# Python 3 Cheat Sheet

*Latest version on :*
*https://perso.limsi.fr/pointal/python:memento*

## Base Types

*integer, float, boolean, string, bytes*

```
int 783  0 -192  0b010  0o642  0xF3
          zero    binary  octal  hexa
float 9.23  0.0  -1.7e-6
                 ×10^-6
bool True  False
str "One\nTwo"
     escaped new line
    'I\'m'
     escaped '
```

*Multiline string:*

```
"""X\tY\tZ
1\t2\t3"""
   escaped tab
bytes b"toto\xfe\775"
       hexadecimal  octal
```

*immutables*

## Container Types

- **ordered sequences**, fast index access, repeatable values

```
list [1,5,9]   ["x",11,8.9]   ["mot"]   []
tuple (1,5,9)   11,"y",7.4   ("mot",)   ()
```

*Non modifiable values (immutables)* — *expression with only comas → tuple*

```
str bytes   (ordered sequences of chars / bytes)
""  b""
```

- **key containers**, no *a priori* order, fast key access, each key is unique

```
dictionary  dict {"key":"value"}   dict(a=3,b=4,k="v")   {}
(key/value associations)  {1:"one",3:"three",2:"two",3.14:"π"}
collection  set {"key1","key2"}   {1,9,3,0}   set()
```

*keys=hashable values (base types, immutables…)*  `frozenset` *immutable set*  *empty*

## Identifiers

*for variables, functions, modules, classes… names*

`a…zA…Z_` followed by `a…zA…Z_0…9`

- diacritics allowed but should be avoided
- language keywords forbidden
- lower/UPPER case discrimination

☺ `a toto x7 y_max BigOne`
☹ ~~`8y and for`~~

## Variables assignment

`=`

*assignment ⇔* **binding** *of a name with a value*

*1) evaluation of right side expression value*
*2) assignment in order with left side names*

```
x=1.2+8+sin(y)
a=b=c=0          assignment to same value
y,z,r=9.2,-7.6,0 multiple assignments
a,b=b,a          values swap
a,*b=seq
*a,b=seq         unpacking of sequence in item and list
x+=3             increment ⇔ x=x+3   and *= /= %= …
x-=2             decrement ⇔ x=x-2
x=None           « undefined » constant value
del x            remove name x
```

## Conversions

`type(`*expression*`)`

```
int("15") → 15
int("3f",16) → 63        can specify integer number base in 2nd parameter
int(15.56) → 15          truncate decimal part
float("-11.24e8") → -1124000000.0
round(15.56,1)→15.6      rounding to 1 decimal (0 decimal → integer number)
bool(x)  False for null x, empty container x , None or False x ; True for other x
str(x)→"…"   representation string of x for display (cf. formatting on the back)
chr(64)→'@'  ord('@')→64   code ↔ char
repr(x)→"…"  literal representation string of x
bytes([72,9,64]) → b'H\t@'
list("abc") → ['a','b','c']
dict([(3,"three"),(1,"one")]) → {1:'one',3:'three'}
set(["one","two"]) → {'one','two'}
separator str and sequence of str → assembled str
   ':'.join(['toto','12','pswd']) → 'toto:12:pswd'
str splitted on whitespaces → list of str
   "words with  spaces".split() → ['words','with','spaces']
str splitted on separator str → list of str
   "1,4,8,2".split(",") → ['1','4','8','2']
sequence of one type → list of another type (via list comprehension)
   [int(x) for x in ('1','29','-3')] → [1,29,-3]
```

## Sequence Containers Indexing

*for lists, tuples, strings, bytes…*

```
negative index   -5  -4  -3  -2  -1
positive index    0   1   2   3   4
lst=[10, 20, 30, 40, 50]
positive slice    0   1   2   3   4   5
negative slice   -5  -4  -3  -2  -1
```

**Items count**

`len(lst)→5`

**index from 0**
(here from 0 to 4)

Individual access to **items** via `lst[`*index*`]`

```
lst[0]→10   ⇒ first one      lst[1]→20
lst[-1]→50  ⇒ last one       lst[-2]→40
```

*On mutable sequences (`list`), remove with* `del lst[3]` *and modify with assignment* `lst[4]=25`

Access to **sub-sequences** via `lst[`*start slice*`:`*end slice*`:`*step*`]`

```
lst[:-1]→[10,20,30,40]   lst[::-1]→[50,40,30,20,10]   lst[1:3]→[20,30]   lst[:3]→[10,20,30]
lst[1:-1]→[20,30,40]     lst[::-2]→[50,30,10]         lst[-3:-1]→[30,40] lst[3:]→[40,50]
lst[::2]→[10,30,50]      lst[:]→[10,20,30,40,50]  shallow copy of sequence
```

*Missing slice indication → from start / up to end.*
*On mutable sequences (`list`), remove with* `del lst[3:5]` *and modify with assignment* `lst[1:4]=[15,25]`

## Boolean Logic

Comparisons : `<` `>` `<=` `>=` `==` `!=` (*boolean results*) ≤ ≥ = ≠

`a and b` logical and — *both simulta-neously*

`a or b` logical or — *one or other or both*

*pitfall :* `and` *and* `or` *return* *value* *of* `a` *or of* `b` *(under shortcut evaluation).*
*⇒ ensure that* `a` *and* `b` *are booleans.*

`not a` logical not

`True` `False` — True and False constants

## Statements Blocks

```
parent statement:
    statement block 1…
    ⋮
parent statement:
    statement block2…
    ⋮
next statement after block 1
```

*indentation !*

*configure editor to insert 4 spaces in place of an indentation tab.*

## Modules/Names Imports

*module* `truc` ⇔ *file* `truc.py`

```
from monmod import nom1,nom2 as fct
```
→ *direct access to names, renaming with* `as`

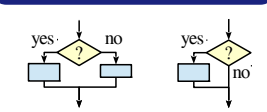
```
import monmod
```
→ *access via* `monmod.nom1` …

*modules and packages searched in python path (cf* `sys.path`*)*

## Conditional Statement

*statement block executed only* ***if*** *a condition is true*

```
if logical condition:
    statements block
```




Can go with several *elif*, *elif*... and only one final *else*. Only the block of first true condition is executed.

```
if age<=18:
    state="Kid"
elif age>65:
    state="Retired"
else:
    state="Active"
```

*with a var* `x`*:*
`if bool(x)==True:` ⇔ `if x:`
`if bool(x)==False:` ⇔ `if not x:`

## Maths

*floating numbers… approximated values*  *angles in radians*

Operators: `+` `-` `*` `/` `//` `%` `**`
Priority `(…)` × ÷ ↑ ↑ $a^b$
integer ÷ ÷ remainder

`@` → matrix × *python3.5+* `numpy`

```
(1+5.3)*2→12.6
abs(-3.2)→3.2
round(3.57,1)→3.6
pow(4,3)→64.0
```

```
from math import sin,pi…
sin(pi/4)→0.707…
cos(2*pi/3)→-0.4999…
sqrt(81)→9.0   ✓
log(e**2)→2.0
ceil(12.5)→13
floor(12.5)→12
```

modules `math`, `statistics`, `random`, `decimal`, `fractions`, `numpy`, *etc. (cf. doc)*

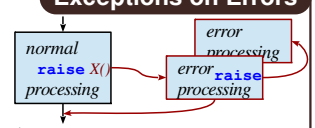
*usual order of operations*

## Exceptions on Errors

Signaling an error:
`raise` *ExcClass(…)*

Errors processing:

```
try:
    normal procesising block
except Exception as e:
    error processing block
```




`finally` *block for final processing in all cases.*

## Conditional Loop Statement

*statements block executed **as long as** condition is true*

```
while logical condition:
    statements block
```


```
s = 0          # initializations before the loop
i = 1          # condition with a least one variable value (here i)
while i <= 100:
    s = s + i**2
    i = i + 1  # make condition variable change !
print("sum:",s)
```

Algo: $s = \sum_{i=1}^{i=100} i^2$

*beware of infinite loops!*

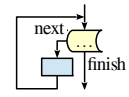
## Loop Control

```
break      immediate exit
continue   next iteration
else block for normal loop exit.
```

## Iterative Loop Statement

*statements block executed **for each** item of a container or iterator*

```
for var in sequence:
    statements block
```




Go over sequence's **values**

```
s = "Some text"   # initializations before the loop
cnt = 0
for c in s:       # loop variable, assignment managed by for statement
    if c == "e":
        cnt = cnt + 1
print("found",cnt,"'e'")
```

*Algo: count number of* `e` *in the string.*

loop on dict/set ⇔ loop on keys sequences
use *slices* to loop on a subset of a sequence

Go over sequence's **index**

- modify item at index
- access items around index (before / after)

```
lst = [11,18,9,12,23,4,17]
lost = []
for idx in range(len(lst)):
    val = lst[idx]
    if val > 15:
        lost.append(val)
        lst[idx] = 15
print("modif:",lst,"-lost:",lost)
```

*Algo: limit values greater than 15, memorizing of lost values.*

*good habit : don't modify loop variable*

Go simultaneously over sequence's **index** and **values**:

```
for idx,val in enumerate(lst):
```

## Display

```
print("v=",3,"cm :",x,",",y+4)
```

items to display : literal values, variables, expressions

**print** options:

- `sep=" "` items separator, default space
- `end="\n"` end of print, default new line
- `file=sys.stdout` print to file, default standard output

## Input

```
s = input("Instructions:")
```

**input** always returns a **string**, convert it to required type (cf. boxed *Conversions* on the other side).

## Generic Operations on Containers

`len(c)` → items count
`min(c)` `max(c)` `sum(c)`
`sorted(c)` → `list` sorted *copy*
`val in c` → boolean, membership operator `in` (absence `not in`)
`enumerate(c)` → *iterator* on (index, value)
`zip(c1,c2…)` → *iterator* on tuples containing $c_i$ items at same index
`all(c)` → `True` if **all** `c` items evaluated to true, else `False`
`any(c)` → `True` if **at least one** item of `c` evaluated true, else `False`

*Note: For dictionaries and sets, these operations use **keys**.*

*Specific to **ordered sequences containers** (lists, tuples, strings, bytes…)*

`reversed(c)` → *inversed iterator* `c*5` → duplicate `c+c2` → concatenate
`c.index(val)` → *position* `c.count(val)` → *events count*

```
import copy
copy.copy(c) → shallow copy of container
copy.deepcopy(c) → deep copy of container
```

## Operations on Lists

modify original list

| | |
|---|---|
| `lst.append(val)` | add item at end |
| `lst.extend(seq)` | add sequence of items at end |
| `lst.insert(idx,val)` | insert item at index |
| `lst.remove(val)` | remove first item with value *val* |
| `lst.pop([idx])` → *value* | remove & return item at index *idx* (default last) |
| `lst.sort()` `lst.reverse()` | sort / reverse liste *in place* |

## Operations on Dictionaries

`d[key]=value` `d.clear()`
`d[key]` → *value* `del d[key]`
`d.update(d2)` update/add associations
`d.keys()` `d.values()` `d.items()` → *iterable views on keys/values/associations*
`d.pop(key[,default])` → *value*
`d.popitem()` → *(key,value)*
`d.get(key[,default])` → *value*
`d.setdefault(key[,default])` → *value*

## Operations on Sets

Operators:

- `|` → union (vertical bar char)
- `&` → intersection
- `-` `^` → difference/symmetric diff.
- `<` `<=` `>` `>=` → inclusion relations

*Operators also exist as methods.*

`s.update(s2)` `s.copy()`
`s.add(key)` `s.remove(key)`
`s.discard(key)` `s.clear()`
`s.pop()`

## Files

*storing data on disk, and reading it back*

```
f = open("file.txt","w",encoding="utf8")
```

- file **variable** for operations
- **name** of file on disk (+path…)
- opening **mode**
  - `'r'` read
  - `'w'` write
  - `'a'` append
  - …`'+'` `'x'` `'b'` `'t'`
- **encoding** of chars for *text files*: `utf8` `ascii` `latin1` …

cf. modules `os`, `os.path` and `pathlib`

**writing**

```
f.write("coucou")
f.writelines(list of lines)
```

**reading**

*read empty string if end of file*

```
f.read([n])        → next chars
                   if n not specified, read up to end !
f.readlines([n])   → list of next lines
f.readline()       → next line
```

*text mode* `t` *by default (read/write* `str`*), possible binary mode* `b` *(read/write* `bytes`*). **Convert from/to required type** !*

`f.close()` dont forget to **close the file** after use !

`f.flush()` write cache
`f.truncate([size])` resize

*reading/writing progress sequentially in the file, modifiable with:*

`f.tell()` → *position*
`f.seek(position[,origin])`

Very common: opening with a guarded block (automatic closing) and reading loop on lines of a text file:

```
with open(…) as f:
    for line in f :
        # processing of line
```

## Integer Sequences

`range([start,] end [,step])`

*start* default 0, *end* not included in sequence, *step* signed, default 1

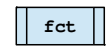
`range(5)` → 0 1 2 3 4
`range(3,8)` → 3 4 5 6 7
`range(2,12,3)` → 2 5 8 11
`range(20,5,-5)` → 20 15 10
`range(len(seq))` → *sequence of index of values in seq*

*range provides an immutable sequence of int constructed as needed*

## Function Definition

function name (identifier)
named parameters

```
def fct(x,y,z):
    """documentation"""
    # statements block, res computation, etc.
    return res
```




result value of the call, if no computed result to return: `return None`

parameters and all variables of this block exist only *in* the block and *during* the function call (think of a "black box")

Advanced: `def fct(x,y,z,*args,a=3,b=5,**kwargs):`

**args variable positional arguments (→`tuple`), default values,*
***kwargs variable named arguments (→`dict`)*

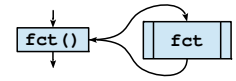
## Function Call

```
r = fct(3,i+2,2*i)
```

*storage/use of returned value* — *one argument per parameter*

this is the use of function name *with parentheses* which does the call

*Advanced: *sequence **dict*




## Operations on Strings

`s.startswith(prefix[,start[,end]])`
`s.endswith(suffix[,start[,end]])` `s.strip([chars])`
`s.count(sub[,start[,end]])` `s.partition(sep)` → *(before,sep,after)*
`s.index(sub[,start[,end]])` `s.find(sub[,start[,end]])`
`s.is…()` *tests on chars categories (ex.* `s.isalpha()` *)*
`s.upper()` `s.lower()` `s.title()` `s.swapcase()`
`s.casefold()` `s.capitalize()` `s.center([width,fill])`
`s.ljust([width,fill])` `s.rjust([width,fill])` `s.zfill([width])`
`s.encode(encoding)` `s.split([sep])` `s.join(seq)`

## Formatting

formating directives — values to format

```
"modele{} {} {}".format(x,y,r) → str
"{selection:formatting!conversion}"
```

- **Selection** :
  - `2`
  - `nom`
  - `0.nom`
  - `4[key]`
  - `0[2]`
- **Formatting** :

*fill char* *alignment* *sign* *mini width*.*precision~maxwidth* *type*

`< > ^ =` `+ - space` `0` at start for filling with 0

integer: `b` binary, `c` char, `d` decimal (default), `o` octal, `x` or `X` hexa…
float: `e` or `E` exponential, `f` or `F` fixed point, `g` or `G` appropriate (default),
string: `s` … `%` percent

- **Conversion** : `s` (readable text) or `r` (literal representation)

Examples:

```
"{:+2.3f}".format(45.72793)
→'+45.728'
"{1:>10s}".format(8,"toto")
→'      toto'
"{x!r}".format(x="I'm")
→'"I\'m"'
```