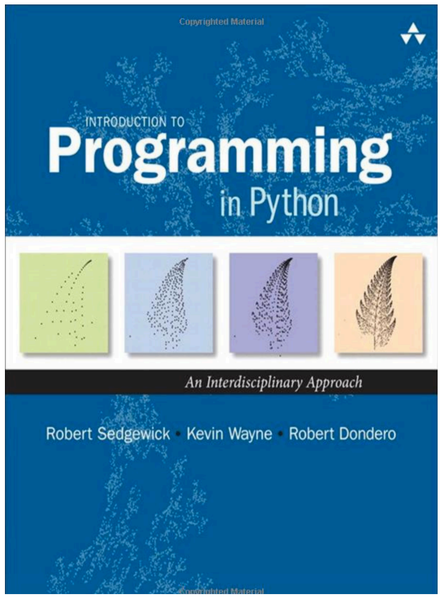
Parte I: Intro pensamiento computacional

Clase 05: Procesando listas y strings

Diego Caro
dcaro@udd.cl



Basada en presentaciones oficiales de libro Introduction to Programming in Python (Sedgewick, Wayne, Dondero).

Disponible en https://introcs.cs.princeton.edu/python

Outline

- Administrivia: tarea 1 y detalles sobre la entrega
- Comprender la utilidad de las listas
- Identificar patrones de uso de procesamiento de datos con listas

Recordatorio: diagramas de flujo

1. Delimitadores

Comienzo y final de algoritmo

2. Datos

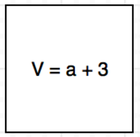
Input y Output

```
x = input()
```

```
print(x)
```

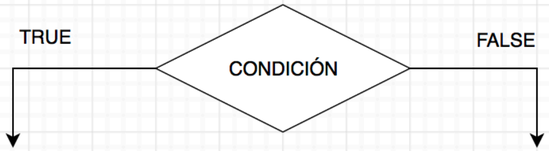
3. Procesos

Variables

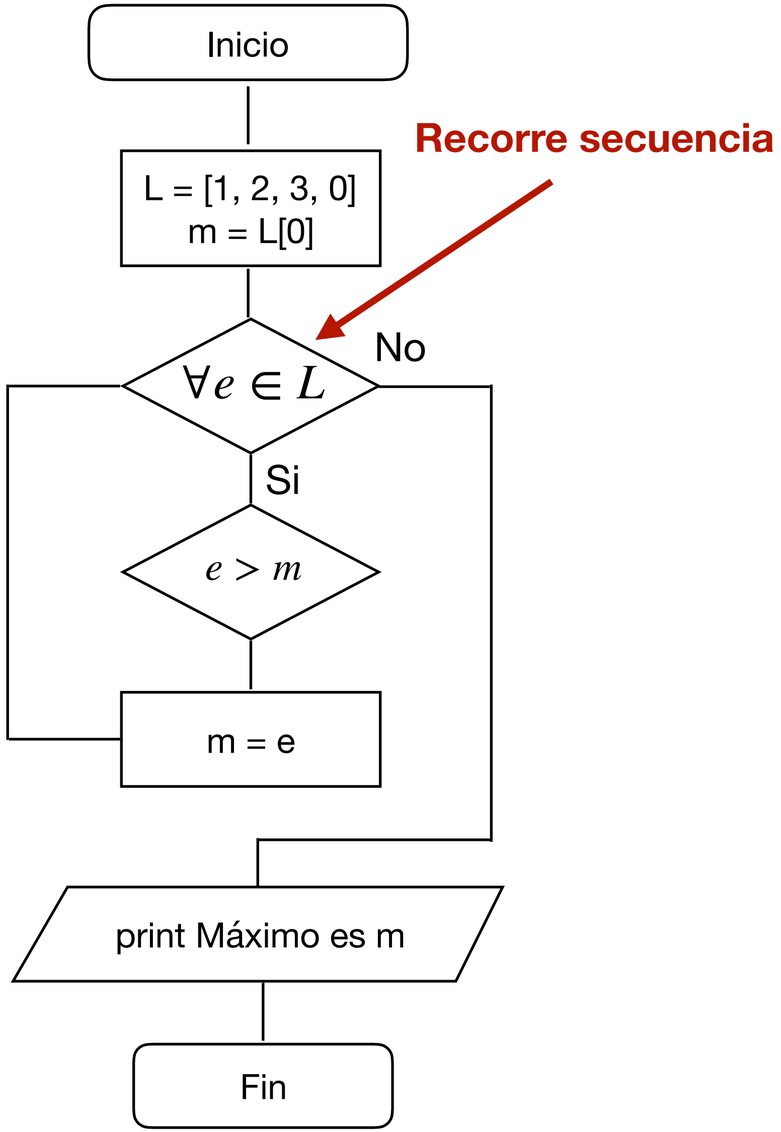


4. Decisión

Condicionales




```
if/elif/else
while
for
```



¿Qué hacen los programas a, b, c y d?

a)

```
L = 10000000*[0, -1, 3, 5, 9, 10, 12, 99, 33]
print('len(L):', len(L))

a = False
for e in L:
    if e < 0:
        a = True
        break
print(a)
```

b)

```
L = 10000000*[0, -1, 3, 5, 9, 10, 12, 99, 33]
print('len(L):', len(L))

a = False
for e in L:
    if e < 0:
        a = True
print(a)
```

c)

```
L = 10000000*[0, -1, 3, 5, 9, 10, 12, 99, 33]
print('len(L):', len(L))

a = False
i = 0
while i < len(L):
    if L[i] < 0:
        a = True
        break
    i += 1
print(a)
```

d)

```
L = 10000000*[0, -1, 3, 5, 9, 10, 12, 99, 33]
print('len(L):', len(L))

a = False
i = 0
while i < len(L):
    if L[i] < 0:
        a = True
    i += 1
print(a)
```

P: ¿Cuál de todos te gusta más? ¿Por qué?

David Winterbottom
@codeinthehole

Follow

Desirable developer skills:

1 Ability to ignore new tools and technologies
2 Taste for simplicity
3 Good code deletion skills
4 Humility

¿Qué hacen los programas a, b, c y d?

a)

```
1 L = [0, -1, 3, 5, 9, 10, 12, 99, 33]
2 t = 0
3 for e in L:
4     if e < 0:
5         continue
6     t += e
7 print(t)
```

Salta a siguiente iteración

b)

```
1 L = [0, -1, 3, 5, 9, 10, 12, 99, 33]
2 t = 0
3 for e in L:
4     if e >= 0:
5         t += e
6 print(t)
```

c)

```
1 L = [0, -1, 3, 5, 9, 10, 12, 99, 33]
2 t = 0
3 i = 0
4 while i < len(L)
5     e = L[i]
6     i += 1
7     if e < 0:
8         continue
9     t += e
10 print(t)
```

Salta a siguiente iteración

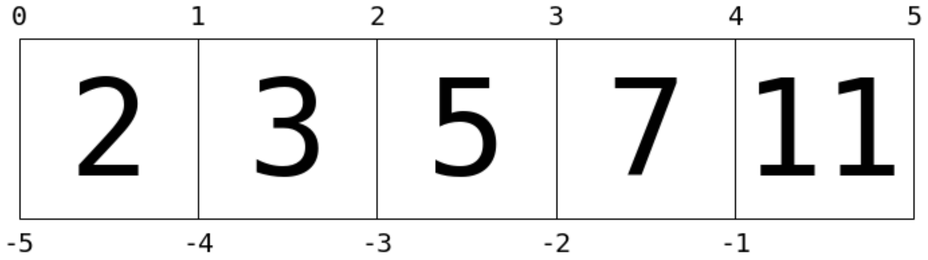
d)

```
1 L = [0, -1, 3, 5, 9, 10, 12, 99, 33]
2 t = 0
3 i = 0
4 while i < len(L)
5     e = L[i]
6     i += 1
7     if e >= 0:
8         t += e
9 print(t)
```

P: ¿Cuál de todos te gusta más? ¿Por qué?

Más sobre acceso en listas

- Los elementos de la lista se pueden acceder con el operador corchete [ ]
- Si la posición del elemento es negativo, se accede desde el final.
- Si accedes una posición que no existe: **ERROR!**




```
1 L = [2, 3, 5, 7, 11]
2 print('L[0]', L[0])
3 print('L[1]', L[1])
4
5 print('L[-1]', L[-1])
6 print('L[-2]', L[-2])
7 print('L[99]', L[99])
```

```
L[0] 2
L[1] 3
L[-1] 11
L[-2] 7
Traceback (most recent call last):
  File "lista-neg.py", line 7, in <module>
    print('L[99]', L[99])
IndexError: list index out of range
```

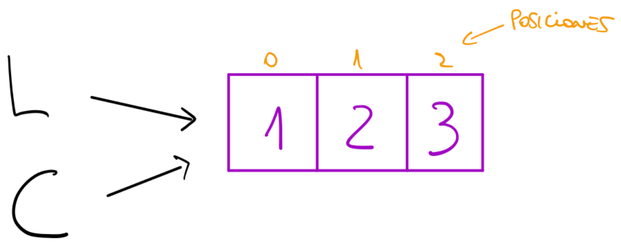
Error, programa se caerá.
Lista L tiene 5 elementos.

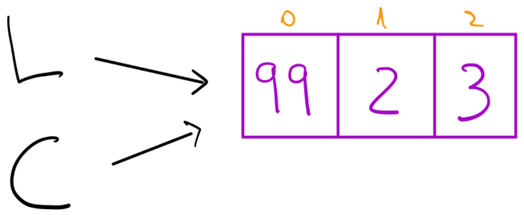
Variable alias

- Si ambos elementos son listas, el operador de asignación crea un nuevo nombre a la variable

```
1 L = [1, 2, 3]
2 C = L
3 L[0] = 99
4
5 print(L)
6 print(C)
```

Crea un alias de la lista





Importante: El operador de asignación '=' crea un alias (dos nombres para una misma variable).
Si quieres copiar una lista usa la función .copy()

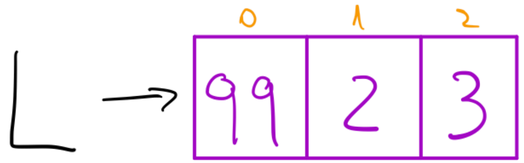
Variable alias

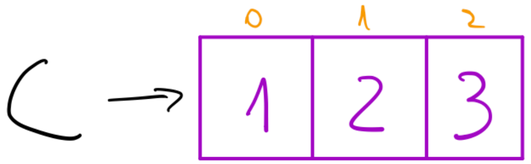
- Si ambos elementos son listas, el operador de asignación crea un nuevo nombre a la variable
- Para crear una copia usa lista.copy()

```
1 L = [1, 2, 3]
2 C = L
3 L[0] = 99
4
5 print(L)
6 print(C)
```

Reemplazar por

```
2 C = L.copy()
```





Importante: El operador de asignación '=' crea un alias (dos nombres para una misma variable).
Si quieres copiar una lista usa la función .copy()

Más operaciones con listas

- Append: agregar nuevo elemento a la lista
- Concatenar: unir dos listas
- Obtener sublista: L[inicio:fin]

- Contiene: elem in L (devuelve True o False)

```
>>> 'a' in ['b','c','d','a']
True
```

```
1  L = [11, 3, 5, 7, 2]
2  print('L', L)
3
4  if 5 in L:
5      print('cinco está en L')
6
7  # Actualizar elemento
8  L[4] = 9999
9  print('L[4]=9999', L)
10
11 # Agregar elemento a listas
12 L.append(100) #modifica lista
13 print('L.append(100)', L)
14
15 # Concatenar lista
16 L2 = L + [19, 17, 13] # crea lista nueva
17 print('L+[19, 17, 13]', L2)
18
19 # Sublista
20 L3 = L[2:5] # Elementos 2,3 y 4
21 print('L[2:5]', L3)
```

```
$ python3 ops.py
L [11, 3, 5, 7, 2]
cinco está en L
L[4]=9999 [11, 3, 5, 7, 9999]
L.append(100) [11, 3, 5, 7, 9999, 100]
L+[19, 17, 13] [11, 3, 5, 7, 9999, 100, 19, 17, 13]
L[2:5] [5, 7, 9999]
```

Desafíos

Crear lista con valores de teclado	`L = [] #lista vacía`
	`for i in range(N):`
	`  v = int(input())`
	`  L.append(v)`

Imprimir valores en lista (uno por uno)	`for elem in L:`
	`  print(elem)`
	
	`# alternativa`
	`for i in range(N):`
	`  print(L[i])`

Encontrar el máximo valor en una lista	`maxi = L[0]`
	`for elem in L:`
	`  if elem > maxi:`
	`  maxi = elem`
	`print(maxi)`

Encontrar el mínimo valor en una lista	`mani = L[0]`
	`for elem in L:`
	`  if elem < mini:`
	`  mini = elem`
	`print(mini)`

Obtener el promedio	`# promedio`
	`suma = 0.0`
	`for elem in L:`
	`  suma = suma + elem`
	`prom = suma/N`

Copiar elementos a otra lista	`L2 = []`
	`for elem in L:`
	`  L2.append(elem)`

Crear nueva listas con elementos invertidos	`N = len(L)`
	`R = []`
	`for i in range(N):`
	`  j = N-i-1`
	`  R.append(L[j])`

Invertir elementos del arreglo	`for i in range(N):`
	`  temp = L[i]`
	`  L[i] = L[N-i-1]`
	`  L[N-i-1] = temp`

Human-based python interpreter™

Genera números aleatorios dentro de un rango

```python
from random import randrange
TRAJES = ['Picas', 'Diamantes', 'Treboles', 'Corazones']
VALORES = ['2', '3', '4', '5', '6', '7', '8', '9', '10',
           'Jota', 'Reina', 'Rey', 'As']

valor = randrange(0, len(VALORES))
traje = randrange(0, len(TRAJES))
print(VALORES[valor],'de', TRAJES[traje])
```

```python
from random import randrange
TRAJES = ['Picas', 'Diamantes', 'Treboles', 'Corazones']
VALORES = ['2', '3', '4', '5', '6', '7', '8', '9', '10',
           'Jota', 'Reina', 'Rey', 'As']

mazo = []
for traje in TRAJES:
    for valor in VALORES:
        mazo.append(valor + ' de ' + traje)

print(mazo)
```

Ejercicio 1

El profesor Rossa tiene problemas para usar el computador, así que normalmente calcula el promedio de notas de de sus alumnos usando papel y lápiz. Cuando el profesor entregó los promedios, Guru-guru se dió cuenta que su promedio no correspondía a sus calificaciones.

La coordinadora académica de la Facultad le pidió a usted diseñar un programa que permita calcular el promedio de notas, para ayudar al profesor Rossa.

Si usted desea ayudar al profesor Rossa, y hacer justicia con Guru-Guru, resuelva lo siguiente:

1. Escriba un programa que calcule el promedio. Asuma que se le entrega una lista con n números, cada uno de ellos representando una nota y que todas las notas tienen la misma ponderación.
2. Calcule la desviación estándar del promedio de notas del curso.
3. Calcule el promedio ponderado, asuma que le entregan otra lista con n números flotantes representando el porcentaje que representa cada nota.

Resumen

Conceptos

- **Alias:** nuevo nombre a una variable. Si modifico el contenido en una, se modifica en la otra también.

Funciones

- **elem.copy():** crear copia de variable elem

False	await	else	import	pass
None	break	except	in	raise
True	class	finally	is	return
and	continue	for	lambda	try
as	def	from	nonlocal	while
assert	del	global	not	with
async	elif	if	or	yield

https://docs.python.org/3/reference/lexical_analysis.html

		Built-in Functions		
abs()	delattr()	hash()	memoryview()	set()
all()	dict()	help()	min()	setattr()
any()	dir()	hex()	next()	slice()
ascii()	divmod()	id()	object()	sorted()
bin()	enumerate()	input()	oct()	staticmethod()
bool()	eval()	int()	open()	str()
breakpoint()	exec()	isinstance()	ord()	sum()
bytearray()	filter()	issubclass()	pow()	super()
bytes()	float()	iter()	print()	tuple()
callable()	format()	len()	property()	type()
chr()	frozenset()	list()	range()	vars()
classmethod()	getattr()	locals()	repr()	zip()
compile()	globals()	map()	reversed()	__import__()
complex()	hasattr()	max()	round()	

https://docs.python.org/3/library/functions.html

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"toto"
```

- **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:"n"}
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
☹ 0y 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

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

indentation : 1 tab = 4 spaces

♯ 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)

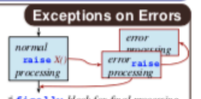
Exceptions on Errors

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

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

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.

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

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

good habit : don't modify loop variable

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
```

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

```
val in c → boolean, membership operator in (absence not in)
enumerate(c) → iterator on (index, value)
zip(c1,c2…) → iterator on tuples containing ci 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
```

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
d.items()      } 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' latin1 …
- **encoding** of chars for *text files*: utf8 ascii

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
```

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*

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*

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]
```

- **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"'
```

https://perso.limsi.fr/pointal/_media/python:cours:mementopython3-english.pdf