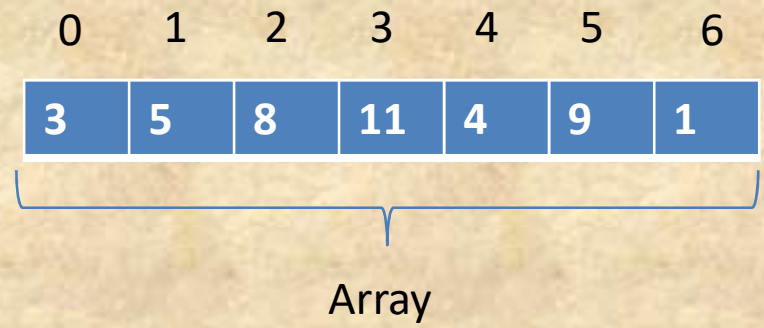
HARISH CHANDRA P.G. COLLEGE, VARANASI

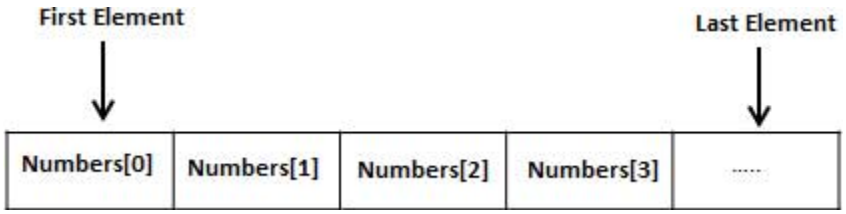
Subject:- *Data Structure using C & C++*
Class:- *BCA 3rd Semester*
Topic : *Introduction to Data Structure and its characteristics Array*
Sub-Topic:- *Array and its operation*
Key Words : *Single and Multidimensional array , Sprase array , Lower and Upper Triangular Matrix*



Name :- *Alok Kumar*
Department of *BCA*
Harish Chandra P G College ,Varanasi.
Mobile no *9696019403*
Email :- *alok.seth4@gmail.com*

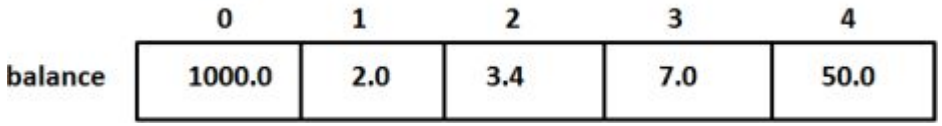
Arrays a kind of data structure that can store a fixed-size sequential collection of elements of the same type. An array is used to store a collection of data, but it is often more useful to think of an array as a collection of variables of the same type.

All arrays consist of contiguous memory locations. The lowest address corresponds to the first element and the highest address to the last element.



Declaring Arrays

type arrayName [arraySize];
Example - double balance[10];
double balance[] = {1000.0, 2.0, 3.4, 7.0, 50.0};



Program to illustrate concept of Array

```
#include <stdio.h>


 int main ()
 {
 int n[ 10 ]; /* n is an array of 10 integers */
 int i,j; /* initialize elements of array n to 0 */
for ( i = 0; i < 10; i++ )
{
n[ i ] = i + 100; /* set element at location i to i + 100 */
}
 /* output each array element's value */
for (j = 0; j < 10; j++ )
 {
 printf("Element[%d] = %d\n", j, n[j] );
}
return 0;
}
```

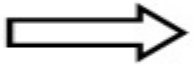
Sparse Array

A sparse array is an array of data in which many elements have a value of zero. This is in contrast to a dense array, where most of the elements have non-zero values or are “full” of numbers. A sparse array may be treated differently than a dense array in digital data handling.

2D array is used to represent a sparse matrix in which there are three rows named as
Row: Index of row, where non-zero element is located
Column: Index of column, where non-zero element is located
Value: Value of the non zero element located at index – (row, column)

$$\begin{bmatrix} 0 & 0 & 3 & 0 & 4 \\ 0 & 0 & 5 & 7 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 2 & 6 & 0 & 0 \end{bmatrix}$$

Sparse matrix



Row	0	0	1	1	3	3
Column	2	4	2	3	1	2
Value	3	4	5	7	2	6

Vector representation

Triangular Matrices

Triangular matrices: A square matrix with elements sij = 0 for j < i is termed upper triangular matrix. In other words, a square matrix is upper triangular if all its entries below the main diagonal are zero.

Example of a 2 × 2 upper triangular matrix:

A square matrix with elements $s_{ij} = 0$ for j > i is termed lower triangular matrix.
In other words, a square matrix is lower triangular if all its entries above the main diagonal are zero.

Example of a 3 × 3 lower triangular matrix:

- Diagonal matrices are both upper and lower triangular since they have zeroes above and below the main diagonal.
- The inverse of a lower triangular matrix is also lower triangular.
- The product of two or more lower triangular matrices is also lower triangular.
- The transpose of a lower triangular matrix is upper triangular.
- The inverse of an upper triangular matrix is also upper triangular.
- The product of two or more upper triangular matrices is also upper triangular.
- The transpose of an upper triangular matrix is lower triangular.

Example 1: Classify the following matrices into upper and lower triangular matrices:

$$\begin{bmatrix} 1 & 4 & 2 \\ 0 & 3 & 4 \\ 0 & 0 & 1 \end{bmatrix}, \begin{bmatrix} 1 & 0 & 0 \\ 2 & 8 & 0 \\ 4 & 9 & 7 \end{bmatrix}, \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 3 \end{bmatrix}, \begin{bmatrix} 2 & 3 & 5 \\ 0 & 8 & 9 \\ 0 & 0 & 7 \end{bmatrix}, \begin{bmatrix} 1 & 2 & 3 & 4 \\ 0 & 0 & 3 & 4 \\ 0 & 0 & 0 & 5 \end{bmatrix}$$

Upper Triangular Matrix

Lower Triangular Matrix

Lower as well as Upper Triangular Matrix

Upper Triangular Matrix.

Neither Upper nor Lower Triangular Matrix because it is not a Square Matrix.

Thank you