Advanced Python

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Reference

- Wes McKinney, **Python for Data Analysis**: Data Wrangling with Pandas, NumPy, and IPython, O'Reilly Media, 2nd Edition, 2018.
  - Material: https://github.com/wesm/pydata-book

Outline

3.1 Data Structures and Sequences

3.2 Functions

3.3 Files and the Operating System

Outline

3.1 Data Structures and Sequences

3.2 Functions

3.3 Files and the Operating System

- Tuple
- List
- Sequence Functions
- Dict

Tuple

- A tuple is a fixed-length, **immutable sequence** of Python objects.
- How to **convert objects to tuples**?
- What are the functions of operators **+** and ***** on tuples?
- **Swapping**: What is Python way to swap two vars?

```
In [5]: tuple([4, 0, 2])
Out[5]: (4, 0, 2)

In [6]: tup = tuple('string')
In [7]: tup
Out[7]: ('s', 't', 'r', 'i', 'n', 'g')

In [13]: (4, None, 'foo') + ('bar',)
Out[13]: (4, None, 'foo', 'bar')

In [24]: b, a = a, b
```

List

- List are **ordered** and **mutable**.
- How to **convert objects to lists**?
- What is the difference between `.append()` and `.insert()`?

```
In [37]: tup = ('foo', 'bar')
In [38]: b_list = list(tup)
In [39]: b_list
Out[39]: ['foo', 'bar']

In [44]: list(range(0, 7))
Out[44]: [0, 1, 2, 3, 4, 5, 6]

In [45]: b_list.append('baz')
In [47]: b_list.insert(1, 'red')
In [48]: b_list
Out[48]: ['foo', 'red', 'bar', 'baz']
```

List – Add and remove

- What is the difference between `.pop()` and `.remove()`?
- What is the difference between `.append()` and `.extend()`?

```
In [48]: b_list
Out[48]: ['foo', 'red', 'bar', 'baz']

In [49]: b_list.pop(0)
Out[49]: 'foo'

In [53]: b_list.remove('red')
In [54]: b_list
Out[54]: ['bar', 'baz']

In [59]: b_list.extend([7, 8])
In [60]: b_list
Out[60]: ['bar', 'baz', 7, 8]
```

List – Sort

- You can sort lists using `.sort()` and `sorted()`. What is the difference?

```
In [61]: a = [7, 2, 5, 1, 3]
In [62]: sorted(a)
Out[62]: [1, 2, 3, 5, 7]
In [63]: a
Out[63]: [7, 2, 5, 1, 3]

In [64]: a.sort()
In [65]: a
Out[65]: [1, 2, 3, 5, 7]
```

Syntax:

```
list.sort(reverse=True|False, key=myFunc)
```

Built-in Sequence Functions

- What does each of the following functions do?
- `enumerate()`
- `zip()`
- `reversed()`
  - What is the difference between `sorted(reverse=True)` and `reversed()`?

```
l1 = ['foo', 'bar', 'baz']
l2 = ['one', 'two', 'three']
for i, (a, b) in enumerate(zip(l1, l2)):
    print('{0}: {1}, {2}'.format(i, a, b))
0: foo, one
1: bar, two
2: baz, three
```

```
list(reversed(range(10)))
[9, 8, 7, 6, 5, 4, 3, 2, 1, 0]
```

Dictionary

- **Hash map** or **associative array** between **key-value** pairs.

- What is the difference between `.pop()` and `del`?

```
d1 = {'a' : 1, 'b' : 2}
d1['c'] = 's'
d1
{'a' : 1, 'b' : 2, 'c' : 's'}

del d1['a']
ret = d1.pop('c')
ret
's'
d1
{'b' : 2}
```

Dictionary Methods

- Creating a dictionary

```
mapping = {}
for key, value in zip(k_l, v_l):
    mapping[key] = value
```

- .update()
- .get()
- .keys()
- .values()
- .items()

```
d1.update({'b' : 11, 'c' : 12})
```

```
value = d.get(key, default_value)
```

```
for key, value in d.items():
    mapping[key] = value
```

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3.1 Data Structures and Sequences

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3.3 Files and the Operating System

- Namespaces, Scope, and Local Functions
- Returning Multiple Values
- Functions Are Objects
- Anonymous (Lambda) Functions
- Currying: Partial Argument Application
- Generators

Namespaces, Scope, and Local Functions

- Functions can access variables in two different scopes: **global** and **local**.
- Variables that are **assigned within** a function by default are assigned to the **local namespace**.
- What happens to **a** after the calling `func()`?

```
def func():
    a = []
    a.append(1)
            ### ### ###
a = []
def func():
    a.append(1)
            ### ### ###
def func():
    global a
    a = []
    a.append(1)
```

Returning Multiple Values

- How to return **multiple values** from a function?

- What do you think about this **alternative**?

```
def f():
    a = 5
    b = 6
    c = 7
    return a, b, c

a, b, c = f()
      ### ### ###
def f():
    a = 5
    b = 6
    return {'a' : a, 'b' : b}
```

Functions Are Objects

- Since Python functions are objects, you can:
  - **Put them** in lists
  - **Iterate** on them

```
string = '...'
func_list = [f1, f2, f3]
for func in func_list:
     string = func(string)
```

  - Use them as **arguments to other functions**

```
for x in map(f1, iter):
    print(x)
```

Anonymous (Lambda) Functions

- Writing functions consisting of a **single statement**
- How to **sort** a collection of strings by the **number of distinct letters** in each string?

```
def short_function(x):
    return x * 2
```

```
equiv_anon = lambda x: x * 2
```

```
strings.sort(key=lambda x:
    len(set(list(x))))
```

```
strings = ['card', 'aaaa', 'abab']

['aaaa', 'abab', 'card']
```

Currying: Partial Argument Application

- Currying is deriving new functions from existing ones.
- In Python, use **partial()**

```
def add_numbers(x, y):
    return x + y

from functools import partial
add_five = partial(add_numbers, 5)
add_five(4)
9
```

Generators

- Use **iter()** to create an iterable object.

```
some_dict = {'a': 1, 'b': 2, 'c': 3}

dict_iterator = iter(some_dict)

next(dict_iterator)
'a'

list(dict_iterator)
['b', 'c']
```

itertools module

Table 3-2. Some useful itertools functions

Function	Description
combinations(iterable, k)	Generates a sequence of all possible k-tuples of elements in the iterable, ignoring order and without replacement (see also the companion function combinations_with_replacement)
permutations(iterable, k)	Generates a sequence of all possible k-tuples of elements in the iterable, respecting order
groupby(iterable[, keyfunc])	Generates (key, sub-iterator) for each unique key
product(*iterables, repeat=1)	Generates the Cartesian product of the input iterables as tuples, similar to a nested for loop

```
list(itertools.combinations(['a','b','c'], 2))
[('a', 'b'), ('a', 'c'), ('b', 'c')]
```

itertools module

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`product(*iterables, repeat=1)`	Generates the Cartesian product of the input iterables as tuples, similar to a nested `for` loop

```
list(itertools.permutations(['a','b','c'], 2))
[('a', 'b'), ('a', 'c'), ('b', 'a'), ('b', 'c'), ('c', 'a'), ('c', 'b')]
```

`itertools` module

- **Group** the following list by the **first letter**.

```
names = ['Alan', 'Adam', 'Wes', 'Will', 'Albert', 'Steven']
import itertools
first_letter = lambda x: x[0]
names.sort(key=first_letter)
for letter, n in itertools.groupby(names, first_letter):
    print(letter, list(n)) # n is a generator
A ['Alan', 'Adam', 'Albert']
S ['Steven']
W ['Wes', 'Will']
```

itertools module

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groupby(iterable[, keyfunc])	Generates (key, sub-iterator) for each unique key
product(*iterables, repeat=1)	Generates the Cartesian product of the input iterables as tuples, similar to a nested for loop

```
list(itertools.product([1, 2], ['a', 'b']))
[(1, 'a'), (1, 'b'), (2, 'a'), (2, 'b')]
```

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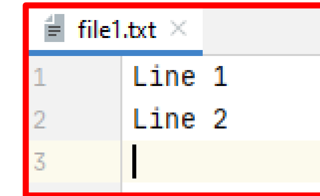
Python File Support

- The built-in **open** function supports opening a file for reading or writing.
- You can **iterate** on the file handle.




```
path = 'folder\\file1.txt' # or /
f = open(path)  # read default mode
for line in f:
    # remove right white space
    line = line.rstrip()
    print(line)
f.close()

Line 1
Line 2
```

- **Alternative syntax**

```
with open(path) as f:
    for line in f:
        print(line.rstrip())
```

Python File Modes

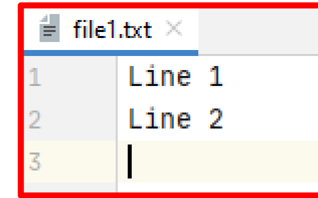
Mode	Description
r	Read-only mode
w	Write-only mode; creates a new file (erasing the data for any file with the same name)
x	Write-only mode; creates a new file, but fails if the file path already exists
a	Append to existing file (create the file if it does not already exist)
r+	Read and write
b	Add to mode for binary files (i.e., 'rb' or 'wb')
t	Text mode for files (automatically decoding bytes to Unicode). This is the default if not specified. Add t to other modes to use this (i.e., 'rt' or 'xt')

The default is text mode and utf-8 encoding.

Python File Support

- How to read a file into a **list of strings**?

- Use **read**, **tell**, and **seek** to control the reading process.




```python
with open(path) as f:
    lines = [x.rstrip() for x in f]
```

```
>>> print(f.read(3))
Lin
>>> f.tell()
3
>>> f.seek(8)
8
>>> print(f.read(6))
Line 2
```

Important Python File Methods or Attributes

Method	Description
`read([size])`	Return data from file as a string, with optional `size` argument indicating the number of bytes to read
`readlines([size])`	Return list of lines in the file, with optional `size` argument
`write(str)`	Write passed string to file
`writelines(strings)`	Write passed sequence of strings to the file
`close()`	Close the handle
`flush()`	Flush the internal I/O buffer to disk
`seek(pos)`	Move to indicated file position (integer)
`tell()`	Return current file position as integer
`closed`	`True` if the file is closed

Writing to Files

- How to copy a text file skipping empty lines?

```
with open('tmp.txt', 'w') as handle:
    handle.writelines(x for x in open(path) if len(x) > 1)
```

Homework

- Solve the homework on **Advanced Python Programming**

Summary

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