Chapter-1

# Structures and Pointers

Structure is a user defined data type which representsa collection of logically related data items.

## Defining a structure

To define a structure you use the struct statement.The format of structure statement is

```
struct  [struct tag]
{
    Member definition;
   Member definition;
    --------------
    ----------------
};
```

The members of a structure is also called structure elements.

For Example:

```
struct student
   {
        int rollno;
        char grade;
        float percentage;
    };
```

## Accessing elements of a structure

The elements of a structure are accessed using the dot (.) operator or Period operator.The syntax for accessing elements is,

**[Object name][Operator][Member variable Name]**

For Example: s.name.

```
#include<iostream>

using namespace std;

struct student

{

   int rollno;

   int m1,m2,m3;

};

int main()

{

   student s; //Object declared

   cout<<"Enter the marks in Three subjects";

   cin>>s.m1>>s.m2>>s.m3;

   cout<<"Total="<<s.m1+s.m2+s.m3;

return(0);

}
```

## Nested Structure

A Structure placed inside another structure is called a nested structure.

## Difference between Array and Structure

| Array | Structure |
|---|---|
| An array is a collection of similar data type(Homogeneous) | A structure is a collection of different data types(Heterogeneous) |
| The elements of an array are accessed using an index | The elements of a structure is accessed using dot(.) operator |
| Array is derived data type | Structure is user defined data type |

## Pointer

The data stored in computer occupies a memory cell.Each cell has a unique address.A pointer points to the address of memory location.It holds the address of the memory location.

Declaring a pointer

We can declare a pointer,similar to a variable.The syntax is

**Data_Type *Pointer_Variable;**

For Example:

int *ptr;

Here ptr is a pointer variable and points to an integer data type.

Initializing a pointer

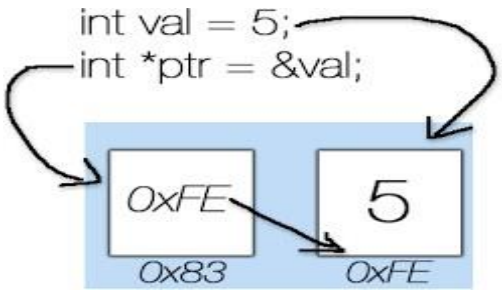
We can initialize a pointer as,

Ptr=&a;

Here the pointer variable **ptr** contains the address of variable a.

The content of or deferencing operator or indirectionoperator ( ***** ) is used to get the value stored at the location held by a pointer variable.The * operator is also known as value at operator.

The address of operator(**&**) is used to retrieve the address of a variable.




```
#include<iostream>

using namespace std;

int main()

{

int a=10;

int *Ptr=&a;

cout<<"The value of a="<<a<<"\n";

cout<<"The address of a="<<Ptr;

return 0;

}
```

Output:

The value of a=10

The address of a= oxffoo;

## Memory allocation

Allocation of memory for a variable during compilation time is known as static memory allocation.Once the memory is allocated during compile time it cannot be expanded or compressed.

For example:


int a[10] as integer;

During compilation the compiler will allocates 20 bytes .

The process of allocating memory during execution time is called **dynamic memory allocation**.This is done using **'new'** and **'delete'** operators.

**Memork leak** is a situation where once memory is dynamically allocated to a variable and if later the memory is not de-allocated after its purpose is satisfied,the memory gets lost.This problem where memory is dynamically allocated but not released ,hence not accessible to any problem is called memory leak.

## new and delete operators

The ***new*** operator is used to allocate memory during execution(run-time).It is a unary operator.The syntax is

**pointer_variable=new data_type;**

The ***delete*** operator is used to free memory allocated using new operator.The syntax is

***delete pointer_variable;***

```
#include<iostream>

using namespace std;

int main()

{
```

```
  int i,*p;
   p=new int[10];
   cout<<"Enter the elements";
  for(i=0;i<10;i++)
  {
  cin>>p[i];
}
  for(i=0;i<10;i++)
  {
 cout<<p[i]<<"\t";
}
delete[]p;
return 0;
}
```


## Pointers and array

There is a close relationship between pointers and array.C++ treats the name of array as a pointer.The name of array is a pointer pointing to the first element of the array.

For example:

```
char ch[10],* ptr;
ptr=ch;
```

here ptr points to the address of first array element in ch.To access fifth element you can use

ch[4] ;  or  *(ptr+4);

Note:Currently ptr points to address of first element in the array ch.

## Operations on pointers

Arithmetic operations can be performed on a pointer.

For Example;

int  a[50];

int *ptr;

ptr=&a[0] ;  //ptr refers to the base address of array a.

**ptr - -  or  - - ptr**;

Moves the pointer to the previous address.(If the base address was 1000 the operation – ptr moves the pointer to 998 memory location ie,1000 – 2.

cout<<ptr; //Displays 1000 ie, the address of a[0](Base address);

cout<<*ptr;//Displays the value at a[0];

**Program to find average marks of students**

```
#include<iostream>

using namespace std;

int main( )

{

int n,sum=0,*mark_ptr,i;
```

```
float avg;
mark_ptr=new int;
cout<<"Enter the No of Students";
cin>>n;
for(i=0;i<n;i++)
 {
   cin>>*(mark_ptr + i);
   sum=sum+*(mark_ptr+i);
  }
avg=(float)sum/n;
cout<<"Average="<<avg;
return 0;
}
```

**Note:**Only equality**(= =)** and not equality**(! =)** operators can be applied to a pointer.

**Self referential structures**

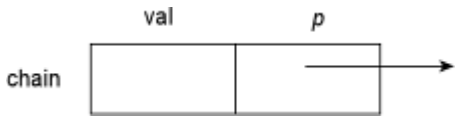
When a member of a structure is declared as a pointer to the structure itself,then the structure is called as self referential structure.

For example:

```
struct chain {
int val;
chain *p;
```

};

The structure has two members val and p.The member p is a pointer to a structure of type chain.




Some examples of self referential structures are **linked list**,**stack**,**trees** etc.

## Dynamic array

A dynamic array is an array created during run time using new operator.The synatx for creating a dynamic array is

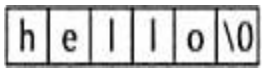
Pointer= new data_type[size];

For example:

P=new int[10]; //declares a dynamic array of size 10.

## Pointer and String

A string is an array of characters,and array name can be considered as a string variable.Every string in C++ is terminated by a Null character**(\0).**For example the string ***hello*** is represented in memory as




Intializing an array

The above array can be initialized as

char ch[ ]=”hello”;

or

```
char ch={'h','e','l','l','o','\0'};
```

**We can use a character pointer to reference the array.**

```
char s[10];//character array declaration
 char *ptr;//character pointer declaration;
 cin>>s;
 ptr=s;//Copying contents of s to ptr
```

**Example:**

```
int main()
 { char a[10];
 strcpy(a, "hello");//copies the string hello to a
 cout << a; return(0);
 }
```

**Output:**

hello

**Advantages of character pointer**

- Strings can be managed by optimal memory space.
- Assignment operator can be used to copy strings.
- No wastage of memory.