Assignment 1

1.

a)

Importing ourworldindata csv file

In [4]:
```
import pandas as pd

# https://ourworldindata.org/life-expectancy#life-expectancy-and-gdp
df = pd.read_csv('datasets\life-expectancy-vs-gdp-per-capita.csv')
df.columns
```

Out[4]:
```
Index(['Entity', 'Code', 'Year', 'Total population (Gapminder, HYDE & UN)',
       'Continent', 'Life expectancy',
       'Real GDP per capita in 2011US$, multiple benchmarks (Maddison Project Database (2018))'],
      dtype='object')
```

Cleaning and selecting data

We chose the year 2012 simply because we found it to not have a lot of missing data for GDP and life expectancy.

In [5]:
```
# Renaming the GDP per capita and total population columns for simplicity
df.rename(columns={'Real GDP per capita in 2011US$, multiple benchmarks (Maddison Project Database (2018))': 'GDP per capita', 'Total population (Gapminder, HYDE & UN)': 'Total population'}, inplace=True)

# Only selecting the rows where year is 2012
gdp2012 = df[df['Year'] == 2012]

# Creating dataframe with the relevant columns
gdp2012 = pd.DataFrame(gdp2012, columns=['Entity', 'Year', 'GDP per capita', 'Life expectancy', 'Total population'])

# Cleaning the data, removing NaN-values
gdp2012.dropna(subset=['GDP per capita'], inplace=True)
gdp2012.dropna(subset=['Life expectancy'], inplace=True)

# Removing non-countries
gdp2012 = gdp2012[gdp2012['Entity'] != 'World']
gdp2012 = gdp2012[gdp2012['Entity'] != 'Africa']

gdp2012
```

Out[5]:

	Entity	Year	GDP per capita	Life expectancy	Total population
213	Afghanistan	2012	1945.0	62.054	31161000.0
557	Albania	2012	10344.0	77.252	2914000.0
777	Algeria	2012	13242.0	75.436	37384000.0
1363	Angola	2012	8074.0	57.236	25108000.0
1874	Argentina	2012	19841.0	75.598	41755000.0
...	...	...	...	...	...
48669	Venezuela	2012	17752.0	73.037	29361000.0
48889	Vietnam	2012	4911.0	74.958	89802000.0
49767	Yemen	2012	3707.0	65.920	24473000.0
49990	Zambia	2012	3413.0	58.502	14465000.0
50211	Zimbabwe	2012	1623.0	55.032	13115000.0

166 rows × 5 columns

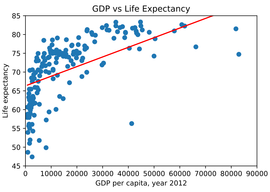
Plotting the data

We added a simple regression line with the help of numpy in order to make the correlation clearer.

The x and y limits were changed to make the graph clearer since one outlier (Qatar) made the graph hard to interpret.

In [6]:
```
import matplotlib.pyplot as plt
import numpy as np

x = gdp2012['GDP per capita']
y = gdp2012['Life expectancy']

# Creating scatterplot with custom x and y limits
plt.scatter(x, y)
plt.xlim(0, 90000) # Includes every country except for Qatar
plt.ylim(45, 85)

# Adding regression line
k, m = np.polyfit(x, y, 1)
plt.plot(x, k*x + m, color='red')

# Adding title and labels
plt.title('GDP vs Life Expectancy')
plt.xlabel('GDP per capita, year 2012')
plt.ylabel('Life expectancy')
```

Out[6]:
```
Text(0, 0.5, 'Life expectancy')
```



b)

There seems to be a correlation between GDP per capita and life expectancy, which seems reasonable since richer countries tends to have better access to e.g. healthcare.

c)

We removed all rows with missing data for either GDP or life expectancy since they were not useful. The rows for World and Africa were also removed since we only include countries in this and do not want these values to mess with e.g. the mean and standard deviation. When plotting the data, we also changed the x-limit in order to exclude Qatar since their extremely high GDP per capita made the graph hard to interpret.

d)

In [7]:
```
# Calculating the standard deviation and mean of the life expectancy
sd = np.std(gdp2012['Life expectancy'])
mean = np.mean(gdp2012['Life expectancy'])

# Selecting all the rows where the life expectancy is higher than one standard deviation above the mean
countries_above_one_sd = gdp2012[gdp2012['Life expectancy'] > (mean + sd)]

countries_above_one_sd
```

Out[7]:

	Entity	Year	GDP per capita	Life expectancy	Total population
2507	Australia	2012	44871.0	82.291	22904000.0
2727	Austria	2012	43052.0	80.906	8502000.0
4277	Belgium	2012	38907.0	80.444	11085000.0
7569	Canada	2012	41615.0	81.674	34922000.0
10717	Cyprus	2012	27174.0	79.812	1135000.0
11472	Denmark	2012	43697.0	79.958	5611000.0
14757	Finland	2012	38865.0	80.586	5415000.0
15710	France	2012	36773.0	81.852	63564000.0
16736	Germany	2012	43198.0	80.391	80973000.0
17247	Greece	2012	23898.0	80.963	10781000.0
19222	Hong Kong	2012	44716.0	83.329	7047000.0
19662	Iceland	2012	37721.0	82.095	326000.0
20771	Ireland	2012	48120.0	80.593	4608000.0
21062	Israel	2012	29852.0	81.833	7615000.0
21292	Italy	2012	35142.0	82.298	59879000.0
21740	Japan	2012	35143.0	83.283	128424000.0
25280	Luxembourg	2012	57873.0	80.955	531000.0
26670	Malta	2012	24000.0	81.314	422000.0
30610	Netherlands	2012	45412.0	81.212	16792000.0
30901	New Zealand	2012	31720.0	81.233	4468000.0
32555	Norway	2012	81826.0	81.512	5014000.0
35763	Portugal	2012	25743.0	80.513	10526000.0
39708	Singapore	2012	61905.0	82.254	5369000.0
40218	Slovenia	2012	26022.0	80.001	2058000.0
41194	South Korea	2012	32485.0	81.137	50061000.0
41645	Spain	2012	31491.0	82.384	47063000.0
43026	Sweden	2012	42579.0	81.834	9543000.0
43247	Switzerland	2012	60777.0	82.626	8008000.0
47274	United Kingdom	2012	35784.0	80.739	64525000.0

e)

In [8]:
```
# Calculating the standard deviation of life expectancy
sd_life = np.std(gdp2012['Life expectancy'])

# Calculating the mean of GDP and life expectancy
mean_life = np.mean(gdp2012['Life expectancy'])
mean_gdp = np.mean(gdp2012['GDP per capita'])

# We count all values above this value as having a high life expectancy
high_life = mean_life + (sd_life / 2)

# Selecting the rows where life expectancy is above high_life and GDP is below the mean
results = gdp2012[gdp2012['Life expectancy'] > high_life]
results = results[results['GDP per capita'] < mean_gdp]

results
```

Out[8]:

	Entity	Year	GDP per capita	Life expectancy	Total population
557	Albania	2012	10344.0	77.252	2914000.0
777	Algeria	2012	13242.0	75.436	37384000.0
3829	Barbados	2012	10475.0	78.547	284000.0
5517	Bosnia and Herzegovina	2012	9388.0	76.401	3605000.0
9033	Colombia	2012	12078.0	75.882	46076000.0
9763	Costa Rica	2012	12397.0	79.074	4688000.0
10427	Cuba	2012	7138.0	78.446	11257000.0
12496	Ecuador	2012	10342.0	75.495	15474000.0
23960	Lebanon	2012	15903.0	78.611	5538000.0
28999	Montenegro	2012	15709.0	75.823	626000.0
41865	Sri Lanka	2012	9588.0	75.796	20533000.0
45519	Tunisia	2012	10749.0	75.376	10847000.0

f)

In [9]:
```
# Add column for total GDP to gdp2012 dataframe
total_gdp = gdp2012['GDP per capita'] * gdp2012['Total population']
gdp2012['Total GDP'] = total_gdp

# Calculating the mean of total GDP and life expectancy
mean_life = np.mean(gdp2012['Life expectancy'])
mean_total_gdp = np.mean(gdp2012['Total GDP'])

# Selecting the rows where total gdp is higher than the mean and life expectancy is below the mean
results = gdp2012[gdp2012['Total GDP'] > mean_total_gdp]
results = results[results['Life expectancy'] < mean_life]

results
```

Out[9]:

	Entity	Year	GDP per capita	Life expectancy	Total population	Total GDP
12724	Egypt	2012	10736.0	70.736	8.642200e+07	9.278266e+11
19886	India	2012	4974.0	67.545	1.265780e+09	6.295990e+12
20106	Indonesia	2012	9144.0	69.866	2.484520e+08	2.271845e+12
31561	Nigeria	2012	5370.0	51.786	1.672290e+08	8.980197e+11
33118	Pakistan	2012	4568.0	65.849	1.872800e+08	8.554950e+11
36564	Russia	2012	23827.0	69.944	1.439940e+08	3.430945e+12
40973	South Africa	2012	11880.0	60.060	5.283300e+07	6.276560e+11

These countries listed in the table above all have high GDP (can be indicated as a strong economy) and low life expectancy. This means that not every strong economy (or at least high GDP) have high life expectancy. This might be due to their high total population or money not being fairly distributed. If you have a large population it does not matter that your GDP is higher than other smaller countries since it will be spread across more people.

g)

In [10]:
```
# Calculating the mean of total GDP and life expectancy
mean_life = np.mean(gdp2012['Life expectancy'])
mean_gdp = np.mean(gdp2012['GDP per capita'])

# Selecting the rows where gdp per capita is higher than the mean and life expectancy is below the mean
results = gdp2012[gdp2012['GDP per capita'] > mean_gdp]
results = results[results['Life expectancy'] < mean_life]

results
```

Out[10]:

	Entity	Year	GDP per capita	Life expectancy	Total population	Total GDP
13164	Equatorial Guinea	2012	41292.0	56.288	1031000.0	4.257205e+10
22182	Kazakhstan	2012	21947.0	68.805	16752000.0	3.676561e+11
36564	Russia	2012	23827.0	69.944	143994000.0	3.430945e+12

Now we only get three results, with only Russia being in both. Since the population size does not matter here, these countries low life expectancy might be explained by money not being fairly distributed and general bad healthcare for the majority of citizens. There only being three countries in this list indicates that there are very few countries that have high GDP per capita and low life expectancy. With other words, being a rich country does in almost all cases mean that your citizens will live long.

2

a)