VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
On

DATA STRUCTURES (23CS3PCDST)

Submitted by

AAMAL MAGDUM (1BM23CS002)

in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING

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Department of Computer Science and Engineering

This is to certify that the Lab work entitled **"DATA STRUCTURES"** carried out by **AAMAL MAGDUM (1BM23CS002)**, who is bonafide student of **B. M. S. College of Engineering**. It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2024-25. The Lab report has been approved as it satisfies the academic requirements in respect of Data structures Lab - **(23CS3PCDST)** work prescribed for the said degree.

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Course outcomes:

CO1	Apply the concept of linear and nonlinear data structures.
CO2	Analyze data structure operations for a given problem
CO3	Design and develop solutions using the operations of linear and nonlinear data structure for a given specification.
CO4	Conduct practical experiments for demonstrating the operations of different data structures.

Lab program 1:

Write a program to simulate the working of stack using an array with the following:
a) Push
b) Pop
c) Display
The program should print appropriate messages for stack overflow, stack underflow.

```
#include<stdio.h>
#include<stdlib.h>
int stack[10],top=-1,i,item;
#define max 3

void push(){
   if(top==max-1){
      printf("Stack Overflow\n");
   }
   else{
      top++;
      printf("Enter Element to Push: ");
      scanf("%d",&item);
      stack[top]=item;
   }
}

int pop(){
   if (top==-1){
      printf("Stack Underflow\n");
      return -1;
   }
   item=stack[top];
   top=top-1;
   return (item);
}

void display(){
   if (top==-1){
      printf("Stack Empty\n");
   }
   else{
      printf("The Stack is: \n");
      for(i=top;i>-1;i--){
         printf("%d\n",stack[i]);
      }
   }
}

void main(){
   while(1){
      int userInput;
      printf("Enter option: \n1. Push\n2. Pop\n3. Display\n4. Exit\n");
```

```
        scanf("%d",&userInput);
        switch(userInput){
            case 1: push();
                break;
            case 2: item=pop();
                if(item!=-1){
                    printf("The Popped Element is: %d \n",item);
                }
                break;
            case 3: display();
                break;
            case 4: exit(0);
                break;
        }
    }
}
```

Output:

```
Enter option:
1. Push
2. Pop
3. Display
4. Exit
1
Enter Element to Push: 1
Enter option:
1. Push
2. Pop
3. Display
4. Exit
1
Enter Element to Push: 2
Enter option:
1. Push
2. Pop
3. Display
4. Exit
1
Enter Element to Push: 3
Enter option:
1. Push
2. Pop
3. Display
4. Exit
```

```
4. Exit
1
Stack Overflow
Enter option:
1. Push
2. Pop
3. Display
4. Exit
3
The Stack is:
3
2
1
Enter option:
1. Push
2. Pop
3. Display
4. Exit
2
The Popped Element is: 3
Enter option:
1. Push
2. Pop
3. Display
4. Exit
2
The Popped Element is: 2
Enter option:
1. Push
2. Pop
3. Display
4. Exit
2
The Popped Element is: 1
Enter option:
1. Push
2. Pop
3. Display
4. Exit
2
Stack Underflow
Enter option:
1. Push
2. Pop
3. Display
4. Exit
3
Stack Empty
Enter option:
1. Push
2. Pop
3. Display
4. Exit
```

Lab program 2:

Write a program to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators +, -, * and /

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

int i = 0, pos = 0, top = -1, length;
char symbol, temp, infix[20], postfix[20], stack[20];

void infixtopostfix();
void push(char symbol);
char pop();
int pred(char symb);

int main()
{
   printf("Enter infix expression:\n");
   scanf("%s", infix);

   infixtopostfix();
   printf("\nInfix expression:\n%s", infix);
   printf("\nPostfix expression:\n%s", postfix);
   return 0;
}

void infixtopostfix() {
   length = strlen(infix);
   push('#');
   while (i < length) {
      symbol = infix[i];
      switch (symbol) {
         case '(':
            push(symbol);
            break;

         case ')':
            temp = pop();
            while (temp != '(') {
               postfix[pos++] = temp;
               temp = pop();
            }
            break;

         case '+':
         case '-':
         case '*':
         case '/':
```

```
            case '^':
               while (pred(stack[top]) >= pred(symbol)) {
                  temp = pop();
                  postfix[pos++] = temp;
               }
               push(symbol);
               break;

            default:
               postfix[pos++] = symbol;
         }
         i++;
      }

      while (top > 0) {
         temp = pop();
         postfix[pos++] = temp;
      }
      postfix[pos] = '\0';
}

void push(char symbol) {
   top = top + 1;
   stack[top] = symbol;
}

char pop() {
   return stack[top--];
}

int pred(char symbol) {
   int p;
   switch (symbol) {
      case '^':
         p = 3;
         break;

      case '*':
      case '/':
         p = 2;
         break;

      case '+':
      case '-':
         p = 1;
         break;

      case '(':
         p = 0;
         break;
```

```
        case '#':
            p = -1;
            break;

        default:
            p = -1;
            break;
    }
    return p;
}
```

Output:

```
Enter infix expression:
A^B*C-D+E/F/(G+H)

Infix expression:
A^B*C-D+E/F/(G+H)
Postfix expression:
AB^C*D-EF/GH+/+
```

LEETCODE:

Given a string s containing just the characters '(', ')', '{', '}', '[' and ']', determine if the input string is valid.

```
#include<string.h>

bool isValid(char* s) {
    int len = strlen(s);
    char stack[len];
    int top = -1;

    for(int i = 0; i < len; i++) {
        if(s[i] == '(' || s[i] == '{' || s[i] == '[') {
            top++;
            stack[top] = s[i];
        } else {
            if (top == -1) {
                return false;
            }
            if((s[i] == ')' && stack[top] == '(') ||
               (s[i] == '}' && stack[top] == '{') ||
               (s[i] == ']' && stack[top] == '[')) {
                top--;
            } else {
                return false;
            }
```

```
        }
    }
    return top == -1;
}
```

Lab program 3:

a) WAP to simulate the working of a queue of integers using an array. Provide the following operations: Insert, Delete, Display. The program should print appropriate messages for queue empty and queue overflow conditions.

```
#include <stdio.h>
#include <stdlib.h>
#define max 3

int front=-1, rear=-1, i, queue[10], ch, item;

void insert();
int del();
void display();

void main()
{
   while (1)
   {
      printf("\n1. INSERT \n2. DELETE \n3. DISPLAY \n4. EXIT \nEnter Your
Choice: ");
      scanf("%d",&ch);
      switch (ch)
      {
         case 1: insert();
               break;
         case 2: item=del();
               if (item!=-1)
               {
                  printf("The Deleted Item is:%d\n", item);
               } break;
         case 3: display();
               break;
         case 4: exit(0);
      }
   }
}

void insert()
{
   if (rear==max-1)
   {
      printf("Queue is Full \n");
      return;
   }
   printf("Enter Element: \n");
   scanf("%d",&item);
   if (rear ==-1 && front ==-1)
   {
```

```
        rear=0;
        front=0;
    }
    else
    {
        rear=rear+1;
    }
    queue[rear]=item;
    return;
}

int del()
{
    if (front==-1 && rear==-1)
    {
        printf("Queue is Empty\n");
        return -1;
    }
    item=queue[front];

    if (front==rear)
    {
        front=-1;
        rear=-1;
    }
    else
    {
        front=front+1;
    }
    return item;
}

void display()
{
    if (front==-1 && rear==-1)
    {
        printf("Queue is Empty \n");
        return;
    }
    printf("The Elements of the Queue are: \n");
    for (i=front;i<=max-1;i++)
    {
        printf("%d \n", queue[i]);
    }
    return;
}
```

Output:

```
1. INSERT
2. DELETE
3. DISPLAY
4. EXIT
Enter Your Choice: 1
Enter Element:
11

1. INSERT
2. DELETE
3. DISPLAY
4. EXIT
Enter Your Choice: 1
Enter Element:
12

1. INSERT
2. DELETE
3. DISPLAY
4. EXIT
Enter Your Choice: 1
Enter Element:
13
```

```
1. INSERT
2. DELETE
3. DISPLAY
4. EXIT
Enter Your Choice: 1
Queue is Full

1. INSERT
2. DELETE
3. DISPLAY
4. EXIT
Enter Your Choice: 3
The Elements of the Queue are:
11
12
13

1. INSERT
2. DELETE
3. DISPLAY
4. EXIT
Enter Your Choice: 2
The Deleted Item is:11

1. INSERT
2. DELETE
```

```
1. INSERT
2. DELETE
3. DISPLAY
4. EXIT
Enter Your Choice: 2
The Deleted Item is:12

1. INSERT
2. DELETE
3. DISPLAY
4. EXIT
Enter Your Choice: 2
The Deleted Item is:13

1. INSERT
2. DELETE
3. DISPLAY
4. EXIT
Enter Your Choice: 2
Queue is Empty

1. INSERT
2. DELETE
3. DISPLAY
4. EXIT
Enter Your Choice: 3
4. EXIT
Enter Your Choice: 2
The Deleted Item is:13

1. INSERT
2. DELETE
3. DISPLAY
4. EXIT
Enter Your Choice: 2
Queue is Empty

1. INSERT
2. DELETE
3. DISPLAY
4. EXIT
Enter Your Choice: 3
Queue is Empty

1. INSERT
2. DELETE
3. DISPLAY
4. EXIT
Enter Your Choice: 4
```

b) WAP to simulate the working of a circular queue of integers using an array. Provide the following operations: Insert, Delete & Display The program should print appropriate messages for queue empty and queue overflow conditions

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#define MAX 4

void Insert();
int Delete();
void Display();

int cq[20];
int front=-1, rear=-1, item, ch, i;

void main()
{
   while(1)
   {
      printf(" \n1. Insert \n2. Delete \n3. Display \n4. Exit");
      printf("\nEnter Your Choice: ");
      scanf("%d",&ch);
      switch(ch)
      {
         case 1: Insert();
            break;
         case 2: item=Delete();
               if (item!=-1)
               {
                  printf("The Dequeued Element is: %d",item);
               }
               break;
         case 3: Display();
            break;
         case 4: exit(0);
      }
   }
}

void Insert()
{
   if (front == (rear+1) % MAX)
      {
         printf("Circular Queue is Full. \n");
         return;
      }
   if (rear==-1 && front==-1)
   {
      rear=0;
```

```
        front=0;
    }
    else
        rear=(rear+1)%MAX;
    printf("Enter the Element to be Inserted: ");
    scanf("%d",&item);
    cq[rear]=item;
    return;
}

int Delete()
{
    if(front==-1 && rear==-1)
    {
        printf("Circular Queue is Empty. \n");
        return (-1);
    }
    item=cq[front];
    if(front==rear)
    {
        front=-1;
        rear=-1;
    }
    else
        front=(front+1)%MAX;
    return item;
}

void Display()
{
    if(front==-1 && rear==-1)
    {
        printf("Circular Queue is Empty. \n");
        return;
    }

    printf("Circular Queue Contents: \n");
    if (front<=rear)
    {
        for (int i=front;i<=rear;i++)
        {
            printf("%d\n",cq[i]);
        }
    }

   else
   {
        for(int i=front;i<=MAX-1;i++)
        {
            printf("%d\n",cq[i]);
```

```
            }
            for (int i=0;i<=rear;i++)
            {
                printf("%d\n",cq[i]);
            }
        }
        return;
    }
```

Output:

```
1. Insert
2. Delete
3. Display
4. Exit
Enter Your Choice: 1
Enter the Element to be Inserted: 1

1. Insert
2. Delete
3. Display
4. Exit
Enter Your Choice: 1
Enter the Element to be Inserted: 2

1. Insert
2. Delete
3. Display
4. Exit
Enter Your Choice: 1
Enter the Element to be Inserted: 3

1. Insert
2. Delete
3. Display
4. Exit
```

```
4. Exit
Enter Your Choice: 1
Enter the Element to be Inserted: 4

1. Insert
2. Delete
3. Display
4. Exit
Enter Your Choice: 1
Circular Queue is Full.

1. Insert
2. Delete
3. Display
4. Exit
Enter Your Choice: 3
Circular Queue Contents:
1
2
3
4

1. Insert
2. Delete
3. Display
4. Exit
```

```
1. Insert
2. Delete
3. Display
4. Exit
Enter Your Choice: 2
The Dequeued Element is: 1
1. Insert
2. Delete
3. Display
4. Exit
Enter Your Choice: 2
The Dequeued Element is: 2
1. Insert
2. Delete
3. Display
4. Exit
Enter Your Choice: 2
The Dequeued Element is: 3
1. Insert
2. Delete
3. Display
4. Exit
Enter Your Choice: 2
The Dequeued Element is: 4
```

```
Enter Your Choice: 2
The Dequeued Element is: 3
1. Insert
2. Delete
3. Display
4. Exit
Enter Your Choice: 2
The Dequeued Element is: 4
1. Insert
2. Delete
3. Display
4. Exit
Enter Your Choice: 2
Circular Queue is Empty.

1. Insert
2. Delete
3. Display
4. Exit
Enter Your Choice: 4
```

Lab program 4:

WAP to Implement Singly Linked List with following operations

a) Create a linked list.

b) Insertion of a node at first position, at any position and at end of list.

Display the contents of the linked list

```
#include <stdio.h>
#include <stdlib.h>
struct Node {
    int data;
    struct Node *link;
};
typedef struct Node node;
node *start = NULL;
node *new1, *curr, *ptr;

void create();
void display();
void InsertStart();
void InsertPosition();
void InsertEnd();

void main() {
    int ch;
    while (1) {
        printf("\n1. Create \n2. Display \n3. Insert at Beginning \n4. Insert at Position \n5. Insert at End \n6. Exit");
        printf("\nEnter Your Choice: ");
        scanf("%d", &ch);
```

```
        switch (ch) {
            case 1: create();
                break;
            case 2: display();
                break;
            case 3: InsertStart();
                break;
            case 4: InsertPosition();
                break;
            case 5: InsertEnd();
                break;
            case 6: exit(0);
        }
    }
}

void create() {
    char ch;

    do {
        new1 = (node*)malloc(sizeof(node));
       printf("\nEnter Value: ");
       scanf("%d",&new1->data);
       if (start==NULL)
       {
          start=new1;
          curr=new1;
       }
       else {
```

```
            curr->link = new1;
            curr=new1;
        }

        printf("Do You Want to Add an Element (Y/N)? ");
        scanf(" %c", &ch);
    } while (ch == 'y' || ch == 'Y');
    curr->link=NULL;
}

void display() {
    if (start == NULL) {
        printf("\nLinked List is Empty.");
        return;
    }

    ptr = start;
    printf("\nElements in Linked List: \n");

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

void InsertStart() {
    new1 = (node*)malloc(sizeof(node));
    printf("\nEnter Value: ");
```

```
    scanf("%d",&new1->data);
    if(start==NULL)
    {
        start=new1;
        new1->link=NULL;
        return;
    }
    else {
        new1->link=start;
        start=new1;
        return;
    }
}

void InsertEnd() {
    new1 = (node*)malloc(sizeof(node));
    printf("\nEnter Value: ");
    scanf("%d",&new1->data);
    if(start==NULL)
    {
        start=new1;
        new1->link=NULL;
        return;
    }

    ptr=start;
    while(ptr->link !=NULL)
    {
        ptr=ptr->link;
```

```
    }
    ptr->link=new1;
    new1->link=NULL;
    return;
}

void InsertPosition() {
    new1 = (node*)malloc(sizeof(node));
    printf("\nEnter Value: ");
    scanf("%d",&new1->data);
    if(start==NULL)
    {
        start=new1;
        new1->link=NULL;
        return;
    }

    int i=1, pos;
    ptr=start;
    printf("\nEnter Position: ");
    scanf("%d",&pos);
    while (ptr!=NULL && i<pos-1)
    {
        ptr=ptr->link;
        i++;
    }
    if(ptr==NULL)
    {
        return;
```

```
    }

    new1->link=ptr->link;
    ptr->link=new1;
}
```

Output:

```
1. Create
2. Display
3. Insert at Beginning
4. Insert at Position
5. Insert at End
6. Exit
Enter Your Choice: 1

Enter Value: 1
Do You Want to Add an Element (Y/N)? y

Enter Value: 2
Do You Want to Add an Element (Y/N)? y

Enter Value: 3
Do You Want to Add an Element (Y/N)? y

Enter Value: 4
Do You Want to Add an Element (Y/N)? n

1. Create
2. Display
3. Insert at Beginning
4. Insert at Position
5. Insert at End
```

```
5. Insert at End
6. Exit
Enter Your Choice: 2

Elements in Linked List:
1 2 3 4

1. Create
2. Display
3. Insert at Beginning
4. Insert at Position
5. Insert at End
6. Exit
Enter Your Choice: 3

Enter Value: 0

1. Create
2. Display
3. Insert at Beginning
4. Insert at Position
5. Insert at End
6. Exit
Enter Your Choice: 4

Enter Value: 5
```

```
3. Insert at Beginning
4. Insert at Position
5. Insert at End
6. Exit
Enter Your Choice: 5

Enter Value: 6

1. Create
2. Display
3. Insert at Beginning
4. Insert at Position
5. Insert at End
6. Exit
Enter Your Choice: 2

Elements in Linked List:
0 1 2 3 4 5 6

1. Create
2. Display
3. Insert at Beginning
4. Insert at Position
5. Insert at End
6. Exit
Enter Your Choice: 6
```

LEETCODE:

Given a string s, find the first non-repeating character in it and return its index. If it does not exist, return -1.

```
int firstUniqChar(char* s) {
    int freq[26] = {0};
    for (int i = 0; s[i] != '\0'; i++) {
        freq[s[i] - 'a']++;
    }
    for (int i = 0; s[i] != '\0'; i++) {
        if (freq[s[i] - 'a'] == 1) {
            return i;
        }
    }
    return -1;
}
```

Lab program 5:

WAP to Implement Singly Linked List with following operations

a) Create a linked list.

b) Deletion of first element, specified element and last element in the list.

c) Display the contents of the linked list.

```
#include <stdio.h>
#include <stdlib.h>
struct Node {
    int data;
    struct Node *link;
};
typedef struct Node node;
node *start = NULL;
node *new1, *curr, *ptr;

void create();
void display();
void DeleteStart();
void DeletePosition();
void DeleteEnd();

void main() {
    int ch;
    while (1) {
        printf("\n1. Create \n2. Display \n3. Delete from Beginning \n4. Delete at Position \n5. Delete at End \n6. Exit");
        printf("\nEnter Your Choice: ");
        scanf("%d", &ch);
```

```
        switch (ch) {
            case 1: create();
                break;
            case 2: display();
                break;
            case 3: DeleteStart();
                break;
            case 4: DeletePosition();
                break;
            case 5: DeleteEnd();
                break;
            case 6: exit(0);
        }
    }
}

void create() {
    char ch;

    do {
        new1 = (node*)malloc(sizeof(node));
       printf("\nEnter Value: ");
       scanf("%d",&new1->data);
       if (start==NULL)
       {
          start=new1;
          curr=new1;
       }
       else {
```

```
            curr->link = new1;
            curr=new1;
        }

        printf("Do You Want to Add an Element (Y/N)? ");
        scanf(" %c", &ch);
    } while (ch == 'y' || ch == 'Y');
    curr->link=NULL;
}

void display() {
    if (start == NULL) {
        printf("\nLinked List is Empty.");
        return;
    }

    ptr = start;
    printf("\nElements in Linked List: \n");

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

void DeleteStart() {
    if (start == NULL) {
        printf("\nLinked List is Empty.\n");
```

```
        return;
    }

    node *temp = start;
    start = start->link;
    free(temp);
    printf("\nFirst Element Deleted.\n");
}

void DeletePosition() {
    int i=1,pos;
    if (start == NULL) {
        printf("\nLinked List is Empty.\n");
        return;
    }

    printf("\nEnter Position: ");
    scanf("%d", &pos);

    node *temp = start;
    node *prev = NULL;

    if (pos == 1) {
        start = temp->link;
        free(temp);
        printf("\nElement at Position %d Deleted.\n", pos);
        return;
    }
```

```
    while (temp != NULL && i < pos) {
        prev = temp;
        temp = temp->link;
        i++;
    }

    if (temp == NULL) {
        printf("\nPosition Not Found.\n");
        return;
    }

    prev->link = temp->link;
    free(temp);
    printf("\nElement at Position %d Deleted\n", pos);
}

void DeleteEnd() {
    if (start == NULL) {
        printf("\nLinked List is Empty.\n");
        return;
    }

    node *temp = start;
    node *prev = NULL;

    if (start->link == NULL) {
        start = NULL;
        free(temp);
        printf("\nLast Element Deleted.\n");
```

```
        return;
    }

    while (temp->link != NULL) {
        prev = temp;
        temp = temp->link;
    }

    prev->link = NULL;
    free(temp);
    printf("\nLast element Deleted.\n");
}
```

Output:

```
1. Create
2. Display
3. Delete from Beginning
4. Delete at Position
5. Delete at End
6. Exit
Enter Your Choice: 1

Enter Value: 1
Do You Want to Add an Element (Y/N)? y

Enter Value: 2
Do You Want to Add an Element (Y/N)? y

Enter Value: 3
Do You Want to Add an Element (Y/N)? y

Enter Value: 4
Do You Want to Add an Element (Y/N)? n

1. Create
2. Display
3. Delete from Beginning
4. Delete at Position
5. Delete at End
6. Exit
```

```
Enter Your Choice: 2

Elements in Linked List:
1 2 3 4

1. Create
2. Display
3. Delete from Beginning
4. Delete at Position
5. Delete at End
6. Exit
Enter Your Choice: 3

First Element Deleted.

1. Create
2. Display
3. Delete from Beginning
4. Delete at Position
5. Delete at End
6. Exit
Enter Your Choice: 5

Last element Deleted.

1. Create
```

```
1. Create
2. Display
3. Delete from Beginning
4. Delete at Position
5. Delete at End
6. Exit
Enter Your Choice: 4

Enter Position: 2

Element at Position 2 Deleted

1. Create
2. Display
3. Delete from Beginning
4. Delete at Position
5. Delete at End
6. Exit
Enter Your Choice: 2

Elements in Linked List:
2

1. Create
2. Display
3. Delete from Beginning
```

Lab program 6:

a) **WAP to Implement Single Link List with following operations: Sort the linked list, Reverse the linked list, Concatenation of two linked lists.**

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

struct Node {
   int data;
   struct Node *link;
};
typedef struct Node node;

node *start = NULL, *temp, *new1, *curr;
int ch;
char c;

void createList();
void sort();
void reverse();
void display();
void concatenate();

void createList() {
   do {
      new1 = (node*)malloc(sizeof(node));
      printf("Enter Value: ");
      scanf("%d", &new1->data);
      new1->link = NULL;
```

```
        if (start == NULL) {
            start = new1;
            curr = new1;
        } else {
            curr->link = new1;
            curr = new1;
        }
        printf("Do you want to add another element (Y/N): ");
        scanf(" %c", &c);
    } while (c == 'y' || c == 'Y');
}

void sort() {
    if (start == NULL) {
        printf("The Linked List is Empty.\n");
        return;
    }

    node *i, *j;
    int tempData;
    for (i = start; i != NULL; i = i->link) {
        for (j = i->link; j != NULL; j = j->link) {
            if (i->data > j->data) {
                tempData = i->data;
                i->data = j->data;
                j->data = tempData;
            }
        }
    }
```

```
    printf("Linked List is Sorted.\n");
}

void reverse() {
    node *a = start, *b = NULL;
    while (a != NULL) {
        temp = a->link;
        a->link = b;
        b = a;
        a = temp;
    }
    start = b;
    printf("Linked List is Reversed.\n");
}

void display() {
    if (start == NULL) {
        printf("Linked list is Empty\n");
        return;
    }

    temp = start;
    printf("Elements in Linked List:\n");
    while (temp != NULL) {
        printf("%d\t", temp->data);
        temp = temp->link;
    }
    printf("\n");
}
```

```
void concatenate() {
    node *start2 = NULL, *curr2 = NULL;

    printf("Enter the second linked list:\n");
    createList();

    do {
        new1 = (node*)malloc(sizeof(node));
        printf("Enter value for second list: ");
        scanf("%d", &new1->data);
        new1->link = NULL;

        if (start2 == NULL) {
            start2 = new1;
            curr2 = new1;
        } else {
            curr2->link = new1;
            curr2 = new1;
        }
        printf("Do you want to add another element (Y/N): ");
        scanf(" %c", &c);
    } while (c == 'y' || c == 'Y');

    if (start == NULL) {
        start = start2;
    } else {
        temp = start;
        while (temp->link != NULL) {
```

```
            temp = temp->link;
        }
        temp->link = start2;
    }
    start2 = NULL;
    printf("Lists concatenated successfully.\n");
}

int main() {
    while (1) {
        printf("\n1. Create 1st Linked List\n2. Sort Linked List\n3. Reverse Linked List\n4. Concatenate Linked Lists\n5. Display Linked List\n6. Exit\n");
        printf("Enter Your Choice: ");
        scanf("%d", &ch);
        switch (ch) {
            case 1:
                createList();
                break;
            case 2:
                sort();
                break;
            case 3:
                reverse();
                break;
            case 4:
                concatenate();
                break;
            case 5:
                display();
                break;
```

```
            case 6:
                exit(0);
                break;
            default:
                printf("Invalid choice. Please try again.\n");
                break;
        }
    }
}
```

Output:

```
1. Create 1st Linked List
2. Sort Linked List
3. Reverse Linked List
4. Concatenate Linked Lists
5. Display Linked List
6. Exit
Enter Your Choice: 1
Enter Value: 1
Do you want to add another element (Y/N): y
Enter Value: 2
Do you want to add another element (Y/N): y
Enter Value: 3
Do you want to add another element (Y/N): n

1. Create 1st Linked List
2. Sort Linked List
3. Reverse Linked List
4. Concatenate Linked Lists
5. Display Linked List
6. Exit
Enter Your Choice: 3
Linked List is Reversed.

1. Create 1st Linked List
2. Sort Linked List
```

```
6. Exit
Enter Your Choice: 3
Linked List is Reversed.

1. Create 1st Linked List
2. Sort Linked List
3. Reverse Linked List
4. Concatenate Linked Lists
5. Display Linked List
6. Exit
Enter Your Choice: 5
Elements in Linked List:
3   2   1

1. Create 1st Linked List
2. Sort Linked List
3. Reverse Linked List
4. Concatenate Linked Lists
5. Display Linked List
6. Exit
Enter Your Choice: 2
Linked List is Sorted.

1. Create 1st Linked List
2. Sort Linked List
3. Reverse Linked List
```

```
1. Create 1st Linked List
2. Sort Linked List
3. Reverse Linked List
4. Concatenate Linked Lists
5. Display Linked List
6. Exit
Enter Your Choice: 5
Elements in Linked List:
1   2   3

1. Create 1st Linked List
2. Sort Linked List
3. Reverse Linked List
4. Concatenate Linked Lists
5. Display Linked List
6. Exit
Enter Your Choice: 4
Enter the second linked list:
Enter Value: 4
Do you want to add another element (Y/N): y
Enter Value: 5
Do you want to add another element (Y/N): y
Enter Value: 6
Do you want to add another element (Y/N): n
Enter value for second list: 7
```

```
3. Reverse Linked List
4. Concatenate Linked Lists
5. Display Linked List
6. Exit
Enter Your Choice: 4
Enter the second linked list:
Enter Value: 4
Do you want to add another element (Y/N): y
Enter Value: 5
Do you want to add another element (Y/N): y
Enter Value: 6
Do you want to add another element (Y/N): n
Enter value for second list: 7
Do you want to add another element (Y/N): n
Lists concatenated successfully.

1. Create 1st Linked List
2. Sort Linked List
3. Reverse Linked List
4. Concatenate Linked Lists
5. Display Linked List
6. Exit
Enter Your Choice: 2
Linked List is Sorted.
```

b) WAP to Implement Single Link List to simulate Stack & Queue Operations.

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

struct Node {
   int data;
   struct Node *link;
};

typedef struct Node node;

//Stack
node *top = NULL;

void push();
void pop();
void displayStack();

void push() {
   node *new1 = (node*)malloc(sizeof(node));
   if (new1 == NULL) {
      printf("\nStack Overflow.\n");
      return;
   }

   printf("\nEnter Value to Push: ");
   scanf("%d", &new1->data);
   new1->link = top;
   top = new1;
}

void pop() {
   if (top == NULL) {
      printf("\nStack Underflow.\n");
      return;
   }

   node *temp = top;
   printf("\nPopped Element: %d\n", temp->data);
   top = top->link;
   free(temp);
}

void displayStack() {
   if (top == NULL) {
      printf("\nThe Stack is Empty.\n");
      return;
   }
```

```
    printf("\nElements in the Stack: ");
    node *temp = top;
    while (temp != NULL) {
        printf("%d ", temp->data);
        temp = temp->link;
    }
    printf("\n");
}


//Queue
node *front = NULL, *rear = NULL;

void insert();
void del();
void displayQueue();

void insert() {
    node *new1 = (node*)malloc(sizeof(node));
    if (new1 == NULL) {
        printf("\nQueue Full.\n");
        return;
    }

    printf("\nEnter Value to Insert: ");
    scanf("%d", &new1->data);
    new1->link = NULL;

    if (rear == NULL) {
        front = rear = new1;
        return;
    }
    rear->link = new1;
    rear = new1;
}

void del() {
    if (front == NULL) {
        printf("\nQueue Empty.\n");
        return;
    }

    node *temp = front;
    printf("\nDeleted Element: %d\n", temp->data);
    front = front->link;

    if (front == NULL) {
        rear = NULL;
    }
    free(temp);
```

```
}

void displayQueue() {
   if (front == NULL) {
      printf("\nThe Queue is Empty.\n");
      return;
   }

   printf("\nElements in the Queue: ");
   node *temp = front;
   while (temp != NULL) {
      printf("%d ", temp->data);
      temp = temp->link;
   }
   printf("\n");
}


// Main
void main(){
   int ch;

   while (1) {
      printf("\n1. Push (Stack) \n2. Pop (Stack) \n3. Display (Stack)");
      printf("\n4. Insert (Queue) \n5. Delete (Queue) \n6. Display (Queue) \n7. Exit");
      printf("\nEnter Your Choice: ");
      scanf("%d", &ch);

      switch (ch) {
         case 1:
            push();
            break;
         case 2:
            pop();
            break;
         case 3:
            displayStack();
            break;
         case 4:
            insert();
            break;
         case 5:
            del();
            break;
         case 6:
            displayQueue();
            break;
         case 7:
            exit(0);
         default:
```

```
            printf("\nEnter Your Choice: \n");
        }
    }
}
```

Output:

```
1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 1

Enter Value to Push: 1

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 1

Enter Value to Push: 2

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
```

```
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 1

Enter Value to Push: 3

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 3

Elements in the Stack: 3 2 1

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
```

```
Enter Your Choice: 2

Popped Element: 3

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 2

Popped Element: 2

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 2

Popped Element: 1

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 2

Stack Underflow.

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 4

Enter Value to Insert: 1

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
```

```
7. Exit
Enter Your Choice: 4

Enter Value to Insert: 2

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 4

Enter Value to Insert: 3

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 6

Elements in the Queue: 1 2 3

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 5

Deleted Element: 1

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 5

Deleted Element: 2

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
```

```
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 5

Deleted Element: 3

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 5

Queue Empty.

1. Push (Stack)
2. Pop (Stack)
3. Display (Stack)
4. Insert (Queue)
5. Delete (Queue)
6. Display (Queue)
7. Exit
Enter Your Choice: 7
```

Lab program 7:

Write a program to implement doubly linked list.

```
#include <stdio.h>
#include <stdlib.h>
struct Node {
    int data;
    struct Node *left;
    struct Node *right;
};
typedef struct Node node;
node *start = NULL;
node *new1, *curr, *ptr;

void create();
void display();
void InsertLeft();
void DeleteSpecificElement();

void main() {
    int ch;
    while (1) {
        printf("\n1. Create \n2. Display \n3. Insert Left \n4. Delete Specific Element \n5. Exit");
        printf("\nEnter Your Choice: ");
        scanf("%d", &ch);

        switch (ch) {
            case 1: create();
                break;
            case 2: display();
```

```
            break;
        case 3: InsertLeft();
            break;
        case 4: DeleteSpecificElement();
            break;
        case 5: exit(0);
      }
   }
}

void create() {
   char ch;

   do {
      new1 = (node*)malloc(sizeof(node));
      printf("\nEnter Value: ");
      scanf("%d", &new1->data);
      new1->left = NULL;
      new1->right = NULL;

      if (start == NULL) {
         start = new1;
         curr = new1;
      } else {
         curr->right = new1;
         new1->left = curr;
         curr = new1;
      }
```

```
        printf("Do You Want to Add an Element (Y/N)? ");
        scanf(" %c", &ch);
    } while (ch == 'y' || ch == 'Y');
}

void display() {
    if (start == NULL) {
        printf("\nLinked List is Empty.");
        return;
    }

    ptr = start;
    printf("\nElements in Linked List: \n");

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

void InsertLeft() {
    int val;
    printf("\nEnter Value: ");
    scanf("%d", &val);

    new1 = (node*)malloc(sizeof(node));
    new1->data = val;
    new1->left = NULL;
```

```
    new1->right = NULL;

    printf("\nEnter the Value to Insert Left of: ");
    scanf("%d", &val);

    ptr = start;
    while (ptr != NULL && ptr->data != val) {
        ptr = ptr->right;
    }

    if (ptr != NULL) {
        new1->right = ptr;
        new1->left = ptr->left;
        if (ptr->left != NULL) {
            ptr->left->right = new1;
        }
        ptr->left = new1;
        if (ptr == start) {
            start = new1;
        }
    } else {
        printf("\nValue not found.\n");
    }
}

void DeleteSpecificElement() {
    int value;
    printf("\nEnter Value to Delete: ");
    scanf("%d", &value);
```

```
    ptr = start;
    while (ptr != NULL && ptr->data != value) {
        ptr = ptr->right;
    }

    if (ptr == NULL) {
        printf("\nValue not found.\n");
        return;
    }

    if (ptr->left != NULL) {
        ptr->left->right = ptr->right;
    }
    if (ptr->right != NULL) {
        ptr->right->left = ptr->left;
    }
    if (ptr == start) {
        start = ptr->right;
    }

    free(ptr);
    printf("\nElement with value %d deleted.\n", value);
}
```

Output:

```
1. Create
2. Display
3. Insert Left
4. Delete Specific Element
5. Exit
Enter Your Choice: 1

Enter Value: 11
Do You Want to Add an Element (Y/N)? y

Enter Value: 22
Do You Want to Add an Element (Y/N)? y

Enter Value: 33
Do You Want to Add an Element (Y/N)? y

Enter Value: 44
Do You Want to Add an Element (Y/N)? n

1. Create
2. Display
3. Insert Left
4. Delete Specific Element
5. Exit
Enter Your Choice: 2
```

```
Elements in Linked List:
11 22 33 44

1. Create
2. Display
3. Insert Left
4. Delete Specific Element
5. Exit
Enter Your Choice: 3

Enter Value: 10

Enter the Value to Insert Left of: 11

1. Create
2. Display
3. Insert Left
4. Delete Specific Element
5. Exit
Enter Your Choice: 2

Elements in Linked List:
10 11 22 33 44

1. Create
```

```
2. Display
3. Insert Left
4. Delete Specific Element
5. Exit
Enter Your Choice: 4

Enter Value to Delete: 11

Element with value 11 deleted.

1. Create
2. Display
3. Insert Left
4. Delete Specific Element
5. Exit
Enter Your Choice: 2

Elements in Linked List:
10 22 33 44

1. Create
2. Display
3. Insert Left
4. Delete Specific Element
5. Exit
Enter Your Choice: 5
```

Lab program 8:

Write a program

a) To construct a binary Search tree.

b) To traverse the tree using all the methods i.e., inorder, preorder and post order

c) To display the elements in the tree.

```
#include <stdio.h>
#include <stdlib.h>
typedef struct Node {
    int data;
    struct Node *left, *right;
} node;
node* createNode(int data) {
    node* new1 = (node*)malloc(sizeof(node));
    new1->data = data;
    new1->left = new1->right = NULL;
    return new1;
}
node* insertNode(node* root, int data) {
    if (root == NULL) {
        return createNode(data);
    }
    if (data < root->data) {
        root->left = insertNode(root->left, data);
    } else {
        root->right = insertNode(root->right, data);
    }
    return root;
}
```

```
void inorderTraversal(node* root) {
   if (root != NULL) {
      inorderTraversal(root->left);
      printf("%d ", root->data);
      inorderTraversal(root->right);
   }
}

void preorderTraversal(node* root) {
   if (root != NULL) {
      printf("%d ", root->data);
      preorderTraversal(root->left);
      preorderTraversal(root->right);
   }
}

void postorderTraversal(node* root) {
   if (root != NULL) {
      postorderTraversal(root->left);
      postorderTraversal(root->right);
      printf("%d ", root->data);
   }
}

void displayTree(node* root, int space) {
   if (root == NULL) {
      return;
   }
```

```
    space += 10;
    displayTree(root->right, space);
    printf("\n");
    for (int i = 10; i < space; i++) {
        printf(" ");
    }
    printf("%d\n", root->data);
    displayTree(root->left, space);
}

int main() {
    node* root = NULL;
    int choice, value;
    printf("Binary Search Tree Operations:\n");
    while (1) {
        printf("\n1. Insert\n2. In-order Traversal\n3. Pre-order Traversal\n4. Post-order
Traversal\n5. Display Tree\n6. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter the value to insert: ");
                scanf("%d", &value);
                root = insertNode(root, value);
                break;
            case 2:
                printf("In-order Traversal: ");
                inorderTraversal(root);
```

```
            printf("\n");
            break;
        case 3:
            printf("Pre-order Traversal: ");
            preorderTraversal(root);
            printf("\n");
            break;
        case 4:
            printf("Post-order Traversal: ");
            postorderTraversal(root);
            printf("\n");
            break;
        case 5:
            printf("Tree Representation:\n");
            displayTree(root, 0);
            printf("\n");
            break;
        case 6:
            exit(0);
        default:
            printf("Invalid choice. Please try again.\n");
      }
   }
   return 0;
}
```

Output:

```
Binary Search Tree Operations:

1. Insert
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
5. Display Tree
6. Exit
Enter your choice: 1
Enter the value to insert: 3

1. Insert
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
5. Display Tree
6. Exit
Enter your choice: 1
Enter the value to insert: 2

1. Insert
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
5. Display Tree
6. Exit
```

```
Enter your choice: 1
Enter the value to insert: 1

1. Insert
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
5. Display Tree
6. Exit
Enter your choice: 1
Enter the value to insert: 5

1. Insert
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
5. Display Tree
6. Exit
Enter your choice: 1
Enter the value to insert: 4

1. Insert
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
5. Display Tree
```

```
6. Exit
Enter your choice: 2
In-order Traversal: 1 2 3 4 5

1. Insert
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
5. Display Tree
6. Exit
Enter your choice: 3
Pre-order Traversal: 3 2 1 5 4

1. Insert
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
5. Display Tree
6. Exit
Enter your choice: 4
Post-order Traversal: 1 2 4 5 3

1. Insert
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
```

```
3. Pre-order Traversal
4. Post-order Traversal
5. Display Tree
6. Exit
Enter your choice: 5
Tree Representation:

         5

                  4

3

         2

                  1


1. Insert
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
5. Display Tree
6. Exit
Enter your choice: 6
```

Lab program 9:

a) Write a program to traverse a graph using BFS method.

```
#include <stdio.h>
#include <stdlib.h>
#define MAX 100
int queue[MAX], front = -1, rear = -1;
void enqueue(int item) {
   if (rear == MAX - 1) {
      printf("Queue Overflow\n");
      return;
   }
   if (front == -1) front = 0;
   queue[++rear] = item;
}
int dequeue() {
   if (front == -1 || front > rear) {
      printf("Queue Underflow\n");
      return -1;
   }
   return queue[front++];

void bfs(int graph[MAX][MAX], int visited[MAX], int start, int n) {
   int i;
   enqueue(start);
   visited[start] = 1;
   printf("BFS Traversal: ");
   while (front <= rear) {
      int current = dequeue();
      printf("%d ", current)
      for (i = 0; i < n; i++) {
```

```
            if (graph[current][i] == 1 && !visited[i]) {
                enqueue(i);
                visited[i] = 1;
            }
        }
    }
    printf("\n");
}
int main() {
    int n, i, j, start;
    int graph[MAX][MAX], visited[MAX] = {0}
    printf("Enter the number of vertices: ");
    scanf("%d", &n)
    printf("Enter the adjacency matrix:\n");
    for (i = 0; i < n; i++)
        for (j = 0; j < n; j++)
            scanf("%d", &graph[i][j])
    printf("Enter the starting vertex: ");
    scanf("%d", &start)
    bfs(graph, visited, start, n);
    return 0;
}
```

Output:

```
Enter the number of vertices: 5
Enter the adjacency matrix:
0 0 1 1 1
0 0 0 1 1
1 0 0 1 0
1 1 1 0 1
1 1 0 0 0
Enter the starting vertex: 2
BFS Traversal: 2 0 3 4 1
```

b) Write a program to check whether given graph is connected or not using DFS method.

```
#include <stdio.h>
#define MAX 10
int a[MAX][MAX], vis[MAX], n;
void dfsConnected(int v) {
    vis[v] = 1;
    for (int i = 0; i < n; i++) {
        if (a[v][i] == 1 && !vis[i]) {
            dfsConnected(i);
        }
    }
}
int isConnected() {
    for (int i = 0; i < n; i++) {
        vis[i] = 0;
    }
    dfsConnected(0);
    for (int i = 0; i < n; i++) {
        if (!vis[i]) {
            return 0;
        }
    }
    return 1;
void dfs(int v) {
    printf("%d ", v+1);
    vis[v] = 1;
    for (int i = 0; i < n; i++) {
        if (a[v][i] == 1 && vis[i] == 0) {
```

```
            dfs(i);
        }
    }
}
void main() {
    int i, j
    printf("Enter Number of Vertices: ");
    scanf("%d", &n);
    printf("Enter Adjacency Matrix:\n");
    for (i = 0; i < n; i++) {
        for (j = 0; j < n; j++) {
            scanf("%d", &a[i][j]);
        }

    for (i = 0; i < n; i++) {
        vis[i] = 0;
    }
    printf("DFS Traversal: ");
    for (i = 0; i < n; i++) {
        if (vis[i] == 0) {
            dfs(i);
        }
    }

    printf("\n");
    if (isConnected()) {
        printf("The graph is connected.\n");
    }
    else {
```

```
        printf("The graph is not connected.\n");
    }
}
```

Output:

```
Enter Number of Vertices: 5
Enter Adjacency Matrix:
0 0 1 1 1
0 0 0 1 1
1 0 0 1 0
1 1 1 0 1
1 1 0 0 0
DFS Traversal: 1 3 4 2 5
The graph is connected.
```

Lab program 10:

Given a File of N employee records with a set K of Keys(4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are integers. Design and develop a Program in C that uses Hash function H: K -> L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

```
#include <stdio.h>
#include <stdlib.h>
#define MAX_EMPLOYEES 100
#define m 100
typedef struct {
int key;
int address;
} EmployeeRecord; int hashTable[m];
int hashFunction(int key) { return key % m;
}
int insert(int key) {
int index = hashFunction(key); while (hashTable[index] != -1) {
index = (index + 1) % m;
}
hashTable[index] = key; return index;
}
void displayHashTable() { printf("\nHash Table:\n"); printf("Index Key\n");
for (int i = 0; i < m; i++) {

if (hashTable[i] != -1) {
printf("%d       %d\n", i, hashTable[i]);
}
}
```

```
}
int main() {
for (int i = 0; i < m; i++) { hashTable[i] = -1;
}
int employeeKeys[MAX_EMPLOYEES]; int numEmployees;

printf("Enter number of employees: "); scanf("%d", &numEmployees);

printf("Enter the employee keys (4-digit integers):\n"); for (int i = 0; i < numEmployees; i++)
{
scanf("%d", &employeeKeys[i]);
}
for (int i = 0; i < numEmployees; i++) { int address = insert(employeeKeys[i]);
printf("Employee key %d inserted at address %d\n", employeeKeys[i], address);
}
displayHashTable(); return 0;
}
```

Output:

```
Enter number of employees: 7
Enter the employee keys (4-digit integers):
1111
1728
1983
1622
1834
1143
1091
Employee key 1111 inserted at address 11
Employee key 1728 inserted at address 28
Employee key 1983 inserted at address 83
Employee key 1622 inserted at address 22
Employee key 1834 inserted at address 34
Employee key 1143 inserted at address 43
Employee key 1091 inserted at address 91

Hash Table:
Index Key
11  1111
22  1622
28  1728
34  1834
43  1143
83  1983
91  1091
```