**ARRAYS**

# Introduction

Arrays (or lists) are one of the most common and simple data structures, which organize items sequentially in memory.

Operations of Array:

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| Operation | Description | Time Complexity | Explanation |
| Access | Accessing an element by index | O(1) | Direct access to any element, as items are stored contiguously in memory. |
| Push (at the end) | Adding an element to the end of the array | O(1) | No shifting required; new item is appended at the end of the array. |
| Pop (from the end) | Removing the last element from the array | O(1) | No shifting required; last item is removed. |
| Unshift (at the beginning) | Adding an element at the beginning of the array | O(n) | All elements need to be shifted to make space for the new item. |
| Splice (at a specific index) | Inserting or removing an element at a specific index | O(n) | Elements need to be shifted, depending on whether you are inserting or deleting. |
| Traversal | Iterating over all elements in the array | O(n) | Each element is visited once in a linear fashion. |

- Fast Operations: Access, Push, and Pop at the end of the array are all fast with O(1) time complexity.

- Slower Operations: Inserting or deleting from the beginning or middle of the array (Unshift, Splice) involves O(n) time complexity due to the need to shift elements.

# Static and Dynamic arrays

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| **Aspect** | **Static Arrays** | **Dynamic Arrays** |
| Size | Fixed size, must be specified ahead of time. | Can dynamically resize as needed. |
| Memory Allocation | Fixed allocation of memory, no room for expansion. | Memory is reallocated and expanded when the array grows. |
| Element Addition | Requires copying and reallocating the entire array when adding elements beyond the initial size. | Items are added seamlessly, with automatic memory expansion. |
| Memory Management | Manual memory management, requires knowledge of available space. | Automatic memory management, with no need for manual intervention. |
| Languages | C++, languages with static arrays. | JavaScript, Python, Java (ArrayList), languages with dynamic arrays. |