무료 전자 책

배우기

numpy

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#numpy

1: numpy

NumPy (" " " ") Python .

1.3.0	2009-03-20
1.4.0	2010-07-21
1.5.0	2010-11-18
1.6.0	2011-05-15
1.6.1	2011 7 24
1.6.2	2012-05-20
1.7.0	2013-02-12
1.7.1	2013-04-07
1.7.2	2013-12-31
1.8.0	2013-11-10
1.8.1	2014-03-26
1.8.2	2014-08-09
1.9.0	2014-09-07
1.9.1	2014-11-02
1.9.2	2015-03-01
1.10.0	2015-10-07
1.10.1	2015-10-12
1.10.2	2015-12-14
1.10.4 *	2016-01-07
1.11.0	2016-05-29

Examples

Mac

Mac NumPy pip.

```
pip install numpy
```

Conda .
Windows, Mac Linux Conda

1. Conda . Anaconda (, numpy) Miniconda (Conda, Python) Conda . Anaconda Miniconda Conda .
2. Miniconda . `conda install numpy`

Windows

pypi (pip) Numpy Windows . Windows .

Christopher Gohlke . . 64 Python 3.5 :

1. `numpy-1.11.1+mkl-cp35-cp35m-win_amd64.whl`
2. Windows (cmd powershell)
3. `pip install C:\path_to_download\numpy-1.11.1+mkl-cp35-cp35m-win_amd64.whl` `pip install C:\path_to_download\numpy-1.11.1+mkl-cp35-cp35m-win_amd64.whl`

, Winpython . Anaconda Python numpy .

`conda` .

1. `conda` `conda` .
2. Windows .
3. . `conda install numpy`

Linux

NumPy Linux Linux .

Linux Python 2.x Python 3.x NumPy . APT `numpy` .

```
sudo apt-get install python-numpy
sudo apt-get install python3-numpy
```

zypper (Suse), yum (Fedora) .

`numpy` Python 2 Python `pip` Python 3 `pip3` .

```
pip install numpy  # install numpy for Python 2
pip3 install numpy  # install numpy for Python 3
```

`pip` Linux Python 2 Python 3 .

```
sudo apt-get install python-pip  # pip for Python 2
```

```
sudo apt-get install python3-pip  # pip for Python 3
```

`pip` 2 `pip3` PIP 3. (, ,) numpy .

`numpy` `virtualenv` Python `numpy` . Ubuntu `virtualenv` .

```
sudo apt-get install virtualenv
```

Python 2 Python 3 virtualenv `pip` `numpy` .

```
virtualenv venv  # create virtualenv named venv for Python 2
virtualenv venv -p python3  # create virtualenv named venv for Python 3
source venv/bin/activate  # activate virtualenv named venv
pip install numpy  # use pip for Python 2 and Python 3; do not use pip3 for Python3
```

numpy .

```
import numpy as np
```

`np` numpy . "np" "numpy" .

```
x = np.array([1,2,3,4])
```

Rackspace Jupyter Notebook

Jupyter . numpy . Jupyter numpy Rackspace tmpnb.org .

: . Jupyter UC Berkeley Cal Poly San Luis Obispo . Rackspace .

`numpy` tmpnb.org :

1. tmpnb.org .
2. `Welcome to Python.ipynb`
3. >> Python 2
4. New >> Python 3

numpy : https://riptutorial.com/ko/numpy/topic/823/numpy-

2: ndarray

- `def __array_prepare__(self, out_arr: ndarray, context: Tuple[ufunc, Tuple, int] = None) -> ndarray: # called on the way into a ufunc`
- `def __array_wrap__(self, out_arr: ndarray, context: Tuple[ufunc, Tuple, int] = None) -> ndarray: # called on the way out of a ufunc`
- `__array_priority__: int # used to determine which argument to invoke the above methods on when a ufunc is called`
- `def __array_finalize__(self, obj: ndarray): # called whenever a new instance of this class comes into existence, even if this happens by routes other than __new__`

Examples

```
class MySubClass(np.ndarray):
    def __new__(cls, input_array, info=None):
        obj = np.asarray(input_array).view(cls)
        obj.info = info
        return obj

    def __array_finalize__(self, obj):
        # handles MySubClass(...)
        if obj is None:
            pass

        # handles my_subclass[...] or my_subclass.view(MySubClass) or ufunc output
        elif isinstance(obj, MySubClass):
            self.info = obj.info

        # handles my_arr.view(MySubClass)
        else:
            self.info = None

    def __array_prepare__(self, out_arr, context=None):
        # called before a ufunc runs
        if context is not None:
            func, args, which_return_val = context

        return super().__array_prepare__(out_arr, context)

    def __array_wrap__(self, out_arr, context=None):
        # called after a ufunc runs
        if context is not None:
            func, args, which_return_val = context

        return super().__array_wrap__(out_arr, context)
```

`context` `func` A ufunc `np.add` , `args` A `tuple` `which_return_val` ufunc

ndarray : https://riptutorial.com/ko/numpy/topic/6431/ndarray---

3: np.linalg

1.8 np.linalg np.linalg " . , . , A 3x3 .

```
np.random.seed(123)
A = np.random.rand(2,3,3)
b = np.random.rand(2,3)
x = np.linalg.solve(A, b)

print np.dot(A[0,:,:], x[0,:])
# array([ 0.53155137,  0.53182759,  0.63440096])

print b[0,:]
# array([ 0.53155137,  0.53182759,  0.63440096])
```

np a : (..., M, M) array_like .

Examples

np.solve

.

```
x0 + 2 * x1 + x2 = 4
     x1 + x2 = 3
x0 +      x2 = 5
```

A * x = b .

```
A = np.array([[1, 2, 1],
              [0, 1, 1],
              [1, 0, 1]])
b = np.array([4, 3, 5])
```

np.linalg.solve x .

```
x = np.linalg.solve(A, b)
# Out: x = array([ 1.5, -0.5,  3.5])
```

A . .A / (0). , A linalg.solve linalg.solve LinAlgError: Singular matrix :

```
A = np.array([[1, 2, 1],
              [2, 4, 2],   # Note that this row 2 * the first row
              [1, 0, 1]])
b = np.array([4,8,5])
```

np.linalg.lstsq .

np.linalg.lstsq

.

.

```
x0 + 2 * x1 + x2 = 4
x0 + x1 + 2 * x2 = 3
2 * x0 + x1 + x2 = 5
x0 + x1 + x2 = 4
```

. A * x = b :

```
A = np.array([[1, 2, 1],
              [1,1,2],
              [2,1,1],
              [1,1,1]])
b = np.array([4,3,5,4])
```

np.linalg.lstsq np.linalg.lstsq .

```
x, residuals, rank, s = np.linalg.lstsq(A,b)
```

x , residuals , A rank , s A rank . b lstsq b .

```
A = np.array([[1, 2, 1],
              [1,1,2],
              [2,1,1],
              [1,1,1]])
b = np.array([[4,3,5,4],[1,2,3,4]]).T # transpose to align dimensions
x, residuals, rank, s = np.linalg.lstsq(A,b)
print x # columns of x are solutions corresponding to columns of b
#[[ 2.05263158  1.63157895]
# [ 1.05263158 -0.36842105]
# [ 0.05263158  0.63157895]]
print residuals # also one for each column in b
#[ 0.84210526  5.26315789]
```

rank s A .

np.linalg : https://riptutorial.com/ko/numpy/topic/3753/np-linalg---

4: numpy.cross

- `numpy.cross(a, b)` *a b* (*a b*)
- `numpy.cross(a, b, axisa=-1)` # *a b* , *a* st *axisa* .
- `numpy.cross(a, b, axisa=-1, axisb=-1, axisc=-1)` *a b* , *axisc*
- `numpy.cross(a, b, axis=None)` # *A* *B*, *A*, *B* ,

a, b	, a b 2 3 . (, 2) . a 'B' cross(a,b) a b . b a cross(a,b) a b . a b . cross(a,b) cross(a[0],b[0]), cross(a[1], b[1]), ... cross(a[0],b[0]), cross(a[1], b[1]), ...
/ b	a , . axisa cross() a . . axisb b b . cross() , . axisc cross . axisc .
	axisa , axisb axisc . axis axis .

Examples

Numpy `cross` . `[1, 0, 0]` `[0, 1, 0]` `[0, 0, 1]` . Numpy .

```
>>> a = np.array([1, 0, 0])
>>> b = np.array([0, 1, 0])
>>> np.cross(a, b)
array([0, 0, 1])
```

3 . Numpy . `c` `[c1, c2]` Numpy `[c1, c2, 0]` 0 . ,

```
>>> c = np.array([0, 2])
>>> np.cross(a, c)
array([0, 0, 2])
```

Numpy `ndarray` dot , cross .

```
>>> a.cross(b)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
AttributeError: 'numpy.ndarray' object has no attribute 'cross'
```

3- (2-) .

```
>>> a=np.array([[1,0,0],[0,1,0],[0,0,1]])
>>> b=np.array([1,0,0])
>>> np.cross(a,b)
array([[ 0,  0,  0],
       [ 0,  0, -1],
       [ 0,  1,  0]])
```

([np.cross (a [0], b), np.cross (a [1], b), np.cross (a [2], b)]).

`b` 3- (2-) , `a` . " " . .

```
>>> b=np.array([[0,0,1],[1,0,0],[0,1,0]])
>>> np.cross(a,b)
array([[ 0, -1,  0],
       [ 0,  0, -1],
       [-1,  0,  0]])
```

```
array([np.cross(a[0],b[0]), np.cross(a[1],b[1]), np.cross(a[2],b[2])])
```

numpy `a[0,:]` `a[1,:]` `a[2,:]` . Numpy.cross axisa . ,

```
>>> a=np.array([[1,1,1],[0,1,0],[1,0,-1]])
>>> b=np.array([0,0,1])
>>> np.cross(a,b)
array([[ 1, -1,  0],
       [ 1,  0,  0],
       [ 0, -1,  0]])
>>> np.cross(a,b,axisa=0)
array([[ 0, -1,  0],
       [ 1, -1,  0],
       [ 0, -1,  0]])
>>> np.cross(a,b,axisa=1)
array([[ 1, -1,  0],
       [ 1,  0,  0],
       [ 0, -1,  0]])
```

`axisa=1` `(np.cross([1,1,1],b), np.cross([0,1,0],b), np.cross([1,0,-1],b))` . axisa ( ) . `axisa=0` `(np.cross([1,0,1],b), np.cross([1,1,0],b), np.cross([1,0,-1],b))` .

`axisb` 2 `b` .

axisa axisb numpy . axisc `a b` numpy . `a b`

```
>>> np.cross(a,b,1)
array([[ 1, -1,  0],
       [ 1,  0,  0],
       [ 0, -1,  0]])
>>> np.cross(a,b,1,axisc=0)
array([[ 1,  1,  0],
       [-1,  0, -1],
       [ 0,  0,  0]])
>>> np.cross(a,b,1,axisc=1)
array([[ 1, -1,  0],
       [ 1,  0,  0],
       [ 0, -1,  0]])
```

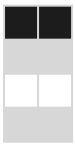
`axisc=1` `axisc` . , . axisc . `axisc=0` .

`axisa` , `axisb` `axisc` `axisc` . `axis` . axisa, axisb axisc .

numpy.cross : https://riptutorial.com/ko/numpy/topic/6166/numpy-cross

5: numpy.dot

- numpy.dot (a, b, out =)



numpy.dot

a b . a b 1-D . . out .

Examples

. numpy.ndarray .

```
>>> import numpy as np
>>> A = np.ones((4,4))
>>> A
array([[ 1.,  1.,  1.,  1.],
       [ 1.,  1.,  1.,  1.],
       [ 1.,  1.,  1.,  1.],
       [ 1.,  1.,  1.,  1.]])
>>> B = np.ones((4,2))
>>> B
array([[ 1.,  1.],
       [ 1.,  1.],
       [ 1.,  1.],
       [ 1.,  1.]])
>>> A.dot(B)
array([[ 4.,  4.],
       [ 4.,  4.],
       [ 4.,  4.],
       [ 4.,  4.]])
```

numpy .

```
>>> np.dot(A,B)
array([[ 4.,  4.],
       [ 4.,  4.],
       [ 4.,  4.],
       [ 4.,  4.]])
```

1 numpy .

```
>>> v = np.array([1,2])
>>> w = np.array([1,2])
>>> v.dot(w)
5
>>> np.dot(w,v)
5
```

```
>>> np.dot(v,w)
5
```

out

numpy out = None . . . .

```
>>> I = np.eye(2)
>>> I
array([[ 1.,  0.],
       [ 0.,  1.]])
>>> result = np.zeros((2,2))
>>> result
array([[ 0.,  0.],
       [ 0.,  0.]])
>>> np.dot(I, I, out=result)
array([[ 1.,  0.],
       [ 0.,  1.]])
>>> result
array([[ 1.,  0.],
       [ 0.,  1.]])
```

dtype int .

```
>>> np.dot(I, I, out=result)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ValueError: output array is not acceptable (must have the right type, nr dimensions, and be a
C-Array)
```

Fortran ( ) .

```
>>> result = np.zeros((2,2), order='F')
>>> np.dot(I, I, out=result)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ValueError: output array is not acceptable (must have the right type, nr dimensions, and be a
C-Array)
```

numpy.dot 8 8 .

```
>>> a
array([[ 1.,  2.],
       [ 3.,  1.]])
>>> b
array([[  1.,   2.,   3.,   4.,   5.,   6.,   7.,   8.],
       [  9.,  10.,  11.,  12.,  13.,  14.,  15.,  16.]])
>>> np.dot(a, b)
array([[ 19.,  22.,  25.,  28.,  31.,  34.,  37.,  40.],
       [ 12.,  16.,  20.,  24.,  28.,  32.,  36.,  40.]])
```

( ) .

```
>>> b
```

```
array([[  1.,   9.],
       [  2.,  10.],
       [  3.,  11.],
       [  4.,  12.],
       [  5.,  13.],
       [  6.,  14.],
       [  7.,  15.],
       [  8.,  16.]])
>>> np.dot(a, b.T).T
array([[ 19.,  12.],
       [ 22.,  16.],
       [ 25.,  20.],
       [ 28.,  24.],
       [ 31.,  28.],
       [ 34.,  32.],
       [ 37.,  36.],
       [ 40.,  40.]])
```

einsum . .

```
>>> np.einsum('...ij,...j', a, b)
```

. .

```
>>> a
array([[[ 0,  1],
        [ 2,  3]],
       [[ 4,  5],
        [ 6,  7]],
       [[ 8,  9],
        [10, 11]],
       [[12, 13],
        [14, 15]],
       [[16, 17],
        [18, 19]],
       [[20, 21],
        [22, 23]],
       [[24, 25],
        [26, 27]],
       [[28, 29],
        [30, 31]]])
>>> np.einsum('...ij,...j', a, b)
array([[   9.,   29.],
       [  58.,   82.],
       [ 123.,  151.],
       [ 204.,  236.],
       [ 301.,  337.],
       [ 414.,  454.],
       [ 543.,  587.],
       [ 688.,  736.]])
```

numpy.dot . . ( )

```
>>> np.diag(np.dot(b,b.T))
array([  82.,  104.,  130.,  160.,  194.,  232.,  274.,  320.])
```

-

```
>>> (b * b).sum(axis=-1)
array([  82.,  104.,  130.,  160.,  194.,  232.,  274.,  320.])
```

einsum

```
>>> np.einsum('...j,...j', b, b)
array([  82.,  104.,  130.,  160.,  194.,  232.,  274.,  320.])
```

numpy.dot : https://riptutorial.com/ko/numpy/topic/3198/numpy-dot

6: numpy IO

Examples

```
x = np.random.random([100,100])
x.tofile('/path/to/dir/saved_binary.npy')
y = fromfile('/path/to/dir/saved_binary.npy')
z = y.reshape(100,100)
all(x==z)
# Output:
#     True
```

np.loadtxt CSV .

```
# File:
#    # Col_1 Col_2
#    1, 1
#    2, 4
#    3, 9
np.loadtxt('/path/to/dir/csvlike.txt', delimiter=',', comments='#')
# Output:
# array([[ 1.,  1.],
#        [ 2.,  4.],
#        [ 3.,  9.]])
```

np.fromregex .

```
np.fromregex('/path/to/dir/csvlike.txt', r'(\d+),\s(\d+)', np.int64)
# Output:
# array([[1, 1],
#        [2, 4],
#        [3, 9]])
```

CSV ASCII

np.loadtxt np.savetxt ASCII .

```
import numpy as np
x = np.random.random([100,100])
np.savetxt("filename.txt", x)
```

.

```
np.savetxt("filename.txt", x, delimiter=", " ,
    newline="\n", comments="$ ", fmt="%1.2f",
    header="commented example text")
```

:

```
$ commented example text
```

```
0.30, 0.61, 0.34, 0.13, 0.52, 0.62, 0.35, 0.87, 0.48, [...]
```

CSV

( ).

`fromfile` - . tofile .

`genfromtxt` - . . skip_header .

`loadtxt` - . .

genfromtxt loadtxt . genfromtxt .

, ( ):

myfile.csv :

```
#descriptive text line to skip
1.0, 2, 3
4, 5.5, 6

import numpy as np
np.genfromtxt('path/to/myfile.csv',delimiter=',',skiprows=1)
```

:

```
array([[ 1. ,  2. ,  3. ],
       [ 4. ,  5.5,  6. ]])
```

, ():

```
1   2.0000  buckle_my_shoe
3   4.0000  margery_door

import numpy as np
np.genfromtxt('filename', dtype= None)


array([(1, 2.0, 'buckle_my_shoe'), (3, 4.0, 'margery_door')],
dtype=[('f0', '<i4'), ('f1', '<f8'), ('f2', '|S14')])
```

dtype=None .

:

: 1 2 3 4 5 6 7 8 9 10 11 22 13 14 15 16 17 18 19 20 21 22 23 24

:

```
result=np.fromfile(path_to_file,dtype=float,sep="\t",count=-1)
```

numpy IO : https://riptutorial.com/ko/numpy/topic/4973/numpy--io

7:

( ) .

Examples

np.polyfit

$ f (x) = mx + c $.

```
npoints = 20
slope = 2
offset = 3
x = np.arange(npoints)
y = slope * x + offset + np.random.normal(size=npoints)
p = np.polyfit(x,y,1)           # Last argument is degree of polynomial
```

:

```
import matplotlib.pyplot as plt
f = np.poly1d(p)                # So we can call f(x)
fig = plt.figure()
ax  = fig.add_subplot(111)
plt.plot(x, y, 'bo', label="Data")
plt.plot(x,f(x), 'b-',label="Polyfit")
plt.show()
```

: https://docs.scipy.org/doc/numpy/reference/generated/numpy.polyfit.html numpy .

np.linalg.lstsq

polyfit .

```
npoints = 20
slope = 2
offset = 3
x = np.arange(npoints)
y = slope * x + offset + np.random.normal(size=npoints)
```

| cA b | ** 2

```
import matplotlib.pyplot as plt # So we can plot the resulting fit
A = np.vstack([x,np.ones(npoints)]).T
m, c = np.linalg.lstsq(A, y)[0] # Don't care about residuals right now
fig = plt.figure()
ax  = fig.add_subplot(111)
plt.plot(x, y, 'bo', label="Data")
plt.plot(x, m*x+c, 'r--',label="Least Squares")
plt.show()
```

: https://docs.scipy.org/doc/numpy/reference/generated/numpy.linalg.lstsq.html numpy .

: https://riptutorial.com/ko/numpy/topic/8808/---

8:

Examples

numpy `where` true (`condition`) (`numpy.nonzero`). .

```
import numpy as np

a = np.arange(20).reshape(2,10)
# a = array([[ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
#            [10, 11, 12, 13, 14, 15, 16, 17, 18, 19]])

# Generate boolean array indicating which values in a are both greater than 7 and less than 13
condition = np.bitwise_and(a>7, a<13)
# condition = array([[False, False, False, False, False, False, False, False,  True, True],
#                    [True,  True,  True, False, False, False, False, False, False, False]],
dtype=bool)

# Get the indices of a where the condition is True
ind = np.where(condition)
# ind = (array([0, 0, 1, 1, 1]), array([8, 9, 0, 1, 2]))

keep = a[ind]
# keep = [ 8  9 10 11 12]
```

extract . condition condition array .

```
# np.extract(condition, array)
keep = np.extract(condition, a)
# keep = [ 8  9 10 11 12]
```

x y where . True x False y .

```
# Set elements of a which are NOT greater than 7 and less than 13 to zero, np.where(condition,
x, y)
a = np.where(condition, a, a*0)
print(a)
# Out: array([[ 0,  0,  0,  0,  0,  0,  0,  0,  8,  9],
#             [10, 11, 12,  0,  0,  0,  0,  0,  0,  0]])
```

.

```
a = np.random.normal(size=10)
print(a)
#[-1.19423121  1.10481873  0.26332982 -0.53300387 -0.04809928  1.77107775
# 1.16741359  0.17699948 -0.06342169 -1.74213078]
b = a[a>0]
print(b)
#[ 1.10481873  0.26332982  1.77107775  1.16741359  0.17699948]
```

: https://riptutorial.com/ko/numpy/topic/6187/-

9:

NumPy `random` .

.

Examples

```
# Generates 5 random numbers from a uniform distribution [0, 1)
np.random.rand(5)
# Out: array([ 0.4071833 ,  0.069167  ,  0.69742877,  0.45354268,  0.7220556 ])
```

`random.seed` :

```
np.random.seed(0)
np.random.rand(5)
# Out: array([ 0.5488135 ,  0.71518937,  0.60276338,  0.54488318,  0.4236548 ])
```

:

```
prng = np.random.RandomState(0)
prng.rand(5)
# Out: array([ 0.5488135 ,  0.71518937,  0.60276338,  0.54488318,  0.4236548 ])
```

```
# Creates a 5x5 random integer array ranging from 10 (inclusive) to 20 (inclusive)
np.random.randint(10, 20, (5, 5))

'''
Out: array([[12, 14, 17, 16, 18],
            [18, 11, 16, 17, 17],
            [18, 11, 15, 19, 18],
            [19, 14, 13, 10, 13],
            [15, 10, 12, 13, 18]])
'''
```

```
letters = list('abcde')
```

(-).

```
np.random.choice(letters, 3)
'''
Out: array(['e', 'e', 'd'],
      dtype='<U1')
'''
```

:

```
np.random.choice(letters, 3, replace=False)
'''
```

```
Out: array(['a', 'c', 'd'],
      dtype='<U1')
'''
```

.

```
# Choses 'a' with 40% chance, 'b' with 30% and the remaining ones with 10% each
np.random.choice(letters, size=10, p=[0.4, 0.3, 0.1, 0.1, 0.1])

'''
Out: array(['a', 'b', 'e', 'b', 'a', 'b', 'b', 'c', 'a', 'b'],
  dtype='<U1')
'''
```

()

```
# Generate 5 random numbers from a standard normal distribution
# (mean = 0, standard deviation = 1)
np.random.randn(5)
# Out: array([-0.84423086,  0.70564081, -0.39878617, -0.82719653, -0.4157447 ])

# This result can also be achieved with the more general np.random.normal
np.random.normal(0, 1, 5)
# Out: array([-0.84423086,  0.70564081, -0.39878617, -0.82719653, -0.4157447 ])

# Specify the distribution's parameters
# Generate 5 random numbers drawn from a normal distribution with mean=70, std=10
np.random.normal(70, 10, 5)
# Out: array([ 72.06498837,  65.43118674,  59.40024236,  76.14957316,  84.29660766])
```

`numpy.random` (: `poisson` , `binomial` `logistic`

```
np.random.poisson(2.5, 5)  # 5 numbers, lambda=5
# Out: array([0, 2, 4, 3, 5])

np.random.binomial(4, 0.3, 5)  # 5 numbers, n=4, p=0.3
# Out: array([1, 0, 2, 1, 0])

np.random.logistic(2.3, 1.2, 5)  # 5 numbers, location=2.3, scale=1.2
# Out: array([ 1.23471936,  2.28598718, -0.81045893,  2.2474899 ,  4.15836878])
```

: https://riptutorial.com/ko/numpy/topic/2060/--

10:

N `ndarrays` numpy . .

. for .

Examples

```
np.empty((2,3))
```

. .

```
np.array([0,1,2,3])
# Out: array([0, 1, 2, 3])
```

```
np.arange(4)
# Out: array([0, 1, 2, 3])
```

0

```
np.zeros((3,2))
# Out:
# array([[ 0.,  0.],
#        [ 0.,  0.],
#        [ 0.,  0.]])
```

```
np.ones((3,2))
# Out:
# array([[ 1.,  1.],
#        [ 1.,  1.],
#        [ 1.,  1.]])
```

```
np.linspace(0,1,21)
# Out:
# array([ 0.  ,  0.05,  0.1 ,  0.15,  0.2 ,  0.25,  0.3 ,  0.35,  0.4 ,
#         0.45,  0.5 ,  0.55,  0.6 ,  0.65,  0.7 ,  0.75,  0.8 ,  0.85,
#         0.9 ,  0.95,  1.  ])
```

```
np.logspace(-2,2,5)
# Out:
# array([  1.00000000e-02,   1.00000000e-01,   1.00000000e+00,
#          1.00000000e+01,   1.00000000e+02])
```

```
np.fromfunction(lambda i: i**2, (5,))
# Out:
# array([  0.,   1.,   4.,   9.,  16.])
np.fromfunction(lambda i,j: i**2, (3,3))
# Out:
# array([[ 0.,  0.,  0.],
```

```
#        [ 1.,  1.,  1.],
#        [ 4.,  4.,  4.]])
```

```
x = np.arange(4)
x
#Out:array([0, 1, 2, 3])
```

```
x+10
#Out: array([10, 11, 12, 13])
```

.

```
x*2
#Out: array([0, 2, 4, 6])
```

.

```
x+x
#Out: array([0, 2, 4, 6])
```

.

```
x*x
#Out: array([0, 1, 4, 9])
```

( )

```
x.dot(x)
#Out: 14
```

3.5 @ .

```
x = np.diag(np.arange(4))
print(x)
'''
   Out: array([[0, 0, 0, 0],
   [0, 1, 0, 0],
   [0, 0, 2, 0],
   [0, 0, 0, 3]])
'''
print(x@x)
print(x)
'''
   Out: array([[0, 0, 0, 0],
   [0, 1, 0, 0],
   [0, 0, 4, 0],
   [0, 0, 0, 9]])
'''
```

. . .

```
#np.append(array, values_to_append, axis=None)
x = np.array([0,1,2,3,4])
np.append(x, [5,6,7,8,9])
# Out: array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
x
# Out: array([0, 1, 2, 3, 4])
y = np.append(x, [5,6,7,8,9])
y
# Out: array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

hstack . . ( )
vstack . . ( )

```
# np.hstack(tup), np.vstack(tup)
x = np.array([0,0,0])
y = np.array([1,1,1])
z = np.array([2,2,2])
np.hstack(x,y,z)
# Out: array([0, 0, 0, 1, 1, 1, 2, 2, 2])
np.vstack(x,y,z)
# Out: array([[0, 0, 0],
#             [1, 1, 1],
#             [2, 2, 2]])
```

`i:j:k` `i` () `j` () `k` . 0.

```
x = np.arange(10)
x[0]
# Out: 0

x[0:4]
# Out: array([0, 1, 2, 3])

x[0:4:2]
# Out:array([0, 2])
```

. `-1` .

```
x[-1]
# Out: 9
x[-1:0:-1]
# Out: array([9, 8, 7, 6, 5, 4, 3, 2, 1])
```

. .

```
x = np.arange(16).reshape((4,4))
x
# Out:
#     array([[ 0,  1,  2,  3],
#            [ 4,  5,  6,  7],
#            [ 8,  9, 10, 11],
#            [12, 13, 14, 15]])

x[1,1]
# Out: 5
```

```
x[0:3,0]
# Out: array([0, 4, 8])

x[0:3, 0:3]
# Out:
#     array([[ 0,  1,  2],
#            [ 4,  5,  6],
#            [ 8,  9, 10]])

x[0:3:2, 0:3:2]
# Out:
#     array([[ 0,  2],
#            [ 8, 10]])
```

```
arr = np.arange(10).reshape(2, 5)
```

`.transpose` :

```
arr.transpose()
# Out:
#      array([[0, 5],
#             [1, 6],
#             [2, 7],
#             [3, 8],
#             [4, 9]])
```

`.T` :

```
arr.T
# Out:
#     array([[0, 5],
#            [1, 6],
#            [2, 7],
#            [3, 8],
#            [4, 9]])
```

`np.transpose` :

```
np.transpose(arr)
# Out:
#     array([[0, 5],
#            [1, 6],
#            [2, 7],
#            [3, 8],
#            [4, 9]])
```

2 ( ). n . `array.shape` `array.shape` .

```
a = np.arange(12).reshape((3,2,2))
a.transpose() # equivalent to a.transpose(2,1,0)
# Out:
#   array([[[ 0,  4,  8],
#           [ 2,  6, 10]],
#
```

```
#          [[ 1,  5,  9],
#           [ 3,  7, 11]]])
```

.

```
a.transpose(2,0,1)
# Out:
#    array([[[ 0,  2],
#            [ 4,  6],
#            [ 8, 10]],
#
#           [[ 1,  3],
#            [ 5,  7],
#            [ 9, 11]]])

a = np.arange(24).reshape((2,3,4))  # shape (2,3,4)
a.transpose(2,0,1).shape
# Out:
#    (4, 2, 3)
```

```
arr = np.arange(7)
print(arr)
# Out: array([0, 1, 2, 3, 4, 5, 6])
```

.

```
arr > 4
# Out: array([False, False, False, False, False,  True,  True], dtype=bool)
```

4 .

```
arr[arr>4]
# Out: array([5, 6])
```

(:) .

```
# Two related arrays of same length, i.e. parallel arrays
idxs = np.arange(10)
sqrs = idxs**2

# Retrieve elements from one array using a condition on the other
my_sqrs = sqrs[idxs % 2 == 0]
print(my_sqrs)
# Out: array([0, 4, 16, 36, 64])
```

`numpy.reshape` (`numpy.ndarray.reshape`) , :

```
print(np.arange(10).reshape((2, 5)))
# [[0 1 2 3 4]
#  [5 6 7 8 9]]
```

.

```
a = np.arange(12)
a.reshape((3, 4))
print(a)
# [ 0  1  2  3  4  5  6  7  8  9 10 11]
```

, `shape` AN `ndarray` :

```
a = np.arange(12)
a.shape = (3, 4)
print(a)
# [[ 0  1  2  3]
#  [ 4  5  6  7]
#  [ 8  9 10 11]]
```

`ndarray` `shape` .

`shape` `-1` . numpy .

```
a = np.arange(12)
print(a.reshape((3, -1)))
# [[ 0  1  2  3]
#  [ 4  5  6  7]
#  [ 8  9 10 11]]
```

:

```
a = np.arange(12)
print(a.reshape((3, 2, -1)))

# [[[ 0  1]
#   [ 2  3]]

#  [[ 4  5]
#   [ 6  7]]

#  [[ 8  9]
#   [10 11]]]
```

`a.reshape((3, -1, -1))` `ValueError` .

Numpy . , .

```
# Create two arrays of the same size
a = np.arange(6).reshape(2, 3)
b = np.ones(6).reshape(2, 3)

a
# array([0, 1, 2],
#       [3, 4, 5])
b
# array([1, 1, 1],
#       [1, 1, 1])

# a + b: a and b are added elementwise
a + b
```

```
# array([1, 2, 3],
#       [4, 5, 6])
```

Numpy . " " .

```
# Create arrays of shapes (1, 5) and (13, 1) respectively
a = np.arange(5).reshape(1, 5)
a
# array([[0, 1, 2, 3, 4]])
b = np.arange(4).reshape(4, 1)
b
# array([0],
#       [1],
#       [2],
#       [3])

# When multiplying a * b, slices with the same dimensions are multiplied
# elementwise. In the case of a * b, the one and only row of a is multiplied
# with each scalar down the one and only column of b.
a*b
# array([[ 0,  0,  0,  0,  0],
#        [ 0,  1,  2,  3,  4],
#        [ 0,  2,  4,  6,  8],
#        [ 0,  3,  6,  9, 12]])
```

, 2D 3D .

```
# Create arrays of shapes (2, 2, 3) and (2, 3) respectively
a = np.arange(12).reshape(2, 2, 3)
a
# array([[[ 0  1  2]
#         [ 3  4  5]]
#
#        [[ 6  7  8]
#         [ 9 10 11]]])
b = np.arange(6).reshape(2, 3)
# array([[0, 1, 2],
#        [3, 4, 5]])

# Executing a*b broadcasts b to each (2, 3) slice of a,
# multiplying elementwise.
a*b
# array([[[ 0,  1,  4],
#         [ 9, 16, 25]],
#
#        [[ 0,  7, 16],
#         [27, 40, 55]]])

# Executing b*a gives the same result, i.e. the smaller
# array is broadcast over the other.
```

?

.

. 1 . .

:

```
(7, 5, 3)    # compatible because dimensions are the same
(7, 5, 3)


(7, 5, 3)    # compatible because second dimension is 1
(7, 1, 3)

(7, 5, 3, 5) # compatible because exceeding dimensions are not compared
      (3, 5)

(3, 4, 5)    # incompatible
   (5, 5)

(3, 4, 5)    # compatible
   (1, 5)
```

.

CSV

```
filePath = "file.csv"
data = np.genfromtxt(filePath)
```

. .

```
data = np.genfromtxt(filePath, dtype='float', delimiter=';', skip_header=1, usecols=(0,1,3) )
```

Numpy n : ndarray

numpy `ndarray` (*n-*). `ndarray` .

- (,)
- (, *n*)

1 :

```
x = np.arange(15)
# array([ 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14])
x.shape
# (15,)
```

2 :

```
x = np.asarray([[0, 1, 2, 3, 4], [5, 6, 7, 8, 9], [10, 11, 12, 13, 14]])
x
# array([[ 0, 1, 2, 3, 4],
# [ 5, 6, 7, 8, 9],
# [10, 11, 12, 13, 14]])
```

```
x.shape
# (3, 5)
```

3 :

```
np.arange(12).reshape([2,3,2])
```

.

```
x = np.empty([2, 2])
# array([[ 0., 0.],
# [ 0., 0.]])
```

.

```
x = np.empty([2, 2])
# array([[ 0., 0.],
# [ 0., 0.]])

x.dtype
# dtype('float64')
```

numpy .

```
x = np.asarray([[1, 2], [3, 4]])
x.dtype
# dtype('int32')
```

numpy `ndarray`

```
x[1, 1] = 1.5 # assign a float value
x[1, 1]
# 1
# value has been casted to int
x[1, 1] = 'z' # value cannot be casted, resulting in a ValueError
```

.

```
x = np.asarray([[1, 2], [3, 4]])
# array([[1, 2],
         [3, 4]])
y = np.asarray([[5, 6]])
# array([[5, 6]])
```

2x2 1x2 . .

```
# x + y
array([[ 6, 8],
       [ 8, 10]])
```

`y` " " .

```
array([[5, 6],
       [5, 6]])
```

x .

:

- ndarray : N (ndarray)
- : ndarray .

: https://riptutorial.com/ko/numpy/topic/1296/

11:

Numpy .

Examples

numpy.save numpy.load

np.save np.load numpy .

```
import numpy as np

a = np.random.randint(10,size=(3,3))
np.save('arr', a)

a2 = np.load('arr.npy')
print a2
```

: https://riptutorial.com/ko/numpy/topic/10891/--

12:

Examples

`dtype=bool` `0`, `None`, `False` True .

```
import numpy as np

bool_arr = np.array([1, 0.5, 0, None, 'a', '', True, False], dtype=bool)
print(bool_arr)
# output: [ True  True False False  True False  True False]
```

numpy .

```
arr_1 = np.random.randn(3, 3)
arr_2 = np.random.randn(3, 3)

bool_arr = arr_1 < 0.5
print(bool_arr.dtype)
# output: bool

bool_arr = arr_1 < arr_2
print(bool_arr.dtype)
# output: bool
```

: https://riptutorial.com/ko/numpy/topic/6072/-

S. No		Contributors
1	numpy	Andras Deak, Chris Mueller, Code-Ninja, Community, Dux, edwinksl, grovduck, Hammer, hashcode55, Joshua Cook, karel, Kersten, Mpaull, prasastoadi, rlee827, sebix, user2314737, Yassie
2	ndarray	Eric
3	np.linalg	Daniel, DataSwede, Fermi paradox, Mahdi, Sean Easter
4	numpy.cross	bob.sacamento, Mad Physicist
5	numpy.dot	bpachev, paddyg, Shubham Dang
6	numpy IO	Alex, atomh33ls, Sparkler
7		Alex
8		Alex, farleytpm
9		amin, ayhan, B8vrede, Dux, Fermi paradox, user2314737
10		Andras Deak, ayhan, B Samedi, B8vrede, Benjamin, DataSwede, Dux, Gwen, Hamlet, Hammer, KARANJ, Keith L, pixatlazaki, Ryan, Sean Easter, Sparkler, The Hagen, TPVasconcelos, user2314737
11		obachtos
12		Chris Mueller