The Python Standard Library

Useful modules for quick implementations

Isn’t Python alone powerful enough, you poser ?

- Tons of standard modules included in the base Python installation
- You can use them on training websites and during contests
- Many tools implementing commonly functions commonly used in competitive programming

Hold on, there's a fuckton of them, which ones should I try ?

Da smol ones

- copy : hard copy an object
- pprint : print, but prettier
- fractions : fractions
- heapq : Implementation of a priority queue
- json : you guessed it
- base64 : base64
- functools : magic functions
- bisect : Array bisection algorithm

But wait, there's more !

Da big ones

- itertools : operations on iterators, generate combinations...
- math : math
- re : Regular expressions for pattern matching
- string : string stuff
- collections : data structures

Copy : copy, like... for real

When you don’t want to copy the pointer but the real object...

Can be useful !

```
copy.copy(x)              # Shallow (pointer) copy
copy.deepcopy(x[, memo])  # Deep (object) copy
```

Pprint, because apes hate debuggers


```
>>> from pprint import pprint
>>> print(matrix)
[[1, 2, 3, 4, 5], [1, 2, 3, 4, 5], [1, 2, 3, 4, 5], [1, 2, 3, 4, 5], [1, 2, 3, 4, 5]]
>>> pprint(matrix)
[[1, 2, 3, 4, 5],
 [1, 2, 3, 4, 5],
 [1, 2, 3, 4, 5],
 [1, 2, 3, 4, 5],
 [1, 2, 3, 4, 5]]
```

Fractions : fractions

- Some problems may need to use fractions, and it's a pain in the ass to reimplement
- Once again, the PSL has a solution !

```
>>> Fraction(2,6) - Fraction(1,12)
Fraction(1, 4)
>>> Fraction(2,6) * Fraction(1,12)
Fraction(1, 36)
```

Heapq : a priority queue

Will be essential for Dijkstra's Algorithm ʒ(¯▭¯ʒ)

```
from heapq import *

list = [5, 2, 4, 1, 3, 2]
heapify(list)

print(heappop(list))
heappush(list, 5)
print(heappop(list))
print(list)
```

Json : load/encode easily json objects

- Transform back and forth json files
- An easy way to store arrays/dicts

```
import json
with open("object.json", "w") as f:
   f.write(json.dumps([ 'foo', {'bar': ('baz', None,
1.0, 2)}]))

with open("object.json", "r") as f:
   a = f.readline()
   print(a)
   print(json.loads(a))
```

Base64 : encode and decode raw bytes

Ever seen those sequences with `=` at the end ? That's base64

```
import base64
a = base64.b64encode(b"Lalalala")
print(a)
print(base64.b64decode(a))
```

Bisect : array binary search

Who said you have to implement your own binary search algorithm ?

Given a sorted list, get the position of an element to be inserted

```
from bisect import bisect_left

data = [6, 4, 2, 7, 2, 8, 9]
data.sort()
print(data)
print(a := bisect_left(data, 5))
data.insert(a, 5)
print(data)
```

Functools, cached functions

```
@lru_cache(maxsize=500)  # @cache en 3.9
def factorial(n):
    return n*factorial(n-1) if n else 0
```

- Cache the result of functions
- Automatic memoization
- Results still have to be proven...

Itertools (not gonna lie, it’s mainly for brute-forcing)

Main goal: to create effectives iterators for you to work on

Itertools is optimized for the creation of iterators

Will allow you to gain time if you know what you are looking for

Really useful to exploring basic combinatorics spaces

Itertools (you are not going to count to infinity, are you ?)

Infinite iterators:

Iterator	Arguments	Results	Example
`count()`	start, [step]	start, start+step, start+2*step, …	`count(10) --> 10 11 12 13 14 ...`
`cycle()`	p	p0, p1, … plast, p0, p1, …	`cycle('ABCD') --> A B C D A B C D ...`
`repeat()`	elem [,n]	elem, elem, elem, … endlessly or up to n times	`repeat(10, 3) --> 10 10 10`

stop counting

Itertools (who knows... it might be useful)

Iterator	Arguments	Results	Example
`accumulate()`	p [,func]	p0, p0+p1, p0+p1+p2, ...	`accumulate([1,2,3,4,5]) --> 1 3 6 10 15`
`compress()`	data, selectors	(d[0] if s[0]), (d[1] if s[1]), ...	`compress('ABCDEF', [1,0,1,0,1,1]) --> A C E F`
`dropwhile()`	pred, seq	seq[n], seq[n+1], starting when pred fails	`dropwhile(lambda x: x<5, [1,4,6,4,1]) --> 6 4 1`
`filterfalse()`	pred, seq	elements of seq where pred(elem) is false	`filterfalse(lambda x: x%2, range(10)) --> 0 2 4 6 8`
`takewhile()`	pred, seq	seq[0], seq[1], until pred fails	`takewhile(lambda x: x<5, [1,4,6,4,1]) --> 1 4`

Itertools (try doing that on $O(n^3)$)

Combinatoric iterators:

Iterator	Arguments	Results
`product()`	p, q, … [repeat=1]	cartesian product, equivalent to a nested for-loop
`permutations()`	p[, r]	r-length tuples, all possible orderings, no repeated elements
`combinations()`	p, r	r-length tuples, in sorted order, no repeated elements
`combinations_with_replacement()`	p, r	r-length tuples, in sorted order, with repeated elements

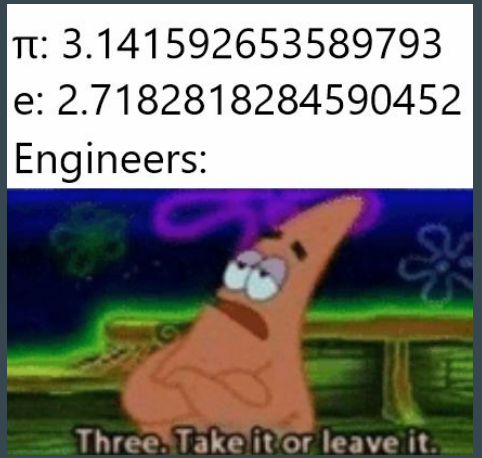
Examples	Results
`product('ABCD', repeat=2)`	`AA AB AC AD BA BB BC BD CA CB CC CD DA DB DC DD`
`permutations('ABCD', 2)`	`AB AC AD BA BC BD CA CB CD DA DB DC`
`combinations('ABCD', 2)`	`AB AC AD BC BD CD`
`combinations_with_replacement('ABCD', 2)`	`AA AB AC AD BB BC BD CC CD DD`

Math, Some situational Functions...

- math.**comb**(*n*, *k*)
- math.**factorial**(*x*) Deprecated since version 3.9
- math.**gcd**(**integers*) only two arguments were supported before 3.9
- math.**trunc**(*x*)
- math.**exp**(*x*)
- math.**log**(*x*[, *base*])
- math.**pow**(*x*, *y*)
- math.**cos**(*x*)
- math.**dist**(*p*, *q*)
- math.**degrees**(*x*)

...and some Constants

- math.**pi**
- math.**e**
- Math.**inf** equivalent to float('inf')



Collections : data structures, containers

- Deque : implementation of a 2-ended-queue

  Can be a stack, as well as a queue : append left, right, push left, right

```
from collections import deque
a = deque([1, 3])
a.append(5)  # Append right
a.appendleft(2)
print(a.pop())  # Pop right
print(a.popleft())
print(a.popleft())
print(a)
```

Collections : Counter

Count occurences in lists

Many easy exercises are based on counting => Cheese them !

```
from collections import Counter
l = [2, 2, 1, 5, 2, 5, 1, 1]
print(Counter(l))
print(Counter(l).most_common())
```

Collections : defaultdict

Dicts with elements initialized as a list, an object...

```
from collections import defaultdict
d = defaultdict(list)
d[1].append(2)
print(d.items())
```

String, if the built-in strings aren't cool enough for you

- Useful constants : `string.ascii_letters, string.punctuation`
- Lots of formatting options ! *(however consider using* fstring *over* .format() *in Python 3.6+)*
- Template strings
- Offers more options than the built-in *my_string.format(...)*

Re : regular expressions and pattern matching

Regex are dreaded, for good reasons. Though, they can be useful !

```
from re import match, findall
print(match("^[0-9]{2}$", "12"))
print(findall("[0-9]{2}", "0901023"))
```

(Le coffre au trésor)