# Introduction to Python

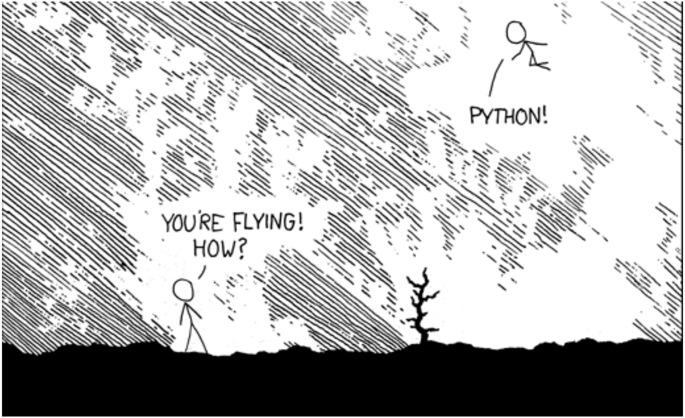
Petr Zemek

Senior Developer at Avast Software
Threat Labs (Viruslab)
petr.zemek@avast.com
https://petrzemek.net

Principles of Programming Languages, BUT FIT, 2018-03-05

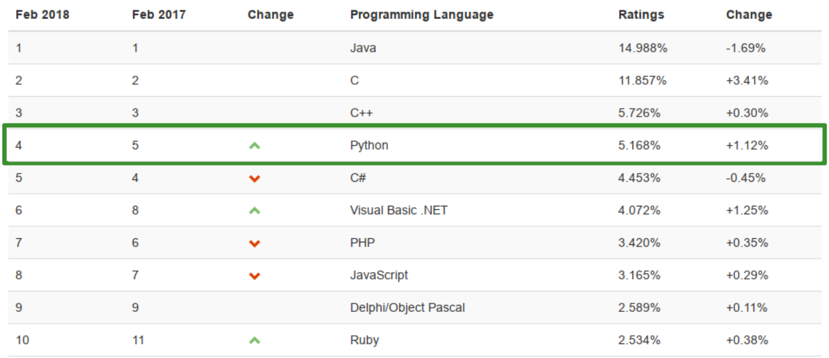
# Motto

*"Python makes you fly."*



https://xkcd.com/353/

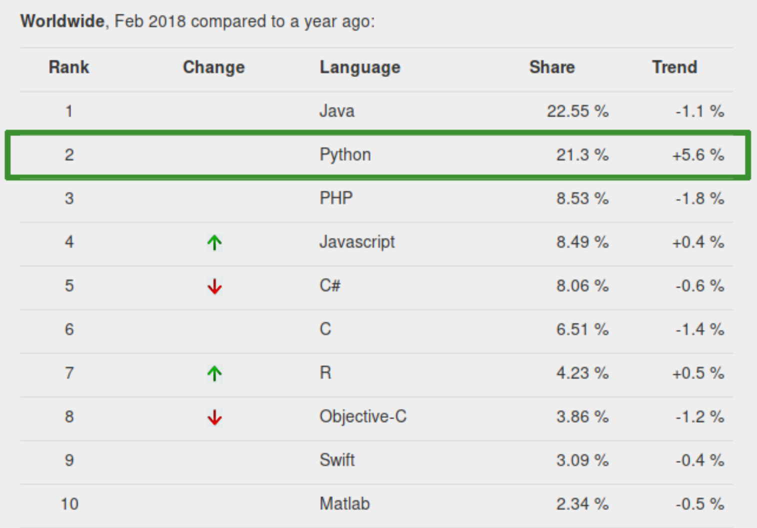
# Why Python? Whetting our Appetite



| Feb 2018 | Feb 2017 | Change | Programming Language | Ratings | Change |
|---|---|---|---|---|---|
| 1 | 1 | | Java | 14.988% | -1.69% |
| 2 | 2 | | C | 11.857% | +3.41% |
| 3 | 3 | | C++ | 5.726% | +0.30% |
| 4 | 5 | ▲ | Python | 5.168% | +1.12% |
| 5 | 4 | ▼ | C# | 4.453% | -0.45% |
| 6 | 8 | ▲ | Visual Basic .NET | 4.072% | +1.25% |
| 7 | 6 | ▼ | PHP | 3.420% | +0.35% |
| 8 | 7 | ▼ | JavaScript | 3.165% | +0.29% |
| 9 | 9 | | Delphi/Object Pascal | 2.589% | +0.11% |
| 10 | 11 | ▲ | Ruby | 2.534% | +0.38% |

http://www.tiobe.com/tiobe-index/

# Why Python? Whetting our Appetite

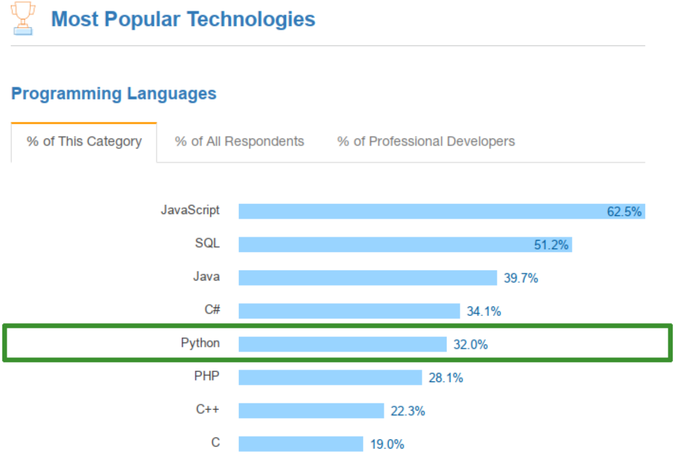


**Worldwide**, Feb 2018 compared to a year ago:

| Rank | Change | Language | Share | Trend |
|---|---|---|---|---|
| 1 | | Java | 22.55 % | -1.1 % |
| 2 | | Python | 21.3 % | +5.6 % |
| 3 | | PHP | 8.53 % | -1.8 % |
| 4 | ↑ | Javascript | 8.49 % | +0.4 % |
| 5 | ↓ | C# | 8.06 % | -0.6 % |
| 6 | | C | 6.51 % | -1.4 % |
| 7 | ↑ | R | 4.23 % | +0.5 % |
| 8 | ↓ | Objective-C | 3.86 % | -1.2 % |
| 9 | | Swift | 3.09 % | -0.4 % |
| 10 | | Matlab | 2.34 % | -0.5 % |

http://pypl.github.io/

# Why Python? Whetting our Appetite

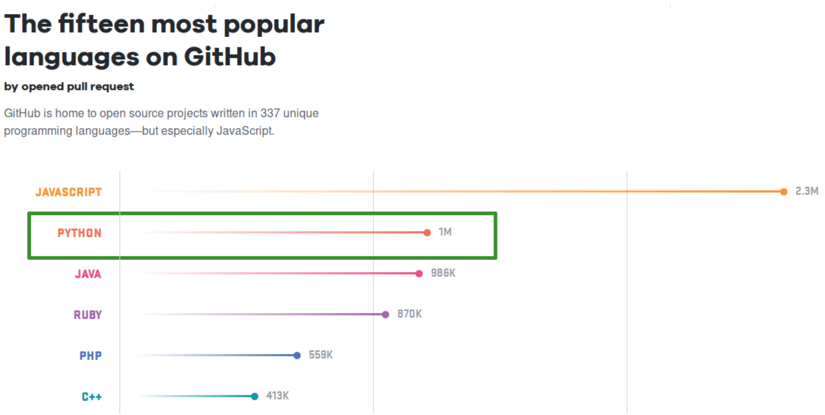


Most Popular Technologies

Programming Languages

https://insights.stackoverflow.com/survey/2017

# Why Python? Whetting our Appetite



**The fifteen most popular languages on GitHub**

**by opened pull request**

GitHub is home to open source projects written in 337 unique programming languages—but especially JavaScript.

https://octoverse.github.com/

# What is Python?

- widely used, general-purpose high-level programming language

# What is Python?

- widely used, general-purpose high-level programming language
- design philosophy emphasizes code readability

# What is Python?

- widely used, general-purpose high-level programming language
- design philosophy emphasizes code readability
- multiparadigm (procedural, object oriented)

# What is Python?

- widely used, general-purpose high-level programming language
- design philosophy emphasizes code readability
- multiparadigm (procedural, object oriented)
- compiled to bytecode and interpreted in a virtual machine

# What is Python?

- widely used, general-purpose high-level programming language
- design philosophy emphasizes code readability
- multiparadigm (procedural, object oriented)
- compiled to bytecode and interpreted in a virtual machine
- everything is an object

# What is Python?

- widely used, general-purpose high-level programming language
- design philosophy emphasizes code readability
- multiparadigm (procedural, object oriented)
- compiled to bytecode and interpreted in a virtual machine
- everything is an object
- strongly, dynamically typed

# What is Python?

- widely used, general-purpose high-level programming language
- design philosophy emphasizes code readability
- multiparadigm (procedural, object oriented)
- compiled to bytecode and interpreted in a virtual machine
- everything is an object
- strongly, dynamically typed
- duck typing

# What is Python?

- widely used, general-purpose high-level programming language
- design philosophy emphasizes code readability
- multiparadigm (procedural, object oriented)
- compiled to bytecode and interpreted in a virtual machine
- everything is an object
- strongly, dynamically typed
- duck typing
- whitespace is significant

# What is Python?

- widely used, general-purpose high-level programming language
- design philosophy emphasizes code readability
- multiparadigm (procedural, object oriented)
- compiled to bytecode and interpreted in a virtual machine
- everything is an object
- strongly, dynamically typed
- duck typing
- whitespace is significant
- portable (Windows, Linux, macOS)

# What is Python?

- widely used, general-purpose high-level programming language
- design philosophy emphasizes code readability
- multiparadigm (procedural, object oriented)
- compiled to bytecode and interpreted in a virtual machine
- everything is an object
- strongly, dynamically typed
- duck typing
- whitespace is significant
- portable (Windows, Linux, macOS)
- many implementations (CPython, PyPy, Jython, IronPython)

# What is Python?

- widely used, general-purpose high-level programming language
- design philosophy emphasizes code readability
- multiparadigm (procedural, object oriented)
- compiled to bytecode and interpreted in a virtual machine
- everything is an object
- strongly, dynamically typed
- duck typing
- whitespace is significant
- portable (Windows, Linux, macOS)
- many implementations (CPython, PyPy, Jython, IronPython)
- automatic memory management (garbage collector)

# What is Python?

- widely used, general-purpose high-level programming language
- design philosophy emphasizes code readability
- multiparadigm (procedural, object oriented)
- compiled to bytecode and interpreted in a virtual machine
- everything is an object
- strongly, dynamically typed
- duck typing
- whitespace is significant
- portable (Windows, Linux, macOS)
- many implementations (CPython, PyPy, Jython, IronPython)
- automatic memory management (garbage collector)
- free (both as in “free speech” and “free beer”)

# A Glimpse at Python History

- invented in the beginning of 1990s by Guido van Rossum

# A Glimpse at Python History

- invented in the beginning of 1990s by Guido van Rossum

# A Glimpse at Python History

- invented in the beginning of 1990s by Guido van Rossum

- its name stems from “Monty Python’s Flying Circus”

# A Glimpse at Python History

- invented in the beginning of 1990s by Guido van Rossum

- its name stems from “Monty Python′s Flying Circus”
- version history:
  - Python 1.0 (January 1994)

# A Glimpse at Python History

- invented in the beginning of 1990s by Guido van Rossum

- its name stems from "Monty Python's Flying Circus"
- version history:
  - Python 1.0 (January 1994)
  - Python 2 (October 2000)
    - Python 2.7 (July 2010) – latest 2.x version († 2020)

# A Glimpse at Python History

- invented in the beginning of 1990s by Guido van Rossum

- its name stems from “Monty Python’s Flying Circus”
- version history:
  - Python 1.0 (January 1994)
  - Python 2 (October 2000)
    - Python 2.7 (July 2010) – latest 2.x version († 2020)
  - Python 3 (December 2008)
    - Python 3.6 (December 2016) – latest 3.x version

# Diving Into Python

- interactive shell

```
$ python
Python 3.6.4 (default, Jan  5 2018, 02:35:40)
>>> print(’Hello, world!’)
Hello, world!
```

# Diving Into Python

- interactive shell

```
$ python
Python 3.6.4 (default, Jan  5 2018, 02:35:40)
>>> print(’Hello, world!’)
Hello, world!
```

- running from source

```
# In file hello.py:
print(’Hello, world!’)

$ python hello.py
Hello, world!
```

# Diving Into Python

- interactive shell

```
$ python
Python 3.6.4 (default, Jan  5 2018, 02:35:40)
>>> print(’Hello, world!’)
Hello, world!
```

- running from source

```
# In file hello.py:
print(’Hello, world!’)

$ python hello.py
Hello, world!
```

- combination

```
$ python -i hello.py
Hello, world!
>>>
```

# Built-In Primitive Data Types

- NoneType

```
None
```

# Built-In Primitive Data Types

- NoneType

  ```
  None
  ```

- bool

  ```
  True, False
  ```

# Built-In Primitive Data Types

- NoneType

```
None
```

- bool

```
True, False
```

- int

```
-1024, 0, 17821223734857348538746273464545
```

# Built-In Primitive Data Types

- NoneType

```
None
```

- bool

```
True, False
```

- int

```
-1024, 0, 17821223734857348538746273464545
```

- float

```
0.125, 1e200, float(’inf’), float(’nan’)
```

# Built-In Primitive Data Types

- NoneType

```
None
```

- bool

```
True, False
```

- int

```
-1024, 0, 17821223734857348538746273464545
```

- float

```
0.125, 1e200, float(’inf’), float(’nan’)
```

- complex

```
2 + 3j
```

# Built-In Primitive Data Types

- NoneType

```
None
```

- bool

```
True, False
```

- int

```
-1024, 0, 17821223734857348538746273464545
```

- float

```
0.125, 1e200, float('inf'), float('nan')
```

- complex

```
2 + 3j
```

- str

```
'Do you like jalapeño peppers?'
```

# Built-In Primitive Data Types

- NoneType

  ```
  None
  ```

- bool

  ```
  True, False
  ```

- int

  ```
  -1024, 0, 17821223734857348538746273464545
  ```

- float

  ```
  0.125, 1e200, float(’inf’), float(’nan’)
  ```

- complex

  ```
  2 + 3j
  ```

- str

  ```
  ’Do you like jalapeño peppers?’
  ```

- bytes

  ```
  b’\x68\x65\x6c\x6c\x6f’
  ```

# Intermezzo: Encodings

- character set vs encoding

# Intermezzo: Encodings

- character set vs encoding
- single-byte vs multi-byte

# Intermezzo: Encodings

- character set vs encoding
- single-byte vs multi-byte
- Unicode vs UTF-8, UTF-16, UTF-32

# Intermezzo: Encodings

- character set vs encoding
- single-byte vs multi-byte
- Unicode vs UTF-8, UTF-16, UTF-32
- `str` vs `bytes`

# Intermezzo: Encodings

- character set vs encoding
- single-byte vs multi-byte
- Unicode vs UTF-8, UTF-16, UTF-32
- `str` vs `bytes`

https://cs-blog.petrzemek.net/2015-08-09-znakova-sada-vs-kodovani

# Built-In Collection Types

- list

```
[1, 2.0, 'hey!', None]
```

# Built-In Collection Types

- list

```
[1, 2.0, 'hey!', None]
```

- tuple

```
('Cabernet Sauvignon', 1995)
```

# Built-In Collection Types

- list

```
[1, 2.0, 'hey!', None]
```

- tuple

```
('Cabernet Sauvignon', 1995)
```

- set

```
{1, 2, 3, 4, 5}
```

# Built-In Collection Types

- list

```
[1, 2.0, ’hey!’, None]
```

- tuple

```
(’Cabernet Sauvignon’, 1995)
```

- set

```
{1, 2, 3, 4, 5}
```

- dict

```
{
    ’John’: 2.5,
    ’Paul’: 1.5,
    ’Laura’: 1,
}
```

# Variables and Bindings

- name binding (we attach a name to an object)

# Variables and Bindings

- name binding (we attach a name to an object)
- dynamic typing

# Variables and Bindings

- name binding (we attach a name to an object)
- dynamic typing
- no explicit declarations until Python 3.5 (*type hints*)

# Variables and Bindings

- name binding (we attach a name to an object)
- dynamic typing
- no explicit declarations until Python 3.5 (*type hints*)

```
>>> x = 1                    # x --> 1
```

# Variables and Bindings

- name binding (we attach a name to an object)
- dynamic typing
- no explicit declarations until Python 3.5 (*type hints*)

```
>>> x = 1                 # x --> 1
>>> x = 'hi there'        # x --> 'hi there'
```

# Variables and Bindings

- name binding (we attach a name to an object)
- dynamic typing
- no explicit declarations until Python 3.5 (*type hints*)

```
>>> x = 1                # x --> 1
>>> x = 'hi there'       # x --> 'hi there'

>>> a = [1, 2]           # a --> [1, 2]
```

# Variables and Bindings

- name binding (we attach a name to an object)
- dynamic typing
- no explicit declarations until Python 3.5 (*type hints*)

```
>>> x = 1                # x --> 1
>>> x = ’hi there’       # x --> ’hi there’

>>> a = [1, 2]           # a --> [1, 2]
>>> b = a                # a --> [1, 2] <-- b
```

# Variables and Bindings

- name binding (we attach a name to an object)
- dynamic typing
- no explicit declarations until Python 3.5 (*type hints*)

```
>>> x = 1                   # x --> 1
>>> x = 'hi there'          # x --> 'hi there'

>>> a = [1, 2]              # a --> [1, 2]
>>> b = a                   # a --> [1, 2] <-- b
>>> a.append(3)             # a --> [1, 2, 3] <-- b
```

# Variables and Bindings

- name binding (we attach a name to an object)
- dynamic typing
- no explicit declarations until Python 3.5 (*type hints*)

```
>>> x = 1                   # x --> 1
>>> x = ’hi there’          # x --> ’hi there’

>>> a = [1, 2]              # a --> [1, 2]
>>> b = a                   # a --> [1, 2] <-- b
>>> a.append(3)             # a --> [1, 2, 3] <-- b
>>> a
[1, 2, 3]
>>> b
[1, 2, 3]
```

# Variables and Bindings

- name binding (we attach a name to an object)
- dynamic typing
- no explicit declarations until Python 3.5 (*type hints*)

```
>>> x = 1                 # x --> 1
>>> x = 'hi there'        # x --> 'hi there'

>>> a = [1, 2]            # a --> [1, 2]
>>> b = a                 # a --> [1, 2] <-- b
>>> a.append(3)           # a --> [1, 2, 3] <-- b
>>> a
[1, 2, 3]
>>> b
[1, 2, 3]
>>> b = [4]               # a --> [1, 2, 3]; b --> [4]
```

# Operations

arithmetic `+ - * / // % **`

# Operations

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| arithmetic | + | - | * | / | // | % | ** |
| comparison | == | != | < | > | <= | >= | |

# Operations

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| arithmetic | + | - | * | / | // | % | ** |
| comparison | == | != | < | > | <= | >= | |
| bitwise | << | >> | \| | & | ^ | ~ | |

# Operations

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| arithmetic | + | - | * | / | // | % | ** |
| comparison | == | != | < | > | <= | >= | |
| bitwise | << | >> | \| | & | ^ | ~ | |
| indexing | [] | | | | | | |

# Operations

<table>
<tr><td>arithmetic</td><td>+</td><td>-</td><td>*</td><td>/</td><td>//</td><td>%</td><td>**</td></tr>
<tr><td>comparison</td><td>==</td><td>!=</td><td><</td><td>></td><td><=</td><td>>=</td><td></td></tr>
<tr><td>bitwise</td><td><<</td><td>>></td><td>|</td><td>&</td><td>^</td><td>~</td><td></td></tr>
<tr><td>indexing</td><td>[]</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>slicing</td><td>[:]</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

# Operations

<table>
<tr><td>arithmetic</td><td>+ - * / // % **</td></tr>
<tr><td>comparison</td><td>== != < > <= >=</td></tr>
<tr><td>bitwise</td><td><< >> | & ^ ~</td></tr>
<tr><td>indexing</td><td>[]</td></tr>
<tr><td>slicing</td><td>[:]</td></tr>
<tr><td>call</td><td>()</td></tr>
</table>

# Operations

| | |
|---|---|
| arithmetic | + - * / // % ** |
| comparison | == != < > <= >= |
| bitwise | << >> \| & ^ ~ |
| indexing | [] |
| slicing | [:] |
| call | () |
| logical | and or not |

# Operations

| | |
|---|---|
| arithmetic | + - * / // % ** |
| comparison | == != < > <= >= |
| bitwise | << >> \| & ^ ~ |
| indexing | [ ] |
| slicing | [ : ] |
| call | ( ) |
| logical | and or not |
| assignment | = += -= *= /= //= %= **= ... |

# Operations

| | |
|---|---|
| arithmetic | + - * / // % ** |
| comparison | == != < > <= >= |
| bitwise | << >> \| & ^ ~ |
| indexing | [] |
| slicing | [:] |
| call | () |
| logical | and or not |
| assignment | = += -= *= /= //= %= **= ... |
| other | in is |

# Basic Statements

= assignment statements

```
x = 1
x += 41
```

# Basic Statements

= assignment statements

```
x = 1
x += 41
```

*(expr)* expression statements

```
print('My name is', name)
```

# Basic Statements

= assignment statements

```
x = 1
x += 41
```

*(expr)* expression statements

```
print(’My name is’, name)
```

if conditional execution

```
if x > 10:
    x = 10
elif x < 5:
    x = 5
else:
    print(’error’)
```

# Basic Statements (Continued)

for traversing collections

```
for color in [’red’, ’green’, ’blue’]:
    print(color)
```

# Basic Statements (Continued)

for traversing collections

```
for color in ['red', 'green', 'blue']:
    print(color)
```

while repeated execution

```
while x > 0:
    print(x)
    x -= 1
```

# Basic Statements (Continued)

for — traversing collections

```python
for color in ['red', 'green', 'blue']:
    print(color)
```

while — repeated execution

```python
while x > 0:
    print(x)
    x -= 1
```

break — breaking from a loop

# Basic Statements (Continued)

for traversing collections

```
for color in ['red', 'green', 'blue']:
    print(color)
```

while repeated execution

```
while x > 0:
    print(x)
    x -= 1
```

break breaking from a loop

continue continuing with the next cycle of a loop

# Basic Statements (Continued)

for traversing collections

```python
for color in ['red', 'green', 'blue']:
    print(color)
```

while repeated execution

```python
while x > 0:
    print(x)
    x -= 1
```

break breaking from a loop

continue continuing with the next cycle of a loop

assert assertions

# Basic Statements (Continued)

for traversing collections

```
for color in ['red', 'green', 'blue']:
    print(color)
```

while repeated execution

```
while x > 0:
    print(x)
    x -= 1
```

break breaking from a loop

continue continuing with the next cycle of a loop

assert assertions

return returning from a function

# Basic Statements (Continued)

for traversing collections

```
for color in ['red', 'green', 'blue']:
    print(color)
```

while repeated execution

```
while x > 0:
    print(x)
    x -= 1
```

break breaking from a loop

continue continuing with the next cycle of a loop

assert assertions

return returning from a function

pass does nothing

# Functions

```python
def factorial(n):
    """Returns the factorial of n."""
    if n == 0:
        return 1
    else:
        return n * factorial(n - 1)

x = factorial(5)  # 120
```

# Functions

```python
def factorial(n):
    """Returns the factorial of n."""
    if n == 0:
        return 1
    else:
        return n * factorial(n - 1)

x = factorial(5)  # 120
```

- first-class objects

# Functions

```
def factorial(n):
    """Returns the factorial of n."""
    if n == 0:
        return 1
    else:
        return n * factorial(n - 1)

x = factorial(5)  # 120
```

- first-class objects
- can be nested

# Functions

```python
def factorial(n):
    """Returns the factorial of n."""
    if n == 0:
        return 1
    else:
        return n * factorial(n - 1)

x = factorial(5)  # 120
```

- first-class objects
- can be nested
- default arguments

# Functions

```
def factorial(n):
    """Returns the factorial of n."""
    if n == 0:
        return 1
    else:
        return n * factorial(n - 1)

x = factorial(5)  # 120
```

- first-class objects
- can be nested
- default arguments
- keyword arguments

# Functions

```
def factorial(n):
    """Returns the factorial of n."""
    if n == 0:
        return 1
    else:
        return n * factorial(n - 1)

x = factorial(5)  # 120
```

- first-class objects
- can be nested
- default arguments
- keyword arguments
- variable-length arguments

# Scoping

# Scoping

```
...  # A
def foo():
    ...  # B
    def bar():
        ...  # C
        while cond:
            ... # D
            print(x)
```

# Scoping

```
...   # A
def foo():
    ...   # B
    def bar():
        ...   # C
        while cond:
            ... # D
            print(x)
```

- lexical scoping

# Scoping

```
...  # A
def foo():
    ...  # B
    def bar():
        ...  # C
        while cond:
            ... # D
            print(x)
```

- lexical scoping
- LEGB: a concise rule for scope resolution
  1. **L**ocal
  2. **E**nclosing
  3. **G**lobal
  4. **B**uilt-in

# Scoping

```
...   # A
def foo():
    ...   # B
    def bar():
        ...   # C
        while cond:
            ... # D
            print(x)
```

- lexical scoping
- LEGB: a concise rule for scope resolution
  1. **L**ocal
  2. **E**nclosing
  3. **G**lobal
  4. **B**uilt-in
- **`if`**, **`for`**, etc. do not introduce a new scope

# Scoping

```
...  # A
def foo():
    ...  # B
    def bar():
        ...  # C
        while cond:
            ... # D
            print(x)
```

- lexical scoping
- LEGB: a concise rule for scope resolution
  1. **L**ocal
  2. **E**nclosing
  3. **G**lobal
  4. **B**uilt-in
- `if`, `for`, etc. do not introduce a new scope
- explicit declarations via `global` and `nonlocal`

# Lifetimes

# Lifetimes

- global variables exist until program exits

# Lifetimes

- global variables exist until program exits
- local variables exist until function exits

# Lifetimes

- global variables exist until program exits
- local variables exist until function exits
- explicit deletion via `del`

# Namespaces, Modules, and Packages

```
# Example of a custom package:

network/
    __init__.py
    socket.py
    http/
        __init__.py
        request.py
        response.py
        ...
    bittorrent/
        __init__.py
        torrent.py
        bencoding.py
        ...
    ...
```

# Namespaces, Modules, and Packages

```
# Example of a custom package:

network/
    __init__.py
    socket.py
    http/
        __init__.py
        request.py
        response.py
        ...
    bittorrent/
        __init__.py
        torrent.py
        bencoding.py
        ...
    ...

from network.http.request import Request
```

# Imports

```
# Import a single module.
import time
```

# Imports

```
# Import a single module.
import time

# Import multiple modules at once.
import os, re, sys
```

# Imports

```python
# Import a single module.
import time

# Import multiple modules at once.
import os, re, sys

# Import under a different name.
import multiprocessing as mp
```

# Imports

```python
# Import a single module.
import time

# Import multiple modules at once.
import os, re, sys

# Import under a different name.
import multiprocessing as mp

# Import a single item from a module.
from threading import Thread
```

# Imports

```python
# Import a single module.
import time

# Import multiple modules at once.
import os, re, sys

# Import under a different name.
import multiprocessing as mp

# Import a single item from a module.
from threading import Thread

# Import multiple items from a module.
from collections import namedtuple, defaultdict
```

# Imports

```
# Import a single module.
import time

# Import multiple modules at once.
import os, re, sys

# Import under a different name.
import multiprocessing as mp

# Import a single item from a module.
from threading import Thread

# Import multiple items from a module.
from collections import namedtuple, defaultdict

# Import everything from the given module.
# (Use with caution!)
from email import *
```

# Object-Oriented Programming

```python
from math import sqrt

class Point:
    """Representation of a point in 2D space."""

    def __init__(self, x, y):
        self.x = x
        self.y = y

    def distance(self, other):
        return sqrt((other.x - self.x) ** 2 +
                    (other.y - self.y) ** 2)

a = Point(1, 2)
b = Point(3, 4)
print(a.distance(b))  # 2.8284271247461903
```

# Object-Oriented Programming (Basics)

- instance creation and initialization

# Object-Oriented Programming (Basics)

- instance creation and initialization
- methods versus functions

# Object-Oriented Programming (Basics)

- instance creation and initialization
- methods versus functions
- classes are first-class objects

# Object-Oriented Programming (Basics)

- instance creation and initialization
- methods versus functions
- classes are first-class objects
- everything is public

# Object-Oriented Programming (Basics)

- instance creation and initialization
- methods versus functions
- classes are first-class objects
- everything is public
- everything can be overridden

# Object-Oriented Programming (Basics)

- instance creation and initialization
- methods versus functions
- classes are first-class objects
- everything is public
- everything can be overridden
- each class automatically inherits from `object`

# Object-Oriented Programming (Basics)

- instance creation and initialization
- methods versus functions
- classes are first-class objects
- everything is public
- everything can be overridden
- each class automatically inherits from `object`
- multiple inheritance, method resolution order (MRO)

# Object-Oriented Programming (Basics)

- instance creation and initialization
- methods versus functions
- classes are first-class objects
- everything is public
- everything can be overridden
- each class automatically inherits from `object`
- multiple inheritance, method resolution order (MRO)
- calling base-class methods

# Object-Oriented Programming (Basics)

- instance creation and initialization
- methods versus functions
- classes are first-class objects
- everything is public
- everything can be overridden
- each class automatically inherits from `object`
- multiple inheritance, method resolution order (MRO)
- calling base-class methods
- instance variables vs class variables

# Object-Oriented Programming (Basics)

- instance creation and initialization
- methods versus functions
- classes are first-class objects
- everything is public
- everything can be overridden
- each class automatically inherits from `object`
- multiple inheritance, method resolution order (MRO)
- calling base-class methods
- instance variables vs class variables
- instance methods vs class methods vs static methods

# Object-Oriented Programming (Basics)

- instance creation and initialization
- methods versus functions
- classes are first-class objects
- everything is public
- everything can be overridden
- each class automatically inherits from `object`
- multiple inheritance, method resolution order (MRO)
- calling base-class methods
- instance variables vs class variables
- instance methods vs class methods vs static methods
- properties

# Object-Oriented Programming (Advanced)

- instance creation in detail (`__new__()`, `__init__()`)

# Object-Oriented Programming (Advanced)

- instance creation in detail (`__new__()`, `__init__()`)
- instance memory layout (`__dict__`, `__slots__`)

# Object-Oriented Programming (Advanced)

- instance creation in detail (`__new__()`, `__init__()`)
- instance memory layout (`__dict__`, `__slots__`)
- "internal" (_) and pseudo-private (__) attributes

# Object-Oriented Programming (Advanced)

- instance creation in detail (`__new__()`, `__init__()`)
- instance memory layout (`__dict__`, `__slots__`)
- “internal” (_) and pseudo-private (__) attributes
- special methods (`__$method__()`), operator overloading

# Object-Oriented Programming (Advanced)

- instance creation in detail (`__new__()`, `__init__()`)
- instance memory layout (`__dict__`, `__slots__`)
- "internal" (_) and pseudo-private (__) attributes
- special methods (`__$method__()`), operator overloading
- cooperative multiple inheritance, mixins, `super()`

# Object-Oriented Programming (Advanced)

- instance creation in detail (`__new__()`, `__init__()`)
- instance memory layout (`__dict__`, `__slots__`)
- “internal” (_) and pseudo-private (__) attributes
- special methods (`__$method__()`), operator overloading
- cooperative multiple inheritance, mixins, `super()`
- instance finalization (`__del__()`)

# Object-Oriented Programming (Advanced)

- instance creation in detail (`__new__()`, `__init__()`)
- instance memory layout (`__dict__`, `__slots__`)
- “internal” (_) and pseudo-private (__) attributes
- special methods (`__$method__()`), operator overloading
- cooperative multiple inheritance, mixins, `super()`
- instance finalization (`__del__()`)
- hooking into attribute lookup (`__getattr[ibute]__()`)

# Object-Oriented Programming (Advanced)

- instance creation in detail (`__new__()`, `__init__()`)
- instance memory layout (`__dict__`, `__slots__`)
- “internal” (_) and pseudo-private (__) attributes
- special methods (`__$method__()`), operator overloading
- cooperative multiple inheritance, mixins, `super()`
- instance finalization (`__del__()`)
- hooking into attribute lookup (`__getattr[ibute]__()`)
- protocols, duck typing

# Object-Oriented Programming (Advanced)

- instance creation in detail (`__new__()`, `__init__()`)
- instance memory layout (`__dict__`, `__slots__`)
- “internal” (_) and pseudo-private (__) attributes
- special methods (`__$method__()`), operator overloading
- cooperative multiple inheritance, mixins, `super()`
- instance finalization (`__del__()`)
- hooking into attribute lookup (`__getattr[ibute]__()`)
- protocols, duck typing
- interfaces, abstract base classes (`abc`)

# Object-Oriented Programming (Advanced)

- instance creation in detail (`__new__()`, `__init__()`)
- instance memory layout (`__dict__`, `__slots__`)
- "internal" (_) and pseudo-private (__) attributes
- special methods (`__$method__()`), operator overloading
- cooperative multiple inheritance, mixins, `super()`
- instance finalization (`__del__()`)
- hooking into attribute lookup (`__getattr[ibute]__()`)
- protocols, duck typing
- interfaces, abstract base classes (`abc`)
- classes can be created and extended during runtime

# Object-Oriented Programming (Advanced)

- instance creation in detail (`__new__()`, `__init__()`)
- instance memory layout (`__dict__`, `__slots__`)
- “internal” (_) and pseudo-private (__) attributes
- special methods (`__$method__()`), operator overloading
- cooperative multiple inheritance, mixins, `super()`
- instance finalization (`__del__()`)
- hooking into attribute lookup (`__getattr[ibute]__()`)
- protocols, duck typing
- interfaces, abstract base classes (`abc`)
- classes can be created and extended during runtime
- classes are instances of *metaclasses*

# Error Handling and Exceptions

```
# Raising an exception:
raise IOError('not enough space')
```

# Error Handling and Exceptions

```
# Raising an exception:
raise IOError(’not enough space’)

# Exception handling:
try:
    # code
```

# Error Handling and Exceptions

```
# Raising an exception:
raise IOError('not enough space')

# Exception handling:
try:
    # code
except IOError as ex:
    # handle a specific exception
```

# Error Handling and Exceptions

```
# Raising an exception:
raise IOError(’not enough space’)

# Exception handling:
try:
    # code
except IOError as ex:
    # handle a specific exception
except:
    # handle all other exceptions
```

# Error Handling and Exceptions

```
# Raising an exception:
raise IOError(’not enough space’)

# Exception handling:
try:
    # code
except IOError as ex:
    # handle a specific exception
except:
    # handle all other exceptions
else:
    # no exception was raised
```

# Error Handling and Exceptions

```
# Raising an exception:
raise IOError(’not enough space’)

# Exception handling:
try:
    # code
except IOError as ex:
    # handle a specific exception
except:
    # handle all other exceptions
else:
    # no exception was raised
finally:
    # clean-up actions, always executed
```

# Exception-Safe Resource Management

```
# Bad:
f = open(’file.txt’, ’r’)
contents = f.read()
f.close()
```

# Exception-Safe Resource Management

```
# Bad:
f = open(’file.txt’, ’r’)
contents = f.read()
f.close()

# Better:
f = open(’file.txt’, ’r’)
try:
    contents = f.read()
finally:
    f.close()
```

# Exception-Safe Resource Management

```
# Bad:
f = open(’file.txt’, ’r’)
contents = f.read()
f.close()

# Better:
f = open(’file.txt’, ’r’)
try:
    contents = f.read()
finally:
    f.close()

# The best:
with open(’file.txt’, ’r’) as f:
    contents = f.read()
```

# Exception-Safe Resource Management

```
# Bad:
f = open(’file.txt’, ’r’)
contents = f.read()
f.close()

# Better:
f = open(’file.txt’, ’r’)
try:
    contents = f.read()
finally:
    f.close()

# The best:
with open(’file.txt’, ’r’) as f:
    contents = f.read()
```

https://cs-blog.petrzemek.net/2013-11-17-jeste-jednou-a-lepe-prace-se-souborem-v-pythonu

# Intermezzo: Text vs Binary Files

- text vs binary mode

```
with open(file_path, ’r’) as f:
    text = f.read()

with open(file_path, ’rb’) as f:
    data = f.read()
```

# Intermezzo: Text vs Binary Files

- text vs binary mode

```
with open(file_path, 'r') as f:
    text = f.read()

with open(file_path, 'rb') as f:
    data = f.read()
```

- differences between text and binary modes in Python:

# Intermezzo: Text vs Binary Files

- text vs binary mode

```
with open(file_path, 'r') as f:
    text = f.read()

with open(file_path, 'rb') as f:
    data = f.read()
```

- differences between text and binary modes in Python:
  1. decoding

# Intermezzo: Text vs Binary Files

- text vs binary mode

```
with open(file_path, 'r') as f:
    text = f.read()

with open(file_path, 'rb') as f:
    data = f.read()
```

- differences between text and binary modes in Python:
  1. decoding
  2. end-of-line conversions

# Intermezzo: Text vs Binary Files

- text vs binary mode

```
with open(file_path, 'r') as f:
    text = f.read()

with open(file_path, 'rb') as f:
    data = f.read()
```

- differences between text and binary modes in Python:
  1. decoding
  2. end-of-line conversions
  3. buffering

# Intermezzo: Text vs Binary Files

- text vs binary mode

```
with open(file_path, 'r') as f:
    text = f.read()

with open(file_path, 'rb') as f:
    data = f.read()
```

- differences between text and binary modes in Python:
  1. decoding
  2. end-of-line conversions
  3. buffering

https://cs-blog.petrzemek.net/2015-08-26-textove-vs-binarni-soubory

# Some Cool Language Features

- string formatting (*f-strings*, Python 3.6)

```
name = 'Joe'
item = 'bike'
print(f'Hey {name}, where is my {item}?')
```

# Some Cool Language Features

- string formatting (*f-strings*, Python 3.6)

```
name = ’Joe’
item = ’bike’
print(f’Hey {name}, where is my {item}?’)
```

- anonymous functions

```
people.sort(key=lambda person: person.name)
```

# Some Cool Language Features

- string formatting (*f-strings*, Python 3.6)

```
name = ’Joe’
item = ’bike’
print(f’Hey {name}, where is my {item}?’)
```

- anonymous functions

```
people.sort(key=lambda person: person.name)
```

- list/set/dict comprehensions

```
list = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
squares = [x ** 2 for x in list if x % 2 == 0]
# [4, 16, 36, 64, 100]
```

# Some Cool Language Features

- string formatting (*f-strings*, Python 3.6)

```
name = 'Joe'
item = 'bike'
print(f'Hey {name}, where is my {item}?')
```

- anonymous functions

```
people.sort(key=lambda person: person.name)
```

- list/set/dict comprehensions

```
list = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
squares = [x ** 2 for x in list if x % 2 == 0]
# [4, 16, 36, 64, 100]
```

- conditional expressions

```
cost = 'cheap' if price <= 100 else 'expensive'
```

# Some Cool Language Features (Continued)

- `eval()` and `exec()`

```
a = eval('1 + 3')           # a = 4
exec('b = [1, 2, 3]')       # b = [1, 2, 3]
```

# Some Cool Language Features (Continued)

- `eval()` and `exec()`

```
a = eval(’1 + 3’)       # a = 4
exec(’b = [1, 2, 3]’)   # b = [1, 2, 3]
```

- dynamic typing

```
def print_all(col):
    for i in col:
        print(i)

print_all([1, 2, 3])
print_all((’a’, ’b’, ’c’))
```

# Some Cool Language Features (Continued)

- eval() and exec()

```
a = eval(’1 + 3’)       # a = 4
exec(’b = [1, 2, 3]’)   # b = [1, 2, 3]
```

- dynamic typing

```
def print_all(col):
    for i in col:
        print(i)

print_all([1, 2, 3])
print_all((’a’, ’b’, ’c’))
```

- enumerate()

```
for i, person in enumerate(people):
    print(i, ’:’, person)
```

# Some Cool Language Features (Continued)

- chained comparisons

```
if 1 < x < 5:
    # ...
```

# Some Cool Language Features (Continued)

- chained comparisons

```
if 1 < x < 5:
    # ...
```

- digits separator (Python 3.6)

```
1_483_349_803
```

# Some Cool Language Features (Continued)

- chained comparisons

```
if 1 < x < 5:
    # ...
```

- digits separator (Python 3.6)

```
1_483_349_803
```

- tuple unpacking

```
head, *middle, tail = [1, 2, 3, 4, 5]
```

# Some Cool Language Features (Continued)

- generators

```
def fibonacci():
    a, b = 0, 1
    while True:
        yield a
        a, b = b, a + b

fib = fibonacci()
next(fib)  # 0
next(fib)  # 1
next(fib)  # 1
next(fib)  # 2
next(fib)  # 3
next(fib)  # 5
next(fib)  # 8
```

# Weird Language Features

- `for` with `else`

```
for item in some_list:
    if item == 5:
        break
else:
    print("not found")
```

# Weird Language Features

- `for` with `else`

```
for item in some_list:
    if item == 5:
        break
else:
    print("not found")
```

- mutating default arguments

```
def foo(x=[]):
    x.append(4)
    return x

print(foo([1, 2, 3]))  # [1, 2, 3, 4]
print(foo())           # [4]
print(foo())           # [4, 4]
```

# Weird Language Features

- `for` with `else`

```
for item in some_list:
    if item == 5:
        break
else:
    print("not found")
```

- mutating default arguments

```
def foo(x=[]):
    x.append(4)
    return x

print(foo([1, 2, 3]))  # [1, 2, 3, 4]
print(foo())           # [4]
print(foo())           # [4, 4]
```

- non-ASCII identifiers

```
π = 3.1415
```

# What We Have Skipped

- metaclasses
- decorators
- descriptors
- context managers
- threading
- multiprocessing
- asynchronous I/O
- coroutines
- annotations (type hints)
- ... and more ...

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)
- data types (`datetime`, `collections`, `queue`)

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)
- data types (`datetime`, `collections`, `queue`)
- concurrency (`threading`, `multiprocessing`, `asyncio`)

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)
- data types (`datetime`, `collections`, `queue`)
- concurrency (`threading`, `multiprocessing`, `asyncio`)
- math (`math`, `decimal`, `fractions`, `statistics`)

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)
- data types (`datetime`, `collections`, `queue`)
- concurrency (`threading`, `multiprocessing`, `asyncio`)
- math (`math`, `decimal`, `fractions`, `statistics`)
- operating system and filesystem (`os`, `shutil`, `tempfile`)

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)
- data types (`datetime`, `collections`, `queue`)
- concurrency (`threading`, `multiprocessing`, `asyncio`)
- math (`math`, `decimal`, `fractions`, `statistics`)
- operating system and filesystem (`os`, `shutil`, `tempfile`)
- IPC and networking (`signal`, `mmap`, `select`, `socket`)

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)
- data types (`datetime`, `collections`, `queue`)
- concurrency (`threading`, `multiprocessing`, `asyncio`)
- math (`math`, `decimal`, `fractions`, `statistics`)
- operating system and filesystem (`os`, `shutil`, `tempfile`)
- IPC and networking (`signal`, `mmap`, `select`, `socket`)
- Internet protocols (`urllib`, `email`, `smtplib`, `ipaddress`)

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)
- data types (`datetime`, `collections`, `queue`)
- concurrency (`threading`, `multiprocessing`, `asyncio`)
- math (`math`, `decimal`, `fractions`, `statistics`)
- operating system and filesystem (`os`, `shutil`, `tempfile`)
- IPC and networking (`signal`, `mmap`, `select`, `socket`)
- Internet protocols (`urllib`, `email`, `smtplib`, `ipaddress`)
- compression (`zipfile`, `tarfile`, `gzip`)

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)
- data types (`datetime`, `collections`, `queue`)
- concurrency (`threading`, `multiprocessing`, `asyncio`)
- math (`math`, `decimal`, `fractions`, `statistics`)
- operating system and filesystem (`os`, `shutil`, `tempfile`)
- IPC and networking (`signal`, `mmap`, `select`, `socket`)
- Internet protocols (`urllib`, `email`, `smtplib`, `ipaddress`)
- compression (`zipfile`, `tarfile`, `gzip`)
- cryptography (`hashlib`, `secrets`)

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)
- data types (`datetime`, `collections`, `queue`)
- concurrency (`threading`, `multiprocessing`, `asyncio`)
- math (`math`, `decimal`, `fractions`, `statistics`)
- operating system and filesystem (`os`, `shutil`, `tempfile`)
- IPC and networking (`signal`, `mmap`, `select`, `socket`)
- Internet protocols (`urllib`, `email`, `smtplib`, `ipaddress`)
- compression (`zipfile`, `tarfile`, `gzip`)
- cryptography (`hashlib`, `secrets`)
- functional-like programming (`itertools`, `functools`)

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)
- data types (`datetime`, `collections`, `queue`)
- concurrency (`threading`, `multiprocessing`, `asyncio`)
- math (`math`, `decimal`, `fractions`, `statistics`)
- operating system and filesystem (`os`, `shutil`, `tempfile`)
- IPC and networking (`signal`, `mmap`, `select`, `socket`)
- Internet protocols (`urllib`, `email`, `smtplib`, `ipaddress`)
- compression (`zipfile`, `tarfile`, `gzip`)
- cryptography (`hashlib`, `secrets`)
- functional-like programming (`itertools`, `functools`)
- development (`unittest`, `doctest`, `venv`)

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)
- data types (`datetime`, `collections`, `queue`)
- concurrency (`threading`, `multiprocessing`, `asyncio`)
- math (`math`, `decimal`, `fractions`, `statistics`)
- operating system and filesystem (`os`, `shutil`, `tempfile`)
- IPC and networking (`signal`, `mmap`, `select`, `socket`)
- Internet protocols (`urllib`, `email`, `smtplib`, `ipaddress`)
- compression (`zipfile`, `tarfile`, `gzip`)
- cryptography (`hashlib`, `secrets`)
- functional-like programming (`itertools`, `functools`)
- development (`unittest`, `doctest`, `venv`)
- debugging and profiling (`pdb`, `timeit`, `dis`)

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)
- data types (`datetime`, `collections`, `queue`)
- concurrency (`threading`, `multiprocessing`, `asyncio`)
- math (`math`, `decimal`, `fractions`, `statistics`)
- operating system and filesystem (`os`, `shutil`, `tempfile`)
- IPC and networking (`signal`, `mmap`, `select`, `socket`)
- Internet protocols (`urllib`, `email`, `smtplib`, `ipaddress`)
- compression (`zipfile`, `tarfile`, `gzip`)
- cryptography (`hashlib`, `secrets`)
- functional-like programming (`itertools`, `functools`)
- development (`unittest`, `doctest`, `venv`)
- debugging and profiling (`pdb`, `timeit`, `dis`)
- other (`logging`, `argparse`, `ctypes`)

# A Brief Tour of the Standard Library

- text processing (`re`, `json`, `xml`, `csv`, `base64`)
- data types (`datetime`, `collections`, `queue`)
- concurrency (`threading`, `multiprocessing`, `asyncio`)
- math (`math`, `decimal`, `fractions`, `statistics`)
- operating system and filesystem (`os`, `shutil`, `tempfile`)
- IPC and networking (`signal`, `mmap`, `select`, `socket`)
- Internet protocols (`urllib`, `email`, `smtplib`, `ipaddress`)
- compression (`zipfile`, `tarfile`, `gzip`)
- cryptography (`hashlib`, `secrets`)
- functional-like programming (`itertools`, `functools`)
- development (`unittest`, `doctest`, `venv`)
- debugging and profiling (`pdb`, `timeit`, `dis`)
- other (`logging`, `argparse`, `ctypes`)
- ...

# Some Other Interesting Libraries and Projects

- `pip` (installation of Python packages)

# Some Other Interesting Libraries and Projects

- `pip` (installation of Python packages)
- `requests` (HTTP for humans)

# Some Other Interesting Libraries and Projects

- `pip` (installation of Python packages)
- `requests` (HTTP for humans)
- `sphinx` (documentation)

# Some Other Interesting Libraries and Projects

- `pip` (installation of Python packages)
- `requests` (HTTP for humans)
- `sphinx` (documentation)
- `sqlalchemy` (database toolkit)

# Some Other Interesting Libraries and Projects

- `pip` (installation of Python packages)
- `requests` (HTTP for humans)
- `sphinx` (documentation)
- `sqlalchemy` (database toolkit)
- `numpy`, `scipy` (scientific computing)

# Some Other Interesting Libraries and Projects

- `pip` (installation of Python packages)
- `requests` (HTTP for humans)
- `sphinx` (documentation)
- `sqlalchemy` (database toolkit)
- `numpy`, `scipy` (scientific computing)
- `django`, `flask` (web frameworks)

# Some Other Interesting Libraries and Projects

- `pip` (installation of Python packages)
- `requests` (HTTP for humans)
- `sphinx` (documentation)
- `sqlalchemy` (database toolkit)
- `numpy`, `scipy` (scientific computing)
- `django`, `flask` (web frameworks)
- `coverage` (code coverage)

# Some Other Interesting Libraries and Projects

- `pip` (installation of Python packages)
- `requests` (HTTP for humans)
- `sphinx` (documentation)
- `sqlalchemy` (database toolkit)
- `numpy`, `scipy` (scientific computing)
- `django`, `flask` (web frameworks)
- `coverage` (code coverage)
- `ply` (Python Lex and Yacc)

# Some Other Interesting Libraries and Projects

- `pip` (installation of Python packages)
- `requests` (HTTP for humans)
- `sphinx` (documentation)
- `sqlalchemy` (database toolkit)
- `numpy`, `scipy` (scientific computing)
- `django`, `flask` (web frameworks)
- `coverage` (code coverage)
- `ply` (Python Lex and Yacc)
- `matplotlib` (2D plotting)

# Some Other Interesting Libraries and Projects

- `pip` (installation of Python packages)
- `requests` (HTTP for humans)
- `sphinx` (documentation)
- `sqlalchemy` (database toolkit)
- `numpy`, `scipy` (scientific computing)
- `django`, `flask` (web frameworks)
- `coverage` (code coverage)
- `ply` (Python Lex and Yacc)
- `matplotlib` (2D plotting)
- `pygal` (charting)

# Some Other Interesting Libraries and Projects

- `pip` (installation of Python packages)
- `requests` (HTTP for humans)
- `sphinx` (documentation)
- `sqlalchemy` (database toolkit)
- `numpy`, `scipy` (scientific computing)
- `django`, `flask` (web frameworks)
- `coverage` (code coverage)
- `ply` (Python Lex and Yacc)
- `matplotlib` (2D plotting)
- `pygal` (charting)
- `pygame` (games)

# Some Other Interesting Libraries and Projects

- `pip` (installation of Python packages)
- `requests` (HTTP for humans)
- `sphinx` (documentation)
- `sqlalchemy` (database toolkit)
- `numpy`, `scipy` (scientific computing)
- `django`, `flask` (web frameworks)
- `coverage` (code coverage)
- `ply` (Python Lex and Yacc)
- `matplotlib` (2D plotting)
- `pygal` (charting)
- `pygame` (games)
- `pyqt` (GUI)

# Some Other Interesting Libraries and Projects

- `pip` (installation of Python packages)
- `requests` (HTTP for humans)
- `sphinx` (documentation)
- `sqlalchemy` (database toolkit)
- `numpy`, `scipy` (scientific computing)
- `django`, `flask` (web frameworks)
- `coverage` (code coverage)
- `ply` (Python Lex and Yacc)
- `matplotlib` (2D plotting)
- `pygal` (charting)
- `pygame` (games)
- `pyqt` (GUI)
- `retdec-python` (decompilation)

# Advantages of Python

- + clean and simple syntax

# Advantages of Python

- + clean and simple syntax
- + easy to learn

# Advantages of Python

- + clean and simple syntax
- + easy to learn
- + productivity (high-level constructs)

# Advantages of Python

+ clean and simple syntax
+ easy to learn
+ productivity (high-level constructs)
+ powerful built-in types

# Advantages of Python

- + clean and simple syntax
- + easy to learn
- + productivity (high-level constructs)
- + powerful built-in types
- + elegant and flexible module system

# Advantages of Python

- + clean and simple syntax
- + easy to learn
- + productivity (high-level constructs)
- + powerful built-in types
- + elegant and flexible module system
- + excellent standard library

# Advantages of Python

- + clean and simple syntax
- + easy to learn
- + productivity (high-level constructs)
- + powerful built-in types
- + elegant and flexible module system
- + excellent standard library
- + reflection

# Advantages of Python

- + clean and simple syntax
- + easy to learn
- + productivity (high-level constructs)
- + powerful built-in types
- + elegant and flexible module system
- + excellent standard library
- + reflection
- + multiparadigm (procedural, object oriented)

# Advantages of Python

- + clean and simple syntax
- + easy to learn
- + productivity (high-level constructs)
- + powerful built-in types
- + elegant and flexible module system
- + excellent standard library
- + reflection
- + multiparadigm (procedural, object oriented)
- + generic programming (duck typing)

# Advantages of Python

+ clean and simple syntax
+ easy to learn
+ productivity (high-level constructs)
+ powerful built-in types
+ elegant and flexible module system
+ excellent standard library
+ reflection
+ multiparadigm (procedural, object oriented)
+ generic programming (duck typing)
+ widely used

# Disadvantages of Python

- not very fast on computationally intensive operations

# Disadvantages of Python

- not very fast on computationally intensive operations
- not for memory-intensive tasks

# Disadvantages of Python

- not very fast on computationally intensive operations
- not for memory-intensive tasks
- limited parallelism with threads (Global Interpreter Lock)

# Disadvantages of Python

- not very fast on computationally intensive operations
- not for memory-intensive tasks
- limited parallelism with threads (Global Interpreter Lock)
- limited notion of constness

# Disadvantages of Python

- not very fast on computationally intensive operations
- not for memory-intensive tasks
- limited parallelism with threads (Global Interpreter Lock)
- limited notion of constness
- portable, but some parts are OS-specific

# Disadvantages of Python

- not very fast on computationally intensive operations
- not for memory-intensive tasks
- limited parallelism with threads (Global Interpreter Lock)
- limited notion of constness
- portable, but some parts are OS-specific
- Python 2 vs 3 (incompatibilities)

# Varying Opinions

+/- everything is public

# Varying Opinions

- +/- everything is public
- +/- unsystematic documentation

# Varying Opinions

+/- everything is public

+/- unsystematic documentation

+/- whitespace is significant

# Varying Opinions

+/- everything is public

+/- unsystematic documentation

+/- whitespace is significant

+/- standardization

# Varying Opinions

+/- everything is public

+/- unsystematic documentation

+/- whitespace is significant

+/- standardization

+/- supports “monkey patching”

# Varying Opinions

- +/- everything is public
- +/- unsystematic documentation
- +/- whitespace is significant
- +/- standardization
- +/- supports “monkey patching“
- +/- not suitable for writing low-level code

# Varying Opinions

- +/- everything is public
- +/- unsystematic documentation
- +/- whitespace is significant
- +/- standardization
- +/- supports “monkey patching”
- +/- not suitable for writing low-level code
- +/- dynamic typing

# Varying Opinions

+/- everything is public

+/- unsystematic documentation

+/- whitespace is significant

+/- standardization

+/- supports “monkey patching“

+/- not suitable for writing low-level code

+/- dynamic typing

https://cs-blog.petrzemek.net/2014-10-26-co-se-mi-nelibi-na-pythonu

# Summary

- imperative language
- multiparadigm (procedural, object oriented)
- strongly typed
- dynamically typed
- interpreted (translated to internal representation)
- modularity is directly supported (packages, modules)

# Where to Look for Further Information?

- Python Programming Language – Official Website
  https://www.python.org/
- Python 3 Documentation
  https://docs.python.org/3/
- Official Python 3 Tutorial
  https://docs.python.org/3/tutorial/
- Dive into Python 3
  http://www.diveintopython3.net/
- Learning Python, 5th Edition (2013)
  http://shop.oreilly.com/product/0636920028154.do
- Fluent Python (2015)
  http://shop.oreilly.com/product/0636920032519.do