# ③ Numpy

Date / Page — OM Student Notebooks

⇒ It is a multi dimentional array library.

| List | NumPy |
|---|---|
| * Very Slow | * Very fast |
| → Variable type | → fixed type |
| → More memory needed for storing each element. | → Less memory needed for storing each element. |
| → NumPy uses scattered memory | → NumPy uses Contigious memory |

⇒ Applications of NumPy?

- → MATLAB Replacement
- → Plotting (Matplotlib)
- → Backend (Pandas)

★ Initializing an array

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

→ A list

Date
Page

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```
b = np.array([[1,2,3],[4,5,6]])
```

→
```
[[1. 2 3]
 [4 5 6]]
```

★ Get Dimension

```
a.ndim      b.ndim
```
→ 1 → 2

★ Get Shape

```
a.shape     b.shape
```
→ (3) → (3,2)

★ Get Type

```
a.dtype
```
→ Int32

★ Spacifing type while initialization

```
a = np.array([1,2,3], dtype='int16')
```

★ Get Size

```
a.itemsize
```
→ 2 ⟶ 2m byte

Date
Page

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* Get number of item

a.size → 3

b.size → 6

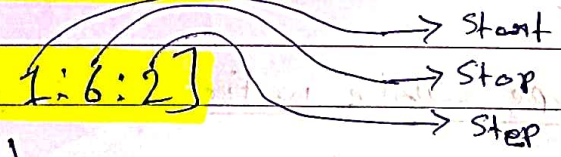
* Get total size

a.nbytes → 6

* Accessing / Changing specific elements, rows, columns etc...

a = np.array([[1,2,3,4,5,6,7],[8,9,10,11,12,13,14]])

* a[1,5] ⇒ 13
* a[0,:] ⇒ [1,2,3,4,5,6,7]
* a[:,2] ⇒ [3,10]
* a[0,1:6:2] → [2,4,6]



Date
Page

## * Initializing different types of Arrays

`np.zeros((2,3))` → shape

```
[[0 0 0]
 [0 0 0]]
```

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

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

`np.full((2,3), 27)`

```
[[27, 27, 27]
 [27, 27, 27]]
```

`np.random.rand(2,3)` → two parameter

```
[[0.8, 0.7, 0.5]
 [0.1, 0.2, 0.34]]
```

→ random number between 0 & 1

`np.random.random_sample((2,3))` → shape

`np.random.randint(4, 8, size=(2,3))`

```
[[6 5 4]
 [4 7 5]]
```

→ End

→ Start

Date
Page

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```
np.identity(3)
```

→
```
[[1 0 0],
 [0 1 0],
 [0 0 1]]
```

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

```
ar1 = np.repeat(arr, 3, axis=0)
```

→
```
[[1,2,3]
 [1,2,3]
 [1,2,3]]
```

⇒ Be careful when copying array

```
b = a.copy()
```

★ Mathematics (basic)

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

```
a+2
```
→ [3, 4, 5, 6]

```
a*2
```
→ [2, 4, 6, 8]

```
a**2
```
→ [1, 4, 9, 16]

Data
Page

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## ★ Linear Algebra

`np.matmul(a, b)`

↳ Matrix multiplication of a & b

`np.linalg.det(a)`

↳ Determinant of a

## ★ Statistics

`np.min(a)`

↳ Smallest element in array a

`np.max(a)`

↳ Largest element in array a

⇒ Axis can be added to above function as an argument.

`np.sum(a)`

↳ Sum of all element in a

Date
Page

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## ★ Reorganizing Arrays

```
a = np.array([[1,2,3],[4,5,6]])
b = np.reshape(a,(2,3))
```

→
```
[[1,2],
 [3,4],
 [5,6]]
```

```
v1 = np.array([1,2,3,4])
v2 = np.array([5,6,7,8])
np.vstack([v1,v2])
```

→
```
[[1,2,3,4],
 [5,6,7,8]]
```

```
np.hstack((v1,v2))
```

→ `[1,2,3,4,5,6,7,8]`

## ★ Load data from file

```
a = np.genfromtxt('data.txt', delimiter=',')
```

→ This will load all data as float

⇒ To change dtype:

```
a = a.astype('int32')
```

Date
Page

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## * Boolean masking & advanced indexing

```
a = np.array([[1,2,3],[4,5,6]])
```

`a>=3`

→ [[False, False, True],
[True, True, True]]

`a[a>=3]`

→ [3,4,5,6]

`np.any(a>=5, axis=0)`

→ [False True True]

`np.all(a>=3, axis=0)`

→ [False, False, True]

$$a = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

`a[[0,2], 1:]`

→ $\begin{bmatrix} 2 & 3 \\ 8 & 9 \end{bmatrix}$