<https://docs.python.org/3/tutorial/classes.html>

By now you have probably noticed that most container objects can be looped over using a [for](https://docs.python.org/3/reference/compound_stmts.html#for) statement:

**for** element **in** [1, 2, 3]:

print(element)

**for** element **in** (1, 2, 3):

print(element)

**for** key **in** {'one':1, 'two':2}:

print(key)

**for** char **in** "123":

print(char)

**for** line **in** open("myfile.txt"):

print(line, end='')

This style of access is clear, concise, and convenient. The use of iterators pervades and unifies Python. Behind the scenes, the [for](https://docs.python.org/3/reference/compound_stmts.html#for) statement calls [iter()](https://docs.python.org/3/library/functions.html" \l "iter" \o "iter) on the container object. The function returns an iterator object that defines the method [\_\_next\_\_()](https://docs.python.org/3/library/stdtypes.html#iterator.__next__) which accesses elements in the container one at a time. When there are no more elements, [\_\_next\_\_()](https://docs.python.org/3/library/stdtypes.html#iterator.__next__) raises a [StopIteration](https://docs.python.org/3/library/exceptions.html" \l "StopIteration" \o "StopIteration) exception which tells the for loop to terminate. You can call the [\_\_next\_\_()](https://docs.python.org/3/library/stdtypes.html#iterator.__next__) method using the [next()](https://docs.python.org/3/library/functions.html#next) built-in function; this example shows how it all works:

>>>

**>>>** s = 'abc'

**>>>** it = iter(s)

**>>>** it

<str\_iterator object at 0x10c90e650>

**>>>** next(it)

'a'

**>>>** next(it)

'b'

**>>>** next(it)

'c'

**>>>** next(it)

Traceback (most recent call last):

File "<stdin>", line 1, in <module>

next(it)

StopIteration

Having seen the mechanics behind the iterator protocol, it is easy to add iterator behavior to your classes. Define an \_\_iter\_\_() method which returns an object with a [\_\_next\_\_()](https://docs.python.org/3/library/stdtypes.html#iterator.__next__) method. If the class defines \_\_next\_\_(), then \_\_iter\_\_() can just return self:

**class** **Reverse**:

*"""Iterator for looping over a sequence backwards."""*

**def** \_\_init\_\_(self, data):

self.data = data

self.index = len(data)

**def** \_\_iter\_\_(self):

**return** self

**def** \_\_next\_\_(self):

**if** self.index == 0:

**raise** **StopIteration**

self.index = self.index - 1

**return** self.data[self.index]

>>>

**>>>** rev = Reverse('spam')

**>>>** iter(rev)

<\_\_main\_\_.Reverse object at 0x00A1DB50>

**>>> for** char **in** rev:

**...**  print(char)

**...**

m

a

p

s

9.9. Generators

[Generators](https://docs.python.org/3/glossary.html#term-generator) are a simple and powerful tool for creating iterators. They are written like regular functions but use the [yield](https://docs.python.org/3/reference/simple_stmts.html#yield) statement whenever they want to return data. Each time [next()](https://docs.python.org/3/library/functions.html#next) is called on it, the generator resumes where it left off (it remembers all the data values and which statement was last executed). An example shows that generators can be trivially easy to create:

**def** reverse(data):

**for** index **in** range(len(data)-1, -1, -1):

**yield** data[index]

>>>

**>>> for** char **in** reverse('golf'):

**...**  print(char)

**...**

f

l

o

g

Anything that can be done with generators can also be done with class-based iterators as described in the previous section. What makes generators so compact is that the \_\_iter\_\_() and [\_\_next\_\_()](https://docs.python.org/3/reference/expressions.html#generator.__next__) methods are created automatically.

Another key feature is that the local variables and execution state are automatically saved between calls. This made the function easier to write and much more clear than an approach using instance variables like self.index and self.data.

In addition to automatic method creation and saving program state, when generators terminate, they automatically raise [StopIteration](https://docs.python.org/3/library/exceptions.html" \l "StopIteration" \o "StopIteration). In combination, these features make it easy to create iterators with no more effort than writing a regular function.