

Generators

Announcements

Generators

Generators and Generator Functions

```
>>> def plus_minus(x):  
...     yield x  
...     yield -x  
  
>>> t = plus_minus(3)  
>>> next(t)  
3  
>>> next(t)  
-3  
>>> t  
<generator object plus_minus ...>
```

A *generator function* is a function that **yields** values instead of **returning** them

A normal function **returns** once; a *generator function* can **yield** multiple times

A *generator* is an iterator created automatically by calling a *generator function*

When a *generator function* is called, it returns a *generator* that iterates over its yields

(Demo)

Generators & Iterators

Generator Functions can Yield from Iterators

A **yield from** statement yields all values from an iterator or iterable (Python 3.3)

```
>>> list(a_then_b([3, 4], [5, 6]))  
[3, 4, 5, 6]
```

```
def a_then_b(a, b):  
    for x in a:  
        yield x  
    for x in b:  
        yield x
```

```
def a_then_b(a, b):  
    yield from a  
    yield from b
```

```
>>> list(countdown(5))  
[5, 4, 3, 2, 1]
```

```
def countdown(k):  
    if k > 0:  
        yield k  
        yield from countdown(k-1)
```

(Demo)

Generator Functions with Return Statements

A Return Statement Within a Generator Function

Upon executing a return statement, a generator function exits and cannot yield more values.

```
def f(x):                                >>> list(f(2))
    yield x                               [2, 3]
    yield x + 1
    return
    yield x + 3
```

Providing a value to be returned is allowed, but this value is not yielded.

```
def g(x):                                >>> list(g(2))
    yield x                               [2, 3]
    yield x + 1
    return x + 2
    yield x + 3
```

It is possible to access the returned value (but you don't need to know how).

```
def h(x):                                >>> list(h(2))
    y = yield from g(x)                   [2, 3, 4]
    yield y
```


Example: Partitions

Yielding Partitions

A partition of a positive integer n , using parts up to size m , is a way in which n can be expressed as the sum of positive integer parts up to m in increasing order.

`partitions(6, 4)`

$$2 + 4 = 6$$

$$1 + 1 + 4 = 6$$

$$3 + 3 = 6$$

$$1 + 2 + 3 = 6$$

$$1 + 1 + 1 + 3 = 6$$

$$2 + 2 + 2 = 6$$

$$1 + 1 + 2 + 2 = 6$$

$$1 + 1 + 1 + 1 + 2 = 6$$

$$1 + 1 + 1 + 1 + 1 + 1 = 6$$

```
def count_partitions(n, m):  
    if n == 0:  
        return 1  
    elif n < 0:  
        return 0  
    elif m == 0:  
        return 0  
    else:  
        with_m = count_partitions(n-m, m)  
        without_m = count_partitions(n, m-1)  
        return with_m + without_m
```

(Demo)