Introduction to Python - I

Overview

- General aspects
- Getting and installing Python
- Elementary use of Python
- Expressions and statements
- Collections
- Functions and arguments

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  - ... but not only
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    - CGI Applications
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Several other languages have similar characteristics or cover, at least partially, Python's areas of application.

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>>> 2+2
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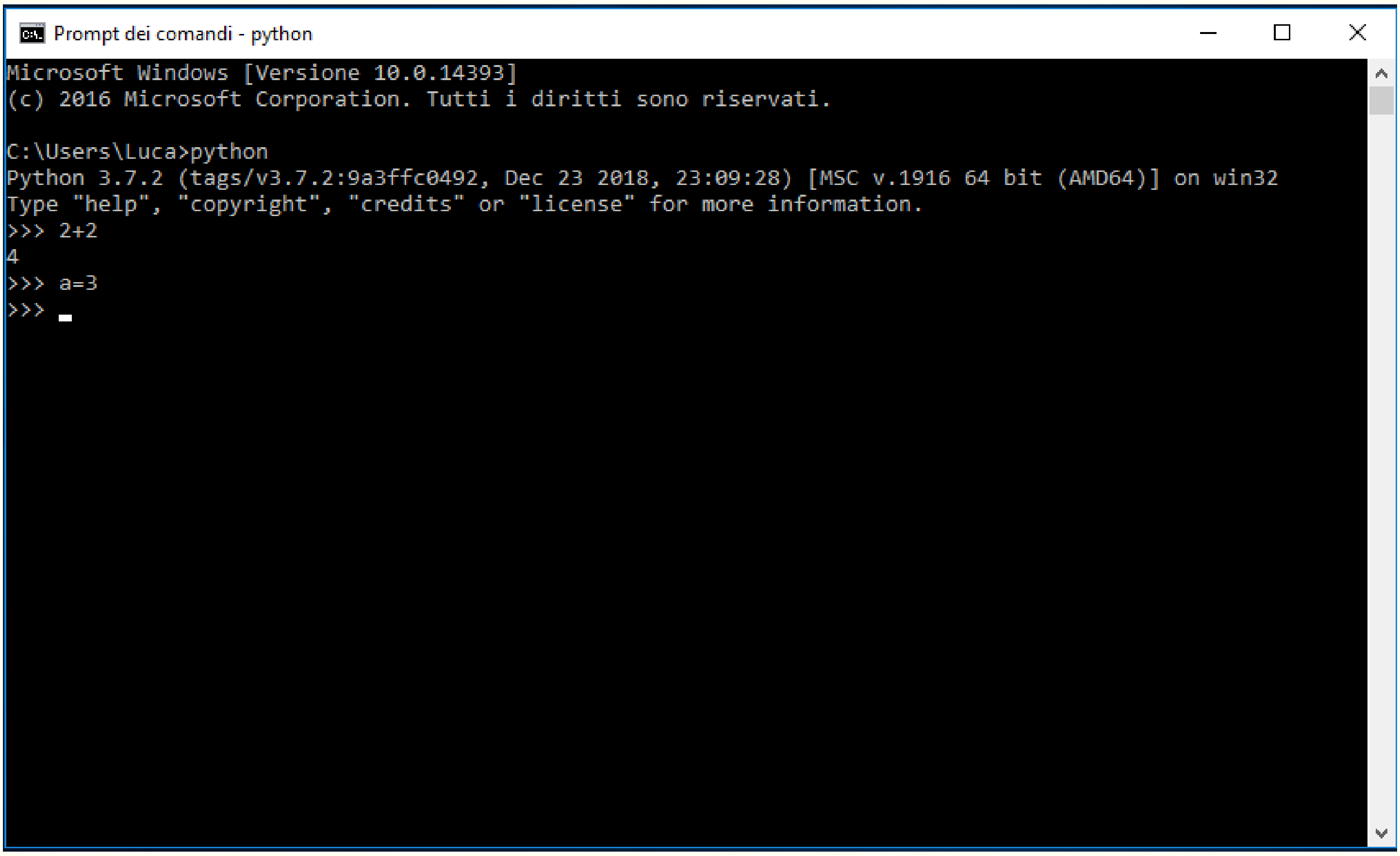

Beginner's Python -2

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Prompt dei comandi - python

```
Microsoft Windows [Versione 10.0.14393]
(c) 2016 Microsoft Corporation. Tutti i diritti sono riservati.

C:\Users\Luca>python
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 23 2018, 23:09:28) [MSC v.1916 64 bit (AMD64)] on win32
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Beginner's Python -3

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In the following we will be using extensively the Python interactive mode to illustrate many language features.

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Proceeding with the previous example...

```
>>> k
[4, 3, 2, 1]
>>> del p[2]
>>> p
[4, 3, 1]
>>> k
[4, 3, 1]
>>> p = 0
>>> p
0
>>> k
[4, 3, 1]
```

Proceeding with the previous example...

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1. The **del** statement deletes the object indicated by the argument

Proceeding with the previous example...

```
>>> k
[4, 3, 2, 1]
>>> del p[2]   ← 1
>>> p
[4, 3, 1]      ← 2
>>> k
[4, 3, 1]      ← 2
>>> p = 0      ↖
>>> p            3
0
>>> k
[4, 3, 1]      ← 4
```

1. The **del** statement deletes the object indicated by the argument
2. Both **k** and **p** are affected

Proceeding with the previous example...

```
>>> k
[4, 3, 2, 1]
>>> del p[2]  ← 1
>>> p
[4, 3, 1]  ← 2
>>> k
[4, 3, 1]  ← 2
>>> p = 0  ← 3
>>> p
0
>>> k
[4, 3, 1]  ← 4
```

1. The **del** statement deletes the object indicated by the argument
2. Both **k** and **p** are affected
3. Here the name **p** is reused

Expressions and statements -4

Proceeding with the previous example...

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>>> k
[4, 3, 2, 1]
>>> del p[2]  ← 1
>>> p
[4, 3, 1]  ← 2
>>> k
[4, 3, 1]  ← 2
>>> p = 0  ↖ 3
>>> p
0
>>> k
[4, 3, 1]  ← 4
```

1. The **del** statement deletes the object indicated by the argument
2. Both **k** and **p** are affected
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4. **k** is (obviously) not affected

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>>> p
0
>>> k
[4, 3, 1]      ← 4
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1. The **del** statement deletes the object indicated by the argument
2. Both **k** and **p** are affected
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→

Numerical types

```
>>> a = 3                ← 1
>>> a
3
>>> b = 3.1415926        ← 2
>>> b
3.1415926
>>> float(a)             ← 3
3.0
>>> int(b)               ← 3
3
>>> c = complex(a,b)     ← 4
>>> c
(3+3.1415926j)
```

Numerical types

```
>>> a = 3            ← 1
>>> a
3
>>> b = 3.1415926    ← 2
>>> b
3.1415926
>>> float(a)         ← 3
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3
>>> c = complex(a,b) ← 4
>>> c
(3+3.1415926j)
```

1. Python provides an integer type

Numerical types

```
>>> a = 3              ← 1
>>> a
3
>>> b = 3.1415926      ← 2
>>> b
3.1415926
>>> float(a)           ← 3
3.0
>>> int(b)             ← 3
3
>>> c = complex(a,b)   ← 4
>>> c
(3+3.1415926j)
```

1. Python provides an integer type
2. A float tipe

Numerical types

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>>> a = 3               ← 1
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3
>>> b = 3.1415926       ← 2
>>> b
3.1415926
>>> float(a)            ← 3
3.0
>>> int(b)              ← 3
3
>>> c = complex(a,b)    ← 4
>>> c
(3+3.1415926j)
```

1. Python provides an integer type
2. A float tipe
3. Conversion functions

Data types and expressions -1

Numerical types

```
>>> a = 3          ← 1
>>> a
3
>>> b = 3.1415926  ← 2
>>> b
3.1415926
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1. Python provides an integer type
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4. And a complex type

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3
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>>> int(b)           ← 3
3
>>> c = complex(a,b) ← 4
>>> c
(3+3.1415926j)
```

1. Python provides an integer type
2. A float tipe
3. Conversion functions
4. And a complex type

→

Numerical expressions

```
>>> a+b*c
(12.424777800000001+9.86960406437476j)
>>> a**2+b**2
18.869604064374762
>>> a**2-b**2+c
(2.1303959356252395+3.1415926j)
```

Data types and expressions -2

Numerical expressions

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>>> a+b*c          ← 1
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>>> a**2+b**2
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Data types and expressions -2

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```

1. Python's numerical expressions are pretty standard

Numerical expressions

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```

1. Python’s numerical expressions are pretty standard
2. Different (but compatible) data types are automatically converted whenever possible

Data types and expressions -2

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>>> a**2+b**2
18.869604064374762
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(2.130395935625239 5+3.1415926j)
```

1. Python’s numerical expressions are pretty standard
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Conditional expressions

```
>>> a = 7
>>> b = 9
>>> a if a>b else b
9
>>> c = a+(a if a>b else b)
>>> c
16
```

Data types and expressions -2

Numerical expressions

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>>> a+b*c          ⟵ 1
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Data types and expressions -2

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1. A conditional expression
2. Conditional expressions can be used as any other Python expression

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```

1. A conditional expression
2. Conditional expressions can be used as any other Python expression

→

Boolean type and logical expressions

```
>>> a = 3
>>> b = 9
>>> a == b
False
>>> a > b
False
>>> a < b
True
>>> c = 7
>>> c < b and c > a
True
```

Boolean type and logical expressions

```
>>> a = 3
>>> b = 9
>>> a == b
False   ← 1
>>> a > b
False
>>> a < b
True   ← 1
>>> c = 7
>>> c < b and c > a
True
```

Data types and expressions -3

Boolean type and logical expressions

```
>>> a = 3
>>> b = 9
>>> a == b      ← 2,3
False     ← 1
>>> a > b       ← 2
False
>>> a < b       ← 2
True      ← 1
>>> c = 7
>>> c < b and c > a     ← 2
True
```

Boolean type and logical expressions

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>>> a = 3
>>> b = 9
>>> a == b    ← 2,3
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False
>>> a < b    ← 2
True    ← 1
>>> c = 7
>>> c < b and c > a    ← 2
True
```

1. Python provides a boolean type with values: `True` and `False`

Boolean type and logical expressions

```
>>> a = 3
>>> b = 9
>>> a == b      ⟵ 2,3
False   ⟵ 1
>>> a > b       ⟵ 2
False
>>> a < b       ⟵ 2
True    ⟵ 1
>>> c = 7
>>> c < b and c > a     ⟵ 2
True
```

1. Python provides a boolean type with values: `True` and `False`
2. Python's logical expressions are pretty standard

Data types and expressions -3

Boolean type and logical expressions

```
>>> a = 3
>>> b = 9
>>> a == b   ← 2,3
False        ← 1
>>> a > b    ← 2
False
>>> a < b    ← 2
True         ← 1
>>> c = 7
>>> c < b and c > a   ← 2
True
```

1. Python provides a boolean type with values: `True` and `False`
2. Python's logical expressions are pretty standard
3. Note the difference between **=** (assignment symbol) and **==** (logical equality operator)

Data types and expressions -3

Boolean type and logical expressions

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>>> a = 3
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True          ← 1
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True
```

1. Python provides a boolean type with values: `True` and `False`
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→

Data types and expressions -4

Other Python types may be interpreted as True/False boolean values in logical expressions.

Note: the `bool()` function evaluates the boolean value of its argument...

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```
>>> bool(0)
False
>>> bool(127)
True
>>> bool(0.0)
False
>>> bool(0.0000001)
True
>>> bool(complex(0,0))
False
>>> bool(complex(0,0.01))
True
>>> bool("")
False
>>> bool("abc")
True
>>> bool([])
False
>>> bool([1,2,3])
True
```

Data types and expressions -4

Other Python types may be interpreted as True/False boolean values in logical expressions.

Note: the `bool()` function evaluates the boolean value of its argument...

```
>>> bool(0)                  ←  1
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>>> bool(127)                ←  1
True
>>> bool(0.0)                ←  1
False
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True
>>> bool(complex(0,0))       ←  1
False
>>> bool(complex(0,0.01))    ←  1
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Data types and expressions -4

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1. A numerical value is `False` if zero, `True` otherwise

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1. A numerical value is `False` if zero, `True` otherwise
2. A string (or any other kind of “collection”) evaluates to `False` if empty, to `True` if not empty

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→

String type and expressions

```
>>> a = "The quick brown fox"
>>> b = "jumps over the lazy dog"
>>> a+" "+b
'The quick brown fox jumps over the lazy dog'
>>> a > b
False
>>> a[2], b[7]
('e', 'v')
>>> a.upper()
'THE QUICK BROWN FOX'
>>> b.find("the")
11
>>> a.endswith("fox")
True
```

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>>> b.find("the")      ← 4
11
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>>> a = "The quick brown fox"
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>>> a+" "+b                          ← 1
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True                            |
```

1. In string expressions the symbol **+** indicates concatenation

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'THE QUICK BROWN FOX'   |
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True                    |
```

1. In string expressions the symbol **+** indicates concatenation
2. The symbols $<$, $>$ evaluate the lexical order

Data types and expressions -5

String type and expressions

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1. In string expressions the symbol **+** indicates concatenation
2. The symbols <, > evaluate the lexical order
3. Strings are also “collections of characters”

Data types and expressions -5

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1. In string expressions the symbol **+** indicates concatenation
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Data types and expressions -5

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String formatting

String interpolation with % operator

Format specifications (%d, %s, ...) in the format string are substituted by corresponding values, properly converted

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```
>>> a = 3.3
>>> b = 2
>>> c = a+b
>>> d = "%d %s %d is %d" % (a,"plus",b,c)
>>> d
'3 plus 2 is 5'
```

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```

String interpolation with the `format()` method

```
>>> a = 3.3
>>> b = 2
>>> c = a+b
>>> "{0} {2} {1} is {result}".format(a, b, "plus", result=c)
'3.3 plus 2 is 5.3'
```

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'3 plus 2 is 5'
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>>> d
'3 plus 2 is 5'
```

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'3.3 plus 2 is 5.3'
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'3 plus 2 is 5'
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>>> a = 3.3
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'3.3 plus 2 is 5.3'
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>>> d
'3 plus 2 is 5'
```

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>>> a = 3.3
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>>> "{0} {2} {1} is {result}".format(a, b, "plus", result=c)
'3.3 plus 2 is 5.3'
```

String interpolation with **f** strings

```
>>> a = 3.3
>>> b = 2
>>> c = a+b
>>> s = "plus"
>>> f"{a} {s} {b} is {c}"
'3.3 plus 2 is 5.3'
```

String formatting

String interpolation with % operator

Format specifications (%d, %s, ...) in the format string are substituted by corresponding values, properly converted

```
>>> a = 3.3
>>> b = 2
>>> c = a+b
>>> d = "%d %s %d is %d" % (a,"plus",b,c)
>>> d
'3 plus 2 is 5'
```

String interpolation with the `format()` method

```
>>> a = 3.3
>>> b = 2
>>> c = a+b
>>> "{0} {2} {1} is {result}".format(a, b, "plus", result=c)
'3.3 plus 2 is 5.3'
```

String interpolation with **f** strings

```
>>> a = 3.3
>>> b = 2
>>> c = a+b
>>> s = "plus"
>>> f"{a} {s} {b} is {c}"
'3.3 plus 2 is 5.3'
```

← 1

String formatting

String interpolation with % operator

Format specifications (%d, %s, ...) in the format string are substituted by corresponding values, properly converted

```
>>> a = 3.3
>>> b = 2
>>> c = a+b
>>> d = "%d %s %d is %d" % (a,"plus",b,c)
>>> d
'3 plus 2 is 5'
```

String interpolation with the `format()` method

```
>>> a = 3.3
>>> b = 2
>>> c = a+b
>>> "{0} {2} {1} is {result}".format(a, b, "plus", result=c)
'3.3 plus 2 is 5.3'
```

String interpolation with **f** strings

```
>>> a = 3.3
>>> b = 2
>>> c = a+b
>>> s = "plus"
>>> f"{a} {s} {b} is {c}"   ← 1
'3.3 plus 2 is 5.3'
```

1. Here we use directly variable names

String interpolation with % operator

Format specifications (%d, %s, ...) in the format string are substituted by corresponding values, properly converted

```
>>> a = 3.3
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'3 plus 2 is 5'
```

String interpolation with the `format()` method

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>>> a = 3.3
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String interpolation with **f** strings

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1. Here we use directly variable names

→

The *None* type

Python provides a **None** type to express ”non existent” or ”undefined” values

The *None* type

Python provides a **None** type to express ”non existent” or ”undefined” values

```
>>> a = None
>>> type(a)
<class 'NoneType'>

>>> a+1
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: unsupported operand type(s) for +: 'NoneType' and 'int'

>>> "abc"+a
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: must be str, not NoneType

>>> bool(a)
False
```

The *None* type

Python provides a **None** type to express ”non existent” or ”undefined” values

```
>>> a = None     ← 1
>>> type(a)
<class 'NoneType'>

>>> a+1     ← 2
Traceback (most recent call last):
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>>> "abc"+a     ← 3
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: must be str, not NoneType

>>> bool(a)     ← 4
False
```

Data types and expressions -6

The *None* type

Python provides a **None** type to express ”non existent” or ”undefined” values

```
>>> a = None        ← 1
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Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: unsupported operand type(s) for +: 'NoneType' and 'int'

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False
```

1. None is a constant of type `None`

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Traceback (most recent call last):
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TypeError: must be str, not NoneType

>>> bool(a)     ← 4
False
```

1. None is a constant of type `None`
2. None is not an integer ...

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>>> type(a)
<class 'NoneType'>

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Traceback (most recent call last):
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TypeError: must be str, not NoneType

>>> bool(a)        ← 4
False
```

1. None is a constant of type `None`
2. None is not an integer ...
3. None is not a string ...

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>>> a = None    ← 1
>>> type(a)
<class 'NoneType'>

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Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
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>>> "abc"+a    ← 3
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>>> bool(a)    ← 4
False
```

1. None is a constant of type `None`
2. None is not an integer ...
3. None is not a string ...
4. None is logically *False* ...

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>>> bool(a)        ← 4
False
```

1. None is a constant of type `None`
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3. None is not a string ...
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→

Conditional statement

Conditional statement

```
>>> a = 7
>>> b = 9
>>> if a>b:
...     print(a,">",b)
...     c = a+a
... elif a<b:
...     print(b,">",a)
...     c = a+b
... else:
...     print(a,"=",b)
...     c = a*2
...
9 > 7
>>> c
16
```

Conditional statement

```
>>> a = 7
>>> b = 9
>>> if a>b:          ← 1, 2
...     print(a,">",b)
...     c = a+a       ← 3
... elif a<b:
...     print(b,">",a)
...     c = a+b       ← 3
... else:
...     print(a,"=",b)
...     c = a*2       ← 3
...
9 > 7
>>> c
16
```

Conditionals and loops -1

Conditional statement

```
>>> a = 7
>>> b = 9
>>> if a>b:          ← 1, 2
...     print(a,">",b)
...     c = a+a          ← 3
... elif a<b:
...     print(b,">",a)
...     c = a+b          ← 3
... else:
...     print(a,"=",b)
...     c = a*2          ← 3
...
9 > 7
>>> c
16
```

1. Conditional statements use keywords: **if**, **elif**, **else**

Conditional statement

```
>>> a = 7
>>> b = 9
>>> if a>b:          ← 1, 2
...     print(a,">",b)
...     c = a+a      ← 3
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...     print(b,">",a)
...     c = a+b      ← 3
... else:
...     print(a,"=",b)
...     c = a*2      ← 3
...
9 > 7
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16
```

1. Conditional statements use keywords: **if**, **elif**, **else**
2. Note the colon (**:**) at the end of the conditional clause

Conditionals and loops -1

Conditional statement

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>>> a = 7
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>>> if a>b:              ← 1, 2
...     print(a,">",b)
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...     c = a+b          ← 3
... else:
...     print(a,"=",b)
...     c = a*2          ← 3
...
9 > 7
>>> c
16
```

1. Conditional statements use keywords: **if**, **elif**, **else**
2. Note the colon (**:**) at the end of the conditional clause
3. Conditional blocks are <u>indented</u>

Conditionals and loops -1

Conditional statement

```
>>> a = 7
>>> b = 9
>>> if a>b:          ← 1, 2
...     print(a,">",b)
...     c = a+a       ← 3
... elif a<b:
...     print(b,">",a)
...     c = a+b       ← 3
... else:
...     print(a,"=",b)
...     c = a*2       ← 3
...
9 > 7
>>> c
16
```

1. Conditional statements use keywords: **if**, **elif**, **else**
2. Note the colon (**:**) at the end of the conditional clause
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In Python text alignment is meaningful!

The amount of space before statements is arbitrary, provided it is the same for all the statements of the block.

Conditionals and loops -1

Conditional statement

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>>> a = 7
>>> b = 9
>>> if a>b:     ←  1, 2
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... elif a<b:
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...     c = a+b      ←  3
... else:
...     print(a,"=",b)
...     c = a*2      ←  3
...
9 > 7
>>> c
16
```

1. Conditional statements use keywords: **if**, **elif**, **else**
2. Note the colon (**:**) at the end of the conditional clause
3. Conditional blocks are indented

> In Python text alignment is meaningful!
>
> The amount of space before statements is arbitrary, provided it is the same for all the statements of the block.

→

The while loop

The loop block is repeated until the condition becomes `False`

```
>>> a = 5
>>> while a>1:
...     print("a =",a)
...     a -= 1
...
a = 5
a = 4
a = 3
a = 2
>>>
```

Conditionals and loops -2

The `while` loop

The loop block is repeated until the condition becomes `False`

```
>>> a = 5
>>> while a>1:
...     print("a =",a)    ← 1
...     a -= 1
...
a = 5
a = 4
a = 3
a = 2
>>>
```

The while loop

The loop block is repeated until the condition becomes `False`

```
>>> a = 5
>>> while a>1:
...     print("a =",a)      ← 1
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...
a = 5
a = 4
a = 3
a = 2
>>>
```

1. Again, the loop block is indented

The `while` loop

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```
>>> a = 5
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...    a -= 1
...
a = 5
a = 4
a = 3
a = 2
>>>
```

1. Again, the loop block is indented

The `for` loop

Python's `for` loop iterates on the elements of a collection

```
>>> for c in "Hi there!":
...   print(c)
...
H
i

t
h
e
r
e
!
>>>
```

The `while` loop

> The loop block is repeated until the condition becomes `False`

```
>>> a = 5
>>> while a>1:
...     print("a =",a)     ← 1
...     a -= 1
...
a = 5
a = 4
a = 3
a = 2
>>>
```

1. Again, the loop block is indented

The `for` loop

> Python's `for` loop iterates on the elements of a collection

```
>>> for c in "Hi there!":
...   print(c)
...
H
i

t
h
e
r
e
!
>>>
```

The break statement

```
>>> for c in "Hi there!":
...   if c==" ":
...      break
...   print(c)
...
H
i
>>>
```

The break statement

```
>>> for c in "Hi there!":
...   if c==" ":
...     break ⟵
...   print(c)
...
H
i
>>>
```

The break statement

```
>>> for c in "Hi there!":
...   if c==" ":
...      break ←
...   print(c)
...
H
i
>>>
```

- Loops can be interrupted before their “natural” end with the `break` statement

The `break` statement

```
>>> for c in "Hi there!":
...   if c==" ":
...      break
...   print(c)
...
H
i
>>>
```

- Loops can be interrupted before their “natural” end with the `break` statement

The `continue` statement

```
>>> for c in "Hi there!":
...  if c in " !":
...    continue
...  print(c)
...
H
i
t
h
e
r
e
>>>
```

The break statement

```
>>> for c in "Hi there!":
...   if c==" ":
...      break ←
...   print(c)
...
H
i
>>>
```

- Loops can be interrupted before their “natural” end with the `break` statement

The continue statement

```
>>> for c in "Hi there!":
...  if c in " !": ← 2
...    continue  ← 1
...  print(c)
...
H
i
t
h
e
r
e
>>>
```

The break statement

```
>>> for c in "Hi there!":
...    if c==" ":
...       break ←
...    print(c)
...
H
i
>>>
```

- Loops can be interrupted before their “natural” end with the `break` statement

The continue statement

```
>>> for c in "Hi there!":
...   if c in " !":  ← 2
...     continue   ← 1
...   print(c)
...
H
i
t
h
e
r
e
>>>
```

1. The normal flux of a loop can be modified by the `continue` statement, which jumps to the next iteration

The `break` statement

```
>>> for c in "Hi there!":
...   if c==" ":
...      break  ⟵
...   print(c)
...
H
i
>>>
```

- Loops can be interrupted before their “natural” end with the `break` statement

The `continue` statement

```
>>> for c in "Hi there!":
...  if c in " !":  ⟵ 2
...    continue  ⟵ 1
...  print(c)
...
H
i
t
h
e
r
e
>>>
```

1. The normal flux of a loop can be modified by the `continue` statement, which jumps to the next iteration
2. Note another use of the keyword **in**

The break statement

```
>>> for c in "Hi there!":
...    if c==" ":
...       break  ⟵
...    print(c)
...
H
i
>>>
```

- Loops can be interrupted before their “natural” end with the `break` statement

The continue statement

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>>> for c in "Hi there!":
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...   print(c)
...
H
i
t
h
e
r
e
>>>
```

1. The normal flux of a loop can be modified by the `continue` statement, which jumps to the next iteration
2. Note another use of the keyword **in**

⟶

Collections

```
>>> atuple = (1, 2, 4, "five", 6.0, -7, "VIII")
>>> alist = [1, "due", 3, "five", 7.96]
>>> adict = {1:"one", 2:2, 3:3.1415926, "five":5}
>>> aset = set(atuple)
>>> text = "Hi there!"
```

Collections

```
>>> atuple = (1, 2, 4, "five", 6.0, -7, "VIII")  ← 1
>>> alist = [1, "due", 3, "five", 7.96]  ← 2
>>> adict = {1:"one", 2:2, 3:3.1415926, "five":5}  ← 3
>>> aset = set(atuple)  ← 4
>>> text = "Hi there!"  ← 5
```

Collections

```
>>> atuple = (1, 2, 4, "five", 6.0, -7, "VIII")  ← 1
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```

1. *tuple*: non mutable collection of objects, possibly different in type. Referenced by **index**.

Collections

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```

1. *tuple*: non mutable collection of objects, possibly different in type. Referenced by **index**.
2. *list*: mutable collection of objects, possibly different in type. Referenced by **index**

Collections

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1. *tuple*: non mutable collection of objects, possibly different in type. Referenced by **index**.
2. *list*: mutable collection of objects, possibly different in type. Referenced by **index**
3. *dictionary*: mutable collection of objects, possibly different in type. Referenced by **key**

Collections

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>>> atuple = (1, 2, 4, "five", 6.0, -7, "VIII") ← 1
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>>> text = "Hi there!" ← 5
```

1. *tuple*: non mutable collection of objects, possibly different in type. Referenced by **index**.
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4. *set*: mutable collection of unique objects, (*frozenset*: non mutable). Supports usual operations on sets

Collections

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```

1. *tuple*: non mutable collection of objects, possibly different in type. Referenced by **index**.
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Collections

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```

1. *tuple*: non mutable collection of objects, possibly different in type. Referenced by **index**.
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5. *string*: non mutable collection of characters

→

Collections -2

From the Manual:

Operation	Result
`x in s`	*True* if any element of **s** is equal to **x**, else *False*
`x not in s`	*False* if any element of **s** is equal to **x**, else *True*
`s+t`	concatenation of **s** and **t**
`s*n, n*s`	**s** + **s** + **s** + ... **n** times (**n** integer)
`s[i]`	i*th* element of **s** (base 0)
`s[i:j]`	slice of **s** from i*th* to (j-1)*th*
`s[i:j:k]`	slice of **s** from i*th* to (j-1)*th*, with stride k
`len(s)`	length (number of elements) of **s**
`min(s)`	the smallest element in **s**
`max(s)`	the greatest element in **s**
`s.index(x)`	index of the first occurrence of x in **s**
`s.count(x)`	number of occurrences of x in **s**

Collections -2

From the Manual:

Operation	Result	
`x in s`	*True* if any element of **s** is equal to **x**, else *False*	-1
`x not in s`	*False* if any element of **s** is equal to **x**, else *True*	
`s+t`	concatenation of **s** and **t**	-2
`s*n, n*s`	**s** + **s** + **s** + ... **n** times (**n** integer)	
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-1

-2

1. What's the meaning if **s** is a dictionary?

From the Manual:

Operation	Result	
`x in s`	*True* if any element of **s** is equal to **x**, else *False*	-1
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`s+t`	concatenation of **s** and **t**	-2
`s*n, n*s`	**s** + **s** + **s** + ... **n** times (**n** integer)	
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`s[i:j]`	slice of **s** from i*th* to (j-1)*th*	
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`min(s)`	the smallest element in **s**	
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`s.index(x)`	index of the first occurrence of x in **s**	
`s.count(x)`	number of occurrences of x in **s**	

1. What's the meaning if **s** is a dictionary?
2. We have seen already the **+** sign with the meaning of concatenation

Collections -2

From the Manual:

Operation	Result	
`x in s`	*True* if any element of **s** is equal to **x**, else *False*	-1
`x not in s`	*False* if any element of **s** is equal to **x**, else *True*	
`s+t`	concatenation of **s** and **t**	-2
`s*n, n*s`	**s** + **s** + **s** + ... **n** times (**n** integer)	
`s[i]`	i*th* element of **s** (base 0)	
`s[i:j]`	slice of **s** from i*th* to (j-1)*th*	
`s[i:j:k]`	slice of **s** from i*th* to (j-1)*th*, with stride k	
`len(s)`	length (number of elements) of **s**	
`min(s)`	the smallest element in **s**	
`max(s)`	the greatest element in **s**	
`s.index(x)`	index of the first occurrence of x in **s**	
`s.count(x)`	number of occurrences of x in **s**	

1. What's the meaning if **s** is a dictionary?
2. We have seen already the **+** sign with the meaning of concatenation

→

Comprehension

```
>>> atuple
(1, 2, 4, 'five', 6.0, -7, 'VIII')
>>> newlist = [x*x for x in atuple if type(x) in (int, float)]
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Collections -3

Comprehension

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1. Powerful syntax to create collections from other collections

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2. Here we created a list from a tuple

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1. Powerful syntax to create collections from other collections
2. Here we created a list from a tuple

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>>> kk = ("one", "two", "three")
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>>> newdict = {k: v for k, v in zip(kk, vv)}
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>>> list(zip(kk, vv))
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# Example code

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Functions and arguments -1

file: funny.py (function **definition**)

```
def funny(a, b, default=3.1415926, toint=False):
    if toint:
        cvt = lambda x: int(x)
    else:
        cvt = lambda x: x
    if a > b:
        return cvt(a)
    elif a < b:
        return cvt(b)
    return cvt(default)
```

Functions and arguments -1

file: `funny.py` (function **definition**)

```
def funny(a, b, default=3.1415926, toint=False):  ⟵ 1, 2
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1. a, b: **positional** arguments

Functions and arguments -1

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Functions and arguments -1

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Functions and arguments -1

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How to use functions (function **call**):

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Traceback (most recent call last):
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Functions and arguments -2

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Functions and arguments -2

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Functions and arguments -2

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Functions and arguments -3

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Functions and arguments -4

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Let's see the general case:

file: `showarg.py`

```
def showarg(a, b, d=15, *pos, **kw):
    print("Positional required arguments (a,b):", a, b)
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→

Calling `showarg()`:

```
>>> from showarg import showarg

>>> showarg(1, 2)
Positional required arguments (a,b): 1 2
Standard named arguments (d): 15
Positional variable arguments (pos): ()
Named variable arguments (kw): {}

>>> showarg(1, 2, 3, 4, 5, 6, opt1=7, opt2=8)
Positional required arguments (a,b): 1 2
Standard named arguments (d): 3
Positional variable arguments (pos): (4, 5, 6)
Named variable arguments (kw): {'opt1': 7, 'opt2': 8}
```

Functions and arguments -5

Calling showarg():

```
>>> from showarg import showarg

>>> showarg(1, 2)   ← 1
Positional required arguments (a,b): 1 2
Standard named arguments (d): 15   ← 2
Positional variable arguments (pos): ()   ← 3
Named variable arguments (kw): {}   ← 3

>>> showarg(1, 2, 3, 4, 5, 6, opt1=7, opt2=8)   ← 4
Positional required arguments (a,b): 1 2
Standard named arguments (d): 3   ← 5
Positional variable arguments (pos): (4, 5, 6)
Named variable arguments (kw): {'opt1': 7, 'opt2': 8}
```

Calling showarg():

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>>> from showarg import showarg

>>> showarg(1, 2)   ← 1
Positional required arguments (a,b): 1 2
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Positional variable arguments (pos): ()   ← 3
Named variable arguments (kw): {}   ← 3

>>> showarg(1, 2, 3, 4, 5, 6, opt1=7, opt2=8)   ← 4
Positional required arguments (a,b): 1 2
Standard named arguments (d): 3   ← 5
Positional variable arguments (pos): (4, 5, 6)
Named variable arguments (kw): {'opt1': 7, 'opt2': 8}
```

1. Call with required arguments only

Calling `showarg()`:

```
>>> from showarg import showarg

>>> showarg(1, 2)   ← 1
Positional required arguments (a,b): 1 2
Standard named arguments (d): 15   ← 2
Positional variable arguments (pos): ()   ← 3
Named variable arguments (kw): {}   ← 3

>>> showarg(1, 2, 3, 4, 5, 6, opt1=7, opt2=8)   ← 4
Positional required arguments (a,b): 1 2
Standard named arguments (d): 3   ← 5
Positional variable arguments (pos): (4, 5, 6)
Named variable arguments (kw): {'opt1': 7, 'opt2': 8}
```

1. Call with required arguments only
2. The optional argument gets the default value

Functions and arguments -5

Calling `showarg()`:

```
>>> from showarg import showarg

>>> showarg(1, 2)  ← 1
Positional required arguments (a,b): 1 2
Standard named arguments (d): 15  ← 2
Positional variable arguments (pos): ()  ← 3
Named variable arguments (kw): {}  ← 3

>>> showarg(1, 2, 3, 4, 5, 6, opt1=7, opt2=8)  ← 4
Positional required arguments (a,b): 1 2
Standard named arguments (d): 3  ← 5
Positional variable arguments (pos): (4, 5, 6)
Named variable arguments (kw): {'opt1': 7, 'opt2': 8}
```

1. Call with required arguments only
2. The optional argument gets the default value
3. Variable arguments (not specified in the call) are empty

Calling `showarg()`:

```
>>> from showarg import showarg

>>> showarg(1, 2)                                  ← 1
Positional required arguments (a,b): 1 2
Standard named arguments (d): 15                   ← 2
Positional variable arguments (pos): ()            ← 3
Named variable arguments (kw): {}                  ← 3

>>> showarg(1, 2, 3, 4, 5, 6, opt1=7, opt2=8)      ← 4
Positional required arguments (a,b): 1 2
Standard named arguments (d): 3                    ← 5
Positional variable arguments (pos): (4, 5, 6)
Named variable arguments (kw): {'opt1': 7, 'opt2': 8}
```

1. Call with required arguments only
2. The optional argument gets the default value
3. Variable arguments (not specified in the call) are empty
4. Call with variable arguments both positional and named

Functions and arguments -5

Calling `showarg()`:

```
>>> from showarg import showarg

>>> showarg(1, 2)  ⟵ 1
Positional required arguments (a,b): 1 2
Standard named arguments (d): 15  ⟵ 2
Positional variable arguments (pos): ()  ⟵ 3
Named variable arguments (kw): {}  ⟵ 3

>>> showarg(1, 2, 3, 4, 5, 6, opt1=7, opt2=8)  ⟵ 4
Positional required arguments (a,b): 1 2
Standard named arguments (d): 3  ⟵ 5
Positional variable arguments (pos): (4, 5, 6)
Named variable arguments (kw): {'opt1': 7, 'opt2': 8}
```

1. Call with required arguments only
2. The optional argument gets the default value
3. Variable arguments (not specified in the call) are empty
4. Call with variable arguments both positional and named
5. The named argument is specified positionally in the call

Functions and arguments -5

Calling showarg():

```
>>> from showarg import showarg

>>> showarg(1, 2)                                          ← 1
Positional required arguments (a,b): 1 2
Standard named arguments (d): 15                           ← 2
Positional variable arguments (pos): ()                    ← 3
Named variable arguments (kw): {}                          ← 3

>>> showarg(1, 2, 3, 4, 5, 6, opt1=7, opt2=8)             ← 4
Positional required arguments (a,b): 1 2
Standard named arguments (d): 3                            ← 5
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Named variable arguments (kw): {'opt1': 7, 'opt2': 8}
```

1. Call with required arguments only
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→

Functions and arguments -6

Python allows to put arbitrary argument lists in the function call with a syntax analogous to variable argument lists in function definition.

Functions and arguments -6

Python allows to put arbitrary argument lists in the function call with a syntax analogous to variable argument lists in function definition.

Another way to call `showarg()`:

```
>>> ps=(10,11,12)
>>> ak={"arg1":13, "arg2":14, "arg3":15}

>>> showarg(1, 2, 3, 4, 5, 6, opt1=7, opt2=8, *ps, **ak)
Positional required arguments (a,b): 1 2
Standard named arguments (d): 3
Positional variable arguments (pos): (4, 5, 6, 10, 11, 12)
Named variable arguments (kw): {'opt1': 7, 'opt2': 8, 'arg3': 15,
 'arg2': 14, 'arg1': 13}
```

Functions and arguments -6

> Python allows to put arbitrary argument lists in the function call with a syntax analogous to variable argument lists in function definition.

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Positional required arguments (a,b): 1 2
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 'arg2': 14, 'arg1': 13}   ← 4
```

1. Definition of a *tuple* (**ps**) for additional positional arguments

Functions and arguments -6

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Positional variable arguments (pos): (4, 5, 6, 10, 11, 12) ⟵ 3
Named variable arguments (kw): {'opt1': 7, 'opt2': 8, 'arg3': 15,
 'arg2': 14, 'arg1': 13}  ⟵ 4
```

1. Definition of a *tuple* (**ps**) for additional positional arguments
2. Definition of a *dictionary* (**ak**) for additional named arguments

Functions and arguments -6

Python allows to put arbitrary argument lists in the function call with a syntax analogous to variable argument lists in function definition.

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```
>>> ps=(10,11,12)  ⟵ 1
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>>> showarg(1, 2, 3, 4, 5, 6, opt1=7, opt2=8, *ps, **ak)
Positional required arguments (a,b): 1 2
Standard named arguments (d): 3
Positional variable arguments (pos): (4, 5, 6, 10, 11, 12)  ⟵ 3
Named variable arguments (kw): {'opt1': 7, 'opt2': 8, 'arg3': 15,
 'arg2': 14, 'arg1': 13}  ⟵ 4
```

1. Definition of a *tuple* (**ps**) for additional positional arguments
2. Definition of a *dictionary* (**ak**) for additional named arguments
3. The **pos** *tuple* in the function “receives” positional parameters other than required ones and the content of **ps** *tuple* from the call

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```
>>> ps=(10,11,12)          ← 1
>>> ak={"arg1":13, "arg2":14, "arg3":15}          ← 2

>>> showarg(1, 2, 3, 4, 5, 6, opt1=7, opt2=8, *ps, **ak)
Positional required arguments (a,b): 1 2
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Positional variable arguments (pos): (4, 5, 6, 10, 11, 12)          ← 3
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1. Definition of a *tuple* (**ps**) for additional positional arguments
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3. The **pos** *tuple* in the function “receives” positional parameters other than required ones and the content of **ps** *tuple* from the call
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Functions and arguments -6

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1. Definition of a *tuple* (**ps**) for additional positional arguments
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→

End of Part I