Introduction to programming, Lesson 6: matplotlib

matplotlib is probably the single most used Python package for 2D-graphics. It provides both a very quick way to visualize data from Python and publication-quality figures in many formats.

1. Let us start with an example of a pie chart drawn with pyplot.

```python
import matplotlib.pyplot as plt
import numpy as np
plt.figure(figsize=(6,6))
labels = 'Vegetarian', 'Fish', 'Meat', 'Grill'
fracs = np.array([15,30,45, 10])
plt.pie(fracs, labels=labels, autopct='%1.1f%%')
plt.title('Meal choices at the ENS cantine')
plt.savefig("meals.png")
plt.show()
```

2. **Pyramid of ages:** Draw a pie chart of female and male age groups in department 14 (Calvados).

![Pie chart of meal choices at the ENS cantine](meals.png)

3. Here is an example of a bar chart for programming language usage.

```python
import matplotlib.pyplot as plt
import numpy as np

languages = np.array(['Python', 'C++', 'Java', 'Perl', 'Scala', 'Lisp'])
number_of_users = np.array([10, 8, 6, 4, 2, 1])
plt.title('Programming language usage')
x_pos = np.linspace(1, len(languages), len(languages))  #Return a numpy array [1, 2, …, len(languages)]
bc = plt.bar(x_pos - 0.4, number_of_users, color = 'b')
plt.xticks(x_pos, languages)  #label the ticks on the x-axis
plt.ylabel('Usage')
plt.savefig('programming_languages.png')
plt.show()
```

4. **Pyramid of ages:** Your task is to draw a bar chart of male and female populations by ages. To add a legend to your graph, use `plt.legend((bc_men[0], bc_women[0]), ('Men', 'Women'))`.
5. Here is an example of drawing the graph of a line.

```python
import matplotlib.pyplot as plt
import numpy as np

""Each graph consists of a collection of (x, y) points. The array X contains the x-coordinates of the points, and the array y contains the y-coordinates of the points (in the same order)."

X = np.linspace(0, 10, 10)
Y = np.linspace(20, 40, 10)
plt.plot(X, Y, color = "green", linewidth = 1.0, linestyle = "--", label = "line")
plt.xlim(0, 10) #set x limits
plt.xticks(np.linspace(0, 10, 6, endpoint = True)) #set x ticks
plt.xlabel('x') #label of the x-axis
plt.ylim(15, 45) #set y limits
plt.yticks(np.linspace(15, 45, 7, endpoint = True)) #set y ticks
plt.ylabel('y')
plt.legend(loc = 'upper left', frameon = False) #label of the graph
plt.savefig('graph.png')
plt.show()
```

6. **Carbon dioxide levels**: Mauna Loa Observatory (MLO) is a premier atmospheric research facility that has been continuously monitoring and collecting data related to atmospheric change since the 1950's. Our task will be to draw a graph of average carbon dioxide levels from 1951 to 2017.

   Download co2-annmean-mlo.csv
   Create a function that parses this data into two numpy arrays, years and co2_level
   Draw a graph following Exercise 5.