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Introduction to Programming with Python

II.2. Basic elements

Oscar Delgado
oscar.delgado@uam.es

Loops - for

Starts with 0, not 1

for *variable* in range(*number of times to repeat*):
statements to be repeated

Nothing special about variable name. It's a convention to use the letters i, j, k for loops.

colon

Loops - for

```
for i in range(3):
        num = eval(input('Enter a number: '))
        print ('The square of your number is', num*num)
print('The loop is now done.')
```

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Loops – **range** function

range(*start*, *end*, *increment*)

Statement	Values generated
`range(10)`	`0,1,2,3,4,5,6,7,8,9`
`range(1,10)`	`1,2,3,4,5,6,7,8,9`
`range(3,7)`	`3,4,5,6`
`range(2,15,3)`	`2,5,8,11,14`
`range(9,2,-1)`	`9,8,7,6,5,4,3`

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while loop

Suitable when we don't know ahead of time exactly how many times it has to be repeated

```
while <<condition>>:
    # statements to be repeated go here
```

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while loop

```
for i in range(10):
    num = eval(input('Enter number: '))
    if num<0:
        break
```

```
i=0
num=1
while i<10 and num>0:
    num = eval(input('Enter a number: '))
```

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Math operators

Operator	Description
+	addition
–	subtraction
*	multiplication
/	division
**	exponentiation
//	integer division
%	modulo (remainder)

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Random numbers

Module import

```
from random import randint

x = randint(1,10)
print('A random number between 1 and 10: ', x)
```

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Random numbers

Module import

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x = randint(1,10)
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```

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Math functions

from math import ...

sin, cos, tan, exp, log, log10, factorial, sqrt, floor, ceil, pi, e

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Conditionals

```
if boolean_expression:
        <<true_branch>>
else:
        <<false branch>>
```

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Conditionals

```
from random import randint

num = randint(1,10)
guess = eval(input('Enter your guess: '))
if guess==num:
    print('You got it!')
else:
    print('Sorry. The number is ', num)
```

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Conditional operators

`if x>3:`	if x is greater than 3
`if x>=3:`	if x is greater than or equal to 3
`if x==3:`	if x is 3
`if x!=3:`	if x is not 3
`if x==3 and y ==5:`	if x is 3 and y is 5
`if x==3 or y==5:`	if x is 3 or y is 5

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Common mistakes

The equality operator needs TWO equal signs

Incorrect	Correct
`if x=1:`	`if x==1:`

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Strings

Data type for representing text

```
s = 'Hello'
t = "Hello"
m = """This is a long string that is
spread across two lines."""
```

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Strings

Empty string The empty string '' is the string equivalent of the number 0, with nothing in it.

Length To get the length of a string (how many characters it has), use the built-in function len. For example, len('Hello') is 5.

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Strings – Concatenation and repetition

Expression	Result
`'AB'+'cd'`	`'ABcd'`
`'A'+'7'+'B'`	`'A7B'`
`'Hi'*4`	`'HiHiHiHi'`

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Strings – The **in** operator

The **in** operator is used to tell if a string contains something.

```
if 'a' in string:
        print('Your string contains the letter a.')

if ';' not in string:
        print('Your string does not contain any semicolons.')
```

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Strings – Indexing

T ves some examples of indexing the s

Remember that first character is s[0], not s[1]

S ement	Result	Description
s[0]	P	first character of s
s[1]	y	second character of s
s[-1]	n	last character of s
s [illegible]	o	second-to-last character of s

Negative indices count backwards from the end of the string.

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Strings – Slices

A *slice* is used to pick out part of a string

index: 0 1 2 3 4 5 6 7 8 9
letters: a b c d e f g h i j

Code	Result	Description
`s[2:5]`	`cde`	characters at indices 2, 3, 4
`s[ :5]`	`abcde`	first five characters
`s[5: ]`	`fghij`	characters from index 5 to the end
`s[-2: ]`	`ij`	last two characters
`s[ : ]`	`abcdefghij`	entire string
`s[1:7:2]`	`bdf`	characters from index 1 to 6, by twos
`s[ : :-1]`	`jihgfedcba`	a negative step reverses the string

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Strings are immutable

Python strings are **immutable**, which means we can't modify any part of them.

```
s[4]='X'
```

```
s = s[:4] + 'X' + s[5:]
```

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Strings methods

Method	Description
`lower()`	returns a string with every letter of the original in lowercase
`upper()`	returns a string with every letter of the original in uppercase
`replace(x,y)`	returns a string with every occurrence of `x` replaced by `y`
`count(x)`	counts the number of occurrences of `x` in the string
`index(x)`	returns the location of the first occurrence of `x`
`isalpha()`	returns **`True`** if every character of the string is a letter

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Strings methods - Examples

Statement	Description
`print(s.count(' '))`	prints the number of spaces in the string
`s = s.upper()`	changes the string to all caps
`s = s.replace('Hi','Hello')`	replaces each `'Hi'` in `s` with `'Hello'`
`print(s.index('a'))`	prints location of the first `'a'` in `s`

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Counting

The key to counting is to use a variable to keep the count

```
count = 0
for i in range(10):
    num = eval(input('Enter a number: '))
    if num>10:
        count=count+1
print('There are', count, 'numbers greater than 10.')
```

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Flag variables

A flag variable can be used to let one part of your program know when something happens in another part of it.

```
num = eval(input('Enter number: '))

flag = 0
for i in range(2,num):
    if num%i==0:
        flag = 1

if flag==1:
    print('Not prime')
else:
    print('Prime')
```

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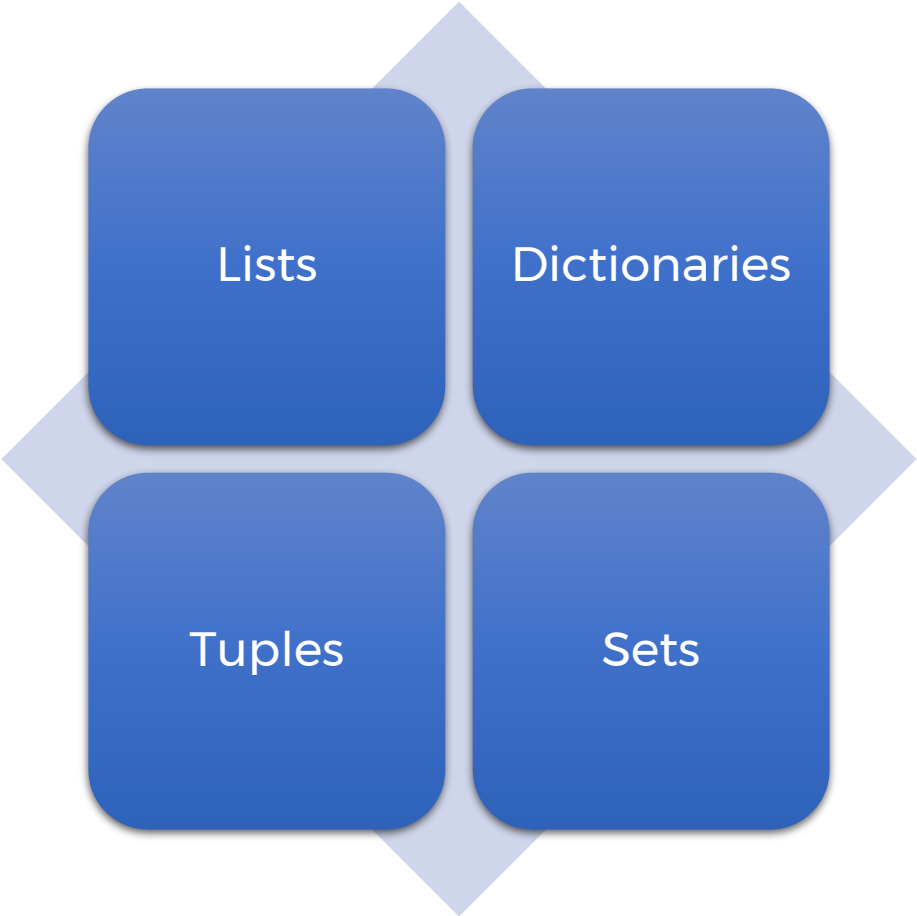
Data structures



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Lists

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Lists

Ordered set of objects

Creating lists Here is a simple list:

```
L = [1,2,3]
```

The empty list The empty list is []. It is the list equivalent of 0 or ''

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Lists

Printing lists You can use the **print** function to print the entire contents of a list.

```
L = [1,2,3]
print(L)
```

Data types Lists can contain all kinds of things, even other lists. For example, the following is a valid list:

```
[1, 2.718, 'abc', [5,6,7]]
```

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Similarities to strings

len The number of items in L is given by len(L)

in The in operator tells you if a list contains something.

```
if 2 in L:
    print('Your list contains the number 2.')
if 0 not in L:
    print('Your list has no zeroes.')
```

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Similarities to strings

Indexing and slicing — These work exactly as with strings. For example, L[0] is the first item of the list L and L[:3] gives the first three items.

index and **count** — These methods work the same as they do for strings.

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Similarities to strings

+ and * — The + operator adds one list to the end of another. The * operator repeats a list. Here are some examples:

Expression	Result
`[7,8]+[3,4,5]`	`[7,8,3,4,5]`
`[7,8]*3`	`[7,8,7,8,7,8]`
`[0]*5`	`[0,0,0,0,0]`

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Similarities to strings

Looping — The same types of loops that work for strings also work for lists. The following example prints out the items of a list, one-by-one, on separate lines.

```
for item in L:
    print(item)
```

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List methods

Method	Description
`append(x)`	adds `x` to the end of the list
`sort()`	sorts the list
`count(x)`	returns the number of times `x` occurs in the list
`index(x)`	returns the location of the first occurrence of `x`
`reverse()`	reverses the list
`remove(x)`	removes first occurrence of `x` from the list
`pop(p)`	removes the item at index `p` and returns its value
`insert(p,x)`	inserts `x` at index `p` of the list

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List methods - Examples

Example 1 Write a program that generates a list L of 50 random numbers between 1 and 100

```
from random import randint
L = []
for i in range(50):
    L.append(randint(1,100))
```

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split()

The **split** method returns a list of the words of a string. It assumes that words are separated by *whitespace*, which can be either spaces, tabs or newline characters, by default, or any other character specified.

```
s = 'Hi! This is a test.'
print(s.split())
```

```
s = '1-800-271-8281'
print(s.split('-'))
```

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join()

The **join** method is in some sense the opposite of split. It is a string method that takes a list of strings and joins them together into a single string.

Operation	Result
`' '.join(L)`	`A B C`
`''.join(L)`	`ABC`
`', '.join(L)`	`A, B, C`
`'***'.join(L)`	`A***B***C`

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Multi-dimensional lists

In Python, one way to create a two-dimensional list is to create a list whose items are themselves lists

```
L = [[1,2,3],
     [4,5,6],
     [7,8,9]]
```

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Multi-dimensional lists

Indexing We use two indices to access individual items. To get the entry in row r, column c, use the following:

```
L[r][c]
```

Printing One easy option is to use the **pprint** function of the pprint module.

```
from pprint import pprint
pprint(L)
```

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Reading lists

How to read an undetermined number of integers, letters or characters from keyboard or a file into a list

eval() The string needs to be exactly formatted as a list '[x,x,x]' (odd for a user typing)

```
L = eval(input('Enter a list: '))
print('The first element is ', L[0])
```

```
Enter a list: [5,7,9]
The first element is 5
```

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Reading lists

split() Any separator can be used (more natural for user)

```
L = list(input("Enter some numbers separated by
commas")).split(",")
print(L)
```

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Removing elements

del() If we know position of the element to be removed:

```
L=[1,2,3]
del(L[1])
# Now, L=[1,3]
```

remove() If we know the value of the element but not its position:

```
L=[1,2,3]
L.remove(1)
# Now, L=[2,3]
```

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From strings to lists and viceversa

String > List Usually with **split()** function:

```
"1:2:3".split(":")
# ['1','2','3']
```

List > String One easy option is to use the **pprint** function of the pprint module.

```
":".join(['1','2','3'])
# "1:2:3"
```

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Dictionaries

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Dictionaries

Non-ordered set of (key,value) pairs

Creating dictionaries Here is a simple dictionary:

```
d = {'January': 31, 'February': 28}
```

Keys
Must be of immutable type (strings, numbers) and unique

Value
Any type and value are allowed

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Updating dictionaries

Adding/changing elements `d['January'] = 30`

Removing elements `del(d['January'])`

Empty dictionary `d={}`

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Working with dictionaries

in operator Works like usual in strings and lists:

```
letter = input('Enter a letter: ')
if letter in d:
    print('The value is', d[letter])
else:
    print('Not in dictionary')
```

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Working with dictionaries

Looping Works like usual in strings and lists:

Print all keys

```
for key in d:
    print(key)
```

Print all values

```
for key in d:
    print(d[key])
```

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List of keys and values

To obtain a list of all keys or values

Dicts are non-ordered!!

```
d = {'A':1, 'B':3}
list(d.keys())
```

```
['A','B']
```

```
d = {'A':1, 'B':3}
list(d.values())
```

```
[1,3]
```

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