In [1]:
```
print("Welcome to Numpy-4")
```
```
Welcome to Numpy-4
```

- **Matrix Multiplication**✅
  - `matmul()`, `@`, `dot()` ✅
- **Vectorization**✅
  - `np.vectorize()` ✅
- **Broadcasting**✅
- **Array splitting and Merging**
  - Splitting arrays - `split()`, `hsplit()`, `vsplit()`
  - Merging Arrays - `hstack()`, `vstack()`
- **Dimension Expansion and Reduction**✅
  - `np.expand_dims()` ✅
  - `np.newaxis` ✅
  - `np.sqeeze()` ✅
- **Shallow vs Deep Copy**✅
  - `view()` ✅
  - `copy()` ✅
  - `copy.deepcopy()` ✅

- **Dimension Expansion and Reduction**
  - `np.expand_dims()`
  - `np.newaxis`
  - `np.sqeeze()`

In [2]:
```
a=np.arange(6)
a
```
Out[2]:
```
array([0, 1, 2, 3, 4, 5])
```
In [3]:
```
a.shape
```
Out[3]:
```
(6,)
```
In [4]:
```
a.ndim
```
Out[4]:
```
1
```
In [8]:
```
np.expand_dims(a,axis=0).shape
```
Out[8]:
```
(1, 6)
```
In [13]:
```
np.expand_dims(a,axis=0)
```
Out[13]:
```
array([[0, 1, 2, 3, 4, 5]])
```
In [14]:
```
np.expand_dims(a,axis=1)
```
Out[14]:
```
array([[0],
       [1],
       [2],
       [3],
       [4],
       [5]])
```
In [9]:
```
np.expand_dims(a,axis=1).shape
```
Out[9]:
```
(6, 1)
```
In [11]:
```
# np.expand_dims(a,axis=2).shape
```
In [15]:
```
a
```
Out[15]:
```
array([0, 1, 2, 3, 4, 5])
```
In [16]:
```
a
```
Out[16]:
```
array([0, 1, 2, 3, 4, 5])
```
In [ ]:

In [18]:
```
a.reshape((6,1,1,1,1,1,1,1))
```
Out[18]:
```
array([[[[[[[[0]]]]]]],



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



       [[[[[[[2]]]]]]],



       [[[[[[[3]]]]]]],



       [[[[[[[4]]]]]]],



       [[[[[[[5]]]]]]]])
```
In [ ]:

In [20]:
```
# a.reshape((6,1,1,1,1,1,1,2))
```
In [ ]:

In [21]:
```
a=np.arange(1,13).reshape((3,4))
a
```
Out[21]:
```
array([[ 1,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```
In [22]:
```
a.ndim
```
Out[22]:
```
2
```
In [23]:
```
a.shape
```
Out[23]:
```
(3, 4)
```
In [24]:
```
np.expand_dims(a,axis=0).shape
```
Out[24]:
```
(1, 3, 4)
```
In [25]:
```
np.expand_dims(a,axis=1).shape
```
Out[25]:
```
(3, 1, 4)
```
In [26]:
```
np.expand_dims(a,axis=2).shape
```
Out[26]:
```
(3, 4, 1)
```
In [27]:
```
np.expand_dims(a,axis=0)
```
Out[27]:
```
array([[[ 1,  2,  3,  4],
        [ 5,  6,  7,  8],
        [ 9, 10, 11, 12]]])
```
In [28]:
```
np.expand_dims(a,axis=1)
```
Out[28]:
```
array([[[ 1,  2,  3,  4]],

       [[ 5,  6,  7,  8]],

       [[ 9, 10, 11, 12]]])
```
In [29]:
```
np.expand_dims(a,axis=2)
```
Out[29]:
```
array([[[ 1],
        [ 2],
        [ 3],
        [ 4]],

       [[ 5],
        [ 6],
        [ 7],
        [ 8]],

       [[ 9],
        [10],
        [11],
        [12]]])
```
In [30]:
```
a=np.arange(1,25).reshape((2,3,4))
a
```
Out[30]:
```
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 [31]:
```
a.shape
```
Out[31]:
```
(2, 3, 4)
```
In [32]:
```
a.ndim
```
Out[32]:
```
3
```
In [33]:
```
np.expand_dims(a,axis=0).shape
```
Out[33]:
```
(1, 2, 3, 4)
```
In [34]:
```
np.expand_dims(a,axis=1).shape
```
Out[34]:
```
(2, 1, 3, 4)
```
In [35]:
```
np.expand_dims(a,axis=2).shape
```
Out[35]:
```
(2, 3, 1, 4)
```
In [36]:
```
np.expand_dims(a,axis=3).shape
```
Out[36]:
```
(2, 3, 4, 1)
```
In [ ]:

In [37]:
```
a=np.arange(6)
a
```
Out[37]:
```
array([0, 1, 2, 3, 4, 5])
```
In [38]:
```
a.shape
```
Out[38]:
```
(6,)
```
In [39]:
```
a[np.newaxis,:].shape
```
Out[39]:
```
(1, 6)
```
In [40]:
```
a[:,np.newaxis].shape
```
Out[40]:
```
(6, 1)
```
In [41]:
```
a[:,np.newaxis,np.newaxis,np.newaxis].shape
```
Out[41]:
```
(6, 1, 1, 1)
```
In [42]:
```
a[:,np.newaxis,np.newaxis,np.newaxis]
```
Out[42]:
```
array([[[[0]]],


       [[[1]]],


       [[[2]]],


       [[[3]]],


       [[[4]]],


       [[[5]]]])
```
In [43]:
```
a.shape
```
Out[43]:
```
(6,)
```
In [45]:
```
a[np.newaxis,np.newaxis,:,np.newaxis,np.newaxis,np.newaxis,np.newaxis,np.newaxis,np.newaxis,np.newaxis].shape
```
Out[45]:
```
(1, 1, 6, 1, 1, 1, 1, 1, 1, 1)
```
In [49]:
```
# a[np.newaxis,np.newaxis,:,np.newaxis,np.newaxis,np.newaxis,np.newaxis,np.newaxis,np.newaxis,np.newaxis]
```
In [48]:
```
# a.reshape((1,1,1,1,1,3,2,1,1,1,1,1))
```
In [51]:
```
b=np.arange(1,13).reshape((3,4))
b
```
Out[51]:
```
array([[ 1,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```
In [52]:
```
b.shape
```
Out[52]:
```
(3, 4)
```
In [53]:
```
b.ndim
```
Out[53]:
```
2
```
In [55]:
```
b[np.newaxis,:].shape
```
Out[55]:
```
(1, 3, 4)
```
In [56]:
```
b[:,np.newaxis].shape
```
Out[56]:
```
(3, 1, 4)
```
In [57]:
```
b[:,np.newaxis,np.newaxis].shape
```
Out[57]:
```
(3, 1, 1, 4)
```
In [58]:
```
b[:,np.newaxis,:,np.newaxis].shape
```
Out[58]:
```
(3, 1, 4, 1)
```
In [59]:
```
b[:,:,np.newaxis,np.newaxis].shape
```
Out[59]:
```
(3, 4, 1, 1)
```
In [61]:
```
# b[:,:,np.newaxis,np.newaxis,:].shape
```
In [ ]:

In [62]:
```
c=np.arange(1,25).reshape((2,3,4))
c
```
Out[62]:
```
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 [63]:
```
c.ndim
```
Out[63]:
```
3
```
In [64]:
```
c.shape
```
Out[64]:
```
(2, 3, 4)
```
In [66]:
```
c[np.newaxis,:].shape
```
Out[66]:
```
(1, 2, 3, 4)
```
In [67]:
```
c[np.newaxis,:,np.newaxis].shape
```
Out[67]:
```
(1, 2, 1, 3, 4)
```
In [68]:
```
c[np.newaxis,:,:,np.newaxis].shape
```
Out[68]:
```
(1, 2, 3, 1, 4)
```
In [69]:
```
c[:,np.newaxis,:,np.newaxis].shape
```
Out[69]:
```
(2, 1, 3, 1, 4)
```
In [70]:
```
c[:,:,np.newaxis,:,np.newaxis].shape
```
Out[70]:
```
(2, 3, 1, 4, 1)
```
In [71]:
```
c[:,:,np.newaxis,:,np.newaxis,np.newaxis,np.newaxis].shape
```
Out[71]:
```
(2, 3, 1, 4, 1, 1, 1)
```
In [72]:
```
c[:,:,None,:,None,None,None].shape
```
Out[72]:
```
(2, 3, 1, 4, 1, 1, 1)
```
In [73]:
```
np.squeeze?
```
In [75]:
```
a
```
Out[75]:
```
array([0, 1, 2, 3, 4, 5])
```
In [76]:
```
b
```
Out[76]:
```
array([[ 1,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```
In [77]:
```
c
```
Out[77]:
```
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 [78]:
```
c.shape
```
Out[78]:
```
(2, 3, 4)
```
In [85]:
```
d=c.reshape((1,2,1,3,1,4,1,1,1))
d.shape
```
Out[85]:
```
(1, 2, 1, 3, 1, 4, 1, 1, 1)
```
In [84]:
```
np.squeeze(d).shape
```
Out[84]:
```
(2, 3, 4)
```
In [87]:
```
np.squeeze(d,axis=2).shape
```
Out[87]:
```
(1, 2, 3, 1, 4, 1, 1, 1)
```
In [90]:
```
# np.squeeze(d,axis=1).shape
```
In [93]:
```
np.squeeze(d,axis=(4,6,7)).shape
```
Out[93]:
```
(1, 2, 1, 3, 4, 1)
```
In [91]:
```
np.squeeze?
```
In [94]:
```
c
```
Out[94]:
```
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 [95]:
```
c.shape
```
Out[95]:
```
(2, 3, 4)
```
In [97]:
```
np.squeeze(c).shape
```
Out[97]:
```
(2, 3, 4)
```
In [98]:
```
d.shape
```
Out[98]:
```
(1, 2, 1, 3, 1, 4, 1, 1, 1)
```
In [99]:
```
np.squeeze?
```
In [ ]:

- **Shallow vs Deep Copy**
  - `view()`
  - `copy()`
  - `copy.deepcopy()`

In [ ]:

In [100…
```
a=np.array([1,2,3,4])
a
```
Out[100…
```
array([1, 2, 3, 4])
```
In [101…
```
b=a.reshape((2,2))
b
```
Out[101…
```
array([[1, 2],
       [3, 4]])
```
In [102…
```
a[0]=100
a
```
Out[102…
```
array([100,   2,   3,   4])
```
In [103…
```
b
```
Out[103…
```
array([[100,   2],
       [  3,   4]])
```
In [104…
```
b[1,1]=99
b
```
Out[104…
```
array([[100,   2],
       [  3,  99]])
```
In [105…
```
a
```
Out[105…
```
array([100,   2,   3,  99])
```
In [106…
```
c=a[::2]
```
In [107…
```
c
```
Out[107…
```
array([100,   3])
```
In [109…
```
c[1]=999
c
```
Out[109…
```
array([100, 999])
```
In [110…
```
a
```
Out[110…
```
array([100,   2, 999,  99])
```
In [111…
```
b
```
Out[111…
```
array([[100,   2],
       [999,  99]])
```
In [121…
```
a=np.array([1,2,3,4])
a
```
Out[121…
```
array([1, 2, 3, 4])
```
In [113…
```
x=a+2
x
```
Out[113…
```
array([3, 4, 5, 6])
```
In [114…
```
a
```
Out[114…
```
array([1, 2, 3, 4])
```
In [116…
```
x
```
Out[116…
```
array([3, 4, 5, 6])
```
In [117…
```
a[0]=100
```
In [118…
```
a
```
Out[118…
```
array([100,   2,   3,   4])
```
In [119…
```
x
```
Out[119…
```
array([3, 4, 5, 6])
```
In [122…
```
y=a+0
y
```
Out[122…
```
array([1, 2, 3, 4])
```
In [123…
```
a
```
Out[123…
```
array([1, 2, 3, 4])
```
In [124…
```
y
```
Out[124…
```
array([1, 2, 3, 4])
```
In [125…
```
a[0]=100
```
In [126…
```
a
```
Out[126…
```
array([100,   2,   3,   4])
```
In [127…
```
y
```
Out[127…
```
array([1, 2, 3, 4])
```
In [128…
```
q=a*1
q
```
Out[128…
```
array([100,   2,   3,   4])
```
In [ ]:

In [ ]:

In [ ]:

In [129…
```
a=np.array([1,2,3,4])
b=a.reshape((2,2))
c=a[::2]
d=a+0
e=a*1
```
In [130…
```
np.shares_memory(a,b)
```
Out[130…
```
True
```
In [131…
```
np.shares_memory(a,c)
```
Out[131…
```
True
```
In [132…
```
np.shares_memory(a,d)
```
Out[132…
```
False
```
In [133…
```
np.shares_memory(a,e)
```
Out[133…
```
False
```
In [134…
```
np.shares_memory(b,c)
```
Out[134…
```
True
```
In [ ]:

In [135…
```
a=np.array([1,2,3,4])
a
```
Out[135…
```
array([1, 2, 3, 4])
```
In [136…
```
b=a.view()
b
```
Out[136…
```
array([1, 2, 3, 4])
```
In [137…
```
b[0]=100
b
```
Out[137…
```
array([100,   2,   3,   4])
```
In [138…
```
a
```
Out[138…
```
array([100,   2,   3,   4])
```
In [139…
```
a=np.array([1,2,3,4])
a
```
Out[139…
```
array([1, 2, 3, 4])
```
In [140…
```
c=a.copy()
c
```
Out[140…
```
array([1, 2, 3, 4])
```
In [141…
```
a[0]=100
```
In [142…
```
a
```
Out[142…
```
array([100,   2,   3,   4])
```
In [143…
```
c
```
Out[143…
```
array([1, 2, 3, 4])
```
In [144…
```
np.shares_memory(a,c)
```
Out[144…
```
False
```
In [ ]:

In [145…
```
a=np.array([1,"m",[1,2,3]],dtype="object")
a
```
Out[145…
```
array([1, 'm', list([1, 2, 3])], dtype=object)
```
In [146…
```
b=a.copy()
b
```
Out[146…
```
array([1, 'm', list([1, 2, 3])], dtype=object)
```
In [147…
```
np.shares_memory(a,b)
```
Out[147…
```
False
```
In [149…
```
a[2][0]=100
a
```
Out[149…
```
array([1, 'm', list([100, 2, 3])], dtype=object)
```
In [150…
```
b
```
Out[150…
```
array([1, 'm', list([100, 2, 3])], dtype=object)
```
In [152…
```
b[2][2]=99
```
In [153…
```
b
```
Out[153…
```
array([1, 'm', list([100, 2, 99])], dtype=object)
```
In [154…
```
a
```
Out[154…
```
array([1, 'm', list([100, 2, 99])], dtype=object)
```
In [156…
```
a=np.array([1,"m",[1,2,3]],dtype="object")
a
```
Out[156…
```
array([1, 'm', list([1, 2, 3])], dtype=object)
```
In [155…
```
import copy
```
In [157…
```
b=copy.deepcopy(a)
b
```
Out[157…
```
array([1, 'm', list([1, 2, 3])], dtype=object)
```
In [159…
```
a[2][0]=100
```
In [160…
```
a
```
Out[160…
```
array([1, 'm', list([100, 2, 3])], dtype=object)
```
In [161…
```
b
```
Out[161…
```
array([1, 'm', list([1, 2, 3])], dtype=object)
```
In [ ]:

In [ ]:

In [ ]:

In [164…
```
a=np.arange(1,13).reshape((3,4))
a
```
Out[164…
```
array([[ 1,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```
In [171…
```
# np.expand_dims(a,axis = 0).expand_dims(a,axis=2)
```
In [170…
```
np.expand_dims(np.expand_dims(a,axis = 0),axis=2).shape
```
Out[170…
```
(1, 3, 1, 4)
```
In [ ]:

In [ ]:

In [ ]: