CHAPTER 10

POINTERS

Session Objectives

- What is meant by pointer is and why it can ne used?
- How to Declare and access a pointer variable
- Explain Pointer Increment/Decrement
- Explain the use of pointers with arrays
- Explain How Pointer To Functions can be used
- Explain Pointers to Structures can be used

POINTERS

Pointer is the variable which stores the address of the another variable

Declaration of pointer :

```
syntax :   datatype  *pointername;
```

Example :

```
int *ptr;
char *pt;
```

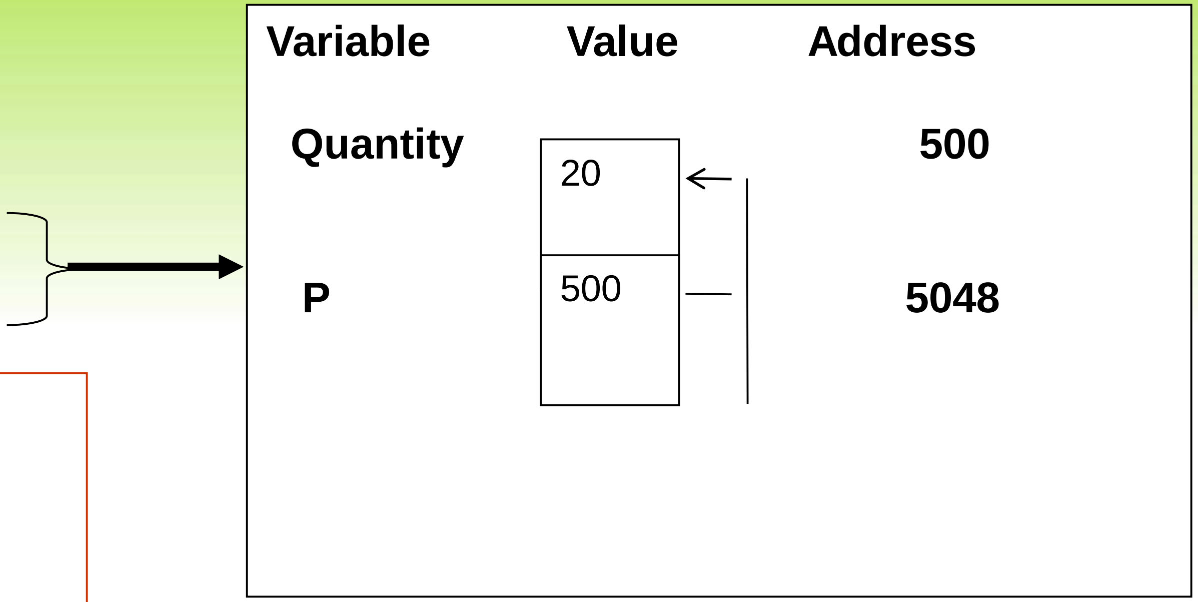
Assigning data to the pointer variable

syntax :

pointervariablename=&variablename;

For Example :

```
int  *a,b=10;
a=&b;
int *p,quantity=20;
p=&quantity;
```



For Example :

```
#include<stdio.h>
void main()
{
int val=100;
printf("%u\n",&val);
printf("%d\n",val);
printf("%d\n",*(&val));
}
```

Why are Pointers Used ?

- To return more than one value from a function
- To pass arrays & strings more conveniently from one function to another
- To manipulate arrays more easily by moving pointers to them, Instead of moving the arrays themselves
- To allocate memory and access it (Dynamic Memory Allocation)
- To create complex data structures such as Linked List, Where one data structure must contain references to other data structures

Advantages:

☺ A pointer enables us to access a variable that is defined outside the function.

☺ Pointers are more efficient in handling the data tables.

☺ Pointers reduce the length and complexity of a program.

☺ They increase the execution speed.

☺ The use of a pointer array to character strings results in saving of data storage space in memory.

☺ The function pointer can be used to call a function

☺ Pointer arrays give a convenient method for storing strings

☺Many of the ‘C’ Built-in functions that work with strings use Pointers

☺It provides a way of accessing a variable without referring to the variable directly

```
#include<stdio.h>
#include<conio.h>
void main()
{
int n=10;
int *ptr;
ptr=&n;
printf("Value of n is %d",n);
printf("\nAddress of n is %x",&n);
printf("\nAddres of pointer is %x",ptr);
printf("\nvalue stored in pointer is %d",*ptr);
getch();
}
```

Example 2

```
#include<stdio.h>
#include<stdlib.h>
#define size 10
void main()
{
char name[size];
char *i;
printf("\n Enter your name ");
gets(name);
i=name;
printf("\n Now printing your name is    :");
while(*i != '\0')
{
printf("%c",*i);
i++;
}
}
```

Explain how the variable can be accessed by pointer

```
#include<stdio.h>
#include<conio.h>
void main()
{
int r;
float a,*b;
clrscr();
printf("\n Enter the radius of the circle");
scanf("%d",&r);
a=3.14*r*r;
b=&a;
printf("\n The value of a=%f",a);
printf("\n The value of a=%u",&a);
printf("\n The value of b=%u",b);
printf("\n The value of a=%f",*b);
getch();
}
```

Pointer Arithmetic

- Addition and subtraction are the only operations that can be performed on pointers.

- Take a look at the following example :

```
int var, *ptr_var;
ptr_var = &var;
var = 500;
ptr_var++ ;
```

- Let var be an integer type variable having the value 500 and stored at the address 1000.

- Then ptr_var has the value 1000 stored in it. Since integers are 2 bytes long, after the expression “ptr_var++;” ptr_var will have the value as 1002 and not 1001.

Pointer Increment process example

```
#include<stdio.h>
#include<conio.h>
void main()
{
int *ptr;  //static memory allocation
clrscr();
ptr=(int *) malloc(sizeof(int));
*ptr=100;
printf("\n%u\n",ptr);  //address of ptr
printf("\n%d\n",*ptr);
ptr++;  // increment 2 bytes
*ptr=101;
printf("\n%d\n",*ptr);
free(ptr);
getch();
}
```

/* *__Note :__* int *ptr=100 means 100 is a address
 *ptr=100 or 101 means 100 is a value */

HINTS

- Each time a pointer is incremented, it points to the memory location of the next element of its base type.
- Each time it is decremented it points to the location of the previous element.
- All other pointers will increase or decrease depending on the length of the data type they are pointing to.
- Two pointers can be compared in a relational expression provided both the pointers are pointing to variables of the same type.

Increment & Decrement Operations Using Pointer

```
#include<stdio.h>
void main()
{
int i=100,*iptr;
float f=122.354,*fptr;
char c='d',*cptr;
iptr=&i;
fptr=&f;
cptr=&c;
printf("The values of the variables");
printf("\n%d",*iptr);
printf("\n%f",*fptr);
printf("\n%c",*cptr);
printf("\nStarting Address");
printf("\n%u",iptr);
printf("\n%u",fptr);
printf("\n%u",cptr);
iptr++;
fptr++;
cptr++;
printf("\nPointer Incrementing");
printf("\n%u",iptr);
printf("\n%u",fptr);
printf("\n%u",cptr);
iptr--;
fptr--;
```

```
cptr--;
printf("\nPointer Decrementing");
printf("\n%u",iptr);
printf("\n%u",fptr);
printf("\n%u",cptr);
getch();
}
```

The Pointer Special Operators

The Pointer Special Operators

& → Returns the memory address of the operand

* → It is the complement of &. It returns the value contained in the memory location pointed to by the pointer variable’s value

Write a C program to find the length of the string Using Pointer

```
#include<stdio.h>
#include<string.h>
void main()
{
char *text[20],*pt;
int len;
pt=*text;
printf("Enter the string");
scanf("%s",*text);
while(*pt!='\0')
{
putchar(*pt++);
}
len=pt -*text;
printf("\nLength of the string is %d",len);
}
```

```
/*Add Two Numbers using pointers*/
#include<stdio.h>
void main()
{
int a,b,*c=&a,*d=&b;
printf("Enter two numbers to be summed");
scanf("%d %d",&a,&b);
printf("The sum of two numbers=%d",c + d);
getch();
}
```

Pointers With Arrays

The address of an array element can be expressed in two ways :

- **By writing the actual array element preceded by the ambersand (&) sign.**
- **By writing an expression in which the subscript is added to the array name.**

```
/* Array Using Pointers */
#include<stdio.h>
#include<conio.h>
void main()
{
int b[100],*iptr;
iptr=&b;
clrscr();
printf("The initial value of iptr is %u\n",iptr);
iptr++;
printf("Incremented value of iptr is %u\n",iptr);
getch();
}
```

POINTERS IN ARRAYS Example 2

```
#include<stdio.h>
#include<conio.h>
void main()
{
int arr[]={10,20,30,40};
int *ptr,i;
clrscr();
ptr=arr;  // same as &arr[0];
printf("\n The Result of the array is ");
for(i=0;i<4;i++)
{
printf("%d\n",*ptr);
ptr++;
}
getch();
}
```

Output

```
10

20

30

40
```

Pointers as Function Arguments

When pointers are passed to a function :

- **The address of the data item is passed and thus the function can freely access the contents of that address from within the function**

- **In this way, function arguments permit data-items to be altered in the calling routine and the function.**

- **When the arguments are pointers or arrays, a call by reference is made to the function as opposed to a call by value for the variable arguments.**

FUNCTION POINTER EXAMPLE

```
#include<stdio.h>
#include<conio.h>

int (* function) (int,int);  /*function
pointer prototype */

int addition(int a,int b)
{
return a+b;
}

int subtraction(int a,int b)
{
return a-b;
}
void main()
{
int val;
/* assign the func. addition into the
function pointer */
function=addition;
/* Invoke the func. Addition  */
val=(function) (20,100);

printf("\n Addition result
=%d",val);

/* assign the function subtraction into
the function pointer */
function=subtraction;

/* invoke the func. subtraction &
syntax for function pointer call */

val=(function) (200,100);
printf("\nSubtraction result
=%d",val);
getch();
}
```

Pointers To Structures

- Pointers to structures are allowed in C, but there are some special aspects to structure pointers that a user of pointers to structures must be aware of.
- The following statement declares ptr as a pointer to data of that type -

```
struct book *ptr;
```

How the structure can be accessed by a pointer variable

```
#include<stdio.h>
#include<stdlib.h>
struct student
{
int roll_no;
char name[20];
float marks;
}st;
void main()
{
struct student *ptr;
printf("\n \t Enter the record");
printf("\n Enter the Roll Number");
scanf("%d",&st.roll_no);

printf("\n Enter the Name");
scanf("%s",st.name);

printf("\n Enter the Marks");
scanf("%f",&st.marks);
ptr=&st;
printf("\n display the details using
structure variables");

printf( "%d %s %f", st.roll_no, st.name,
st.marks);

printf("\n display the details using
pointer variables");
printf( "%d %s %f",ptr->roll_no,
ptr->name, ptr->marks);
}

void print_rec(int r,char n[ ],float m)
{
printf("\n You have Entered Following
record");
printf("\n %d %s %f",r,n,m);
}
```