numpy

Dr. Ilkay Altintas and Dr. Leo Porter

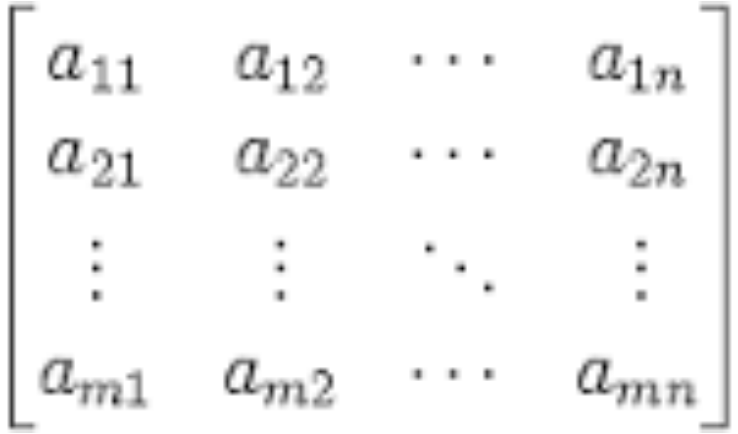
Twitter: #UCSDpython4DS

By the end of this video, you should be able to:

- Describe the value of numpy to data science

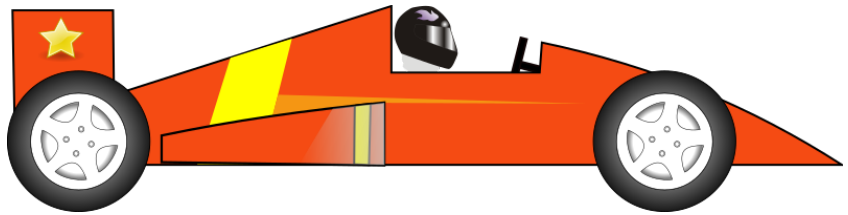
What are the key features of numpy?

- Multi-dimensional arrays
- Built-in array operations
- Simplified, but powerful array interactions → broadcasting
- Integration of other languages (Fortran, C, C++)



Why numpy for data science?

- Speed



- Functionality

Many packages are built on Numpy!

numpy: ndarray Basics

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By the end of this video, you should be able to:

- Create Rank 1 and Rank 2 ndarrays
- Access elements in ndarrays using basic indexing
- Use built-in functions to quickly and easily create useful ndarrays

numpy: ndarray Indexing

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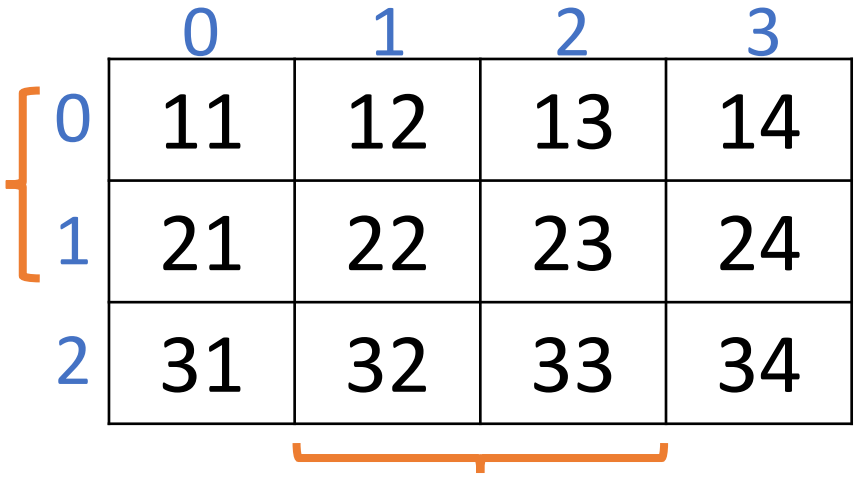
By the end of this video, you should be able to:

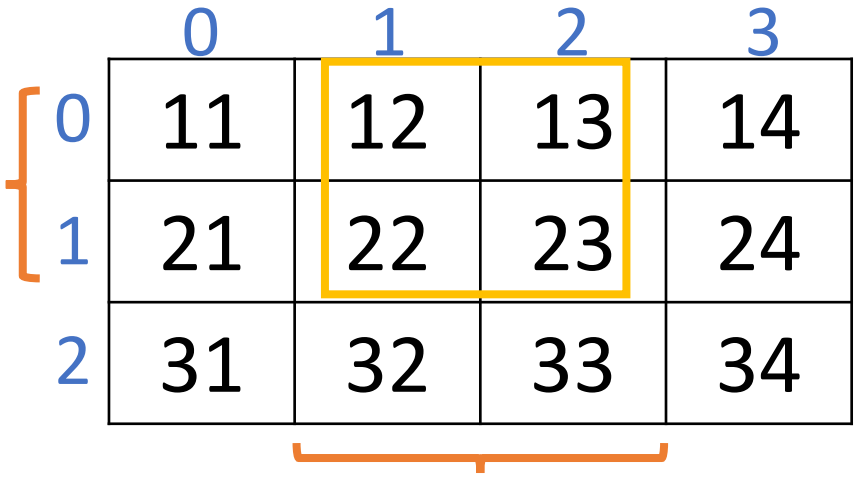
- Use slice indexing to access subsets of an ndarray
- Recognize that such indexing creates a second reference to the same underlying data

an_array =

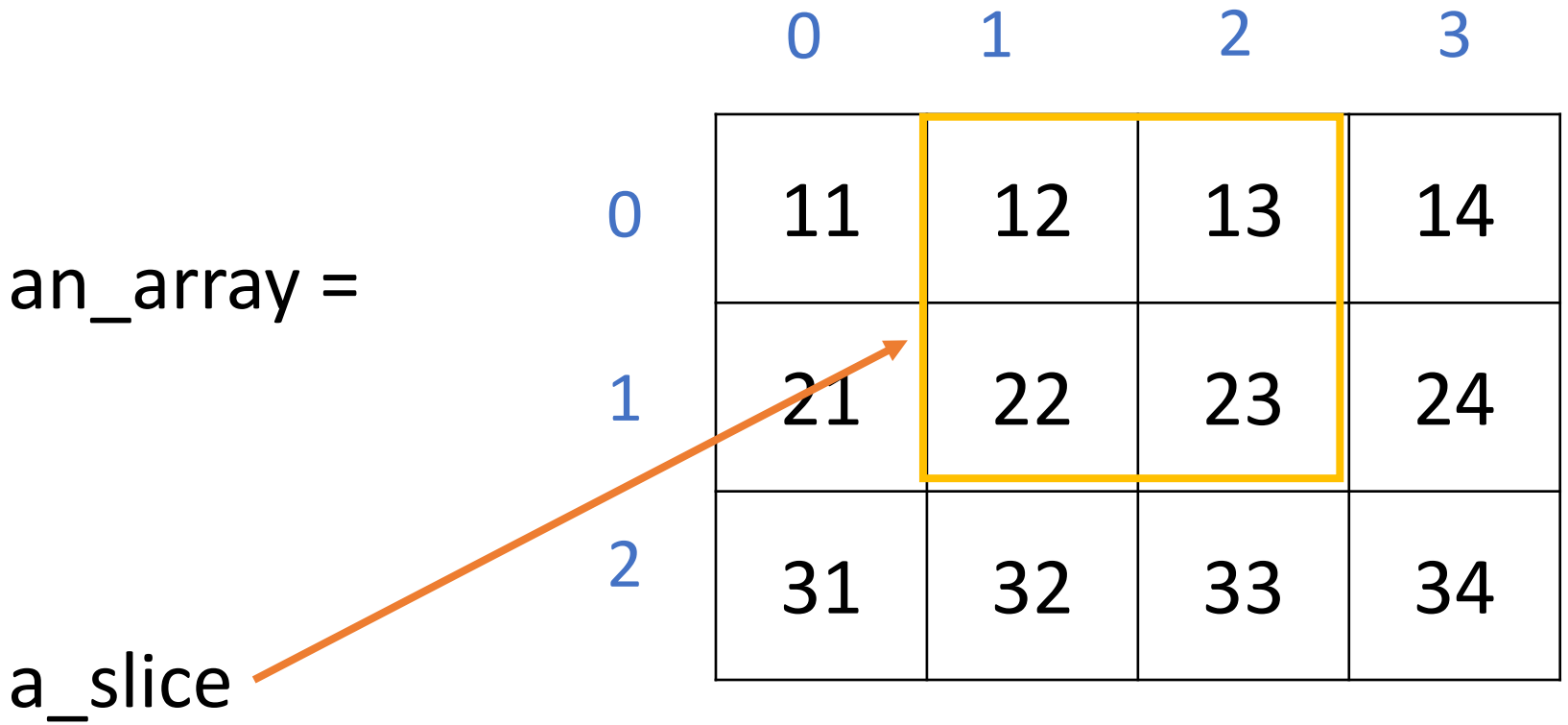


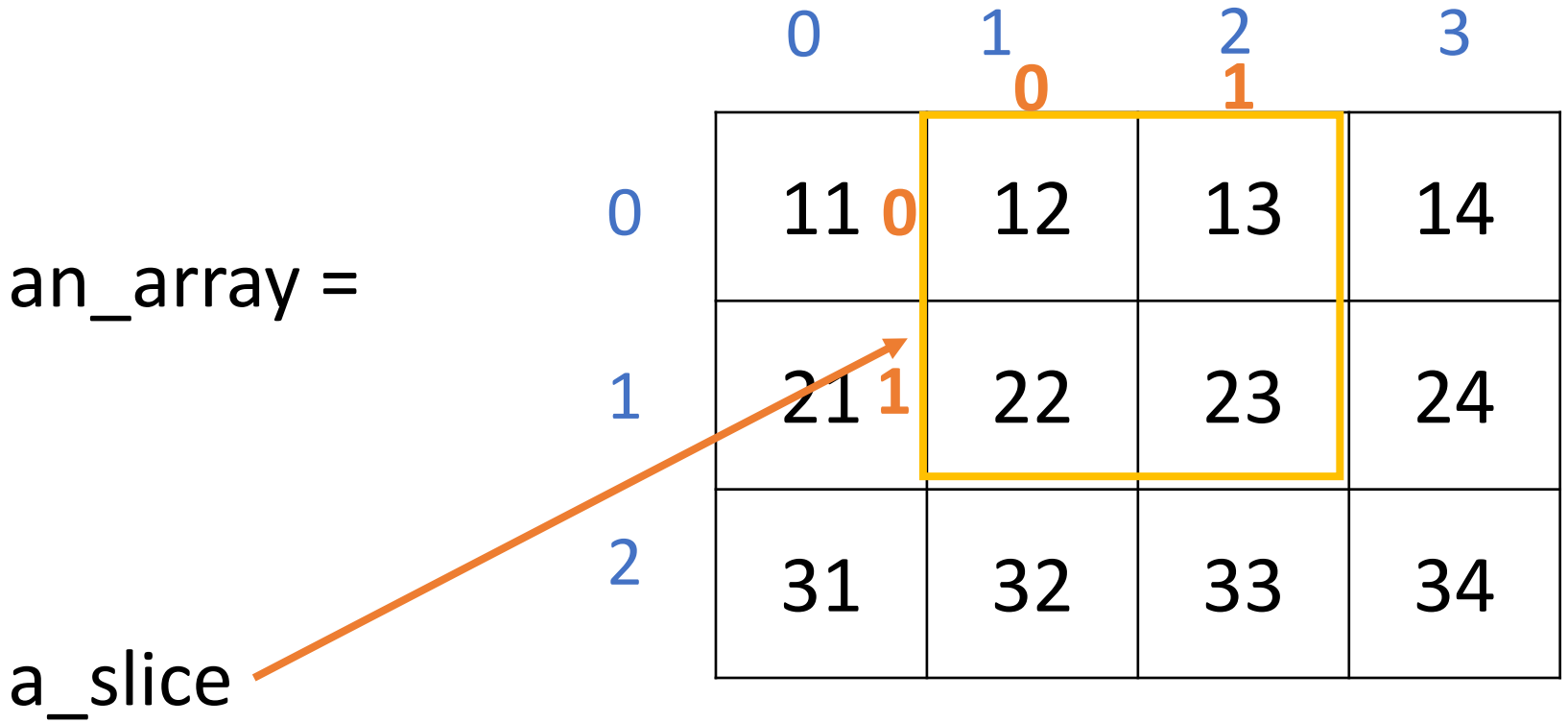
a_slice = an_array[:2, 1:3]

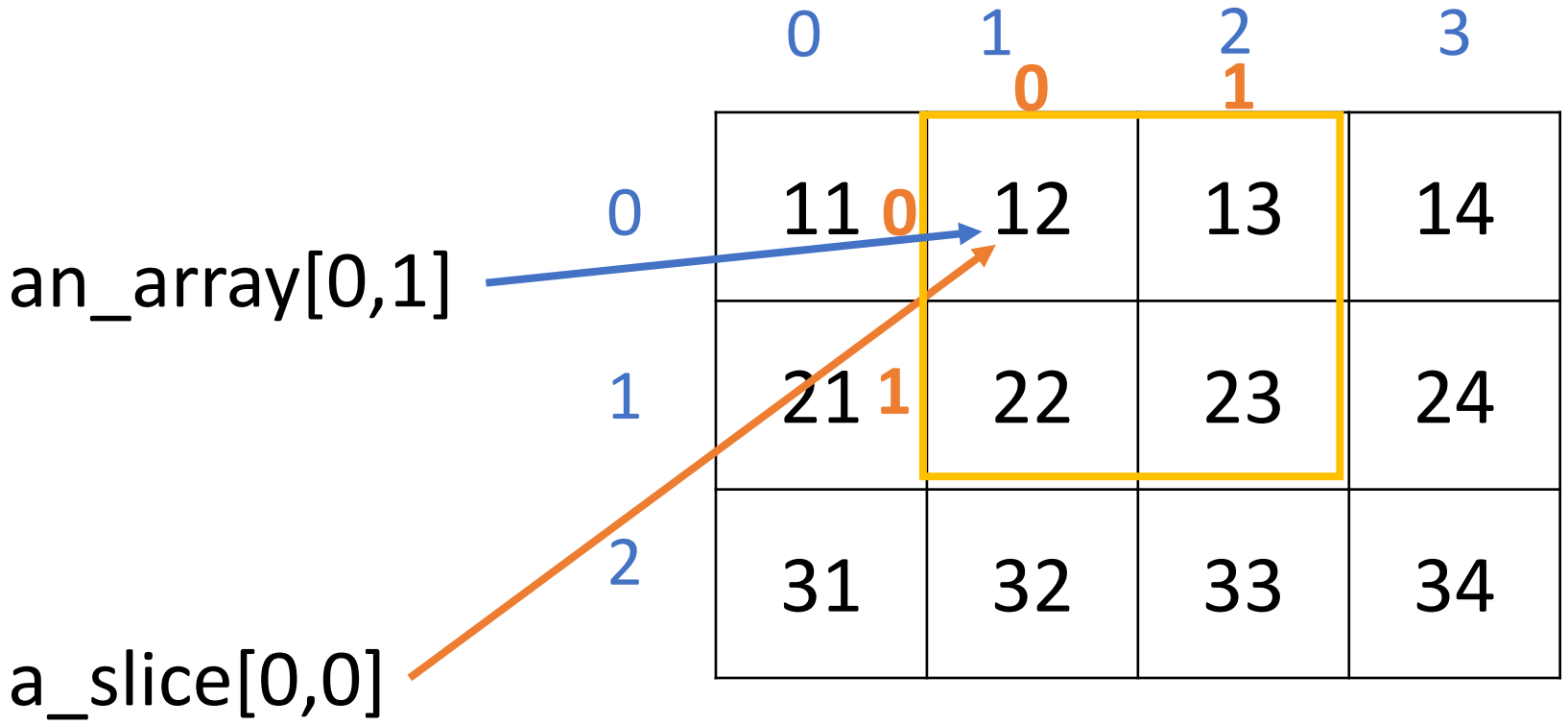
an_array =



a_slice = an_array[:2, 1:3]


0
1
2
3
an_array =
0
1
2
11
12
13
14
21
22
23
24
31
32
33
34
a_slice


an_array =
a_slice
0
1
2
3
0
1
0
1
11
12
13
14
21
22
23
24
31
32
33
34


0
1
2
3
0
1
0
1
11
12
13
14
21
22
23
24
31
32
33
34
an_array[0,1]
a_slice[0,0]
0
1
2

numpy:
ndarray Boolean Indexing

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By the end of this video, you should be able to:

- Use boolean indexing to access and permute relevant data in ndarrays

numpy: ndarray Datatypes and Operations

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By the end of this video, you should be able to:

- Examine and set the datatype of an ndarray
- Use common ndarray functions

numpy: Statistical, Sorting, and Set Operations

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By the end of this video, you should be able to:

- Use common ndarray functions for data analysis including statistical, sorting, and set operations

numpy: Broadcasting

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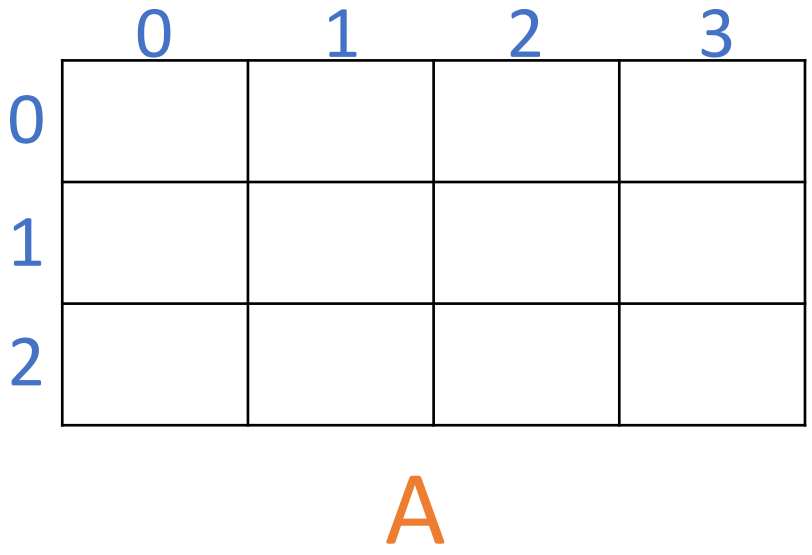
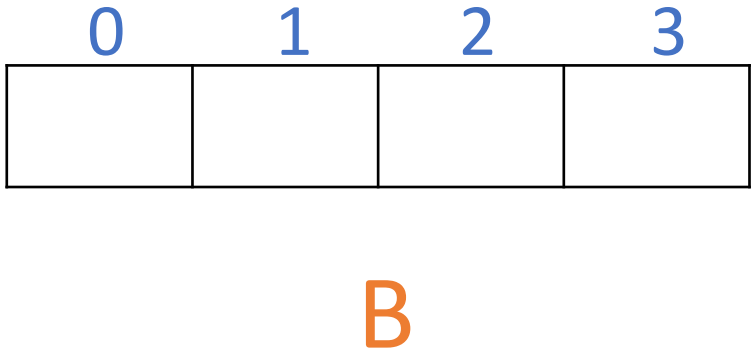
By the end of this video, you should be able to:

- employ broadcasting to perform operations on different size ndarrays


0
1
2
3
0
1
2
A


0
1
2
3
B

	0	1	2	3
0	1	2	3	4
1	5	6	7	8
2	9	10	11	12

A

+

0	1	2	3
0	1	0	2

B

	0	1	2	3
0	1	2	3	4
1	5	6	7	8
2	9	10	11	12

A

+

0	1	2	3	
0	1	0	2	B
0	1	0	2	B
0	1	0	2	B

	0	1	2	3
0	1	3	3	6
1	5	7	7	10
2	9	11	11	14

Result

Broadcasting rules

"When operating on two arrays, NumPy compares their shapes element-wise. It starts with the trailing dimensions, and works its way forward. Two dimensions are compatible when

1. they are equal, or
2. one of them is 1"

https://docs.scipy.org/doc/numpy/user/basics.broadcasting.html

numpy:
Speed Test: ndarray vs. list

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By the end of this video, you should be able to:

- Describe the speed benefits of ndarrays over lists