Intermediate! python

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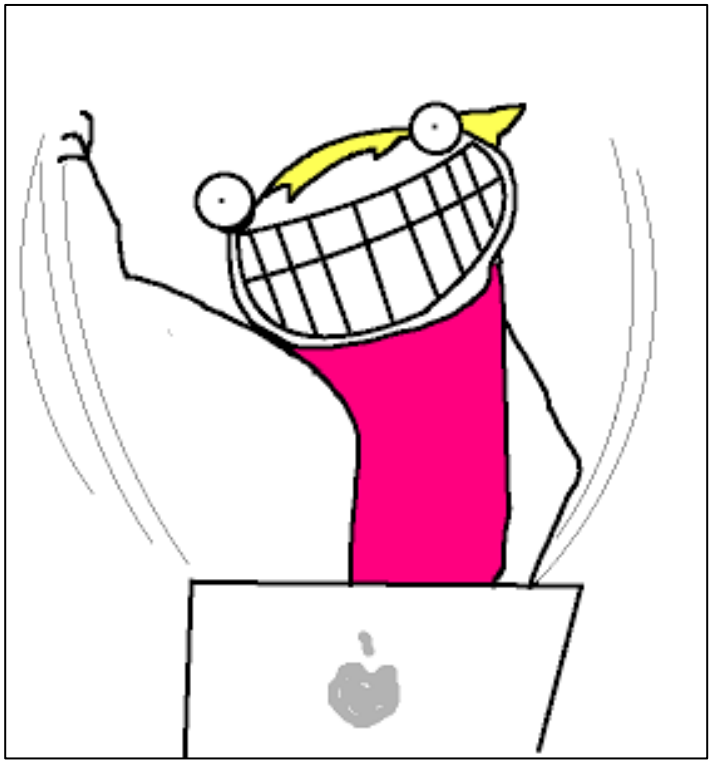
Why am I giving this talk?

- I went to PyCon 2015 and saw all this cool—but confusing—code.
- To help YOU!
  - Get excited
  - Be more efficient
  - Understand others' code



Hyperbole and a Half

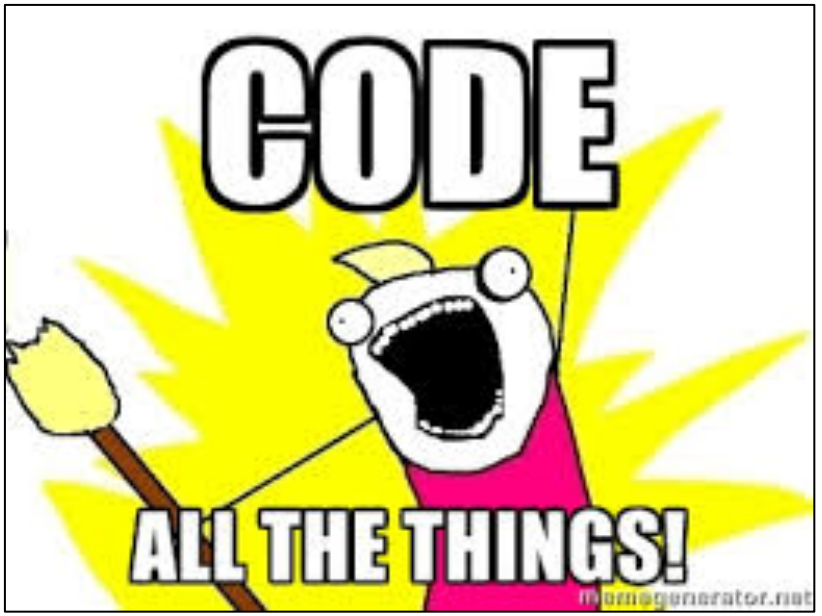
Format

Part 1

Short lectures about:

- List comprehensions
- Iterators
- Generators
- Decorators

Part 2



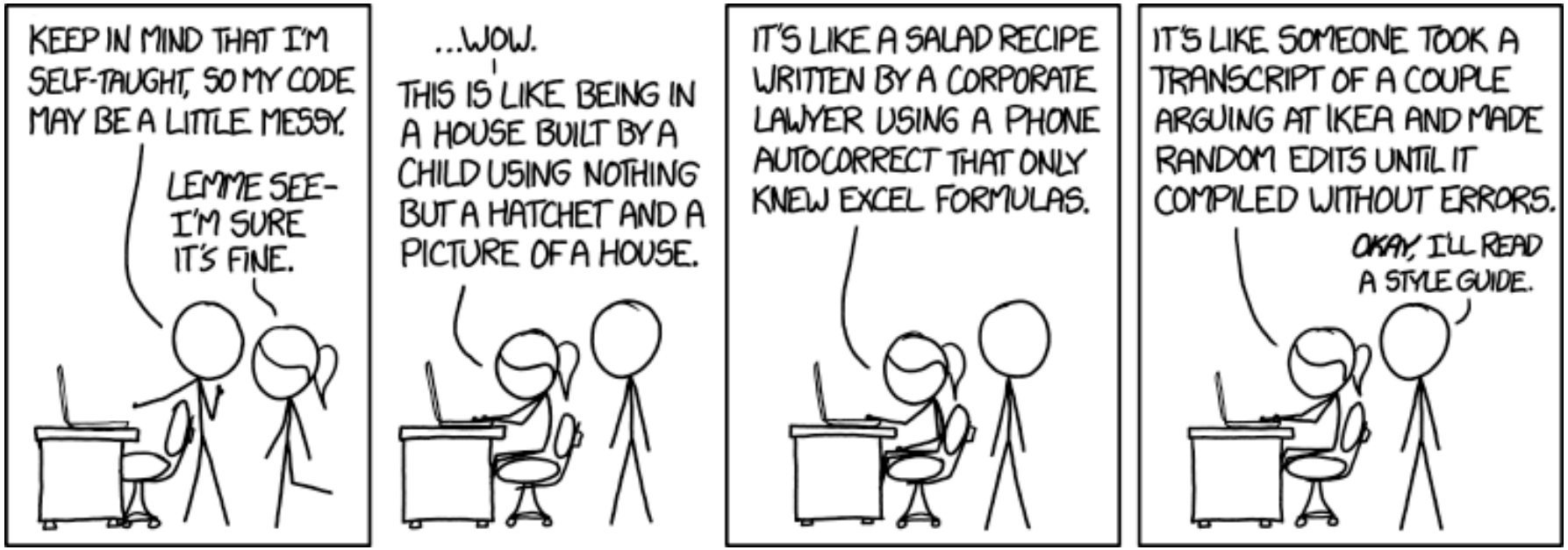
...that you want to.

The Zen of Python

Beautiful is better than ugly.

The Zen of Python

Readability counts.



List comprehension

Python has compact syntax for list creation:

new list = [transform iterate filter]

How to use list comprehension (LC)

- Say you want to print the squared integers in a list:

```
some_list = [1, "4", 9, "a", 0, 4]
```

- The end result will be: `[1, 81, 0, 16]`
- How can we do this using a list comprehension?

How to use LC

1. First things first:

```
[]
```

2. Iterate over the sequence:

```
[for num in my_list]
```

3. Write the filter condition:

```
[for num in my_list if list type(num) == int]
```

4. Include the transformed result:

```
[num**2 for num in my_list if list type(num) == int]
```

5. Optional: save result to a new list

```
squared_ints = [num**2 for num in my_list \
                if type(num) == int]
```

List comprehension

When to use LC

- When you're using a loop to transform a sequence
- When you don't want to write code like this:

```
numbers = [0,1,2,3,4,5,6,7,8,9]
size = len(numbers)
i = 0
evens = []
while i < size:
    if i % 2 == 0:
        evens.append(i)
    i += 1
```

List comprehension

When NOT to use LC

Don’t use list comprehensions for:

- deeply nested iterations,
- complicated transformations, or
- code that would be easier understood if it were written using **for** or **while** loops.

Iterators

Iterator: An object that implements the iterator protocol.

Iterable object: an object that can yield objects one at a time.

Iterators are based on two methods:

1. **next()**
2. **__iter__()**

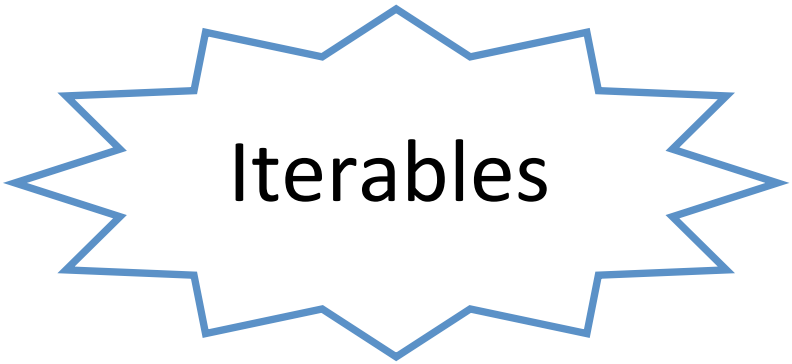
You've seen this before!

Looping over...

- lists
- strings
- dictionary keys
- files

```
for n in [5,6,7,8,9]:
    print n
```

```
for key in {"x": 1, "y": 2}
    print key
```



How to use iterators

```
iter_object = iter(object)
```

Example: read lines in a file

```
with open('mydata.txt') as fp:
    for line in iter(fp.readline, ''):
        process_line(line)
```

How to use iterators

```
>>> s = 'abc'
>>> it = iter(s)
>>> it
<iterator object at 0x1014b6110>
>>> next(it)
'a'
>>> next(it)
'b'
```

How to use iterators

```
>>> next(it)
'c'
>>> next(it)
StopIteration
```

Iterate? Iterable? Iterator?

- To **iterate**: take an item of something, one after another
- An **iterable** is an object that you can get an iterator from either by:
  1. An **__iter__()** method
  2. A **__getitem__()** method that can take sequential indexes starting from zero
- An **iterator** is an object with a **next()** or **__next__()** method

When to use iterators

You already do!

Generators

- Generators are functions that use **yield** expressions.
- When called, generators immediately return an **iterator.**
- Using **next()**, the iterator advances the generator to its next yield expression.

First: a regular function

```
def firstn(n):
    num, nums = 0, []
    while num < n:
        nums.append(num)
        num += 1
    return nums

sum_of_first_n = sum(firstn(1000000))
```

How to use generators

```
def firstn(n):
    num = 0
    while num < n:
        yield num
        num += 1

sum_of_first_n = sum(firstn(1000000))
```

Generator expressions

- A generalization of list comprehensions and generators
- Yield one item at a time

Generator expressions (lazy!)

Syntax:

```
lc_doubles = [2 * n for n in [1,2,3,4,5]]
```

```
genexp = (2 * n for n in [1,2,3,4,5])
genexp_doubles = list(double_genexp)
```

Materialize

```
genexp = (2 * n for n in range(1,6))
genexp_doubles = list(double_genexp)
```

- Providing the generator expression as an argument to **list()** builds the entire list.
- Use **range()** or **xrange()** to create sequences of numbers.

- Other built-in functions that take iterables:
  - sorted()
  - min(), max()
  - sum()
  - dict()
  - all(), any()

Generator expression example

```
>>> gen = (value for value in [4,5,6,7,8,9]\
           if value > 5)
>>> gen
<generator object <genexpr> at 0x103bb6d70>
>>> next(gen)
6
>>> min(gen)
7
>>> min(gen)
ValueError: min() arg is an empty sequence
```

Confused by generators?

This generator:

```
def pos_generator(seq):
    for x in seq:
        if x >= 0:
            yield x
```

Is equivalent to this generator expression:

```
def pos_gen_exp(seq):
    return(x for x in seq if x >= 0)
```

And they both produce the same result:

```
>>> list(pos_generator(range(-5, 5))) == \
    list(pos_gen_exp(range(-5, 5))) -> True
```

When to use generators

- You have a lot of data to iterate over
- To avoid materialization

When to NOT use generators

- Slicing is necessary
- They're tricky to debug
  - Can only access values one at a time, not the whole collection
- It's necessary to iterate over your inputs multiple times

Decorators

- Do something before, during, and/or after some code
- Goal: reduce boilerplate code
- Extend the behavior of a function without modifying it
- “Design pattern that allows behavior to be added to an existing object dynamically.”

Functions: review

```
def foo():
    """Docstring"""
    print 'Hello!'
```

```
>>> foo
>>> foo()
```

```
>>> bar = foo
>>> bar.__name__
'foo'
```

Parameters: positional, keyword, variable (*args), variable keyword (**kwargs)

```
def get_foo():
    return foo
```

```
>>> dir(foo)
```

```
def adder():
    def add(x,y):
        return x + y
    return add

>>> adder()
>>> adder()(2,4)
```

Decorators

Generic decorator pattern

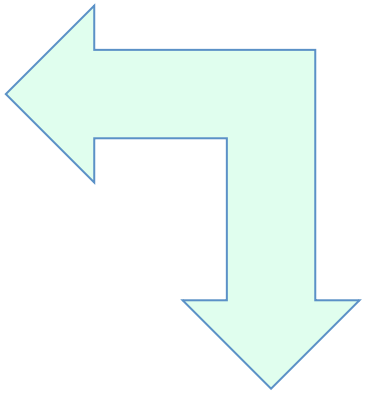
```
def mydecorator(function):
    def inner_function(*args, **kw):
        # do some stuff before
        result = function(*args, *kw)
        # do some stuff after
        return result
    return inner_function
```

To use:

```
@mydecorator
function()
```

Equivalent syntax

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



```
def myfunc():
    pass
myfunc = mydecorator(myfunc)
```

```
def verbose(func):
    def inner_function(*args, **kwargs):
        print "before", func.__name__
        result = func(*args, **kwargs)
        print "after", func.__name__
        return result
    return inner_function
```

```
@verbose
def print_message():
    print "Hello there!"
```

```
>>> print_message()
before print_message
Hello there!
after print_message
```


All credit goes to Matt Harrison for this example!

Flask example

```
from app import app

@app.route('/')
@app.route('/index')
def index():
    return "Hello, World!"
```

http://blog.miguelgrinberg.com/post/the-flask-mega-tutorial-part-i-hello-world

Decorators

When to use decorators

- Minimize boilerplate code and simplify functions
- Logging
- Error handling
- Caching expensive calculations
- Retrying functions that might fail

Playtime!

Suggested order:

1. List comprehensions
2. Iterators
3. Generators
4. Decorators

Github repository:

github.com/cterp/pyladies-intermediate-python

References

1. https://docs.python.org/
2. Slatkin, Brett: Effective Python: 59 Specific Ways to Write Better Python. Addison-Wedley, 2015.
3. Alchin, Marty: Pro Python: Advanced coding techniques and tools. Apress, 2010.
4. Anything Matt Harrison writes about Python.

What to do next

Module suggestions:

- iterator
- collections
  - Tired of counting?
- itertools

This workshop was really only about one thing...

Lazily materialize objects whenever possible.