**EXERCISE 4: EMPLOYEE MANAGEMENT SYSTEM**

**Explain how arrays are represented in memory and their advantages.**

An array is a collection of items of the same variable type that are stored at contiguous memory locations.

Each item in an array is indexed starting with 0. Each element in an array is accessed through its index.

For example, to access the i th element, the address is calculated as

Base address + ( i \* size of element )

**Advantages of Arrays:**

* Arrays provide direct and efficient access to any element in the collection. Accessing an element in an array is an O(1) operation. The time required to access an element is constant and does not depend on the size of the array.
* Arrays allow for fast data retrieval because the data is stored in contiguous memory locations. The data can be accessed quickly and efficiently without the need for complex data structures.
* Arrays are a memory-efficient way of storing data.
* Arrays can be used to store a wide range of data types, including integers, floating-point numbers, characters, and even complex data structures such as objects and pointers.

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

| **Operation** | **Best Case** | **Average Case** | **Worst Case** |
| --- | --- | --- | --- |
| **Traversal** | Ω(N) | θ(N) | O(N) |
| **Insertion** | Ω(1) – at the end if space is available | θ(N) – at the beginning of middle. Shift of elements | O(N) - at the beginning of middle. Shift of elements |
| **Deletion** | Ω(1) | θ(N) | O(N) |
| **Searching** | Ω(1) – finding in the first position of the array | θ(N) - finding in middle or last position of the array | O(N) - finding in the last position of the array |

**Discuss the limitations of arrays and when to use them.**

**Limitations,**

* Fixed size in array makes it impossible to store extra data if required.
* Allocating less memory than required to an array leads to loss of data.
* Allocating more memory than required to an array leads to wastage of memory space.
* An array is homogeneous in nature so, a single array cannot store values of different data types.
* Arrays store data in contiguous memory locations, which makes deletion and insertion very difficult to implement.

**When to Use Arrays**

* Number of Elements is Known and Fixed.
* Fast Access by Index is Required
* Memory Usage Needs to Be Efficient (Overhead in other data structures like pointer to next node in linked list is present in array)