Leiden University
Medical Center

Python Programming

Flow Control

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Outline

Working with scripts

Interpreters are great for prototyping, but not really suitable if you want to share or release code. To do so, we write our Python commands in scripts (and later, modules). A script is a simple text file containing Python instructions to execute.

Executing scripts

There are two common ways to execute a script:

- As an argument of the Python interpreter command.
- As a standalone executable (with the appropriate shebang line and file mode).

IPython gives you a third option:

- As an argument of the `%run` magic.

Writing your script

Let's start with a simple hello world example.

Open your text editor and write the following Python statement:

first_script.py

```
1 print("Hello world!")
```

Save the file as first_script.py and go to your shell.

Running the script

Let's try the first method, i.e., using your script as an argument:

terminal

```
$ python first_script.py
```

Is the output as you expect?

Running the script

For the second method, we need to do two more things:

- Open the script in your editor and add the following line to the very top:
  - *#!/usr/bin/env python*
- Save the file, go back to the shell, and allow the file to be executed.

terminal

```
$ chmod +x first_script.py
```

You can now execute the file directly:

terminal

```
$ ./first_script.py
```

Is the output the same as the previous method?

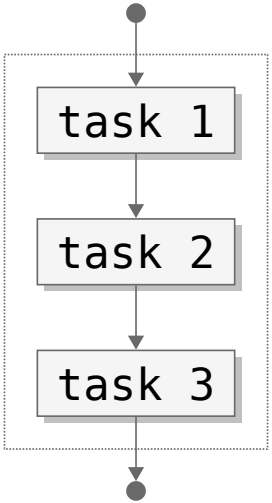
Running the script

Finally, try out the third method. Open an IPython interpreter session and do:

IPython

```
In [1]: %run first_script.py
```

Sequential Execution



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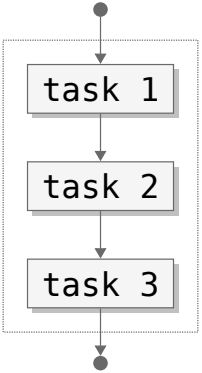

sum.py

```
1  a = 100
2  b = 200
3  print(a+b)
```

terminal

```
$ python sum.py
300
```

Intermezzo - User input

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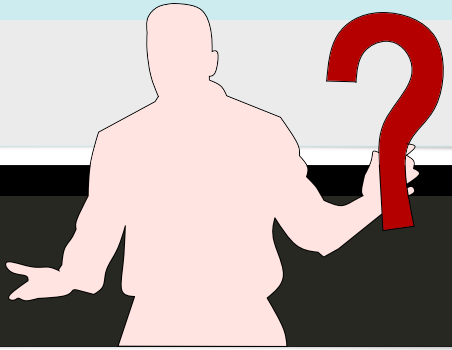

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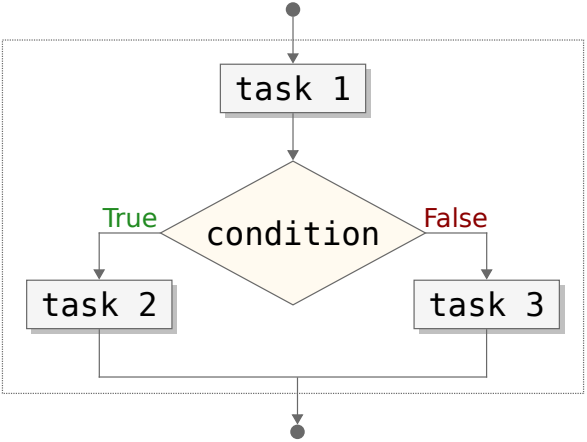
Conditionals



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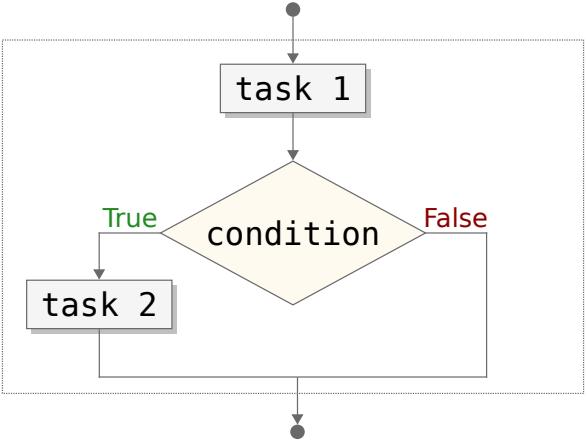

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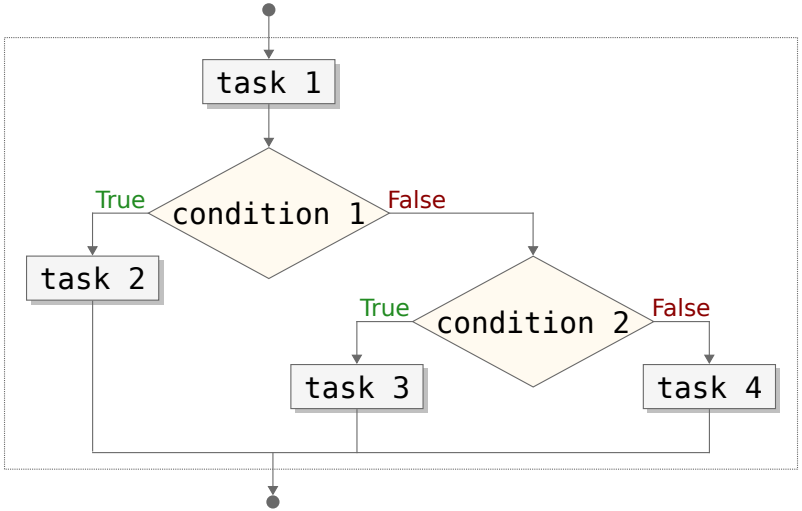

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IPython

```
In [14]: bool(0)
Out[14]: False

In [15]: bool(1)
Out[15]: True

In [16]: bool([False])
Out[16]: True
```

Comparisons

Operation	Meaning	Example
`<`	strictly less than	`x < y`
`<=`	less than or equal	`x <= y`
`>`	strictly greater than	`x > y`
`>=`	greater than or equal	`x >= y`
`==`	equal	`x == y`
`!=`	not equal	`x != y`
`is`	object identity	`x is y`
`is not`	negated object identity	`x is not y`

Comparisons

IPython

```
In [17]: 3 < 4
Out[17]: True

In [18]: 3 <= 3.5
Out[18]: True

In [19]: 3 == 3.0
Out[19]: True

In [20]: 3 is 3.0
Out[20]: False

In [21]: 3 is 3
Out[21]: True
```

Boolean (Logical) Operations

Operation	Result	Notes
`x or y`	if `x` is false, then `y`, else `x`	(1)
`x and y`	if `x` is false, then `x`, else `y`	(2)
`not x`	if `x` is false, then `True`, else `False`	(3)

1. It evaluates `y` only if `x` is false.
2. It evaluates `y` only if `x` is true.
3. `not x == y` is interpreted as `not (x == y)` and `x == not y` is a syntax error.

Boolean (Logical) Operations

x	y	x or y	x and y
True	True	True	True
True	False	True	False
False	True	True	False
False	False	False	False

Boolean (Logical) Operations

IPython

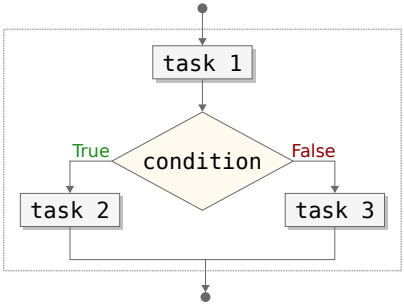
```
In [22]: 3 < 4 and 5 <= 10
Out[22]: True

In [23]: 3 < 4 or 5 <= 10
Out[23]: True

In [24]: 3 < 4 and 5 > 10
Out[24]: False

In [25]: 3 < 4 and 5 > 10
Out[25]: True
```

`if` statement



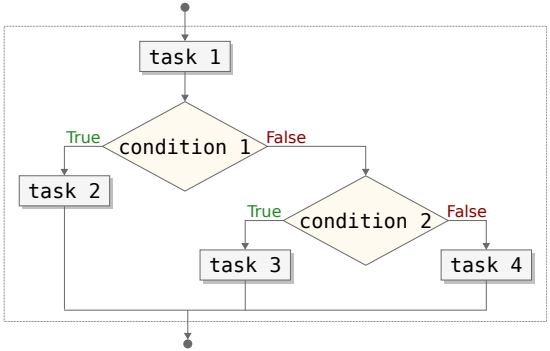
max.py

```
1  a = int(input('a = '))
2  b = int(input('b = '))
3
4  if a > b:
5      print(a)
6  else:
7      print(b)
```

terminal

```
$ python max.py
a = 100
b = 200
200
```

`if` statement



compare.py

```
1  a = int(input('a = '))
2  b = int(input('b = '))
3
4  if a > b:
5      print(a)
6  elif a == b:
7      print('equal')
8  else:
9      print(b)
```

terminal

```
$ python compare.py
a = 100
b = 100
equal
```

Indentation

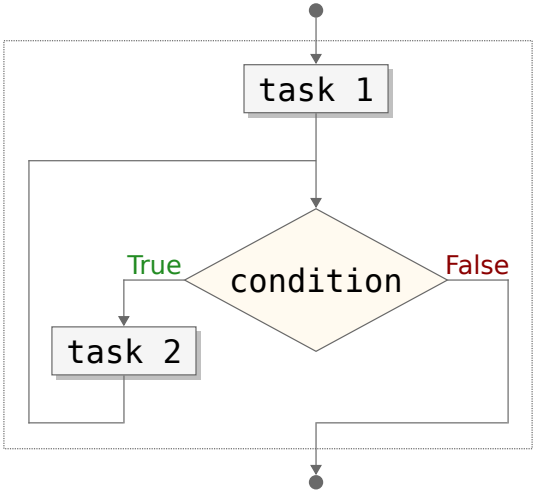
Python uses indentation to delimit blocks

- Instead of `begin ... end` or `{ ... }` in other languages.
- Always increase indentation by 4 spaces, never use tabs.
  - In any case, be consistent.

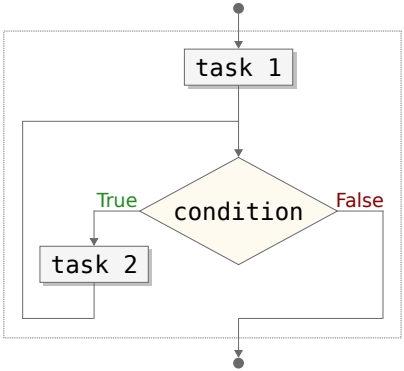
indentation_example.py

```
1 if False:
2     if False:
3         print('Why am I here?')
4     else:
5         while True:
6             print('When will it stop?')
7     print("And we're back to the first indentation level")
```

Loops



`while` statement



while_example.py

```
1 i = 0
2 while i < 5:
3     print(i)
4     i += 1
```

terminal

```
$ python while_example.py
0
1
2
3
4
```

`for` statement

Used to iterate over a sequence.

for_example.py

```
1 colors = ['red', 'white', 'blue', 'orange']
2
3 for color in colors:
4     print(color)
```

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```
1  colors = ['red', 'white', 'blue', 'orange']
2
3  for color in colors:
4      print(color)
```

terminal

```
$ python for_example.py
red
white
blue
orange
```

Python anti-patterns

These are common for programmers coming from other languages.

unpythonic.py

```
1  i = 0
2  while i < len(colors):
3      print(colors[i])
4      i += 1
5
6  for i in range(len(colors)):
7      print(colors[i])
```

We call them unpythonic.

Additionals

iteration.py

```
# Iteration with values and indices:
for i, color in enumerate(['red', 'yellow', 'blue']):
    print(i, '->', color)

# Taking two sequences together:
for city, population in zip(['Delft', 'Leiden'], [101030, 121562]):
    print(city, '->', population)

# Iterating over a dictionary yields keys:
for key in {'a': 33, 'b': 17, 'c': 18}:
    print(key)

# Iterating over a file yields lines:
for line in open('data/short_file.txt'):
    print(line)
```

The pass statement

If you ever need a statement syntactically but don't want to do anything, use `pass`.

comments_example.py

```
1 while False:
2     # This is never executed anyway.
3     pass
```

Comments

Comments are prepended by # and completely ignored.

comments_example.py

```
1 # Create the list.
2 l = []
3
4 # Add 42 to this list.
5 l.append(42)
```

Hands on!

1. Write a program that prints those numbers which are divisible by 13 and multiple of 5, between 10 and 1313 (both included).