

Python Programming

Flow Control



Outline

Sequential Execution

Conditionals

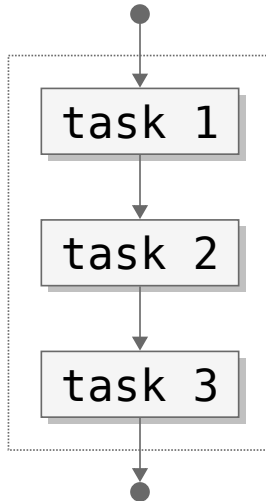
Indentation

Loops

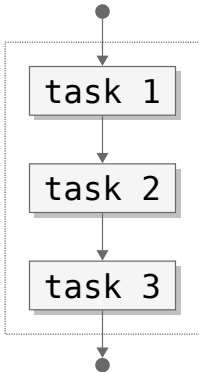
Comprehensions

Hands on!

Sequential Execution



Sequential Execution



sum.py

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

terminal

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

Intermezzo - User input

Performed with the `input([prompt])` built-in function:

- If the `prompt` argument is present, it is written to the standard output.
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a = 100
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100200
```

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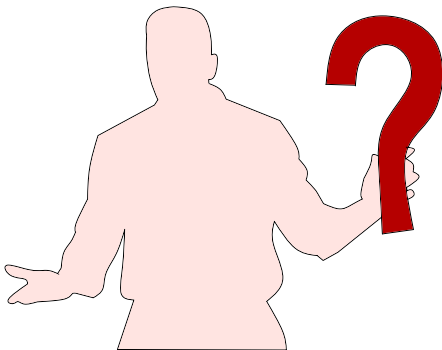
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sum.py

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```

terminal

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a = 100
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300
```

Sequential Execution

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1 a = int(input('a = '))
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3 print(a+b)
```

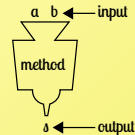
terminal

```
$ python sum.py
a = 100
b = 200
300
```

$$\underbrace{100}_a + \underbrace{200}_b = 300$$

a = 100
b = 200
s = a + b

a = from the user
b = from the user
s = a + b
return "s" (print?)



Intermezzo - Comments

Comments are prepended by `#` and completely ignored.

sum.py

```
1  # Retrieve the input
2  a = int(input('a = '))
3  b = int(input('b = '))
4
5  # Compute and display the result
6  print(a+b)
```

Conditionals

Sequential Execution

Conditionals

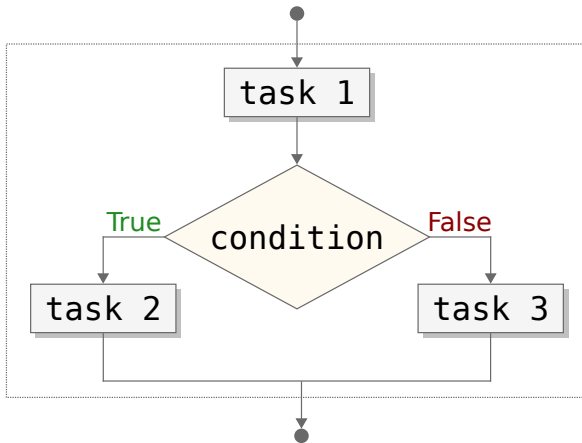
Indentation

Loops

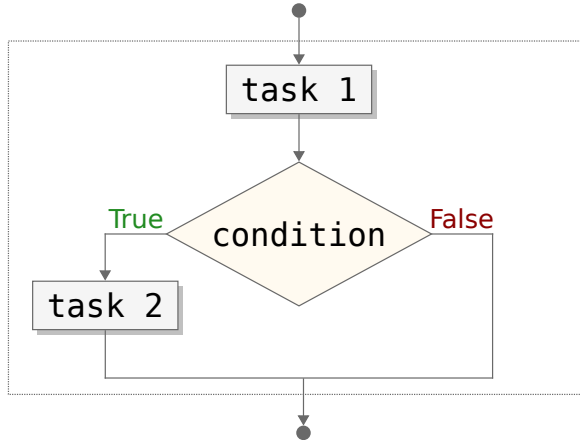
Comprehensions

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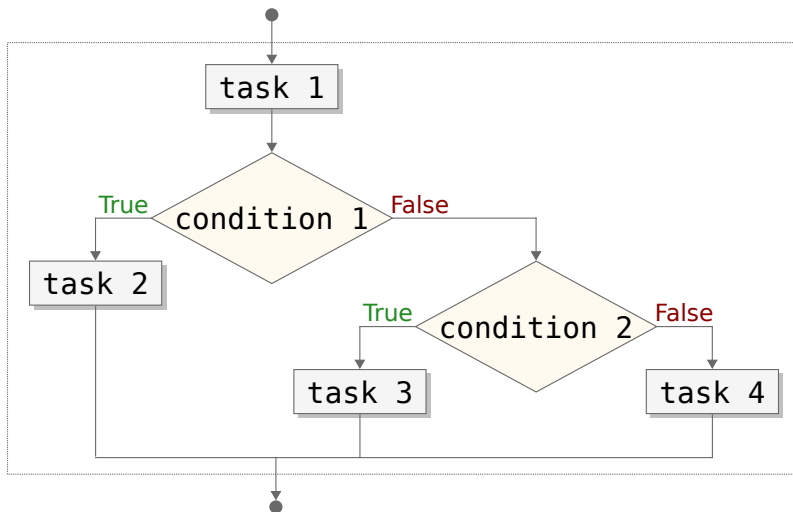
Conditionals



Conditionals



Conditionals



Truth Value Testing

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 - empty sequences and collections: `''` , `()` , `[]` , `{}` , `set()` , `range(0)` .

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 - empty sequences and collections: `''`, `()`, `[]`, `{}`, `set()`, `range(0)`.
- For the moment, let's assume that any other object is considered **true**.

IPython

```
In [13]: bool(0)
```

```
Out[13]: False
```

```
In [14]: bool(1)
```

```
Out[14]: True
```

```
In [15]: bool([False])
```

```
Out[15]: True
```

Comparisons

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

Conditionals

Comparisons

IPython

```
In [16]: 3 < 4
```

```
Out[16]: True
```

```
In [17]: 3 <= 3.5
```

```
Out[17]: True
```

```
In [18]: 3 == 3.0
```

```
Out[18]: True
```

```
In [19]: 3 is 3.0
```

```
Out[19]: False
```

```
In [20]: 3 is 3
```

```
Out[20]: True
```

Boolean (Logical) Operations

Operation	Result	Notes
<code>x or y</code>	if <code>x</code> is false, then <code>y</code> , else <code>x</code>	(1)
<code>x and y</code>	if <code>x</code> is false, then <code>x</code> , else <code>y</code>	(2)
<code>not x</code>	if <code>x</code> is false, then <code>True</code> , else <code>False</code>	(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 [21]: 3 < 4 and 5 <= 10
```

```
Out[21]: True
```

```
In [22]: 3 < 4 or 5 <= 10
```

```
Out[22]: True
```

```
In [23]: 3 < 4 and 5 > 10
```

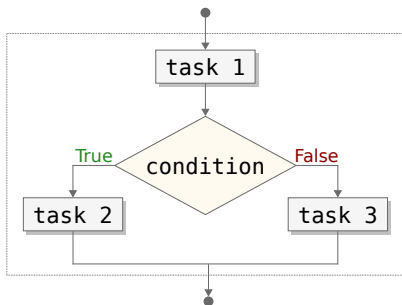
```
Out[23]: False
```

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

```
Out[24]: True
```

Conditionals

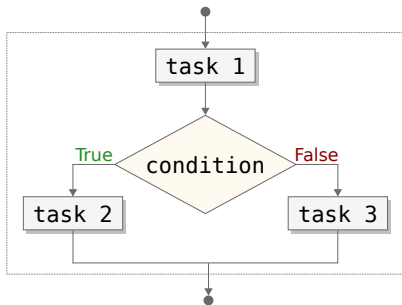
`if` statement



```
if condition :  
    task 2  
else:  
    task 3
```

Conditionals

if statement



max.py

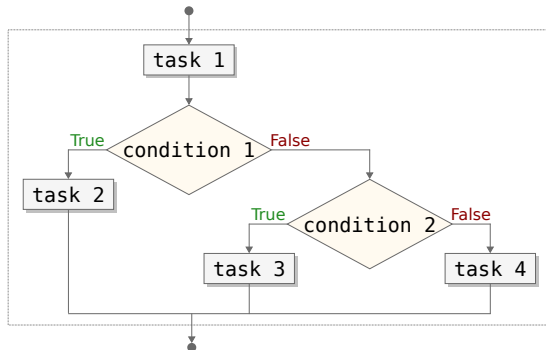
```
1 a = int(input('a = '))
2 b = int(input('b = '))
3
4 if a > b:
5     print(a)
6 else:
7     print(b)
```

terminal

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

Conditionals

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

Sequential Execution

Conditionals

Indentation

Loops

Comprehensions

Hands on!

Indentation

Python uses indentation to delimit code blocks.

- Instead of `begin ... end` or `{ ... }` in other languages.
- Be consistent (e.g., only use an indentation of 4 spaces).
 - Never use tabs.

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

Sequential Execution

Conditionals

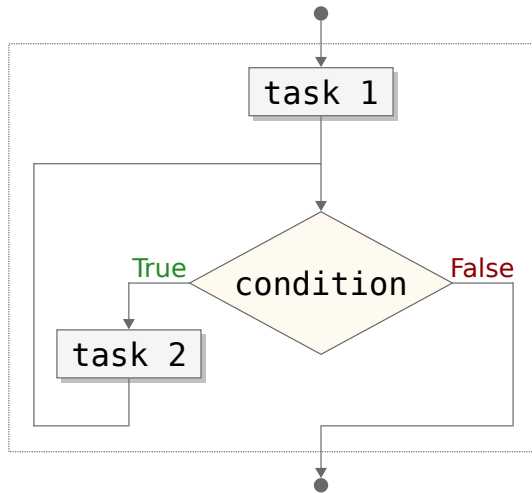
Indentation

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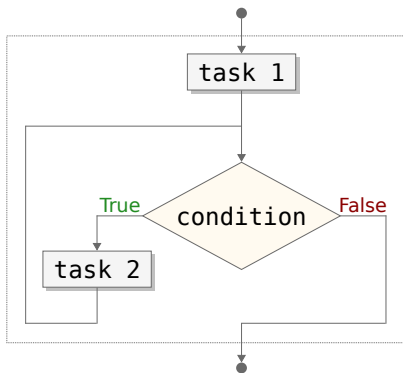
Hands on!

Loops



Loops

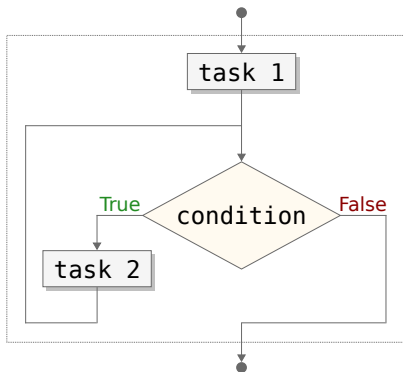
`while` statement



```
while condition :  
    task 2
```

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
```

Loops

Infinite loop

infinite_loop.py

```
1 while True:
2     print('yes')
```

terminal

```
$ python infinite_loop.py
yes
yes
yes
yes
...
```

Loops

`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)
```

Loops

`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)
```

terminal

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

Python anti-patterns

These are common for programmers coming from other languages.

unpythonic.py

```
1 colors = ['red', 'white', 'blue']
2
3 i = 0
4 while i < len(colors):
5     print(colors[i])
6     i += 1
7
8 for i in range(len(colors)):
9     print(colors[i])
```

We call them unpythonic.

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These are common for programmers coming from other languages.

unpythonic.py

```
1 colors = ['red', 'white', 'blue']
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8 for i in range(len(colors)):
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```

We call them unpythonic.

The Pythonic way:

for_example.py

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

Loops

`break` and `continue` statements

Loops

`break` and `continue` statements

`break` will immediately exit a loop.

break_example.py

```
1  # Print up to the first negative
2  for i in [6, 3, -1, 7, -2, 5]:
3      if i < 0:
4          break
5      print(i)
```

Loops

`break` and `continue` statements

`break` will immediately exit a loop.

break_example.py

```
1  # Print up to the first negative
2  for i in [6, 3, -1, 7, -2, 5]:
3      if i < 0:
4          break
5      print(i)
```

terminal

```
$ python break_example.py
6
3
```

Loops

`break` and `continue` statements

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break_example.py

```
1  # Print up to the first negative
2  for i in [6, 3, -1, 7, -2, 5]:
3      if i < 0:
4          break
5      print(i)
```

terminal

```
$ python break_example.py
6
3
```

`continue` will skip the current block.

continue_example.py

```
1  # Print only positive numbers
2  for i in [6, 3, -1, 7, -2, 5]:
3      if i < 0:
4          continue
5      print(i)
```

Loops

`break` and `continue` statements

`break` will immediately exit a loop.

break_example.py

```
1  # Print up to the first negative
2  for i in [6, 3, -1, 7, -2, 5]:
3      if i < 0:
4          break
5      print(i)
```

terminal

```
$ python break_example.py
6
3
```

`continue` will skip the current block.

continue_example.py

```
1  # Print only positive numbers
2  for i in [6, 3, -1, 7, -2, 5]:
3      if i < 0:
4          continue
5      print(i)
```

terminal

```
$ python continue_example.py
6
3
7
5
```

Additional

iteration.py

```
1  # Iteration with values and indices:
2  for i, color in enumerate(['red', 'yellow', 'blue']):
3      print(i, '->', color)
4
5  # Taking two sequences together:
6  for city, population in zip(['Delft', 'Leiden'], [101030, 121562]):
7      print(city, '->', population)
8
9  # Iterating over a dictionary yields keys:
10 for key in {'a': 33, 'b': 17, 'c': 18}:
11     print(key)
12
13 # Iterating over a file yields lines:
14 for line in open('data/short_file.txt'):
15     print(line)
```

The `pass` statement

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

pass_statement.py

```
1 age = int(input('Please enter your age: '))
2
3 if age < 18:
4     # This is to be decided.
5     pass
6 else:
7     print('You can apply for a driver\'s permit in most of the countries.')
```

Comprehensions

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Hands on!

Lists

Similar to mathematical set notation (e.g., $x|x \in R \wedge x > 0$), we can create lists.

IPython

```
In [25]: [(x, x * x) for x in range(10) if x % 2]
Out[25]: [(1, 1), (3, 9), (5, 25), (7, 49), (9, 81)]
```


Sets and dictionaries

IPython

```
In [26]: {c for c in 'LUMC-standard' if 'a' <= c <= 'z'}
```

```
Out[26]: 'a', 'd', 'n', 'r', 's', 't'
```

Dictionaries

IPython

```
In [27]: colors = ['red', 'white', 'blue', 'orange']
```

```
In [28]: {c: len(c) for c in colors}
```

```
Out[28]: {'blue': 4, 'orange': 6, 'red': 3, 'white': 5}
```

Python `print`

IPython

```
In [29]: print('{} {}'.format('one', 'two'))  
Out[29]: one two
```

More information:

- <https://pyformat.info/>

Write a python program for each of the following exercises:

1. **Special numbers**

Print only those numbers which are divisible by `13` and multiple of `5`, between `10` and `1313` (both included).

2. **Bank account simulator**

Take as input an initial bank account balance (e.g., `1000`). Next, accept inputs consisting of either expenses (e.g., `-13.99`) or revenues (e.g., `20`) until the user introduces `exit`. After each input, in case the balance is about to go negative, print an error message (e.g., `Operation not permitted: insufficient funds.`). Otherwise, print the new balance value.