UNIT IV STRUCTURES AND UNION 9

Structure - Nested structures – Pointer and Structures – Array of structures – Self referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility.

SELF REFERENTIAL STRUCTURES

A self referential structure is used to create data structures like linked lists, stacks, etc. Following is an example of this kind of structure:

```
struct struct_name
{
        datatype datatypename;
        struct_name * pointer_name;
};
```

A self-referential structure is one of the data structures which refer to the pointer to (points) to another structure of the same type. For example, a linked list is supposed to be a self-referential data structure. The next node of a node is being pointed, which is of the same struct type. For example,

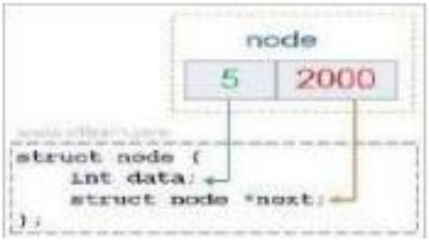
```
typedef struct listnode
{
        void *data;
        struct listnode *next;
} linked_list;
```

In the above example, the listnode is a self-referential structure – because the *next is of the type struct listnode.

SINGLY LINKED LIST

A linked list is a way to store a collection of elements. Like an array these can be character or integers. Each element in a linked list is stored in the form of a node.

Node:

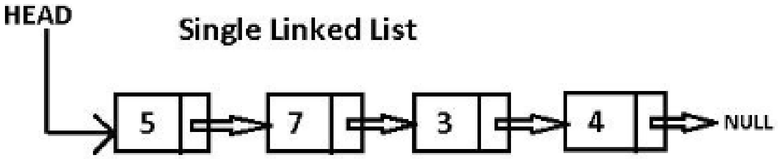


```
struct node {
    int data;
    struct node *next;
};
```

A node is a collection of two sub-elements or parts. A data part that stores the element and a next part that stores the link to the next node.

Linked List:

A linked list is formed when many such nodes are linked together to form a chain. Each node points to the next node present in the order. The first node is always used as a reference to traverse the list and is called HEAD. The last node points to NULL.



Declaring a Linked list :

In C language, a linked list can be implemented using structure and pointers.

```
struct LinkedList
{
        int data;
        struct LinkedList *next;
};
```

The above definition is used to create every node in the list. The data field stores the element and the next is a pointer to store the address of the next node. In place of a data type, struct LinkedList is written before next. That's because its a self-referencing pointer. It means a pointer that points to whatever it is a part of. Here next is a part of a node and it will point to the next node.

Creating a Node:

Let's define a data type of struct LinkedList to make code cleaner.

```
typedef struct LinkedList *node; //Define node as pointer of data type struct LinkedList
node createNode()
```

```
{
    node temp; // declare a node
    temp = (node)malloc(sizeof(struct LinkedList)); // allocate memory using malloc()
    temp->next = NULL;// make next point to NULL
    return temp;//return the new node
}
```

typedef is used to define a data type in C. malloc() is used to dynamically allocate a single block of memory in C, it is available in the header file stdlib.h. sizeof() is used to determine size in bytes of an element in C. Here it is used to determine size of each node and sent as a parameter to malloc. The above code will create a node with data as value and next pointing to NULL. Let's see how to add a node to the linked list:

```
    node addNode(node head, int value)
    {
        node temp,p;// declare two nodes temp and p
        temp = createNode();//createNode will return a new node with data = value
    and next pointing to NULL.
        temp->data = value; // add element's value to data part of node
        if(head == NULL)
        {
            head = temp; //when linked list is empty
        }
        else
        {
            p = head;//assign head to p
            while(p->next != NULL)
            {
                p = p->next;//traverse the list until p is the last node.The last
            node always points to NULL.
            }
            p->next = temp;//Point the previous last node to the new node created.
        }
        return head;
    }
```

Here the new node will always be added after the last node. This is known as inserting a node at the rear end.

This type of linked list is known as a simple or singly linked list. A simple linked list can be traversed in only one direction from head to the last node. The last node is checked by the condition :

p->next = NULL;

Here -> is used to access the next sub element of node p. NULL denotes no node exists after the current node , i.e. its the end of the list.

Traversing the list:

The linked list can be traversed in a while loop by using the head node as a starting reference:

```
node p;
p = head;
while(p != NULL)
{
        p = p->next;
}
```

TYPEDEF

The C programming language provides a keyword called typedef, by using this keyword you can create a user defined name for existing data type. Generally typedef are use to create an alias name (nickname).

Declaration of typedef

```
        typedef datatype alias_name;
```

Example:

```
typedef int tindata;
```

Example program:

```
#include<stdio.h>
#include<conio.h>
typedef int intdata;
void main()
{
        int a=10;
        integerdata b=20
        typedef intdata integerdata;//Intergerdata is again alias name of intdata
        integerdata s;
        s=a+b;
        printf("\nSum::%d",s);
        getch();
}
```

Output:

```
Sum::30
```

Code Explanation

In above program Intdata is an user defined name or alias name for an integer data Type. All properties of the integer will be applied on Intdata also. Integerdata is an alias name to existing user defined name called Intdata.

Advantages of typedef

- It makes the program more portable.
- Typedef makes complex declarations easier to understand.

typedef with struct

Take a look at below structure declaration

```
        struct student
        {
                int id;
                char *name;
                float percentage;
        };
        struct student a,b;
```

As we can see we have to include keyword struct every time you declare a new variable, but if we use typedef then the declaration will be as easy as below.

```
        typedef struct
        {
                int id;
                char *name;
                float percentage;
        }student;
        student a,b;
```

This way typedef makes your declaration simpler.