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10 Python Iteration Things I Regret Not Knowing Earlier

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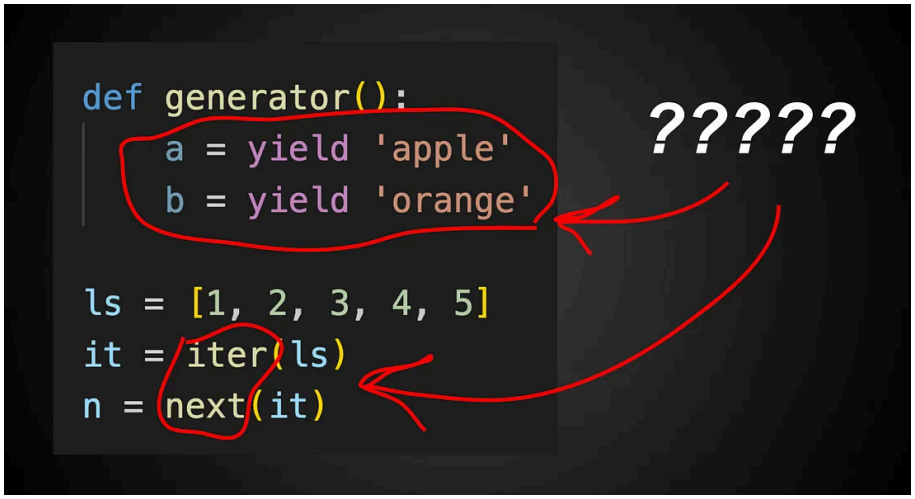

1) enumerate() & zip()

Note — *enumerate()* and *zip()* are built-in functions. We don't need to import anything.

The *enumerate()* function allows us to generate both the index and value concurrently while iterating through a list (or tuple). Which is useful if we need to index for whatever reason.

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```
fruits = ['apple', 'orange', 'pear']

for index, fruit in enumerate(fruits):
    print(f'{index=} {fruit=}')

# index=0 fruit='apple'
# index=1 fruit='orange'
# index=2 fruit='pear'
```

The *zip()* function allows us to iterate through 2 or more iterables (eg lists/tuples) concurrently. We simply need to pass our iterables into the *zip()* function.

```
fruits = ['apple', 'orange', 'pear']
prices = [4, 5, 6]
shops = ['A', 'B', 'C']

for f,p,s in zip(fruits, prices, shops):
    print(f, p, s)

# apple 4 A
# orange 5 B
# pear 6 C
```

Do note that the *zip()* function stops generating values if we reach the end of *just one* of the iterables. For instance, in the example below, we are limited by *fruits* which contains only 2 elements.

```
fruits = ['apple', 'orange']
prices = [4, 5, 6, 7, 8, 9]
shops = ['A', 'B', 'C', 'D']

for f,p,s in zip(fruits, prices, shops):
    print(f, p, s)

# apple 4 A
# orange 5 B
```

2) The 'break' keyword

The *break* keyword is used inside a loop — either a for loop or while loop.

When executed, the *break* keyword immediately stops the entire loop.

In the following example, *break* executes in our 2nd iteration where word=='boy'. As such, our for loop stops immediately, and does not go on to 'cat' and 'dog'

```
words = ['apple', 'boy', 'cat', 'dog']
for word in words:
    print(word)

    if word == 'boy':
        break

# apple
# boy
```

The *break* keyword words for while loops too. In the following example, we *break* when num reaches 3, which allows us to get out of the while loop.

```
num = 1
while True:
    print(num, end=' ')

    if num == 3:
        break

    num += 1

# 1 2 3
```

3) The 'continue' keyword

Like *break,* the *continue* keyword is used inside either a for loop or while loop.

When executed, the *continue* keyword skips only the current iteration, and moves on immediately to the next iteration. The *continue* keyword does not stop the entire loop.

In the example below, *continue* is executed if word is either 'boy' or 'cat'. When this is the case, the specific iteration is skipped. As such, only 'apple' and 'dog' are printed

```
words = ['apple', 'boy', 'cat', 'dog']

for word in words:
    if word in ['boy', 'cat']:
        continue

    print(word)

# apple
# dog
```

4) for-else and while-else loops

Yes, while unintuitive, there are such things as *for-else* and *while-else* loops in Python.

In both *for-else* and *while-else* loops, the *else* block runs if the *break* keyword does not execute during the loop.

If *break* doesn't execute during the loop, the *else* block will run:

```
for i in range(3):
    pass
else:
    print('this prints')
```

If *break* executes during the loop, the *else* block will not run:

```
for i in range(3):
    break
else:
    print('not printed')
```

This is useful is cases where we want to check if *break* executes during the loop without having to create an additional variable for this.

Quick Pause

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5) itertools.product

Here's a normal nested for loop (for loop within a for loop)

```
fruits = ['apple', 'orange']
prices = [4, 5]
shops = ['A', 'B']

for fruit in fruits:
    for price in prices:
        for shop in shops:
            print(fruit, price, shop)

# apple 4 A
# apple 4 B
# apple 5 A
# apple 5 B
# orange 4 A
# orange 4 B
# orange 5 A
# orange 5 B
```

If we don't wish to write so many nested for loops, we can use *itertools.product* to help us. In short, *itertools.product* simulates a multi-nested for loop without us having to write the multi-nested for loops.

```
fruits = ['apple', 'orange']
prices = [4, 5]
shops = ['A', 'B']

from itertools import product

for f, p, s in product(fruits, prices, shops):
    print(f, p, s)

# apple 4 A
# apple 4 B
# apple 5 A
# apple 5 B
# orange 4 A
# orange 4 B
# orange 5 A
# orange 5 B
```

itertools.product can handle as many nested for loops as we want it to (though whether your algorithm is an efficient one is another question altogether)

```
for a in A:
    for b in B:
        for c in C:
            for d in D:
                for e in E:
                    print(a, b, c, d, e)

# this is the same as:

from itertools import product

for a,b,c,d,e in product(A,B,C,D,E):
    print(a, b, c, d, e)
```

Note — *itertools* is part of the Python Standard Library, which means we do not need to install anything. We simply need to import it.

6) itertools.pairwise (and other functions)

Let's say we have a bunch of numbers:

```
ls = [1, 2, 3, 4, 5]
```

And in this list, we wish to compare each adjacent pair of numbers — 1 and 2, 2 and 3, 3 and 4, 4 and 5 (for whatever reason)

To do this, we could write a for loop using range(len(ls)-1) and do index manipulation:

```
ls = [1, 2, 3, 4, 5]

for i in range(len(ls)-1):
    l = ls[i]
    r = ls[i+1]
    print(l, r)

# 1 2
# 2 3
# 3 4
# 4 5
```

If we don't wish to deal with this logic (or if we just want to make our code a lot more readable at first glance), we can choose to use *itertools.pairwise* instead.

The *itertools.pairwise* function generates every adjacent pair of elements in our list.

```python
ls = [1, 2, 3, 4, 5]

from itertools import pairwise

for l,r in pairwise(ls):
    print(l, r)

# 1 2
# 2 3
# 3 4
# 4 5
```

Aside from this, the *itertools* module contains many other useful iteration functions.

```python
import itertools

# repeats 1,2,3,1,2,3,... indefinitely
for n in itertools.cycle([1, 2, 3]):
    print(n)

ls = [1, 2, 3, 4, 5]

# lists all permutations of length 2
for perm in itertools.permutations(ls, 2):
    print(perm)

# lists all combinations of length 2
for comb in itertools.combinations(ls, 2):
    print(comb)
```

7) Generator functions

Generator functions are functions that use the *yield* keyword to output stuff.

Here, we have a simple trivial generator function *test()*

```
def test():
    yield 'apple'
    yield 'orange'
    yield 'pear'

print(test())
# <generator object test at 0x100b73740>
```

^ here, if we call *test()* like we would with normal functions, we won't get the *apple, orange and pear* — instead, we print some generator object.

This is because generator functions return a generator object.

And generator objects are meant to be iterated across. The simplest way would be to either 1) use a for loop or 2) wrap our generator object with list()

```
def test():
    yield 'apple'
    yield 'orange'
    yield 'pear'

for fruit in test():
    print(fruit, end=' ')
# apple orange pear

print(list(test()))
# ['apple', 'orange', 'pear']
```

8) Why we use generator functions

We use generator functions if we want to output a value the moment we have it. This is especially useful if we have a large amount of data and don't wish to load all the data into memory (which could lead to a out-of-memory error)

Here's a simple comparison example:

Let's assume the *dostuff()* function does some sort of transformation to *item.*

```
# normal function
def transform(ls):
    out = []
    for item in ls:
        out.append(dostuff(item))
    return out

# generator function
def transform(ls):
    for item in ls:
        yield dostuff(item)
```

In our normal function, we first *finish computing all transformed items,* and store it in out before returning it. So if we have an input list containing 1 million elements, we:

- store all *dostuff(item)* in our output list (stored in memory)
- wait for all 1 million computations to finish before returning it
- which might lead to out-of-memory errors and ineffeciency

In our generator function, we *yield* (output) a value the moment it is ready to be output.

- we don't store all 1 million entries in memory
- we don't wait for all 1 million computations to finish before returning anything

As such, I often use generators in place of normal functions when I want to maximize efficiency and to avoid out-of-memory errors.

9) iter() and next()

Here's a simple list, which we use a for loop to iterate over.

```
ls = ['apple', 'orange', 'pear']

for i in ls:
    print(i)

# apple
# orange
# pear
```

Internally, the for loop actually uses an *iterator object*.

To get the iterator object of our list, we use the *iter()* function.

```
ls = ['apple', 'orange', 'pear']

iterator_obj = iter(ls)

print(iterator_obj)
# <list_iterator object at 0x104db4430>
```

Our iterator object contains a sequence of items that we can access by iterating through it. To do this, we can use the *next()* function to get *only the next item.*

```
ls = ['apple', 'orange', 'pear']

iterator_obj = iter(ls)

print(next(iterator_obj))   # apple
print(next(iterator_obj))   # orange
print(next(iterator_obj))   # pear
```

Note — every time we call *next()* on an iterator object, an internal pointer inside the iterator moves to the next item. So if we call *next()* on the same iterator object, the following item will be returned.

As such, we can simply use *next()* again and again until the iterator object runs out of stuff to return. And when this happens, it raises the StopIteration exception.

```
ls = ['apple', 'orange', 'pear']

iterator_obj = iter(ls)

print(next(iterator_obj))   # apple
print(next(iterator_obj))   # orange
print(next(iterator_obj))   # pear

print(next(iterator_obj))
# StopIteration error
```

We can choose to use this method over for loops and while loops if we want more control over our iteration.

10) Sending data to our generator function

Let's first write a simple generator function.

```
def test():
    a = yield 'apple'
    print('a is', a, end='; ')
    b = yield 'pineapple'
    print('b is', b, end='; ')
    c = yield 'pear'
```

Notice that instead of a simple *yield ABC* statement, now we have *a = yield 'apple'*

The line *a = yield 'apple'* does a couple of things:

- it yields *apple* as per normal
- it then checks if we send anything to the generator using *.send()*
- if we do not send anything, *a* takes the value None
- if we send something, *a* takes the value that we send

Let's first iterate through our generator function without using *.send()*

```
def test():
    a = yield 'apple'
    print('a is', a, end='; ')
    b = yield 'pineapple'
    print('b is', b, end='; ')
    c = yield 'pear'

gen = test()
print(next(gen))    # apple
print(next(gen))    # a is None; pineapple
print(next(gen))    # b is None; pear
```

- here, notice that our function yields *apple, pineapple and pear* as usual
- since we don't use *.send(), a* and *b* are assigned to None

Next, let's actually use *.send()* to send a value to our generator.

When using *.send(),* note that we actually also yield something. As such, we replace the second *next(gen)* with the line *gen.send(7)*

```
def test():
    a = yield 'apple'
    print('a is', a, end='; ')
    b = yield 'pineapple'
    print('b is', b, end='; ')
    c = yield 'pear'

gen = test()
print(next(gen))    # apple
print(gen.send(7))  # a is 7; pineapple
print(next(gen))    # b is None; pear
```

- *a = yield 'apple'* yields *apple* first
- it then checks if we send anything to the generator using *.send()*
- we do send the value 7, so *a* is assigned to the value 7 (hence printing *a is 7*)
- *b = yield 'pineapple'* yields *pineapple* next
- it then checks if we send anything to the generator using *.send()*
- we do not send anything now, so *b* is assigned to None (printing *b is None*)
- *c = yield 'pear'* yields *pear*

Let's take a look at a less trivial example — a simple counting generator:

```
def increment(num=0):
    while True:
        value_from_send = yield num
        if value_from_send is None:
            num += 1
        else:
            num = value_from_send
```

If we don't *.send()* anything to our generator, it just returns 0, 1, 2, 3 ...

```python
def increment(num=0):
    while True:
        value_from_send = yield num
        if value_from_send is None:
            num += 1
        else:
            num = value_from_send

gen = increment()
print(next(gen))    # 0
print(next(gen))    # 1
print(next(gen))    # 2
print(next(gen))    # 3
print(next(gen))    # 4
```

However, if we *.send()* a value to our generator, it starts counting from that value:

```python
def increment(num=0):
    while True:
        value_from_send = yield num
        if value_from_send is None:
            num += 1
        else:
            num = value_from_send

gen = increment()
print(next(gen))    # 0
print(next(gen))    # 1
print(gen.send(10)) # 10
print(next(gen))    # 11
print(next(gen))    # 12
```

As such, if we ever need absolute control over our iteration, we might need to consider using *iter(), next()* and *.send()*

Conclusion

Hopefully this was clear and easy to understand

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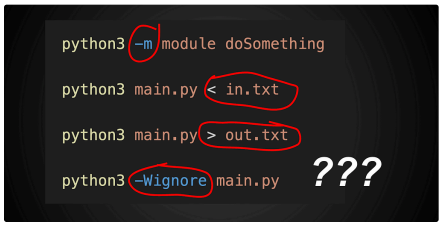

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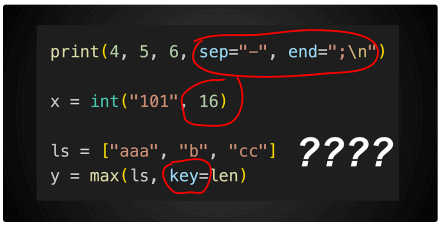

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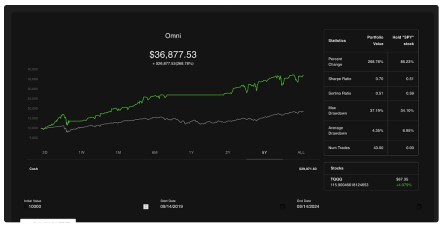

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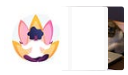

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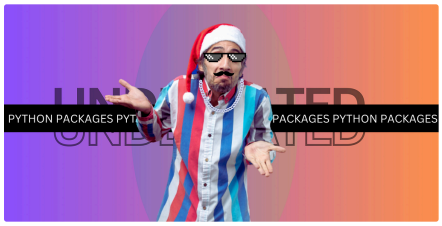

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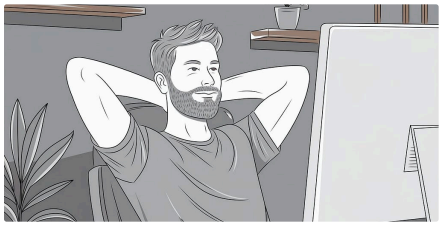

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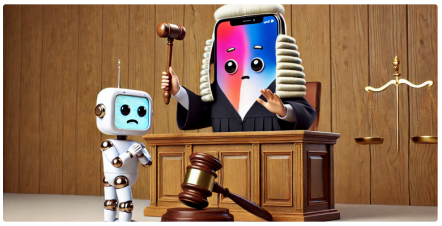

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