The Standard Library Tour

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About me

- software engineer at Ataccama

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- over 5 years of diverse experience in the IT industry, ranging from tech support and testing to analysis and development

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- over 5 years of diverse experience in the IT industry, ranging from tech support and testing to analysis and development
- based in Prague
- co-organizer of Pyvo - Prague Python meetups & co-organizer of PyCon CZ

What is the standard library?

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- a collection of modules and functions included with Python

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- offers numerous functionalities without installing 3rd party libraries

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- a collection of modules and functions included with Python
- offers numerous functionalities without installing 3rd party libraries
- functionalities include interacting with OS, running servers, scientific computing, debugging, data manipulation, and more

Why should you use the standard library?

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- you're not re-inventing the wheel when it comes to finding solutions

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- you're not re-inventing the wheel when it comes to finding solutions
- the solutions that are available have already been optimized for efficiency
- using these pre-existing solutions can help avoid encountering bugs that have already been fixed

What is this talk about?

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- a brief overview of lesser-known features of the standard library

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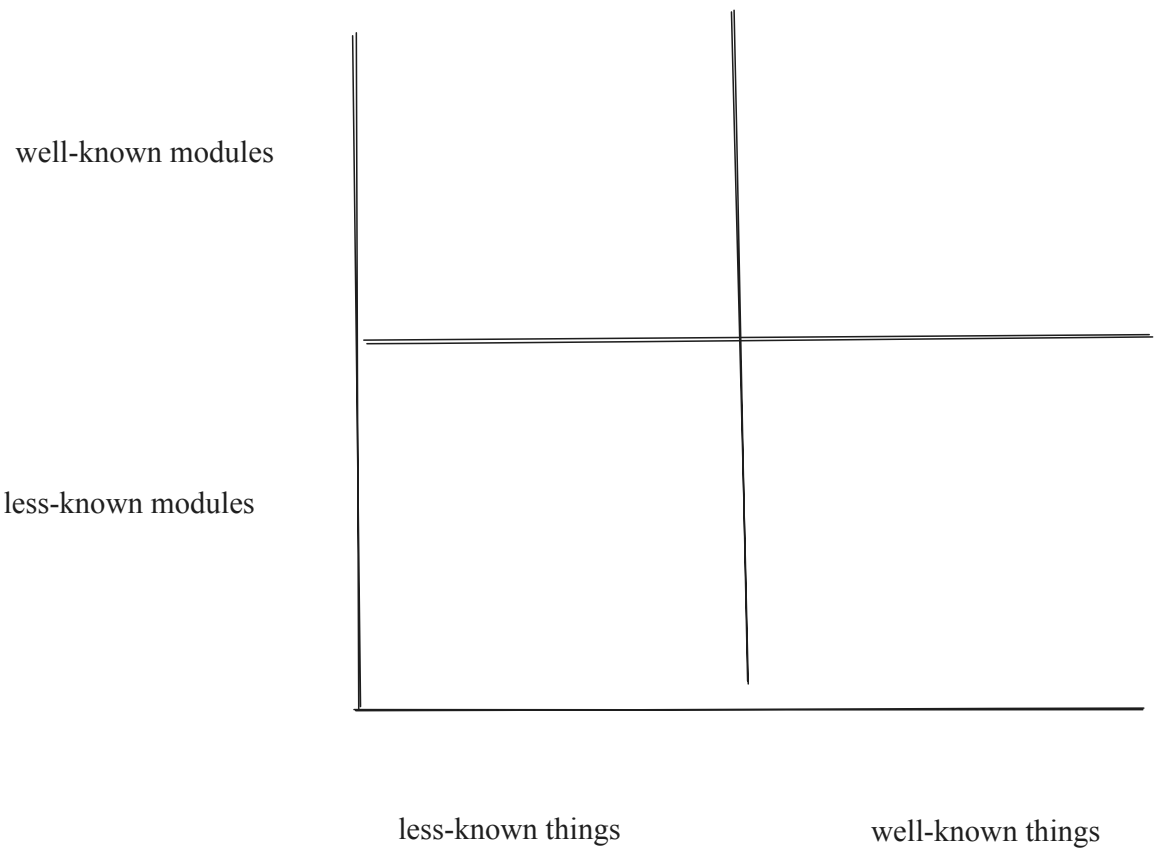
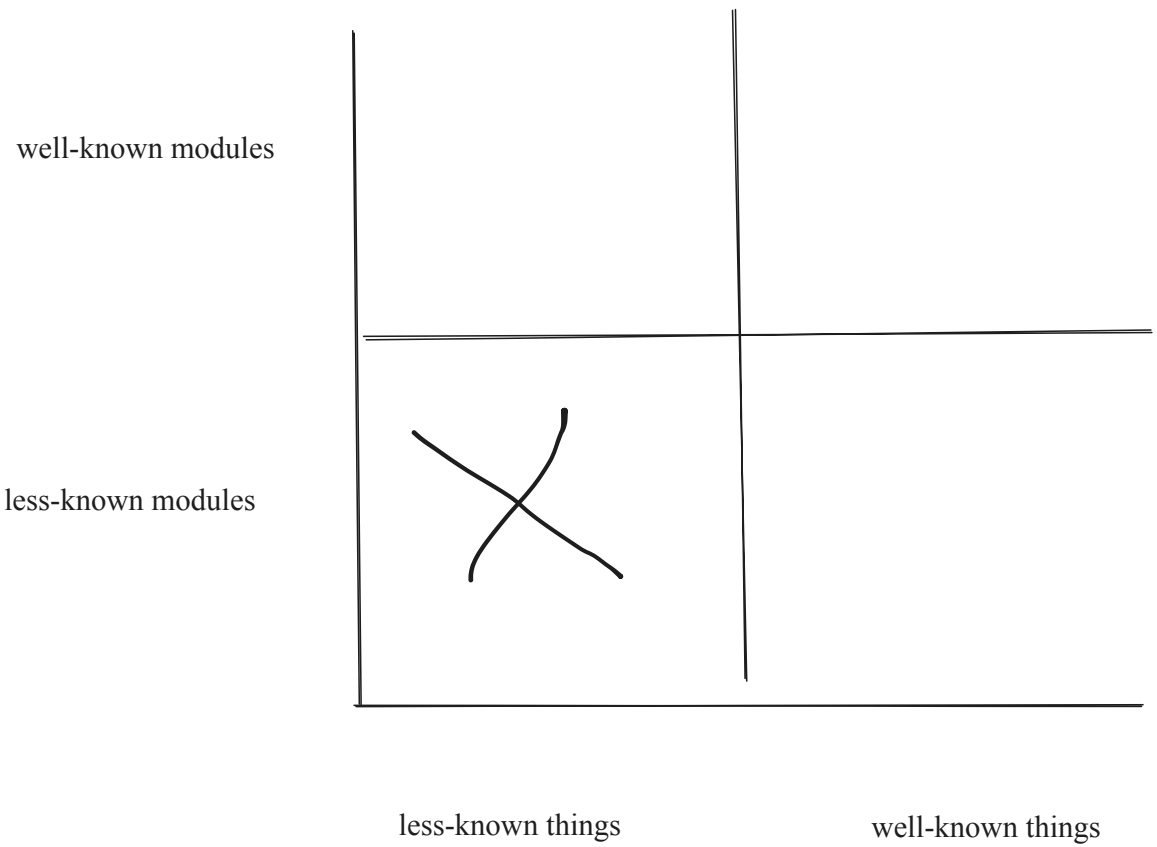
- a brief overview of lesser-known features of the standard library
- the aim is to discover the unknown unknowns - features that you didn't even know exist

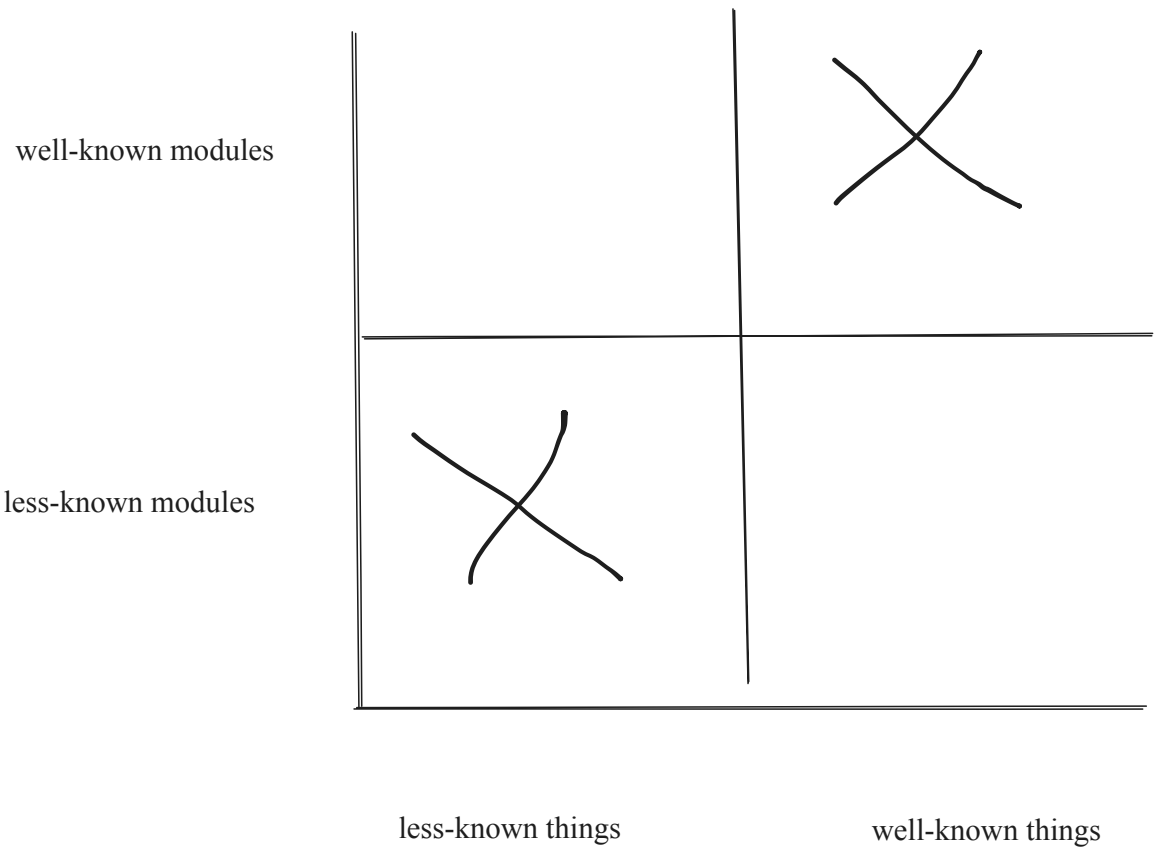
What is this talk about?



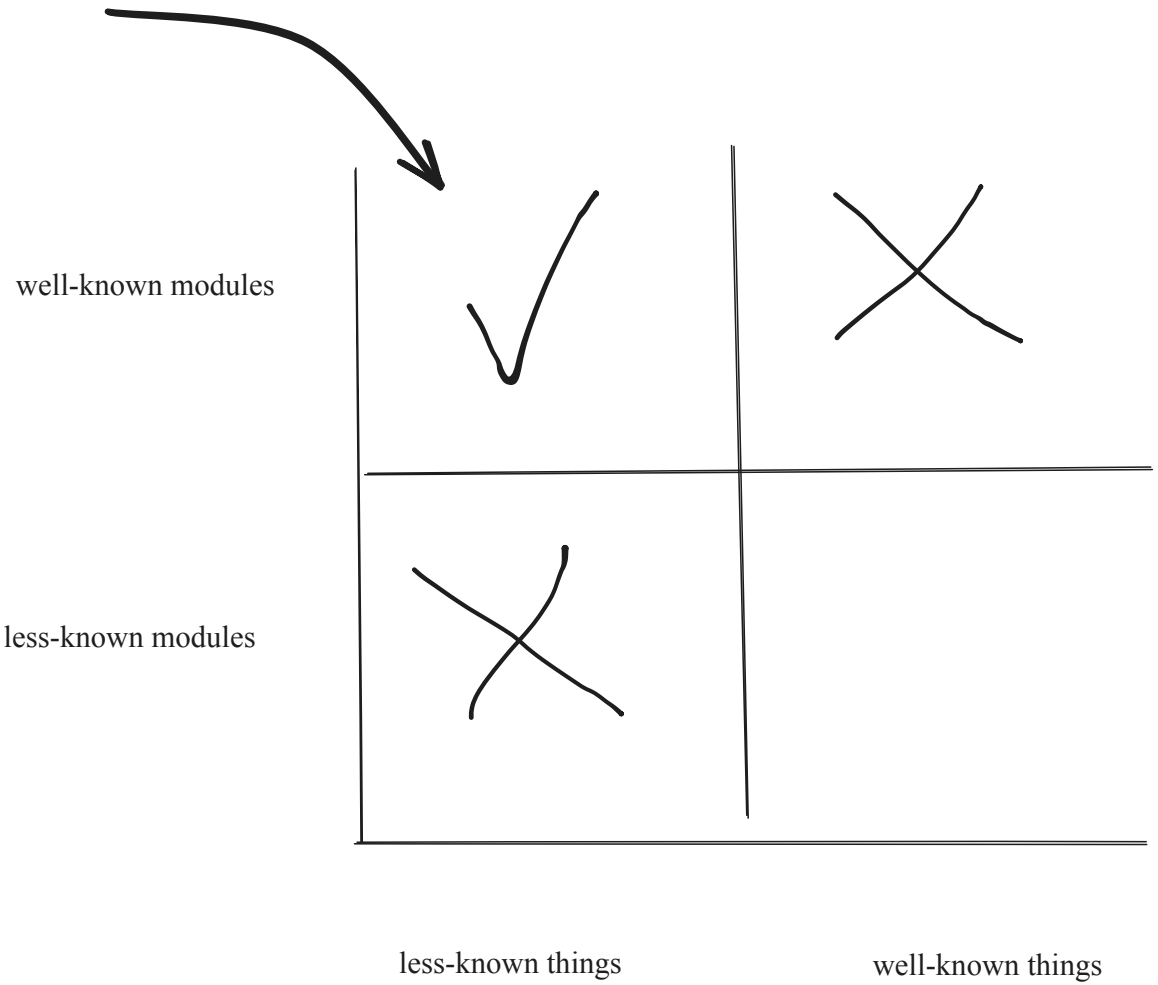
What is this talk about?



What is this talk about?



Well-known modules that do less-known things



Disclaimer

- all code examples are illustrative

Functools

Functools

- one of the most frequently used modules inside the standard library

Functools

- one of the most frequently used modules inside the standard library
- functools includes a variety of tools for working with functions, including tools for modifying function behavior or creating function-like objects

Functools

```
1 def add(x, y):
2     if isinstance(x, int) and isinstance(y, int):
3         return x + y
4     elif isinstance(x, str) and isinstance(y, str):
5         return x + " " + y
6     else:
7         raise ValueError("Unsupported data type")
```

Functools

```
1  def add(x, y):
2      if isinstance(x, int) and isinstance(y, int):
3          return x + y
4      elif isinstance(x, str) and isinstance(y, str):
5          return x + " " + y
6      else:
7          raise ValueError("Unsupported data type")
8
9  print(add(1, 2))
10 print(add("Hello", "World!"))
11 print(add(1, "World!"))
```

Functools

```
3
Hello World!
Traceback (most recent call last):
  File "/home/mia/Documents/repos/osobní/python/demo/europython/singledispatch.py", line 12, in <module>
    print(add(1, "World!"))
  File "/home/mia/Documents/repos/osobní/python/demo/europython/singledispatch.py", line 7, in add
    raise ValueError("Unsupported data type")
ValueError: Unsupported data type
```

Functools

```
1  from functools import singledispatch
2
3
4  @singledispatch
5  def add(x, y):
6      raise ValueError("Unsupported data type")
7
8
9  @add.register
10 def _(x: int, y: int):
11     return x + y
12
13
14 @add.register
15 def _(x: str, y: str):
16     return x + " " + y
```

Functools

- @singledispatch is used for function overloading
  - creating several methods with the same name which differ from each other in the type of input parameters or the number of input parameters

Functools

- @singledispatch is used for function overloading
  - creating several methods with the same name which differ from each other in the type of input parameters or the number of input parameters
- commonly used for cases when you work with different data types as input to your functions

Functools

- the advantage of @singledispatch over if/elif/else type checking:

Functools

- the advantage of @singledispatch over if/elif/else type checking:
  - easier to modify - each function that handles one type is independent and can be modified independently of others

Functools

- the advantage of @singledispatch over if/elif/else type checking:
  - easier to modify - each function that handles one type is independent and can be modified independently of others
  - the code is cleaner and more readable

Functools

- @singledispatch dispatches only for the first argument

Functools

- @singledispatch dispatches only for the first argument
- the downside is, if there are multiple arguments, third-party libraries need to be used

Functools

Functools

```
1 def add_to_two(x, y=2):
2     return x + y
3
4 print(add_to_two(3))
```

Functools

```
1 def add_to_three(x, y=3):
2     return x + y
3
4 print(add_to_three(2))
```

Functools

```
1  import functools
2
3
4  def add(x, y):
5      return x + y
6
7  add_to_two = functools.partial(add, y=2)
8  add_to_three = functools.partial(add, y=3)
9
10 print(add_to_two(3))
11 print(add_to_three(3))
```

Functools

```
1  import functools
2
3
4  def add(x, y):
5      return x + y
6
7  add_to_two = functools.partial(add, y=2)
8  add_to_three = functools.partial(add, y=3)
9
10 print(add_to_two(3))
11 print(add_to_three(3))
12
13 5
14 6
```

Functools

- partial is used to create a new function with some of the arguments of the original function

Functools

- partial is used to create a new function with some of the arguments of the original function
- it can be used with any callable, including built-in functions, methods from other libraries, args and kwargs

Functools

- the main advantage of using partial is code reusability and adhering to the DRY principle (Don't Repeat Yourself)

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- a common use case is when you need to call a function with the same argument multiple times

Functools

- the main advantage of using partial is code reusability and adhering to the DRY principle (Don't Repeat Yourself)
- a common use case is when you need to call a function with the same argument multiple times
- the main downside is that partial may not be intuitive for new Python developers

Functools

```
1 import functools
2
3 def fibonacci(n):
4     if n < 2:
5         return n
6     return fibonacci(n-1) + fibonacci(n-2)
```

Functools

```
1 import functools
2
3 @functools.lru_cache(maxsize=None)
4 def fibonacci(n):
5     if n < 2:
6         return n
7     return fibonacci(n-1) + fibonacci(n-2)
```

Functools

```
1 import functools
2
3 @functools.cache
4 def fibonacci(n):
5     if n < 2:
6         return n
7     return fibonacci(n-1) + fibonacci(n-2)
```

Functools

- @lru_cache (Least Recently Used) stores the results of function calls

Functools

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- @lru_cache checks for the key in cache dictionary, when the key is present the wrapper returns the value and updates the cache hit info

Functools

- @lru_cache (Least Recently Used) stores the results of function calls
- it checks for the key in cache dictionary, when the key is present the wrapper returns the value and updates the cache hit info
- if the key is missing, the wrapper calls the user function with passed arguments, updates the cache miss info and returns the result

Functools

- if the cache is full, the @lru_cache evicts the old items and adds new ones

Functools

- @cache is available from version 3.9

Functools

- @cache is available from version 3.9
- it is same as @lru_cache(maxsize=None)

Functools

- @cache is available from version 3.9
- it is same as @lru_cache(maxsize=None)
- @cache doesn't evict the old values, so it's faster

Functools

```
1 mia@mias-
  ntb:~/Documents/repos/osobní/python/demo/europython$
  python3 -mtimeit -s 'import fibonacci_without_cache as f'
  'f.fibonacci(n=20)'
2 200 loops, best of 5: 1.03 msec per loop
3
4 mia@mias-
  ntb:~/Documents/repos/osobní/python/demo/europython$
  python3 -mtimeit -s 'import fibonacci_with_lru_cache as f'
  'f.fibonacci(n=20)'
5 5000000 loops, best of 5: 97.1 nsec per loop
6
7 mia@mias-
  ntb:~/Documents/repos/osobní/python/demo/europython$
  python3 -mtimeit -s 'import fibonacci_with_cache as f'
  'f.fibonacci(n=20)'
8 2000000 loops, best of 5: 97.8 nsec per loop
```

Itertools

Itertools

- provide various functions that create iterators for efficient looping

Itertools

- provide various functions that create iterators for efficient looping
- they are useful for handling large data streams

Itertools

```
1  list1 = [1, 2, 3]
2  list2 = [4, 5, 6]
3
4  product = []
5
6  for i in list1:
7      for j in list2:
8          product.append((i, j))
9  print(product)
10
11 mia@mias-
   ntb:~/Documents/repos/osobní/python/demo/europython$
   python3 product.py
12 [(1, 4), (1, 5), (1, 6), (2, 4), (2, 5), (2, 6), (3, 4),
   (3, 5), (3, 6)]
```

Itertools

```
1 import itertools
2
3 list1 = [1, 2, 3]
4 list2 = [4, 5, 6]
5
6 print(list(itertools.product(list1, list2)))
7
8 mia@mias-
  ntb:~/Documents/repos/osobní/python/demo/europython$
  python3 product.py
9 [(1, 4), (1, 5), (1, 6), (2, 4), (2, 5), (2, 6), (3, 4),
  (3, 5), (3, 6)]
```

Itertools

- product() returns the cartesian product of two iterables

Itertools

```
1 list1 = [1, 2, 3, 4]
2 list2 = [4, 5, 6]
3
4 print(list(filter(lambda i: i in list1, list2)))
5
6 mia@mias-
  ntb:~/Documents/repos/osobní/python/demo/europython$
  python3 filter.py
7 [4]
```

Itertools

```
1  import itertools
2
3
4  list1 = [1, 2, 3, 4]
5  list2 = [4, 5, 6]
6
7  print(list(itertools.filterfalse(lambda i: i in list1,
   list2)))
8
9  mia@mias-
   ntb:~/Documents/repos/osobní/python/demo/europython$
   python3 filter.py
10 [5, 6]
```

Itertools

- filterfalse() filters elements from an iterable returning only those for which the predicate is false

Itertools

- filterfalse() filters elements from an iterable returning only those for which the predicate is false
- the opposite of built-in filter()

Itertools

```
1 numbers = [1, 2, 3]
2 letters = ['a', 'b', 'c', 'd', 'e']
3
4 print(list(zip(numbers, letters)))
```

Itertools

```
1 numbers = [1, 2, 3]
2 letters = ['a', 'b', 'c', 'd', 'e']
3
4 print(list(zip(numbers, letters)))
5
6 mia@mias-
  ntb:~/Documents/repos/osobní/python/demo/europython$
  python3 zip.py
7 [(1, 'a'), (2, 'b'), (3, 'c')]
```

Itertools

```
1 import itertools
2
3 numbers = [1, 2, 3]
4 letters = ['a', 'b', 'c', 'd', 'e']
5
6 print(list(itertools.zip_longest(numbers, letters)))
7
8 mia@mias-
  ntb:~/Documents/repos/osobní/python/demo/europython$
  python3 zip_longest.py
9 [(1, 'a'), (2, 'b'), (3, 'c'), (None, 'd'), (None, 'e')]
```

Collections

Collections

```
1 dict1 = {"a": 1, "b": 2, "c": 3}
2 dict2 = {"d": 4, "e": 5, "f": 6}
```

Collections

```
1  dict1 = {"a": 1, "b": 2, "c": 3}
2  dict2 = {"d": 4, "e": 5, "f": 6}
3
4  if "c" in dict1:
5      print(dict1["c"])
6  elif "c" in dict2:
7      print(dict2["c"])
8  else:
9      print("Not found")
10
11 mia@mias-
   ntb:~/Documents/repos/osobní/python/demo/europython$
   python3 chainmap.py
12 3
```

Collections

```
1  from collections import ChainMap
2
3  dict1 = {"a": 1, "b": 2, "c": 3}
4  dict2 = {"d": 4, "e": 5, "f": 6}
5
6  chain_dict = ChainMap(dict1, dict2)
7  print(chain_dict["c"])
8
9  mia@mias-
   ntb:~/Documents/repos/osobní/python/demo/europython$
   python3 chainmap.py
10 3
```

Collections

```
1  dict1 = {"a": 1, "b": 2, "c": 3}
2  dict2 = {"d": 4, "e": 5, "f": 6}
3
4  new_dict = {}
5  new_dict.update(dict1)
6  new_dict.update(dict2)
7
8  print(new_dict)
9
10 mia@mias-
   ntb:~/Documents/repos/osobní/python/demo/europython$
   python3 chainmap.py
11 {'a': 1, 'b': 2, 'c': 3, 'd': 4, 'e': 5, 'f': 6}
```

Collections

- ChainMap references already existing dictionaries and doesn't copy any data

Collections

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- it groups multiple dictionaries into one and provides a single, dynamic view

Collections

- ChainMap references already existing dictionaries and doesn't copy any data
- it groups multiple dictionaries into one and provides a single, dynamic view
- when one of the dictionaries gets updated, the update is visible in ChainMap as well

Collections

```
1 dict1 = {"a": 1, "b": 2, "c": 3}
2
3 print(dict1["d"])
```

Collections

```
1 dict1 = {"a": 1, "b": 2, "c": 3}
2
3 print(dict1["d"])
4
5 mia@mias-
  ntb:~/Documents/repos/osobní/python/demo/europython$
  python3 default_dict.py
6 Traceback (most recent call last):
7   File
  "/home/mia/Documents/repos/osobní/python/demo/europython/de
  fault_dict.py", line 3, in <module>
8     print(dict1["d"])
9 KeyError: 'd'
```

Collections

```
1 from collections import defaultdict
2
3 dict1 = defaultdict(lambda: None, {"a": 1, "b": 2, "c": 3})
4
5 print(dict1["d"])
```

Collections

```
1 from collections import defaultdict
2
3 dict1 = defaultdict(lambda: None, {"a": 1, "b": 2, "c": 3})
4
5 print(dict1["d"])
6
7 mia@mias-
  ntb:~/Documents/repos/osobní/python/demo/europython$
  python3 default_dict.py
8 None
```

Collections

- defaultdict is a container-like dictionary that returns a default value for a non-existing key

Collections

- defaultdict is a container-like dictionary that returns a default value for a non-existing key
- it's commonly used for grouping or counting elements in a collection

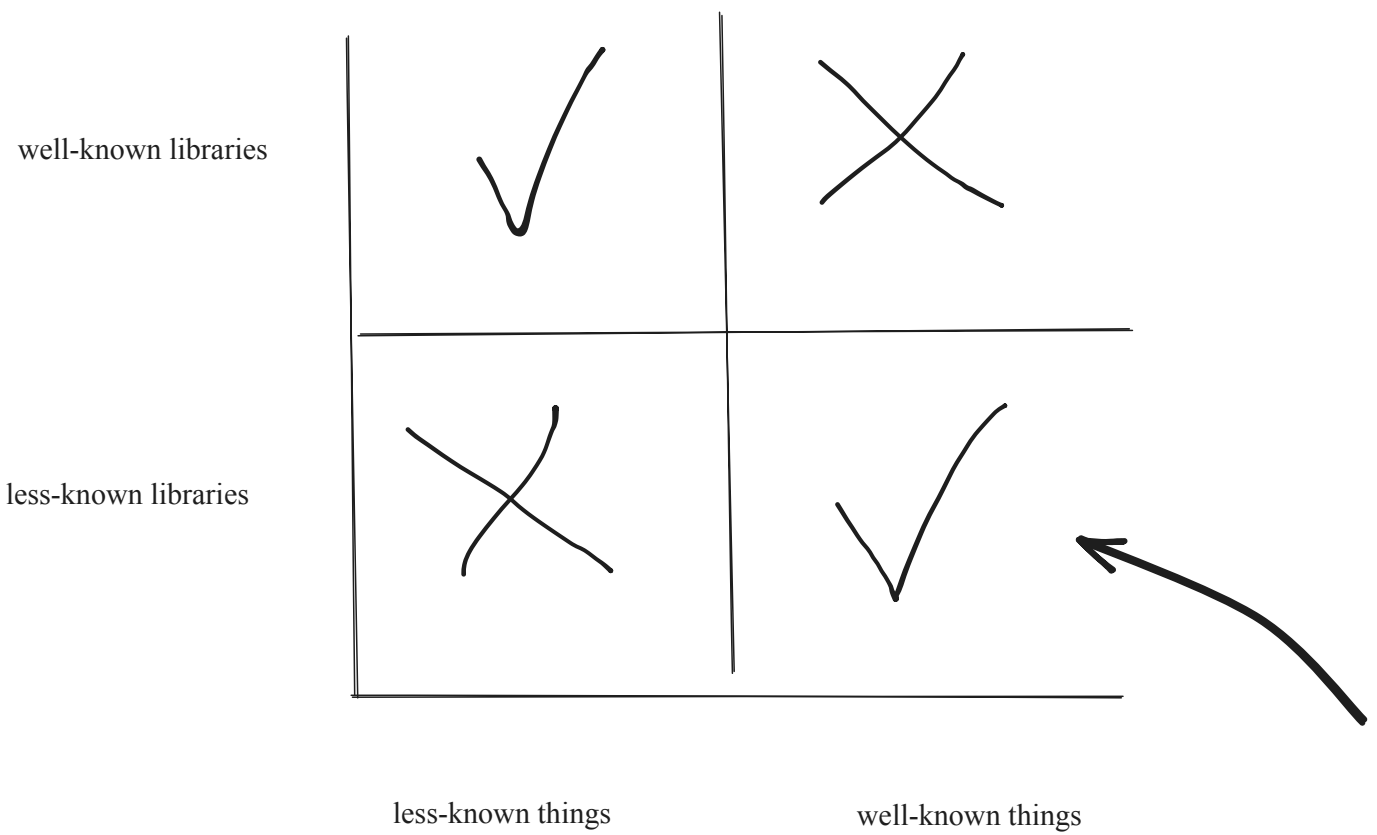
Collections

- defaultdict is a container-like dictionary that returns a default value for a non-existing key
- it's commonly used for grouping or counting elements in a collection
- defaultdict can make code simpler and more readable by eliminating the need to check if a key is already present in the dictionary before doing operations on it

Collections

```
1 dict2 = defaultdict(lambda: None, defaultdict(lambda: None,
  {"a": 1, "b": 2, "c": 3}))
2
3 print(dict2["d"])
4
5 mia@mias-
  ntb:~/Documents/repos/osobní/python/demo/europython$
  python3 default_dict.py
6 None
```

Less-known modules which do well-known things



Testing

Testing

```
1 def add(x, y):
2     return x + y
```

Testing

```
 1 def add(x, y):
 2     """
 3     Adds the two input numbers.
 4
 5     >>> add(2, 3)
 6     5
 7     >>> add(-1, 1)
 8     0
 9     >>> add(-10, -5)
10     -15
11     """
12     return x + y
13
14 if __name__ == "__main__":
15     import doctest
16     doctest.testmod()
```

Testing

```
1 mia@mias-
  ntb:~/Documents/repos/osobní/python/demo/europython$
  python3 testmod.py
2
```

Testing

```
 1 def add(x, y):
 2     """
 3     Adds the two input numbers.
 4
 5     >>> add(2, 3)
 6     5
 7     >>> add(-1, 1)
 8     0
 9     >>> add(-10, -5)
10     15  # this line changed
11     """
12     return x + y
13
14 if __name__ == "__main__":
15     import doctest
16     doctest.testmod()
```

Example

```
1  mia@mias-
   ntb:~/Documents/repos/osobní/python/demo/europython$
   python3 testmod.py
2  **********************************************************
   ***********
3  File
   "/home/mia/Documents/repos/osobní/python/demo/europython/t
   estmod.py", line 9, in __main__.add
4  Failed example:
5      add(-10, -5)
6  Expected:
7      15
8  Got:
9      -15
10 **********************************************************
   ***********
11 1 items had failures:
```

Testing

- Testmod() is used for simple scenarios

Testing

- Testmod() is used for simple scenarios
- mostly for quick-and-dirty kind of testing and documenting simple scenarios

Testing

- Testmod() is used for simple scenarios
- mostly for quick-and-dirty kind of testing and documenting simple scenarios
- test cases are readable to humans - it allows you to test and document your code in the same time

Comparing sequences

Comparing sequences

```
1 string1 = "Hello world!"
2 string2 = "Hello World!"
```

Comparing sequences

```
1  import difflib
2  from pprint import pprint
3
4  string1 = "Hello world!"
5  string2 = "Hello World!"
6
7  d = difflib.Differ()
8  result = list(d.compare(string1, string2))
9
10 pprint(result)
```

Comparing sequences

```
mia@mias-ntb:~/Documents/repos/osobní/python/demo/europython$ python3 differ.py
['  H',
 '  e',
 '  l',
 '  l',
 '  o',
 '   ',
 '- w',
 '+ W',
 '  o',
 '  r',
 '  l',
 '  d',
 '  !']
```

Comparing sequences

```
1 import difflib
2 from pprint import pprint
3
4 string1 = "Hello world!"
5 string2 = "Hello World!"
6
7 s = difflib.SequenceMatcher(None, string1, string2)
8 print(s.ratio())
```

Comparing sequences

```
1  import difflib
2  from pprint import pprint
3
4  string1 = "Hello world!"
5  string2 = "Hello World!"
6
7  s = difflib.SequenceMatcher(None, string1, string2)
8  print(s.ratio())
9
10 mia@mias-
   ntb:~/Documents/repos/osobní/python/demo/europython$
   python3 differ.py
11 0.9166666666666666
```

Comparing sequences

- DiffLib is used for comparing pair of sequences of any type (strings, tuples, lists etc.) as long as the sequence elements are hashable

Comparing sequences

- DiffLib is used for comparing pair of sequences of any type (strings, tuples, lists etc.) as long as the sequence elements are hashable
- uses the Ratcliff/Obershelp algorithm
  - number of overlapping characters between the two strings * 2 / total number of characters in both strings

Comparing sequences

- with DiffLib.ratio() we can measure the similarity of the sequences

Comparing sequences

- with DiffLib.ratio() we can measure the similarity of the sequences
  - values between 0 (no match) and 1 (identical match)

Comparing sequences

- with DiffLib.ratio() we can measure the similarity of the sequences
  - values between 0 (no match) and 1 (identical match)
  - a rule of thumb is ratio() value over 0.6 means the sequences are close matches

Comparing files and directories

Comparing files and directories

```
1 import filecmp
2
3 file1 = "./dir1/file1.py"
4 file2 = "./dir2/file2.py"
5
6 cmp = filecmp.cmp(file1, file2)
7
8 print(cmp)
```

Comparing files and directories

```
1  import filecmp
2
3  file1 = "./dir1/file1.py"
4  file2 = "./dir2/file2.py"
5
6  cmp = filecmp.cmp(file1, file2)
7
8  print(cmp)
9
10 mia@mias-
   ntb:~/Documents/repos/osobní/python/demo/europython$
   python3 compare.py
11 True
```

Comparing files and directories

```
1 dir1 = "./dir1"
2 dir2 = "./dir2"
3
4 cmp_dirs = filecmp.dircmp(dir1, dir2)
5 cmp_dirs.report()
```

Comparing files and directories

```
1  dir1 = "./dir1"
2  dir2 = "./dir2"
3
4  cmp_dirs = filecmp.dircmp(dir1, dir2)
5  cmp_dirs.report()
6
7  mia@mias-
   ntb:~/Documents/repos/osobní/python/demo/europython$
   python3 compare.py
8  diff ./dir1 ./dir2
9  Only in ./dir1 : ['file1.py']
10 Only in ./dir2 : ['file2.py']
```

Comparing files and directories

- the filecmp module defines functions to compare files

Comparing files and directories

- the filecmp module defines functions to compare files
- the dircmp class constructs a new directory comparison object co compare two directories and provides multiple functions to define what to compare and how to show the results

Comparing files and directories

- the filecmp module defines functions to compare files
- the dircmp class constructs a new directory comparison object co compare two directories and provides multiple functions to define what to compare and how to show the results
- the filecmp() module is useful for cases where we have different versions of the same project

Context manager

Context manager

```
1  from contextlib import contextmanager
2
3
4  @contextmanager
5  def managed_file(name):
6      try:
7          f = open(name, "w")
8          print("Opened the file: ", name)
9          yield f
10     finally:
11         f.close()
12         print("Closed the file: ", name)
13
14
15 with managed_file("hello.txt") as f:
16     f.write("Hello world!")
17     print("Wrote to file")
```

Context manager

```
1 mia@mias-
  ntb:~/Documents/repos/osobní/python/demo/europython$
  python3 context_manager.py
2 Opened the file:  hello.txt
3 Wrote to file
4 Closed the file:  hello.txt
```

Context manager

- defines a factory function for 'with' statement contexts

Context manager

- defines a factory function for 'with' statement contexts
- provides a clean, easy-to-read way to manage resources that need setup and teardown phases

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- defines a factory function for 'with' statement contexts
- provides a clean, easy-to-read way to manage resources that need setup and teardown phases
- you can nest multiple context managers with blocks to use them at once or use in a single with statement by separating them with commas

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  - changing and restoring global settings

Context manager

```
1  import aiofiles
2  from contextlib import asynccontextmanager
3  import asyncio
4
5
6  @asynccontextmanager
7  async def managed_file(name):
8      try:
9          f = await aiofiles.open(name, "w")
10         print("Opened the file: ", name)
11         yield f
12     finally:
13         await f.close()
14         print("Closed the file: ", name)
15
```

Context manager

```
async def main():
    async with managed_file("hello.txt") as f:
        await f.write("Hello world!")
        print("Wrote to file")


asyncio.run(main())
```

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- always verify if there's an existing tool for your task and if it suits your needs before attempting to create something from scratch

Thank you for your attention!

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Q&A

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