1)Explain how arrays are represented in memory and their advantages.

Ans. Arrays are used to store multiple elements of the same data type under a single variable name. They provide a way to efficiently manage and access a collection of data.

**Memory Representation of Arrays**

* In memory, arrays are stored in contiguous locations.
* Each element is stored in adjacent memory locations.
* The memory representation of an array is like a long tape of bytes, with each element taking up a certain number of bytes.
* They allow fast access to elements using index-based addressing

**Advantages of array data structure**

* Efficient access to elements: Arrays provide direct and efficient access to any element in the collection. Accessing an element in an array is an O(1) operation, meaning that the time required to access an element is constant and does not depend on the size of the array.
* Memory efficiency: Arrays are a memory-efficient way of storing data. Because the elements of an array are stored in contiguous memory locations, the size of the array is known at compile time. This means that memory can be allocated for the entire array in one block, reducing memory fragmentation.

2)Analyze the time complexity of each operation (add, search, traverse, delete).

Ans.

**Add Employee**

Time Complexity: 𝑂(1) - This operation involves assigning the new employee to the next available index in the array, which takes constant time.

**Search Employee**

Time Complexity: 𝑂(𝑛) - In the worst case, the method may have to check all employees in the array (if the employee is not found or is the last one in the array), resulting in linear time complexity.

**Traverse Employees**

Time Complexity: 𝑂(𝑛) - This operation involves iterating through all employees in the array, which takes linear time.

**Delete Employee**

Time Complexity: 𝑂(𝑛) - Searching for the employee takes 𝑂(𝑛) time in the worst case. Deleting the employee involves shifting all subsequent employees one position to the left, which also takes O(n) time. Therefore, the overall time complexity is linear.

3)Discuss the limitations of arrays and when to use them.

Ans.

**Disadvantages of array data structure**

* Fixed size: Arrays have a fixed size that is determined at the time of creation. This means that if the size of the array needs to be increased, a new array must be created and the data must be copied from the old array to the new array, which can be time-consuming and memory-intensive.
* Insertion and deletion issues: Inserting or deleting an element from an array can be inefficient and time-consuming because all the elements after the insertion or deletion point must be shifted to accommodate the change.
* Limited data type support: Arrays have limited support for complex data types such as objects and structures, as the elements of an array must all be of the same data type.

**Advantages**

When dealing with a large number of similar data items, such as roll numbers of multiple students, using individual variables for each item becomes impractical. This is where arrays come into play.

* Arrays allow us to store multiple values under a single variable name.
* They provide a way to efficiently manage and process large amounts of data.
* Each elements of an array has a specific index which makes them easier to locate using their index.