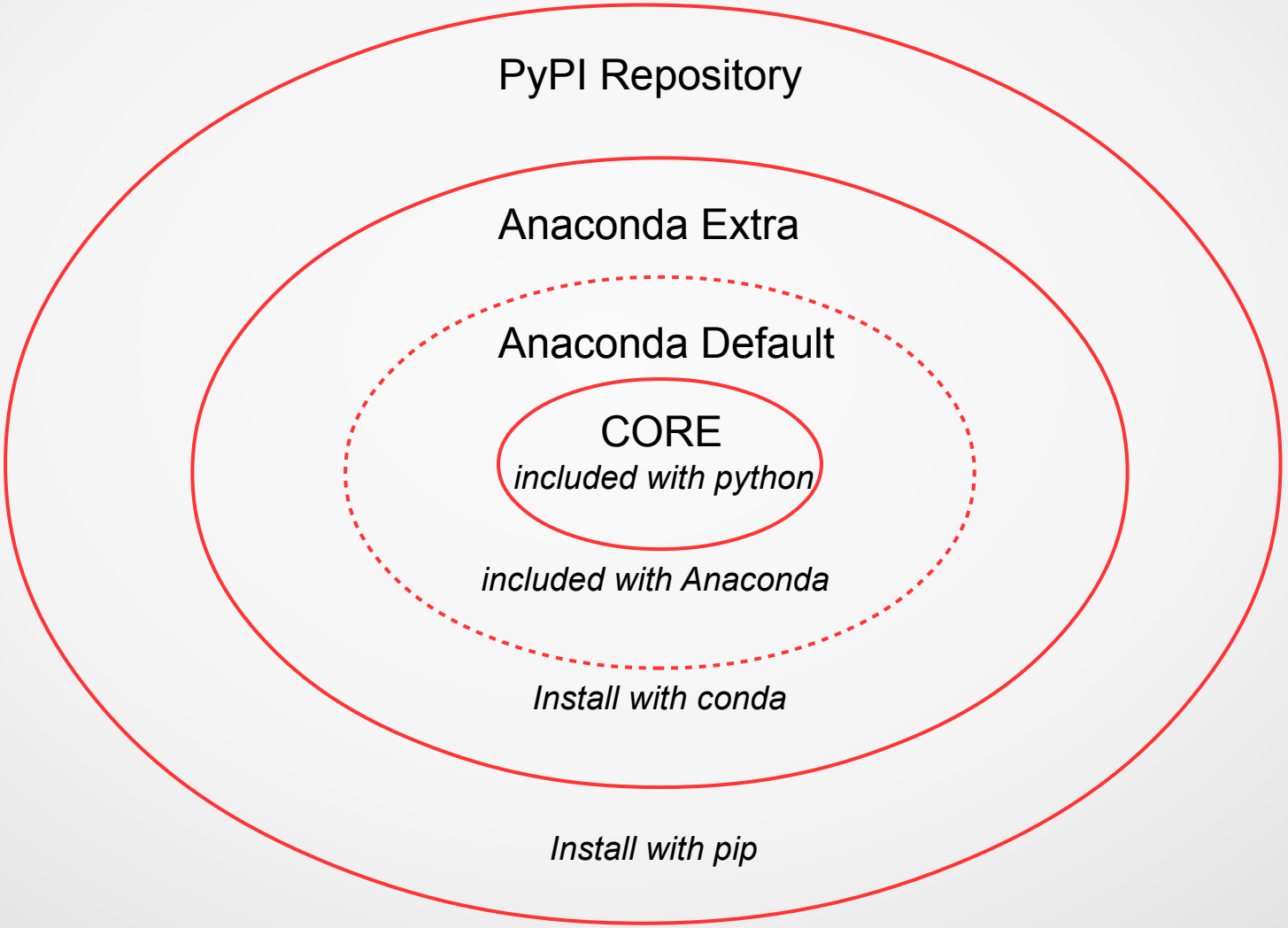
Python Modules (using Anaconda)



What Can Python Do?

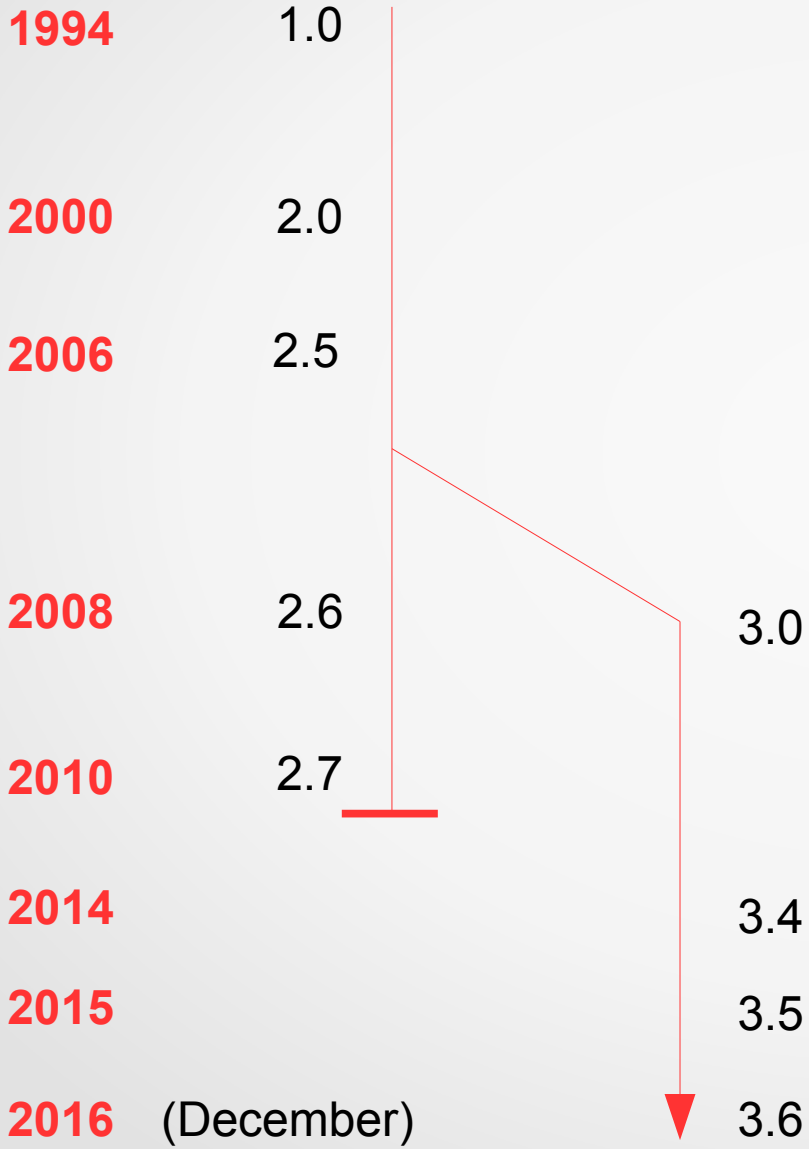
- Web apps
- Web services (REST, SOAP)
- Data mining/web scraping
- Data science
- End-user GUI apps
- System Administration (Windows, Mac, Linux)
- Scientific/Engineering analysis
- Data visualization
- Cloud apps

Advantages of Python

- Readable
- Multi-paradigm
- Modular
- Exceptions
- Standard library
- Extensible and embeddable

Disadvantages of Python

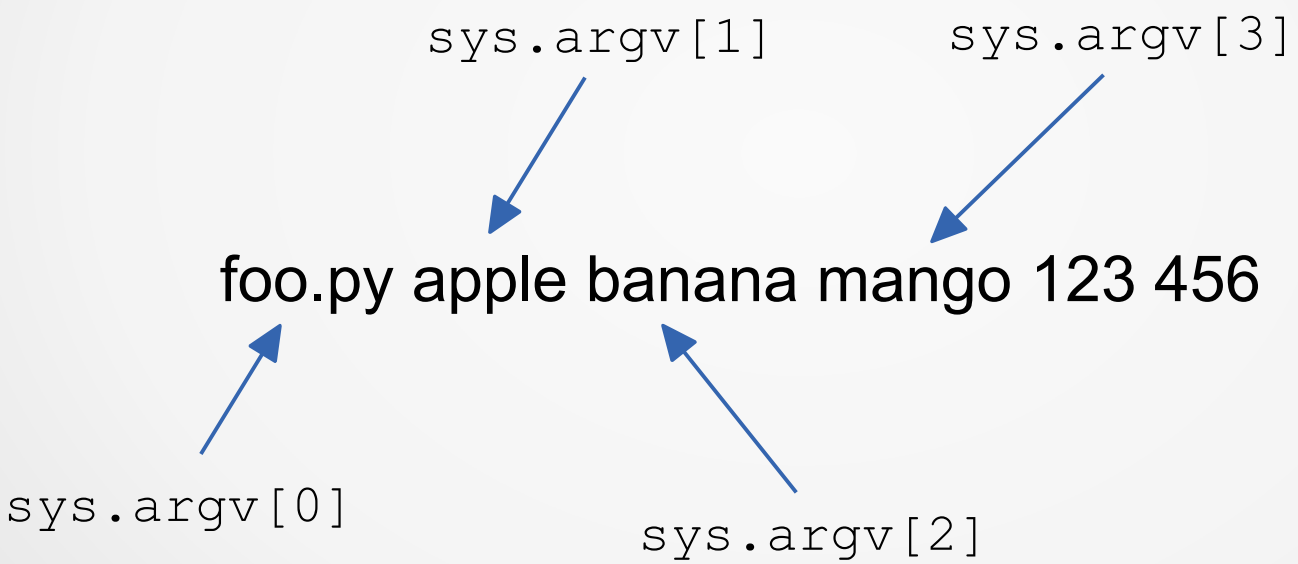
Python Evolution



String literals

- Single-delimited
  - 'spam\n' "spam\n"
- Triple-delimited
  - '''spam\n''' """spam\n"""
- Raw
  - r'spam\n'

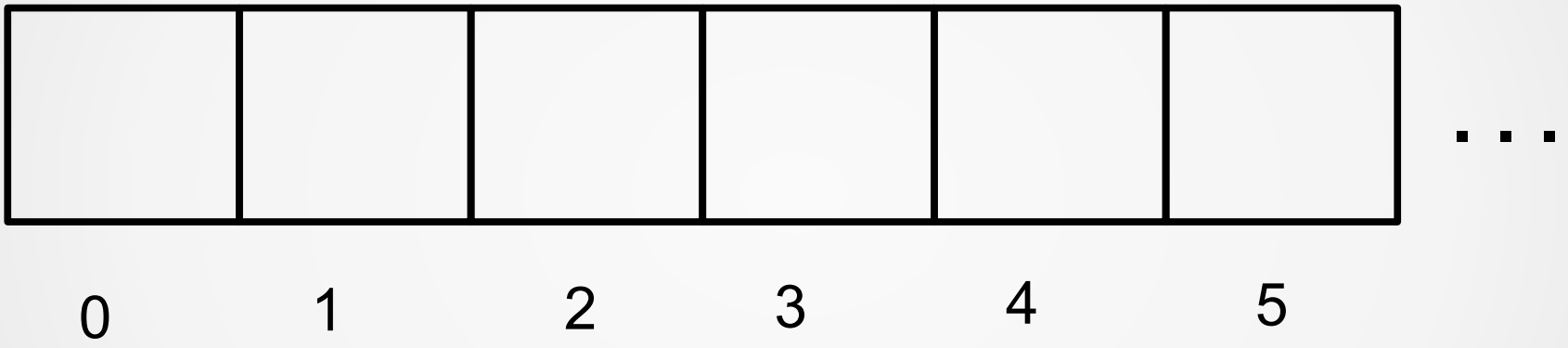
Command Line Parameters



Indenting blocks

```
Block statement:
    Statement
    Statement
    Nested Block Statement:
        Statement
        Statement
    Statement
    Statement

Statement
```

Sequences



Slices

$^{0}W\ ^{1}O\ ^{2}M\ ^{3}B\ ^{4}A\ ^{5}T\ ^{6}$

```
s = "WOMBAT"

s[0:3]        first 3 characters  "WOM"
s[:3]         same, using default start of 0 "WOM"
s[1:4]        s[1] through s[3] "OMB"
s[3:6]        s[3] through end  "BAT"
s[3:len(s)]   s[3] through end  "BAT"
s[3:]         s[3] through end, using default end "BAT"
```

Lists vs Tuples

Lists

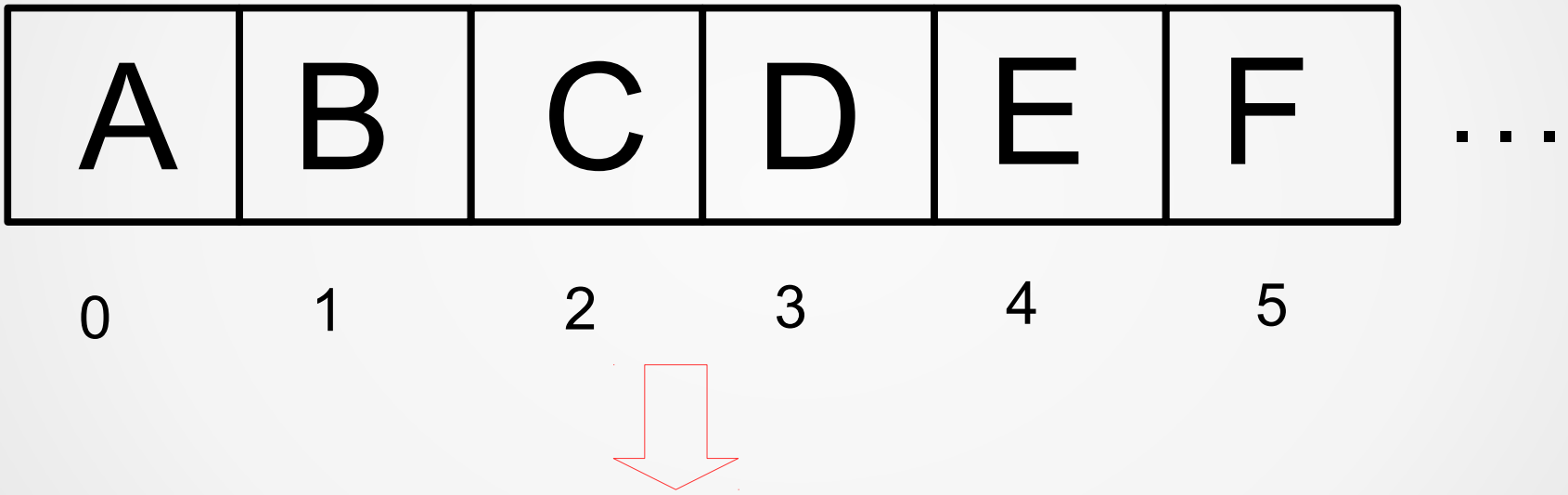
- Dynamic Array
- Mutable/unhashable
- Order doesn't matter
- Designed for looping
- Think "ARRAY"

Tuples

- Collection of related fields
- Immutable/hashable
- Order matters
- Designed for unpacking
- Think "STRUCT" or "RECORD"

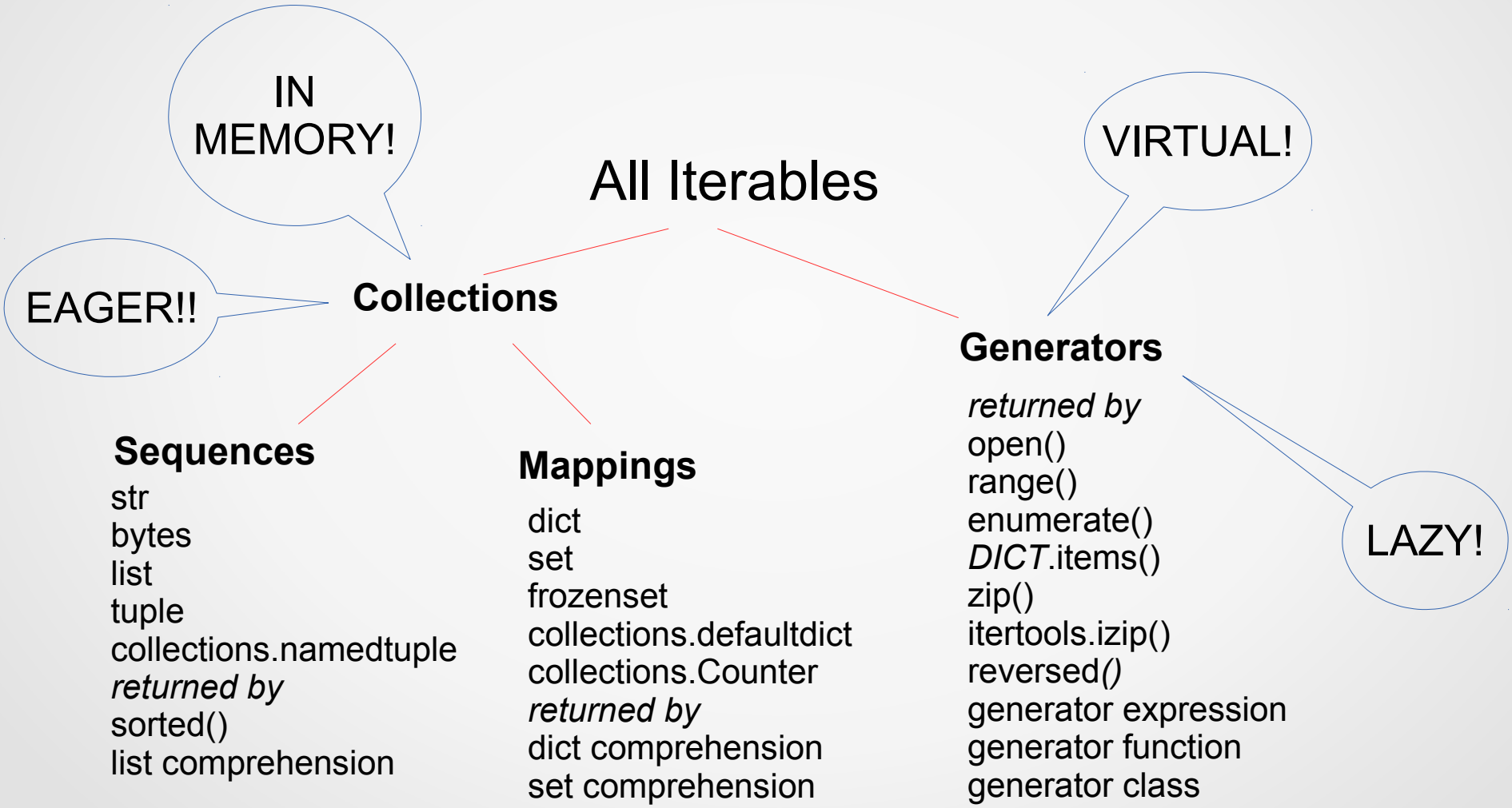
Myth #1: tuples are just read-only lists
Myth #2: tuples are faster than lists
Myth #3: tuples use less memory than lists (*slightly* true)

enumerate()

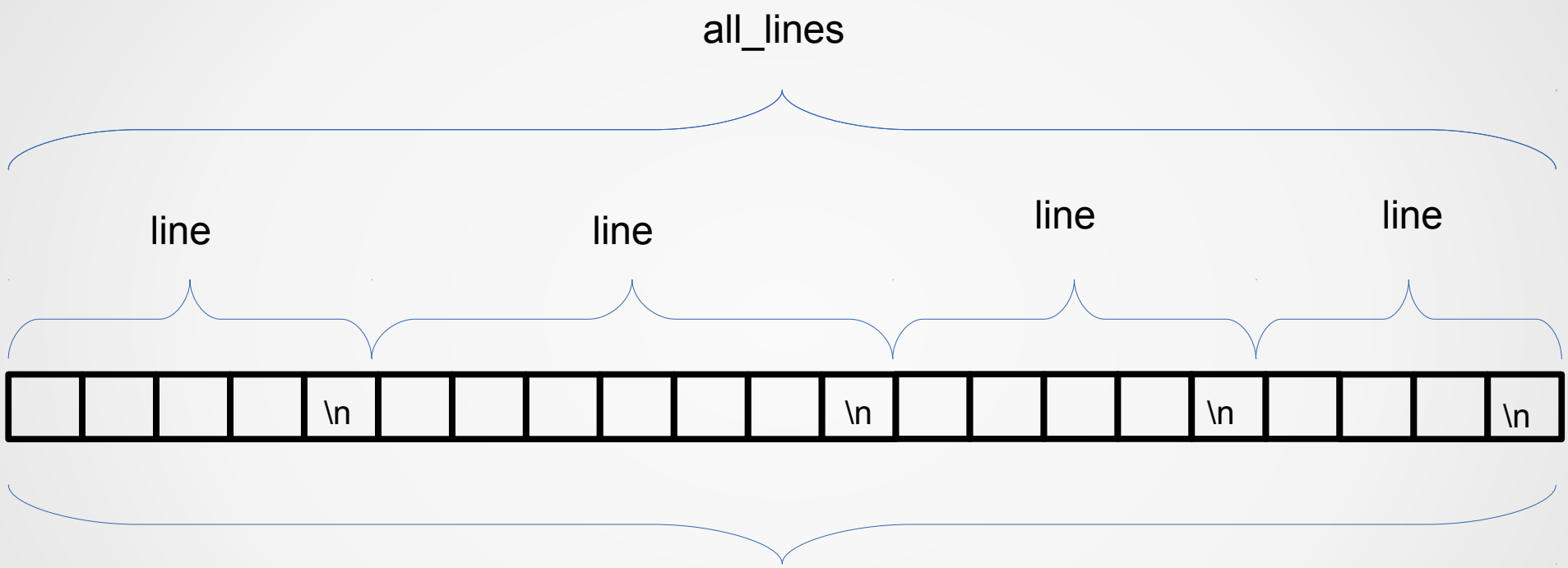


(0, A), (1, B), (2, C), (3, D), (4, E), (5, F)...

Iterables


All Iterables
IN MEMORY!
EAGER!!
Collections
VIRTUAL!
LAZY!
Generators
Sequences
str
bytes
list
tuple
collections.namedtuple
returned by
sorted()
list comprehension
Mappings
dict
set
frozenset
collections.defaultdict
collections.Counter
returned by
dict comprehension
set comprehension
returned by
open()
range()
enumerate()
DICT.items()
zip()
itertools.izip()
reversed()
generator expression
generator function
generator class

Reading text files



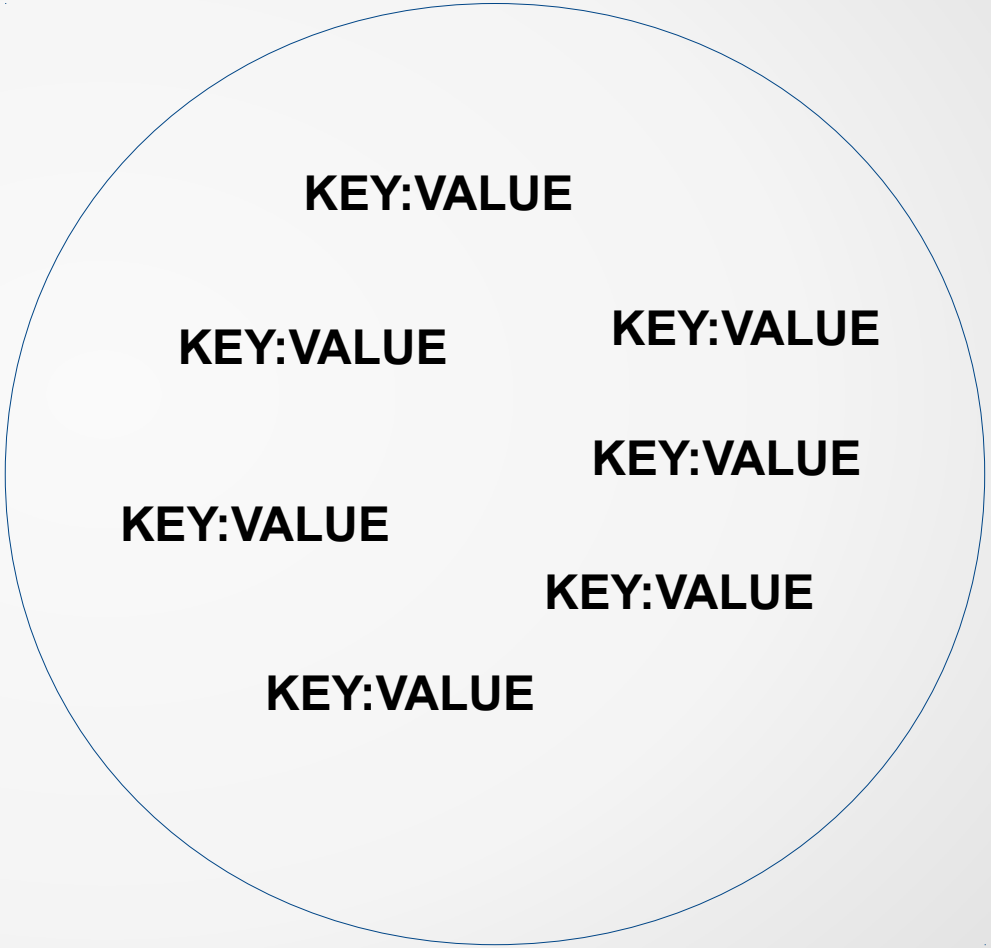

```
for line in FILE:
    pass

contents = FILE.read()

all_lines = FILE.readlines()
```

What do these words mean?

- formication
- ramiferous

Dictionary

- Key/value pairs
- Keys ordered (3.6+)
- Keys not ordered (<3.6)
- Keys are unique
- Use .items() to loop through k/v pairs



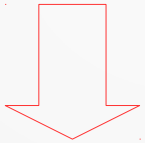
dict.items()

A	B	C	D	E	F
100	200	300	400	500	600

keys

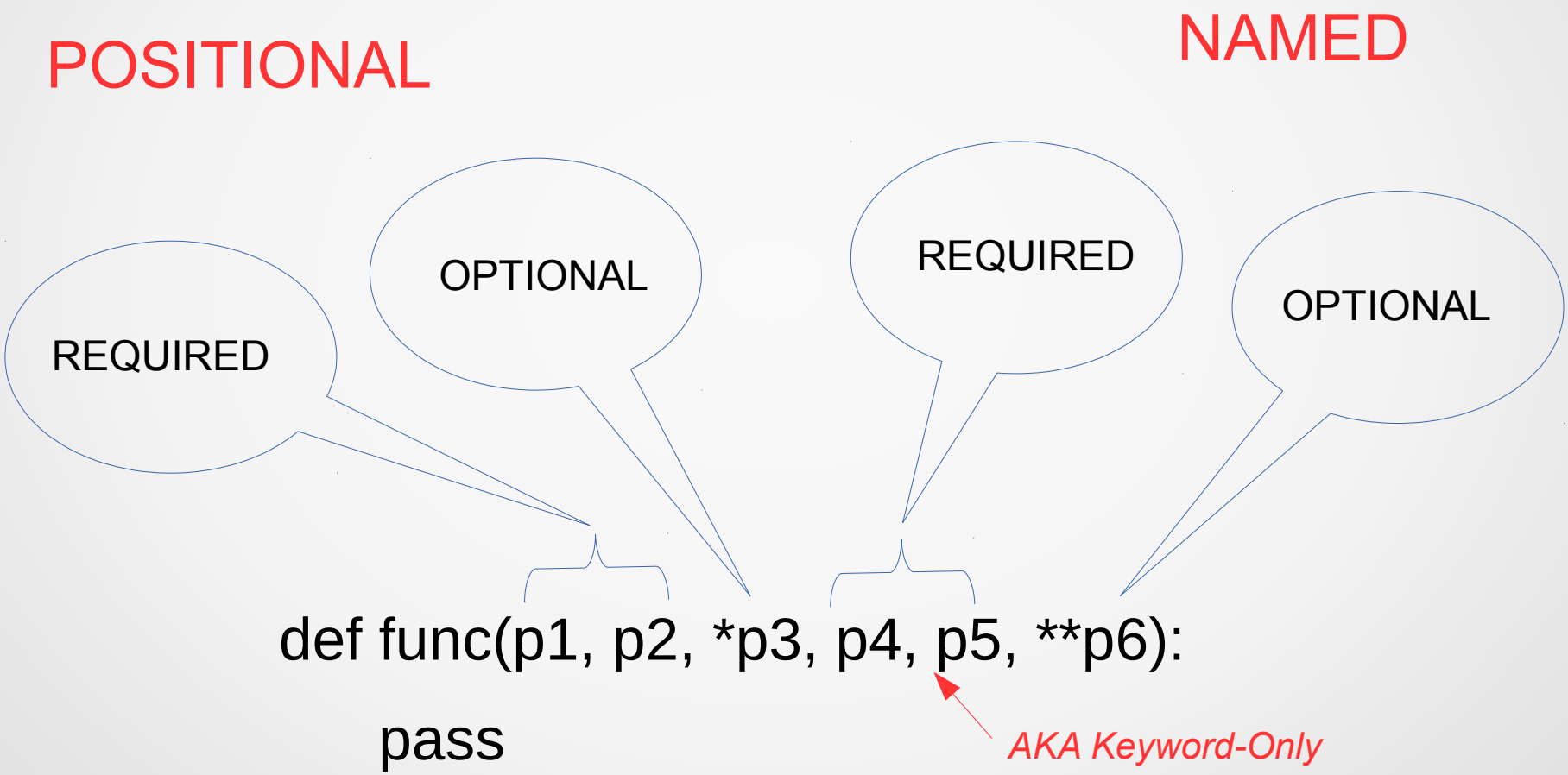
. . .

values

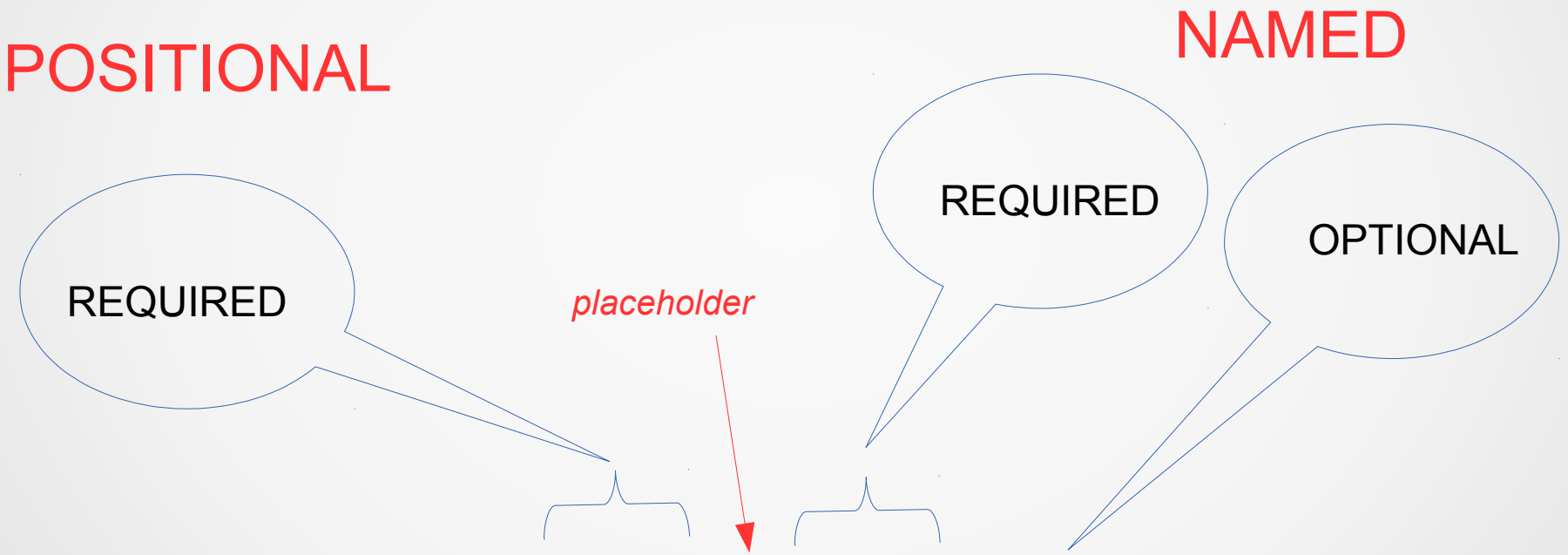


(A, 100), (B, 200), (C, 300), (D, 400), (E, 500), (F, 600) ...

Function parameters

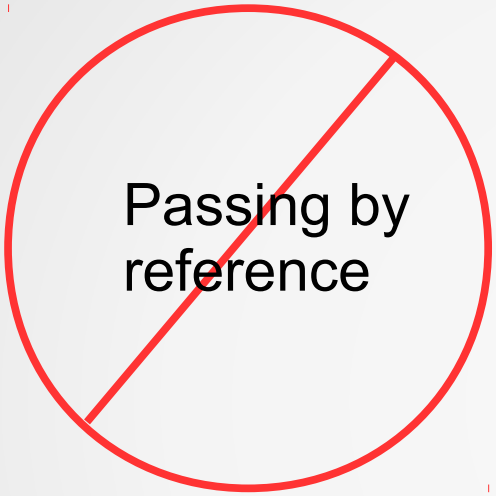


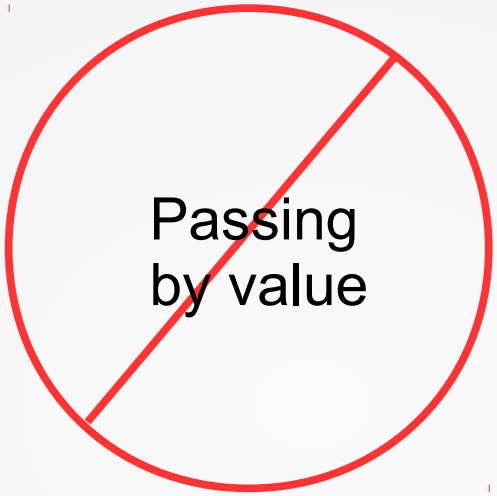
Function parameters, cont'd




```
def func(p1, p2, *, p4, p5, **p6):
    pass
```

Parameter passing



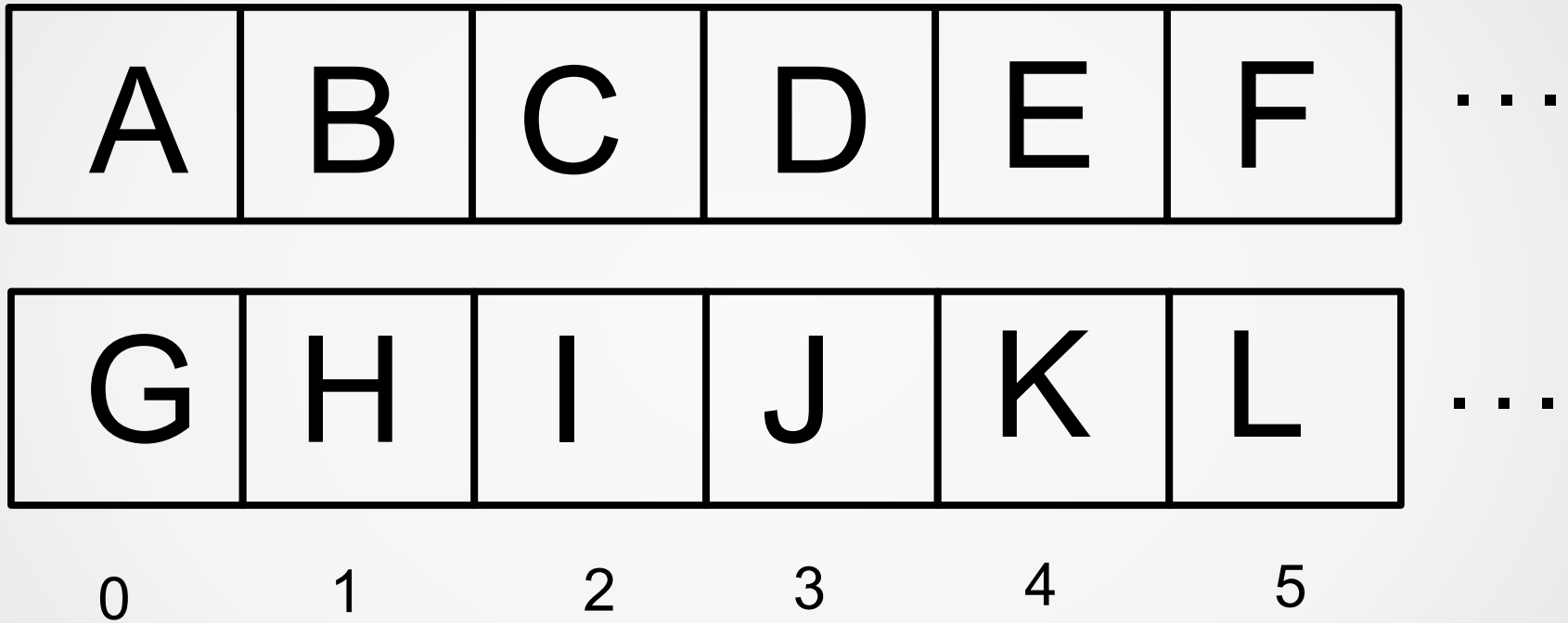


Passing by
sharing

- Read-only reference is passed
- Mutables may be changed via reference
- Immutables may not be changed

```
def spam(x, y):
    x = 5
    y.append('ham')

foo = 17
bar = ['toast', 'jam']

spam(foo, bar)
```

zip()



(A, G), (B,H), (C, I), (D, J), (E, K), (F, L)...

Sorting

- Numbers

  n, n, n, …

- Strings

  "$C_1C_2C_3$", "$C_1C_2C_3$", "$C_1C_2C_3$", …

- Iterables

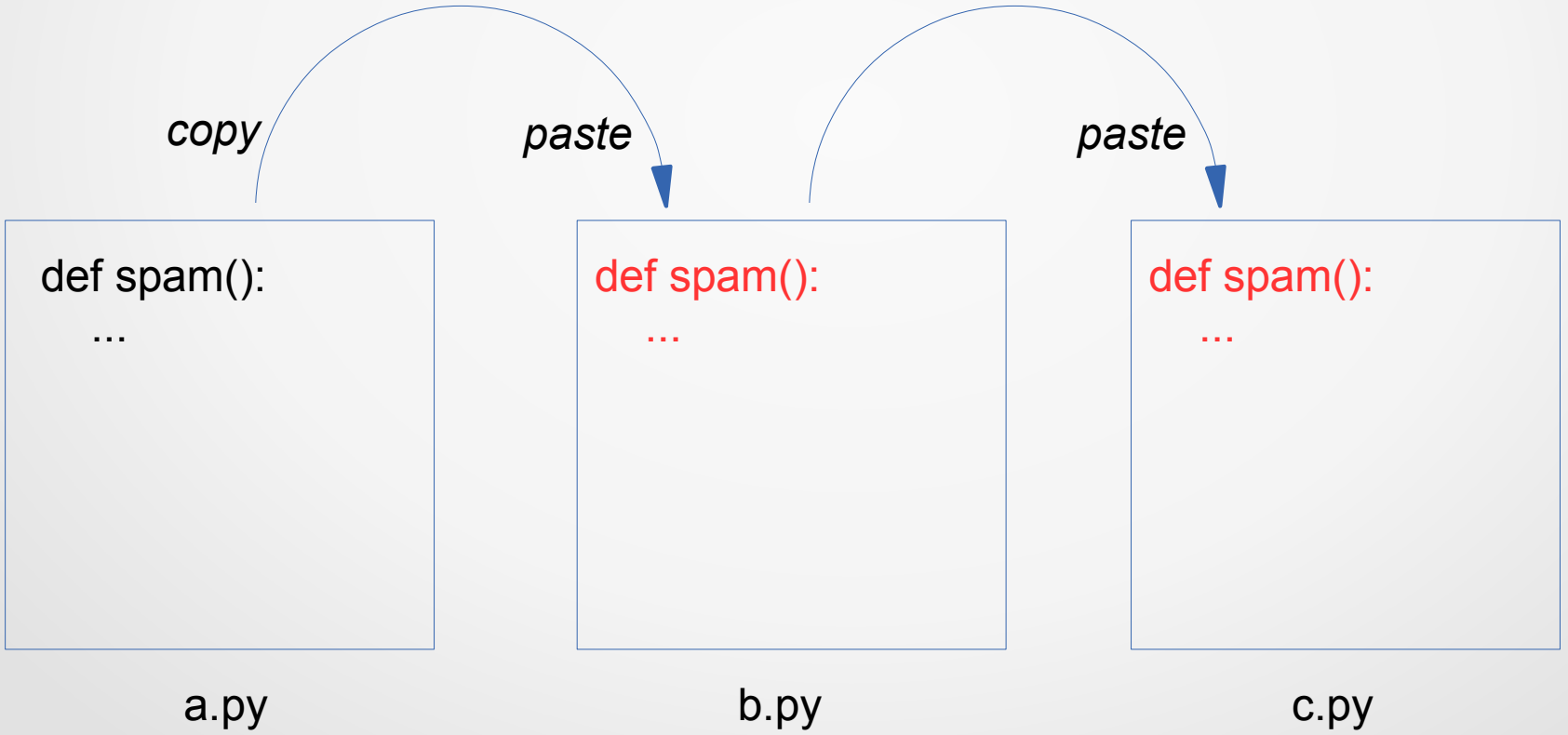
  [O_1, O_2, O_3], [O_1, O_2, O_3], [O_1, O_2, O_3], …

- ***dict***.items()

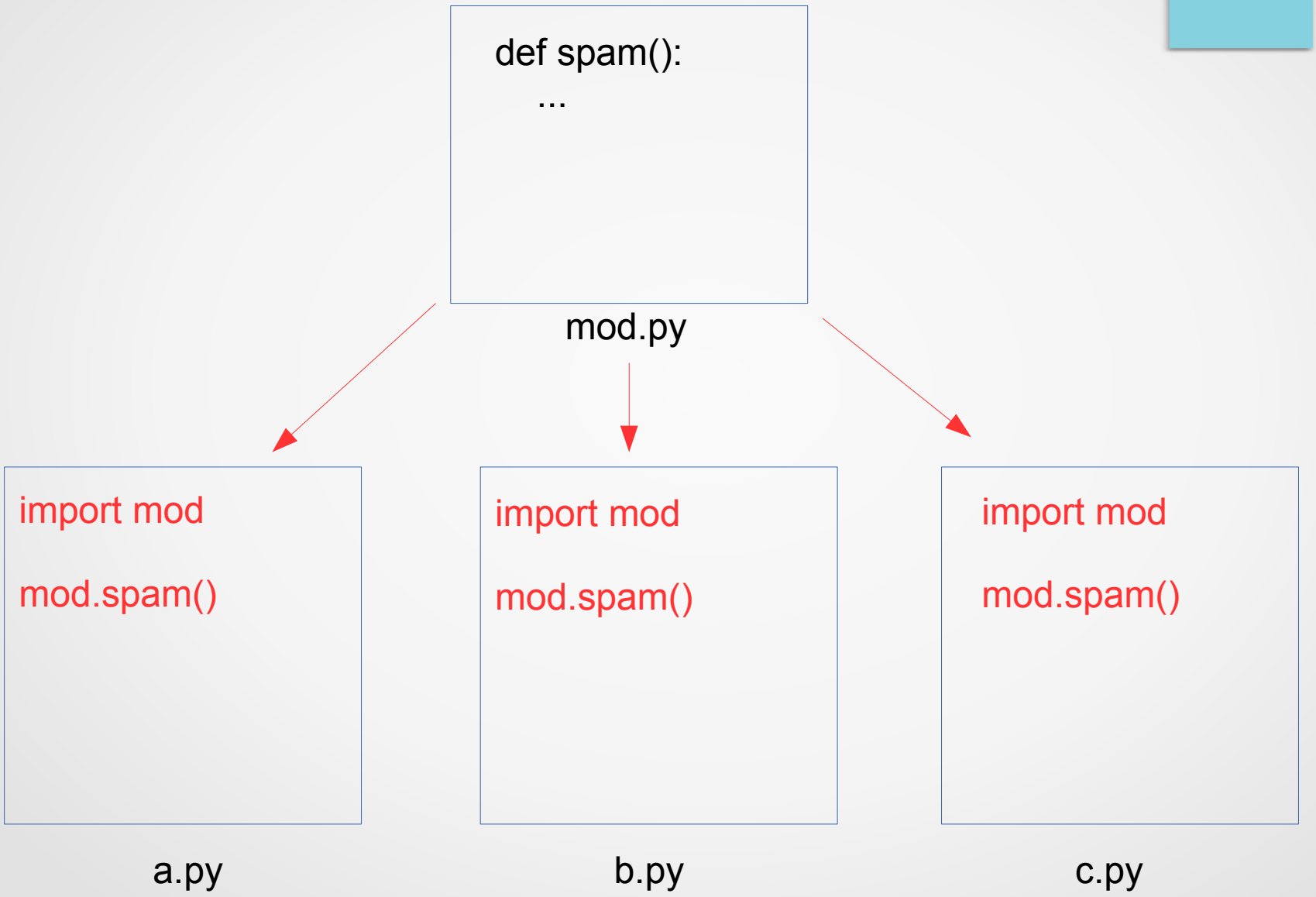
  (key, value), (key, value), (key, value), ...

Copying and pasting functions

DON'T DO THIS!!



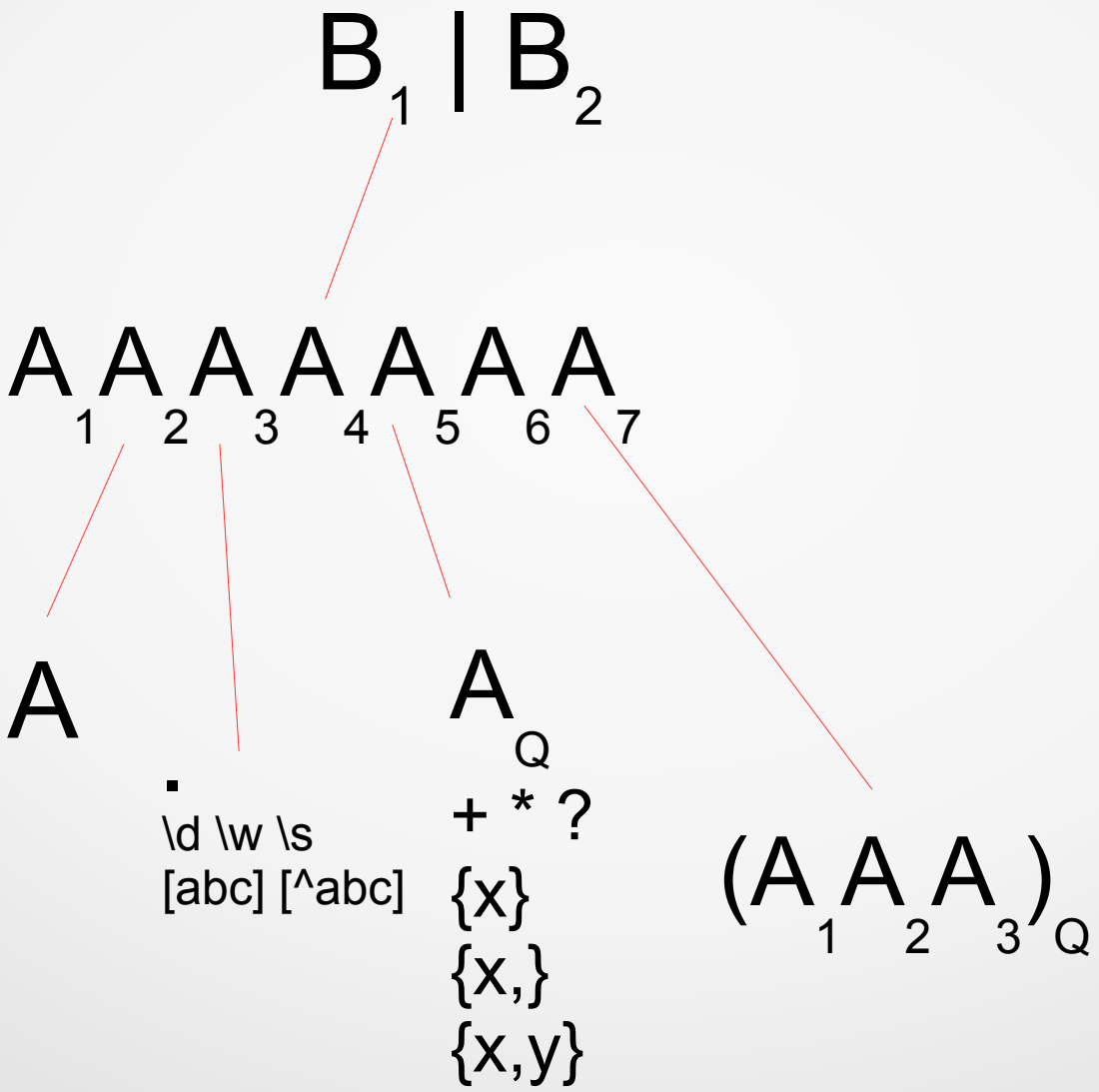
Using a module



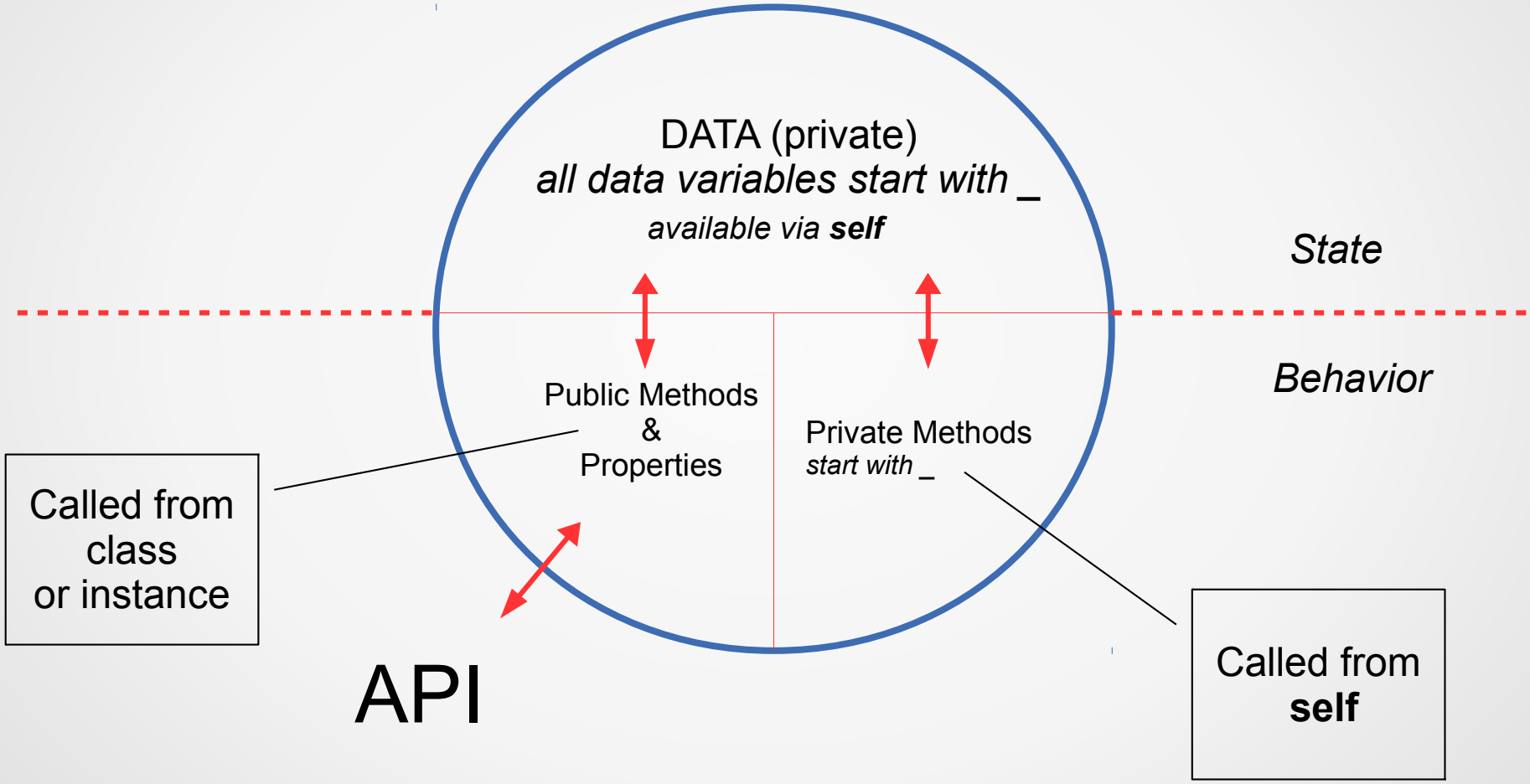
Regular expression tasks

- Search (is the match in the text?)
- Retrieve (get the matching text)
- Replace (substitute new text for match)
- Split (get what *didn't* match)

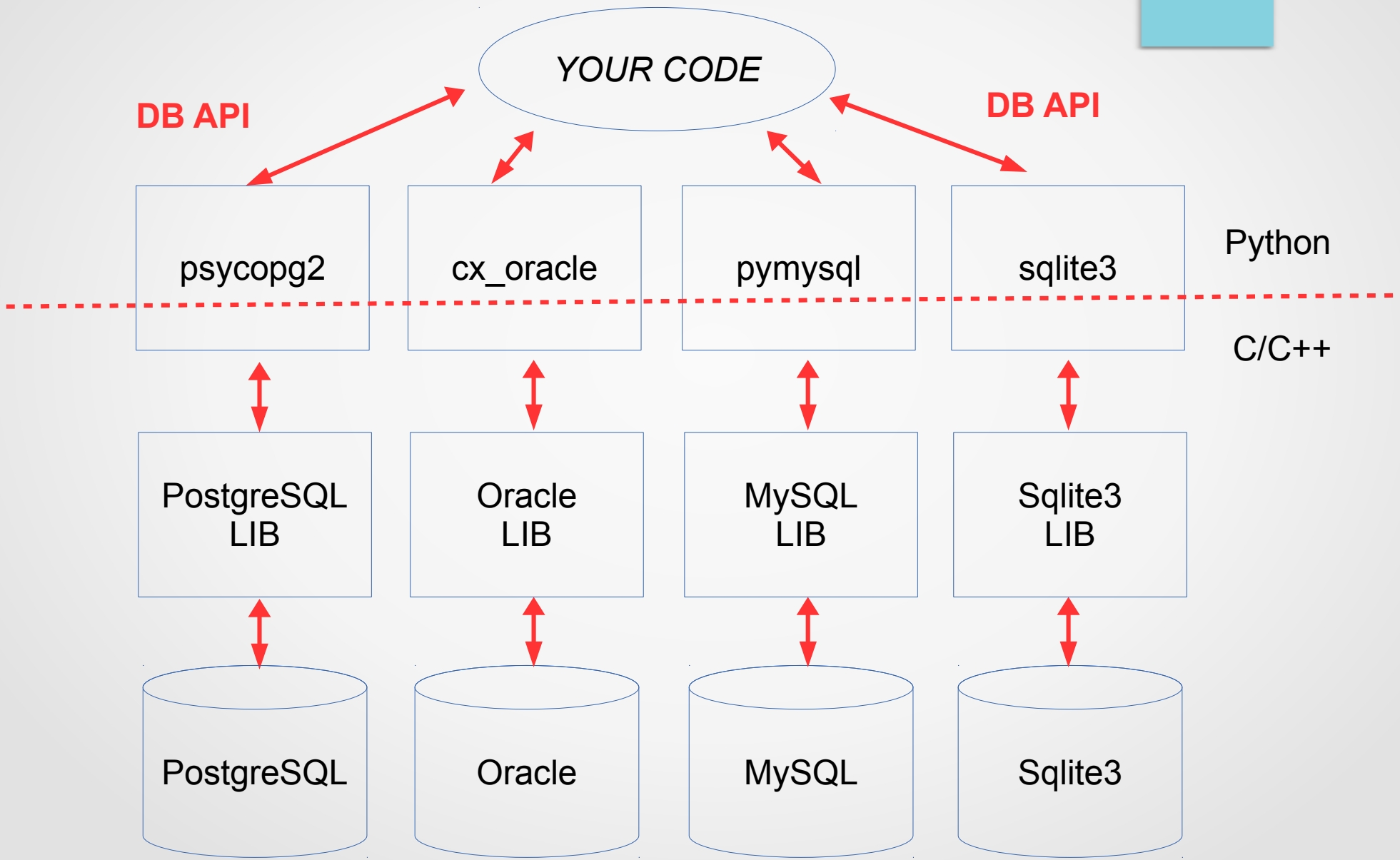
Regular Expressions



A Python Class



Python DB architecture



DB API

- conn = *package*.connect(*server, db, user, password, etc.*)
- cursor = conn.cursor()
- num_lines = cursor.execute(*query*)
- num_lines = cursor.execute(*query-with-placeholders, param-iterable)*)
- all_rows = cursor.fetchall()
- some_rows = cursor.fetchmany(n)
- one_row = cursor.fetchone()
- conn.commit()
- conn.rollback()

SqlAlchemy ORM

DBMS Table

```
create table person (
    id int autoincrement,
    firstname varchar(30),
    lastname varchar(30),
    age int,
)
```

Python class

```
class person(base):
  id = Column(
      Integer,
      primary_key=True
  )
  last_name = Column(String(50))
  first_name = Column(String(50))
  age = Column(Integer)
```

ElementTree

presidents.xml

```
<presidents>
    <president term=1>
        <lastname>Washington</lastname>
        <firstname>George</firstname>
    </president>
    <president term=2>
        <lastname>John</lastname>
        <firstname>Adams</firstname>
    </president>
</presidents>
```

ElementTree

```
Element
      tag='presidents'
  Element {'term':1 }
    tag='president'
      Element
        tag='lastname'
        text='Washington'
      Element
        tag='firstname'
        text='George'
  Element {'term':2 }
    tag='president'
      Element
        tag='lastname'
        text='Adams'
      Element
        tag='firstname'
        text='John'
```

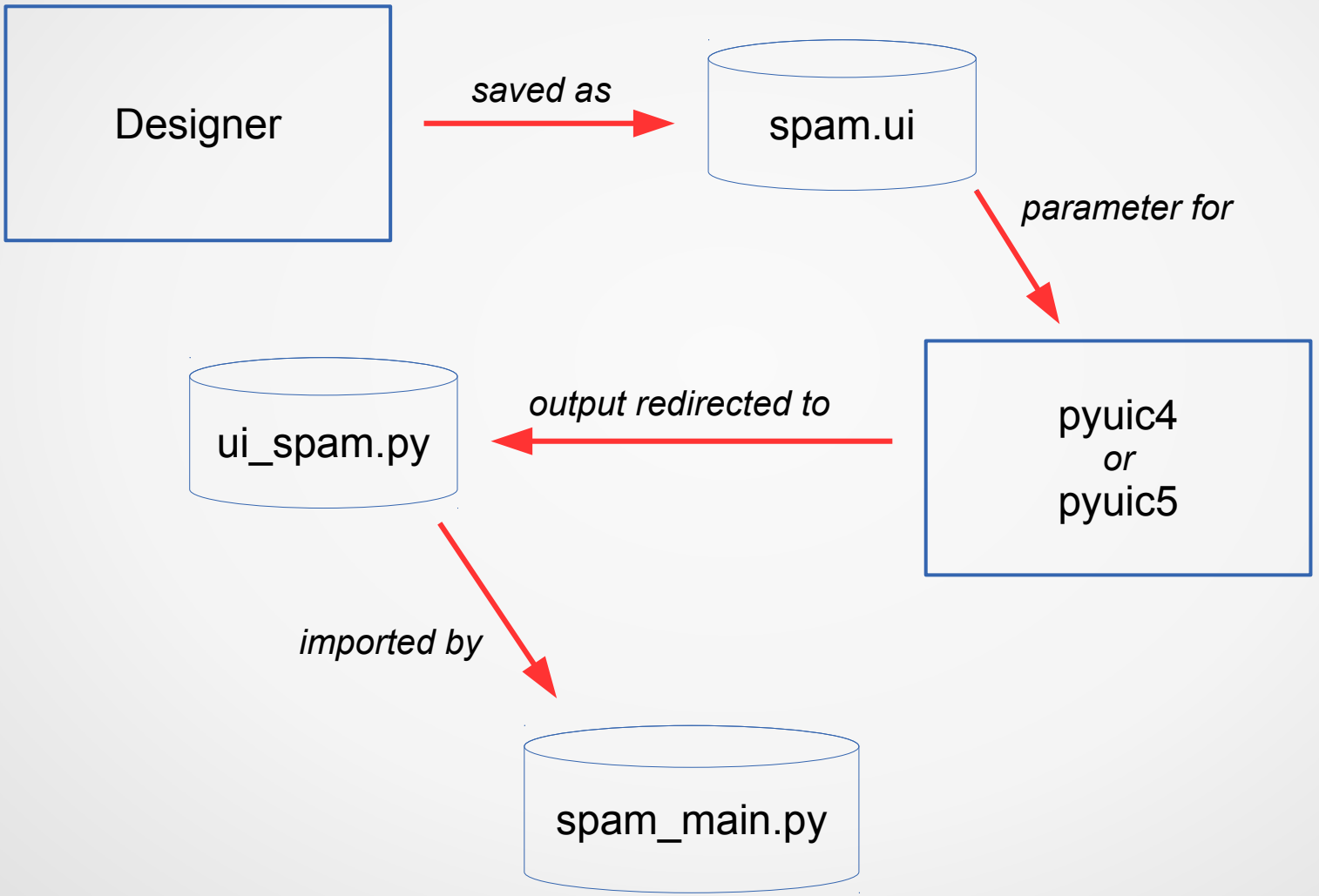
Good sources of Python books

- http://www.packtpub.com
- http://www.oreilly.com

Accessing Excel from Python

- pandas.read_excel()
- openpyxl
- win32com (requires Excel to be running)
- use CSV/TSV
- xlrd, xlwt, xlutil

PyQt Designer Workflow



Jupyter Notebook or IDE?

- Jupyter Notebook
  - Exploratory
  - Temporary
  - Experimental
  - Self-contained
  - Share results
  - Easy visualization
  - One file
- IDE (PyCharm, Spyder, ...)
  - Structured
  - Permanent
  - Modular
  - Share code
  - Development tools
  - GUI takes more effort
  - Many files

Pandas Dataframe Indexing

- DF.*indextype*[row_indexer, column_indexer]
  - Default indexer is **:** (all values)
  - Indexer can be
    - Label (examples: 'a', 5, 'result')
    - List of labels (examples: ['a', 'b', 'e'], [5, 4, 1])
    - Slice (example: 'a':'f', 2:3, 3:, 20150123: :
- Index types
  - .loc (label or Boolean array, NOT positional)
  - .iloc (integer or Boolean array, positional)
  - .ix (hybrid – primarily label, falls back to integer)

Decorator Syntax

```
@mydecorator
def myfunction():
    pass
```

same as

```
myfunction = mydecorator(myfunction)
```

```
@mydecorator(myparam)
def myfunction():
    pass
```

same as

```
myfunction = mydecorator(myparam)(myfunction)
```

Wheels

- Universal Wheel (all platforms)
  - Written for both Python 2 and Python 3
  - No extensions
- Pure Python Wheel (all platforms)
  - Written for Python 2 or Python 3
  - No extensions
- Platform Wheel (platform-specific)
  - Written for Python 2 or Python 3
  - Has extensions
  - Automatically created if non-Python code present

•Two hard problems in computer science

- cache invalidation
- naming things
- off-by-one errors

Context managers

```
with EXPR as VAR:
        BLOCK


mgr = (EXPR)
exit = type(mgr).__exit__  # Not calling it yet
value = type(mgr).__enter__(mgr)
exc = True
try:
    try:
        VAR = value  # Only if "as VAR" is present
        BLOCK
    except:
        # The exceptional case is handled here
        exc = False
        if not exit(mgr, *sys.exc_info()):
            raise
        # The exception is swallowed if exit() returns true
finally:
    # The normal and non-local-goto cases are handled here
    if exc:
        exit(mgr, None, None, None)
```

A Joke

- How do you tell the difference between a plumber and a chemist? Ask them to pronounce unionized.

Why ranges are inclusive/exclusive (Edsger W. Djikstra)

- 2, 3, 4, 5
  - 2:6 inc/exc
  - 1:5 exc/inc
  - 2:5 inc/inc
  - 1:6 exc/exc
- 0, 1, 2, 3
  - 0:4 inc/exc
  - -1:3 exc/inc
  - 0:3 inc/inc
  - -1:4 exc/exc
- -2, -1, 0, 1
  - -2:2 inc/exc
  - -3:1 exc/inc
  - -2:1 inc/inc
  - -3:2 exc/exc

- No Negative numbers
- Stop – start is # values
- Upper bound is lower bound of adjacent range

Python IDEs for science and engineering

- PyCharm
- Spyder
- Roadeo
- Atom (with Hydrogen plugin)
- Sublime Text 3
- Python for Visual Studio code
- Eclipse with PyDev

What LDAP is not

- LDAP is not a server
- LDAP is not a database
- LDAP is not a network service
- LDAP is not an authentication procedure
- LDAP is not a user/password repository
- LDAP is neither open source nor closed source
- LDAP is not a product

LDAP is a PROTOCOL

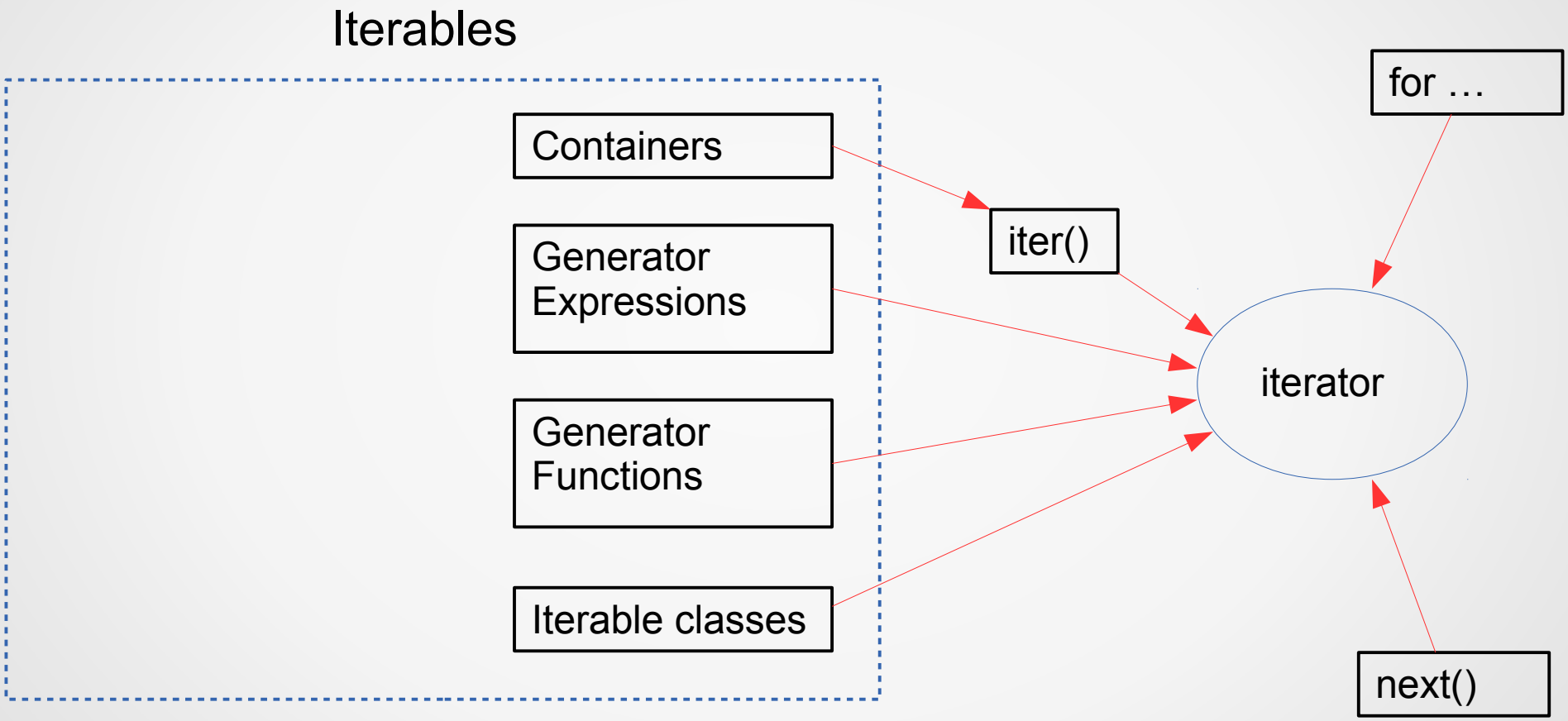
MongoDB Terminology

- _id – unique identifier in every record
- Collection – group of records ("table")
- Cursor – pointer to result set
- Database – Container of Collections ("database")
- Document – set of fields ("row" or "record")
- Field – name/value pair ("column")
- Embedded document – related data ("join")

Why use MongoDB

- Document-oriented
- Ad hoc queries
- Indexing
- Replication
- Load balancing

Iterables and iterators



Packages to install for Django classes

- django
- Environ
- dotenv
- cookiecutter
- django-environ
- django-debug-toolbar

Ways to call C from Python

- Write Python-aware C code (tedious)
- Use SWIG to interface to existing C code
- Use Boost to interface to C code
- Use ctypes to access C dll/so/dylib
- Use cython with inline C code

Python Performance

1. Get your output correct
2. Write tests for the code that generates correct output
3. Optimize as much as you can
4. Benchmark
5. Run tests to make sure your code is correct