

Python

Generators

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学习编程最难的是什么？

You don't know what you don't know

听说过，但不理解 >> 没听说过

Generator function

当你看见 yield, 就说明这是一个生成器函数, 不要把它看作普通的函数

- When invoked, returns a generator object
- Generator objects implement the iterator interface: `.next` (`.__next__` in Python 3)

```
>>> def gen_123():
...     yield 1
...     yield 2
...     yield 3
...
>>> for i in gen_123(): print(i)
1
2
3
>>> g = gen_123()
>>> g
<generator object gen_123 at ...>
>>> next(g)
1
>>> next(g)
2
>>> next(g)
3
>>> next(g)
Traceback (most recent call last):
...
StopIteration
```

Python ≥ 2.6

Generator behavior

- Invoking a generator function builds the generator object but *does not* execute the body of the function

```
>>> def gen_ab():
...     print('starting...')
...     yield 'A'
...     print('here comes B:')
...     yield 'B'
...     print('the end.')
...
>>> for s in gen_ab(): print(s)
starting...
A
here comes B:
B
the end.
>>> g = gen_ab()
>>> next(g)
starting...
'A'
>>> next(g)
here comes B:
'B'
>>> next(g)
Traceback (most recent call last):
...
StopIteration
```

Generator behavior

- The body is executed only when **next** is called, and only up to the following **yield**

```
>>> def gen_ab():
...     print('starting...')
...     yield 'A'
...     print('here comes B:')
...     yield 'B'
...     print('the end.')
...
>>> for s in gen_ab(): print(s)
starting...
A
here comes B:
B
the end.
>>> g = gen_ab()
>>> next(g)
starting...
'A'
>>> next(g)
here comes B:
'B'
>>> next(g)
Traceback (most recent call last):
...
StopIteration
```

到底什么意思？

```
>>> def gen_ab():
```

```
...     print('starting...')
```

```
...     yield 'A'
```

```
...     print('here comes B:')
```

```
...     yield 'B'
```

```
...     print('the end.')
```

g = gen_ab(), 停在这里

第一次调用next(), 停在这里

第二次调用next(), 停在这里

生成器函数可以看成一串事件，yield暂停执行，next恢复执行
“yield是具有暂停功能的return”

```
>>> def gen_ab():
...     print('starting...')
...     yield 'A'
...     print('here comes B:')
...     yield 'B'
...     print('the end.')
...
>>> for s in gen_ab(): print(s)
starting...
A
here comes B:
B
the end.
>>> g = gen_ab()
>>> next(g)
starting...
'A'
>>> next(g)
here comes B:
'B'
>>> next(g)
Traceback (most recent call last):
...
StopIteration
```

斐波那契生成器(Fibonacci)

斐波那契数列:

0,1,1,2,3,5,8,11,19,...

前两个数是0,1, 后一个数是前两个数之和

斐波那契数列生成器

```
def fib(max):  
    a, b = 0, 1 ①  
    while a < max:  
        yield a ②  
        a, b = b, a + b ③
```



```
>>> def fib(max):  
    a, b = 0, 1  
    while a < max:  
        yield a  
        a, b = b, a+b
```

```
>>> for fib_number in fib(100):  
    print(fib_number)
```

```
0  
1  
1  
2  
3  
5  
8  
13  
21  
34  
55  
89
```

for 循环
每次都会调用next()

更深入的讨论: iterator(迭代器)

每次都把返回的a输出
注意yield是“具有暂停功能的return”
return a (= yield a)
fib_number = a
然后打印出来

不要害怕生成器函数里的循环

- 循环就是一个事件流，只不过里面包含了一些条件判断

```
def fib(max):  
    a, b = 0, 1  
    while a < max:  
        yield a  
        a, b = b, a+b
```

等价于

```
def fib(max):  
    a, b = 0, 1  
    if a < max:  
        yield a  
        a, b = b, a+b  
    if a < max:  
        yield a  
        a, b = b, a+b  
    if a < max:  
        yield a  
        a, b = b, a+b  
    ...
```

练习

- 一起写一个斐波那契生成器
- enumerate 函数

内置enumerate函数

`enumerate(iterable, start=0)`

Return an enumerate object. *iterable* must be a sequence, an *iterator*, or some other object which supports iteration. The `__next__()` method of the iterator returned by `enumerate()` returns a tuple containing a count (from *start* which defaults to 0) and the values obtained from iterating over *iterable*.

```
>>> seasons = ['Spring', 'Summer', 'Fall', 'Winter']
>>> list(enumerate(seasons))
[(0, 'Spring'), (1, 'Summer'), (2, 'Fall'), (3, 'Winter')]
>>> list(enumerate(seasons, start=1))
[(1, 'Spring'), (2, 'Summer'), (3, 'Fall'), (4, 'Winter')]
```

list() : 调用next()直到不能调用为止，并且把返回值存入列表，实质就是列表解析
`[i for i in enumerate(seasons)]`

自己写enumerate函数

```
def enumerate(sequence, start=0):  
    n = start  
    for elem in sequence:  
        yield n, elem  
        n += 1
```

生成器表达式

Generator expression

- When evaluated, returns a generator object

g.next()是Python2.X的写法，对应Python3.X中的next(g)

```
>>> g = (n for n in [1, 2, 3])
>>> for i in g: print i
...
1
2
3
>>> g = (n for n in [1, 2, 3])
>>> g
<generator object <genexpr> at
0x109a4deb0>
>>> g.next()
1
>>> g.next()
2
>>> g.next()
3
>>> g.next()
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
StopIteration
```

总结

- 有yield的函数：生成器函数
- yield是带暂停功能的return
- for, list 本质上是在调用next(obj)
- 把生成器函数看成事件流，yield暂停，next继续执行
- 生成器函数内部通常包含循环，循环也是事件流
- 把列表解析的中括号换成小括号就是生成器表达式

为什么要用生成器

- 快
- 内存占用小
需要的时候才会产生
- 语义上的含义
一次性使用
- 保存函数的当前执行环境，包括所有局部变量等

2120

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The Python yield keyword explained

What is the use of the yield keyword in Python? What does it do? For example, I'm trying to understand this code (**):
`def node._get_child_candidates(self, distance, min_dist, max_dist):` if ...

python

iterator

generator

yield

asked Oct 23 '08 at 22:21



Alex. S.

13.2k ● 7 ● 28 ● 42

<http://stackoverflow.com/questions/231767/the-python-yield-keyword-explained>

Q&A