Programming Practices and Techniques

Session 8 - Arrays

Objectives

- Define Arrays
- List the different types of Arrays
- Describe the different search techniques
- Describe the different sort techniques

Introduction

- The organized collection of objects into rows and columns is known as an array
- It can be defined as a group of variables of the same data type grouped together under a single name

Overview of Array 1-2

- A variable is used to store a piece of information in memory
- Earlier the OS would allocate memory space to the variables at random location, then, the OS would need to gather information from all the scattered variables
- They allow the programmer to store more than one value in a variable, at the same time retaining a single reference

Overview of Array 2-2

- The values in an array are stored in contiguous location in memory and can be accessed by a single name
- One constraint with an array is that they store only data pertaining to one particular data type
- While declaring an array, the data type of the data that is stored needs to be specified and all the elements in it have to be of the same type

Array Example

- Create a program, which accepts five numbers and display their total. There can be two methods to proceed:
  - In Example 1, declare five variables to store five numbers, and one variable to store the total.
  - In Example 2, an array is used.

Example1

```
BEGIN
DECLARE num1, num2, num3, num4, num5 and sum as integers
ACCEPT num1
ACCEPT num2
ACCEPT num3
ACCEPT num4
ACCEPT num5
Sum=num1+num2+num3+num4+num5
Display sum
End
```

Advantages of Arrays

- Advantages of using an array are as follows:
  - Reduction in the number of variable names
  - Selection of the variable based on the value of the variable
  - Storage of the entire data sets for multiple time use in a program
  - Declaration of fixed length data set
  - Access the data in any order or at random

Declaring an Array

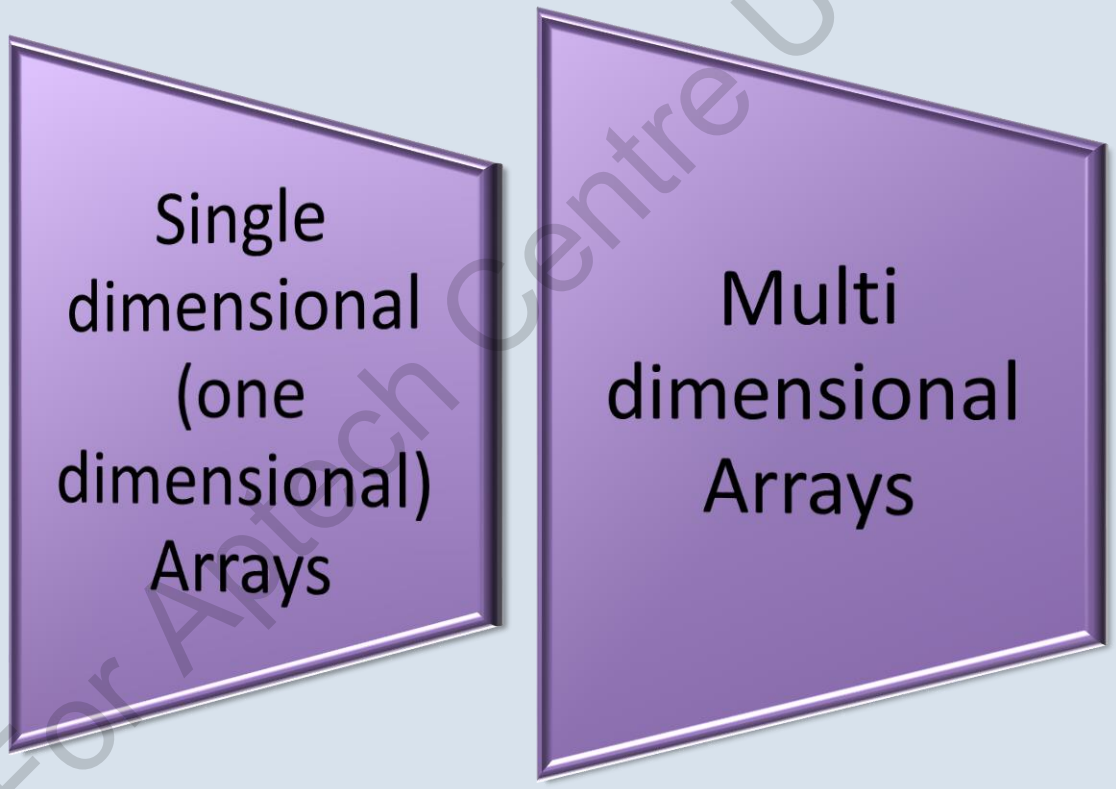
- In example 2, an array is declared with the statement, **`ARRAY arrNums[3]`**
- **ARRAY** is the keyword used in an algorithm to declare an array
- **`arrNums`** is the name of the array, while **`[3]`** indicates the size of the array.

Syntax:

```
arrNum [element number] = value
```

Different Type of Arrays

- Arrays can be divided into two categories:



Single Dimensional Arrays

- The different components of the single dimensional array are called as follows:
  - A name
  - A data type
  - A size
- All the elements of one dimensional array are stored in a row starting from zero to the size of array
- To access an element in one dimensional array, a single subscript is used which can either represent a row or column index

Multi Dimensional Arrays 1-2

- Sometimes data has to be stored and manipulated in a tabular format in the form of matrix
- For example, consider the data provided in table, which represents marks secured by 3 students in 2 different subjects
- If the result of the highest student in all subjects needs to be realized then, one way is by finding out who got highest in physics and chemistry
- If several operations are required to be carried out on the data, then these data needs to be stored in the memory
- The solution to this problem is multi dimensional array, where array would resemble the structure as shown in table

Name	Physics	Chemistry
John	45	60
Mathew	20	67
Ronald	90	35

Multi Dimensional Arrays 2-2

- A multi dimensional arrays resembles a matrix, and has rows and columns

Example 4

```
FOR i IN RANGE 0 TO 1
DO
FOR j IN RANGE 0 TO 2
DO
ACCEPT arrMarks [i][j]
END DO
END DO
```

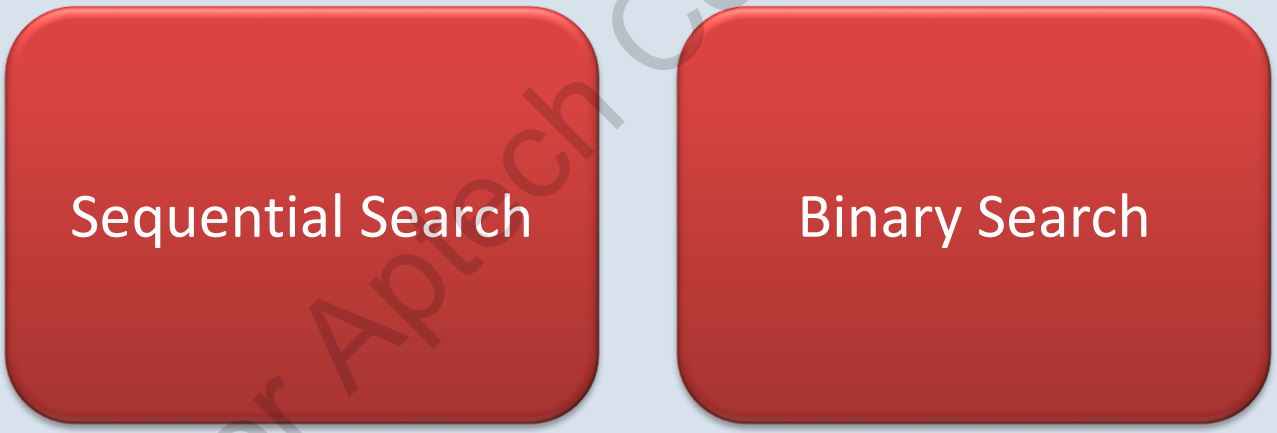
Syntax:

```
ARRAY arrMarks [element number  1][element number 2]
```

Different Search Techniques

- Searching refers to the operation of finding the location of a specific item in a group of items.

- The different search algorithms are as follows:



Sequential Search

- The algorithm for a sequential or linear search is as follows:

```
INPUT: Array of Size N. Target Value T
OUTPUT: Position of T in the list-1
BEGIN
Set FOUND = false
Set I = 0
While (I <= N) and (FOUND is false)
IF List[i] == T THEN
FOUND = true
ELSE
I = I+1
END
IF FOUND==false THEN
T is not present in the List
END
```

Binary Search 1-2

- Binary search is the best search algorithm for a sorted array
- It is a powerful technique for searching an ordered list
- The concept is similar to the way people look for an entry in a dictionary or telephone book

Binary Search 2-2

- The algorithm for a binary search is as follows:

```
BOTTOM = first element
TOP = last element
WHILE ((TOP>=BOTTOM) and (not found)) loop
MID= (TOP + BOTTOM)/2
IF (LIST(MID) = item to find) THEN
FOUND = true
ELSE IF (item to find > LIST(MID) then
BOTTOM = MID+1
ELSE
TOP = MID - 1
END IF
END LOOP
IF FOUND = true
Wanted item is in database
ELSE
Wanted item is NOT in database
END IF
```

- In a binary search, the data set is split into halves and the middle item value is compared with the search value
- If the search value is smaller than the middle item then the first half of the data set or list is searched
- This continues until the search value is located or the remaining list consists of only one item

Different Sort Techniques

- The function of sorting or ordering a list of objects according to some linear order is very fundamental
- Sorting algorithm arranges the elements of a list in a sorted order
- The two types of sorting methods are as follows:

Internal sort

External sort

Internal Sort

- Internal sorting takes place in the main memory of the computer

The different types of internal sorts are as follows:

- Selection sort
- Quick sort
- Bubble sort
- Insertion sort

Click the different internal sort to know more details

- The programmer benefits in this type of sorting because of the random access nature of the main memory

External Sort

- The examples of external sorting are as follows:
  - Sorting with Disk
  - Sorting with Tapes

Summary 1-2

- Arrays are an essential part of programming, as they allow the programmer to store more than one value in a variable, at the same time retaining a single reference
- Array can be defined as a collection of elements of same type that are referenced by a common name
- All items in a one dimensional array are stored either in a row or column and indexing starts from zero and ends with the size of the array minus one
- Most languages support multi dimensional arrays, where instead of storing the data in a single dimension, it can be stored in more than one dimension
- External sorting is necessary when the number and size of objects are large and cannot be accommodated in the main memory

Summary 2-2

- Searching refers to the operation of finding the location of a specific item in a group of items. The different search algorithms are as follows:
  - Sequential Search
  - Binary Search
  - Binary Tree Search
- Internal sorting takes place in the main memory when the data to be sorted is small. The different types of internal sorts are as follows:
  - Selection sort
  - Quick sort
  - Bubble sort
  - Insertion sort