# Python 3 Cheat Sheet

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

## Base Types

*integer, float, boolean, string, bytes*

| | | | | | |
|---|---|---|---|---|---|
| `int` | `783` | `0` *zero* | `-192` | `0b010` *binary* | `0o642` *octal* | `0xF3` *hexa* |

`float 9.23 0.0 -1.7e-6` ($\times 10^{-6}$)
`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` |
| `x-=2` | *decrement* ⇔ `x=x-2` |
| `x=None` | *« undefined » constant value* |
| `del x` | *remove name* `x` |

and `*=` `/=` `%=` …

## 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.*

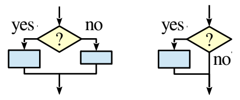
## Modules/Names Imports

*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*

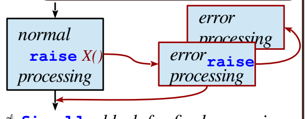
Operators: `+ - * / // % **`
Priority `(…)` × ÷ integer ÷ ÷ remainder $a^b$
`@` → matrix × *python3.5+*`numpy`

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

```
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)*

## Exceptions on Errors

Signaling an error:
`raise` *ExcClass(…)*
Errors processing:
```
try:
    normal processing block
except Exception as e:
    error processing block
```

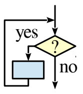


☝ `finally` *block for final processing in all cases.*

## Conditional Loop Statement

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

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



☝ *beware of infinite loops!*

```
s = 0
i = 1
while i <= 100:
    s = s + i**2
    i = i + 1
print("sum:",s)
```

`s = 0`, `i = 1` } *initializations* ***before*** *the loop*; *condition with a least one variable value (here* `i`*)*

☝ *make condition variable change !*

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

## Loop Control

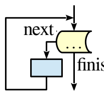
| | |
|---|---|
| `break` | *immediate exit* |
| `continue` | *next iteration* |

☝ `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"
cnt = 0
for c in s:
    if c == "e":
        cnt = cnt + 1
print("found",cnt,"'e'")
```

`s = "Some text"`, `cnt = 0` } *initializations* ***before*** *the loop*

*loop variable,* ***assignment managed by*** `for` ***statement***

*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[`*key*`]` → *value*
- `d.clear()`
- `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

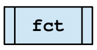
- `range(5)` → 0 1 2 3 4
- `range(2,12,3)` → 2 5 8 11
- `range(3,8)` → 3 4 5 6 7
- `range(20,5,-5)` → 20 15 10
- `range(len(`*seq*`))` → *sequence of index of values in seq*

☝ *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
```



`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`*)*

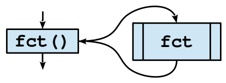
## Function Call

`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]
```

Examples:

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

□ **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)