10. 29 Numpy

In [9]:
```
a = [1, 3, 5]
b = [2, 4, 6]
a+b
```

Out[9]:
```
[1, 3, 5, 2, 4, 6]
```

In [11]:
```
import numpy as np
```

In [7]:
```
A = numpy.array(a)
B = numpy.array(b)
```

In [8]:
```
A+B
```

Out[8]:
```
array([ 3,  7, 11])
```

In [10]:
```
type(A)
```

Out[10]:
```
numpy.ndarray
```

In [13]:
```
X = np.array([[1,2,3],[4,5,6]])
```

In [14]:
```
X
```

Out[14]:
```
array([[1, 2, 3],
       [4, 5, 6]])
```

In [15]:
```
X.shape #차원 의미. 2 x 3
```

Out[15]:
```
(2, 3)
```

10.31 Numpy

In [3]:
```
import numpy as np
#from numpy import A # numpy 안에 있는 A를 가져오자
import matplotlib.pyplot as plt
#A.B = A 패키지에 있는 B
#시험문제에 바로 나올 수 있는 것
#from matplotlib import pyplot as plt 라고도 쓸 수 있음
```

In [7]:
```
np.empty([2,3], dtype='int')
```

Out[7]:
```
array([[         0, 1072168960,          0],
       [1072168960,          0,          0]])
```

In [9]:
```
np.zeros([2,3])
```

Out[9]:
```
array([[0., 0., 0.],
       [0., 0., 0.]])
```

In [12]:
```
np.array([[0,0,0],[0,0,0]])
```

Out[12]:
```
array([[0, 0, 0],
       [0, 0, 0]])
```

In [15]:
```
np.ones([2,3])
```

Out[15]:
```
array([[1., 1., 1.],
       [1., 1., 1.]])
```

In [18]:
```
np.ones([2,3], dtype='int')
```

Out[18]:
```
array([[1, 1, 1],
       [1, 1, 1]])
```

In [19]:
```
np.arange(5) #range()랑 비슷
```

Out[19]:
```
array([0, 1, 2, 3, 4])
```

In [20]:
```
np.arange(0,10,2, dtype='float64')
```

Out[20]:
```
array([0., 2., 4., 6., 8.])
```

In [21]:
```
np.linspace(0,10,6) #linear space. 처음과 끝을 포함하여 6개로 똑같이 나누어준다 (10까지 포함인 모습)
# np.linspace(시작, 종료, 개수) : 개수에 맞게끔 시작과 종료 사이에 균등하게 분배
```

Out[21]:
```
array([ 0.,  2.,  4.,  6.,  8., 10.])
```

In [24]:
```
X = np.array([[1,2,3],[4,5,6]]) #[] 대괄호 두개 = 이차원 ; 대괄호 3개 = 3차원
X
```

Out[24]:
```
array([[1, 2, 3],
       [4, 5, 6]])
```

In [33]:
```
Y = np.array([[[1,2,3],[4,5,6]],[[1,2,3],[4,5,6]]]) #2차원 두 개는 삼차원
Y
```

Out[33]:
```
array([[[1, 2, 3],
        [4, 5, 6]],

       [[1, 2, 3],
        [4, 5, 6]]])
```

In [28]:
```
X.ndim #차원 알려주는
```

Out[28]:
```
2
```

In [29]:
```
X.shape #2x3인 차원이다(?)
```

Out[29]:
```
(2, 3)
```

In [34]:
```
Y.shape #2x3이 2개인 차원
```

Out[34]:
```
(2, 2, 3)
```

In [31]:
```
X.dtype
```

Out[31]:
```
dtype('int32')
```

In [35]:
```
X.astype(float) #타입 변환
```

Out[35]:
```
array([[1., 2., 3.],
       [4., 5., 6.]])
```

In [36]:
```
np.zeros_like(X) # X*0해도 똑같음
# like(배열) 지정한 배열과 동일한 shape의 행열을 만듦
# 종류 : np.zeros_like(), np.ones.like(), np.full_like(), np.empty_like()
```

Out[36]:
```
array([[0, 0, 0],
       [0, 0, 0]])
```

In [38]:
```
data = np.random.normal(0,1,100) # 정규분포normal distribution로 데이터 랜덤생성 .
# np.random.normal(정규분포 평균, 표준편차, (행, 열) or 개수) : 정규 분포 확률 밀도에서 표본 추출
print(data)
```

```
[ 0.17220936  3.63413319  1.79004811  0.43605779 -1.33729651  0.62791974
 -0.27576677  1.59299385  0.6866562  -0.39559477  0.14257864 -0.94367155
  0.61241866  0.5192135   0.34373035 -2.51310141  0.27534836 -0.92343738
  0.41763106 -0.58722763  1.44240769  2.1774158  -0.51703999  0.30987555
 -1.15293726 -0.05220753 -0.95385663  1.1801642   0.9309844  -0.25005757
 -1.07752434 -0.65908623 -0.24064692 -0.13865326 -0.24709929  0.02401597
  1.27916544  0.10482293  0.74158559  0.18170936 -1.03909671 -0.42212284
 -0.44528969  0.29721601  0.08980602 -0.52085625  0.92360159 -0.48917233
 -1.02450491  2.28863031  0.68496109  0.64009845 -1.41452731  1.26460298
  0.4795454   0.89346115  1.02752001 -1.92346047  1.05196862  0.33130818
  0.20861423  0.29873275  0.80336811  0.29719907 -1.12231016 -1.92610588
 -1.34559993 -0.10650772  0.12018836 -0.13937052 -0.29864508  0.63569818
  0.82943184  0.73361811 -0.03781109 -0.30225504 -0.86248564  0.09599242
 -0.56847991  1.39996332  1.24408033 -0.33508835  0.85697196 -0.61379087
  1.28343712  0.27461376 -0.42293543 -0.37213719 -0.11331183  1.90095436
 -0.35644987  0.58728444  0.38027114  0.1546923  -0.57848473 -1.60583919
 -1.15062939  1.9892623  -1.09017288  0.25643626]
```

In [39]:
```
data.ndim
```

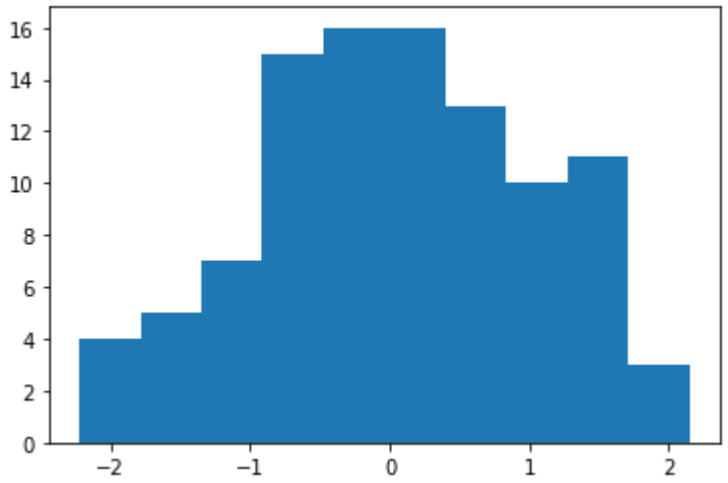
Out[39]:
```
1
```

In [40]:
```
data.shape #그냥 벡터니까. 백개의 데이터가 나왔다는 뜻
```

Out[40]:
```
(100,)
```

In [41]:
```
data = np.random.normal(0,1,100)
print(data)
plt.hist(data,bins=10) #bins 바구니. 그래프의 막대 몇 개인지 정함.
plt.show()
```

```
[-0.3919344   0.85328007  1.31792715 -1.14214277  0.45993339  1.19237434
 -1.02181608 -0.49631218  1.45856153 -0.30358796 -0.93243261  2.14510453
 -2.14206908  0.50933277 -1.32785307 -0.19605045 -1.32569246 -1.42286844
  0.12187997 -0.39704067  0.89102163  0.44603138 -0.44873535  0.62541739
  0.63974312 -0.43001933  1.2323329  -1.16539204  1.28185058  0.81240661
 -1.7697323  -0.05408883  1.394039   -0.34560812  1.40819354 -0.81996811
 -0.65906678  1.5137701   1.88070512  0.58407675 -0.45690393  0.86449837
 -0.31735365 -0.83041907 -2.22251954 -1.51265914 -0.18107539  0.8603055
 -0.76774571 -0.6719022   0.53482455  1.30357288  0.02749976  0.09892231
  0.94722325 -0.090717    0.10708013  0.05055964  0.78872663 -0.62910701
 -1.73355073  0.27333047  0.11956334  0.14437983  1.64404964 -1.04701272
  1.27026342 -0.03661248  0.01094321 -0.22536437 -1.58808479  0.7175769
  0.30770397 -0.53493031  0.92781105 -0.16238469  0.17518897  0.54869091
  0.0344384  -1.9409634  -2.11601669  1.70699606 -0.6335011  -0.46288451
  1.80403256  0.32196506  0.61978296  1.53970266 -0.06353558 -0.80258417
 -0.78887344  0.26148957 -0.71720822 -0.56103709  0.85281175  0.82902079
 -0.69590287  0.37296518  1.38004226 -0.6182597 ]
```



2. Manipulation

In [43]:
```
X = np.ones([2,3,4]) # 2x3x4개 데이터
X
```

Out[43]:
```
array([[[1., 1., 1., 1.],
        [1., 1., 1., 1.],
        [1., 1., 1., 1.]],

       [[1., 1., 1., 1.],
        [1., 1., 1., 1.],
        [1., 1., 1., 1.]]])
```

In [44]:
```
Y = X.reshape(-1,3,2) #같은 차원에서만 변경 가능. 니가 알아서 해라라고 할 때 첫번째에 -1이라고 함.(4,3,2)랑 같은결과
Y
```

Out[44]:
```
array([[[1., 1.],
        [1., 1.],
        [1., 1.]],

       [[1., 1.],
        [1., 1.],
        [1., 1.]],

       [[1., 1.],
        [1., 1.],
        [1., 1.]],

       [[1., 1.],
        [1., 1.],
        [1., 1.]]])
```

In [ ]:
```
np.allclose(X.reshape(-1, 3, 2), Y)
#어레이해서 두 개 비교 . assert는 몰라도 됨
```

In [49]:
```
a = np.random.randint(0,10,[2,3])
b = np.random.random([2,3])
np.savez('test',a,b) # savez() 실제 파일로 저장해줌
```

In [53]:
```
del a,b  # print all interactive variables 메모리 전체 삭제
%who # show available variables now
```

```
X       Y       data    np      numpy   plt
```

In [57]:
```
npzfiles = np.load("test.npz") # 불러오기
npzfiles.files
```

Out[57]:
```
['arr_0', 'arr_1']
```

In [58]:
```
npzfiles['arr_0'] # 57행 결과. a 값. 'arr_1' 넣으면 b 값
```

Out[58]:
```
array([[6, 6, 8],
       [3, 5, 7]])
```

In [4]:
```
data = np.loadtxt("regression.csv", delimiter=",", skiprows=1, dtype={'names':("X", "Y"), 'formats':('f', 'f')})
#파일 불러오기 : np.loadtxt("파일경로",파일에서 사용한 구분자, 데이터타입 지정), data 변수에 array로 넣어준다
data
```

Out[4]:
```
array([( 3.3  , 1.7  ), ( 4.4  , 2.76 ), ( 5.5  , 2.09 ), ( 6.71 , 3.19 ),
       ( 6.93 , 1.694), ( 4.168, 1.573), ( 9.779, 3.366), ( 6.182, 2.596),
       ( 7.59 , 2.53 ), ( 2.167, 1.221), ( 7.042, 2.827), (10.791, 3.465),
       ( 5.313, 1.65 ), ( 7.997, 2.904), ( 5.654, 2.42 ), ( 9.27 , 2.94 ),
       ( 3.1  , 1.3  )], dtype=[('X', '<f4'), ('Y', '<f4')])
```

4.Inspecting

In [59]:
```
arr = np.random.random([5,2,3])
```

In [62]:
```
print(type(arr))
print(len(arr))
print(arr.shape)
print(arr.ndim)
print(arr.size) # 총 elements 개수
print(arr.dtype)
```

```
<class 'numpy.ndarray'>
5
(5, 2, 3)
3
30
float64
```

5.1 Arithmatic

In [66]:
```
a = np.arange(1,5)
b = np.arange(9,5,-1)
print(a)
print(b)
```

```
[1 2 3 4]
[9 8 7 6]
```

In [65]:
```
print(a-b)
print(a*b)
```

```
[-8 -6 -4 -2]
[ 9 16 21 24]
```

5.2 Comparison

In [67]:
```
a = np.arange(1,10).reshape(3,3)
b = np.arange(9,0,-1).reshape(3,3)
print(a)
print(b)
```

```
[[1 2 3]
 [4 5 6]
 [7 8 9]]
[[9 8 7]
 [6 5 4]
 [3 2 1]]
```

In [68]:
```
a == b
```

Out[68]:
```
array([[False, False, False],
       [False,  True, False],
       [False, False, False]])
```

In [69]:
```
a > b
```

Out[69]:
```
array([[False, False, False],
       [False, False,  True],
       [ True,  True,  True]])
```

In [70]:
```
a.sum(), np.sum(a)
```

Out[70]:
```
(45, 45)
```

In [72]:
```
a.sum(axis=0) , np.sum(a,axis=0) # axis = n : n+1번째 차원에서 sum할 것인지. 여기서는 1차원 합이니까 같은 열끼리 합
```

Out[72]:
```
(array([12, 15, 18]), array([12, 15, 18]))
```

In [73]:
```
a.sum(axis=1) , np.sum(a,axis=1) # 같은 행끼리 합
```

Out[73]:
```
(array([ 6, 15, 24]), array([ 6, 15, 24]))
```

Broadcasting

In [75]:
```
a = np.arange(1,25).reshape(4,6)
a
```

Out[75]:
```
array([[ 1,  2,  3,  4,  5,  6],
       [ 7,  8,  9, 10, 11, 12],
       [13, 14, 15, 16, 17, 18],
       [19, 20, 21, 22, 23, 24]])
```

In [76]:
```
a + 100
```

Out[76]:
```
array([[101, 102, 103, 104, 105, 106],
       [107, 108, 109, 110, 111, 112],
       [113, 114, 115, 116, 117, 118],
       [119, 120, 121, 122, 123, 124]])
```

In [77]:
```
b = np.arange(6)
b
```

Out[77]:
```
array([0, 1, 2, 3, 4, 5])
```

In [78]:
```
a + b #행마다 b 더하기
```

Out[78]:
```
array([[ 1,  3,  5,  7,  9, 11],
       [ 7,  9, 11, 13, 15, 17],
       [13, 15, 17, 19, 21, 23],
       [19, 21, 23, 25, 27, 29]])
```

Phasor

In [1]:
```
from matplotlib import pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
from mpl_toolkits.axes_grid1 import make_axes_locatable
import IPython.display as ipd
import numpy as np
%matplotlib notebook
from scipy.signal import lfilter
```

In [2]:
```
# parameter setting
amp  = 1
sr = 10000
dur = 0.5
freq = 100.0
```

In [ ]:
```
t 0.0001 0.0002 0.0003 ... 0.5000 # 우리가 만들고자 하는 타임. (duration. sr이 10000이고, 0.5까지. sr과 dur만 있으면 time 만듦)
```

In [5]:
```
t = np.arange(1, sr*dur+1)/sr
t
```

Out[5]:
```
array([1.000e-04, 2.000e-04, 3.000e-04, ..., 4.998e-01, 4.999e-01,
       5.000e-01])
```

In [ ]:
```
# 매우 중요 generate time
t = np.arange(1, sr * dur+1)/sr
```

In [ ]:
```
# 매우 중요 generate phase
theta = t * 2*np.pi * freq
```

In [1]:

```
from matplotlib import pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
from mpl_toolkits.axes_grid1 import make_axes_locatable
import IPython.display as ipd
import numpy as np
%matplotlib notebook
from scipy.signal import lfilter
```

Phasor

In [2]:

```
# parameter setting
amp = 1          # range [0.0, 1.0]
sr = 10000       # sampling rate, Hz
dur = 0.5        # in seconds
freq = 100.0     # sine frequency, Hz
```

In [4]:

```
theta = np.arange(0,2*np.pi)
theta
```

Out[4]:

```
array([0., 1., 2., 3., 4., 5., 6.])
```

In [161]:

```
# generate time
t = np.arange(1, sr * dur+1)/sr
```

In [162]:

```
# generate phase
theta = t * 2*np.pi * freq
```

In [8]:

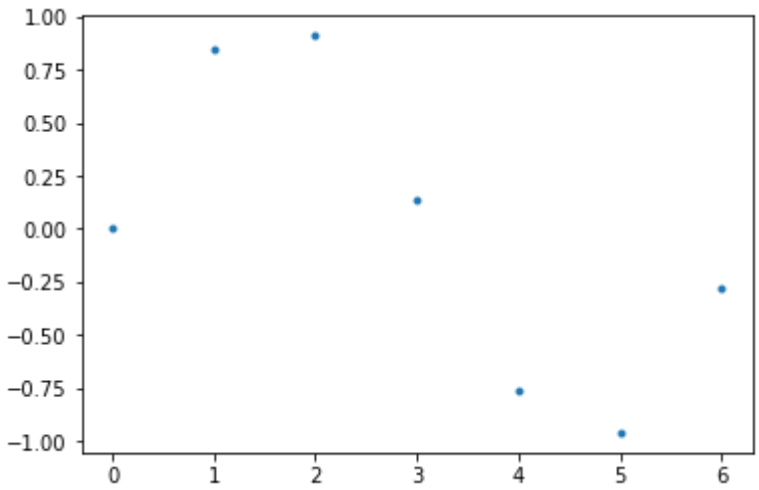
```
# generate signal by cosine-phasor
s = np.sin(theta)
```

In [9]:

```
fig = plt.figure()
ax = fig.add_subplot(111)
ax.plot(theta,s,'.')
```

Out[9]:

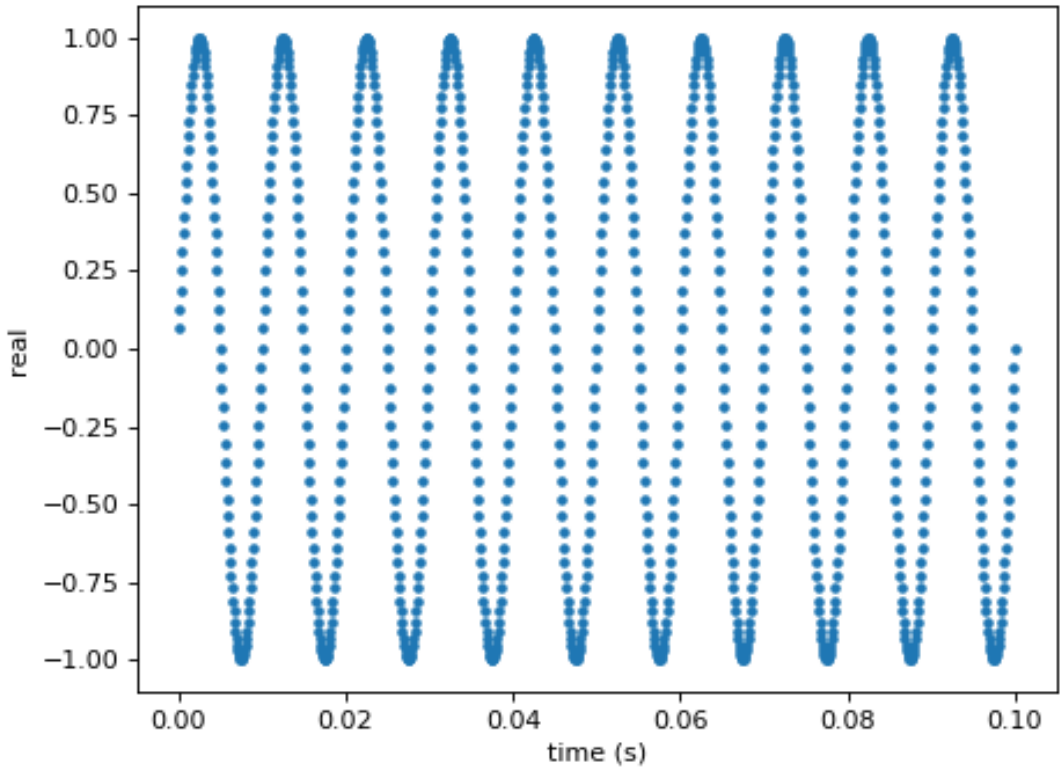
```
[<matplotlib.lines.Line2D at 0x19b9f8310b8>]
```



In [164]:

```
fig = plt.figure()
ax = fig.add_subplot(111)
ax.plot(t[0:1000], s[0:1000], '.')
ax.set_xlabel('time (s)')
ax.set_ylabel('real')
```

<IPython.core.display.Javascript object>



Out[164]:

```
Text(0, 0.5, 'real')
```

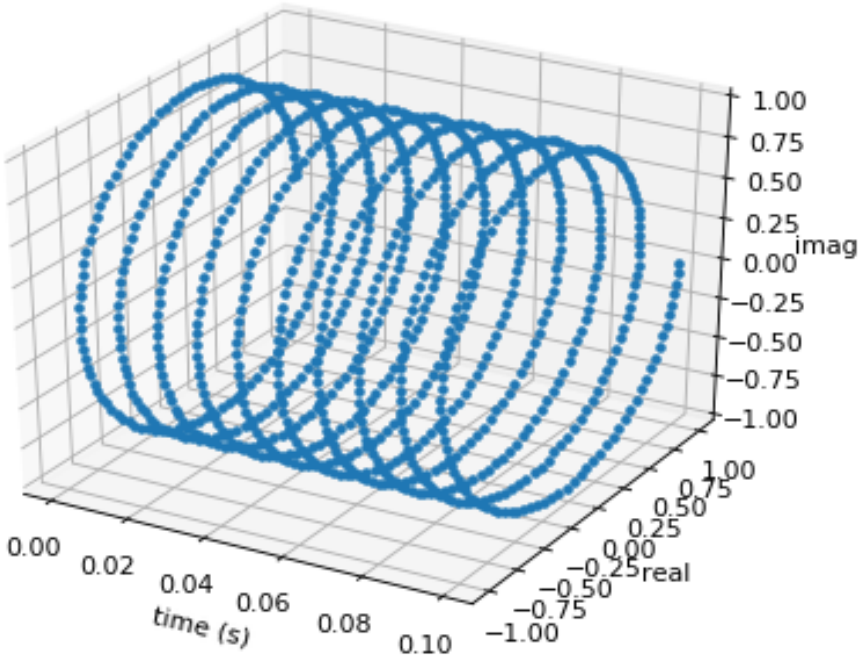
In [72]:

```
# generate signal by complex-phasor
c = np.exp(theta*1j)
```

In [165]:

```
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.plot(t[0:1000], c.real[0:1000], c.imag[0:1000], '.')
ax.set_xlabel('time (s)')
ax.set_ylabel('real')
ax.set_zlabel('imag')
```

```
<IPython.core.display.Javascript object>
```



Out[165]:

```
Text(0.5, 0, 'imag')
```