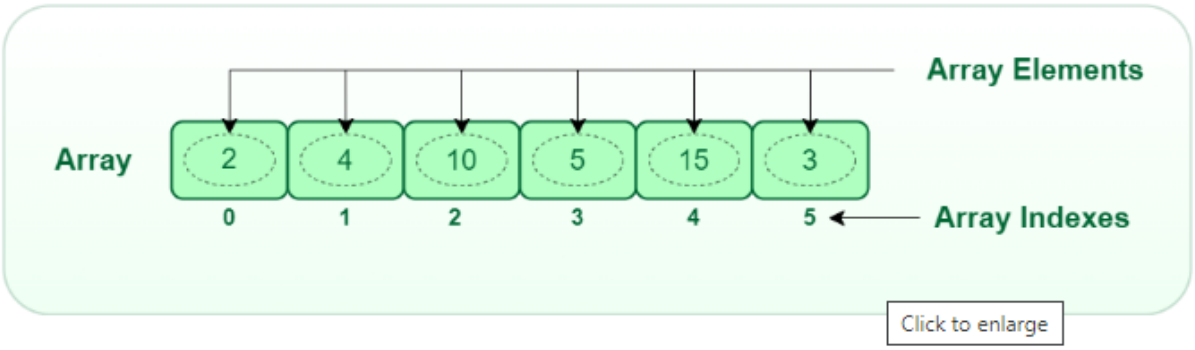
Arrays In Python

An array is a special variable, which can hold more than one value at a time.

An array is a collection of items stored at contiguous memory locations. The idea is to store multiple items of the same type together. This makes it easier to calculate the position of each element by simply adding an offset to a base value, i.e., the memory location of the first element of the array (generally denoted by the name of the array).

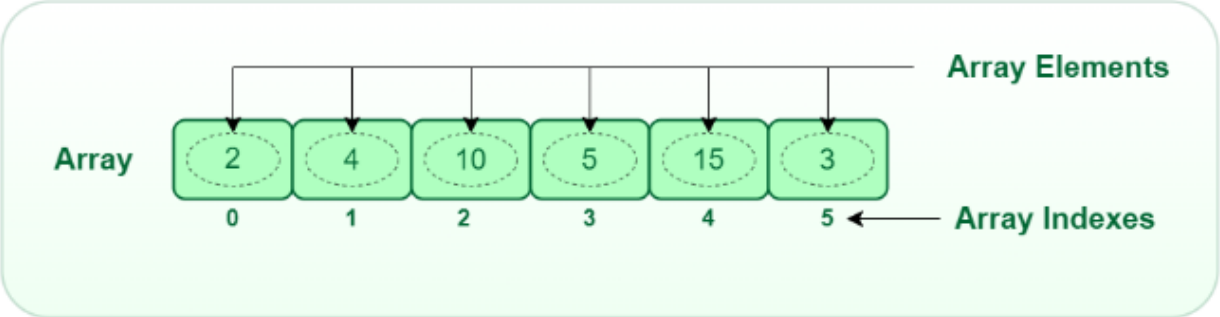


Basic terminologies of array

- **Array Index:** In an array, elements are identified by their indexes. Array index starts from 0.
- **Array element:** Elements are items stored in an array and can be accessed by their index.
- **Array Length:** The length of an array is determined by the number of elements it can contain.

Representation of Array

The representation of an array can be defined by its declaration. A declaration means allocating memory for an array of a given size.



Python code

```
arr = [10, 20, 30] # This array will store integer
arr2 = ['c', 'd', 'e'] # This array will store characters
arr3 = [28.5, 36.5, 40.2] # This array will store floating elements
```

Array declaration

However, the above declaration is **static** or **compile-time** memory allocation, which means that the array element's memory is allocated when a program is compiled. Here only a fixed size (i,e. the size that is mentioned in square brackets **[]**) of memory will be allocated for storage, but don't you think it will not be the same situation as we know the size of the array every time, there might be a case where we don't know the size of the array. If we declare a larger size and store a lesser number of elements will result in a wastage of memory or either be a case where we declare a lesser size then we won't get enough memory to store the rest of the elements. In such cases, static memory allocation is not preferred.

Is it possible to create dynamic array?

The answer is **Yes**. It is possible to allocate memory dynamically. So, dynamic memory allocation is the process of assigning the memory space during the execution time or the run time.

Below are the languages that support dynamic memory allocation:

list of integers

my_list = [1, 2, 3, 4]

Empty list

my_list = []

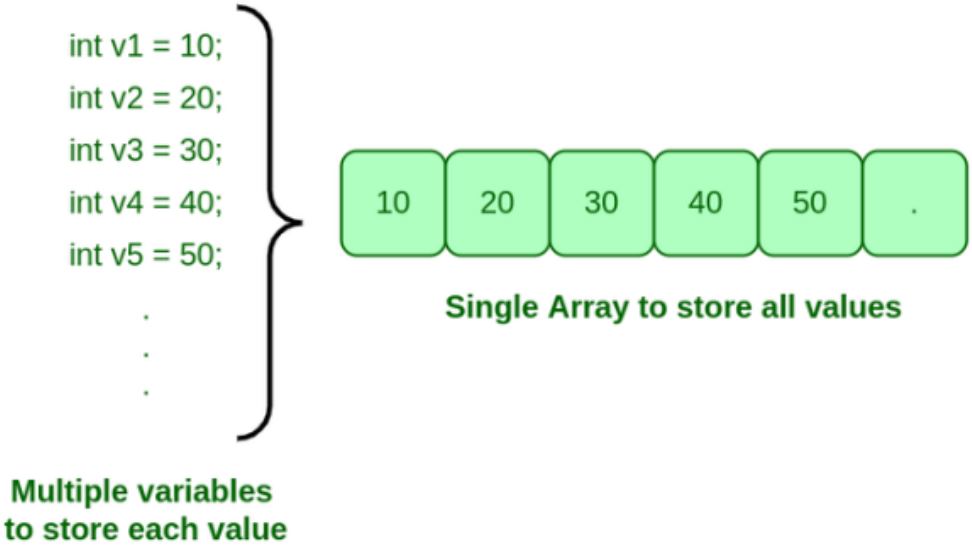
list of mixed data types

my_list = ["Hello", 1, 5.5]

Why Array Data Structures is needed?

Assume there is a class of five students and if we have to keep records of their marks in examination then, we can do this by declaring five variables individual and keeping track of records but what if the number of students becomes very large, it would be challenging to manipulate and maintain the data.

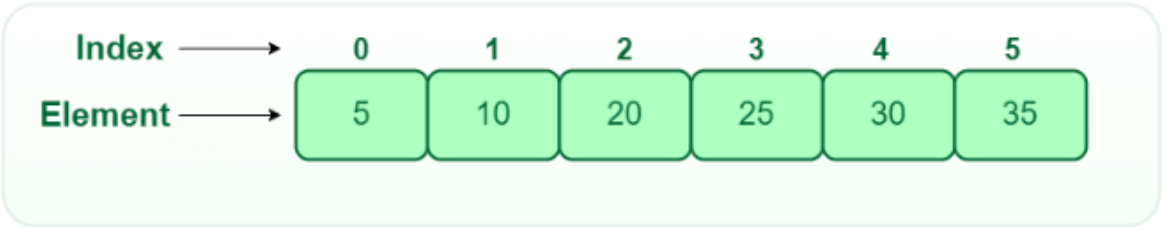
What it means is that, we can use normal variables (v1, v2, v3, ..) when we have a small number of objects. But if we want to store a large number of instances, it becomes difficult to manage them with normal variables. **The idea of an array is to represent many instances in one variable**..



Types of arrays:

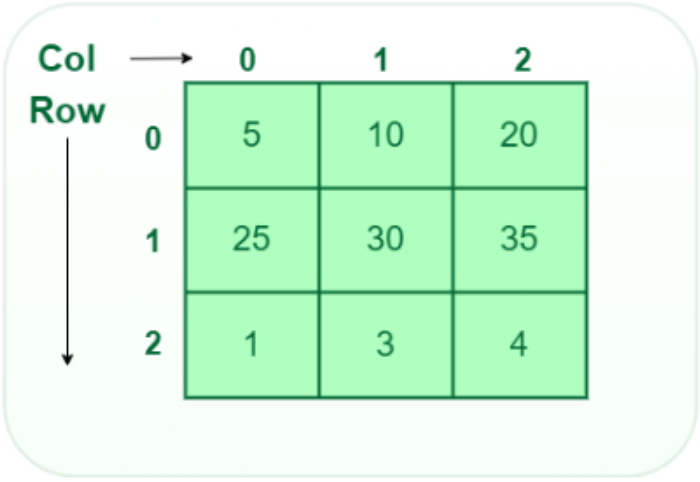
There are majorly two types of arrays:

- **<u>One-dimensional array (1-D arrays)</u>:** You can imagine a 1d array as a row, where elements are stored one after another.



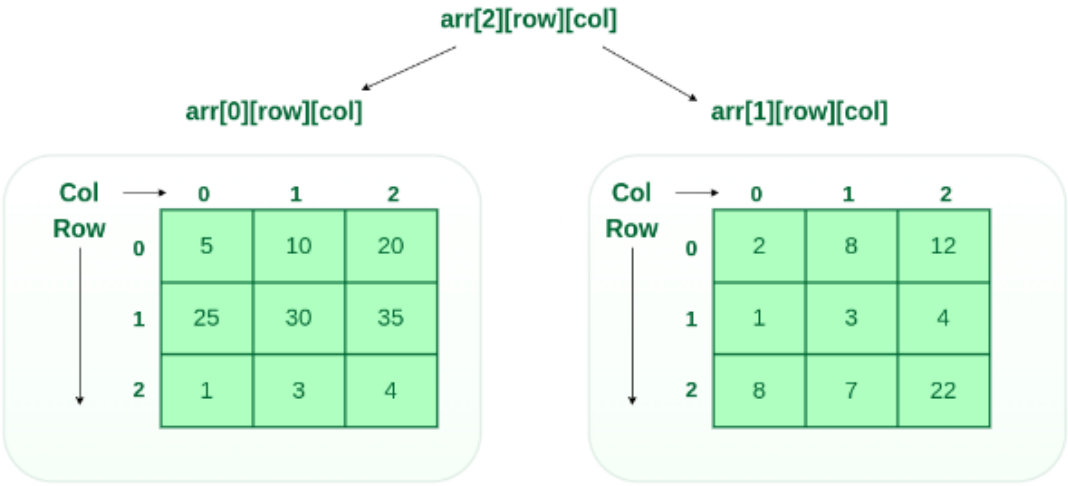
1D array

- **Two-dimensional array:** 2-D **<u>Multidimensional arrays</u>** can be considered as an array of arrays or as a matrix consisting of rows and columns.



2D array

- **Three-dimensional array:** A 3-D **Multidimensional array** contains three dimensions, so it can be considered an array of two-dimensional arrays.



Types of Array operations:

- Traversal: Traverse through the elements of an array.
- Insertion: Inserting a new element in an array.

- Deletion: Deleting element from the array.
- Searching: Search for an element in the array.
- Sorting: Maintaining the order of elements in the array.

Advantages of using Arrays:

- Arrays allow random access to elements. This makes accessing elements by position faster.
- Arrays have better cache locality which makes a pretty big difference in performance.
- Arrays represent multiple data items of the same type using a single name.
- Arrays store multiple data of similar types with the same name.
- Array data structures are used to implement the other data structures like linked lists, stacks, queues, trees, graphs, etc.

Disadvantages of Array:

- As arrays have a fixed size, once the memory is allocated to them, it cannot be increased or decreased, making it impossible to store extra data if required. An array of fixed size is referred to as a static array.
- Allocating less memory than required to an array leads to loss of data.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. This problem is overcome by implementing linked lists, which allow elements to be accessed sequentially.

Application of Array:

- They are used in the implementation of other data structures such as array lists, heaps, hash tables, vectors, and matrices.

    - Database records are usually implemented as arrays.
    - It is used in lookup tables by computer.
    - It is used for different sorting algorithms such as bubble sort insertion sort, merge sort, and quick sort.

- Questions and Resources😑:
    - https://www.geeksforgeeks.org/introduction-to-arrays-data-structure-and-algorithm-tutorials/