Numpy

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1 Introduction to NumPy

NumPy is a low level library written in C (and FORTRAN) for high level mathematical functions. NumPy cleverly overcomes the problem of running slower algorithms on Python by using multidimensional array and functions that operate on arrays. Any algorithm can then be expressed as a function on arrays, allowing the algorithms to be run quickly.

2 Creating Numpy Arrays

1. **Using np.array()/1-D and 2-D:** We give a list to the np.array() function and it produce the output as a nd array.

2. **Using np.zeros/ones/empty/random():**

   - If you give shape in form a tuple to np.zeros() function, It will create an nd array with all element 0.
   - If you give shape in form a tuple to np.ones() function, It will create an nd array with all element 1.

3. **Using np.identity():** If you pass n to the np.identity() function it will give you a n*n identity matrix as output.

4. **Using np.arange():** arange generates an array in a given range.

5. **Using np.linspace():** linspace takes inputs: a, b and n. Where a is lower range, b is a upper range, and n is the no of equidistant points we need. It gives an array starting froma to b having n equidistant points.

6. **Using np.copy():** It copies any numpy array.

3 NumPy Array Properties and Attributes

1. **shape:** arr.shape gives the shape of the array.

2. **ndim:** arr.ndim gives the dimension of the array.

3. **size:** arr.size gives the no of items in array.

4. **itemsize:** arr.itemsize gives the size of each item.

5. **dtype:** arr.dtype gives the data type of the item.

6. **astype:** arr.astype(new_data_type) converts the datatype of the array to new_data_type.

4 NumPy Array vs Python Lists

1. NumPy arrays are faster in terms of execution.

2. NumPy arrays have more functions/capabilities for numbers in comparison to Python Lists.

3. Given same size and same type of item numpy array occupy less memory.

5 Indexing, Slicing and Iteration

1. **arr[idx]:** It gives the idx index element.

2. **arr[i1:i2]:** It gives the element starting from i1 index to i2-1 index.

3. **arr[-1]:** It gives the last element.

4. **nditer:** np.nditer(arr) will give each element of the array in sequence from the start element.

6 Numpy Operations

1. arr1+arr2, arr1-arr2, arr1*arr2, arr1/arr2, all these will do pointwise arithmetic operations.

2. arr*x (Scalar multiplication): It will multiply each element of the array by x.

3. arr ¿ x: It will compare each element of the array from x, and will give output a boolean array containing true or false.

4. reshape: arr.reshape(x,y) reshapes the original array to x*y dimension only when original shape equals to x*y.

5. dot: arr1.dot(arr2) performs dot product.

6. arr.max(), arr.min(), arr.sum(), arr.mean(), arr.std() these functions gives maximum, minimum, sum of the array elements, mean of the array elements and standard deviation of the array elements respectively.

7. np.median(arr), np.sin(arr), np.exp(arr) gives median, sin and exp respectively.

7 Reshaping Numpy Arrays

1. **arr.ravel():** It converts the array into an 1d array.

2. **reshape**

3. **transpose:** It transposes an array.

4. **np.hstack():** It horizontally stacks one array after the other array.

5. **np.vstack():** It vertically stacks one array on top of the other array.

6. **np.hsplit(arr,n):** It splits the array vertically into n arrays.

7. **np.vsplit(arr,n):** It splits the array horizontally into n arrays.

8 Fancy indexing in Numpy

You can pass python list as an index to a numpy array.

9 Indexing with Boolean Arrays

- **arr[arr¿x]:** It will give an array containing only those elements which are greater than x.

10 Plotting graphs using NumPy

import matplotlib.pyplot as plt plt.plot(x,y)

11 Broadcasting

The term broadcasting refers to the ability of Numpy to treat arrays of different shapes during arithmetic operations. Arithmetic operations on arryas are usually done on corresponding elements. If two arrays are of exactly the same shape, then these operations are smoothly performed.

If the dimensions of two arrays are dissimilar, element-to-element operatins are not possible. However, operations on arrays of non-similar shapes is still possible in NumPy, because of the broadcasting capability. The similar array is broadcast to the size of the larger array so that they have compatible shapes.