

# Generators

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## Announcements

# Generators

## Generators and Generator Functions

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```
>>> 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 Iterables

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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
```

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

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

(Demo)

## Example: Partitions

## Yielding Partitions

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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)