

Base Types

integer, float, boolean, string, bytes

```
int 783 0 -192 0b010 0o642 0xF3
float 9.23 0.0 -1.7e-6
bool True False
str "One\nTwo"
bytes b"toto\xfe\775"
```

Non modifiable values (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",)
```

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

```
dict {"key": "value"} dict(a=3,b=4,k="v")
set {"key1", "key2"} {1,9,3,0}
frozenset immutable set
```

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

Conversions

type (expression)

```
int("15") → 15
int("3f",16) → 63
int(15.56) → 15
float("-11.24e8") → -112400000.0
round(15.56,1) → 15.6
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
chr(64) → '@' ord('@') → 64
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]

Variables assignment

= assignment ⇔ binding of a name with a value

- evaluation of right side expression value
- assignment in order with left side names

```
x=1.2+8+sin(y)
a=b=c=0
y,z,r=9.2,-7.6,0
a,b=b,a
a,*b=seq
*a,b=seq
x+=3
x-=2
x=None
del x
```

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]
```

Items count: len(lst) → 5

Individual access to items via lst [index]

```
lst[0] → 10
lst[-1] → 50
```

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: -1] → [20,30,40]
lst[: :2] → [10,30,50]
```

Boolean Logic

Comparisons : < > <= >= == != (boolean results)

a and b logical and both simultaneously

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 block 2...
next statement after block 1
```

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
import monmod
```

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"
```

Maths

floating numbers... approximated values

Operators: + - * / // % **

Priority (...)

```
(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

Maths

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 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



Loop Control

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

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

beware of infinite loops!

```

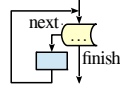
s = 0
i = 1
while i <= 100:
    s = s + i**2
    i = i + 1
print("sum:", s)
    
```

initializations before the loop
condition with a least one variable value (here i)
make condition variable change!

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")
    
```

initializations before the loop
loop variable, assignment managed by for statement
Algo: count number of e in the string.

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 list in place

Operations on Dictionaries

- d[key]=value** **d.clear()**
- d[key] → value** **del d[key]**
- d.update(d2)** { update/add associations
- d.keys()** → iterable views on keys/values/associations
- d.values()** → iterable views on keys/values/associations
- 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()**

Loop on dict/set

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.

Go simultaneously over sequence's index and values:

```

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

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
    
```

fct

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

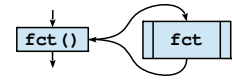
```

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



Files

storing data on disk, and reading it back

```

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

file variable
name of file on disk (+path...)
opening mode
encoding of chars for text files: utf8, ascii, latin1, ...

writing

- f.write("coucou")**
- f.writelines(list of lines)**
- f.close()** dont forget to close the file after use!
- f.flush()** write cache
- f.truncate([size])** resize
- f.tell()** → position
- f.seek(position, origin)**

reading

- 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!

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
    
```

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

formatting 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)

good habit : don't modify loop variable