User-defined functions

PYTHON DATA SCIENCE TOOLBOX (PART 1)

Hugo Bowne-Anderson
Instructor

You’ll learn:

- Define functions without parameters
- Define functions with one parameter
- Define functions that return a value
- Later: multiple arguments, multiple return values

Built-in functions

- str()

```
x = str(5)


print(x)
```

```
'5'
```

```
print(type(x))
```

```
<class 'str'>
```

Defining a function

```
def square():     # <- Function header
    new_value = 4 ** 2     # <- Function body
    print(new_value)
square()
```

```
16
```

Function parameters

```
def square(value):
    new_value = value ** 2
    print(new_value)

square(4)
```

```
16
```

```
square(5)
```

```
25
```

Return values from functions

- Return a value from a function using return

```
def square(value):
    new_value = value ** 2
    return new_value
num = square(4)


print(num)
```

```
16
```

Docstrings

- Docstrings describe what your function does
- Serve as documentation for your function
- Placed in the immediate line after the function header
- In between triple double quotes """

```python
def square(value):
    """Return the square of a value."""
    new_value = value ** 2
    return new_value
```

Let's practice!

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Multiple Parameters and Return Values

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Multiple function parameters

- Accept more than 1 parameter:

```
def raise_to_power(value1, value2):
    """Raise value1 to the power of value2."""
    new_value = value1 ** value2
    return new_value
```

- Call function: # of arguments = # of parameters

```
result = raise_to_power(2, 3)

print(result)
```

```
8
```

A quick jump into tuples

- Make functions return multiple values: Tuples!
- Tuples:
  - Like a list - can contain multiple values
  - Immutable - can’t modify values!
  - Constructed using parentheses ()

```
even_nums = (2, 4, 6)


print(type(even_nums))
```

```
<class 'tuple'>
```

Unpacking tuples

- Unpack a tuple into several variables:

```
even_nums = (2, 4, 6)

a, b, c = even_nums
```

```
print(a)
```

```
2
```

```
print(b)
```

```
4
```

```
print(c)
```

```
6
```

Accessing tuple elements

- Access tuple elements like you do with lists:

```
even_nums = (2, 4, 6)

print(even_nums[1])
```

```
4
```

```
second_num = even_nums[1]

print(second_num)
```

```
4
```

- Uses zero-indexing

Returning multiple values

```python
def raise_both(value1, value2):
    """Raise value1 to the power of value2
    and vice versa."""

    new_value1 = value1 ** value2
    new_value2 = value2 ** value1

    new_tuple = (new_value1, new_value2)

    return new_tuple
```

```python
result = raise_both(2, 3)

print(result)
```

```
(8, 9)
```

```python
result = raise_both(2, 3)
```

Let's practice!

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Bringing it all together

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You've learned:

- How to write functions
    - Accept multiple parameters
    - Return multiple values
- Up next: Functions for analyzing Twitter data

Basic ingredients of a function

- Function Header

```python
def raise_both(value1, value2):
```

- Function body

```python
    """Raise value1 to the power of value2
    and vice versa."""

    new_value1 = value1 ** value2
    new_value2 = value2 ** value1

    new_tuple = (new_value1, new_value2)

    return new_tuple
```

Let's practice!

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Congratulations!

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Next chapters:

- Functions with default arguments
- Functions that accept an arbitrary number of parameters
- Nested functions
- Error-handling within functions
- More function use in data science!

Let's practice!

PYTHON DATA SCIENCE TOOLBOX (PART 1)

Scope and user-defined functions

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Crash course on scope in functions

- Not all objects are accessible everywhere in a script
- Scope - part of the program where an object or name may be accessible
  - Global scope - defined in the main body of a script
  - Local scope - defined inside a function
  - Built-in scope - names in the pre-defined built-ins module

Global vs. local scope (1)

```
def square(value):
    """Returns the square of a number."""
    new_val = value ** 2
    return new_val
square(3)
```

```
9
```

```
new_val
```

```
<hr />----------------------------------------------------------------
NameError                       Traceback (most recent call last)
<ipython-input-3-3cc6c6de5c5c> in <module>()
<hr />--> 1 new_value
NameError: name 'new_val' is not defined
```

Global vs. local scope (2)

```
new_val = 10

def square(value):
    """Returns the square of a number."""
    new_val = value ** 2
    return new_val
square(3)
```

```
9
```

```
new_val
```

```
10
```

Global vs. local scope (3)

```python
new_val = 10

def square(value):
    """Returns the square of a number."""
    new_value2 = new_val ** 2
    return new_value2
square(3)
```

```
100
```

```python
new_val = 20

square(3)
```

```
400
```

Global vs. local scope (4)

```
new_val = 10

def square(value):
    """Returns the square of a number."""
    global new_val
    new_val = new_val ** 2
    return new_val
square(3)
```

```
100
```

```
new_val
```

```
100
```

Let's practice!

PYTHON DATA SCIENCE TOOLBOX (PART 1)

Nested functions

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Nested functions (1)

```python
def outer( ... ):
    """ ... """
    x = ...

    def inner( ... ):
        """ ... """
        y = x ** 2
    return ...
```

Nested functions (2)

```python
def mod2plus5(x1, x2, x3):
    """Returns the remainder plus 5 of three values."""

    new_x1 = x1 % 2 + 5
    new_x2 = x2 % 2 + 5
    new_x3 = x3 % 2 + 5

    return (new_x1, new_x2, new_x3)
```

Nested functions (3)

```python
def mod2plus5(x1, x2, x3):
    """Returns the remainder plus 5 of three values."""

    def inner(x):
        """Returns the remainder plus 5 of a value."""
        return x % 2 + 5

    return (inner(x1), inner(x2), inner(x3))
```

```python
print(mod2plus5(1, 2, 3))
```

```
(6, 5, 6)
```

Returning functions

```python
def raise_val(n):
    """Return the inner function."""

    def inner(x):
    """Raise x to the power of n."""
        raised = x ** n
        return raised

    return inner
```

```python
square = raise_val(2)
cube = raise_val(3)
print(square(2), cube(4))
```

```
4 64
```

Using nonlocal

```python
def outer():
    """Prints the value of n."""
    n = 1

    def inner():
        nonlocal n
        n = 2
        print(n)

    inner()
    print(n)
```

```python
outer()
```

```
2
2
```

Scopes searched

- Local scope
- Enclosing functions
- Global
- Built-in

Let's practice!

PYTHON DATA SCIENCE TOOLBOX (PART 1)

Default and flexible arguments

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You'll learn:

- Writing functions with default arguments
- Using flexible arguments
    - Pass any number of arguments to a functions

Add a default argument

```python
def power(number, pow=1):
    """Raise number to the power of pow."""
    new_value = number ** pow
    return new_value

power(9, 2)
```

```
81
```

```python
power(9, 1)
```

```
9
```

```python
power(9)
```

```
9
```

Flexible arguments: *args (1)

```python
def add_all(*args):
    """Sum all values in *args together."""

    # Initialize sum
    sum_all = 0

    # Accumulate the sum
    for num in args:
        sum_all += num

    return sum_all
```

Flexible arguments: *args (2)

```
add_all(1)
```

```
1
```

```
add_all(1, 2)
```

```
3
```

```
add_all(5, 10, 15, 20)
```

```
50
```

Flexible arguments: **kwargs

```
print_all(name="Hugo Bowne-Anderson", employer="DataCamp")
```

```
name: Hugo Bowne-Anderson
employer: DataCamp
```

Flexible arguments: **kwargs

```
def print_all(**kwargs):
    """Print out key-value pairs in **kwargs."""

    # Print out the key-value pairs
    for key, value in kwargs.items():
        print(key + \": \" + value)
```

```
print_all(name="dumbledore", job="headmaster")
```

```
job: headmaster
name: dumbledore
```

Let's practice!

PYTHON DATA SCIENCE TOOLBOX (PART 1)

Bringing it all together

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Next exercises:

- Generalized functions:
  - Count occurrences for any column
  - Count occurrences for an arbitrary number of columns

Add a default argument

```python
def power(number, pow=1):
    """Raise number to the power of pow."""
    new_value = number ** pow
    return new_value
```

```python
power(9, 2)
```

```
81
```

```python
power(9)
```

```
9
```

Flexible arguments: *args (1)

```python
def add_all(*args):
    """Sum all values in *args together."""

    # Initialize sum
    sum_all = 0

    # Accumulate the sum
    for num in args:
        sum_all = sum_all + num

    return sum_all
```

Let's practice!

PYTHON DATA SCIENCE TOOLBOX (PART 1)

Lambda functions

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Lambda functions

```
raise_to_power = lambda x, y: x ** y


raise_to_power(2, 3)
```

```
8
```

Anonymous functions

- Function map takes two arguments: `map(func, seq)`
- `map()` applies the function to ALL elements in the sequence

```python
nums = [48, 6, 9, 21, 1]

square_all = map(lambda num: num ** 2, nums)

print(square_all)
```

```
<map object at 0x103e065c0>
```

```python
print(list(square_all))
```

```
[2304, 36, 81, 441, 1]
```

Let's practice!

PYTHON DATA SCIENCE TOOLBOX (PART 1)

Introduction to error handling

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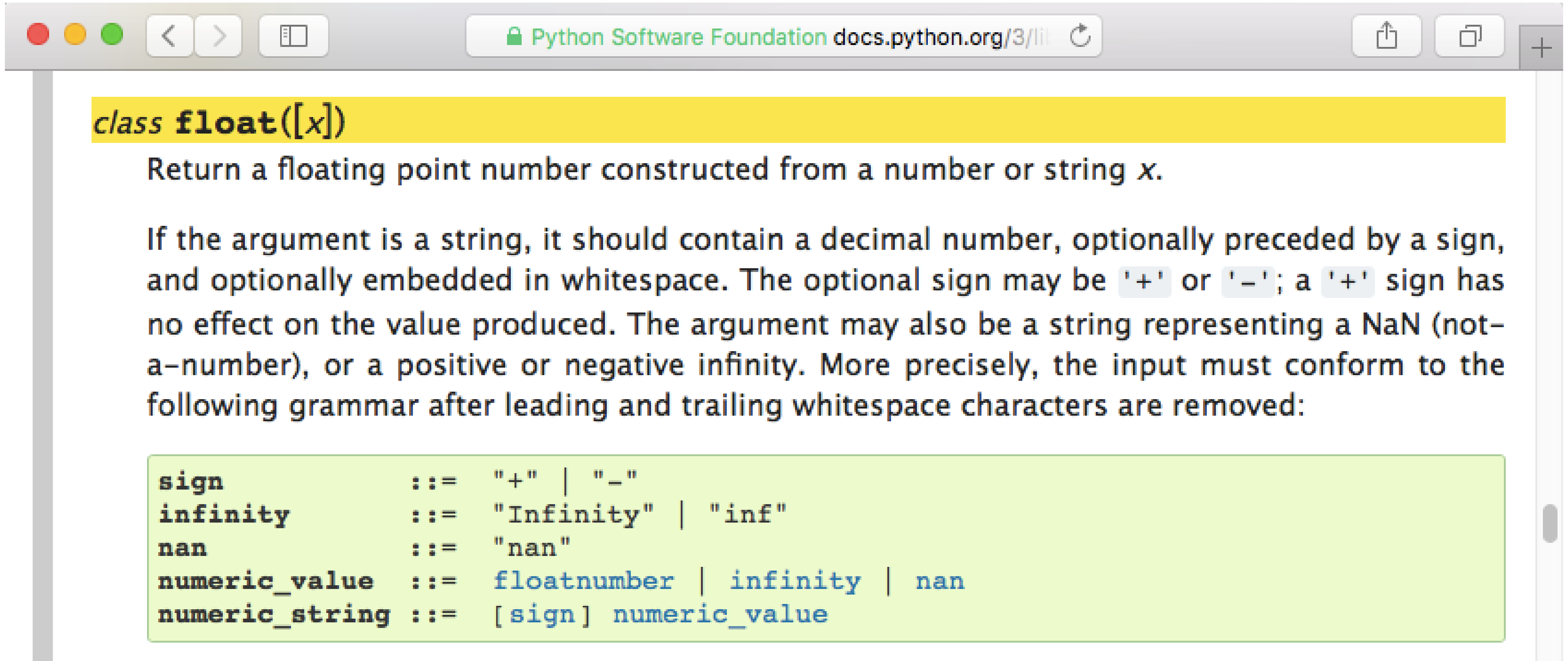
The float() function



class **float**([*x*])

Return a floating point number constructed from a number or string *x*.

If the argument is a string, it should contain a decimal number, optionally preceded by a sign, and optionally embedded in whitespace. The optional sign may be `'+'` or `'-'`; a `'+'` sign has no effect on the value produced. The argument may also be a string representing a NaN (not-a-number), or a positive or negative infinity. More precisely, the input must conform to the following grammar after leading and trailing whitespace characters are removed:

```
sign           ::=  "+" | "-"
infinity       ::=  "Infinity" | "inf"
nan            ::=  "nan"
numeric_value  ::=  floatnumber | infinity | nan
numeric_string ::=  [sign] numeric_value
```

Passing an incorrect argument

```
float(2)
```

```
2.0
```

```
float('2.3')
```

```
2.3
```

```
float('hello')
```

```
<hr />----------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-3-d0ce8bccc8b2> in <module>()
<hr />-> 1 float('hi')
ValueError: could not convert string to float: 'hello'
```

Passing valid arguments

```
def sqrt(x):
    """Returns the square root of a number."""
    return x ** (0.5)
sqrt(4)
```

```
2.0
```

```
sqrt(10)
```

```
3.1622776601683795
```

Passing invalid arguments

```python
sqrt('hello')
```

```
------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
<ipython-input-4-cfb99c64761f> in <module>()
----> 1 sqrt('hello')
<ipython-input-1-939b1a60b413> in sqrt(x)
      1 def sqrt(x):
----> 2     return x**(0.5)
TypeError: unsupported operand type(s) for ** or pow(): 'str' and 'float'
```

Errors and exceptions

- Exceptions - caught during execution
- Catch exceptions with try-except clause
  - Runs the code following try
  - If there's an exception, run the code following except

Errors and exceptions

```python
def sqrt(x):
    """Returns the square root of a number."""
    try:
        return x ** 0.5
    except:
        print('x must be an int or float')

sqrt(4)
```

```
2.0
```

```python
sqrt(10.0)
```

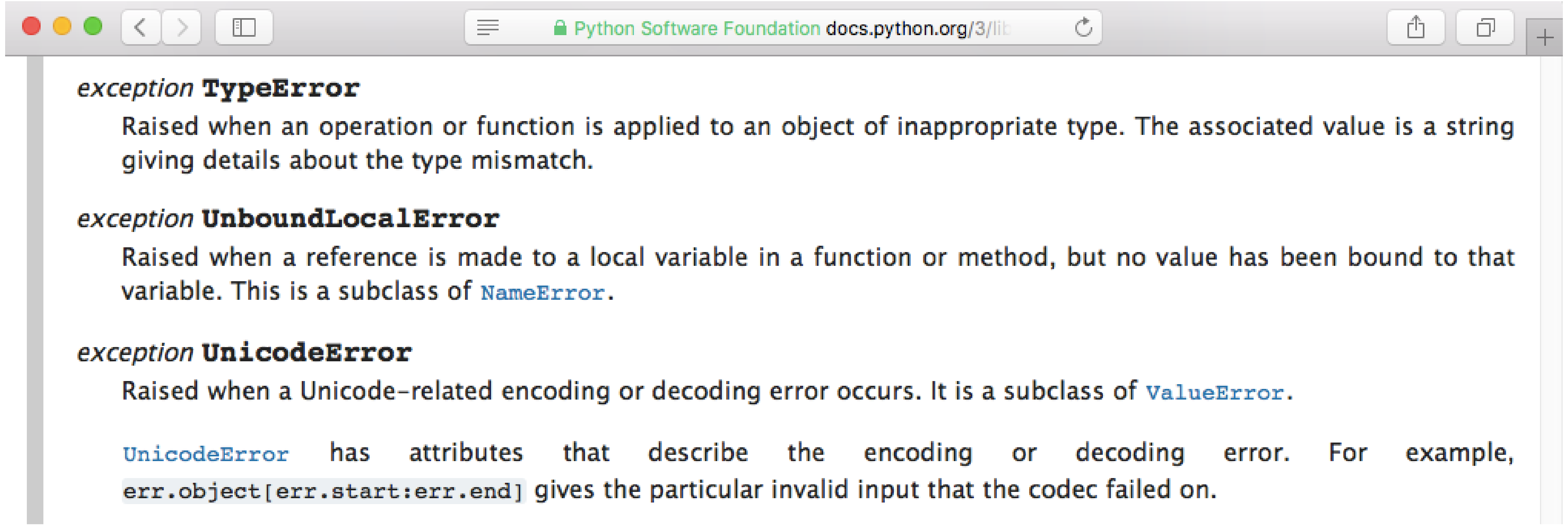
```
3.1622776601683795
```

```python
sqrt('hi')
```

```
x must be an int or float
```

Errors and exceptions

```python
def sqrt(x):
    """Returns the square root of a number."""
    try:
        return x ** 0.5
    except TypeError:
        print('x must be an int or float')
```



exception **TypeError**

Raised when an operation or function is applied to an object of inappropriate type. The associated value is a string giving details about the type mismatch.

exception **UnboundLocalError**

Raised when a reference is made to a local variable in a function or method, but no value has been bound to that variable. This is a subclass of `NameError`.

exception **UnicodeError**

Raised when a Unicode-related encoding or decoding error occurs. It is a subclass of `ValueError`.

`UnicodeError` has attributes that describe the encoding or decoding error. For example, `err.object[err.start:err.end]` gives the particular invalid input that the codec failed on.

Errors and exceptions

```python
sqrt(-9)
```

```
(1.8369701987210297e-16+3j)
```

```python
def sqrt(x):
    """Returns the square root of a number."""
    if x < 0:
        raise ValueError('x must be non-negative')
    try:
        return x ** 0.5
    except TypeError:
        print('x must be an int or float')
```

Errors and exceptions

```
sqrt(-2)
```

```
-----------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-2-4cf32322fa95> in <module>()
----> 1 sqrt(-2)
<ipython-input-1-a7b8126942e3> in sqrt(x)
      1 def sqrt(x):
      2     if x < 0:
----> 3         raise ValueError('x must be non-negative')
      4     try:
      5         return x**(0.5)
ValueError: x must be non-negative
```

Let's practice!

PYTHON DATA SCIENCE TOOLBOX (PART 1)

Bringing it all together

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Errors and exceptions

```python
def sqrt(x):
    try:
        return x ** 0.5
    except:
        print('x must be an int or float')
```

```python
sqrt(4)
```

```
2.0
```

```python
sqrt('hi')
```

```
x must be an int or float
```

Errors and exceptions

```python
def sqrt(x):
    if x < 0:
        raise ValueError('x must be non-negative')
    try:
        return x ** 0.5
    except TypeError:
        print('x must be an int or float')
```

Let's practice!

PYTHON DATA SCIENCE TOOLBOX (PART 1)

Congratulations!

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What you've learned:

- Write functions that accept single and multiple arguments
- Write functions that return one or many values
- Use default, flexible, and keyword arguments
- Global and local scope in functions
- Write lambda functions
- Handle errors

There's more to learn!

- Create lists with list comprehensions
- Iterators - you've seen them before!
- Case studies to apply these techniques to Data Science

Let's practice!

PYTHON DATA SCIENCE TOOLBOX (PART 1)