Program 1. Write a menu driven program to implement linear and binary search also find the location of its first occurrence.

Algorithm :

```
Step 1:  Start
Step 2:  Array element and the required variables are declared
a[10],  i , n, item, pos, j, mid, low, high, temp]

     functions are : lsearch(int a[],int item,int n)
                     bsearch(int a[], int item,int n)
Step 3: Accept the array elements
              For i=0 to n by 1
                 Read : a[i]
Step 4:  Accept the item to be searched
Function  definition:lsearch
 Step 1:   for i=0 to n by 1
               If a[i] = = item
                  pos ← i+1
                 [end of if]
              [end of for]
 Step 2:  if pos! =-1
              Write “item found and position ”
             else
               write “item not found”

 Function  definition:bsearch

 Step 1:  [Initialize low:=0 ,high = n-1]
 Step 2:  for i=0 to n-1 by 1
             if ( a[i] > a[j] )
               temp ← a[i]
               a[i] ← a[j]

 Step 3:   Display the array elements

 Step 4: While (low<=high) do
                   mid← ( low + high ) / 2
                   if (a[mid] = = item)
                          pos←mid+1
                    [end if]
                 else if ( a [mid] >item)
                          high←mid-1
                  else
                        low←mid+1
                  [End of while]
 Step 5: if pos! =-1
               Write “item found and position”
              else
                 Write “item not found”
```

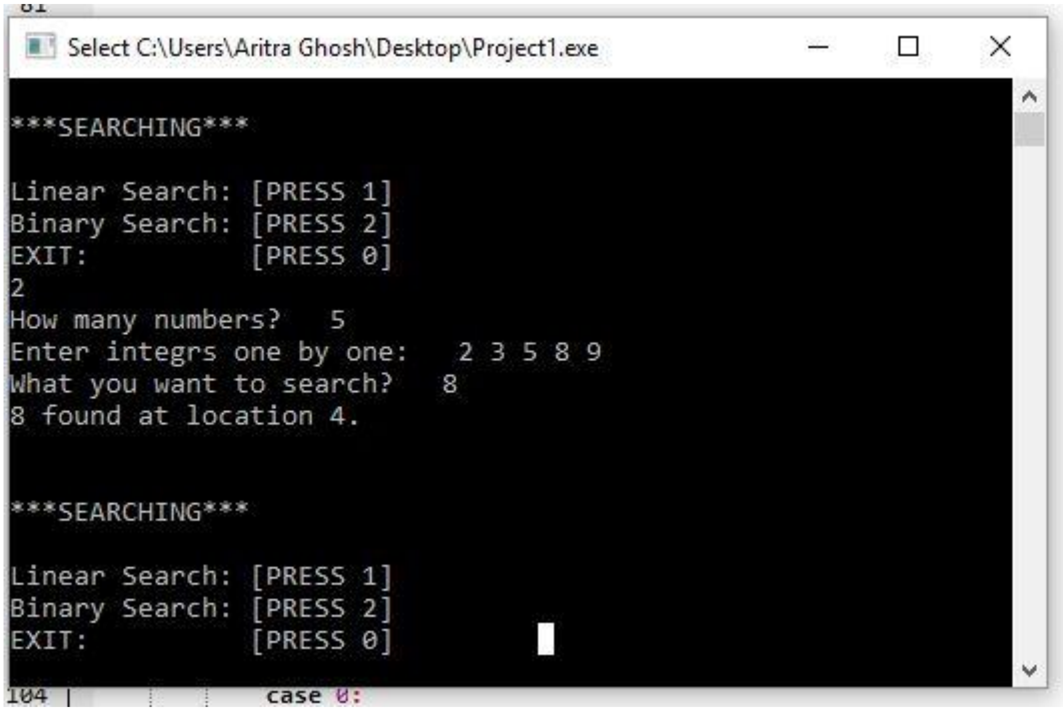
Main function:

Accept the choice from the user and call the functions in order to perform the operations according to users choice.

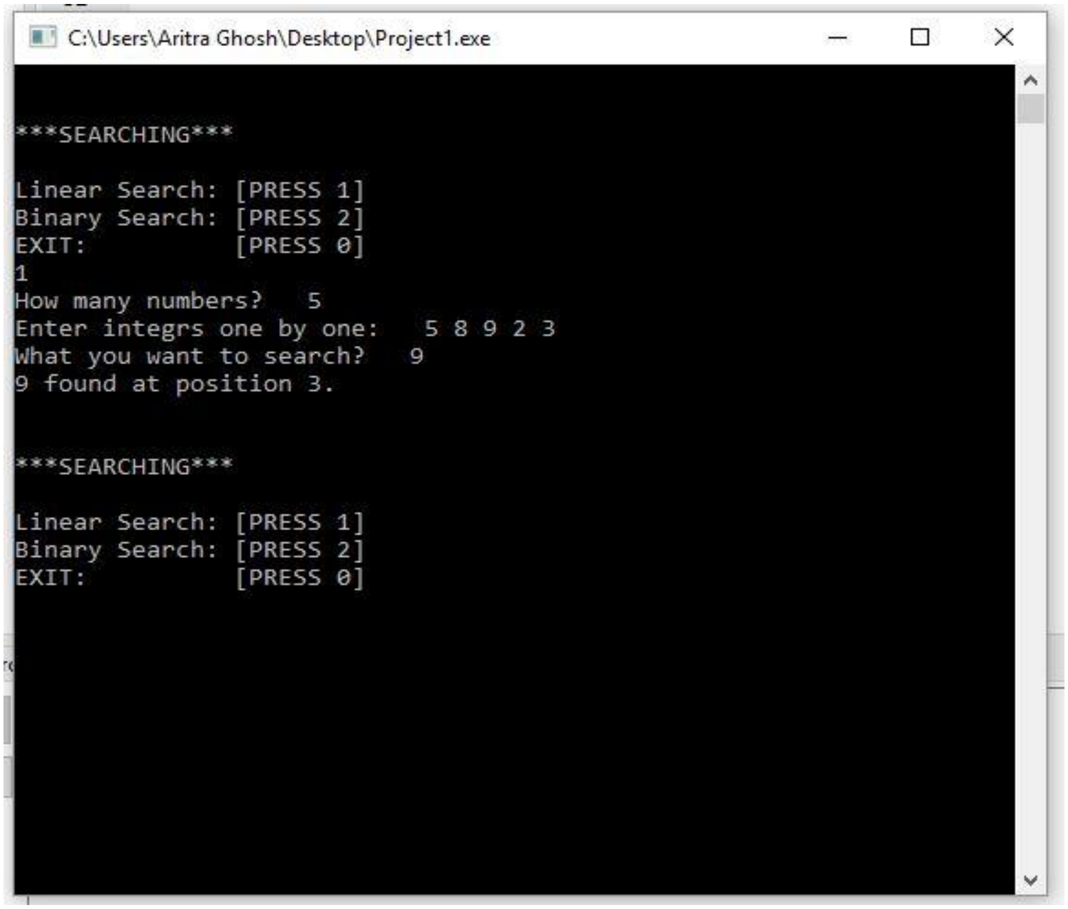
Program:

```
//Q.1: Write a menu driven program to implement linear and binary search also find the
//location of its first occurrence
#include <stdio.h>
#include <stdlib.h>

// Set of useful variables in stracture
struct st{
      int n,arr[100],key;
};

//Input data from keyboard and pass to main()
struct st getData(){
      struct st X;
      int i;
      printf("How many numbers?   ");
      scanf("%d", &X.n);
      printf("Enter integrs one by one:   ");
      for(i = 0; i<X.n; i++){
            scanf("%d", &X.arr[i]);
      }
      printf("What you want to search?   ");
      scanf("%d", &X.key);
      return X;
}

//Execute Linear Search
void linear_Search(int key, int n, int arr[])
{
      int i,flag = 0;
      for(i = 0; i <n; i++){
            if(key == arr[i]){
                  flag = 1;
              printf("%d found at position %d.\n",key,i+1);
            }
      }
      if(flag == 0)
         printf("%d not found in the list",key);
}
//Execute Binary Search
void binary_Search(int key, int n, int arr[])
{
      int i,j,temp;
      int low,high,mid,location;
      int flag = 0;
      for(i = 0; i<=n; ++i){
            for(j = i+1; j<=n; ++j){
                  if(arr[i] > arr[j]){
                        temp = arr[i];
                        arr[i] = arr[j];
                        arr[j] = temp;
                  }
            }
      }
    low = 0;
    high = n-1;
    while(low<=high){
        mid = (low + high) / 2;
            if(arr[mid] == key && n%2 == 0){
                  location = mid;
            flag = 2;
            break;
        }
        else if(arr[mid] == key && n%2 != 0){
            location = mid;
            flag = 1;
            break;
        }
        else if(arr[mid] > key)
            high = mid - 1;
            else if(arr[mid] < key)
            low = mid + 1;
    }
    if(flag == 1)
         printf("%d found at location %d.\n", key, location);
      else if(flag == 2)
         printf("%d found at location %d.\n", key, location+1);
    else
          printf("%d Not found! in the list.\n", key);
}

int main() {
      struct st X;
      int ch;

      //Select Choice
      while(1){
            printf("\n\n***SEARCHING***\n\n");
            printf("Linear Search: [PRESS 1]\n");
            printf("Binary Search: [PRESS 2]\n");
            printf("EXIT:          [PRESS 0]\n");

            scanf("%d", &ch);
            switch(ch){
                  case 1:
                        X = getData();
                        linear_Search(X.key,X.n,X.arr);
                        break;
                  case 2:
                        X = getData();
                        binary_Search(X.key,X.n,X.arr);
                        break;
                case 0:
                  exit(1);
                  return 0;
                default:
                  printf("\nWrong Choice !\n");
            }

      }
      return 0;
      system("PAUSE");
}
```

Output:



```

***SEARCHING***

Linear Search: [PRESS 1]
Binary Search: [PRESS 2]
EXIT:          [PRESS 0]
2
How many numbers?   5
Enter integrs one by one:   2 3 5 8 9
What you want to search?   8
8 found at location 4.


***SEARCHING***

Linear Search: [PRESS 1]
Binary Search: [PRESS 2]
EXIT:          [PRESS 0]
```



```


***SEARCHING***

Linear Search: [PRESS 1]
Binary Search: [PRESS 2]
EXIT:          [PRESS 0]
1
How many numbers?   5
Enter integrs one by one:   5 8 9 2 3
What you want to search?   9
9 found at position 3.


***SEARCHING***

Linear Search: [PRESS 1]
Binary Search: [PRESS 2]
EXIT:          [PRESS 0]
```

Program 2: A menu driven program to sort the array in ascending /descending order using a) Quick sort b) merge sort.

Algorithm :

```
Step 1: Declare the size of the array elements and declare the functions within
the functions and define them  and call them respectively
     functions are:

                    mergesort (int a[],int lb,int ub)
                     merge (int a[],int mid,int lb,int ub)
                     quicksort(int a[],int lb,int ub)

Step 2 : Read the array elements
            For i=0 to n by 1
               Read: a[i]
   function definition :quicksort

   Step 1:  declare the variables up,down,temp,key ,flag=1
   Step 2: if(lb<ub)
   Step 3:   Up←lb
          down←ub
           key←a[lb]
  Step 4: while(flag=1) do
             up←up+1
           Step 5: while(a[up]<key) do
             up←up+1
           [end of while]
   Step 6: while(a[down]>key) do
             Down←down-1
    Step7: If(up<down) then
              temp←a[up]
             a[up] ←a[down]
\             a[down] ←temp
              [end of if]
          else
           flag=0
             [end of while]
    Step 8: temp←a[lb]
    Step 9: a[lb] ←a[down]
    Step 10: a[down] ←temp
    Step 11: Call function quicksort(a,lb,down-1)
    Step 12: Call function quicksort(a,down+1,ub)

      Function definition : mergesort

  Step 1: declare mid
   Step 2:   if(lb<ub)
              mid←(lb+ub)/2
             call functions:
             mergesort(a,lb,mid)
             mergesort(a,mid+1,ub)
            merge(a,lb,mid,ub)
           [end of if ]
```

Function definition : merge

```
    Step 1: An array and the required variables are declared and initialized
            [ j, k, c[20] , i ← lb k ← lb, j←mid+1 ]
    Step 2 : while((i<=mid) && (j<=high)) do

                 if(a[i]<a[j])
                    c[k]←a[i]
                     k←k+1
                           i←i+1
                         [end of if]
                      else
                         c[k]←a[j]
                          k←k+1
                 j←j+1
                      [end of else]
            [end of while]
    Step 3: while(i<=mid) do
            c[k]←a[i]
             k←k+1
              i←i+1
           [end of while]
   Step 4:   while(j<=ub) do
              c[k]←a[j]
               k←k+1
               j←j+1
             [end of while ]
    Step 5:  For : i=lb to i<=k-1 by 1
                 a[i]←c[i]
```

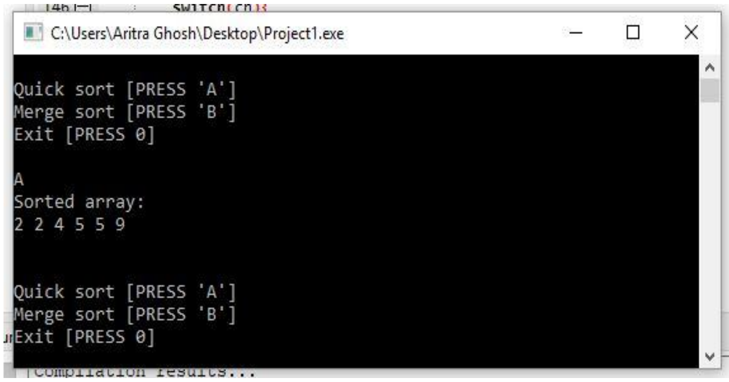
Main function :

Step 1: accept the choice from the user and call the
functions in order to perform the operations according to users choice.

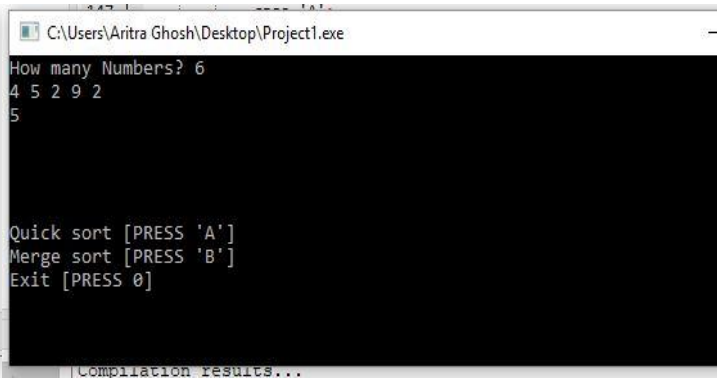
Program:

```
//Q.2: Write a menu driven program to sort the array in ascending/descending order
using
//a) Quick sort b) Merge sort
#include <stdio.h>
#include <stdlib.h>

// A utility function to swap two elements
void swap(int* a, int* b)
{
      int t = *a;
      *a = *b;
      *b = t;
}

int partition(int arr[], int low, int high)
{
      int j;
      int pivot = arr[high]; // pivot
      int i = (low - 1); // Index of smaller element

      for(j = low; j <= high- 1; j++)
      {
            // If current element is smaller than or
            // equal to pivot
            if (arr[j] <= pivot)
            {
                  i++; // increment index of smaller element
                  swap(&arr[i], &arr[j]);
            }
      }
      swap(&arr[i + 1], &arr[high]);
      return (i + 1);
}


void quickSort(int arr[], int low, int high)
{
      if (low < high)
      {
            /* pi is partitioning index, arr[p] is now
            at right place */
            int pi = partition(arr, low, high);

            // Separately sort elements before
            // partition and after partition
            quickSort(arr, low, pi - 1);
            quickSort(arr, pi + 1, high);
      }
}



void merge(int arr[], int l, int m, int r)
{
    int i, j, k;
    int n1 = m - l + 1;
    int n2 =  r - m;
    /* create temp arrays */
    int L[n1], R[n2];

    /* Copy data to temp arrays L[] and R[] */
    for (i = 0; i < n1; i++)
        L[i] = arr[l + i];
    for (j = 0; j < n2; j++)
        R[j] = arr[m + 1+ j];

    /* Merge the temp arrays back into arr[l..r]*/
    i = 0; // Initial index of first subarray
    j = 0; // Initial index of second subarray
    k = l; // Initial index of merged subarray
    while (i < n1 && j < n2)
    {
        if (L[i] <= R[j])
        {
            arr[k] = L[i];
            i++;
        }
        else
        {
            arr[k] = R[j];
            j++;
        }
        k++;
    }

    /* Copy the remaining elements of L[], if there
       are any */
    while (i < n1)
    {
        arr[k] = L[i];
        i++;
        k++;
    }

    /* Copy the remaining elements of R[], if there
       are any */
    while (j < n2)
    {
        arr[k] = R[j];
        j++;
        k++;
    }
}

/* l is for left index and r is right index of the
   sub-array of arr to be sorted */
void mergeSort(int arr[], int l, int r)
{
    if (l < r)
    {
        // Same as (l+r)/2, but avoids overflow for
        // large l and h
        int m = l+(r-l)/2;
        // Sort first and second halves
        mergeSort(arr, l, m);
        mergeSort(arr, m+1, r);

        merge(arr, l, m, r);
    }
}

/* Function to print an array */
void printArray(int arr[], int size)
{
      int i;
      for (i=0; i < size; i++)
            printf("%d ", arr[i]);
      printf("\n");
}

int main()
{
    int n,i;
    char ch;
      int arr[100];
      printf("How many Numbers? ");
      scanf("%d", &n);
      for(i = 0; i<n; i++){
            scanf("%d", &arr[i]);
      }
      printf("\n\n");
      while(1){
            printf("\n\nQuick sort [PRESS 'A']\nMerge sort [PRESS 'B']\nExit [PRESS 
0]\n\n");
            scanf("%c",&ch);
            switch(ch){
                  case 'A':
                        quickSort(arr, 0, n-1);
                        printf("Sorted array: \n");
                        printArray(arr, n);
                        break;

                  case 'B':
                        mergeSort(arr, 0, n - 1);
                        printf("\nSorted array is \n");
                  printArray(arr, n);
                  break;
            case '0':
                  printf("\nThans for Exit!\n");
                  exit(1);

                  }
            }

      return 0;
}
```

Output:



```

Quick sort [PRESS 'A']
Merge sort [PRESS 'B']
Exit [PRESS 0]

A
Sorted array:
2 2 4 5 5 9


Quick sort [PRESS 'A']
Merge sort [PRESS 'B']
Exit [PRESS 0]
```



```
How many Numbers? 6
4 5 2 9 2
5



Quick sort [PRESS 'A']
Merge sort [PRESS 'B']
Exit [PRESS 0]
```

Program 3: A menu driven program to create a linked list and to perform insert and delete operations.

Algorithm:

Step 1: Start

Step 2: The data and link part of the node is being declared within the structure and initially a pointer 'h' of node type which belongs to structure is being initialized to NULL with the help of constructor in the class 'list' and functions are being declared in the class and defined outside the class separately which are used in main function. The display function is used to display the elements in the singly linked list.

The function used are as follows:

Functions:

```
void create( )
void insert( )
void disp( )
int count( )
void del( )
```

Creation of node

```
Step 1: create a pointer 'h' to point to the structure called node
Step 2 : create a node dynamically i.e. allocate memory for storing this
         Structure Using malloc function and assign to 't'
           t←(struct node *) malloc (sizeof(struct node))
Step 3: When the node is being created information and link part should
        be given data
Step 4: When the link part of the node points to NULL, it indicates that the node
        Does not point to anything.
```

Creation of linked list

```
Step 1: Initially 'h' pointer points to NULL, indicating node is empty
Step 2: Another pointer 'p' points to first node i.e 'h'
        [Initialize p:=h]
Step 3: create a new node pointed by 'p' pointer
Step 4: Read in the data element and store the data field
        t->data=num
        t->link=NULL
Step 5: If (p = = NULL), then this new node is first node
          h←t
          p←h
      else
          p = p --→ link
          p→link = t
```

Insertion

```
Step 1: declare 2 variables I, pos, num
Step 2: declare 2 pointers p,t of node type
Step 3: count the no. of nodes
        call the function count( ) and assign to i
Step 4 :Accept the position
Step 5 : create a new node assign address to t
Step 6 : Enter the element to data field
```

```
                          t->data=num
                               t->link=NULL


              [Initialize p=h]
                   i.e p points  to first node
         Step 7:  If item to be inserted at first position
                   Then
                          h=t
                          t->link=p
                  else
                      p = p -→link
                      p→link = t
          Step 8 : while(i<pos-1) do Steps 9,10
                    step 9: p = p →link
                    step 10: i = i+1
         Step 11: [Make connection between new node and next node]
                 t→link = p→link
          Step 12:  p→link = t
                    [make connection between current pointer and new node]
               [End while ]
```

Deletion

```
        Step 1: declare variables I, pos and two pointers p,prev
         Step 2 : Call the function count and assign to i
                          I = count( )
         Step 3: accept position
                 [Initialize p:=h]
         Step 4: if pos = = 1 then
                  h = p → link
          else
          Step 5:  For  i= 1 to i < pos  by 1
                         prev = p
                         p = p → link
                     [ end of for loop ]
                      [ end of else ]
          Step 6:  Prev → link = p → link
                    Free ( p )
                  [ delete the node pointed by ‘p’ pointer ]
```

Counting the no. of nodes

```
    Step 1: declare and initialize pointer ‘p ’ to first node
                [ p =  h ]
    Step 2: initialize count = 0
     Step 3 : if p = =  NULL
               Write “ list is empty “
               Else
     Step 4 :    While ( p!=NULL) do Step 5
                Step 5: Count ← count + 1
                          p= p →link
                 Return count
                [ end of else ]
```

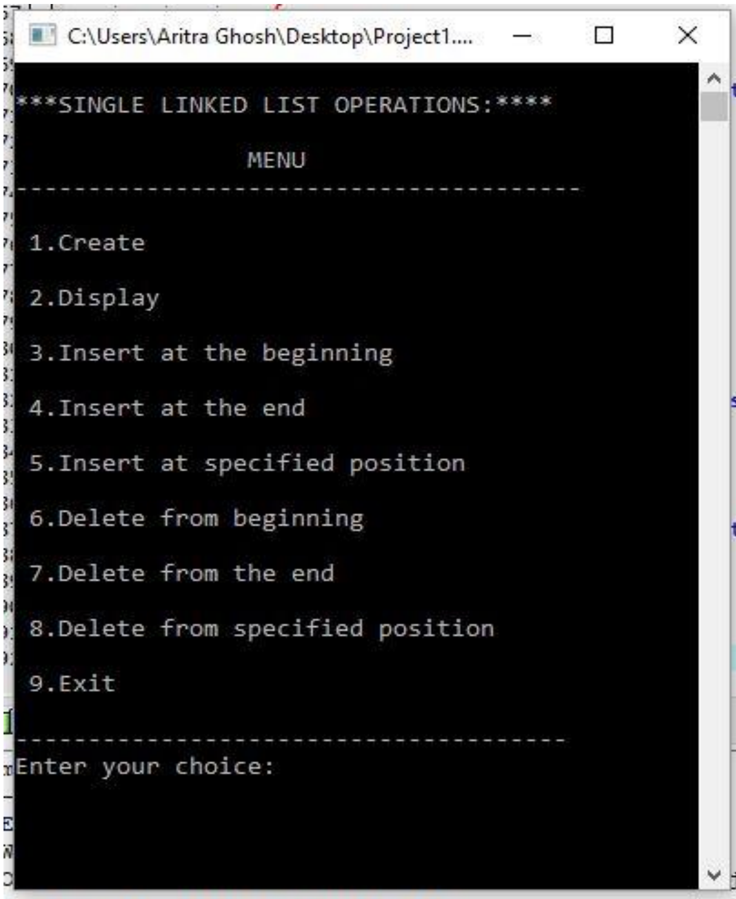
Main function:

accept the choice from the user and call the functions in order to perform the operations according to users choice.

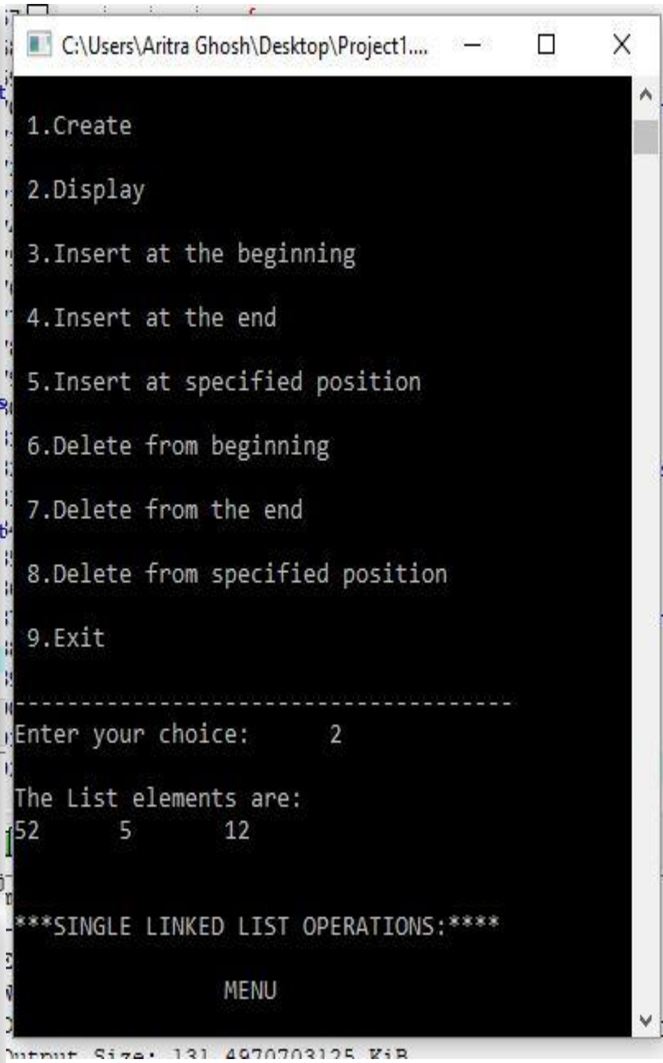
Program:

```
//03. Write a menu driven program to create a linked list and to perform insert and
delete
//operations

#include<stdio.h>
#include<stdlib.h>
/*----Function Prototypes-----*/
void create();
void display();
void insert_begin();
void insert_end();
void insert_pos();
void delete_begin();
void delete_end();
void delete_pos();
/*-----------------------------*/
struct node
{
        int info;
        struct node *next;
};
struct node *start=NULL;
int main()      //main() starts
{
        int choice;
        while(1){
                printf("\n***SINGLE LINKED LIST OPERATIONS:****\n");
                printf("\n                MENU                              \n");
                printf("--------------------------------------\n");
                printf("\n 1.Create     \n");
                printf("\n 2.Display    \n");
                printf("\n 3.Insert at the beginning    \n");
                printf("\n 4.Insert at the end  \n");
                printf("\n 5.Insert at specified position       \n");
                printf("\n 6.Delete from beginning      \n");
                printf("\n 7.Delete from the end        \n");
                printf("\n 8.Delete from specified position     \n");
                printf("\n 9.Exit       \n");
                printf("\n-------------------------------------\n");
                printf("Enter your choice:\t");
                scanf("%d",&choice);
                switch(choice)
                {
                        case 1:
                                        create();
                                        display();
                                        break;
                        case 2:
                                        display();
                                        break;
                        case 3:
                                        insert_begin();
                                        break;
                        case 4:
                                        insert_end();
                                        break;
                        case 5:
                                        insert_pos();
                                        break;
                        case 6:
                                        delete_begin();
                                        break;
                        case 7:
                                        delete_end();
                                        break;
                        case 8:
                                        delete_pos();
                                        break;
                        case 9:
                                        exit(0);
                                        break;
                        default:
                                        printf("\n Wrong Choice:\n");
                                        break;
                }//end of switch()
        }
        return 0;
}//end of main()
void create()
{
        struct node *temp,*ptr;
        temp=(struct node *)malloc(sizeof(struct node));
        if(temp==NULL)
        {
                printf("\nOut of Memory Space:\n");
                exit(0);
        }
        printf("\nEnter the data value for the node:\t");
        scanf("%d",&temp->info);
        temp->next=NULL;
        if(start==NULL)
        {
                start=temp;
        }
        else
        {
                ptr=start;
                while(ptr->next!=NULL)
                {
                        ptr=ptr->next;
                }
                ptr->next=temp;
        }
        printf("Linked List Created.\n");
}//end of create()
void display()
{
        struct node *ptr;
        if(start==NULL)
        {
                printf("\nList is empty:\n");
                return;
        }
        else
        {
                ptr=start;
                printf("\nThe List elements are:\n");
                while(ptr!=NULL)
                {
                        printf("%d\t",ptr->info );
                        ptr=ptr->next ;
                }//end of while
        }//end of else
        printf("\n\n");
}//end of display()
void insert_begin()
{
        struct node *temp;
        temp=(struct node *)malloc(sizeof(struct node));
        if(temp==NULL)
        {
                printf("\nOut of Memory Space:\n");
                return;
        }
        printf("\nEnter the data value for the node:\t" );
        scanf("%d",&temp->info);
        temp->next =NULL;
        if(start==NULL)
        {
                start=temp;
        }
        else
        {
                temp->next=start;
                start=temp;
        }
}//end of insert_begin()
void insert_end()
{
        struct node *temp,*ptr;
        temp=(struct node *)malloc(sizeof(struct node));
        if(temp==NULL)
        {
                printf("\nOut of Memory Space:\n");
                return;
        }
        printf("\nEnter the data value for the node:\t" );
        scanf("%d",&temp->info );
        temp->next =NULL;
        if(start==NULL)
        {
                start=temp;
        }
        else
        {
                ptr=start;
                while(ptr->next !=NULL)
                {
                        ptr=ptr->next ;
                }
                ptr->next =temp;
        }
}//end of insert_end
void insert_pos()
{
        struct node *ptr,*temp;
        int i,pos;
        temp=(struct node *)malloc(sizeof(struct node));
        if(temp==NULL)
        {
                printf("\nOut of Memory Space:\n");
                return;
        }
        printf("\nEnter the position for the new node to be inserted:\t");
        scanf("%d",&pos);
        printf("\nEnter the data value of the node:\t");
        scanf("%d",&temp->info) ;

        temp->next=NULL;
        if(pos==0)
        {
                temp->next=start;
                start=temp;
        }
        else
        {
                for(i=0,ptr=start;i<pos-1;i++)
                {
                        ptr=ptr->next;
                        if(ptr==NULL)
                        {
                                printf("\nPosition not found:[Handle with care]\n");
                                return;
                        }
                }
                temp->next =ptr->next ;
                ptr->next=temp;
        }//end of else
}//end of insert_pos
void delete_begin()
{
        struct node *ptr;
        if(ptr==NULL)
        {
                printf("\nList is Empty:\n");
                return;
        }
        else
        {
                ptr=start;
                start=start->next ;
                printf("\nThe deleted element is :%d\t",ptr->info);
                free(ptr);
        }
}//end of delete_begin()
void delete_end()
{
        struct node *temp,*ptr;
        if(start==NULL)
        {
                printf("\nList is Empty:");
                exit(0);
        }
        else if(start->next ==NULL)
        {
                ptr=start;
                start=NULL;
                printf("\nThe deleted element is:%d\t",ptr->info);
                free(ptr);
        }
        else
        {
                ptr=start;
                while(ptr->next!=NULL)
                {
                        temp=ptr;
                        ptr=ptr->next;
                }
                temp->next=NULL;
                printf("\nThe deleted element is:%d\t",ptr->info);
                free(ptr);
        }
}//end of delete_begin()
void delete_pos()
{
        int i,pos;
        struct node *temp,*ptr;
        if(start==NULL)
        {
                printf("\nThe List is Empty:\n");
                exit(0);
        }
        else
        {
                printf("\nEnter the position of the node to be deleted:\t");
                scanf("%d",&pos);
                if(pos==0)
                {
                        ptr=start;
                        start=start->next ;
                        printf("\nThe deleted element is:%d\t",ptr->info  );
                        free(ptr);
                }
                else
                {
                        ptr=start;
                        for(i=0;i<pos;i++)
                        {
                                temp=ptr;
                                ptr=ptr->next ;
                                if(ptr==NULL)
                                {
                                        printf("\nPosition not Found:\n");
                                        return;
                                }
                        }
                        temp->next =ptr->next ;
                        printf("\nThe deleted element is:%d\t",ptr->info );
                        free(ptr);
                }
        }//end of else
}//end of delete_pos()
```

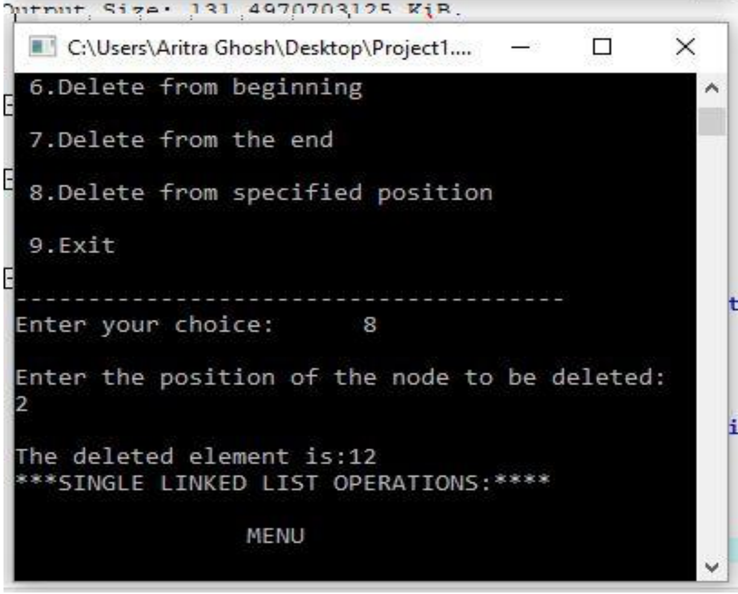
Output:



```
***SINGLE LINKED LIST OPERATIONS:****

                MENU
---------------------------------------

 1.Create

 2.Display

 3.Insert at the beginning

 4.Insert at the end

 5.Insert at specified position

 6.Delete from beginning

 7.Delete from the end

 8.Delete from specified position

 9.Exit

--------------------------------------
Enter your choice:
```



```
 1.Create

 2.Display

 3.Insert at the beginning

 4.Insert at the end

 5.Insert at specified position

 6.Delete from beginning

 7.Delete from the end

 8.Delete from specified position

 9.Exit

--------------------------------------
Enter your choice:     2

The List elements are:
52      5       12


***SINGLE LINKED LIST OPERATIONS:****

                MENU
```



```
 6.Delete from beginning

 7.Delete from the end

 8.Delete from specified position

 9.Exit

--------------------------------------
Enter your choice:      8

Enter the position of the node to be deleted:
2

The deleted element is:12
***SINGLE LINKED LIST OPERATIONS:****

                MENU
```

Program 4: A program to add two polynomials using a linked list.

Algorithm :

```
Step 1: Declare a structure_ element with the following parameters
            Coeff ,degree of type int, next of type element
 Step 2: Declare a structure  _poly with degree of type int and first of type element
```

Functions used:

(Create a new polynomial)
poly * new_poly ()
(Populate a new polynomial)
void   get_poly (poly *p)
(Display a given polynomial)
void   disp_poly (poly *p)
(Create a new polynomial as the sum of two given polynomials)
poly * add_poly (poly *p1, poly *p2)

Main Function

```
     Step 1: create two pointers p1,p2 of type poly
     Step 2: p1 ←new_poly()
             call function get_poly(p1)
             call function  disp_poly(p1)
     Step 3 : p2←new_poly()
              call function get_poly(p1)
               call function  disp_poly(p1)
      Step 4: disp_poly(add_poly(p1,p2)) ( this will display the sum of the two
               polynomials)
```

Functions :

1.poly * new_poly ()

```
        Step1:  poly *p
        Step 2:p ← (poly *) malloc (sizeof (poly))
        Step 3:p->degree ←0
        Step 4: p->first←NULL
        Step 5: return p
```

2.void get_poly (poly *p)

```
        Step 1: declare a, i, coef as integers
        Step 2: Declare *next,*current  of type element
        Step 3: Read the order of the first polynomial
        Step 4: p->degree ←a
        Step 5: next ←NULL
        Step 6:  for i←0 to  p->degree by 1
               Read the coefficient
               current ← (element *) malloc (sizeof(element))
               current->degree ←i
              current->coef  ←coef
             current->next  ←NULL
                if (next != NULL)
```

```
          current->next ←next
           next ←current
          [end of if]
         p->first ←next
         [end of for]
```

3. void disp_poly (poly *p)

```
  Step 1: Declare member as a pointer of type element
  Step 2: Write the order of the polynomial as p->degree
  Step 3:member ←p->first
  Step 4:while member != NULL do
             if (member -> next != NULL)
             write  member->coef, member->degree
               [end of if]
            else
              write  member->coef, member->degree
              member = member -> next
                 [end of while]
```

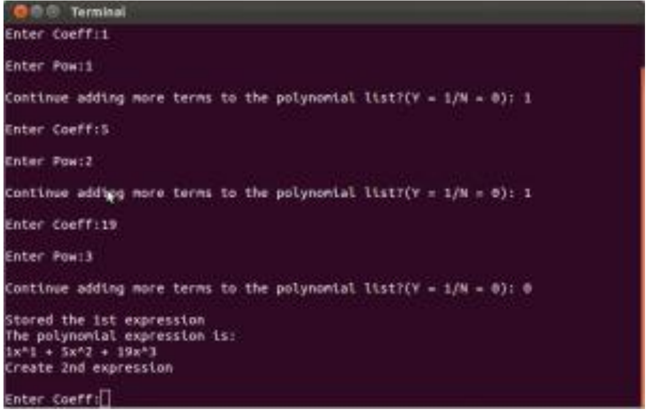
4. poly * add_poly (poly *p1, poly *p2)

```
  Step 1: declare  *higher, *lower, *result of type poly
  Step 2: declare  *member1, *member2, member3 of type element
  Step 3: if (p1->degree > p2->degree)
                 higher ←p1
                 lower  ←p2
                 [end of if]
            else
           higher ←p2
           lower  ←p1
             [end of else]
        Step 4:result ←higher
        Step 5:member1 ←result -> first
        Step 6:member2 ←lower  -> first
        Step 7:while (member1 != NULL)
                  if (member1->degree == member2->degree)
                     member1->coef ←member2->coef+ member1->coef
                     member2 ←member2->next
                      [end of if]
                    member1 ←member1->next
                  [end of while]
         Step 8:return(result)
```

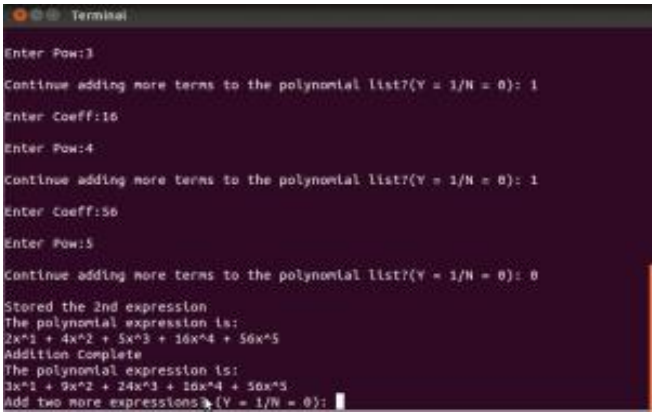
Program :

```
#include<stdio.h>
#include<stdlib.h>
typedef struct link {
    int coeff;
    int pow;
    struct link * next;
} my_poly;

/** The prototypes */
void my_create_poly(my_poly **);
void my_show_poly(my_poly *);
void my_add_poly(my_poly **, my_poly *, my_poly *);

/**
 * The simple menu driven main function
 */
int main(void) {
    int ch;
    do {
        my_poly * poly1, * poly2, * poly3;

        printf("\nCreate 1st expression\n");
        my_create_poly(&poly1);
        printf("\nStored the 1st expression");
        my_show_poly(poly1);

        printf("\nCreate 2nd expression\n");
        my_create_poly(&poly2);
        printf("\nStored the 2nd expression");
        my_show_poly(poly2);

        my_add_poly(&poly3, poly1, poly2);
        my_show_poly(poly3);

        printf("\nAdd two more expressions? (Y = 1/N = 0): ");
        scanf("%d", &ch);
    } while (ch);
    return 0;
}

void my_create_poly(my_poly ** node) {
    int flag; //A flag to control the menu
    int coeff, pow;
    my_poly * tmp_node; //To hold the temporary last address
    tmp_node = (my_poly *) malloc(sizeof(my_poly)); //create the first node
    *node = tmp_node; //Store the head address to the reference variable
    do {
        //Get the user data
        printf("\nEnter Coeff:");
        scanf("%d", &coeff);
        tmp_node->coeff = coeff;
        printf("\nEnter Pow:");
        scanf("%d", &pow);
        tmp_node->pow = pow;
        //Done storing user data

        //Now increase the Linked on user condition
        tmp_node->next = NULL;

        //Ask user for continuation
        printf("\nContinue adding more terms to the polynomial list?(Y = 1/N = 0): ");
        scanf("%d", &flag);
        //printf("\nFLAG: %c\n", flag);
        //Grow the linked list on condition
        if(flag) {
            tmp_node->next = (my_poly *) malloc(sizeof(my_poly)); //Grow the list
            tmp_node = tmp_node->next;
            tmp_node->next = NULL;
        }
    } while (flag);
}

/**
 * The show polynomial function
 * Prints the Polynomial in user readable format
 * @param my_poly * node The polynomial linked list
 * @return void
 */
void my_show_poly(my_poly * node) {
    printf("\nThe polynomial expression is:\n");
    while(node != NULL) {
        printf("%dx^%d", node->coeff, node->pow);
        node = node->next;
        if(node != NULL)
            printf(" + ");
    }
}

/**
 * The polynomial add function
 * Adds two polynomial to a given variable
 * @param my_poly ** result Stores the result
 * @param my_poly * poly1 The first polynomial expression
 * @param my_poly * poly2 The second polynomial expression
 * @return void
 */
void my_add_poly(my_poly ** result, my_poly * poly1, my_poly * poly2) {
    my_poly * tmp_node; //Temporary storage for the linked list
    tmp_node = (my_poly *) malloc(sizeof(my_poly));
    tmp_node->next = NULL;
    *result = tmp_node; //Copy the head address to the result linked list

    //Loop while both of the linked lists have value
    while(poly1 && poly2) {
        if (poly1->pow > poly2->pow) {
            tmp_node->pow = poly1->pow;
            tmp_node->coeff = poly1->coeff;
            poly1 = poly1->next;
        }
        else if (poly1->pow < poly2->pow) {
            tmp_node->pow = poly2->pow;
            tmp_node->coeff = poly2->coeff;
            poly2 = poly2->next;
        }
        else {
            tmp_node->pow = poly1->pow;
            tmp_node->coeff = poly1->coeff + poly2->coeff;
            poly1 = poly1->next;
            poly2 = poly2->next;
        }

        //Grow the linked list on condition
        if(poly1 && poly2) {
            tmp_node->next = (my_poly *) malloc(sizeof(my_poly));
            tmp_node = tmp_node->next;
            tmp_node->next = NULL;
        }
    }

    //Loop while either of the linked lists has value
    while(poly1 || poly2) {
        //We have to create the list at beginning
        //As the last while loop will not create any unnecessary node
        tmp_node->next = (my_poly *) malloc(sizeof(my_poly));
        tmp_node = tmp_node->next;
        tmp_node->next = NULL;

        if(poly1) {
            tmp_node->pow = poly1->pow;
            tmp_node->coeff = poly1->coeff;
            poly1 = poly1->next;
        }
        if(poly2) {
            tmp_node->pow = poly2->pow;
            tmp_node->coeff = poly2->coeff;
            poly2 = poly2->next;
        }
    }

    printf("\nAddition Complete");
}
```

Output:



```
Enter Coeff:1

Enter Pow:1

Continue adding more terms to the polynomial list?(Y = 1/N = 0): 1

Enter Coeff:5

Enter Pow:2

Continue adding more terms to the polynomial list?(Y = 1/N = 0): 1

Enter Coeff:19

Enter Pow:3

Continue adding more terms to the polynomial list?(Y = 1/N = 0): 0

Stored the 1st expression
The polynomial expression is:
1x^1 + 5x^2 + 19x^3
Create 2nd expression

Enter Coeff:
```



```
Enter Pow:3

Continue adding more terms to the polynomial list?(Y = 1/N = 0): 1

Enter Coeff:16

Enter Pow:4

Continue adding more terms to the polynomial list?(Y = 1/N = 0): 1

Enter Coeff:56

Enter Pow:5

Continue adding more terms to the polynomial list?(Y = 1/N = 0): 0

Stored the 2nd expression
The polynomial expression is:
2x^1 + 4x^2 + 5x^3 + 16x^4 + 56x^5
Addition Complete
The polynomial expression is:
3x^1 + 9x^2 + 24x^3 + 16x^4 + 56x^5
Add two more expressions? (Y = 1/N = 0):
```

Program 5: A menu driven program to perform insert and delete operations in a circular linked list.

Algorithm:

Step 1: The data and link part of the node is being declared within the structure and initially a pointer ‘h’ of node type which belongs to structure is being initialized to NULL with the help of constructor in the class clist and functions are being declared in the class and defined outside the class separately which are used in main function. The display function is used to display the elements in the circular list. The functions used are as follows:

Functions:

```
    void create( )
      void insert( )
      void disp( )
      int count( )
      void del( )
```

Creation of node

Step 1: Declaration two pointers‘t’, ‘p’ of node type, three variables i, n, num and initialization of first node i.e. head node ‘h’ to NULL and pointer p stores the address of the head node

```
         h←NULL
           p ← h
Step 2: accept the number of elements to be added
Step 3:  for I = 1 to i<=n by 1
        [accept the data element to be added within the loop ]
         allocate the memory for the node to be created using malloc function and
        the pointer t holds the address of the memory  and input the element in the
         data part of the node which is being created by the ‘t’ pointer.
           t = (struct node*)malloc(sizeof(struct node))
             t->data=num
Step 4:   The link part of the first node is being pointed to NULL
             if(p = = NULL) then
                    h = t
                        t->link = h
                        p = h
                [end of if]
          else
            while(p->link != h) do Step 5
                   step 5 : p = p->link
                        t->link = h
                            p->link = t
                [end of else]
          [end of for loop ]
```

Insertion into the circular linked list

```
Step 1: declare 2 variables I, pos, num
Step 2: declare 2 pointers p, t, q of node type
Step 3: count the no. of nodes
Call the function count and assign to i
                   I = count ( )
Step 3: Accept the position and check for valid position
```

```
[allocate the memory for node pointed by 't' pointer using malloc function so     pointer 't' holds the address of the node]
        t←(struct node *) malloc (sizeof(struct node))
Step 4: Enter the element to data field
                        t->data=num
       [Initialize p:=q= h]
                i.e both  p and q holds the address of  first or head node ]
Step 5: if (pos == 1) then
             [address of data field is stored in first node]
                         h = t;
        if (p != NULL) then
           [address of pointer  'p' is stored in link part of the node]
                  t->link = p
       else
             [ hold the address of  head node in link part]
                     t->link = h
                  [both 'q' and  'p' pointer addresses are same]
                            p = q;
        if (p != NULL) then
                        while(p->link != q) do step 6
Step 6:
                  [ store the address of next node link part into ' p ' pointer and address ]
                       Head node is stored in link]
                               p=p->link;
                                    p->link = h;
                       [end of if ]
              [end of outer if structure ]
            else
                  if(pos = = i+1) then
                     while(p->link!=h) do step 7
Step 7: [store the address of the link field of the node into p pointer,
                         link part address of 't' pointer into link and address head
                          node is stored in link part of 't' pointer]
                         p=p->link
                         p->link=t     t->link=h
                  [end of if structure ]
         else
                     for  i=1 to i<pos-1 by 1
                           p = p->link;
                  [make connection between new node and next node and current pointer                      and new
node ]
                        t->link=p->link
                            p->link=t
                    [end of inner  and  outer else structure ]
```

Deletion of node

```
Step 1: Declare variables I, pos and three  pointers p, prev, q of node type
Step 2: Call the function count and assign to i

  I = count ( )
        If (I = = 0) then



        Write "list is empty"
```

```
Step 3: Accept position and check for valid position i.e.
            [Initialize p = q =h i.e both p and q pointers stores the address
                   head node]
                 if (pos = = 1 and count ( ) = = 1) then
                         [ head node pointer points to NULL ]
                           H = NULL
                         Delete the 'p' pointer which has the current node address
                          [end of if]
Step4:    If (pos == 1) then
                    Address of link is stored in head node pointer
                   h= p->link
                      While (p->link!=q) do step 5
                      Step 5: the link part address is stored in 'p' pointer and now the
                              head node  Address is stored in link, now delete the
                              node pointed by 'q' pointer
                      p=p->link
                     p->link =h
                    free (q)
                [end of if ]
Step 6:  Within the for loop the address of node pointed by 'p' pointer is
          stored  into prev pointer  hich points to previous node data field
         and the  address of the link  Part is stored is now stored in 'p' pointer.

           For  i= 1 to I < pos  by 1
                       Prev = p
                        P = p → link
                   [ end of for loop ]

                Delete the 'p' pointer which is pointing to current node after
                 establishing the link between prev and p pointer
                          Prev->link=p->link
                    [ end of else ]
```

Counting the no. of nodes

```
  Step 1: Declare and initialize pointer 'p ' to first node
               [ p =  h ]
  Step 2: initialize count = 0
        Step 3: if p = = NULL
                Write "list is empty "
              else
 Step 4:    While ( p!=NULL) do Step 5
 Step5:      Count ← count + 1
                       P = p →link
                    Return count
           [end of else]
```

Main function:

Create an object of the class, accept the choice from the user and call the functions in order to perform the operations according to users choice.

Program :

```
#include <stdio.h>
#include<process.h>
#include<stdlib.h>
#include<conio.h>
struct node
{
      int data;
      struct node *link;
}*h=NULL;
 typedef struct node NODE;

 void create();
      void insert();
      void disp();
      int count();
      void del();

void create()
{
      NODE *t,*p;
      int i,n,num;

      p = h;
       printf("\n Enter the number of elements to be added:");
      scanf("%d",&n);
      for(i = 1;i<=n;i++)
      {                  printf("enter the data");
             scanf("%d",&num);
                  t = (struct node*)malloc(sizeof(struct node));
            t->data=num;
            if(p == NULL)
            {
                  h = t;
                  t->link = h;
                  p = h;
            }
            else
            {
                  while(p->link != h)
                        p = p->link;
                  t->link = h;
                  p->link = t;
            }
      }
            printf("\n The linked list is: ");
            disp();
}
void insert()
{
      int  i, pos, num;
      NODE *p,*q,*t;
      i = count();
      printf("\n Enter the location: ");
       scanf("%d",&pos);
      if(pos < 1 || pos > i+1)
            printf("\n Invalid location ");
      else
      {
             printf("\n The linked list before insertion :");
            disp();
            t = (struct node*)malloc(sizeof(struct node));
            printf("\n Enter the value:");
            scanf("%d",&num);
            t->data = num;
            p = q = h;

            if(pos == 1)
            {
                  h=t;
                  if (p != NULL)
                        t->link = p;
                  else
                        t->link = h;
                  p = q;
                  if(p != NULL)
                  {
                        while(p->link != q)
                              p=p->link;
                        p->link = h;
                  }
            }
            else
            {
                  if(pos == i+1)
                  {
                        while(p->link!=h)
                              p=p->link;

                        p->link=t;
                        t->link=h;
                  }
                  else
                  {
                        for(i=1;i<pos-1;i++)
                              p = p->link;
                        t->link=p->link;
                        p->link=t;
                  }
            }
 printf("\n Linked list after insertion:");
            disp();
      }
}
 void del()
{
      int i,pos;
      NODE *p,*prev,*q;
      i = count();

      if(i==0)
      printf("\n Linked list is empty");
      else
      {
            printf("\n Enter the position");
             scanf("%d",&pos);
            if(pos<1 || pos >i)
                  printf("\n Invalid position");
            else
            {
                   printf("\n The linked list before deletion:");
                  disp();
                  p=q=h;
                  if((pos==1) && count() == 1)
                  {
                        h=NULL;
                        free(p);
                  }
                  else
                  {
                        if(pos == 1)
                        {
                              h = p->link;
                              while(p->link != q)
                                    p=p->link;
                              p->link = h;
                              free(q);
                        }
                               else
                        {
                              for(i=1;i<pos;i++)
                              {
                                    prev=p;
                                    p=p->link;
                              }
                              prev->link=p->link;
free(p);
                        }
                  }
                   printf("\n Linked list after deletion :");
                  disp();
            }
            }
      }
void disp()
{
      NODE *p=h;

      if(p==NULL)
            printf("\n Linked list is empty");
      else
      {
            do
            {
            printf("%d",p->data);
            p=p->link;
            }while(p!=h);
            }
}
int count()
{
       NODE *p=h;
      int cnt=0;
      if(p==NULL)
```

```
            return 0;
      else
      {
            do
            {
                  cnt++;
                  p=p->link;
            }while(p!= h);
            return cnt;
      }
}
void main()
{
      int c=0;
      clrscr();
      do
      {
            printf("\n 1.Create");
                  printf("\n 2.Insert");
             printf("\n 3.Delete");
             printf("\n 4.Display");
             printf("\n 5.Exit");
             printf("\n Enter your choice: ");
            scanf("%d",&c);
            switch(c)
            {
                  case 1:
                         create();
                        break;
                  case 2:
                         insert();
                        break;
                  case 3:
                        del();
                        break;
                  case 4:
                        if(count() == 0)
                              printf("\n Linked list is empty");
                        else
                               disp();
                        break;
                  case 5:
                        exit(0);
            }
      }while(c!=5);
      getch();
}
```

Output:

```
1. Create
 2. Insert
 3. Delete
 4. Display
 5. Exit
 Enter your choice: 4
 Linked list is empty
 1. Create
 2. Insert
 3. Delete
 4. Display
 5. Exit
 Enter your choice: 1
 Enter the number of elements to be added 4
 Enter the 1 data : 10
 Enter the 2 data : 15
 Enter the 3 data :  20
Enter the 4 data :  30
 The linked list is    10     15     20     30
 1. Create
 2. Insert
 3. Delete
 4. Display
 5. Exit
 Enter your choice: 2
 Enter the position: 1
 The linked list before insertion :    10     15     20     30
 Enter the value 5
 Linked list after insertion    5     10     20     25     30
1. Create
 2. Insert
 3. Delete
 4. Display
 5. Exit
Enter your choice: 3
Enter the position 3
The linked list before deletion:      5     10     20     25     30
 Linked list after deletion :  5     10     25     30
 1. Create
 2. Insert
 3. Delete
 4. Display
 5. Exit
```

```
Enter your choice: 4
        5      10      25      30
1. Create
 2. Insert
 3. Delete
 4. Display
 5. Exit
 Enter your choice:5
```

Program 6: A menu driven program to perform operations on a stack (linked list implementation).

Algorithm :

Step 1:The data part of the node and 'link' pointer of node type is being declared within the structure a pointer named ' top ' is being declared in the class stack is initialized to NULL with the help of constructor and various functions are declared within the class and defined outside the class separately which are used in main function. The display function is used to display the elements in the stack.

The functions used are as follows:

```
    void push( )
    void pop( )
    void disp( )
    void stacktop( )
```

Function definitions:

1.Push ( ):

```
Step 1: Declare a pointer of node type
Step 2: Accept the value
Step 3: Allocate the memory for the node using malloc function
        and pointer 't' stores the address of node
        newnode= (node *) malloc (sizeof(node))
Step 4: Insert the element into the data field of the node pointed by newnode
        newnode→data=item
Step 5: newnode->link=top
  Step 6:top=newnode
[ end of function]
```

2.pop ( )

```
Step 1:  declare the pointer currnode of node type
Step 2:  if (top = = NULL)
         Write : "stack underflow"
 else
            currnode= top
            ele=currnode->info
           top=currnode->link
[end of else structure ]
[end of function]
```

3.Stacktop ( )

```
Step 1:
       If (top = = NULL)
           Write "Stack underflow "
       Else
           Display the top element pointed by 'top' pointer.
             top→info
```

Main function:

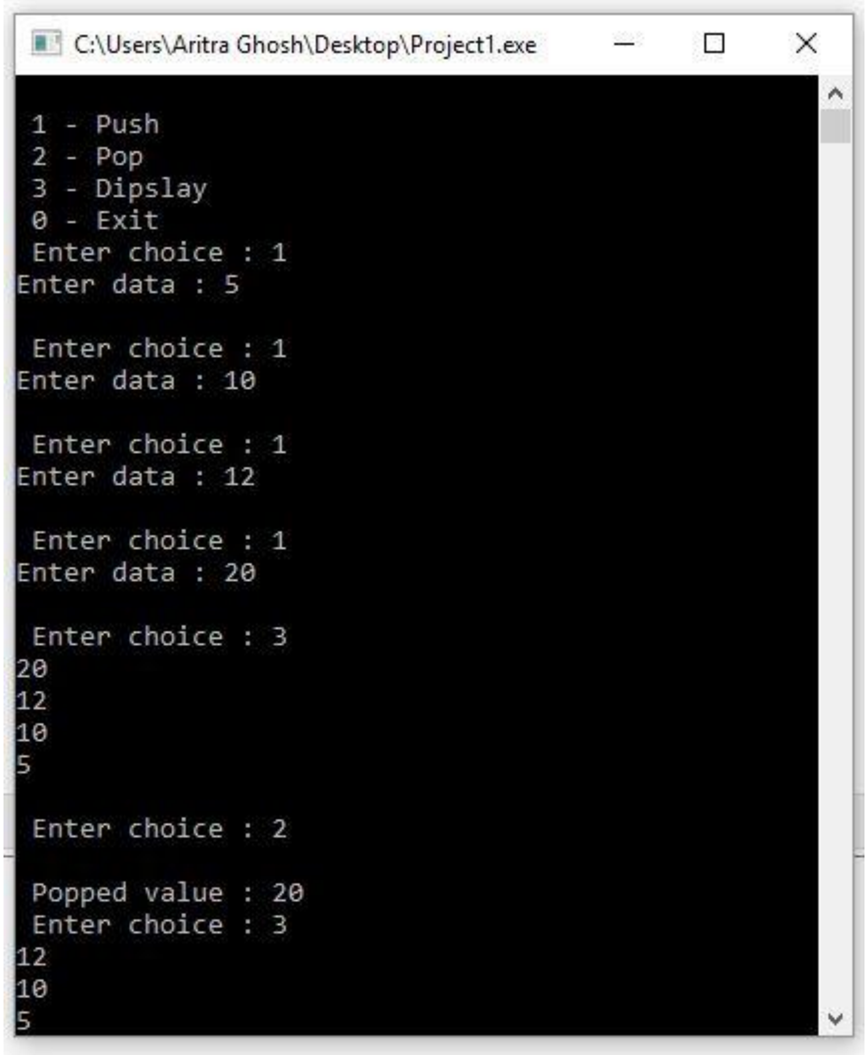
Accept the choice from the user and call the functions in order to perform the operations according to users choice.

Program :

```
/*
 * 6. Write a menu driven program to perform operations on a stack (linked list
implementation)
 */
#include <stdio.h>
#include <stdlib.h>

struct node
{
    int info;
    struct node *ptr;
}*top,*top1,*temp;

int count = 0;
/* Create empty stack */
void create()
{
    top = NULL;
}
/* Push data into stack */
void push(int data)
{
    if (top == NULL)
    {
        top =(struct node *)malloc(1*sizeof(struct node));
        top->ptr = NULL;
        top->info = data;
    }
    else
    {
        temp =(struct node *)malloc(1*sizeof(struct node));
        temp->ptr = top;
        temp->info = data;
        top = temp;
    }
    count++;
}

/* Pop Operation on stack */
void pop()
{
    top1 = top;

    if (top1 == NULL)
    {
        printf("\n Error : Trying to pop from empty stack");
        return;
    }
    else
        top1 = top1->ptr;
    printf("\n Popped value : %d", top->info);
    free(top);
    top = top1;
    count--;
}

/* Display stack elements */
```

```
void display()
{
    top1 = top;

    if (top1 == NULL)
    {
        printf("Stack is empty");
        return;
    }

    while (top1 != NULL)
    {
        printf("%d\n", top1->info);
        top1 = top1->ptr;
    }
 }



int main()
{
    int no, ch, e;

    printf("\n 1 - Push");
    printf("\n 2 - Pop");
    printf("\n 3 - Dipslay");
    printf("\n 0 - Exit");

    create();

    while (1)
    {
        printf("\n Enter choice : ");
        scanf("%d", &ch);

        switch (ch)
        {
        case 1:
            printf("Enter data : ");
            scanf("%d", &no);
            push(no);
            break;
        case 2:
            pop();
            break;
        case 3:
            display();
            break;
        case 0:
            exit(0);
        default :
            printf(" Wrong choice!, Please enter correct value.");
            break;
        }
    }
    return 0;
    system("PAUSE");
}
```

Output:



```
 1 - Push
 2 - Pop
 3 - Dipslay
 0 - Exit
 Enter choice : 1
Enter data : 5

 Enter choice : 1
Enter data : 10

 Enter choice : 1
Enter data : 12

 Enter choice : 1
Enter data : 20

 Enter choice : 3
20
12
10
5

 Enter choice : 2

 Popped value : 20
 Enter choice : 3
12
10
5
```

Program 7: A menu driven recursive program to a) Find factorial of a given number b) Generate first N terms of a fibonacci c) GCD of three numbers.

Algorithm :

```
Step 1: declaration of  functions
                        long fact (int)
                           int gcd (int,int)
                           int fibo (int)
Main function:
 Step 1: Declare the variables ch ,f ,n ,t, i and initialize ch = 0 and f =0
 Step 2: accept choice from user
               do
 Step 3 until choice entered by user is ( ch < = 3 )
         Choice 1: Accept any  positive number
                          call the function fact

        Choice 2: Accept the number of elements in series within for loop
                       for i=1 to i<=n by 1
                            call the function fibo (i)
                         read the data elements
       Choice 3:
                        Accept any 3 values to variables a, b, c
                        If(a==0||b==0||c==0)
                      Write ”invalid input”
                         Else
                            Call the function gcd (a,b) and assign to t
                             t = gcd (a,b)
                        call the function gcd(t, c) and assign to t
                            t=gcd (t,c)
                 [end of main function ]
Function definitions
    1.long fact ( int n)
 Step 1:
           if ( n = = 0)
             return 1
        Step 2:
            else
                 return ( n * (fact(n-1)
[ end of function ]
2. int fibo (int i)
  Step 1:
        if ( i = = 1 )
          return 0
   Step 2:
      if ( i= = 2 )
          return 1
 Step 3:
   else
      return fibo (i-1) + fibo (i-2)
     [end of else  structure]
[end of function]
```

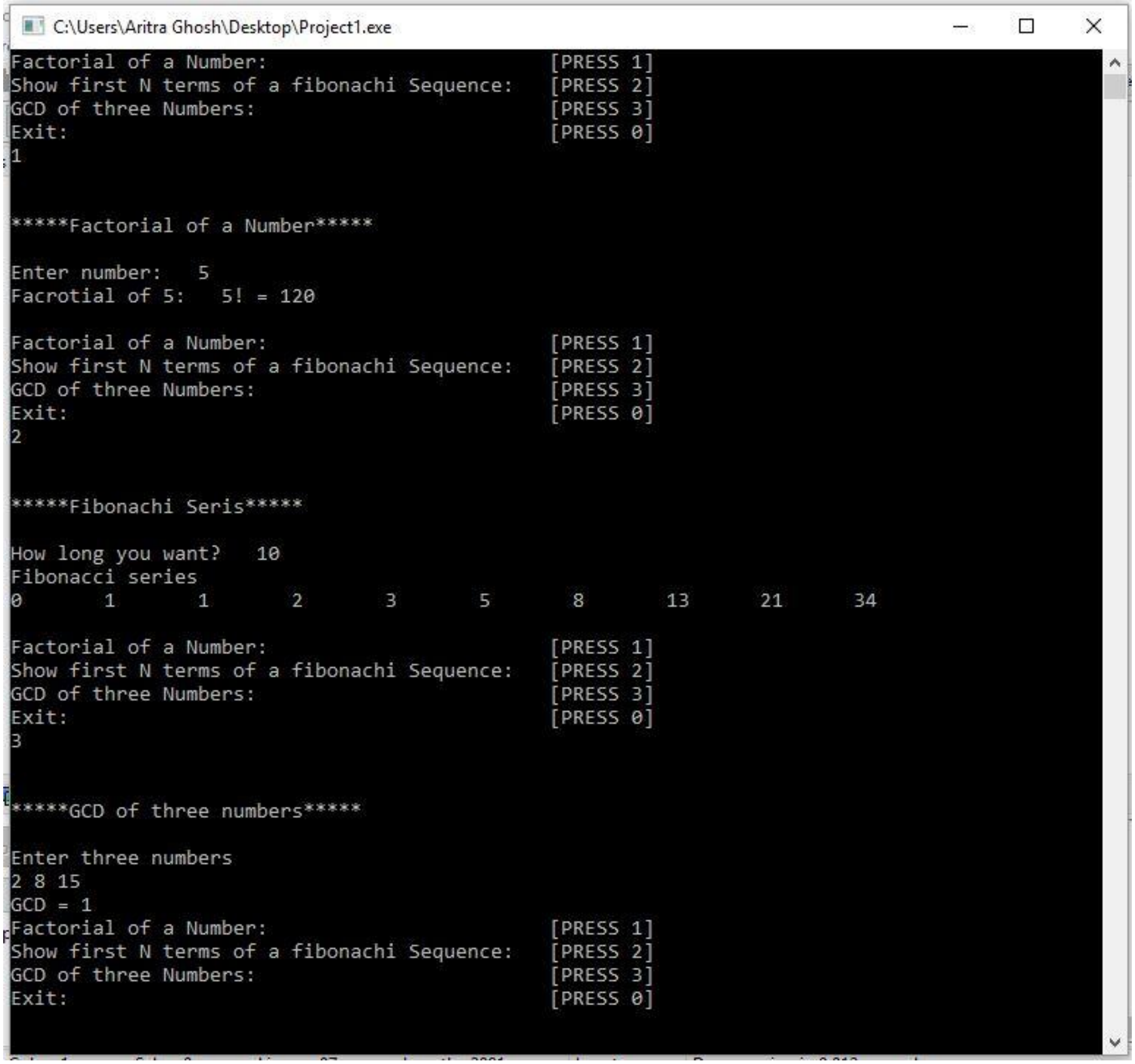
3.int gcd (int x,int y)

```
Step1: if (y==0)
      return x
 Step2: if(x< y)
            return(gcd (y ,x))
      else
            return (gcd (y, x % y))
```

Program :

```
//Write a menu driven recursive program to
//a) find factorial of a given number
//b) generate first N terms of a fibonacci sequence
//c) GCD of three numbers.

#include <stdio.h>
#include <stdlib.h>
long factorial(int n){
      if(n>=1)
         return n*factorial(n-1);
      return 1;
}

int fibonacciSeris(int n)
{
   if ( n == 0 )
      return 0;
   else if ( n == 1 )
      return 1;
   else
      return (fibonacciSeris(n-1) + fibonacciSeris(n-2));
}

int gcd(int a, int b)
{
    if (a == 0)
        return b;
    return gcd(b%a, a);
}
int getGCD(int arr[])
{
    int i,result = arr[0];
    for(i = 1; i < 4; i++)
        result = gcd(arr[i], result);
    return result;
}
int main() {
      int number,arr[4];
      int ch,i,c;
      long result;
      while(1){
            printf("Factorial of a Number:                        [PRESS 1]\n");
            printf("Show first N terms of a fibonachi Sequence:   [PRESS 2]\n");
            printf("GCD of three Numbers:                         [PRESS 3]\n");
            printf("Exit:                                         [PRESS 0]\n");
            scanf("%d", &ch);
            switch(ch){
                  case 1:
                        printf("\n\n*****Factorial of a Number*****\n\n");
                        printf("Enter number:   ");
                        scanf("%d", &number);
                        result = factorial(number);
                        printf("Facrotial of %d:   %d! = 
%ld\n\n",number,number,result);
                        break;
                  case 2:
                        printf("\n\n*****Fibonachi Seris*****\n\n");
                        printf("How long you want?   ");
                        scanf("%d", &number);
                        c = 0;
                        printf("Fibonacci series\n");
                        for(i= 1 ; i<=number ; i++)
                        {
                           printf("%d\t", fibonacciSeris(c));
                   c++;
                }
                printf("\n\n");
                        break;
                  case 3:
                        printf("\n\n*****GCD of three numbers*****\n\n");
                        printf("Enter three numbers\n");
                        for(i = 0; i<3; i++)
                           scanf("%d", &arr[i]);
                        number = getGCD(arr);
                        printf("GCD = %d\n",number);
                        break;
                  case 0:
                        exit(1);
                        system("PAUSE");
                  default:
                         printf("Wrong Choice !\n\n");
                         system("PAUSE");
            }
      }
      return 0;
}
```

Output :



```
Factorial of a Number:                        [PRESS 1]
Show first N terms of a fibonachi Sequence:   [PRESS 2]
GCD of three Numbers:                         [PRESS 3]
Exit:                                         [PRESS 0]
1


*****Factorial of a Number*****

Enter number:   5
Facrotial of 5:   5! = 120

Factorial of a Number:                        [PRESS 1]
Show first N terms of a fibonachi Sequence:   [PRESS 2]
GCD of three Numbers:                         [PRESS 3]
Exit:                                         [PRESS 0]
2


*****Fibonachi Seris*****

How long you want?   10
Fibonacci series
0       1       1       2       3       5       8       13      21      34

Factorial of a Number:                        [PRESS 1]
Show first N terms of a fibonachi Sequence:   [PRESS 2]
GCD of three Numbers:                         [PRESS 3]
Exit:                                         [PRESS 0]
3


*****GCD of three numbers*****

Enter three numbers
2 8 15
GCD = 1
Factorial of a Number:                        [PRESS 1]
Show first N terms of a fibonachi Sequence:   [PRESS 2]
GCD of three Numbers:                         [PRESS 3]
Exit:                                         [PRESS 0]
```

Program 8: A program to solve the problem of towers of Hanoi with 3 pegs and n discs

Algorithm :

Step 1: Declare the variables and function with source, aux, dest as the variables of character type and a variable 'n' is of integer type, the function used is as follows:

```
          void tower( int, char, char ,char)
```

Function definition:

```
tower (  int n , char source, char dest, char aux )
Step 1:
        if ( n = = 1)
            Write: "Move source disk to destination  disk"

 Step 2:
       Else
           Call the function: tower (n-1,source,aux,dest)
          Write: "Move source disk to destination disk"
          Call the function: tower (n-1,aux,dest,source)
            return
         [end of else structure ]
      [ end of function ]
```

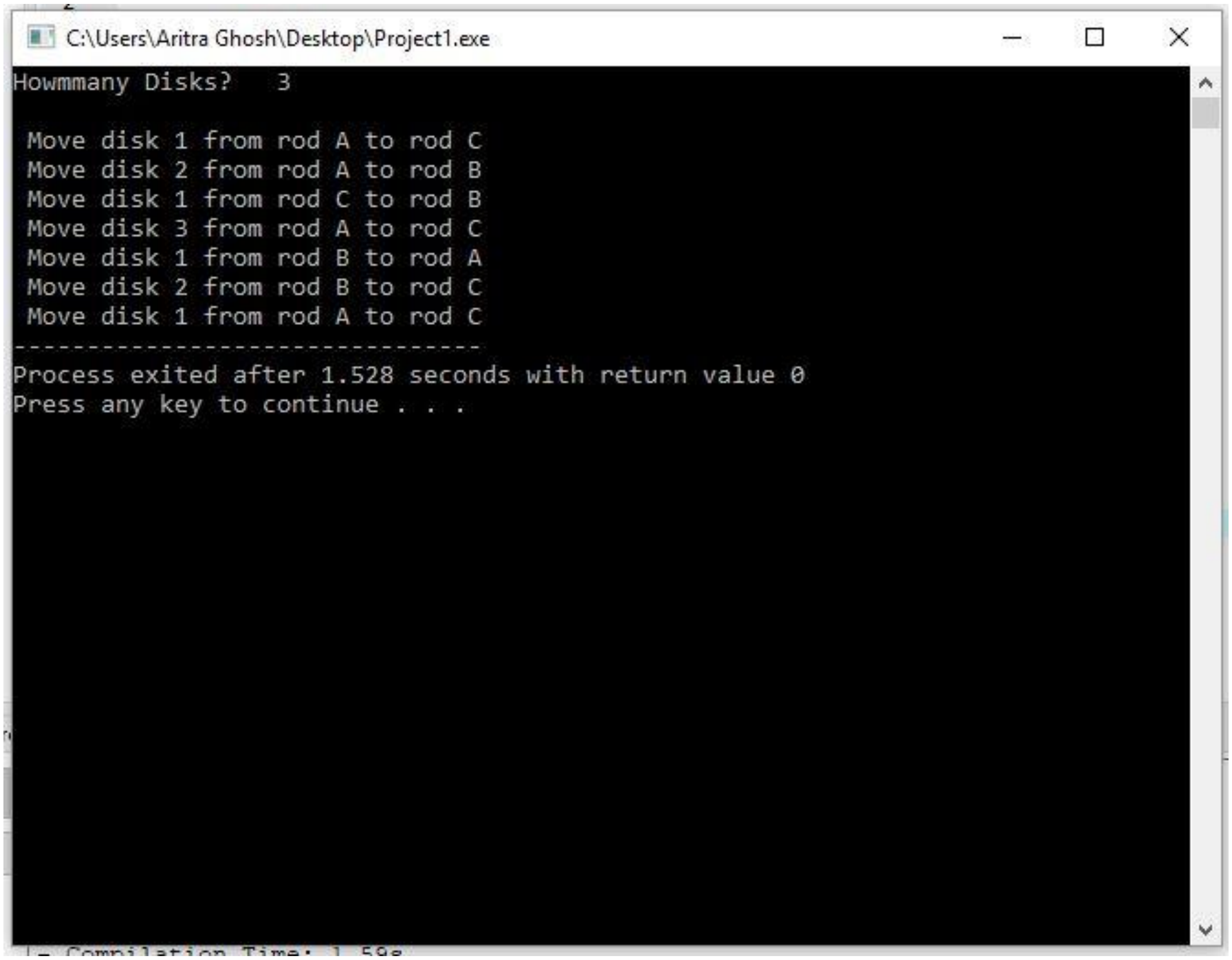
Main function:

Accept the number of disks and call the function by passing the disks accepted as parameters.

Program :

```
//Q.8: A program to solve the problem of towers of Hanoi with 3 pegs and n discs

#include <stdio.h>

// C recursive function to solve tower of hanoi puzzle
void towerOfHanoi(int n, char from_rod, char to_rod, char aux_rod)
{
    if (n == 1)
    {
        printf("\n Move disk 1 from rod %c to rod %c", from_rod, to_rod);
        return;
    }
    towerOfHanoi(n-1, from_rod, aux_rod, to_rod);
    printf("\n Move disk %d from rod %c to rod %c", n, from_rod, to_rod);
    towerOfHanoi(n-1, aux_rod, to_rod, from_rod);
}

int main()
{
    int n;
    printf("Howmmany Disks?   ");
    scanf("%d",&n);
    towerOfHanoi(n, 'A', 'C', 'B');  // A, B and C are names of rods
    return 0;
}
```

Output:


C:\Users\Aritra Ghosh\Desktop\Project1.exe

```
Howmmany Disks?   3

 Move disk 1 from rod A to rod C
 Move disk 2 from rod A to rod B
 Move disk 1 from rod C to rod B
 Move disk 3 from rod A to rod C
 Move disk 1 from rod B to rod A
 Move disk 2 from rod B to rod C
 Move disk 1 from rod A to rod C
--------------------------------
Process exited after 1.528 seconds with return value 0
Press any key to continue . . .
```

- Compilation Time: 1.59s

Program 9: : A menu driven program to perform operations on a circular queue(linked list implementation).

Algorithm :

Step 1: The data part and the pointer ‘next’ is declared within a structure of node type, two pointers ‘front’,’ rear’ of the node type and the required functions are declared within the class called cqueue.

```
 Functions:   void enqueue ( )
              void dequeue ( )
              void show( )
              void q_front ( )
              void q_rear ( )
```

Function declaration:

1. enqueue ( )

```
 Step 1: Declare variable ‘value’ of integer type and a pointer ‘p’ of node type
 Step 2: Accept the value
 Step 3: Allocate the memory for the node using malloc function and pointer ‘p’
             Stores the address of the node
               p=(node *) malloc(sizeof (node))
Step 4: The value accepted is stored in data field whose address is stored in ‘p’
            pointer  and the info field of the pointer is NULL  which is pointed by ‘next’
            pointer.
            p→data = value
            p→next=NULL
 Step 5:   if (front= =NULL) then [indicates queue is empty]
                    front = rear = p
             [ both the pointers hold the address of the first node ‘p’]
                 [end of if]
Step 6:
        else rear ->next = p
               rear = p              [the address of  pointer ‘p’ is stored in rear ]
Step 7:
            p->next = front
        [ the address of ‘front’ is now stored in ‘p’ which is pointed by pointer ‘next’]
             [end of function]
```

2. q_front( )

```
       Step 1:  if (front = = NULL)
                  Write: “Queue is empty”
             else
                   Front ->data [the value of the data field is displayed is queue is
                                      Not empty which is pointed by ‘front’]
          [end of if else structure]
          [end of function]
```

3. **q_rear ( )**

```
  Step 1: if (rear = = NULL)
                   Write: “queue is empty “

              else
                 rear->data
```

```
 [ the  value of the data field at the rear end is pointed by rear pointer is displayed ]
          [end of if else ]
    [end of function ]
```

4. **deququeue**( )

```
 Step 1: if (front = = NULL)
                Write:  "queue is empty "
Step 2: declare a variable of 'temp' of node type and temp variable
            holds the address of 'front' pointer
                temp = front
Step 3: if (front = = rear) then
                front = rear = NULL ( both the pointers point to NULL)
                temp → data
                   free ( temp ) { when both front and rear pointers to NULL, the temp pointer
                                 is stores address of data which is deleted }
                else
 Step 4:
                 front = front->next
                 rear->next = front
                 temp->data
                 free ( temp )

            ['front' pointer holds the address of next node pointed by 'next', rear
               pointer holds the address of front and the data field address is stored
               in temp pointer which is deleted ]
```

5. Show ( )

```
Step 1: Declare 'p' pointer which holds the address of 'front' pointer
Step 2:
               if ( front = = NULL )
              Write: "Queue is empty"
            Else
               Do until (p ! = front)
                     P=p->next (display the queue elements)
               [ end of do while loop ]
           [ end of else ]
```

Main function

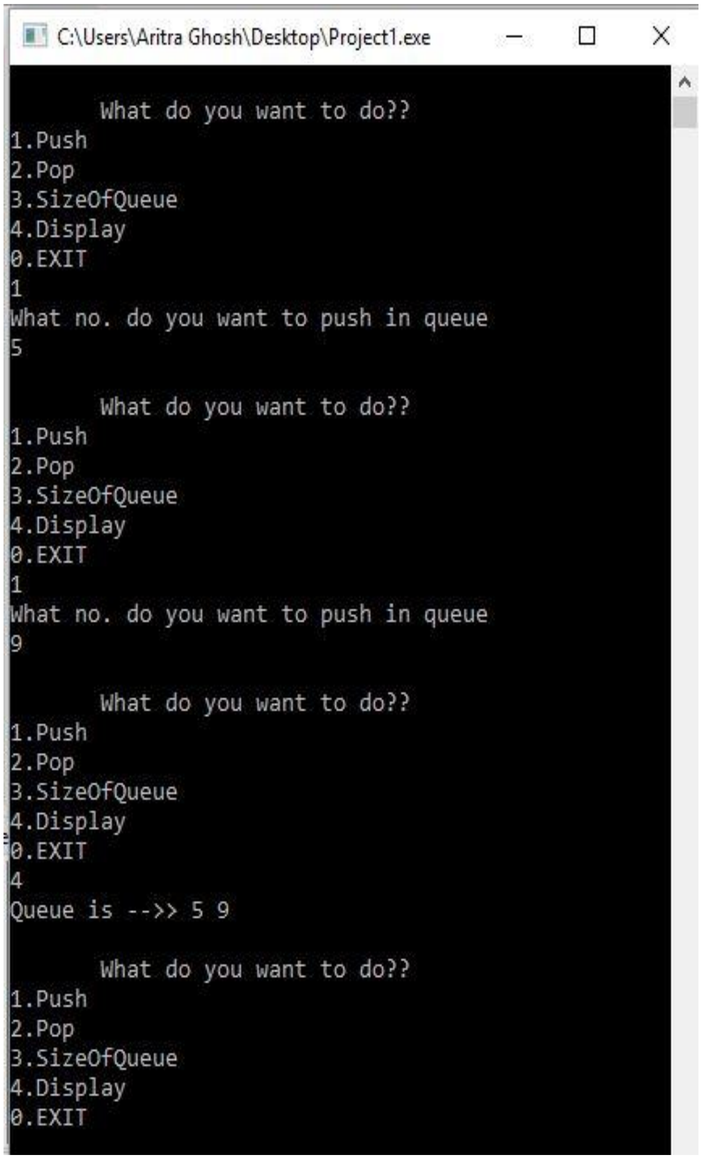
Accept the choice from the user and call the functions in order to perform the operations according to users choice.

Program :

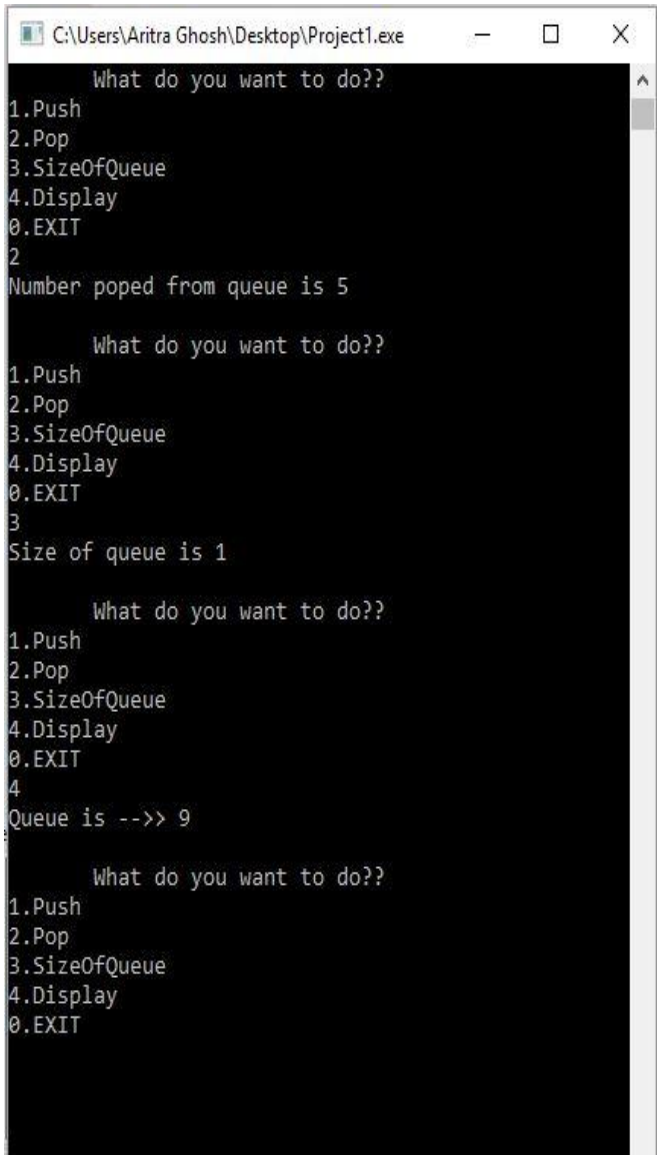
```
//Q.9: Write a menu driven program to perform operations on a circular queue (linked
//list implementation).

#include<stdio.h>
```

```
#include<stdlib.h>
#define que struct queue
#define pf printf
#define sf scanf
struct queue{
      int info;
      struct queue *link;
};
que *front=NULL,*rear=NULL;
int count=0;

void push(int n){
      que *newnode;
      newnode=(struct queue*)malloc(sizeof(struct queue));
      newnode->info=n;
      newnode->link=NULL;
      if(count==0)
      front=newnode;
      else
              rear->link=newnode;
          rear=newnode;
          rear->link=front;
      count++;
}
int pop(void){
      int n;
      que *temp;
      if(count==0)
      return (-1);
      count--;
          if(front==rear)
          {
              n=front->info;
              free(front);
              front=NULL;
              rear=NULL;
          }else
          {
                  temp= front ;
                  n = temp-> info ;
                  front = front -> link ;
                  rear -> link = front ;
                  free ( temp ) ;
          }
      return n;
}
void display(void){
      que *temp;
      int i;
      if(count==0)
      pf("Empty");
      else
      {
      temp=front;
      for(i=0;i<count;i++)
      {
      pf("%d ",temp->info);
      temp=temp->link;
      }
      }
      pf("\n");
}
int size(void)
{
      return count;
}
int main()
{
      int n,ch=10;
      while(ch!=0)
      {
      pf("\n       What do you want to do??\n");
      pf("1.Push\n");
      pf("2.Pop\n");
      pf("3.SizeOfQueue\n");
      pf("4.Display\n");
      pf("0.EXIT\n");
      sf("%d",&ch);
      switch(ch)
      {
            case 1:
                  {
                  pf("What no. do you want to push in queue\n");
                  sf("%d",&n);
                  push(n);
                  break;
                  }
            case 2:
                  {
                  n=pop();
                  if(n==-1)
                  pf("Queue is empty\n");
                  else
                  pf("Number poped from queue is %d\n",n);
                  break;
                  }
            case 3:
                  {
                  n=size();
                  pf("Size of queue is %d\n",n);
                  break;
                  }
            case 4:
                  {
                  pf("Queue is -->> ");
                  display();
                  }
            case 0:
                  break;
            default:
                  pf("Wrong Choice\n");
                  break;
            }
      }
}
```

Output :



```
       What do you want to do??
1.Push
2.Pop
3.SizeOfQueue
4.Display
0.EXIT
1
What no. do you want to push in queue
5

       What do you want to do??
1.Push
2.Pop
3.SizeOfQueue
4.Display
0.EXIT
1
What no. do you want to push in queue
9

       What do you want to do??
1.Push
2.Pop
3.SizeOfQueue
4.Display
0.EXIT
4
Queue is -->> 5 9

       What do you want to do??
1.Push
2.Pop
3.SizeOfQueue
4.Display
0.EXIT
```



```
       What do you want to do??
1.Push
2.Pop
3.SizeOfQueue
4.Display
0.EXIT
2
Number poped from queue is 5

       What do you want to do??
1.Push
2.Pop
3.SizeOfQueue
4.Display
0.EXIT
3
Size of queue is 1

       What do you want to do??
1.Push
2.Pop
3.SizeOfQueue
4.Display
0.EXIT
4
Queue is -->> 9

       What do you want to do??
1.Push
2.Pop
3.SizeOfQueue
4.Display
0.EXIT
```

Program 10: program to find
a) length of string
b) concatenate two strings
c) extract substring from given string
d) finding and replacing string by another

Algorithm :

Step 1: declaration of functions, the functions which are used are as
follows
void concat(char*,char*)
int length(char *)
void substring(char *, int,int)
int stfind(char *,char *)
void strep(char*,char*,int)

Main function

Step 1: declare the variable str1, str2,str3 which stores the character array of size 30. Also declare choice,len,pos,num of type int.

Step 2: Accept the choice from user
Choice 1: Accept two strings str1 and str2 and concatenate both strings using the function concat
concat(str1,str2)

Choice 2: Find the length of the of the string, accept the string by accepting a string str1and length of str1 is found out using the string function strlen, and assigned to variable len
len = strlen(str1)

Choice 3: Accept the string str1, and enter the position from which extraction should happen (pos). Alos enter thenumber of characters to be extracted(num). find out the length of str1.

If (pos+num-1)>len) then extraction is not possible. Otherwise call the function substring(str,pos,num)

```
Choice 4: Accept the two strings, find out the position  using the function
          stfind and assign to variable pos, then the condition is checked for
          replacement of string.
          **pos= stfind(str1,str2)**
          if (pos >0) then
             accept the third string to be replaced  i.e str2
              replace the string by calling the function strep along with
              the position
                  **strep(str1,str2,pos)**
               [end of if structure]
            else
               Substring is not found
```

Function definitions:

Substring ()

Step 1. Declare variable I of type integer ant as a character pointer of type char.
Step 2: t←ptr+p-1
Step 3: for i=0 to n by 1
(t+i←(ptr+p-1+i)

```
      *(t+i)←'\0'
        [end of for]
```

2. **length( )**

```
    Step 1: initialize  len=0;
          [ string is read until   NULL value is reached ,if string is not equal to NULL
         Perform the operations specified within while loop i.e increment the pointer p
          to read next character and increment the variable len and finally return value
            of the len]

         Step 2: while(*ptr!='\0') do step 3
           Step3:
                    ptr←ptr+1
                    len←len+1
          [end of while loop]
          return len
```

3. **concat()**

```
     Step 1: Two parameters p1,p2 of character  pointer  are passed to the function
     Step 2: Check whether  'p1' not equal to NULL, increment p1 to next
             character position.
             While(*p1!='\0')
                  p1←p1 + 1

    Step 3: check for whether 'p2' not equal to NULL, if not then continue with
             step 4
      while(*p2!='\0') do
    Step 4:
                *p1←*p2 [contents of pointer 'r2' stored in pointer 'r1']
               p1←p1 + 1
                p2←p2+1
                   *r1='\0' [ pointer r1 initialized to NULL ]
               [End of while ]
    Step 5: write t as the extracted string.
```

4. **stfind:**

```
    Step 1: declare the variables len,len2,i,j,k
              [initialize i =0 ]

            len ←strlen (r1) [find the length of the string pointed by r1 and assign to
              len]
            len2←strlen(r2) [find the length of the string pointed by r2 and assign to
            len2]



    Step 2: for i=0 to len-len2+1 by 1
             K=1
            Pos=pos+1
             for j = 0 to j<len2 to by
              if ( *(p1+i+j) != *(p2+j) [check for contents of p1 and p2]
                     k=0
               [end of for loop]
```

```
                  Else k=2
                    If(k=2)
                  Return pos
                  [end of for loop]
```

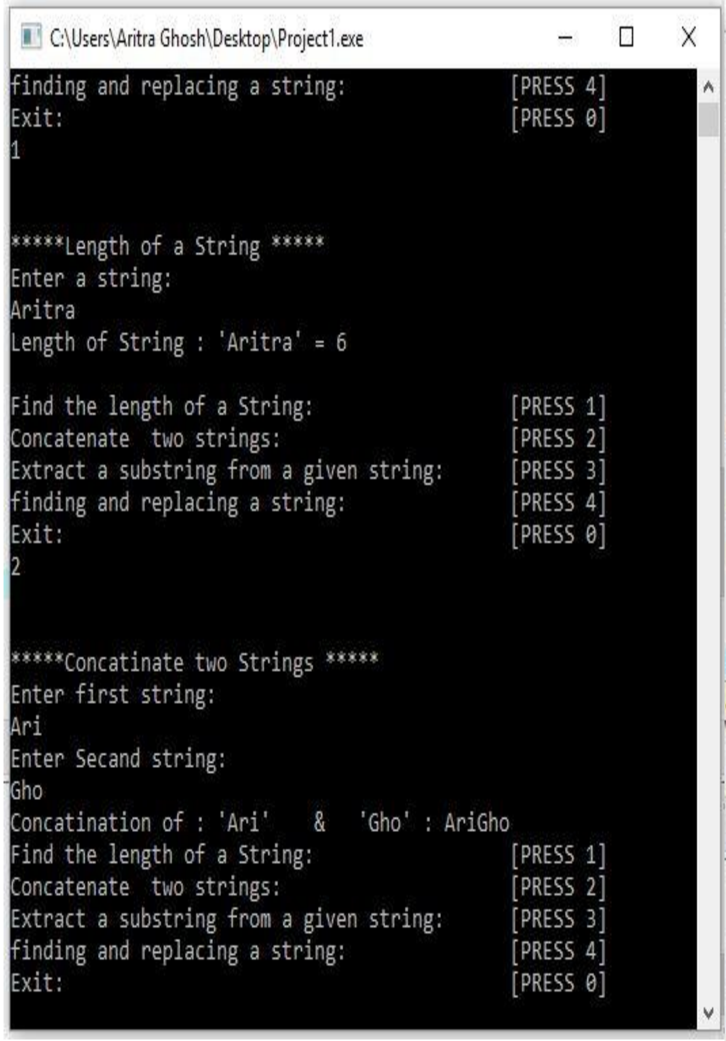
5. **strep ( ):**

```
    Step 1: declare two variables i,len
    Step 2: find out the length of the string pointed by pointer p3
            assign to variable len
             len ←strlen(p3)
    Step 3:
           for i=pos-1 to  i<len+pos-1 by 1
                *(p1+1) ←*p3 [contents of r3 is assigned to r1 content]
                  p3 ←p3 + 1 [increment the pointer to next character position]

               [end of for loop ]
```

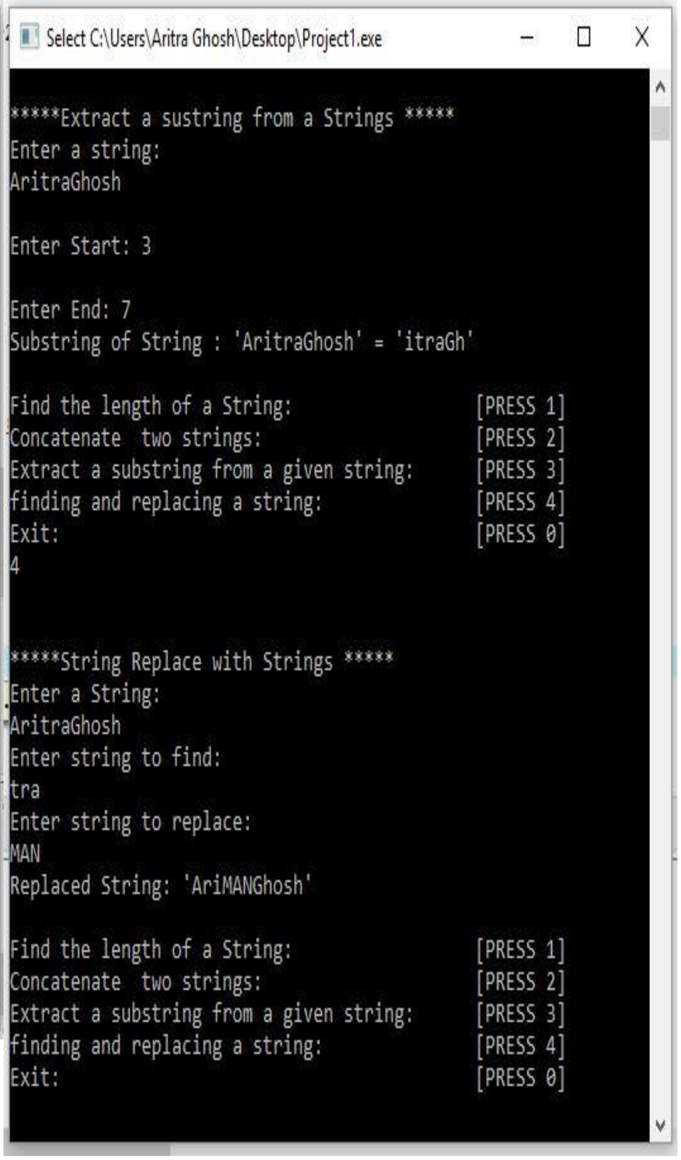
Program :

```
//10. Write  a  menu  driven  program  to  ......
//a) find  the  length  of  a  string
//b) concatenate  two strings
//c) to extract a substring from a given string
//d) finding and replacing a string by another string in a text  ( Use pointers and
user-defined functions)

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
int string_length(char arr[]){
      int i = 0;
      while(arr[i] != '\0'){
            i++;
      }
      return i;
}

void string_concatinate(char str1[], char str2[]){
      int i = 0,j = 0;
      while(str1[i] != '\0'){
            i++;
      }
      while(str2[j] != '\0'){
            str1[i] = str2[j];
            i++;
            j++;
      }
      str1[i]  = '\0';
}
char* extract_substring(char* str, int start, int end, int len)
{
      char* result;
      int i,count=0;
    if (str == 0 || strlen(str) == 0 || strlen(str) < start || strlen(str) <
(start+end))
      return 0;
      else
      {
            result = (char *)malloc(sizeof(len));
            for(i = start-1, count = 0; i<=end; i++, count++){
                  result[count]= str[i];
            }
            result[i] = '\0';
      return result;
      }
}
char *string_replace(char *str, char *str1, char *str2){
      char *result;
    int len1, len2, i, count = 0;
      len1 = strlen(str1);
      len2 = strlen(str2);
      for(i = 0; str[i] != '\0'; i++){
            if(strstr(&str[i], str1) == &str[i])
            {
                  count++;
                  i += len1-1;
            }
      }
      result = (char *)malloc(i + count * (len2 - len1) + 1);
    i = 0;
    while(*str)
    {
        if(strstr(str, str1) == str)
        {
            strcpy(&result[i], str2);
            i += len2;
            str += len1;
        }
        else
            result[i++] = *str++;
    }

    result[i] = '\0';
    return result;
}
int main() {
      int ch;
      int start, end;
      char str[100],str2[100],str1[100];
      char *result = NULL;
      int length,len;

      while(1){
            printf("Find the length of a String:                  [PRESS 1]\n");
            printf("Concatenate  two strings:                     [PRESS 2]\n");
            printf("Extract a substring from a given string:      [PRESS 3]\n");
            printf("finding and replacing a string:               [PRESS 4]\n");
            printf("Exit:                                         [PRESS 0]\n");
            scanf("%d", &ch);
            switch(ch){
                  case 1:
                        printf("\n\n*****Length of a String *****\n");
                        printf("Enter a string: \n");
                        scanf("%s",str);
                        length = string_length(str);
                        printf("Length of String : '%s' = %d\n\n", str,length);
                        break;
                  case 2:
                        printf("\n\n*****Concatinate two Strings *****\n");
                        printf("Enter first string: \n");
                        scanf("%s",str);
                        strcpy(str1,str);
                        printf("Enter Secand string: \n");
                        scanf("%s",str2);
                        string_concatinate(str, str2);
                        printf("Concatination of : '%s'    &   '%s' :\t%s \n",str1,
str2, str);
                        break;
                  case 3:
                        printf("\n\n*****Extract a sustring from a Strings *****\n");
                        printf("Enter a string: \n");
                        scanf("%s",str);
                        len = string_length(str);
                        printf("\nEnter Start: ");
                        scanf("%d", &start);
                        printf("\nEnter End: ");
                        scanf("%d", &end);
                        result = extract_substring(str, start, end, len);
                        if(result != 0)
                              printf("Substring of String : '%s' = '%s'\n\n",
str,result);
                        else
                            printf("\n\nString Extraction Not possible.\n");
                        break;
                  case 4:
                        printf("\n\n*****String Replace with Strings *****\n");
                        printf("Enter a String: \n");
                        scanf("%s",str);
                        printf("Enter string to find: \n");
                        scanf("%s",str1);
                        printf("Enter string to replace: \n");
                        scanf("%s",str2);
                        result = string_replace(str, str1, str2);
                        printf("Replaced String: '%s'\n\n", result);
                        break;
                  case 0:
                        printf("Thanks !   EXIT \n\n");
                        exit(1);
                        system("PAUSE");
                  default:
                         printf("Wrong Choice !\n\n");
                         system("PAUSE");
            }
      }
      system("PAUSE");
      return 0;
}
```

Output :



```
finding and replacing a string:              [PRESS 4]
Exit:                                        [PRESS 0]
1


*****Length of a String *****
Enter a string:
Aritra
Length of String : 'Aritra' = 6

Find the length of a String:                 [PRESS 1]
Concatenate  two strings:                    [PRESS 2]
Extract a substring from a given string:     [PRESS 3]
finding and replacing a string:              [PRESS 4]
Exit:                                        [PRESS 0]
2


*****Concatinate two Strings *****
Enter first string:
Ari
Enter Secand string:
Gho
Concatination of : 'Ari'    &   'Gho' : AriGho
Find the length of a String:                 [PRESS 1]
Concatenate  two strings:                    [PRESS 2]
Extract a substring from a given string:     [PRESS 3]
finding and replacing a string:              [PRESS 4]
Exit:                                        [PRESS 0]
```



```

*****Extract a sustring from a Strings *****
Enter a string:
AritraGhosh

Enter Start: 3

Enter End: 7
Substring of String : 'AritraGhosh' = 'itraGh'

Find the length of a String:                 [PRESS 1]
Concatenate  two strings:                    [PRESS 2]
Extract a substring from a given string:     [PRESS 3]
finding and replacing a string:              [PRESS 4]
Exit:                                        [PRESS 0]
4


*****String Replace with Strings *****
Enter a String:
AritraGhosh
Enter string to find:
tra
Enter string to replace:
MAN
Replaced String: 'AriMANGhosh'

Find the length of a String:                 [PRESS 1]
Concatenate  two strings:                    [PRESS 2]
Extract a substring from a given string:     [PRESS 3]
finding and replacing a string:              [PRESS 4]
Exit:                                        [PRESS 0]
```

Program 11: A program to convert the given infix expression into its postfix form.

Algorithm :

```
          Step 1: Character array variables are being declared which stores
           the constant size, the variables  declared are
            (  infix[size],  postfix[50], stack[50] ,top=0)
            Step 2: stack[0] ←'(';
            Step 3: read infix
            Step 4: j←strlen(infix)
            Step 5: for i=0 to n by 1
             ch←infix[i]
                   if(((ch>='0')&&(ch<='9'))||((ch>='a')&&(ch<='z'))||((ch>='A')&&(ch<='Z')))
                     write ch
                     [end if]

          if(ch=='(')
            top←top+1
          stack[top] ←ch
          [end if]

        if(ch=='^')
      while(stack[top]=='^') do
          top←top-1
        write stack[top]
       [end of while]
Top←top+1
stack[top] ←ch
[end if]
if((ch=='*')||(ch=='/'))
 while((stack[top]=='*')||(stack[top]=='/')||(stack[top]=='^')) do
top←top-1
write stack[top]
[end of while]
Top←top+1
stack[top] ←ch
[end if]
 if((ch=='+')||(ch=='-'))
 while((stack[top]=='*')||(stack[top]=='/')||(stack[top]=='+')||(stack[top]=='-')||(stack[top]=='^'))
  write stack[top]
 top←top+1
 [end  of while]
Top←top+1
 stack[top] ←ch
 [end if]
 if(ch==')')
 while(stack[top]!='(')
top←top-1
 write stack[top]
[end  of while]

 top←top-1
 [end if]
```

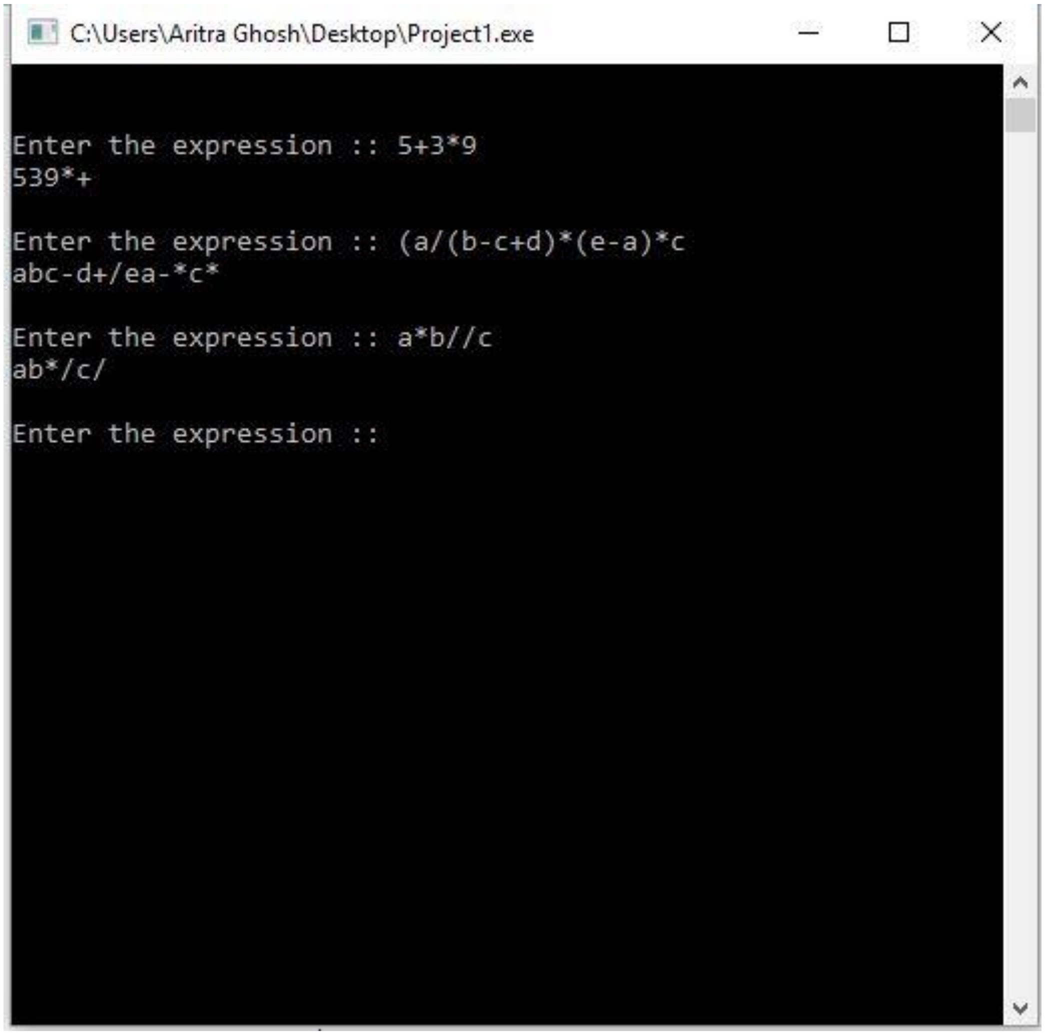
```
[end for]
            Step 6: while(stack[top]!='(') do
  top←top-1
 write stack[top]
[end  of while]
```

Program :

```
//11. Write a program to convert the given infix expression into its postfix form.
#include<stdio.h>
#include<ctype.h>
char stack[20];
int top = -1;
void push(char x)
{
    stack[++top] = x;
}

char pop()
{
    if(top == -1)
        return -1;
    else
        return stack[top--];
}

int priority(char x)
{
    if(x == '(')
        return 0;
    if(x == '+' || x == '-')
        return 1;
    if(x == '*' || x == '/')
        return 2;
}

main()
{
    char exp[20];
    char *e, x;
    printf("Enter the expression :: ");
    scanf("%s",exp);
    e = exp;
    while(*e != '\0')
    {
        if(isalnum(*e))
            printf("%c",*e);
        else if(*e == '(')
            push(*e);
        else if(*e == ')')
        {
            while((x = pop()) != '(')
                printf("%c", x);
        }
        else
        {
            while(priority(stack[top]) >= priority(*e))
```

```
                printf("%c",pop());
            push(*e);
        }
        e++;
    }
    while(top != -1)
    {
        printf("%c",pop());
    }
}
```

Output :



```
Enter the expression :: 5+3*9
539*+

Enter the expression :: (a/(b-c+d)*(e-a)*c
abc-d+/ea-*c*

Enter the expression :: a*b//c
ab*/c/

Enter the expression ::
```

Program 12: Program to evaluate postfix expression

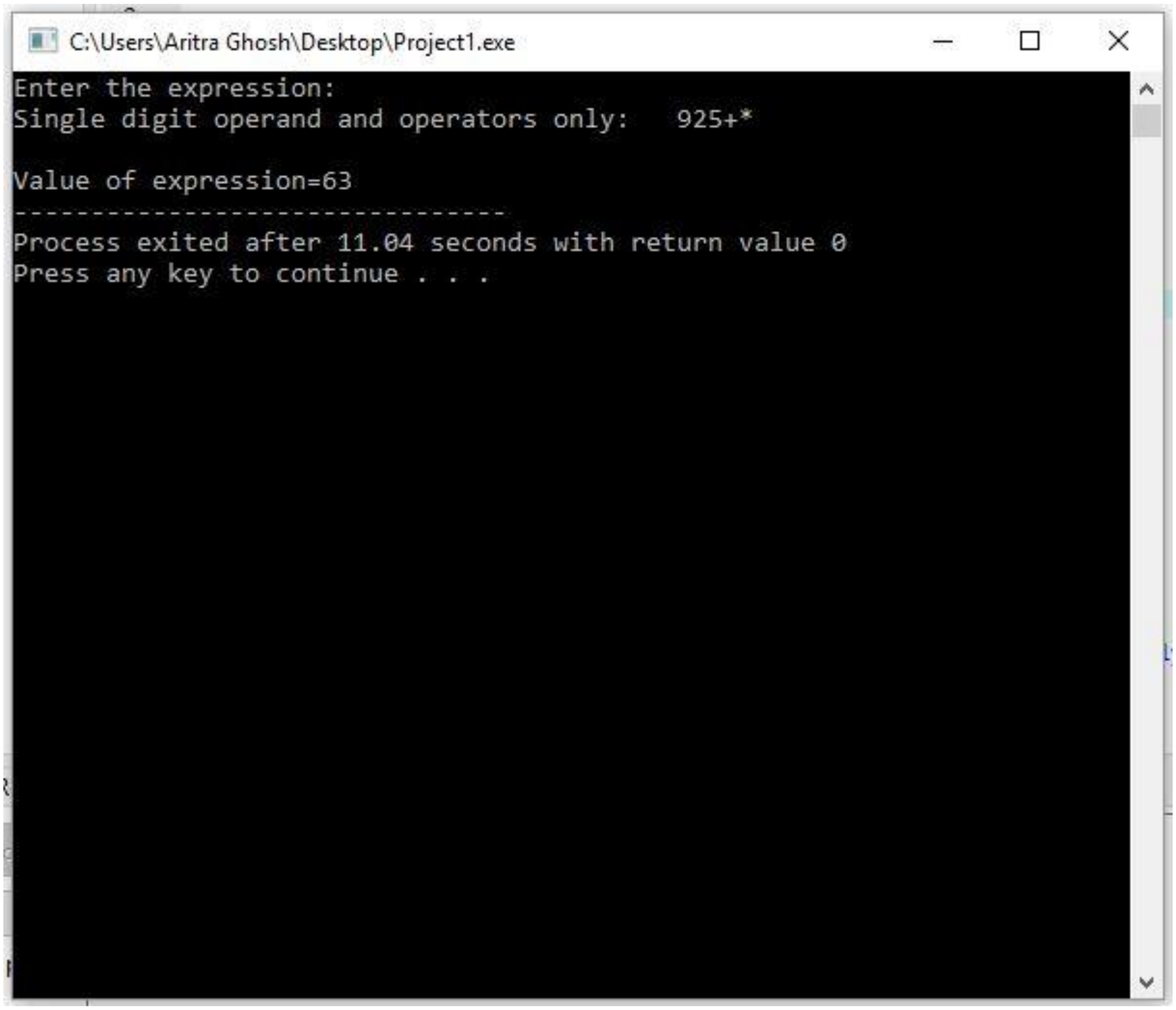
Algorithm :

```
 Step 1:  Declare variables  len, stack[50],len,value,n1,n2,finalresult,result

 function definition:

1.  push ( int  item)
    Step 1: top ← top + 1
             s[top] ← item
               [ increment the top variable and assign the symbol to top element of stack]
            2.   float pop ( )
                 Step 1 : if(top==0)

       Write invalid post fix expression
                                 top←top-1
       stack[top]=0
       return

Main function:
 Step 1 : Accept the postfix expression
  Step 2 : find the length of the of the postfix expression and assign to len
  Step 3 :for i=0 to i<len by 1
            if ( postfix > = 0) && postfix< = '9') then
               call function
                    push (postfix– '0')
                      [end of if ]
              else
if((postfix>='a'&&postfix<='z')||(postfix>='A'&&postfix<='Z'))
read the value for postfix
push(value)
[end of if ]
   else
      n1←pop()
       n2←pop()
      switch(postfix)

  case '^' :
                 result←pow(n1,n2)
                 push(result)
        case '*' :
                 result←n2*n1
                 push(result)
        case '/' :
                 result←n2/n1
                 push(result)
       case '+' :
               result←n2+n1
                push(result)
       case '-' :
                  result←n2-n1
              push(result)
       default: write invalid postfix expression

     [end of switch]
     [end of else]
    [end of for]
   Step 4:finalresult←pop()
   Step 5: Write  final result as thevalue of the expression
```

Program :

```
#include<stdio.h>

#define MAX 20

typedef struct stack
{
      int data[MAX];
      int top;
}stack;

void init(stack *);
int empty(stack *);
int full(stack *);
int pop(stack *);
void push(stack *,int);
int evaluate(char x,int op1,int op2);

int main()
{
      stack s;
      char x;
      int op1,op2,val;
      init(&s);
      printf("Enter the expression(eg: 59+3*)\nSingle digit operand and operators
only:");

      while((x=getchar())!='\n')
      {
            if(isdigit(x))
                  push(&s,x-48);          //x-48 for removing the effect of ASCII
            else
            {
                  op2=pop(&s);
                  op1=pop(&s);
                  val=evaluate(x,op1,op2);
                  push(&s,val);
            }
      }

      val=pop(&s);
      printf("\nValue of expression=%d",val);

      return 0;
}

int evaluate(char x,int op1,int op2)
{
      if(x=='+')
            return(op1+op2);
      if(x=='-')
            return(op1-op2);
      if(x=='*')
            return(op1*op2);
      if(x=='/')
            return(op1/op2);
      if(x=='%')
            return(op1%op2);
}

void init(stack *s)
{
      s->top=-1;
}

int empty(stack *s)
{
      if(s->top==-1)
            return(1);

      return(0);
}

int full(stack *s)
{
      if(s->top==MAX-1)
            return(1);

      return(0);
}

void push(stack *s,int x)
{
      s->top=s->top+1;
      s->data[s->top]=x;
}

int pop(stack *s)
{
      int x;
      x=s->data[s->top];
      s->top=s->top-1;

      return(x);
}
```

Output:



```
Enter the expression:
Single digit operand and operators only:   925+*

Value of expression=63
--------------------------------
Process exited after 11.04 seconds with return value 0
Press any key to continue . . .
```

Program 13: A menu driven program to create a binary tree and to perform insert and delete operations.

Algorithm :

```
Step 1:   Start
Step 2:  Create a structure and declare node *link and *rlink with it along with data.
Step 3: Declare *n, *t, s, d
Step 4: Initialize head = NULL
Step 5: Accept the choice of operation from user store in s
Step 6: Execute corresponding functions from according to choice
 Step 7:  finsert ()
           Declare *n
           Accept value of h -> data
           n->left=NULL;
           n->right=NULL;
           return n;
```

Creation of linked list

```
Step 1: Initially ‘h’ pointer points to NULL, indicating node is empty
Step 2: Another pointer ‘p’ points to first node i.e ‘h’
            [Initialize p:=h]
Step 3: create a new node pointed by ‘p’ pointer
Step 4: Read in the data element and store the data field
            t->data=num
            t->link=NULL
Step 5: If (p = = NULL), then this new node is first node
             h←t
             p←h
         else
              p  = p --→ link
              p→link = t

 Step 6: insert (node * h)
        Declare *t,*n;
        Initialize t=h;
        Accept value of n->data
        n->left=NULL;
        n->right=NULL;
        while(t->left!=NULL || t->right!=NULL)
                     if(t->left!=NULL)
                     if(n->data < t->data)
                              t=t->left;
```

```
Step 7: Check if (t->right!=NULL)
        Check if if(n->data>=t->data)
                t=t->right;
        if((t->left==NULL) && (n->data < t->data))
            break;
        if((t->right==NULL) && (n->data >= t->data))
            break;




    if((n->data < t->data) && (t->left==NULL))
        t->left=n;
    if((n->data > t->data) && (t->right==NULL))
        t->right=n;
Step 8: delete ( )
    Declare f=0,f1=0, *p,*t,*t1,*x;
    t=head;
    while(t!=NULL)
            if(t->data==d)
        then
            f=1;
            x=t;
        endif
     if(t->data > d)
        then
            p=t;
            t=t->left;
        else if(t->data <= d)
        then
            p=t;
            t=t->right;

Step: 9if(f==0)
    Display "Given element not found"
        return head;
    if(x->left==NULL && x->right==NULL)
            if(p->right==x)
            p->right=NULL;
        else
            p->left=NULL;
        free(x);
        return head;

Step 10: if(x->left !=NULL && x->right!=NULL)
```

```
          then
                p=x;
                t1=x->right;
                while(t1->left!=NULL)
                        p=t1; f1=1;
                        t1=t1->left;
           end if
Step: 11  if(t1->left==NULL && t1->right==NULL)
                then
                        x->data=t1->data;
                        if(f1==1)

                  p->left=t1->left;
                        if(f1==0)
                                x->right=t1->right;
                        free(t1);
                        return head;
                        if(t1->right!=NULL)



                                x->data=t1->data;
                        if(f1==1)
                                p->left=t1->right;
                        if(f1==0)
                                p->right=t1->right;
                        free(t1);
                        return head;
        end if
Step: 12 if(x->left==NULL && x->right!=NULL && x->data!=head->data)
        then
                if(p->left==x)
                        p->left=x->right;
                else
                        p->right=x->right;
                free(x);
                return head;

Step: 13  if(x->left!=NULL && x->right==NULL && x->data!=head->data)
           then         if(p->left==x)
                        p->left=x->left;
                else
                        p->right=x->left;
                free(x);
                return head;
```

```
Step: 14 if(x->left!=NULL && x->right==NULL && x->data==head->data)
      then        head=x->left;
                  free(p);
                  return head;
Step:15 if(x->left==NULL && x->right!=NULL && x->data==head->data)
      then
           head=x->right;
           free(p);

     return head;
Step: 16 Stop
```

Main function:

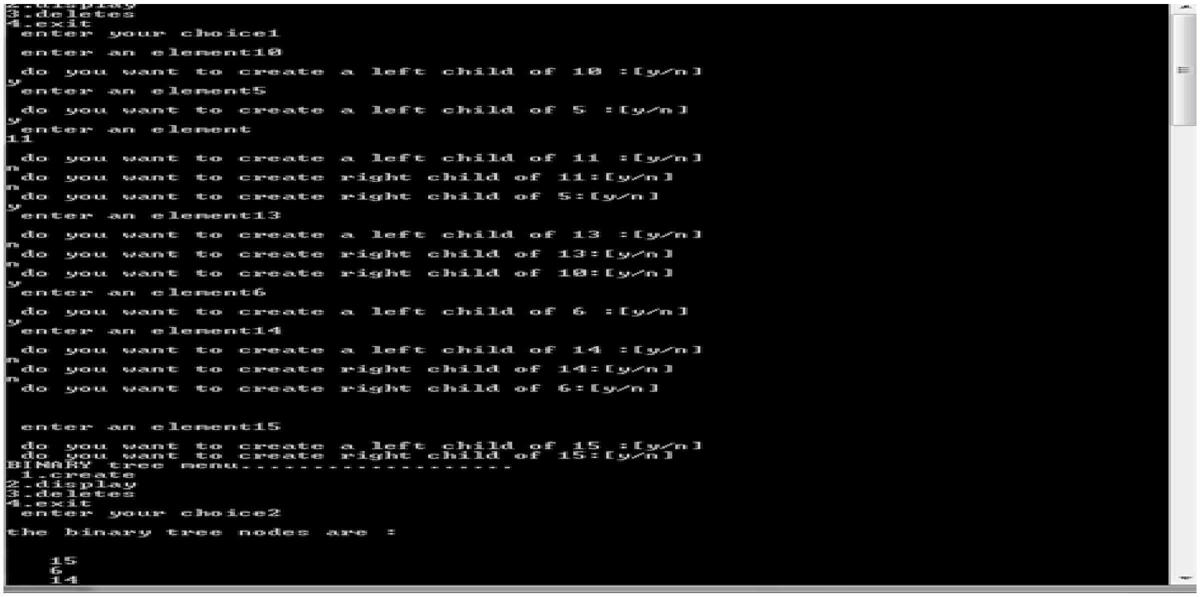
Accept the choice from the user and call the functions in order to perform the operations according to users choice.

Program :

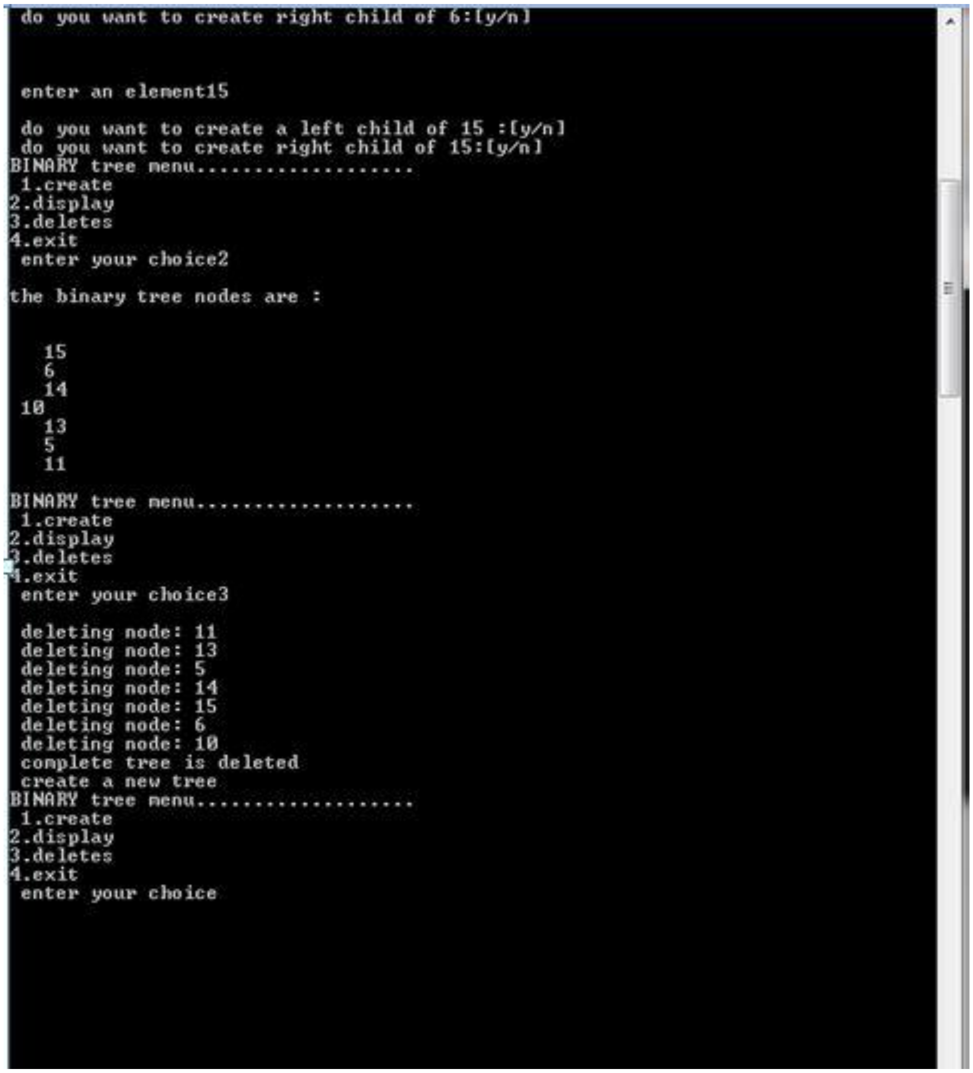
```
//binary tree
#include<stdio.h>
#include<stdlib.h>
#include<conio.h>
struct node
{
 int info;
 struct node *left;
 struct node *right;
};
typedef struct node NODE;
NODE *root=NULL;
void create_tree(NODE *ptr)
{
 NODE *newleft, *newright;
 int item;
 char ch;
 if(ptr != NULL)
 {
  printf("\n enter an element");
  scanf("%d",&item);
  ptr->info=item;
  printf("\n do you want to create a left child of %d :[y/n]\n",ptr-
>info);
  ch=getche();
  if(ch=='y' || ch=='Y')
  {
   newleft=(NODE*)malloc(sizeof(NODE));
   ptr->left=newleft;
   create_tree(newleft);
  }
  else
  {
   ptr->left=NULL;
   create_tree(NULL);
  }
 printf("\n do you want to create right child of %d:[y/n]\n",ptr->info);
 ch=getche();
 if(ch=='Y'|| ch=='y')
 {
  newright=(NODE*)malloc(sizeof(NODE));
  ptr->right=newright;
  create_tree(newright);
 }
else
{
 ptr->right=NULL;
 create_tree(NULL);
}
}
}
void disp(struct node *ptr,int level)
{
 int i;
 if(ptr!=NULL)
 {
  disp(ptr->right,level+1);
  for(i=0;i<level;i++)
  printf(" ");
  printf("%2d\n",ptr->info);
  disp(ptr->left,level+1);
 }


}
void deleteTree(struct node* node)
{
 if(node==NULL)
 return;
 deleteTree(node->left);
 deleteTree(node->right);
 printf("\n deleting node: %d",node->info);
}


void main()
```

```
{
 int item,ch;
 clrscr();
 root=NULL;
 while(1)
 {
  printf("\nBINARY tree menu");
  printf("...................");
  printf("\n 1.create \n2.display \n3.deletes \n4.exit ");
  printf("\n enter your choice");
  scanf("%d",&ch);
  switch(ch)
  {
   case 1:
   root=(NODE*)malloc(sizeof(NODE));
   create_tree(root);
   break;
   case 2:
   printf("\nthe binary tree nodes are :\n\n\n");
   disp(root,1);
   break;
   case 3:
   deleteTree(root);
   printf("\n complete tree is deleted");
   printf("\n create a new tree");
   break;
   case 4:
   exit(1);
   break;
   default:
   printf("invalid choice");
   break;
  }
 }
}
```

Output :



```
2.display
3.deletes
4.exit
 enter your choice1

 enter an element10

 do you want to create a left child of 10 :[y/n]
y
 enter an element5

 do you want to create a left child of 5 :[y/n]
y
 enter an element
11

 do you want to create a left child of 11 :[y/n]
n
 do you want to create right child of 11:[y/n]
n
 do you want to create right child of 5:[y/n]
y
 enter an element13

 do you want to create a left child of 13 :[y/n]
n
 do you want to create right child of 13:[y/n]
n
 do you want to create right child of 10:[y/n]
y
 enter an element6

 do you want to create a left child of 6 :[y/n]
y
 enter an element14

 do you want to create a left child of 14 :[y/n]
n
 do you want to create right child of 14:[y/n]
n
 do you want to create right child of 6:[y/n]


 enter an element15

 do you want to create a left child of 15 :[y/n]
 do you want to create right child of 15:[y/n]
BINARY tree menu...................
 1.create
2.display
3.deletes
4.exit
 enter your choice2

the binary tree nodes are :


   15
   6
   14
```



```
 do you want to create right child of 6:[y/n]


 enter an element15

 do you want to create a left child of 15 :[y/n]
 do you want to create right child of 15:[y/n]
BINARY tree menu...................
 1.create
2.display
3.deletes
4.exit
 enter your choice2

the binary tree nodes are :


   15
   6
   14
 10
   13
   5
   11

BINARY tree menu...................
 1.create
2.display
3.deletes
4.exit
 enter your choice3

 deleting node: 11
 deleting node: 13
 deleting node: 5
 deleting node: 14
 deleting node: 15
 deleting node: 6
 deleting node: 10
 complete tree is deleted
 create a new tree
BINARY tree menu...................
 1.create
2.display
3.deletes
4.exit
 enter your choice
```

Program 14: A menu driven program to create a binary search tree and to perform inorder, preorder and post order traversal.

Algorithm :

```
   Step 1: Two pointers llink, rlink of node type and an integer variable data is
           being declared
   Step 2:  Pointer variable  'root' is being declared of node type and is initialized to
            NULL with help of constructor ,the functions are declared and used within
            main function, the functions that are used are as
            Follows :    void create(int )
                         void disp ( int )
                         void inorder (node * )
                         void porder ( node * )
                         void preorder (node * )
```

function definition:

1. **create ( )**

```
     Step 1 : declare the pointers temp,currptr, ptr of type node
              Step2:   temp = ( node * ) malloc (sizeof (node)
     Step 4: temp->info=item
     Step 5: Both the left and right children of the tree is indicated as NULL
             which indicates that both the left and right children are empty
              t->llink =NULL
              t->rlink=NULL
     Step 6: if ( root = = NULL)    (indicates that root is empty)
                root = temp ( the address of first node is stored in 'root' pointer )
                [end of if]
             else
              currptr = root ( the address of root node is stored in 'currptr' )
                while(currptr!=NULL)
        ptr=currptr
        currptr=(item>currptr->info)?currptr->rlink:currptr->llink;
   [end of while]
   if(ptr->info<item)
         ptr->rlink=temp
           else
    ptr->llink=temp
         [end of else]
```

2. preorder (node *ptr)

```
 Step 1: if (ptr ! = NULL)
           Write ptr->info
         Call functions :
           preorder(ptr->llink)
```

```
          preorder(ptr->rlink)
       [end of if ]
    [end of function ]
```

4. **inorder (node *ptr)**

```
 Step 1: if(ptr!=NULL) ( 'tree is empty")
     call functions : inorder (ptr->llink)
       ptr ->data ( "display the elements pointed by ptr pointer )
      [ end of if ]
     [ End of function ]
```

5. **postorder (node *ptr)**

```
    Step 1:  if ( ptr!=NULL)
               Call functions:
                  Postorder (ptr->left)
                  Postorder (ptr->right)
                 ptr->data (" display the elements pointed by ptr pointer )
             [end of if ]
            [end of function ]
```

Main function:

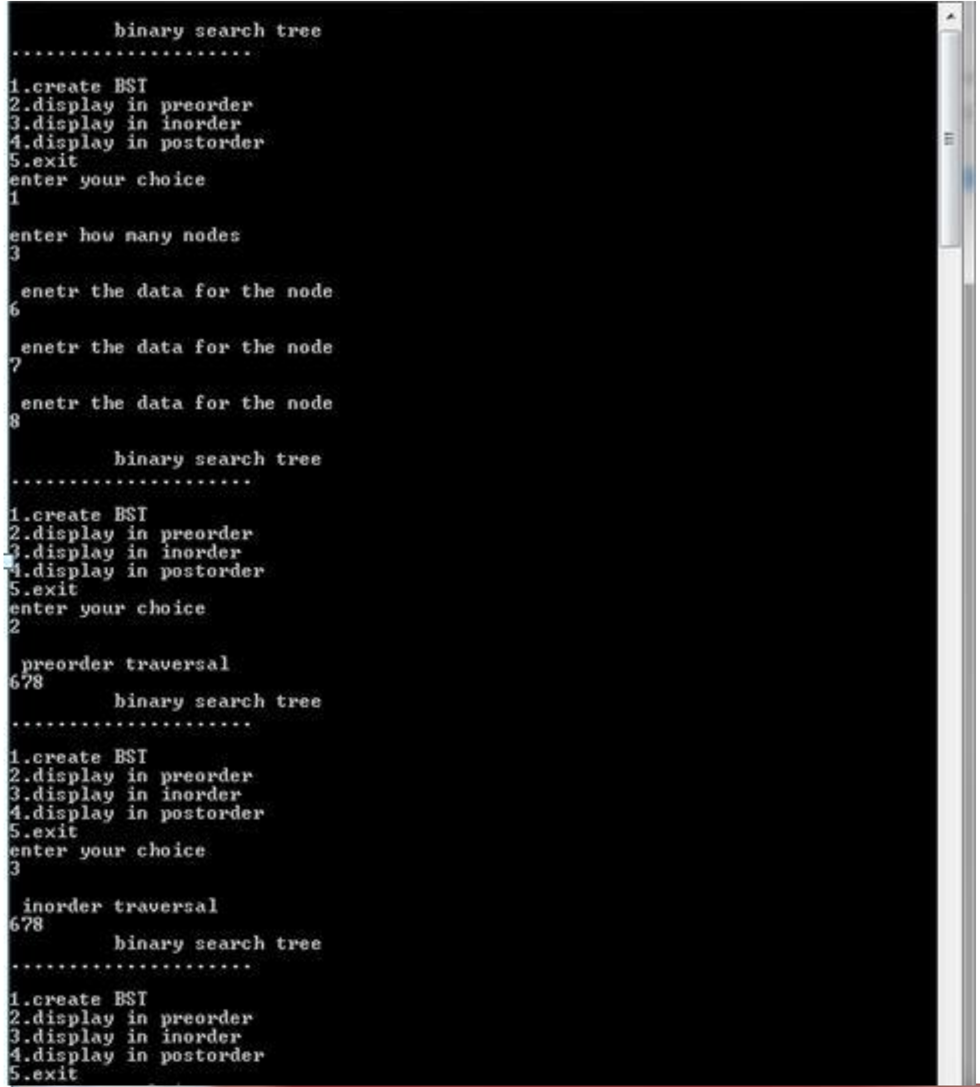
create an object of the class, accept the choice from the user
and call the functions inorder to perform the operations according to users choice.

Program :

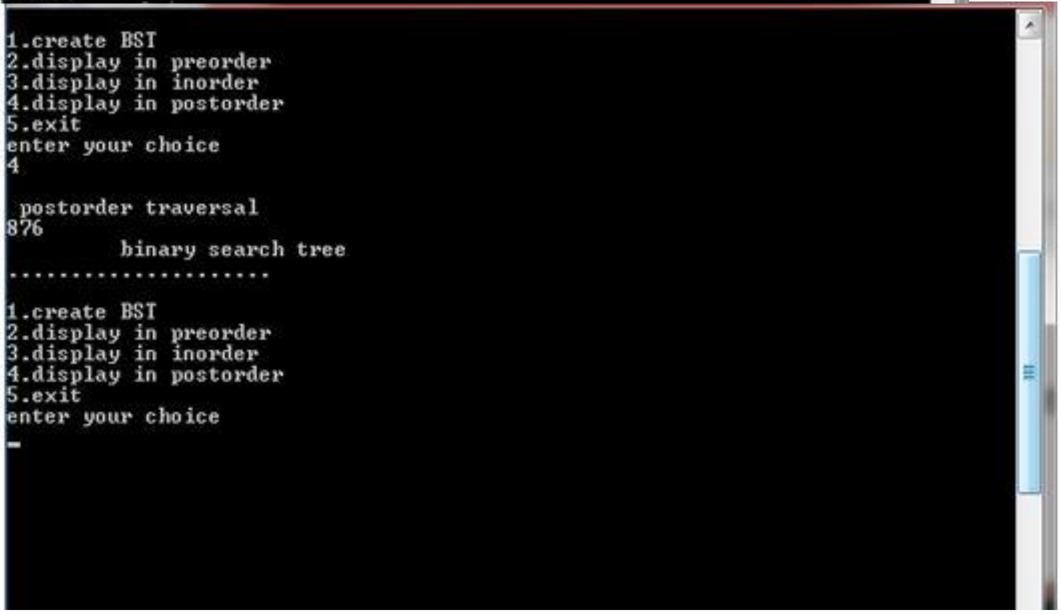
```
//binary search tree
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
struct node
{
 struct node *left;
 struct node *right;
 int info;
};
typedef struct node NODE;
NODE *root=NULL;
void create(int item)
{
 NODE *newnode,*currptr,*ptr;
 newnode=(NODE*)malloc(sizeof(NODE));
 newnode->info=item;
 newnode->left=NULL;
 newnode->right=NULL;
 if(root==NULL)
   root=newnode;
 else
 {
  currptr=root;
  while(currptr!=NULL)
  {
   ptr=currptr;
   currptr=(item>currptr->info)?currptr->right:currptr->left;
  }
  if(item<ptr->info)
   ptr->left=newnode;
  else
   ptr->right=newnode;
}
}
NODE *search(NODE *temp,int item)
{
 if(temp==NULL)
  return NULL;
 else if(item<temp->info)
  search(temp->left,item);
 else if(item>temp->info)
  search(temp->right,item);
 else
  return temp;
}
void pre_order(NODE *ptr)
```

```
{
 if(ptr)
 {
  printf("%d",ptr->info);
  pre_order(ptr->left);
  pre_order(ptr->right);
 }
}
void in_order(NODE *ptr)
{
 if(ptr)
 {
   in_order(ptr->left);
   printf("%d",ptr->info);
   in_order(ptr->right);
 }
}
void post_order(NODE *ptr)
{
 if(ptr)
 {
  post_order(ptr->left);
  post_order(ptr->right);
  printf("%d",ptr->info);
 }
}
int main()
{
 int item,ch,i,n;
 while(1)
 {
  printf("\n\t binary search tree");
  printf("\n.....................\n");
  printf("\n1.create BST");
  printf("\n2.display in preorder");
  printf("\n3.display in inorder");
  printf("\n4.display in postorder");
  printf("\n5.exit");
  printf("\nenter your choice\n");
  scanf("%d",&ch);
  switch(ch)
  {
    case 1:
     printf("\nenter how many nodes\n");
     scanf("%d",&n);
     for(i=0;i<n;i++)
     {
       printf("\n enetr the data for the node\n");
       scanf("%d",&item);
       create(item);
     }
     break;



    case 2:
     printf("\n preorder traversal\n");
     pre_order(root);
     break;

    case 3:
     printf("\n inorder traversal\n");
     in_order(root);
     break;

    case 4:
     printf("\n postorder traversal\n");
     post_order(root);
     break;

    case 5:
     exit(0);

    default:
     printf("\n invalid choice");
    }
  }
}
```

Output :



```
        binary search tree
....................

1.create BST
2.display in preorder
3.display in inorder
4.display in postorder
5.exit
enter your choice
1

enter how many nodes
3

 enetr the data for the node
6

 enetr the data for the node
7

 enetr the data for the node
8

        binary search tree
....................

1.create BST
2.display in preorder
3.display in inorder
4.display in postorder
5.exit
enter your choice
2

 preorder traversal
678
        binary search tree
....................

1.create BST
2.display in preorder
3.display in inorder
4.display in postorder
5.exit
enter your choice
3

 inorder traversal
678
        binary search tree
....................

1.create BST
2.display in preorder
3.display in inorder
4.display in postorder
5.exit
```



```
1.create BST
2.display in preorder
3.display in inorder
4.display in postorder
5.exit
enter your choice
4

 postorder traversal
876
        binary search tree
....................

1.create BST
2.display in preorder
3.display in inorder
4.display in postorder
5.exit
enter your choice
_
```

Program 15: Program to sort N element in ascending order using heap sort

Algorithm :

```
Step 1: Declare the functions
      Functions :
       createheap(int[],int);
       heapsort(int[],int); (int [ ],int)

        function definition:

   1. heapsort(int k[],int n)
  Step 1: declare temp,q,i,j,key of type int;
  Step 2:Call  createheap(k,n)
  Step 3:For q=n;q>=2 decrement q by 1 do
      temp←k[q]
      k[q] ←k[1]
      k[1] ←temp
      i←1
      j←2
     key←k[1]
    if((j+1)<q)
    if(k[j+1]>k[j])
    j←j+1
    [end of if]
  while((j<=(q-1))&&(k[j]>key))
temp←k[j]
k[j] ←k[i]
k[i←temp
i←j
j←2*i
if(j+1<q)
if(k[j+1]>k[j])
j←j+1
else
if(j>n)
j←n
[end of if]
k[i]←key
[end of while]
[end of for]
return
```

```
2: createheap(int k[],int n)

 Step 1: declare  temp,q,i,j,key as variables of type int
  Step 2:forq=2,q<=n by 1 do
i←q
key←k[q]
j←i/2
while((i>1)&&((key>k[j])))
temp←k[j]
k[j]←k[i]


k[i]←temp
i←j
j=←/2
if(j<1)
j←1
[ end of while]
k[i] ←key
[ end of for]
return
```

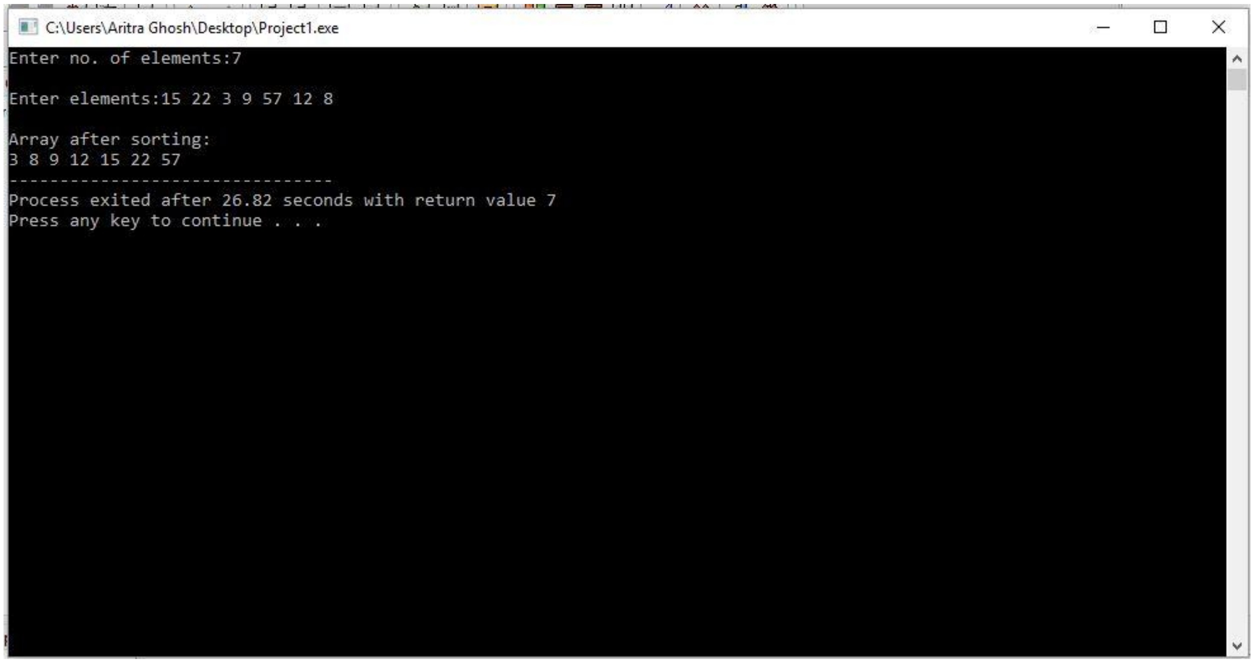
MAIN FUNCTION:

```
  Step 1 : declare variables n, i ,and array variable k[10]
  Step 2: Accept the number of elements
  Step 3: For i = 0 to i< x by 1
                  Accept the elements
             [End of for loop ]

  Step 4: display the elements by accessing the function heapsort   [end of main function ]
```

Program :

```
#include<stdio.h>

void create(int []);
void down_adjust(int [],int);

void main()
{
     int heap[30],n,i,last,temp;
     printf("Enter no. of elements:");
     scanf("%d",&n);
     printf("\nEnter elements:");
     for(i=1;i<=n;i++)
          scanf("%d",&heap[i]);

     //create a heap
     heap[0]=n;
     create(heap);

     //sorting
     while(heap[0] > 1)
     {
          //swap heap[1] and heap[last]
          last=heap[0];
          temp=heap[1];
          heap[1]=heap[last];
          heap[last]=temp;
          heap[0]--;
          down_adjust(heap,1);
     }

     //print sorted data
     printf("\nArray after sorting:\n");
     for(i=1;i<=n;i++)
          printf("%d ",heap[i]);
}

void create(int heap[])
{
     int i,n;
     n=heap[0]; //no. of elements
     for(i=n/2;i>=1;i--)
          down_adjust(heap,i);
}

void down_adjust(int heap[],int i)
{
	int j,temp,n,flag=1;
	n=heap[0];

	while(2*i<=n && flag==1)
	{
		j=2*i;    //j points to left child
		if(j+1<=n && heap[j+1] > heap[j])
			j=j+1;
		if(heap[i] > heap[j])
			flag=0;
		else
		{
			temp=heap[i];
			heap[i]=heap[j];
			heap[j]=temp;
			i=j;
		}
	}
}
```

Output :



```
Enter no. of elements:7

Enter elements:15 22 3 9 57 12 8

Array after sorting:
3 8 9 12 15 22 57
--------------------------------
Process exited after 26.82 seconds with return value 7
Press any key to continue . . .
```