Operations Research
03. Scientific Python Refresher

Learning Resources

- David Beazley*
  - Beazley (2009, 2022); Beazley and Jones (2013)
  - Online Courses
    * Practical Python Programming
    * Advanced Python Mastery
- Cheat Sheets
  - Python Cheat Sheet
  - Scientific Python Cheatsheet
  - "Python for Data Science" Cheat Sheet: NumPy Basics
  - Comprehensive Python Cheat Sheet
  - Sebastian Raschka*: Matrix Cheatsheet
  - Eric Mattes: Cheat Sheets
  - The Best Python Cheat Sheet
- A Reddit pointer for best books on (project-based) Python

Example. In each of the followings, write an oneliner of `Python` to complete the task.

1. `l = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h']` $\Longrightarrow$ `ll = ['b', 'd', 'f', 'h']`
2. `l = [1, 2, 3, 4, 5]` $\Longrightarrow$ `ll = [1, 4, 9, 16, 25]`
3. `l = [2, 5, 5, -1, -1, -1]` $\Longrightarrow$ `ll = [2, 5, -1]`
4. `l = [1, 2, 3], ll = ['A', 'B', 'C']` $\Longrightarrow$ `L = [(1, 'A', 1), (2, 'B', 2), (3, 'C', 3)]`
5. `l = [(1, 2), (2, -2), (5, -3), (-20, 40)]` $\Longrightarrow$ `ll = [(-20, 40), (1, 2), (5, -3), (2, -2)]`

Solution.

(a) `ll = l[1::2]`

(b) `ll = [i**2 for i in l]`

(c) `ll = list(set(l))`

(d) `L = list(zip(l, ll, l))`

(e) `ll = sorted(l, key=lambda x: sum(x), reverse=True)`

Example. Write a `Python` function `mymin(l)` to return the least element of `l`, e.g. `mymin([2, 7, 4, 2]) = 2`, `mymin([-1, 2, -5, 4, 3]) = -5`.

Solution. Without using the built-in `min` function,

```
def mymin(l):
    a = l[0]
    for i in l[1:]:
        if i <= a:
            a = i
    return a
```

Example. Write a `Python` function `mysqrt(a)` to compute the square root of `a`, e.g.
`mysqrt(2) = 1.4142135623730951`,
`mysqrt(3) = 1.7320508075688772`.

Solution. Using Newton's method:

- Find the root of $f(x) = x^2 - a = 0$; update the n-th iteration by

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

- ```
  def mysqrt(a):
      x = a
      for i in range(100):
          x -= (x ** 2 - a) / (2 * x)
      return x
  ```
  ```

References

Beazley, D., 2009. Python: Essential Reference. 4th ed., Addison-Wesley, Upper Saddle River, NJ.

Beazley, D., 2022. Python Distilled. Addison-Wesley, Boston.

Beazley, D., Jones, B., 2013. Python Cookbook. 3rd ed., O'Reilly Media, Sebastopol, CA.