Group 12

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A

Task

Write a Python program that draws a scatter plot of GDP per capita vs life expectancy.

State any assumptions and motivate decisions that you make when selecting data to be plotted, and in combining data.

Assumptions

We assume that we will find a correlation between GDP and life expectancy, regardless of country. We also assume that we will need to test the scatter-plotting a bit until we get it right. Further, we assume that the list of countries are correct and that they are the same for both files we download. (later, we will see that this is not the case. E.g. some countries are missing, continents like Africa are listed…)

Decisions

We decide to import two files, everything to see how it works. We decide on the following layout:

y-axis = life expectancy

x-axis = GDP

```
# Importing librarties

import pandas as pd
import matplotlib.pyplot as plt
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount
```

```
# Importing a lot of data

# Import gdp data
file_path = "/content/drive/MyDrive/test/gdp-per-capita-maddison-2020.csv"

gdpDataCapita = pd.read_csv(file_path)
print(gdpDataCapita)


# Import Life exp
filee_path = "/content/drive/MyDrive/test/life-expectancy.csv"

LifeExpectData = pd.read_csv(filee_path)
```

```
                Entity Code  Year  GDP per capita 417485-annotations
0      Afghanistan  AFG  1950       1156.0000                NaN
1      Afghanistan  AFG  1951       1170.0000                NaN
2      Afghanistan  AFG  1952       1189.0000                NaN
3      Afghanistan  AFG  1953       1240.0000                NaN
4      Afghanistan  AFG  1954       1245.0000                NaN
...            ...  ...   ...             ...                ...
19871     Zimbabwe  ZWE  2014       1594.0000                NaN
19872     Zimbabwe  ZWE  2015       1560.0000                NaN
19873     Zimbabwe  ZWE  2016       1534.0000                NaN
19874     Zimbabwe  ZWE  2017       1582.3662                NaN
19875     Zimbabwe  ZWE  2018       1611.4052                NaN

[19876 rows x 5 columns]
```

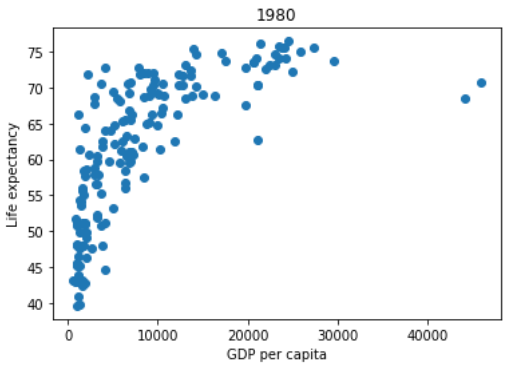
```
# We will get too much data. The scatter-plotting will be all blue, so we need to narrow down. We select 1980 only.
gdpDataCapita = gdpDataCapita[gdpDataCapita['Year'] == 1980]
LifeExpectData = LifeExpectData[LifeExpectData['Year'] == 1980]
```

```
# Now we need to merge the data-sets and remove what we do not need. We keep Entity (country), Life expectency and GDP.

MergedData = pd.merge(LifeExpectData[['Entity', 'Life expectancy at birth (historical)']], gdpDataCapita[['Entity', 'GDP per c

# Check that the data looks OK.
MergedData.head(5)
```

	Entity	Life expectancy at birth (historical)	GDP per capita
0	Afghanistan	39.6	1019.0
1	Albania	70.5	3741.0
2	Algeria	53.3	5024.0
3	Angola	42.4	1532.0
4	Argentina	68.6	13080.0

```
# Adding some labels and a title to the graph
plt.xlabel('GDP per capita')
plt.ylabel('Life expectancy')
plt.title('1980')


# In case we have rows where life expectation OR GDP is missing, we need to remove these.
MergedData = MergedData.dropna()

# Now, time to scatter
plt.scatter(MergedData['GDP per capita'], MergedData['Life expectancy at birth (historical)'])
```

```
<matplotlib.collections.PathCollection at 0x7f0f1610a760>
```

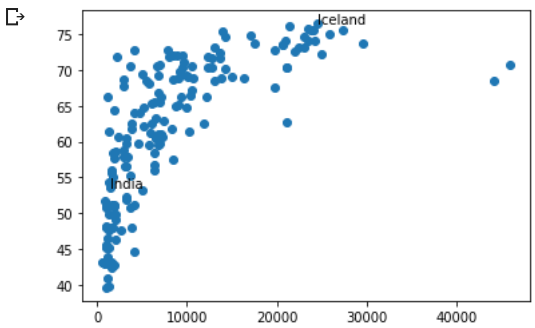


B

Task

Which countries have a life expectancy higher than one standard deviation above the mean?

```
# Now, time to scatter
plt.scatter(MergedData['GDP per capita'], MergedData['Life expectancy at birth (historical)'])

# Add labels to each dot
for j in range(len(MergedData)):
  if (MergedData['Entity'][j] == "Iceland")or (MergedData['Entity'][j] == "India"):
    plt.annotate(MergedData['Entity'][j], (MergedData['GDP per capita'][j], MergedData['Life expectancy at birth (historical)'
```



```
# Which countries have a life expectancy higher than one standard deviation above the mean?

# Calculate mean and standard deviation for 1980
lifeExpectedMean = LifeExpectData["Life expectancy at birth (historical)"].mean()
lifeExpectedStd = LifeExpectData["Life expectancy at birth (historical)"].std()

# Sort out countries above mean + standard deviation
HigherThanStdAboveMean = LifeExpectData[LifeExpectData ["Life expectancy at birth (historical)"] > (lifeExpectedMean + lifeExp

# Print values and countries
print ("Mean value:", lifeExpectedMean)
print ("Standard dev:", lifeExpectedStd)
print ("-----------List of countries -----------------")
print (HigherThanStdAboveMean)
```

```
Mean value: 62.760000000000005
Standard dev: 9.849707470524287
-----------List of countries -----------------
                     Entity Code  Year  Life expectancy at birth (historical)
473                 Andorra  AND  1980                                  76.8
690      Antigua and Barbuda  ATG  1980                                  73.2
1101               Australia  AUS  1980                                  74.6
1183                 Austria  AUT  1980                                  72.7
1797                 Belgium  BEL  1980                                  73.2
2013                 Bermuda  BMU  1980                                  73.5
3083                  Canada  CAN  1980                                  75.1
3909              Costa Rica  CRI  1980                                  72.9
4136                    Cuba  CUB  1980                                  72.8
4623                 Denmark  DNK  1980                                  74.1
5599          Faeroe Islands  FRO  1980                                  76.2
5900                 Finland  FIN  1980                                  73.6
6106                  France  FRA  1980                                  74.2
6547                 Germany  DEU  1980                                  73.1
6692               Gibraltar  GIB  1980                                  73.8
6779                  Greece  GRC  1980                                  74.6
7217                Guernsey  GGY  1980                                  75.2
7580   High-income countries  NaN  1980                                  72.9
7727               Hong Kong  HKG  1980                                  74.9
7989                 Iceland  ISL  1980                                  76.5
8515                  Israel  ISR  1980                                  73.7
8665                   Italy  ITA  1980                                  74.1
8897                   Japan  JPN  1980                                  76.1
10834                  Macao  MAC  1980                                  73.5
11966                 Monaco  MCO  1980                                  74.1
12859            Netherlands  NLD  1980                                  75.8
13005            New Zealand  NZL  1980                                  72.9
13522       Northern America  NaN  1980                                  73.8
13770                 Norway  NOR  1980                                  75.7
14734            Puerto Rico  PRI  1980                                  73.2
15769             San Marino  SMR  1980                                  76.0
17053                  Spain  ESP  1980                                  75.5
17548                 Sweden  SWE  1980                                  75.7
17694            Switzerland  CHE  1980                                  75.6
19259         United Kingdom  GBR  1980                                  73.6
19382          United States  USA  1980                                  73.7
19819                Vatican  VAT  1980                                  74.1
```

```
# What if we do the same on the merged data?

# Calculate mean and standard deviation for 1980
lifeExpectedMean = MergedData["Life expectancy at birth (historical)"].mean()
lifeExpectedStd = MergedData["Life expectancy at birth (historical)"].std()

# Sort out countries above mean + standard deviation
HigherThanStdAboveMean = MergedData[MergedData ["Life expectancy at birth (historical)"] > (lifeExpectedMean + lifeExpectedStd

# Print values and countries
print ("Mean value:", lifeExpectedMean)
print ("Standard dev:", lifeExpectedStd)
print ("-----------List of countries -----------------")
print (HigherThanStdAboveMean)
```

```
Mean value: 61.85000000000001
Standard dev: 10.16825023705827
-----------List of countries -----------------
             Entity  Life expectancy at birth (historical)  GDP per capita
6         Australia                                  74.6        22972.00
7           Austria                                  72.7        21932.00
13          Belgium                                  73.2        23060.00
24           Canada                                  75.1        25784.00
33       Costa Rica                                  72.9         7828.00
```

36	Cuba	72.8	4106.00
40	Denmark	74.1	24272.00
51	Finland	73.6	20640.00
52	France	74.2	23537.00
56	Germany	73.1	22497.00
58	Greece	74.6	14300.00
64	Hong Kong	74.9	17086.00
66	Iceland	76.5	24528.00
71	Ireland	72.5	13614.00
72	Israel	73.7	17508.00
73	Italy	74.1	20959.00
75	Japan	76.1	21404.00
88	Luxembourg	72.3	24951.00
93	Malta	72.1	8920.00
105	Netherlands	75.8	23438.00
106	New Zealand	72.9	19681.00
111	Norway	75.7	24031.00
121	Puerto Rico	73.2	13040.00
137	Spain	75.5	14008.00
139	Sweden	75.7	23809.00
140	Switzerland	75.6	27405.73
154	United Kingdom	73.6	20612.00
155	United States	73.7	29611.00

Comment

Here we note that when comparing the original dataset and the merged version, we get different mean and Standard deviation. In the lists we note that e.g Andorra is missing in the merged dataset. This is because it was not present in the GDP-dataset, so we get different results.

C

Task

Which countries have high life expectancy but have low GDP? (note: GDP and not GDP per capita in question c and d)

Motivate how you have chosen to define “high” and “low”.

Approach

For this we need to get a new dataset with GDP per country:

`gdp-world-regions-stacked-area.csv`

We will continue to look at 1980. We need to put names ("Entity") on the dots and perhaps sort them. We might want to remove the "bastards". If the graph is not clear enough, we might need to list the countries and evaluate.

Motivation for high and low

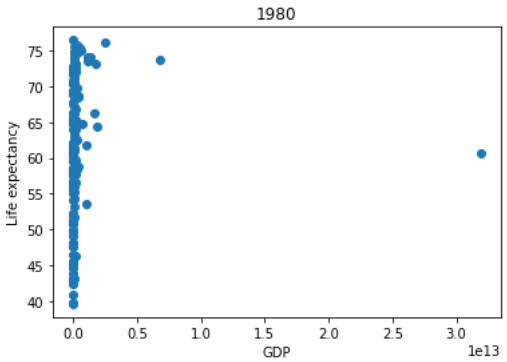
We start out with a visual approach, assuming that in the upper left quarter we will find interesting countries. Therefore, HIGH life expectancy is above 'mean' and LOW GDP is below 'mean'.

```
# ----- Task C -----
# Import the dataset

file_path_gdpDate = "/content/drive/MyDrive/test/gdp-world-regions-stacked-area.csv"
gdpData = pd.read_csv(file_path_gdpDate)



# We will get too much data. The scatter-plotting will be all blue, so we need to narrow down. We select 1980 only.
gdpData = gdpData[gdpData['Year'] == 1980]
LifeExpectData = LifeExpectData[LifeExpectData['Year'] == 1980]


# Now we need to merge the data-sets and remove what we do not need. We keep Entity (country), Life expectency and GDP.

MergedData = pd.merge(LifeExpectData[['Entity', 'Life expectancy at birth (historical)']], gdpData[['Entity', 'GDP']], on ='En

# Check that the data looks OK.
MergedData.head(5)
```

	Entity	Life expectancy at birth (historical)	GDP
0	Afghanistan	39.6	15329836000
1	Albania	70.5	9993753000
2	Algeria	53.3	94481650000
3	Angola	42.4	10330399000
4	Argentina	68.6	371076960000

```
# Adding some labels and a title to the graph
plt.xlabel('GDP')
plt.ylabel('Life expectancy')
plt.title('1980')


# In case we have rows where life expectation OR GDP is missing, we need to remove these.
MergedData = MergedData.dropna()

# Now, time to scatter
plt.scatter(MergedData['GDP'], MergedData['Life expectancy at birth (historical)'])
```

```
<matplotlib.collections.PathCollection at 0x7f0f1651ce80>
```



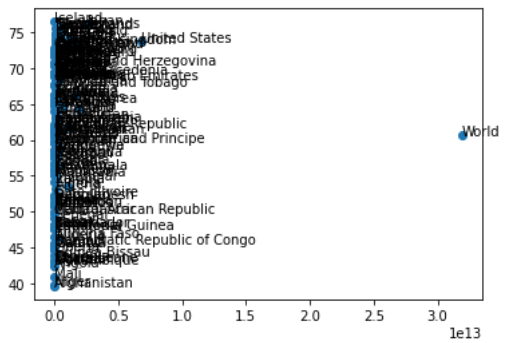
What we've learned so far

We need to put names ("Entity") on the dots and perhaps sort them.

We might want to remove the "bastards".

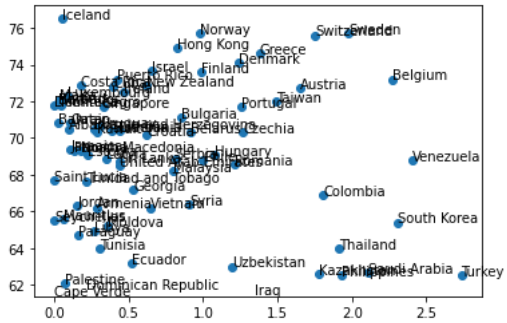
If the graph is not clear enough, we might need to list the countries and evaluate.

```
# Plot
plt.scatter(MergedData['GDP'], MergedData['Life expectancy at birth (historical)'])

# Add labels to each dot
for i in range(len(MergedData)):
    plt.annotate(MergedData['Entity'][i], (MergedData['GDP'][i], MergedData['Life expectancy at birth (historical)'][i]))
```



Now we have labels, and we see that e.g "World" will obscure our data. We might find other aggregated rows, but at this point, we leave it like this for now.

```
# Need to zoom in on the longest lives and lowest GDP. Focus in upper left (above and under mean)
MergedDataLongest = MergedData[MergedData['Life expectancy at birth (historical)'] >=  MergedData["Life expectancy at birth (h
MergedDataLowest = MergedDataLongest[MergedDataLongest['GDP'] <=  MergedDataLongest["GDP"].mean()]


# Plot
plt.scatter(MergedDataLowest['GDP'], MergedDataLowest['Life expectancy at birth (historical)'])

# Add labels to each dot
for j in range(len(MergedData)):
   plt.annotate(MergedData['Entity'][j], (MergedData['GDP'][j], MergedData['Life expectancy at birth (historical)'][j]))
```



Result

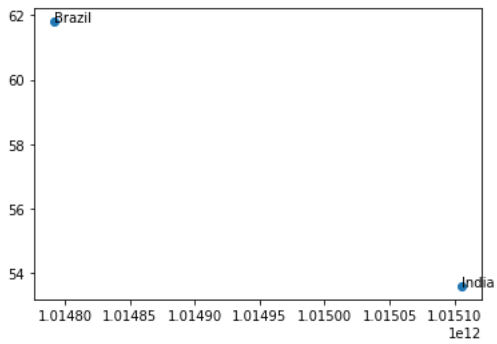
We can see that nordic countries, Hong Kong, Switzerland and other smaller countries are at the top in this graph. These are the countries with high life expectancy but have low GDP.

D

Task

Does every strong economy (normally indicated by GDP) have high life expectancy?

```
# Need to zoom in on the shortest lives and highest GDP. Focus in lower right.
MergedDataShortest = MergedData[MergedData['Life expectancy at birth (historical)'] <=  MergedData["Life expectancy at birth (
MergedDataHighest = MergedDataShortest[MergedDataShortest['GDP'] >=  MergedDataShortest["GDP"].mean()]

# Need to remove "World" from dataset
MergedDataHighest = MergedDataHighest.drop(MergedDataHighest[MergedDataHighest['Entity'].str.contains('World')].index)


# Plot
plt.scatter(MergedDataHighest['GDP'], MergedDataHighest['Life expectancy at birth (historical)'])

# Add labels to each dot
for j in range(len(MergedData)):
   plt.annotate(MergedData['Entity'][j], (MergedData['GDP'][j], MergedData['Life expectancy at birth (historical)'][j]))
```



Result

Interesting enough, we find India and Brazil having low life expectancy but high GDP, so we conclude:

It is not enough to have a strong economy to also have high life expectancy.

E

Task

Related to question d, what would happen if you use GDP per capita as an indicator of a strong economy?

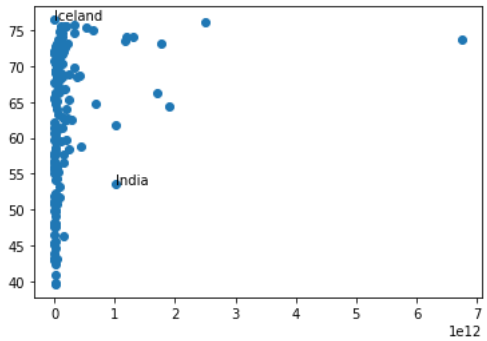
Explain the results you obtained, and discuss any insights you get from comparing the results of d and e.

Approach

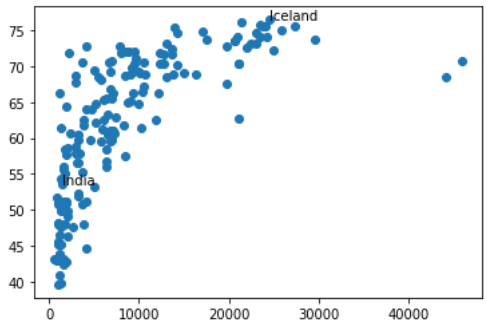
We compare two graphs (GDP ands GDP per capita) and note how Iceland and India are postitioned in relattion to all other countries in the two graphs

```
# Scatter data with GDP per country

# Get rid of "World"
```

```
MergedData = MergedData.drop(MergedData[MergedData['Entity'].str.contains('World')].index)

# Regenerate the index to avoid error after removing "World"
MergedData.reset_index(drop=True, inplace=True)


plt.scatter(MergedData['GDP'], MergedData['Life expectancy at birth (historical)'])

for j in range(len(MergedData)):
  if (MergedData['Entity'][j] == "Iceland")or (MergedData['Entity'][j] == "India"):
    plt.annotate(MergedData['Entity'][j], (MergedData['GDP'][j], MergedData['Life expectancy at birth (historical)'][j]))
```




```
# Scatter data with GDP per capita and per country

MergedDataGDPCapita = pd.merge(LifeExpectData[['Entity', 'Life expectancy at birth (historical)']], gdpDataCapita[['Entity', '
#MergedDataGDPCapita = MergedDataGDPCapita.drop(MergedDataGDPCapita[MergedDataGDPCapita['Entity'].str.contains('World')].index

plt.scatter(MergedDataGDPCapita['GDP per capita'], MergedDataGDPCapita['Life expectancy at birth (historical)'])

for j in range(len(MergedDataGDPCapita)):
  if (MergedDataGDPCapita['Entity'][j] == "Iceland")or (MergedDataGDPCapita['Entity'][j] == "India"):
    plt.annotate(MergedDataGDPCapita['Entity'][j], (MergedDataGDPCapita['GDP per capita'][j], MergedDataGDPCapita['Life expect
```



As expected, Iceland and India stay at the same hight (Life expectancy). We know that e.g Iceland has a very small population, thus it moves to the right when we use "pre capita". India got a big population, thus moves to the left. This shows us that using GDP per capita to illustrate if a country has a strong economy, is a pretty good indicator.

Comparing E and D

In E we could see that some countries had long life expectency, and that they where rather small in population. And we could see that some other countries, India and Brazil, had huge GDP, but rather low life expectancy. But it was not obvious if GDP could mean high life expectancy. In D, we understood that GDP per capita was a better indicator.

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