LECTURE 26

NUMPY II

MCS 275 Spring 2021

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LECTURE 26: NUMPY II

Course bulletins:

- Project 3 due 6:00pm CDT on Friday March 19.
- Project 3 autograder will open on Monday.

WHERE WE LEFT OFF

The `numpy` module is used for multidimensional typed arrays.

Vectors (1D arrays) and matrices (2D arrays) are the most frequently used.

Last time we explored ways to make arrays and access elements.

THE ZEN OF PYTHON

In 2004, Tim Peters wrote a list of principles that describe the design of Python. One is:

> *There should be one---and preferably only one---obvious way to do it.*

THE ZEN OF NUMPY

In contrast, numpy often offers many ways to accomplish a given task, allowing the user to decide which is best.

Numpy is *big*, but you can be productive after learning a small subset.

Let's continue working in the numpy introduction notebook.

UFUNCS

Numpy's "ufuncs" or **universal functions** are functions that can be applied directly to arrays, automatically acting on each element.

Numpy provides a *lot* of these.

Usually, ufuncs allow you to avoid explicit iteration over array elements (which is much slower).

BROADCASTING

If an operation expects arrays of the same dimension, but different dimensions are given, numpy attempts to fix this by **broadcasting**—using duplication to extend an array to a higher dimension.

E.g. `A+1` works when `A` is a numpy array. It adds `1` to each entry. But how?

Broadcasting first turns `1` into an array with the same shape as `A` where each entry is `1`.

Details on the rules for broadcasting in VanderPlas.

AGGREGATIONS

Numpy has operations like sum, product, max, min, all, any, that reduce array dimension.

MASKS

If `A` is an array and `M` is an array of `bool` of the same shape, then `A[M]` refers to a 1D array that lists elements of `A` at positions where `M` is `True`.

Often used to test or modify elements of an array that meet certain criteria, e.g. `A[A>5]=5`.

REFERENCES

- *Python Data Science Handbook* by Jake VanderPlas
  - Chapter 2 contains the introduction to numpy.
  - There is also a print edition from O'Reilly.

REVISION HISTORY

- 2021-03-12 Add notebook link
- 2021-03-12 Initial publication