Exercises – Week 5. Data Structures

Getting Started: Pycharm IDE

Open PyCharm on linux lab computers

- Scroll down to bring up log in screen and log in with your UoB user name and password.

- Click activities (top left corner) to bring up the side panel.

- Click the grid of 9 dots to bring up applications.

- Choose JetBrains PyCharm

- When prompted about the user agreement click accept and read

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Create a new project and Python file

- Click New project or File >> New project >> Pure python

- Unselect 'Create a main.py welcome script'

- Note the file location:
  /home/**UoB_username**/PycharmProjects/**your_projectname**/venv
  where **UoB_username** is your UoB username and rename **your_projectname** to be a name of your choice e.g. EMAT10007_exercises

- Right click on the folder icon with project name next to it (top left of window).

- Choose new >> python file

- Give your file a name e.g. week_1_exercises.py

Write and run code

Type some code and click the green play arrow at the top to run.

Save your project

File >> Save all to save your wor

Open a project you created previously

Click File >> Open >> /home/**UoB_username**/PycharmProjects/**your_projectname**/venv, Open >> New window

Rules for naming variables

- Variable names may contain letters or numbers

- Variable names must begin with a letter

- Variable names are case sensitive (`time` is not the same as `Time`)

- Some `keywords` are reserved by the Python language and cannot be used as variable names. For a full list of keywords reserved by Python, enter the following run the following comand in the editor you are using:

  `help("keywords")`

- Use a consistent naming convention:

  - `snake_case`: lower case letters, words separated by underscore (_)
  - `camel_Case`: first letter of each word capitalised, excluding first word
  - `Pascal_Case`: first letter of each word capitalised

Exercise 1 - Lists

1. Make two lists containing the values `[1,2]` and `[3,4]`.
2. Change the value 1 to the value 5.
3. Make a nested list that contains both lists.
4. Use two loops to print out all the values in the nested list (2x2 matrix) one by one.
5. Write a program that asks the user to input 5 words (strings) and then creates a list containing each word. Print the list. Print the number of characters in the last word.

Exercise 2 - List operations

1. Create a list called `colours` that stores the colours red, green, and blue. What is the result of `3 * colours`?
2. Create the list of Booleans such as `L = [True, True, False]`. What is the result of `all(L)`? What is the result of `any(L)`? Now consider the list `L = [4, 7, -3, 5, 1, 8]`. Write a program that determines whether any element of `L` is negative.
3. Using list comprehension, create lists of the following between 0 and 100:
   - odd numbers
   - multiples of 3
   - prime numbers (NB: this is quite tricky)

   The answers to the last part is [2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97].

Planet	Diameter (km)	Mass	Rotation period
Mercury	4,878	0.06	58.65 (d)
Venus	12,100	0.82	243 (d)
Earth	12,756	1.00	23.934 (h)
Mars	6,794	0.11	24.623 (h)
Jupiter	142,800	317.89	9.842 (h)
Saturn	120,000	95.17	10.233 (h)
Uranus	52,400	14.56	16 (h)
Neptune	48,400	17.24	18 (h)
Pluto	2,445	0.002	6.39 (d)

Table 1: Planet data taken from: https://www.rmg.co.uk/stories/topics/solar-system-data

Exercise 3 - Tuples and dictionaries

1. Make a tuple named `fondue_ingredient` containing the values "gruyere" and "vacherin".
2. Print all the items in the tuple.
3. Change the value "gruyere" to the value "cheddar". Does it work? Why?
4. Consider the colours red, blue, green, black, and white. Their RBG values are (1,0,0), (0,1,0), (0,0,1), (0,0,0), (1,1,1), respectively. Create a dictionary called `colours` that stores the name of the colours as keys and the RGB values as values.
5. Using the `colours` dictionary, run the following code

```
for v in colours:
    print(v)
```

   Are the keys or values printed to the screen? Now try running the code

```
for v in colours.values():
    print(v)
```

   What happens in this case?

Exercise 4 - Modelling using data structures

Table 1 shows some data about the planets in our solar system. The mass of each planet is shown as a factor which when multiplied by the mass of Earth gives the actual mass of the planet in kg. The mass of Earth can be estimated as 5.9722×10^{24} kg. The rotation period is given in units of days (d) or hours (h).

1. Write a program that identifies and outputs the names and rotation periods of planets with a rotation period shorter than Earth's.

Exercise 5 - Sorting lists

1. Write a programme that sorts a list of numbers so that the numbers are in ascending order. Do not use the `sort` method or the `sorted` function to do this.