numpy.outer

numpy.outer(*a*, *b*, *out=None***)** **[source]**
(http://github.com/numpy/numpy/blob/v1.9.1/numpy/core/numeric.py#L998)

Compute the outer product of two vectors.

Given two vectors, `a = [a0, a1, ..., aM]` and `b = [b0, b1, ..., bN]`, the outer product [R55] is:

```
[[a0*b0  a0*b1 ... a0*bN ]
 [a1*b0    .
 [ ...          .
 [aM*b0            aM*bN ]]
```

Parameters:

a *: (M,) array_like*
First input vector. Input is flattened if not already 1-dimensional.

b *: (N,) array_like*
Second input vector. Input is flattened if not already 1-dimensional.

out *: (M, N) ndarray, optional*
A location where the result is stored
New in version 1.9.0.

Returns:

out *: (M, N) ndarray*
`out[i, j] = a[i] * b[j]`

See also:
inner (numpy.inner.html#numpy.inner), einsum (numpy.einsum.html#numpy.einsum)

References

[R55] *(1, 2)* : G. H. Golub and C. F. van Loan, *Matrix Computations*, 3rd ed., Baltimore, MD, Johns Hopkins University Press, 1996, pg. 8.

Examples

Make a (*very* coarse) grid for computing a Mandelbrot set:

```
>>> rl = np.outer(np.ones((5,)), np.linspace(-2, 2, 5))
>>> rl
array([[-2., -1.,  0.,  1.,  2.],
       [-2., -1.,  0.,  1.,  2.],
       [-2., -1.,  0.,  1.,  2.],
       [-2., -1.,  0.,  1.,  2.],
       [-2., -1.,  0.,  1.,  2.]])
>>> im = np.outer(1j*np.linspace(2, -2, 5), np.ones((5,)))
>>> im
array([[ 0.+2.j,  0.+2.j,  0.+2.j,  0.+2.j,  0.+2.j],
       [ 0.+1.j,  0.+1.j,  0.+1.j,  0.+1.j,  0.+1.j],
       [ 0.+0.j,  0.+0.j,  0.+0.j,  0.+0.j,  0.+0.j],
       [ 0.-1.j,  0.-1.j,  0.-1.j,  0.-1.j,  0.-1.j],
       [ 0.-2.j,  0.-2.j,  0.-2.j,  0.-2.j,  0.-2.j]])
>>> grid = rl + im
>>> grid
array([[-2.+2.j, -1.+2.j,  0.+2.j,  1.+2.j,  2.+2.j],
       [-2.+1.j, -1.+1.j,  0.+1.j,  1.+1.j,  2.+1.j],
       [-2.+0.j, -1.+0.j,  0.+0.j,  1.+0.j,  2.+0.j],
       [-2.-1.j, -1.-1.j,  0.-1.j,  1.-1.j,  2.-1.j],
       [-2.-2.j, -1.-2.j,  0.-2.j,  1.-2.j,  2.-2.j]])
```

An example using a “vector” of letters:

```
>>> x = np.array(['a', 'b', 'c'], dtype=object)
>>> np.outer(x, [1, 2, 3])
array([[a, aa, aaa],
       [b, bb, bbb],
       [c, cc, ccc]], dtype=object)
```


Previous topic

numpy.inner (numpy.inner.html)

Next topic

numpy.tensordot (numpy.tensordot.html)