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01CE1301 – Data Structure

Unit - 2
Linear Data Structure & their presentation
(Part 01 - Array)

Prof. Kishan Makadiya
Department of Computer Engineering

Outline

- Representation of Arrays & storage structure
- Sparse matrix and its representation
- Application of Arrays

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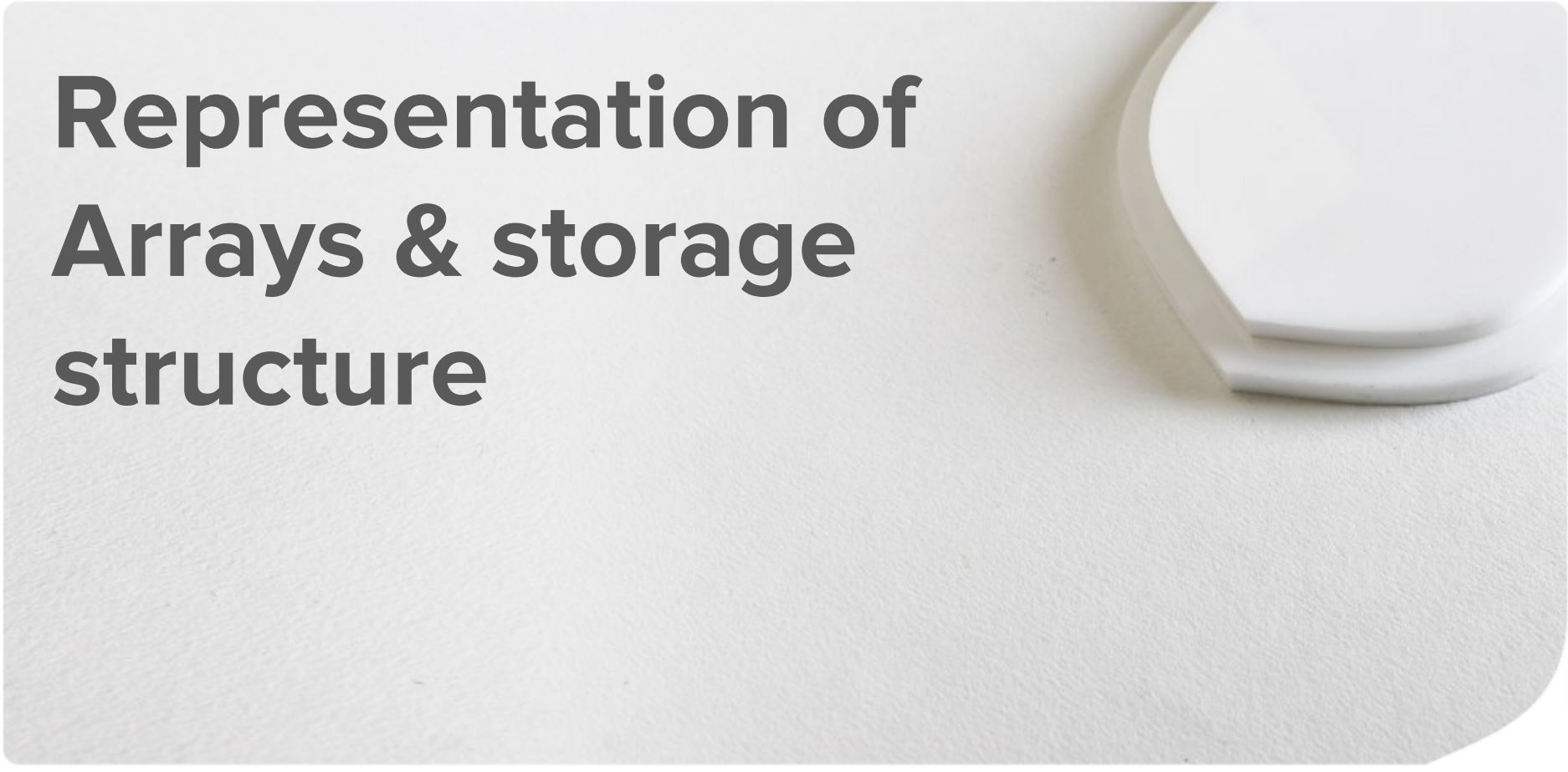
Representation of Arrays & storage structure



Representation of Arrays

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❑ What is Array?

- An **array** is a collection of elements of the **same data types**.
- Number of memory locations is **sequentially** allocated to the array.
- A array size is fixed and therefore requires a fixed number of memory locations.

❑ Two types of Array

- 1-Dimension Array
- Multi Dimension Array

1-Dimensional Arrays

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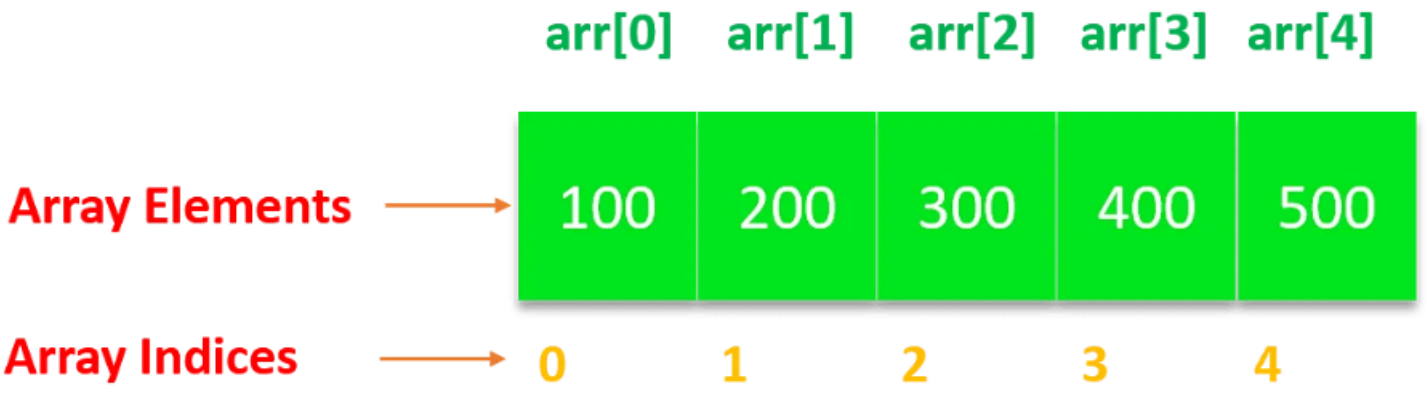
❑ 1-D Array

- Single dimensional array or 1-D array is the simplest form of array.
- This type of array consists of elements of similar types and these elements can be accessed through their indices.



1-Dimensional Arrays

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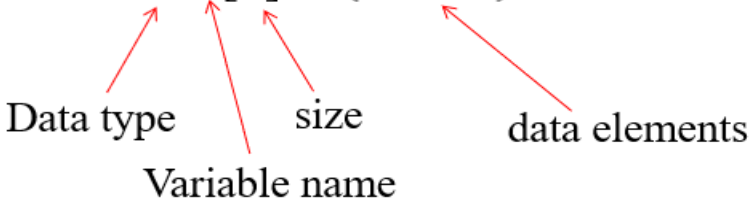
❑ Declaration and Storing Array Elements

1. `int a[3] = {1, 2, 5}` [Compile Time]



2. [Run time]

```
int i, a[3];
for (i=0 ;  i < 3; i++)
    a[i] = i;
```

3. [Run time]

```
int i, a[3];
for (i=0 ; i < 3 ; i++)
    scan("%d", &a[i]);
```

1-Dimensional Arrays

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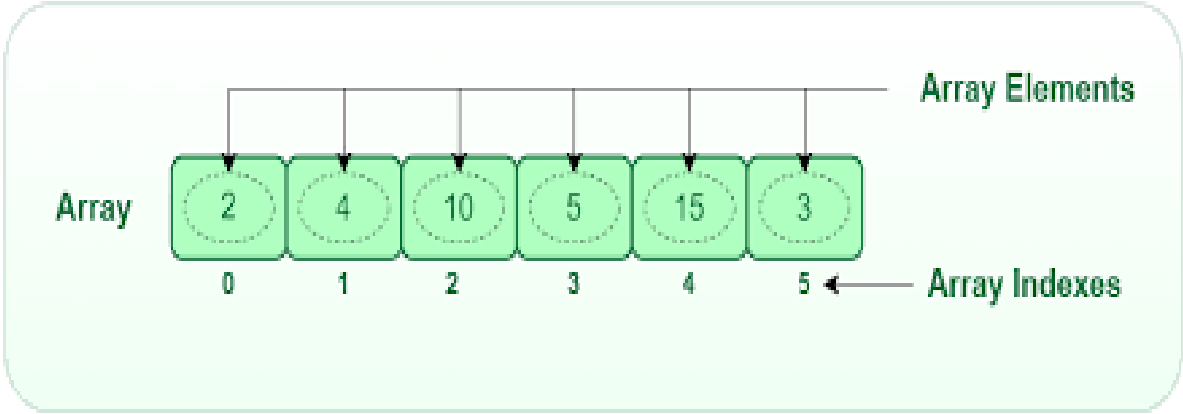
❑ Store array elements

```
for (i = 0; i < n; i++)
{
        scanf("%d", &a[i]);
}
```



❑ Display

```
for (i = 0; i < n; i++)
{
        printf("%d ", a[i]);
}
```

1-Dimensional Arrays

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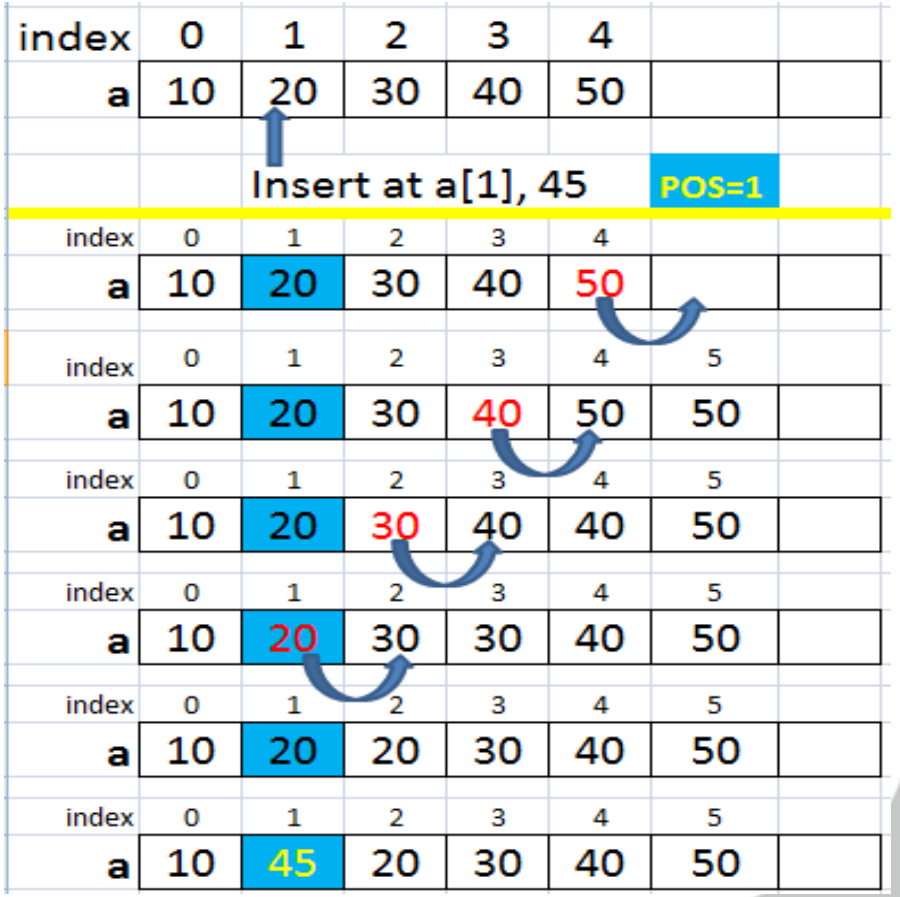
❑ Insert elements at any position

```
n=n+1;                  //n=size of array
for(i = n; i > pos; i--)
{
        a[i]=a[i-1];
}
a[pos-1]=x; //x=element
```



1-Dimensional Arrays

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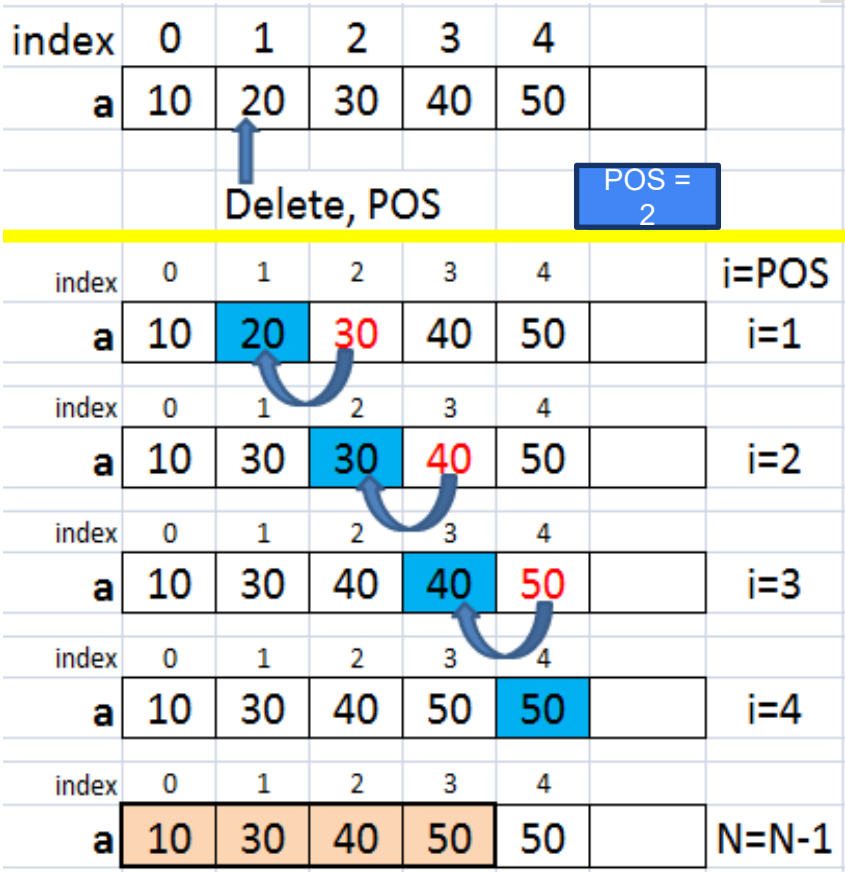
❑ Delete an element

```
for (i = pos - 1; i < num -1; i++)
    {
       arr[i] = arr[i+1]; // assign arr[i+1] to arr[i]
    }
```



2-Dimensional Arrays

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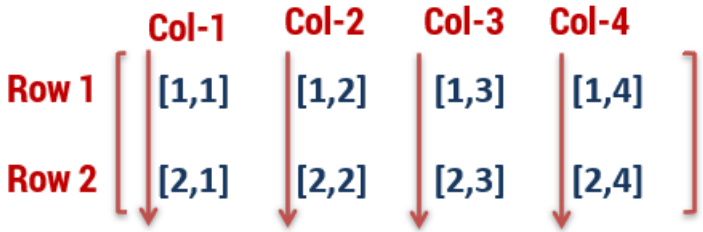
❑ 2-D Array

- Two dimensional arrays are also called ***table*** or ***matrix***
- Two dimensional arrays have two subscripts.
- **Column major order matrix:** Two dimensional array in which elements are stored column by column is called as column major matrix
- Two dimensional array consisting of **two rows** and **four columns** is stored sequentially by columns : A[1,1], A[2,1], A[1,2], A[2,2], A[1,3], A[2,3], A[1,4], A[2,4]



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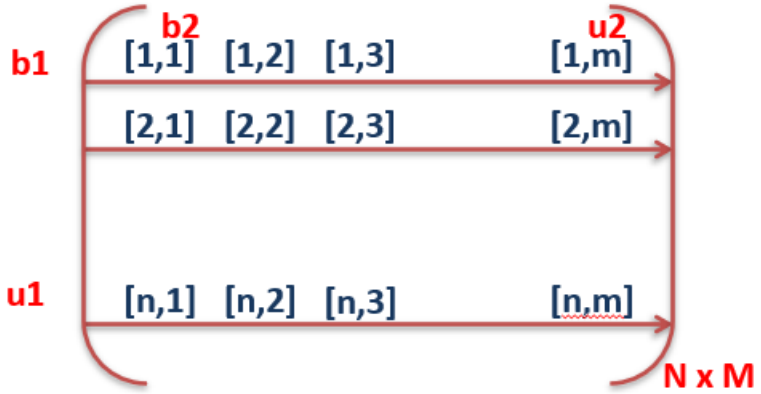
❑ 2-D Array

- **Row major order matrix:** Two dimensional array in which elements are stored row by row is called as row major matrix.



n = no of rows, **m** = no of columns

b1 = lower bound subscript of row
u1 = upper bound subscript of row
n = u1 – b1 + 1

b2 = lower bound subscript of column
u2 = upper bound subscript of column
m = u2 – b2 + 1

Operations of Arrays

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❑ Operation on Arrays

- Insertion of elements
- Deletion of elements
- Traversal
- Searching
- Merging

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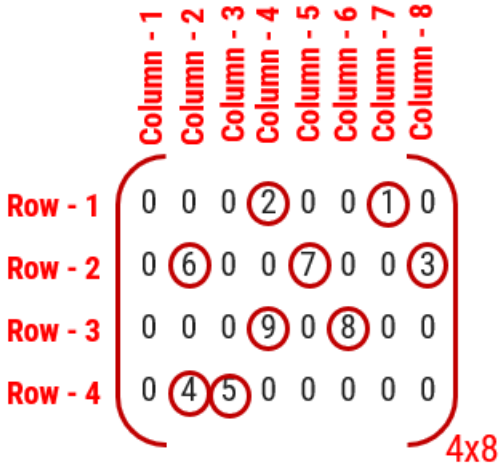
Sparse matrix and its representation

Spars Matrix and its representation

- An m x n matrix is said to be ***sparse*** if “many” of its elements are zero.
- A matrix that is not sparse is called a ***dense matrix***.
- **Example:**



Terms	0	1	2	3	4	5	6	7	8
Row	1	1	2	2	2	3	3	4	4
Column	4	7	2	5	8	4	6	2	3
Value	2	1	6	7	3	9	8	4	5

Linear Representation of given matrix

Polynomial matrix and its representation

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- Matrix representation of polynomial equation
  - We can use array for different kind of operations in polynomial equation such as addition, subtraction, division, differentiation etc…
  - Array can be used to represent Polynomial equation.

Polynomial matrix and its representation

- **Example:**

	Y	Y^2	Y^3	Y^4
X	XY	XY^2	XY^3	XY^4
X^2	X^2Y	X^2Y^2	X^2Y^3	X^2Y^4
X^3	X^3Y	X^3Y^2	X^3Y^3	X^3Y^4
X^4	X^4Y	X^4Y^2	X^4Y^3	X^4Y^4

$2X^2 + 5XY + Y^2$

		Y	Y^2	Y^3	Y^4
	0	0	1	0	0
X	0	5	0	0	0
X^2	2	0	0	0	0
X^3	0	0	0	0	0
X^4	0	0	0	0	0

$X^2 + 3XY + Y^2 + Y - X$

		Y	Y^2	Y^3	Y^4
	0	1	1	0	0
X	-1	3	0	0	0
X^2	1	0	0	0	0
X^3	0	0	0	0	0
X^4	0	0	0	0	0

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Application of Arrays

Application of Arrays

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- To perform **arithmetic operation** on polynomial equation.
- Widely used to implement **mathematical vectors, matrices** and other kinds of **rectangular tables**.
- Used to implement **stack, queue, heap, hash table, string**, etc..
- Can be used for **dynamic memory allocation**.

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