientBoostingRegressor()
Score of the Model on training data:  0.9999979170109737
Mean absolute error 0.018532246805825395
Mean squared error 0.0005260629819864426
Root Mean squared error 0.022936062913814188
Coefficient of determination: 0.9995557520373328
```

```
# Showing top countries with highest happiness score
comp=df[df['Score'] >= 7.4]
comp.plot(x='Country or region', y=['Score','GDP per capita', '
plt.xticks(rotation='vertical')
```

```
(array([0, 1, 2, 3, 4, 5]), <a list of 6 Text major ticklabel objects>)
```



```
# Showing top countries with lowest happiness score
comp=df[df['Score'] <= 3.5]
comp.plot(x='Country or region', y=['Score','GDP per capita', '
<matplotlib.axes._subplots.AxesSubplot at 0x7f5cc87ddbd0>
```



```
# Cross-validation results

from sklearn.model_selection import cross_validate

def create_mod(model):
    mod=model
    mod.fit(X_train,Y_train)
    cv_results = cross_validate(model, X_train, Y_train, cv=7)
    print(mod)
    print("Accurcies of 7 splits are: ")
    print(cv_results['test_score'])
    print("Mean accuracy: "+str(cv_results['test_score'].mean()
    print()

for i in models:
    create_mod(i)
```

```
LinearRegression()
Accurcies of 7 splits are:
[1. 1. 1. 1. 1. 1. 1.]
Mean accuracy: 1.0

RandomForestRegressor()
Accurcies of 7 splits are:
[1.   1.   0.98 1.   1.   1.   1.  ]
Mean accuracy: 0.9960035456679949

GradientBoostingRegressor()
Accurcies of 7 splits are:
[1.   1.   0.99 1.   1.   1.   1.  ]
Mean accuracy: 0.9979077384378103
```

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