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LAB REPORT On

DATA STRUCTURES (23CS3PCDST)

Submitted by

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

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This is to certify that the Lab work entitled **"DATA STRUCTURES"** carried out by Deepthi M **(1BM23CS088)**, 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: Stack

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>

#define STACK_SIZE 5

void push(int st[], int *top) {
   int item;
   if (*top == STACK_SIZE - 1) {
      printf("Stack overflow\n");
   } else {
      printf("\nEnter an item: ");
      scanf("%d", &item);
      (*top)++;
      st[*top] = item;
   }
}

void pop(int st[], int *top) {
   if (*top == -1) {
      printf("Stack underflow\n");
   } else {
```

```
        printf("\n%d item was deleted\n", st[(*top)--]);
    }
}

void display(int st[], int *top) {
    if (*top == -1) {
        printf("Stack is empty\n");
    } else {
        printf("Stack elements are:\n");
        for (int i = 0; i <= *top; i++) {
            printf("%d\t", st[i]);
        }
        printf("\n");
    }
}

int main() {
    printf("Deepthi M \n1BM23CS088\n");

    int st[STACK_SIZE], top = -1, c;

    while (1) {
        printf("\n1. Push\n2. Pop\n3. Display\n4. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &c);

        switch (c) {
            case 1:
                push(st, &top);
                break;
            case 2:
                pop(st, &top);
                break;
            case 3:
                display(st, &top);
                break;
            case 4:
                exit(0);
            default:
                printf("\nInvalid choice!!!\n");
        }
    }

    return 0;
}
```

Output:

```
Deepthi M
1BM23CS088

1. Push
2. Pop
3. Display
4. Exit
Enter your choice: 1

Enter an item: 2

1. Push
2. Pop
3. Display
4. Exit
Enter your choice: 3
Stack elements are:
2

1. Push
2. Pop
3. Display
4. Exit
Enter your choice: 4
```

Lab program 2: Infix to postfix

WAP to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus), - (minus), * (multiply) and / (divide)WAP to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus), - (minus), * (multiply) and / (divide)

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

char s[100];
int top = -1;

void push(char ele) {
   top++;
   s[top] = ele;
}

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

int pr(char op) {
   switch (op) {
      case '#': return 0;
      case '(': return 1;
      case '+': case '-': return 2;
      case '*': case '/': return 3;
      default: return 0;
   }
}

int main() {
   printf("Deepthi M \n1BM23CS088\n");

   char infix[100], ch;
   int i = 0;

   printf("Enter the infix expression: ");
   scanf("%s", infix);

   push('#');

   while (infix[i] != '\0') {
      if (isalpha(infix[i])) {
         printf("%c", infix[i]);
      } else if (infix[i] == '(') {
         push(infix[i]);
      } else if (infix[i] == ')') {
         while (s[top] != '(') {
            ch = pop();
            printf("%c", ch);
         }
         pop();
      } else {
```

```
        while ((s[top] != '#') && (pr(infix[i]) <= pr(s[top]))) {
          ch = pop();
          printf("%c", ch);
        }
        push(infix[i]);
      }
      i++;
    }

    while (top > 0) {
      if (s[top] == '(') {
        printf("INVALID EXPRESSION\n");
        return 1;
      }
      printf("%c", pop());
    }

    return 0;
}
```

Output:

Lab Program 3a: Linear Queue

```
#include <stdio.h>

#include <stdlib.h>

#define MAX 5
```

```
int isFull(int rear) {
   return rear == MAX - 1;
}

int isEmpty(int front) {
   return front == -1;
}

void insert(int queue[], int *front, int *rear, int value) {
   if (isFull(*rear)) {
      printf("Queue Overflow! Cannot insert %d\n", value);
      return;
   }
   if (*rear == -1) {
      *front = 0;
   }
   queue[++(*rear)] = value;
   printf("Inserted %d into the queue\n", value);
}

int delete(int queue[], int *front, int *rear) {
   if (isEmpty(*front)) {
      printf("Queue Underflow! Cannot delete from an empty queue\n");
      return -1;
   }
   int item = queue[*front];
   if (*front == *rear) {
      *front = -1;
      *rear = -1;
   } else {
      (*front)++;
   }
   printf("Deleted %d from the queue\n", item);
```

```
    return item;
}

void display(int queue[], int front, int rear) {
    if (isEmpty(front)) {
        printf("Queue is empty\n");
        return;
    }
    printf("Queue elements: ");
    for (int i = front; i <= rear; i++) {
        printf("%d ", queue[i]);
    }
    printf("\n");
}

int main() {
    printf("Deepthi M \n1BM23CS088\n");

    int queue[MAX];
    int front = -1, rear = -1;
    int choice, value;

    while (1) {
        printf("\nQueue Operations:\n");
        printf("1. Insert\n");
        printf("2. Delete\n");
        printf("3. Display\n");
        printf("4. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter a value to insert: ");
```

```
            scanf("%d", &value);
            insert(queue, &front, &rear, value);
            break;
        case 2:
            delete(queue, &front, &rear);
            break;
        case 3:
            display(queue, front, rear);
            break;
        case 4:
            exit(0);
        default:
            printf("Invalid choice! Please try again.\n");
      }
   }
   return 0;
}
```

output:

```
Deepthi M
1BM23CS088

Queue Operations:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter a value to insert: 2
Inserted 2 into the queue

Queue Operations:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter a value to insert: 4
Inserted 4 into the queue

Queue Operations:
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Queue elements: 2 4
```

Lab Program 3b: Circular Queue

WAP to simulate the working of a circular queue of integers using an array. Provide the following operations: Insert, Delete & DisplayThe program should print appropriate messages for queue empty and queue overflow conditions. The program should be done using pass by reference only.

```
#include <stdio.h>
#include <stdlib.h>
#define MAX 5

int isFull(int front, int rear) {
   return (front == (rear + 1) % MAX);
}

int isEmpty(int front) {
   return front == -1;
}

void enqueue(int queue[], int *front, int *rear, int value) {
   if (isFull(*front, *rear)) {
      printf("Queue is full!\n");
   } else {
      if (*front == -1) {
         *front = 0;
      }
      *rear = (*rear + 1) % MAX;
      queue[*rear] = value;
      printf("Inserted %d\n", value);
   }
}

void dequeue(int queue[], int *front, int *rear) {
   if (isEmpty(*front)) {
      printf("Queue is empty!\n");
   } else {
      printf("Deleted %d\n", queue[*front]);
      if (*front == *rear) {
         *front = -1;
         *rear = -1;
      } else {
         *front = (*front + 1) % MAX;
      }
   }
}

void display(int queue[], int front, int rear) {
   if (isEmpty(front)) {
      printf("Queue is empty!\n");
   } else {
      printf("Queue elements are: ");
      int i = front;
      while (i != rear) {
         printf("%d ", queue[i]);
         i = (i + 1) % MAX;
      }
      printf("%d\n", queue[i]);
   }
}
```

```
int main() {
   printf("Deepthi M \n1BM23CS088\n");

   int queue[MAX];
   int front = -1, rear = -1;
   int choice, value;

   while (1) {
      printf("\nCircular Queue Menu:\n");
      printf("1. Enqueue\n");
      printf("2. Dequeue\n");
      printf("3. Display\n");
      printf("4. Exit\n");
      printf("Enter your choice: ");
      scanf("%d", &choice);

      switch (choice) {
         case 1:
            printf("Enter value to insert: ");
            scanf("%d", &value);
            enqueue(queue, &front, &rear, value);
            break;
         case 2:
            dequeue(queue, &front, &rear);
            break;
         case 3:
            display(queue, front, rear);
            break;
         case 4:
            printf("Exiting...\n");
            exit(0);
         default:
            printf("Invalid choice! Please try again.\n");
      }
   }

   return 0;
}
```

Output:

```
Deepthi M
1BM23CS088

Circular Queue Menu:
1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 1
Enter value to insert: 2
Inserted 2

Circular Queue Menu:
1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 1
Enter value to insert: 5
Inserted 5

Circular Queue Menu:
1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 3
Queue elements are: 2 5
```

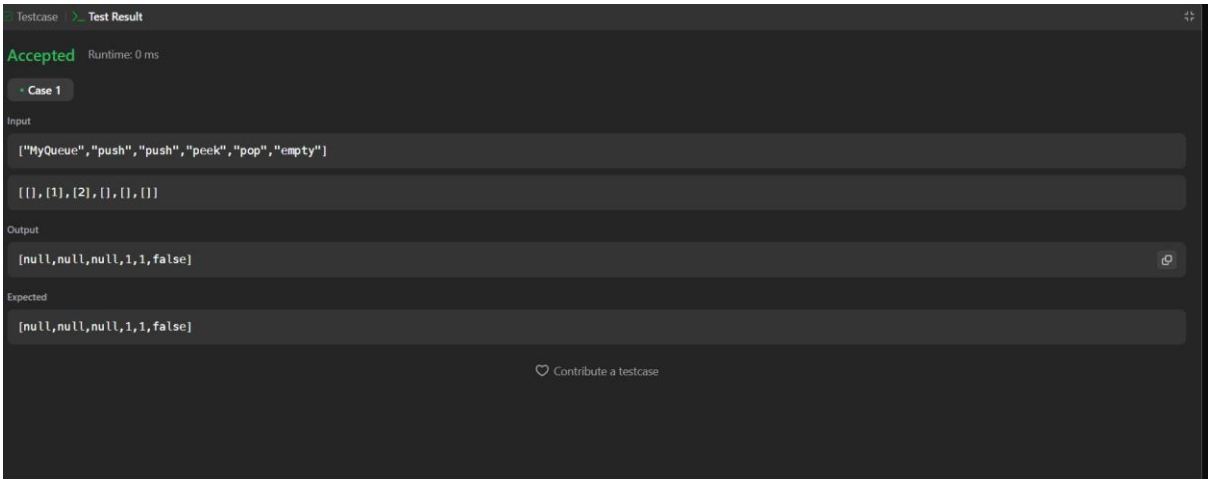
Leet Code: Implement Queue using stacks

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

```
#include<stdlib.h>
#include <stdbool.h>
#define MAX 10


typedef struct {
    int array1[MAX];
    int array2[MAX];
    int top1;
    int top2;

} MyQueue;


MyQueue* myQueueCreate() {
    MyQueue* queue = (MyQueue*)malloc(sizeof(MyQueue));
    queue->top1 = -1;
    queue->top2 = -1;
    return queue;

}

void myQueuePush(MyQueue* obj, int x) {
     if (obj->top1 == MAX - 1)
     {
        printf("Queue is full\n");
        return;
     }
    obj->array1[++(obj->top1)] = x;

}

int myQueuePop(MyQueue* obj) {
    if (obj->top2 == -1)
     {
        if (obj->top1 == -1)
        {
            printf("Queue is empty\n");
            return -1;
        }
        while (obj->top1 != -1)
         {
            obj->array2[++(obj->top2)] = obj->array1[(obj->top1)--];
        }
    }
    return obj->array2[(obj->top2)--];

}

int myQueuePeek(MyQueue* obj) {
     if (obj->top2 == -1)
      {
        if (obj->top1 == -1)
        {
            printf("Queue is empty\n");
            return -1;
        }
```

```
        while (obj->top1 != -1)
        {
            obj->array2[++(obj->top2)] = obj->array1[(obj->top1)--];
        }
    }
    return obj->array2[obj->top2];

}

bool myQueueEmpty(MyQueue* obj) {
    return (obj->top1 == -1 && obj->top2 == -1);

}

void myQueueFree(MyQueue* obj) {
    free(obj);

}
```

Output

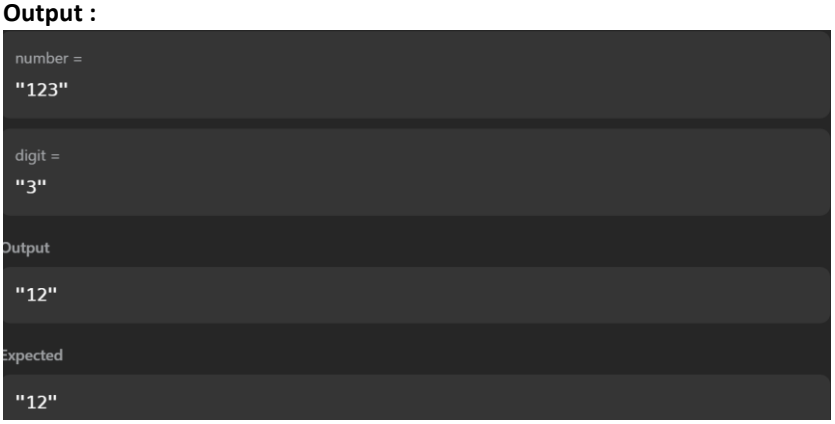


Leet Code: REMOVE DIGIT FROM NUMBER

TO MAXIMISE RESULT

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

char* removeDigit(char* number, char digit) {
    int len = strlen(number);

    for (int i = 0; i < len - 1; i++) {
        if (number[i] == digit && number[i] < number[i + 1]) {
            memmove(&number[i], &number[i + 1], len - i);
            return number;
        }
    }


    for (int i = len - 1; i >= 0; i--) {
        if (number[i] == digit) {

            memmove(&number[i], &number[i + 1], len - i);
            return number;
        }
    }

    return number;
}
```

Output :



number =

"1231"

digit =

"1"

Output

"231"

Expected

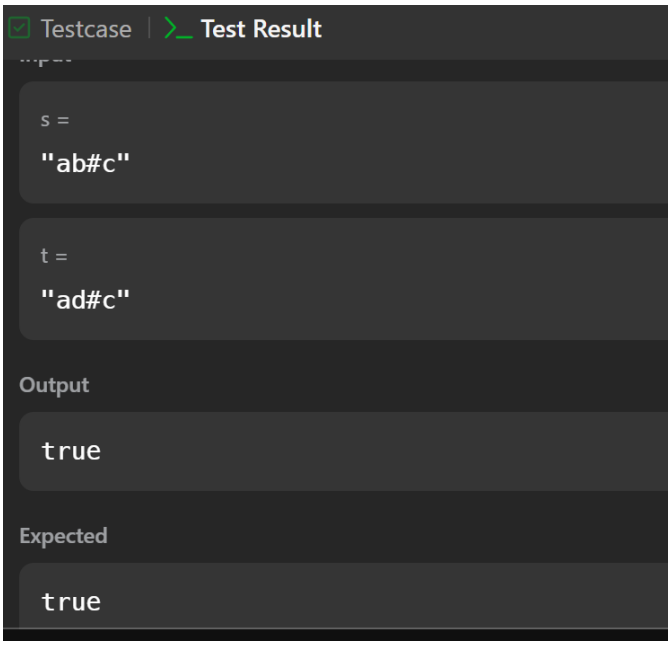
"231"

Leet Code : Backspace String compare

```
typedef struct {
    char items[200];
    int top;
} Stack;


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


void push(Stack* stack, char c) {
    stack->items[++(stack->top)] = c;
}


void pop(Stack* stack) {
    if (stack->top >= 0) {
        --(stack->top);
    }
}


bool backspaceCompare(char* s, char* t) {
    Stack stack1, stack2;
    init(&stack1);
```

```
    init(&stack2);


    for (int i = 0; i < strlen(s); ++i) {
        if (s[i] == '#') {
            pop(&stack1);
        } else {
            push(&stack1, s[i]);
        }
    }


    for (int i = 0; i < strlen(t); ++i) {
        if (t[i] == '#') {
            pop(&stack2);
        } else {
            push(&stack2, t[i]);
        }
    }


    if (stack1.top != stack2.top) {
        return false;
    }


    for (int i = 0; i <= stack1.top; ++i) {
        if (stack1.items[i] != stack2.items[i]) {
            return false;
        }
    }

    return true;
}
```

Output :



Lab Program 4a:

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.

c) Display the contents of the linked list.

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

struct node {
   int value;
   struct node *next;
};

typedef struct node* NODE;

NODE getnode() {
   NODE new_node = (NODE)malloc(sizeof(struct node));
   if (new_node == NULL) {
      printf("Memory allocation failed.\n");
      exit(1);
   }
   return new_node;
}

NODE insert_pos(NODE first, int item, int pos) {
   NODE new = getnode();
   new->value = item;
   new->next = NULL;
   if (first == NULL && pos == 1) {
      return new;
   }
   if (pos < 1) {
      printf("INVALID POSITION\n");
      free(new);
      return first;
   }
   int count = 1;
   NODE current = first, prev = NULL;
   while (count < pos && current != NULL) {
      prev = current;
      current = current->next;
      count++;
   }
   if (count != pos) {
      printf("INVALID POSITION\n");
      free(new);
      return first;
   }
   new->next = current;
   if (prev != NULL) {
      prev->next = new;
   } else {
      return new;
   }
   return first;
```

```
}

NODE insert_beg(int item, NODE first) {
   NODE new = getnode();
   new->value = item;
   new->next = first;
   return new;
}

NODE insert_end(int item, NODE first) {
   NODE new_end = getnode();
   new_end->value = item;
   new_end->next = NULL;
   if (first == NULL) {
      return new_end;
   }
   NODE current = first;
   while (current->next != NULL) {
      current = current->next;
   }
   current->next = new_end;
   return first;
}

NODE delete_first(NODE first) {
   if (first == NULL) {
      printf("LINKED LIST IS EMPTY\n");
      return NULL;
   }
   NODE temp = first;
   first = first->next;
   free(temp);
   return first;
}

NODE delete_end(NODE first) {
   if (first == NULL) {
      printf("LINKED LIST IS EMPTY\n");
      return NULL;
   }
   if (first->next == NULL) {
      free(first);
      return NULL;
   }
   NODE prev = NULL, last = first;
   while (last->next != NULL) {
      prev = last;
      last = last->next;
   }
   prev->next = NULL;
   free(last);
   return first;
}

NODE delete_value(NODE first, int value) {
   if (first == NULL) {
      printf("LINKED LIST IS EMPTY\n");
```

```
        return NULL;
    }
    NODE current = first, prev = NULL;
    while (current != NULL && current->value != value) {
        prev = current;
        current = current->next;
    }
    if (current == NULL) {
        printf("VALUE NOT FOUND\n");
        return first;
    }
    if (prev == NULL) {
        first = current->next;
    } else {
        prev->next = current->next;
    }
    free(current);
    return first;
}

void display(NODE first) {
    if (first == NULL) {
        printf("LINKED LIST IS EMPTY\n");
        return;
    }
    NODE temp = first;
    printf("Linked List: ");
    while (temp != NULL) {
        printf("%d ", temp->value);
        temp = temp->next;
    }
    printf("\n");
}

int main() {
    printf("Deepthi M \n1BM23CS088\n");

    NODE first = NULL;
    int choice, item, pos;

    do {
        printf("\nMenu:\n");
        printf("1. Insert at Beginning\n");
        printf("2. Insert at End\n");
        printf("3. Insert at Position\n");
        printf("4. Delete First\n");
        printf("5. Delete Last\n");
        printf("6. Delete by Value\n");
        printf("7. Display\n");
        printf("8. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter value to insert at beginning: ");
                scanf("%d", &item);
```

```
            first = insert_beg(item, first);
            break;
        case 2:
            printf("Enter value to insert at end: ");
            scanf("%d", &item);
            first = insert_end(item, first);
            break;
        case 3:
            printf("Enter value and position to insert: ");
            scanf("%d %d", &item, &pos);
            first = insert_pos(first, item, pos);
            break;
        case 4:
            first = delete_first(first);
            break;
        case 5:
            first = delete_end(first);
            break;
        case 6:
            printf("Enter value to delete: ");
            scanf("%d", &item);
            first = delete_value(first, item);
            break;
        case 7:
            display(first);
            break;
        case 8:
            printf("Exiting...\n");
            break;
        default:
            printf("Invalid choice.\n");
      }
   } while (choice != 8);

   return 0;
}
```

Output:

```
Deepthi M
1BM23CS088

Menu:
1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Delete First
5. Delete Last
6. Delete by Value
7. Display
8. Exit
Enter your choice: 1
Enter value to insert at beginning: 2

Menu:
1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Delete First
5. Delete Last
6. Delete by Value
7. Display
8. Exit
Enter your choice: 3
Enter value and position to insert: 2
5
INVALID POSITION
```

```
6. Delete by Value
7. Display
8. Exit
Enter your choice: 2
Enter value to insert at end: 7

Menu:
1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Delete First
5. Delete Last
6. Delete by Value
7. Display
8. Exit
Enter your choice: 5

Menu:
1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Delete First
5. Delete Last
6. Delete by Value
7. Display
8. Exit
Enter your choice: 7
Linked List: 2
```

Lab Program 4b:

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 value;
   struct node *next;
};

typedef struct node* NODE;

NODE getnode() {
   NODE new_node =
(NODE)malloc(sizeof(struct node));
   if (new_node == NULL) {
      printf("Memory allocation failed.\n");
      exit(1);
   }
   return new_node;
}

NODE insert_pos(NODE first, int item, int pos) {
   NODE new = getnode();
   new->value = item;
   new->next = NULL;
   if (first == NULL && pos == 1) {
      return new;
   }
   if (pos < 1) {
      printf("INVALID POSITION\n");
      free(new);
      return first;
   }
   int count = 1;
   NODE current = first, prev = NULL;
   while (count < pos && current != NULL) {
      prev = current;
      current = current->next;
      count++;
   }
   if (count != pos) {
      printf("INVALID POSITION\n");
      free(new);
      return first;
   }
   new->next = current;
   if (prev != NULL) {
      prev->next = new;
   } else {
      return new;
   }
```

```
    return first;
}

NODE insert_beg(int item, NODE first) {
    NODE new = getnode();
    new->value = item;
    new->next = first;
    return new;
}

NODE insert_end(int item, NODE first) {
    NODE new_end = getnode();
    new_end->value = item;
    new_end->next = NULL;
    if (first == NULL) {
        return new_end;
    }
    NODE current = first;
    while (current->next != NULL) {
        current = current->next;
    }
    current->next = new_end;
    return first;
}

NODE delete_first(NODE first) {
    if (first == NULL) {
        printf("LINKED LIST IS EMPTY\n");
        return NULL;
    }
    NODE temp = first;
    first = first->next;
    free(temp);
    return first;
}

NODE delete_end(NODE first) {
    if (first == NULL) {
        printf("LINKED LIST IS EMPTY\n");
        return NULL;
    }
    if (first->next == NULL) {
        free(first);
        return NULL;
    }
    NODE prev = NULL, last = first;
    while (last->next != NULL) {
        prev = last;
        last = last->next;
    }
    prev->next = NULL;
    free(last);
    return first;
}

NODE delete_value(NODE first, int value) {
```

```
    if (first == NULL) {
        printf("LINKED LIST IS EMPTY\n");
        return NULL;
    }
    NODE current = first, prev = NULL;
    while (current != NULL && current->value !=
value) {
        prev = current;
        current = current->next;
    }
    if (current == NULL) {
        printf("VALUE NOT FOUND\n");
        return first;
    }
    if (prev == NULL) {
        first = current->next;
    } else {
        prev->next = current->next;
    }
    free(current);
    return first;
}

void display(NODE first) {
    if (first == NULL) {
        printf("LINKED LIST IS EMPTY\n");
        return;
    }
    NODE temp = first;
    printf("Linked List: ");
    while (temp != NULL) {
        printf("%d ", temp->value);
        temp = temp->next;
    }
    printf("\n");
}

int main() {
    printf("Deepthi M \n1BM23CS088\n");

    NODE first = NULL;
    int choice, item, pos;

    do {
        printf("\nMenu:\n");
        printf("1. Insert at Beginning\n");
        printf("2. Insert at End\n");
        printf("3. Insert at Position\n");
        printf("4. Delete First\n");
        printf("5. Delete Last\n");
        printf("6. Delete by Value\n");
        printf("7. Display\n");
        printf("8. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
```

```
        switch (choice) {
            case 1:
                printf("Enter value to insert at
beginning: ");
                scanf("%d", &item);
                first = insert_beg(item, first);
                break;
            case 2:
                printf("Enter value to insert at end: ");
                scanf("%d", &item);
                first = insert_end(item, first);
                break;
            case 3:
                printf("Enter value and position to
insert: ");
                scanf("%d %d", &item, &pos);
                first = insert_pos(first, item, pos);
                break;
            case 4:
                first = delete_first(first);
                break;
            case 5:
                first = delete_end(first);
                break;
            case 6:
                printf("Enter value to delete: ");
                scanf("%d", &item);
                first = delete_value(first, item);
                break;
            case 7:
                display(first);
                break;
            case 8:
                printf("Exiting...\n");
                break;
            default:
                printf("Invalid choice.\n");
        }
    } while (choice != 8);

    return 0;
}
```

Output:

```
Menu:
1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Delete First
5. Delete Last
6. Delete by Value
7. Display
8. Exit
Enter your choice: 5
LINKED LIST IS EMPTY

Menu:
1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Delete First
5. Delete Last
6. Delete by Value
7. Display
8. Exit
Enter your choice: 7
linked list is empty
Menu:
1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Delete First
5. Delete Last
6. Delete by Value
7. Display
8. Exit
Enter your choice: 1
Enter value to insert at beginning: 1

Menu:
1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Delete First
5. Delete Last
6. Delete by Value
7. Display
8. Exit
Enter your choice: 2
Enter value to insert at end: 2
```

```
2. Insert at End
3. Insert at Position
4. Delete First
5. Delete Last
6. Delete by Value
7. Display
8. Exit
Enter your choice: 2
Enter value to insert at end: 2

Menu:
1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Delete First
5. Delete Last
6. Delete by Value
7. Display
8. Exit
Enter your choice: 3
Enter value and position to insert: 3
4
INVALID POSITION

Menu:
1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Delete First
5. Delete Last
6. Delete by Value
7. Display
8. Exit
Enter your choice: 7
1
2

Menu:
1. Insert at Beginning
2. Insert at End
3. Insert at Position
4. Delete First
5. Delete Last
6. Delete by Value
7. Display
8. Exit
Enter your choice: 8

Process returned 0 (0x0)   execution time : 94.875 s
Press any key to continue.
```

Lab Program 5a:

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* next;
};

void append(struct Node** head, int value) {
   struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
   newNode->data = value;
   newNode->next = NULL;
   if (*head == NULL) {
      *head = newNode;
   } else {
      struct Node* temp = *head;
      while (temp->next)
         temp = temp->next;
      temp->next = newNode;
   }
}

void reverse(struct Node** head) {
   struct Node *prev = NULL, *current = *head, *next = NULL;
   while (current) {
      next = current->next;
      current->next = prev;
      prev = current;
      current = next;
   }
   *head = prev;
}

void sort(struct Node* head) {
   struct Node *i, *j;
   int temp;
   for (i = head; i != NULL; i = i->next) {
      for (j = i->next; j != NULL; j = j->next) {
         if (i->data > j->data) {
            temp = i->data;
            i->data = j->data;
            j->data = temp;
         }
      }
   }
}

void concatenate(struct Node** head1, struct Node* head2) {
   if (*head1 == NULL) {
      *head1 = head2;
```

```
    } else {
        struct Node* temp = *head1;
        while (temp->next)
            temp = temp->next;
        temp->next = head2;
    }
}

void printList(struct Node* head) {
    while (head) {
        printf("%d ", head->data);
        head = head->next;
    }
    printf("\n");
}

int main() {
    printf("Deepthi M \n1BM23CS088\n");

    struct Node* list1 = NULL;
    struct Node* list2 = NULL;
    int choice, item;

    do {
        printf("\nENTER THE OPERATION YOU WANT TO PERFORM:\n");
        printf("1. Insert for first node\n");
        printf("2. Insert for second node\n");
        printf("3. Concatenate\n");
        printf("4. Reverse\n");
        printf("5. Sort\n");
        printf("6. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter value for first node: ");
                scanf("%d", &item);
                append(&list1, item);
                break;
            case 2:
                printf("Enter value for second node: ");
                scanf("%d", &item);
                append(&list2, item);
                break;
            case 3:
                concatenate(&list1, list2);
                printf("Concatenated List: ");
                printList(list1);
                break;
            case 4:
                reverse(&list1);
                printf("Reversed List 1: ");
                printList(list1);
                reverse(&list2);
                printf("Reversed List 2: ");
                printList(list2);
```

```
            break;
        case 5:
            sort(list1);
            printf("Sorted List 1: ");
            printList(list1);
            sort(list2);
            printf("Sorted List 2: ");
            printList(list2);
            break;
        case 6:
            printf("Exiting...\n");
            break;
        default:
            printf("Invalid choice. \n");
      }
   } while (choice != 6);

   return 0;
}
```

Output :

```
4. Reverse
5. Sort
6. Exit
Enter your choice: 1
Enter value for first node: 2

ENTER THE OPERATION YOU WANT TO PERFORM:
1. Insert for first node
2. Insert for second node
3. Concatenate
4. Reverse
5. Sort
6. Exit
Enter your choice: 1
Enter value for first node: 4

ENTER THE OPERATION YOU WANT TO PERFORM:
1. Insert for first node
2. Insert for second node
3. Concatenate
4. Reverse
5. Sort
6. Exit
Enter your choice: 4
Reversed List 1: 4 2
Reversed List 2:
```

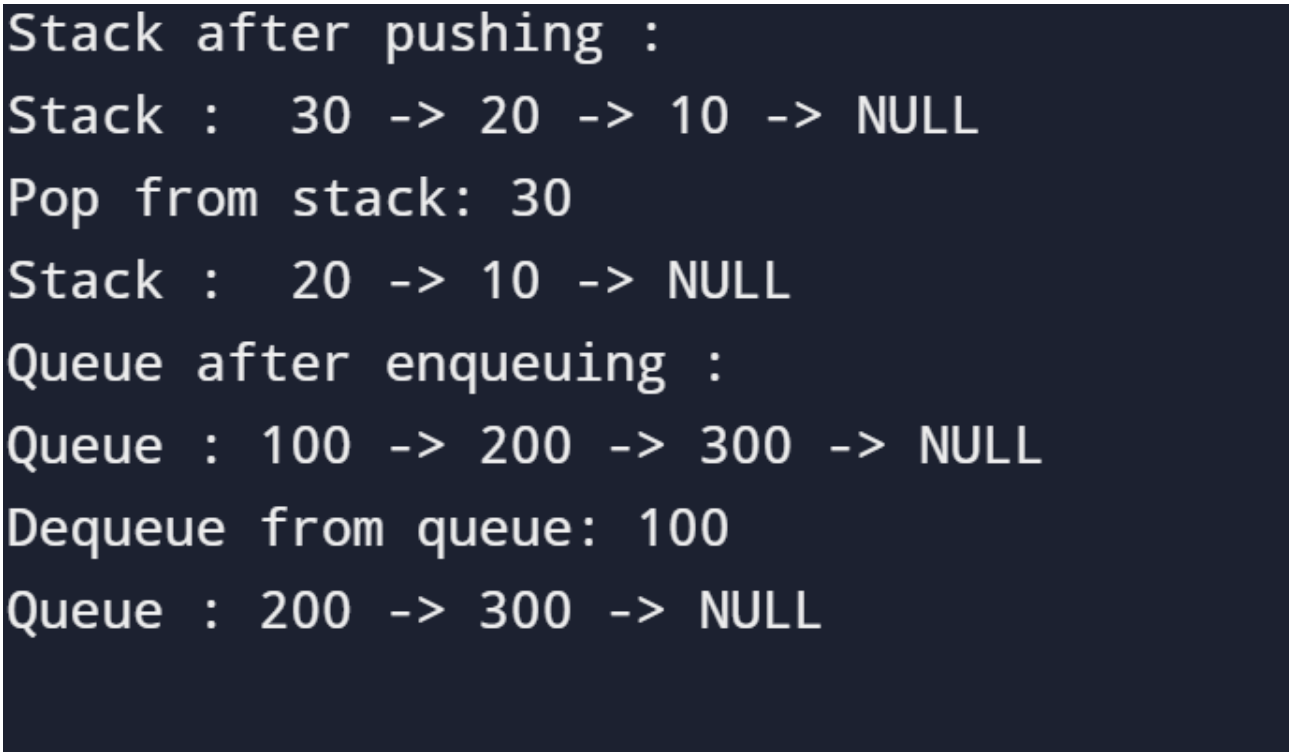
Lab Program 5b: Queue and stack Implementaion

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

// Name: Deepthi M
// USN: 1BM23CS088

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

struct Stack {
   struct Node* top;
};

struct Queue {
   struct Node* front;
   struct Node* rear;
};

void initStack(struct Stack* stack) {
   stack->top = NULL;
}

void initQueue(struct Queue* queue) {
   queue->front = queue->rear = NULL;
}

void push(struct Stack* stack, int data) {
   struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
   newNode->data = data;
   newNode->next = stack->top;
   stack->top = newNode;
}

int pop(struct Stack* stack) {
   if (stack->top == NULL)
      return -1;
   struct Node* temp = stack->top;
   int data = temp->data;
   stack->top = stack->top->next;
   free(temp);
   return data;
}

int peek(struct Stack* stack) {
   if (stack->top == NULL)
      return -1;
   return stack->top->data;
}

void enqueue(struct Queue* queue, int data) {
   struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
   newNode->data = data;
   newNode->next = NULL;
```

```
    if (queue->rear == NULL) {
        queue->front = queue->rear = newNode;
        return;
    }
    queue->rear->next = newNode;
    queue->rear = newNode;
}

int dequeue(struct Queue* queue) {
    if (queue->front == NULL)
        return -1;
    struct Node* temp = queue->front;
    int data = temp->data;
    queue->front = queue->front->next;
    if (queue->front == NULL)
        queue->rear = NULL;
    free(temp);
    return data;
}

int isEmptyStack(struct Stack* stack) {
    return stack->top == NULL;
}

int isEmptyQueue(struct Queue* queue) {
    return queue->front == NULL;
}

void displayStack(struct Stack* stack) {
    struct Node* temp = stack->top;
    printf("Stack :  ");
    while (temp) {
        printf("%d -> ", temp->data);
        temp = temp->next;
    }
    printf("NULL\n");
}

void displayQueue(struct Queue* queue) {
    struct Node* temp = queue->front;
    printf("Queue : ");
    while (temp) {
        printf("%d -> ", temp->data);
        temp = temp->next;
    }
    printf("NULL\n");
}

int main() {
    struct Stack stack;
    struct Queue queue;
    initStack(&stack);
    initQueue(&queue);

    push(&stack, 10);
    push(&stack, 20);
    push(&stack, 30);
```

```
    printf("Stack after pushing :\n");
    displayStack(&stack);

    printf("Pop from stack: %d\n", pop(&stack));
    displayStack(&stack);

    enqueue(&queue, 100);
    enqueue(&queue, 200);
    enqueue(&queue, 300);
    printf("Queue after enqueuing :\n");
    displayQueue(&queue);

    printf("Dequeue from queue: %d\n", dequeue(&queue));
    displayQueue(&queue);

    return 0;
}
```

Output:



Lab Program 6 : DOUBLE LINKED LIST

WAP to Implement doubly link list with primitive operations

a) **Create a doubly linked list.**

b) **Insert a new node to the left of the node.**

c) **Delete the node based on a specific value**

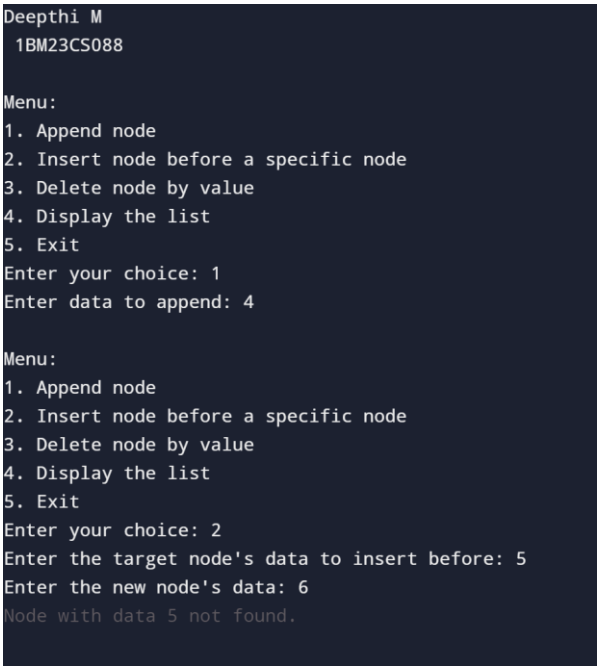
d) **Display the contents of the list**

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

struct Node {
   int data;
   struct Node* prev;
   struct Node* next;
};

struct Node* createNode(int data) {
   struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
   newNode->data = data;
   newNode->prev = NULL;
   newNode->next = NULL;
   return newNode;
}

void append(struct Node** head, int data) {
   struct Node* newNode = createNode(data);
   if (*head == NULL) {
      *head = newNode;
   } else {
      struct Node* temp = *head;
      while (temp->next != NULL) {
         temp = temp->next;
      }
      temp->next = newNode;
      newNode->prev = temp;
   }
}

void insertBefore(struct Node** head, int targetData, int newData) {
   struct Node* temp = *head;
   while (temp != NULL && temp->data != targetData) {
      temp = temp->next;
   }
   if (temp == NULL) {
      printf("Node with data %d not found.\n", targetData);
      return;
   }
   struct Node* newNode = createNode(newData);
   if (temp == *head) {
      newNode->next = *head;
      (*head)->prev = newNode;
      *head = newNode;
      return;
```

```
    }
    newNode->prev = temp->prev;
    newNode->next = temp;
    temp->prev->next = newNode;
    temp->prev = newNode;
}

void deleteNode(struct Node** head, int data) {
    struct Node* temp = *head;
    while (temp != NULL && temp->data != data) {
        temp = temp->next;
    }
    if (temp == NULL) {
        printf("Node with data %d not found.\n", data);
        return;
    }
    if (temp == *head) {
        *head = temp->next;
        if (*head != NULL) {
            (*head)->prev = NULL;
        }
        free(temp);
        return;
    }
    if (temp->next != NULL) {
        temp->next->prev = temp->prev;
    }
    temp->prev->next = temp->next;
    free(temp);
}

void display(struct Node* head) {
    if (head == NULL) {
        printf("The list is empty.\n");
        return;
    }
    struct Node* temp = head;
    printf("Doubly Linked List: ");
    while (temp != NULL) {
        printf("%d <=> ", temp->data);
        temp = temp->next;
    }
    printf("NULL\n");
}

int main() {
    struct Node* head = NULL;
    int choice, data, targetData, newData;
     printf(“Deepthi M \n 1BM23CS088”);
    while (1) {
        printf("\nMenu:\n");
        printf("1. Append node\n");
        printf("2. Insert node before a specific node\n");
        printf("3. Delete node by value\n");
        printf("4. Display the list\n");
        printf("5. Exit\n");
        printf("Enter your choice: ");
```

```
        scanf("%d", &choice);
        switch (choice) {
            case 1:
                printf("Enter data to append: ");
                scanf("%d", &data);
                append(&head, data);
                break;
            case 2:
                printf("Enter the target node's data to insert before: ");
                scanf("%d", &targetData);
                printf("Enter the new node's data: ");
                scanf("%d", &newData);
                insertBefore(&head, targetData, newData);
                break;
            case 3:
                printf("Enter the data of the node to delete: ");
                scanf("%d", &data);
                deleteNode(&head, data);
                break;
            case 4:
                display(head);
                break;
            case 5:
                printf("Exiting the program...\n");
                exit(0);
            default:
                printf("Invalid choice. Please try again.\n");
        }
    }
    return 0;
}
```

Output:



Lab program-8: BINARY TREE

a) To construct a binary Search tree.

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

c) To display the elements in the tree.

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

struct Node {
   int data;
   struct Node *left, *right;
};

struct Node* newNode(int data) {
   struct Node* node = (struct
Node*)malloc(sizeof(struct Node));
   node->data = data;
   node->left = node->right = NULL;
   return node;
}

struct Node* insert(struct Node* root, int data)
{
   if (root == NULL) {
      return newNode(data);
   }
   if (data < root->data) {
      root->left = insert(root->left, data);
   } else {
      root->right = insert(root->right, data);
   }
   return root;
}

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

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

```
}

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

void displayMenu() {
    printf("\nBinary Search Tree Operations\n");
    printf("1. Insert a node\n");
    printf("2. In-order Traversal\n");
    printf("3. Pre-order Traversal\n");
    printf("4. Post-order Traversal\n");
    printf("5. Exit\n");
}

int main() {
    struct Node* root = NULL;
    int choice, data;
   printf(“Deepthi M \n 1BM23CS088”);

    while (1) {
        displayMenu();
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter the value to insert: ");
                scanf("%d", &data);
                root = insert(root, data);
                break;
            case 2:
                printf("In-order Traversal: ");
                inorder(root);
                printf("\n");
                break;
            case 3:
                printf("Pre-order Traversal: ");
                preorder(root);
                printf("\n");
                break;
            case 4:
                printf("Post-order Traversal: ");
                postorder(root);
                printf("\n");
                break;
            case 5:
                printf("Exiting...\n");
                exit(0);
                break;
            default:
```

```
            printf("Invalid choice! Please try
again.\n");
        }
    }

    return 0;
```

Output:

```
Binary Search Tree Operations
1. Insert a node
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
5. Exit
Enter your choice: 1
Enter the value to insert: 4

Binary Search Tree Operations
1. Insert a node
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
5. Exit
Enter your choice: 1
Enter the value to insert: 7

Binary Search Tree Operations
1. Insert a node
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
5. Exit
Enter your choice: 3
Pre-order Traversal: 2 4 7
```

LeetCode: struct ListNode *getIntersectionNode(struct ListNode *headA, struct ListNode *headB) {

if(headA==NULL||headB==NULL) return NULL; struct ListNode *t1=headA,*t2=headB; while(t1!=t2)

```
    {
        t1=t1->next; t2=t2-
        >next; if(t1==t2) return
```

```
        t1; if(t1==NULL)
        t1=headB; if(t2==NULL)
        t2=headA;
    }
    return t1;
}
```

Output:

Lab Program :9a) Write a program to traverse a graph using BFS method.

```
#include<stdio.h>

void bfs(int); int a[10][10],
vis[10], n; void main() {
    int i, j, src; printf("enter the number of
    vertices\n"); scanf("%d", &n); printf("enter the
    adjacency matrix\n"); for(i = 1; i <= n; i++) { for(j =
    1; j <= n; j++) {
            scanf("%d", &a[i][j]);
        } vis[i] = 0;
    }
```

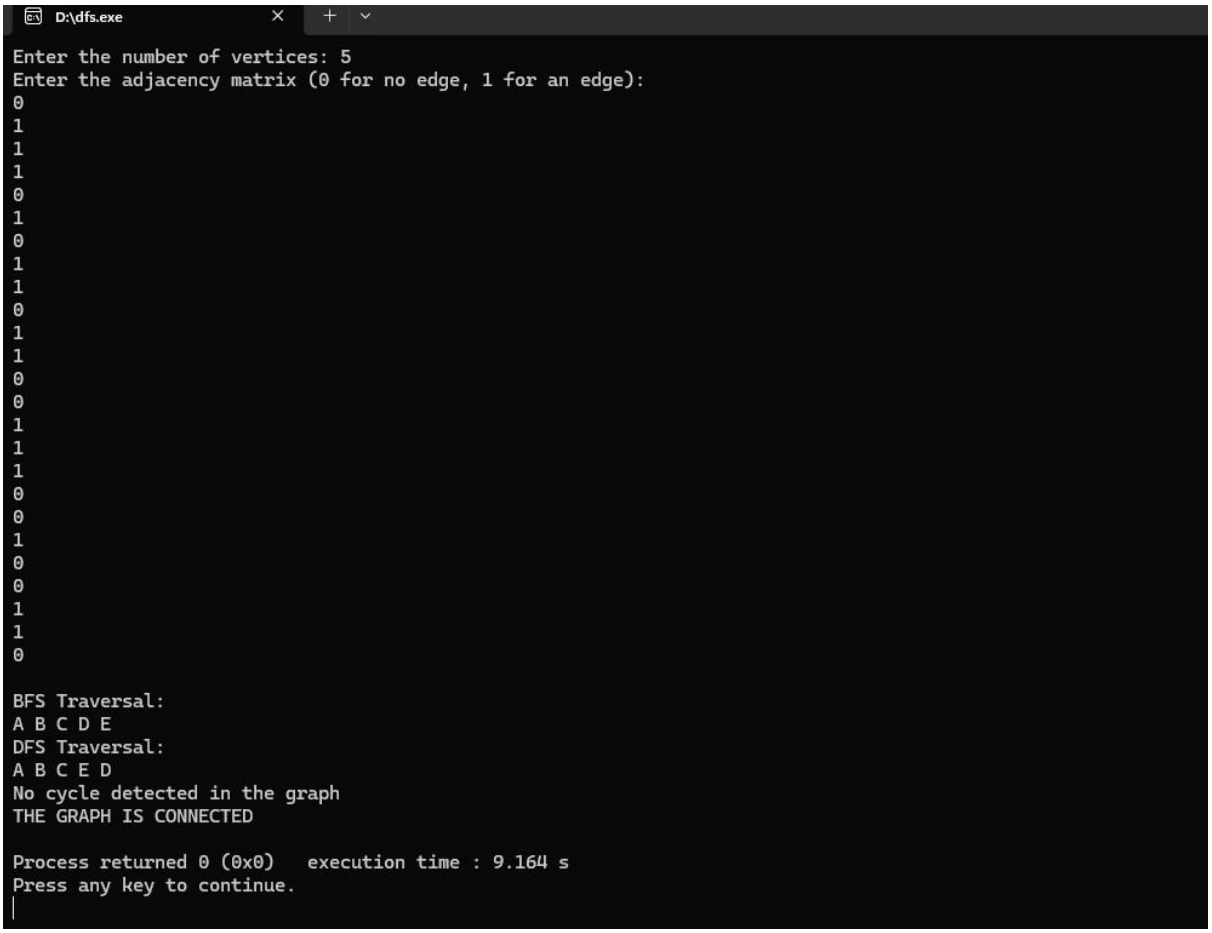
```
    printf("enter the src vertex\n"); scanf("%d", &src);
    printf("nodes reachable from src vertex\n"); bfs(src);
}

void bfs(int v) { int q[10], f = 1, r = 1, u, i; q[r]
    = v; vis[v] = 1; while(f <= r) { u = q[f];
    printf("%d ", u); for(i = 1; i <= n; i++) {
    if(a[v][i] == 1 && vis[i] == 0) { vis[i] = 1;
            r = r + 1;
            q[r] = i;
        }
      }
      f = f + 1;
    }
}
```

```
D:\dfs.exe
Enter the number of vertices: 5
Enter the adjacency matrix (0 for no edge, 1 for an edge):
0
1
1
1
0
1
0
1
1
0
1
1
0
0
1
1
1
0
0
1
0
0
1
1
0

BFS Traversal:
A B C D E
DFS Traversal:
A B C E D
No cycle detected in the graph
THE GRAPH IS CONNECTED

Process returned 0 (0x0)   execution time : 9.164 s
Press any key to continue.
```

Lab Program:9b) Write a program to check whether given graph is connected or not using DFS method.

```
#include<stdio.h>


void bfs(int); int a[10][10],
vis[10], n;


void main() {
   int i, j, src; printf("enter the number of
   vertices\n"); scanf("%d", &n); printf("enter the
   adjacency matrix\n"); for(i = 1; i <= n; i++) { for(j =
   1; j <= n; j++) {
         scanf("%d", &a[i][j]);
      } vis[i] = 0;
   }
   printf("enter the src vertex\n"); scanf("%d", &src);
   printf("nodes reachable from src vertex\n"); bfs(src);
}


void bfs(int v) { int q[10], f = 1, r = 1, u, i; q[r]
   = v; vis[v] = 1; while(f <= r) { u = q[f];
   printf("%d ", u); for(i = 1; i <= n; i++) {
   if(a[v][i] == 1 && vis[i] == 0) { vis[i] = 1;
            r = r + 1;
            q[r] = i;
         }
      }
      f = f + 1;
   }
}
```

Output:



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>

int *ht, key[20], n, m; int

index; int count = 0;

void insert(int key) {

index = key % m;

while (ht[index] != -1) {
index = (index + 1) % m;

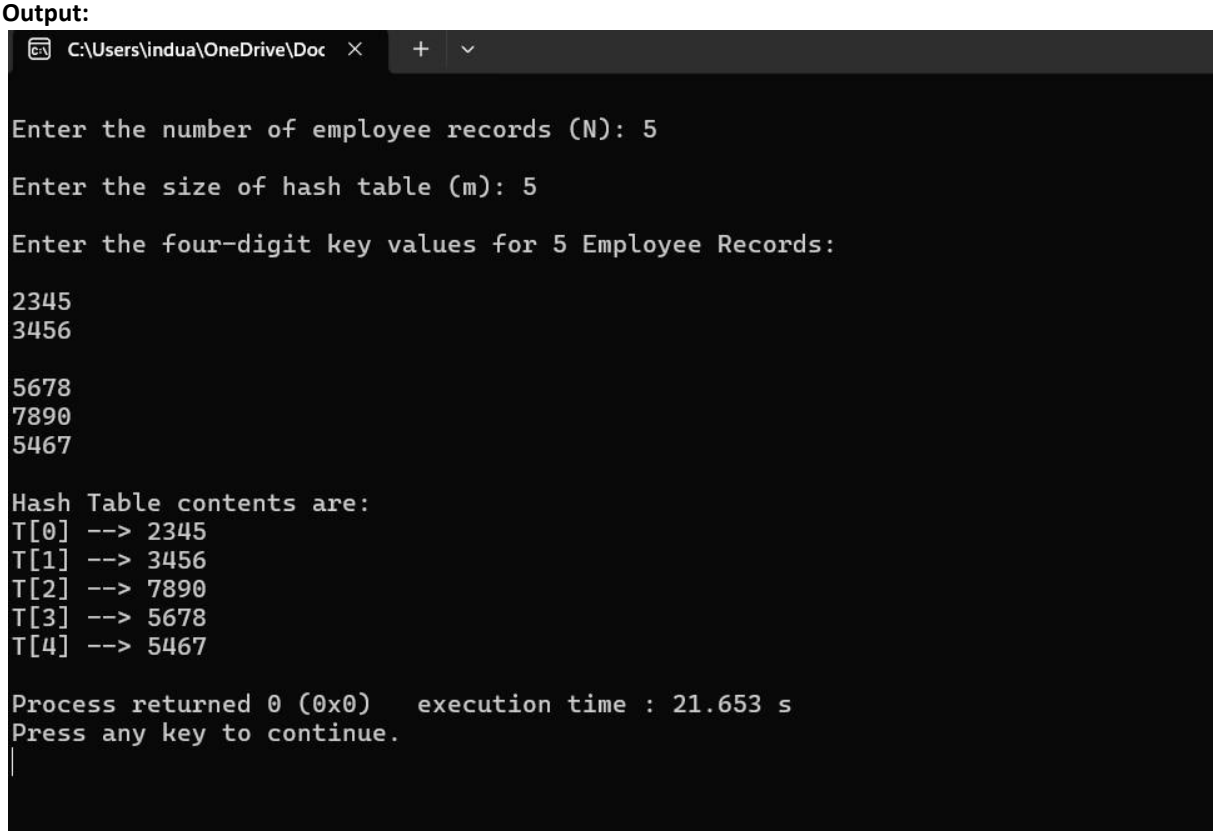
}

ht[index] = key; count++;

}

```
void display() {
   int i;
   if (count == 0) { printf("\nHash Table is
      empty\n"); return;
   }
   printf("\nHash Table contents are:\n"); for (i = 0; i <
   m; i++) {
      printf("T[%d] --> %d\n", i, ht[i]);
   }
}

int main() {
   int i;
   printf("\nEnter the number of employee records (N): "); scanf("%d", &n);

   printf("\nEnter the size of hash table (m): "); scanf("%d", &m);

   ht = (int *)malloc(m * sizeof(int)); for (i = 0; i
   < m; i++) {
      ht[i] = -1;
   }

   printf("\nEnter the four-digit key values for %d Employee Records:\n", n); for (i = 0; i < n; i++) { scanf("%d", &key[i]);
   }

   for (i = 0; i < n; i++) { if (count == m) { printf("\nHash table is full. Cannot insert the record
      with key %d\n", key[i]); break;
      } insert(key[i]);
   }

   display(); free(ht);
   return 0;
}
```

Output:


C:\Users\indua\OneDrive\Doc
Enter the number of employee records (N): 5
Enter the size of hash table (m): 5
Enter the four-digit key values for 5 Employee Records:
2345
3456
5678
7890
5467
Hash Table contents are:
T[0] --> 2345
T[1] --> 3456
T[2] --> 7890
T[3] --> 5678
T[4] --> 5467
Process returned 0 (0x0) execution time : 21.653 s
Press any key to continue.