Mémento v2.0.6

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"        Multiline string:
    escaped new line  """X\tY\tZ
    'I\'m'            1\t2\t3"""
    escaped '         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         unpacking of sequence in
*a,b=seq         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`

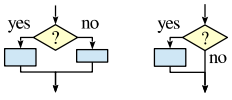
```
from monmod import nom1,nom2 as fct
                  →direct access to names, renaming with as
import monmod  →access via monmod.nom1 …
```

☝ 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*

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
```

☝ *usual order of operations*

angles in radians

```
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
```

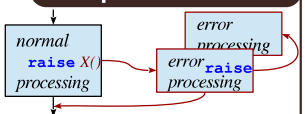
modules `math`, `statistics`, `random`, `decimal`, `fractions`, `numpy`, *etc. (cf. doc)*

Exceptions on Errors

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

Errors processing:

```
try:
    →normal 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!

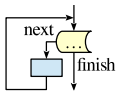
Loop Control

```
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
# loop variable, assignment managed by for statement
for c in s:
    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()          →iterable views on keys/values/associations
d.items()
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…) — cf. modules `os`, `os.path` and `pathlib`
- opening **mode**: `'r'` read, `'w'` write, `'a'` append, …`'+'` `'x'` `'b'` `'t'`
- **encoding** of chars for *text files*: `utf8` `ascii` `latin1` …

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
```

`fct`

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`)*

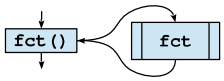
Function Call

```
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.strip([chars])
s.endswith(suffix[,start[,end]])
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"'
```