Leiden University
Medical Center

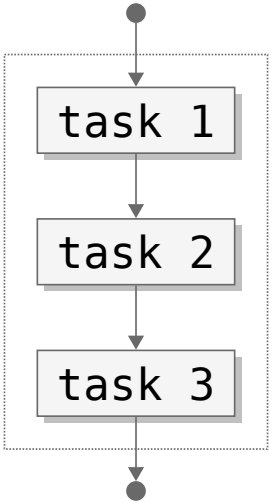
Python Programming

Flow Control

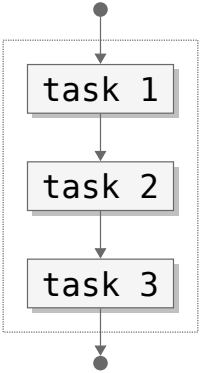
Outline

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.
- The user input is then read as a string.

Intermezzo - User input

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

- If the `prompt` argument is present, it is written to the standard output.
- The user input is then read as a string.

sum.py

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

Intermezzo - User input

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

- If the `prompt` argument is present, it is written to the standard output.
- The user input is then read as a string.

sum.py

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

terminal

```
$ python sum.py
a = 100
b = 200
100200
```

Intermezzo - User input

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

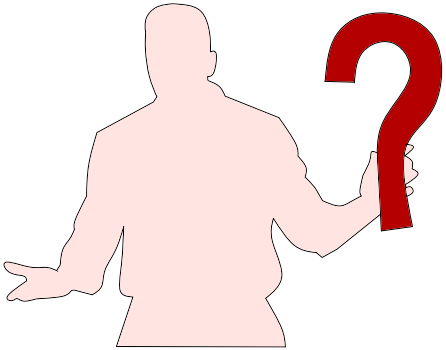
- If the `prompt` argument is present, it is written to the standard output.
- The user input is then read as a string.

sum.py

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

terminal

```
$ python sum.py
a = 100
b = 200
100200
```



Intermezzo - User input

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

- If the `prompt` argument is present, it is written to the standard output.
- The user input is then read as a `string`.

sum.py

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

terminal

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

Intermezzo - User input

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

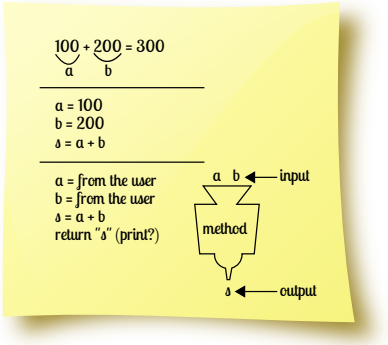
- If the `prompt` argument is present, it is written to the standard output.
- The user input is then read as a `string`.

sum.py

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

terminal

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



Intermezzo - Comments

Comments are prepended by `#` and completely ignored.

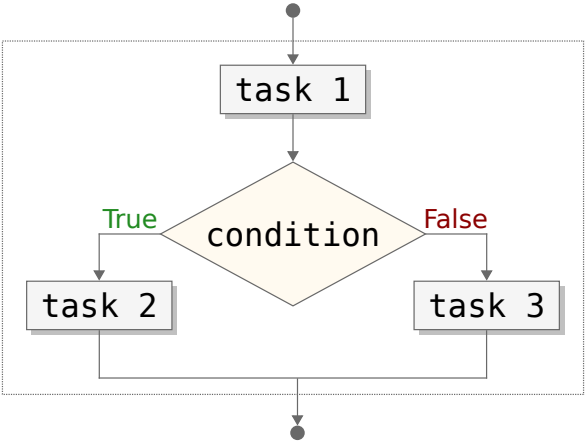
sum.py

```
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)
```

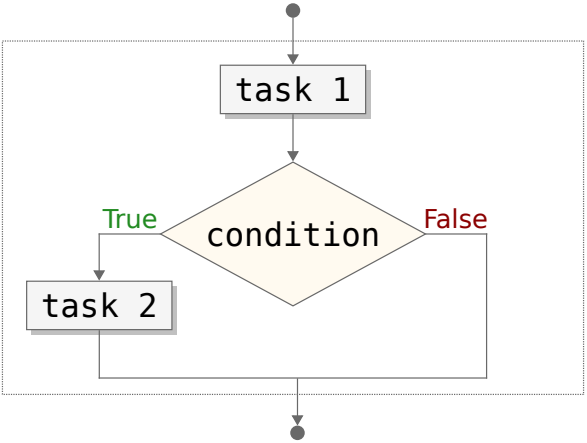
Conditionals

Sequential Execution
Conditionals
Indentation
Loops
Comprehensions
Hands on!

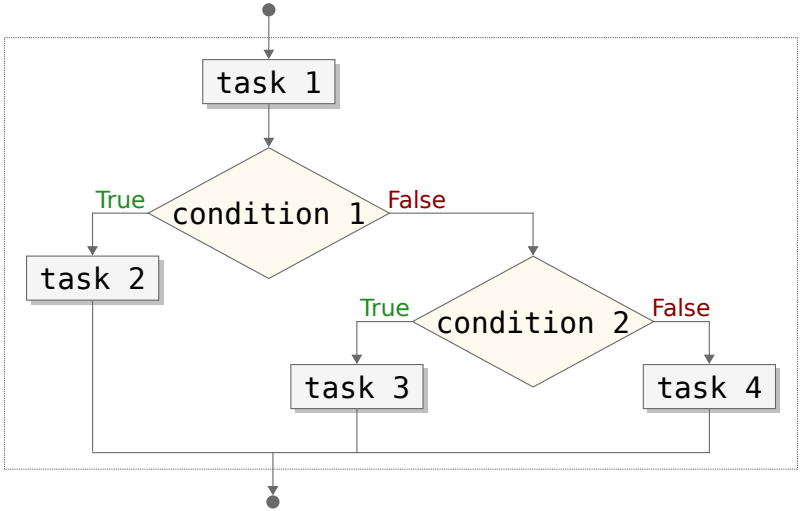
Conditionals



Conditionals



Conditionals



Truth Value Testing

- Built-in objects considered false:
  - constants defined to be false: `None` and `False`.

Truth Value Testing

- Built-in objects considered false:
  - constants defined to be false: `None` and `False`.
  - zero of any numeric type: `0`, `0.0`, `0j`, `Decimal(0)`, `Fraction(0, 1)`.

Truth Value Testing

- Built-in objects considered false:
  - constants defined to be false: `None` and `False`.
  - zero of any numeric type: `0`, `0.0`, `0j`, `Decimal(0)`, `Fraction(0, 1)`.
  - empty sequences and collections: `''`, `()`, `[]`, `{}`, `set()`, `range(0)`.

Truth Value Testing

- Built-in objects considered false:
  - constants defined to be false: `None` and `False`.
  - zero of any numeric type: `0`, `0.0`, `0j`, `Decimal(0)`, `Fraction(0, 1)`.
  - empty sequences and collections: `''`, `()`, `[]`, `{}`, `set()`, `range(0)`.
- For the moment, let's assume that any other object is considered true.

Truth Value Testing

- Built-in objects considered false:
  - constants defined to be false: `None` and `False`.
  - zero of any numeric type: `0`, `0.0`, `0j`, `Decimal(0)`, `Fraction(0, 1)`.
  - 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
`<`	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 [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
`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

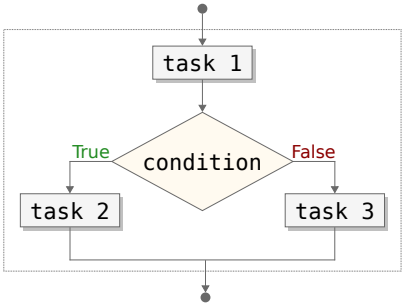
Boolean (Logical) Operations

IPython

```
In [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
```

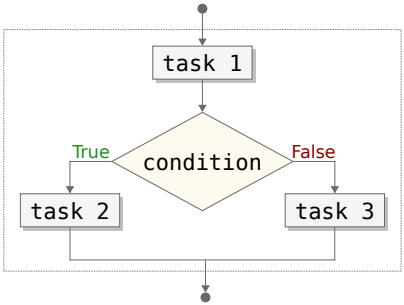
Conditionals

`if` statement




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

`if` statement



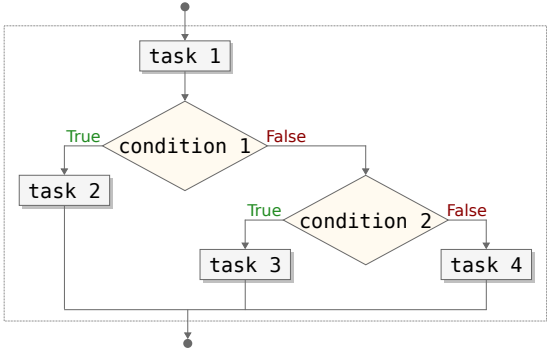
max.py

```
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

Sequential Execution
Conditionals
Indentation
Loops
Comprehensions
Hands on!

Indentation

Python uses indentation to delimit code blocks.

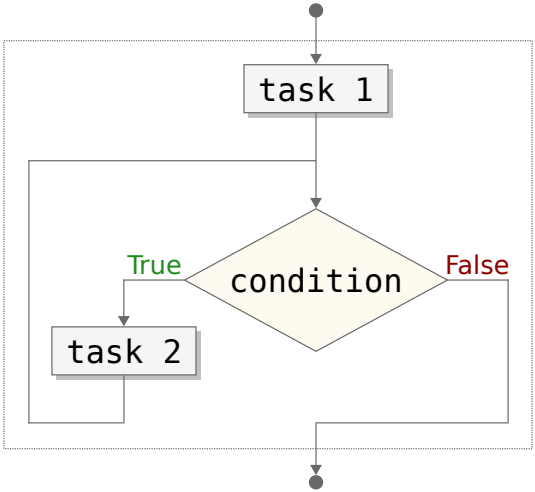
- Instead of `begin ... end` or `{ ... }` in other languages.
- Be consistent (e.g., only use an indentation of 4 spaces).
  - Never use tabs.

indentation_example.py

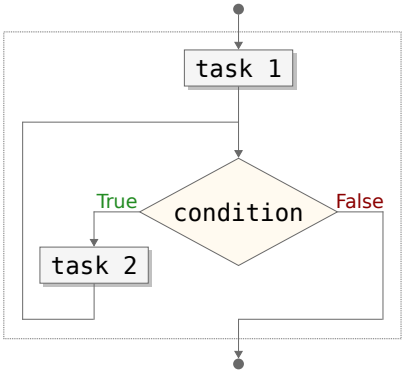
```
1  if False:
2      if False:
3          print('Why am I here?')
4      else:
5          while True:
6              print('When will it stop?')
7      print("And we're back to the first indentation level")
```

Sequential Execution
Conditionals
Indentation
Loops
Comprehensions
Hands on!

Loops

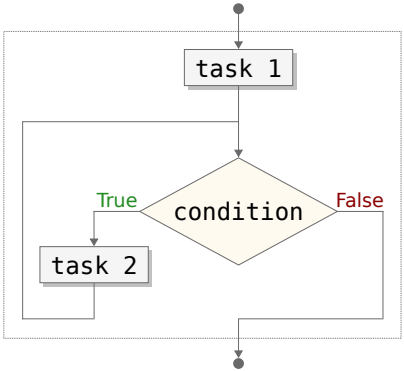


`while` statement




```
while condition :
    task 2
```

`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
```

Infinite loop

infinite_loop.py

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

terminal

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

`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)
```

`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.

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.

The Pythonic way:

for_example.py

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

`break` and `continue` statements

`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)
```

`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
```

`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)
```

`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
```

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 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

Sequential Execution
Conditionals
Indentation
Loops
Comprehensions
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/

Hands on!

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.