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B. Tech/MBA Tech	Workbook	Academic Year- 2024-25
Year:-First	Subject:- Programming for Problem Solving	Semester: - First

Experiment: 8

PART A

(PART A: TO BE REFERRED BY STUDENTS)

Aim: Programming using structure and pointer

Learning Outcomes: The learner would be able to

1. Understand the syntax structure & pointers.
2. Solve problems using structure
3. Implement programs using pointers

Theory:

Structures

- **Structure** is user defined data type.
- Structure is used to store heterogeneous data under unique name.
- Keyword 'struct' is used to declare structure.
- In other word structure is a convenient tool for handling a group of logically related data items of different data types.
- Following are the different instances of structure




Syntax 2.

```
struct structure_name{
    <data-type> member1;
    <data-type> member2;
    -----
    -----
    <data-type>member_n;
}struct_var_list;
```

Example of Syntax 2 :

```
struct student{
    int rollno;
    char nm[10];
    float wt,ht;
}s1,s2,s3,s4,s5;
```

- Above syntax shows, structure definition with structure variable declaration.
- Struct_var_list is list of structure variables.

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Syntax 3.

```
struct {
    <data-type> member1;
    <data-type> member2;
    -----
    -----
    <data-type> member_n;
} struct_var_list;
```

- Above syntax shows, structure definition with structure variable declaration.
- Struct_var_list is list of structure variables as we have structure variable that's why we can omit structure name.

Example of Syntax 3 :

```
struct {
    int rollno;
    char nm[10];
    float wt,ht;
} s1,s2,s3,s4,s5;
```

Accessing Members of a Structure

- C++ provides two operators to access structure members viz dot & arrow.
- Dot(.) is an operator which is used to work with structure variable.
- Arrow (->) is another operator, to work with structure with pointer.
- **Syntax:-**

Structure_variablename.member;

- **Example:-**

s1.rollno;

Assigning Values to structure members:

- With the help of assignment operator we can assign value to the structure members.
- **Syntax:-**

Structure_variable.member=value;

- **Example:-**

```
s1.rollno=50;
s1.name="Rohit";
s1.wt=68.00;
s1.ht=5.7;
```


Initialization of structure: -

- We can initialize structure as like as array by specifying list of values in curly bracket.
- **Syntax:**

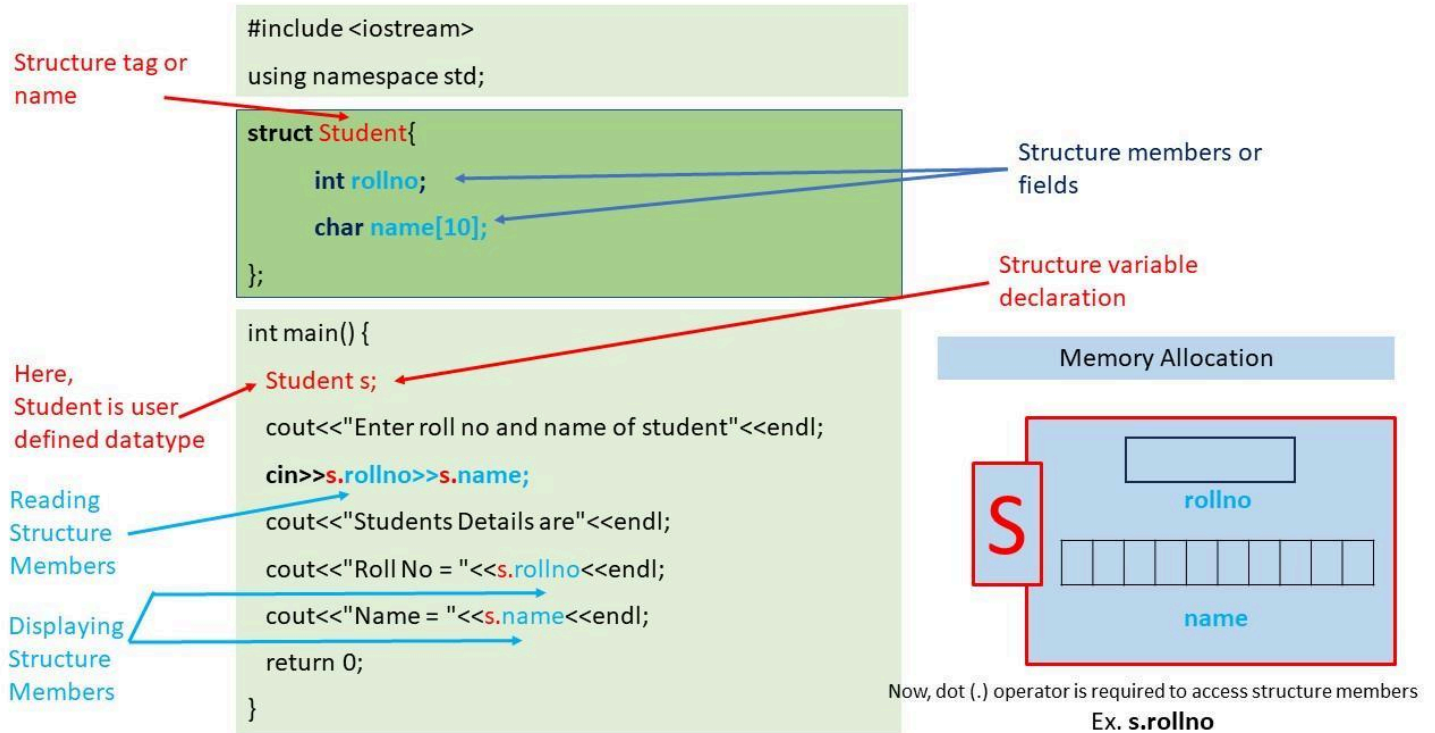
struct structure_name variable_1= { list of values separated by comma };

Example:-

```
struct student s1={50,"Rohit",68.00,5.7};
```

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Write a program to read and display Student information like roll number & name using structure...



```

#include <iostream>
using namespace std;

struct Student{
    int rollno;
    char name[10];
};

int main() {
    Student s;
    cout<<"Enter roll no and name of student"<<endl;
    cin>>s.rollno>>s.name;
    cout<<"Students Details are"<<endl;
    cout<<"Roll No = "<<s.rollno<<endl;
    cout<<"Name = "<<s.name<<endl;
    return 0;
}

```

Annotations:

- Structure tag or name:** Points to `struct Student`.
- Structure members or fields:** Points to `int rollno;` and `char name[10];`.
- Structure variable declaration:** Points to `Student s;`.
- Here, Student is user defined datatype:** Points to `Student s;`.
- Reading Structure Members:** Points to `cin>>s.rollno>>s.name;`.
- Displaying Structure Members:** Points to `cout<<"Roll No = "<<s.rollno<<endl;` and `cout<<"Name = "<<s.name<<endl;`.

Memory Allocation Diagram:

A diagram showing a memory block labeled 'S' containing a box for 'rollno' and an array of boxes for 'name'.

Now, dot (.) operator is required to access structure members
Ex. s.rollno

Array With in Structure:-

- We can have array within a structure
- For example, if we have structure members student_name, & student_marks etc.
- Example:-

```

struct student{
    int rollno;
    char nm[10];
    int marks[5];
};

```


- In above example nm and marks is array within structure

Array of Structure: -

- We can have array of structure
- Syntax

```
struct structure_name arrayname[size];
```
- Example

```
struct student s[100];
```

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Write a structure cricket with information like Player Name, Team Name & Batting average. Write a program to read & display information of 11 players of a team.

```
#include <iostream>
using namespace std;
struct Cricket{
    char pname[10];
    char tname[10];
    float bavg;
};
int main() {
    Cricket c[11];

    cout<<"Enter information of 11 players "<<endl;
    for(int i=0;i<2;i++)
        cin>>c[i].pname[i]>>c[i].tname>>c[i].bavg;

    cout<<"Plyer info:"<<endl;
    for(int i=0;i<2;i++){
        cout<<"Plyer "<<c[i].pname<<endl;
        cout<<"Team "<<c[i].tname<<endl;
        cout<<"Avg "<<c[i].bavg<<endl;
    }

    return 0;
}
```

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Pointers: -

- Pointer is variable, which holds memory address of another variable
- **Pointer Operators:-**
 - o **& - Address of or Direction or referencing operator.**
Address of Operator (&) returns the address allocated to the variable.

Syntax:-

& variable_name;

Example:-

&i;

- o *** - Value at address or Indirection or dereferencing pointer operator**
Value at address (*) operator returns the value stored inside address
'*' is used to declare pointer variable.

Syntax:-

*memory_location;

Example:-

*(&i);

- Suppose we have variable declaration

int i=5; ← Normal Variable

int *p ← Pointer Variable

p=&i; /*Assigning address of variable i to pointer p*/


then following three things will take place, for each variable in memory.

P i ← Name of Memory Location

65524 → 5 ← Value in Memory location

65522 65524 ← Address of Memory Location

Fig:- Memory allocation for variable

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In above fig, p is pointer variable (contains address of i) & that points to variable i.

Pointer Variables Declaration:

- Like normal variable declaration, we can declare pointer variable using value at address operator(*)

Syntax:-

data_type *variable_name;

Example:-

```
int *ptr;
float *ptr2;
char *ch;
```

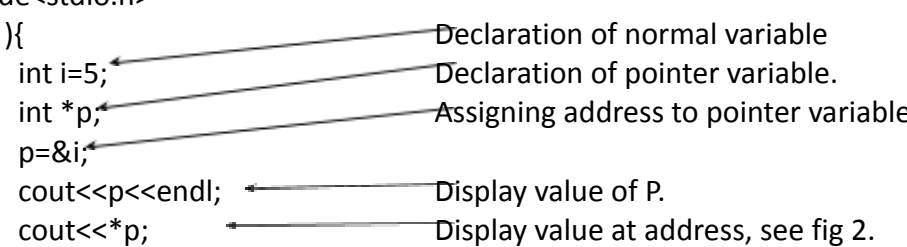
What information pointer variable contains?

- Pointer may be initialized to zero, NULL or an address(if we know).
- Initializing pointer to zero is equivalent to initializing a pointer to NULL.
- NULL is symbolic constant available in "stdio.h".
- Example:-
 1. int *p=0;
 2. int *p=NULL;
 3. int *p=&i;

In example 3 'i' is normal variable & address of i is assign to p.

Programming Example to show use of pointer:


```
#include<stdio.h>
main( ){
    int i=5;
    int *p;
    p=&i;
    cout<<p<<endl;
    cout<<*p;
}
```



Output:-

```
65524
5
```

P i  Name of Memory Location

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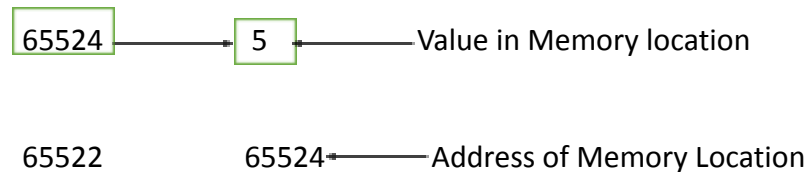
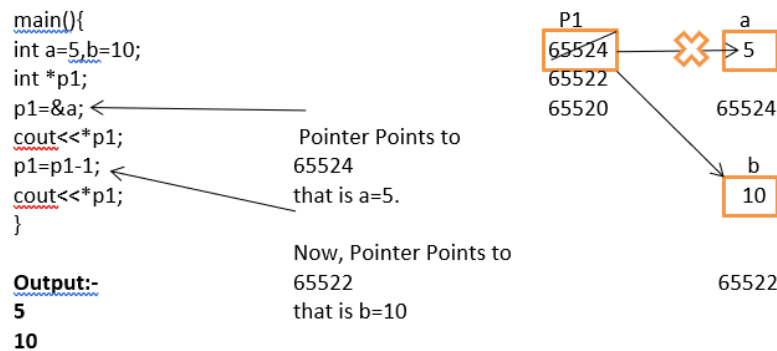


Fig 2:- Memory allocation for i & p

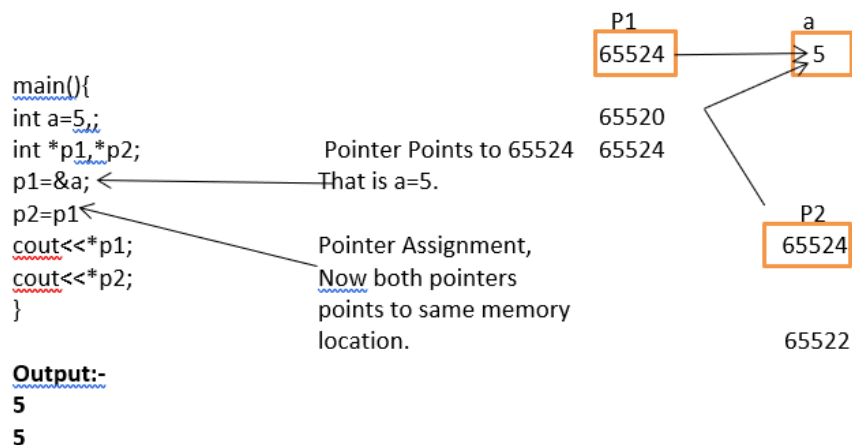
Pointer Arithmetic:-

- Integer constant can be added or subtracted from pointer
- Pointer can be incremented or decremented


Note:- We considered int as 2 byte, in c++ int is of 4 byte, so difference will be of 4.



- Pointer assignment



- One pointer can be subtracted from another pointer.
- Pointers can be compared.
 - o Two pointers can be compared using relational & logical operators like(<,>,<=,>=,==,!=)


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1. We cannot add two pointers.
 - o Two pointers cannot be added.
2. Cannot be multiplied or divided by integer constant.
 - o Pointer cannot be multiplied and/or divided by integer constant.
 - o Two pointers cannot be multiplied or divided.

Pointer to Pointer (Chain of a Pointer).

- One pointer variable contains address of another pointer variable.
- **General syntax is,**
 Data_type **pinter_to_pointer_var_name;
- **Example:-**
 int **p;
- **Example:-**

- | | |
|----------|---------------------------------|
| int a; | - Normal/ordinary variable |
| int *p | - pointer variable |
| int **p | - pointer to pointer |
| int ***p | - pointer to pointer to pointer |

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Call By Address

Pointer variables are used as a parameter

Formal parameter update the value of actual parameter
(refer line no 4 of output)

```
#include <iostream>
using namespace std;
void swap(int *a,int *b){
    cout<<"In swap() before swapping a="<<*a<<" b="<<*b<<endl;
    int c=*a;
    *a=*b;
    *b=c;
    cout<<"In swap() after swapping a="<<*a<<" b="<<*b<<endl;
}
int main() {
    int a=10,b=20;
    cout<<"In main() before swap() call a="<<a<<" b="<<b<<endl;
    swap(&a,&b);           //call by address
    cout<<"In main() after swap() call a="<<a<<" b="<<b<<endl;
    return 0;
}
```


Output:-

In main() before swap() call a=10 b=20

In swap() before swapping a=10 b=20

In swap() after swapping a=20 b=10

In main() after swap() call a=20 b=10


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Tasks:

1. Define structure Employee having data members: emp no, name, address, dept and salary. WAP to read and display information of a employee.
2. Define structure called Employee that will describe the following data emp no, name, address, dept and salary. Develop a program that store information of 10 employees and display names of the employees having salary greater than 50000.
3. There are 50 computers in an office. Every computer has following information CPU type, hard disk size. WAP to store details of all 50 computers and then print details of computers having hard disk size greater than 8 GB.
4. WAP to print ID array of size N using pointer
5. WAP to print string (character array) in reverse order using pointers
6. WAP to find reverse of a string using pointer
7. Write a program to check entered string is palindrome or not using pointer

Additional Question:

1. WAP to copy one string to another using pointer and display copied string-using pointer.
2. WAP to find the number of vowels in entered string using pointer [eg -i/p India o/p A-1, E-0, 1-2, 0-0, U-0]

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