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Que 1. What is NumPy and what are its main features?

Ans: [NumPy](https://www.geeksforgeeks.org/python-numpy/) is a general-purpose array-processing package. It provides a high-performance multidimensional array object and tools for working with these arrays. It is the fundamental package for scientific computing with [Python](https://www.geeksforgeeks.org/python-programming-language/). It is open-source software.

Features Of Numpy:

* A powerful N-dimensional array object
* Sophisticated (broadcasting) functions
* Tools for integrating C/C++ and Fortran code
* Useful linear algebra, Fourier transform, and random number capabilities

Que 2. Explain the difference between a Python list and a NumPy array.

Ans:

**Python Lists**

1. **Element Overhead:** Lists in Python store additional information about each element, such as its type and reference count. This overhead can be significant when dealing with a large number of elements.
2. **Datatype:**Lists can hold different data types, but this can decrease memory efficiency and slow numerical operations.
3. **Memory Fragmentation:** Lists may not store elements in contiguous memory locations, causing memory fragmentation and inefficiency.
4. **Performance:**Lists are not optimized for numerical computations and may have slower mathematical operations due to Python’s interpretation overhead. They are generally used as general-purpose data structures.
5. **Functionality:**Lists can store any data type, but lack specialized NumPy functions for numerical operations.

**Numpy Arrays**

1. **Homogeneous Data:** NumPy arrays store elements of the same data type, making them more compact and memory-efficient than lists.
2. **Fixed Data Type:** NumPy arrays have a fixed data type, reducing memory overhead by eliminating the need to store type information for each element.
3. **Contiguous Memory:** NumPy arrays store elements in adjacent memory locations, reducing fragmentation and allowing for efficient access.
4. **Array Metadata:** NumPy arrays have extra metadata like shape, strides, and data type. However, this overhead is usually smaller than the per-element overhead in lists.
5. **Performance:** NumPy arrays are optimized for numerical computations, with efficient element-wise operations and mathematical functions. These operations are implemented in C, resulting in faster performance than equivalent operations on lists.

Que 3. How do you create a NumPy array?

Ans: Using the numpy.array() function: This is the most common way to create a NumPy array.  can pass a list, tuple, or another NumPy array to the numpy.array() function.

Using the numpy.zeros() and numpy.ones() functions: These functions can be used to create arrays filled with zeros or ones

Using the numpy.empty() function: This function can be used to create an empty array. The array will be filled with random values

Using the numpy.arange() function: This function can be used to create an array of evenly spaced values.  can specify the start, stop, and step values as arguments to the function

Using the numpy.linspace() function: This function can be used to create an array of evenly spaced values within a specified range

Que 4. What is the purpose of broadcasting in NumPy??

Ans: Broadcasting provides a means of vectorizing array operations so that looping occurs in C instead of Python. It does this without making needless copies of data and usually leads to efficient algorithm implementations.

Que 5. How do you perform element-wise operations in NumPy?

Ans:  each element in an array is operated on independently. This can be done using the standard operators (+, -, \*, /, etc.) or the NumPy functions (np.add(), np.subtract(), np.multiply(), np.divide().

Que 6.Explain the difference between np.zeros, np.ones, and np.empty functions in NumPy.

Ans: np.zeros:  It is used to create an array of zeros, which can be used for a variety of purposes, such as initializing an array or storing data.

np.ones: it creates an array of ones instead of zeros. This function can be used for a variety of purposes, such as creating a mask or storing data.

np.empty: It is used to create an array of uninitialized values. This function can be used for a variety of purposes, such as creating a temporary array or storing data that will be overwritten later.

Que 7: Describe the difference between slicing and indexing in NumPy arrays.

Ans: Indexing

is used to access a single element of an array, using its index number. The index number starts from 0 and goes up to the length of the array minus

Slicing

is used to access a subset of elements of an array, using a range of index numbers. The range of index numbers is specified using a colon (:) separator.

Que 8. How do you perform matrix multiplication using NumPy?

Ans:by using numpy.matmul()  function

Example: import numpy as np  
 A = np.array([[1, 2], [3, 4]])  
 B = np.array([[5, 6], [7, 8]])  
 C = np.matmul(A, B)

print(C)

The numpy.matmul() function takes two arrays as input and returns the matrix product of the two arrays. The two arrays must have compatible dimensions in order for the multiplication to be possible. If the arrays have different dimensions, the function will raise a ValueError exception

Que 9. What is the purpose of the np.random module in NumPy

Ans: The np.random module in NumPy is used to generate random numbers and arrays. It provides a wide variety of functions for generating random numbers from different distributions, including uniform, normal, binomial, and Poisson distributions. The np.random module can also be used to generate random permutations of arrays, shuffle arrays, and generate random samples from a given dataset.