

Q1:Write a program to perform various operations in the list:

- Insertion

- Deletion

- Display

```
#include <stdio.h>

#define MAX 100

int main() {
    int arr[MAX], n = 0, choice, pos, value, i;

    while (1) {
        printf("\n---- List 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: // Insertion
                if (n == MAX) {
                    printf("List is full. Cannot insert.\n");
                }
                else {
                    printf("Enter the value to insert: ");
                    scanf("%d", &value);
                    arr[n] = value;
                    n++;
                }
            break;
            case 2: // Deletion
                if (n == 0) {
                    printf("List is empty. Cannot delete.\n");
                }
                else {
                    printf("Enter the position to delete: ");
                    scanf("%d", &pos);
                    if (pos > n - 1) {
                        printf("Position out of range.\n");
                    }
                    else {
                        for (i = pos; i < n - 1; i++) {
                            arr[i] = arr[i + 1];
                        }
                        n--;
                    }
                }
            break;
            case 3: // Display
                if (n == 0) {
                    printf("List is empty.\n");
                }
                else {
                    for (i = 0; i < n; i++) {
                        printf("%d ", arr[i]);
                    }
                    printf("\n");
                }
            break;
            case 4: // Exit
                exit(0);
            break;
            default:
                printf("Invalid choice. Please enter 1, 2, 3, or 4.\n");
        }
    }
}
```

```

} else {

    printf("Enter position to insert (1 to %d): ", n + 1);

    scanf("%d", &pos);

    printf("Enter value to insert: ");

    scanf("%d", &value);

}

if(pos<1||pos>n+1){

    printf("Invalid position!\n");

} else {

    for(i=n-1;i>=pos-1;i--){

        arr[i + 1] = arr[i];

    }

    arr[pos - 1] = value;

    n++;

    printf("Inserted successfully!\n");

}

break;
}

```

case 2: // Deletion

```

if (n == 0) {

    printf("List is empty. Nothing to delete.\n");

} else {

    printf("Enter position to delete (1 to %d): ", n);
}

```

```

scanf("%d", &pos);

if (pos < 1 || pos > n) {
    printf("Invalid position!\n");
} else {
    for(i=pos-1;i<n-1;i++) {
        arr[i] = arr[i + 1];
    }
    n--;
    printf("Deleted successfully!\n");
}
break;

case 3: // Display
if (n == 0) {
    printf("List is empty.\n");
} else {
    printf("List elements: ");
    for (i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }
    printf("\n");
}

```

```
break;
```

```
case 4:
```

```
    printf("Exiting program...\n");
```

```
    return 0;
```

```
default:
```

```
    printf("Invalid choice! Try again.\n");
```

```
}
```

```
}
```

```
---- List Operations ----  
1. Insert  
2. Delete  
3. Display  
4. Exit  
Enter your choice: 1  
Enter position to insert (1 to 1): 1  
Enter value to insert: 1  
Inserted successfully!
```

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

```
---- List Operations ----  
1. Insert  
2. Delete  
3. Display
```

Q2:Write a program to find the arithmetic operations on matrices:

- **SumandSubtraction**
- **Productof2matrices**
- **Transposeofamatrix**

```
#include <stdio.h>

int main() {

    int a[10][10], b[10][10], c[10][10];

    int r1, c1, r2, c2;

    int i, j, k, choice;

    while (1) {

        printf("\n---- Matrix Operations ----\n");

        printf("1. Sum of Two Matrices\n");
        printf("2. Subtraction of Two Matrices\n");
        printf("3. Product of Two Matrices\n");
        printf("4. Transpose of a Matrix\n");
        printf("5. Exit\n");

        printf("Enter your choice: ");

        scanf("%d", &choice);

        switch (choice) {

            case 1: // Sum

                printf("Enter rows and columns of matrices: ");

```

```

scanf("%d %d", &r1, &c1);

printf("Enter Matrix A:\n");
for (i = 0; i < r1; i++)
    for (j = 0; j < c1; j++)
        scanf("%d", &a[i][j]);

printf("Enter Matrix B:\n");
for (i = 0; i < r1; i++)
    for (j = 0; j < c1; j++)
        scanf("%d", &b[i][j]);

printf("Sum of matrices:\n");
for (i = 0; i < r1; i++) {
    for (j = 0; j < c1; j++) {
        c[i][j] = a[i][j] + b[i][j];
        printf("%d ", c[i][j]);
    }
    printf("\n");
}
break;

case 2: // Subtraction
printf("Enter rows and columns of matrices: ");

```

```

scanf("%d %d", &r1, &c1);

printf("Enter Matrix A:\n");
for (i = 0; i < r1; i++)
    for (j = 0; j < c1; j++)
        scanf("%d", &a[i][j]);

printf("Enter Matrix B:\n");
for (i = 0; i < r1; i++)
    for (j = 0; j < c1; j++)
        scanf("%d", &b[i][j]);

printf("Subtraction of matrices (A - B):\n");
for (i = 0; i < r1; i++) {
    for (j = 0; j < c1; j++) {
        c[i][j] = a[i][j] - b[i][j];
        printf("%d ", c[i][j]);
    }
    printf("\n");
}
break;

case 3: // Product
printf("Enter rows and columns of Matrix A: ");

```

```

scanf("%d %d", &r1, &c1);

printf("Enter rows and columns of Matrix B: ");
scanf("%d %d", &r2, &c2);

if (c1 != r2) {
    printf("Matrix multiplication not possible.\n");
    break;
}

printf("Enter Matrix A:\n");
for (i = 0; i < r1; i++)
    for (j = 0; j < c1; j++)
        scanf("%d", &a[i][j]);

printf("Enter Matrix B:\n");
for (i = 0; i < r2; i++)
    for (j = 0; j < c2; j++)
        scanf("%d", &b[i][j]);

// Initialize product matrix
for (i = 0; i < r1; i++)
    for (j = 0; j < c2; j++)
        c[i][j] = 0;

```

```
// Multiply

for (i = 0; i < r1; i++)
    for (j = 0; j < c2; j++)
        for (k = 0; k < c1; k++)
            c[i][j] += a[i][j] * b[k][j]; // mistake here? Actually should be: a[i][k] *
b[k][j]
```

```
printf("Product of matrices:\n");
```

```
for (i = 0; i < r1; i++) {
```

```
    for (j = 0; j < c2; j++)
```

```
        printf("%d ", c[i][j]);
```

```
        printf("\n");
```

```
}
```

```
break;
```

```
case 4: // Transpose
```

```
printf("Enter rows and columns of Matrix: ");
```

```
scanf("%d %d", &r1, &c1);
```

```
printf("Enter Matrix:\n");
```

```
for (i = 0; i < r1; i++)
```

```
    for (j = 0; j < c1; j++)
```

```
        scanf("%d", &a[i][j]);
```

```

printf("Transpose of Matrix:\n");

for (i = 0; i < c1; i++) {

    for (j = 0; j < r1; j++)

        printf("%d ", a[j][i]);

    printf("\n");

}

break;

```

case 5:

```
    return 0;
```

default:

```
    printf("Invalid choice! Try again.\n");
```

```
}
```

```
}
```

```

---- Matrix Operations ----
1. Sum of Two Matrices
2. Subtraction of Two Matrices
3. Product of Two Matrices
4. Transpose of a Matrix
5. Exit
Enter your choice: 1
Enter rows and columns of matrices: 2 3
Enter Matrix A:
1 2 3
4 5 6
Enter Matrix B:
6 7 8
2 4 5
Sum of matrices:
7 9 11
6 9 11

---- Matrix Operations ----
1. Sum of Two Matrices
2. Subtraction of Two Matrices
3. Product of Two Matrices
4. Transpose of a Matrix

```

Q3:Write a Program to sort the list using:

- **BubbleSort**
- **QuickSort**
- **Insertionsort**
- **MergeSort**
- **HeapSort**

Also, find the comparison on the basis of time complexity.

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

```
void bubble(int a[], int n) {  
    int i, j, t;  
    for(i=0;i<n-1;i++)  
        for(j=0;j<n-i-1;j++)  
            if(a[j] > a[j+1]) { t=a[j]; a[j]=a[j+1]; a[j+1]=t; }  
}
```

```
void insertion(int a[], int n) {  
    int i, j, key;  
    for(i=1;i<n;i++) {  
        key = a[i];  
        j = i-1;  
        while(j>=0 && a[j] > key) {  
            a[j+1] = a[j];  
            j--;  
        }  
        a[j+1] = key;  
    }  
}
```

```
}
```

```
void quick(int a[], int low, int high) {  
  
    int i = low, j = high, pivot = a[(low+high)/2], t;  
  
    while(i <= j) {  
        while(a[i] < pivot) i++;  
  
        while(a[j] > pivot) j--;  
  
        if(i <= j) { t=a[i]; a[i]=a[j]; a[j]=t; i++; j--; }  
  
    }  
  
    if(low < j) quick(a, low, j);  
  
    if(i < high) quick(a, i, high);  
  
}
```

```
void mergeArr(int a[], int l, int m, int h) {  
  
    int i=l, j=m+1, k=0, b[100];  
  
    while(i<=m && j<=h)  
        b[k++] = (a[i] < a[j]) ? a[i++] : a[j++];  
  
    while(i<=m) b[k++] = a[i++];  
  
    while(j<=h) b[k++] = a[j++];  
  
    for(i=l, k=0; i<=h; i++, k++) a[i] = b[k];  
  
}
```

```
void merge(int a[], int l, int h) {  
  
    if(l < h) {
```

```

int m = (l+h)/2;
merge(a,l,m);
merge(a,m+1,h);
mergeArr(a,l,m,h);

}

}

void heapify(int a[], int n, int i) {
    int l=2*i+1, r=2*i+2, largest=i, t;
    if(l<n && a[l]>a[largest]) largest=l;
    if(r<n && a[r]>a[largest]) largest=r;
    if(largest!=i) { t=a[i]; a[i]=a[largest]; a[largest]=t; heapify(a,n,largest); }
}

void heap(int a[], int n) {
    int i, t;
    for(i=n/2-1;i>=0;i--)heapify(a,n,i);
    for(i=n-1;i>0;i--) {
        t=a[0]; a[0]=a[i]; a[i]=t;
        heapify(a,i,0);
    }
}

void print(int a[], int n) {

```

```

int i;

for(i=0;i<n;i++) printf("%d ", a[i]);

}

int main() {

    int a[50], n, ch, i;

    printf("Enter n: ");
    scanf("%d", &n);

    printf("Enter elements: ");
    for(i=0;i<n;i++) scanf("%d",&a[i]);

    printf("\n1.Bubble 2.Quick 3.Insertion 4.Merge 5.Heap\nChoice: ");
    scanf("%d", &ch);

    if(ch==1) bubble(a,n);
    else if(ch==2) quick(a,0,n-1);
    else if(ch==3) insertion(a,n);
    else if(ch==4) merge(a,0,n-1);
    else if(ch==5) heap(a,n);
    else printf("Invalid!");

    printf("\nSorted List: ");
    print(a,n);
}

```

```

printf("\n\nTime Complexity:\n");

printf("BubbleSort :O(n^2)\n");

printf("Insertion Sort : O(n^2)\n");

printf("QuickSort :O(nlogn)\n");

printf("MergeSort :O(nlogn)\n");

printf("HeapSort :O(nlogn)\n\n");

return 0;
}

```

```

Enter n: 4
Enter elements: 3
1
2
5

1.Bubble 2.Quick 3.Insertion 4.Merge 5.Heap
Choice: 2

Sorted List: 1 2 3 5

Time Complexity:
Bubble Sort : O(n^2)
Insertion Sort : O(n^2)
Quick Sort : O(n log n)
Merge Sort : O(n log n)
Heap Sort : O(n log n)

```

Q4:Write a program to search the element using:

- LinearSearch -

BinarySearch

Also, find the comparison on the basis of time complexity.

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

```
int linearSearch(int a[], int n, int x) {
```

```
    int i;
```

```
    for(i = 0; i < n; i++)
```

```
        if(a[i] == x)
```

```
            return i;
```

```
    return -1;
```

```
}
```

```
int binarySearch(int a[], int n, int x) {
```

```
    int l=0,r=n-1,mid;
```

```
    while(l <= r) {
```

```
        mid=(l+r)/2;
```

```
        if(a[mid] == x) return mid;
```

```
        else if(a[mid] < x) l = mid + 1;
```

```
        else r = mid - 1;
```

```
}
```

```
    return -1;
```

```
}
```

```
int main() {
```

```
int a[50], n, i, x, choice, pos;

printf("Enter number of elements: ");
scanf("%d", &n);

printf("Enter sorted elements: ");
for(i = 0; i < n; i++)
    scanf("%d", &a[i]);

printf("Enter element to search: ");
scanf("%d", &x);

printf("\n1. Linear Search\n2. Binary Search\nChoice: ");
scanf("%d", &choice);

if(choice == 1) {
    pos = linearSearch(a, n, x);
    if(pos == -1) printf("Element not found.\n");
    else printf("Element found at position %d\n", pos+1);
}

else if(choice == 2) {
    pos = binarySearch(a, n, x);
    if(pos == -1) printf("Element not found.\n");
    else printf("Element found at position %d\n", pos+1);
}
```

```

    }

else {

printf("Invalid choice.\n");

}

printf("\nTime Complexity:\n");

printf("Linear Search : O(n)\n");

printf("Binary Search : O(log n)\n");



return 0;
}

```

```

| Enter number of elements: 2
| Enter sorted elements: 1
| 2
| Enter element to search: 2

1. Linear Search
2. Binary Search
Choice: 2
Element found at position 2

Time Complexity:
Linear Search : O(n)
Binary Search : O(log n)

| === Code Execution Successful ===

```

Q5:Write a program to perform all operations:

-For the Stack using an Array.

-For the Queue using an Array.

- For the Circular Queue using an Array.

```
#include <stdio.h>
#define SIZE 5

int stack[SIZE], top = -1;
int queue[SIZE], front = -1, rear = -1;
int cqueue[SIZE], cfront = -1, crear = -1;

/* ----- STACK OPERATIONS ----- */
void push(int x) {
    if(top == SIZE-1) printf("Stack Overflow\n");
    else stack[++top] = x;
}

void pop() {
    if(top == -1) printf("Stack Underflow\n");
    else printf("Popped: %d\n", stack[top--]);
}

void displayStack() {
    if(top == -1) printf("Stack Empty\n");
    else {
        printf("Stack: ");
        for(int i=0;i<=top;i++) printf("%d ", stack[i]);
        printf("\n");
    }
}
```

```

/* ----- QUEUE OPERATIONS ----- */

void enqueue(int x) {
    if(rear == SIZE-1) printf("Queue Full\n");
    else {
        if(front == -1) front = 0;
        queue[++rear] = x;
    }
}

void dequeue() {
    if(front == -1 || front > rear) printf("Queue Empty\n");
    else printf("Deleted: %d\n", queue[front++]);
}

void displayQueue() {
    if(front == -1 || front > rear) printf("Queue Empty\n");
    else {
        printf("Queue: ");
        for(int i=front;i<=rear;i++) printf("%d ", queue[i]);
        printf("\n");
    }
}

/* ----- CIRCULAR QUEUE OPERATIONS ----- */

void cenqueue(int x) {
    if(cfront == 0 && crear == SIZE-1) || (crear + 1 == cfront))
        printf("Circular Queue Full\n");
    else {
        if(cfront == -1) cfront = 0;
        crear = (crear + 1) % SIZE;
        cqueue[crear] = x;
    }
}

```

```

void cdequeue() {
    if(cfront == -1) printf("Circular Queue Empty\n");
    else {
        printf("Deleted: %d\n", cqueue[cfront]);
        if(cfront == crear) cfront = crear = -1;
        else cfront = (cfront + 1) % SIZE;
    }
}

```

```

void displayCQueue() {
    if(cfront == -1) printf("Circular Queue Empty\n");
    else {
        int i = cfront;
        printf("Circular Queue: ");
        while(1) {
            printf("%d ", cqueue[i]);
            if(i == crear) break;
            i = (i + 1) % SIZE;
        }
        printf("\n");
    }
}

```

```

/* ----- MAIN ----- */

int main() {
    push(10); push(20); push(30);
    displayStack();
    pop();
    displayStack();

    printf("\n");
}

```

```

enqueue(5); enqueue(15); enqueue(25);

```

```
displayQueue();
dequeue();
displayQueue();

printf("\n");

cenqueue(1); cenqueue(2); cenqueue(3);
displayCQueue();
cdequeue();
displayCQueue();

return 0;
}
```

```
Stack: 10 20 30
Popped: 30
Stack: 10 20

Queue: 5 15 25
Deleted: 5
Queue: 15 25

Circular Queue: 1 2 3
Deleted: 1
Circular Queue: 2 3

==== Code Execution Successful ====
```

Q6: Write a program to evaluate the Postfix Notation.

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

int stack[50], top = -1;

void push(int x) {
    stack[++top] = x;
}

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

int main() {
    char exp[50];
    int i, a, b;

    printf("Enter postfix expression: ");
    scanf("%s", exp);

    for(i = 0; exp[i] != '\0'; i++) {
        if(isdigit(exp[i])) {
            push(exp[i] - '0');
        }
        else {
            b = pop();
            a = pop();
            switch(exp[i]) {
                case '+': push(a + b); break;
                case '-': push(a - b); break;
                case '*': push(a * b); break;
            }
        }
    }
}
```

```
        case '/': push(a / b); break;
    }
}
}

printf("Result = %d\n", pop());
return 0;
}

Enter postfix expression: 23*54*+9-
Result = 17

==== Code Execution Successful ===
```

Q7:Write a program to convert infix notation into Postfix Notation.

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

char stack[50];
int top = -1;

void push(char x) { stack[++top] = x; }
char pop() { return stack[top--]; }

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

int main() {
    char infix[50], postfix[50];
    int i, j = 0;

    printf("Enter Infix Expression: ");
    scanf("%s", infix);

    for (i = 0; infix[i] != '\0'; i++) {
        char ch = infix[i];

        if (isalnum(ch))
            postfix[j++] = ch;
        else if (ch == '(')
            push(ch);
        else if (ch == ')') {
```

```

        while (stack[top] != '(')
            postfix[j++] = pop();
            pop();
        }
    else {
        while (top != -1 && priority(stack[top]) >= priority(ch))
            postfix[j++] = pop();
        push(ch);
    }
}

while (top != -1)
    postfix[j++] = pop();

postfix[j] = '\0';

printf("Postfix: %s", postfix);
return 0;
}

```

```

Enter Infix Expression: (A+B)*C
Postfix: AB+C*
==== Code Execution Successful ===

```

Q8:Write a program to perform the operations of the linked list:

- **Insertion**
- **Deletion**
- **Display**

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

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

struct Node* head = NULL;

void insert(int x) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = x;
    newNode->next = head;
    head = newNode;
}

void delete(int x) {
    struct Node *temp = head, *prev = NULL;

    if (temp != NULL && temp->data == x) {
        head = temp->next;
        free(temp);
        return;
    }

    while (temp != NULL && temp->data != x) {
        prev = temp;
        temp = temp->next;
    }

    if (temp == NULL)
        return;

    prev->next = temp->next;
    free(temp);
}
```

```

    }

if (temp == NULL) return;

prev->next = temp->next;
free(temp);
}

void display() {
    struct Node* temp = head;
    while (temp != NULL) {
        printf("%d ", temp->data);
        temp = temp->next;
    }
}

int main() {
    insert(10);           insert(20);
    insert(30);   printf("List after
insertion: "); display();

delete(20);
printf("\nList after deletion: ");
display();

return 0;
}

```

```
List after insertion: 30 20 10
List after deletion: 30 10

==== Code Execution Successful ===
```

Q9:Write a program to perform the operations of the Circular linked list:

- **Insertion**
- **Deletion**
- **Display**

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

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

struct Node* head = NULL;

void insert(int x) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = x;

    if (head == NULL) {
        head = newNode;
        newNode->next = head;
    } else {
        struct Node* temp = head;
        while (temp->next != head)
            temp = temp->next;
        temp->next = newNode;
        newNode->next = head;
    }
}

void delete(int x) {
    if (head == NULL) return;
```

```

struct Node *temp = head, *prev = NULL;

if (temp->data == x && temp->next == head) {
    head = NULL;
    free(temp);
    return;
}

if (temp->data == x) {
    while (temp->next != head)
        temp = temp->next;
    temp->next = head->next;
    free(head);
    head = temp->next;
    return;
}

prev = head;
temp = head->next;

while (temp != head && temp->data != x) {
    prev = temp;
    temp = temp->next;
}

if (temp->data == x) {
    prev->next = temp->next;
    free(temp);
}

void display() {
    if (head == NULL) return;
}

```

```
struct Node* temp = head;
do{
    printf("%d ", temp->data);
    temp = temp->next;
} while (temp != head);

}

int main() {
    insert(10)
    ;
    insert(20)
    ;
    printf("Circular List after insertion: ");
    display();

    delete(20);
    printf("\nCircular List after deletion: ");
    display();

    return 0;
}
```

```
Circular List after insertion: 10 20 30
Circular List after deletion: 10 30
```

```
==== Code Execution Successful ===
```

Q10:Write a program to perform all operations: -

- **For Stack using Linked List.**
- **For Queue using Linked List**
- **For Circular Queue using Linked List**

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

struct Node { int data; struct Node* next; };
struct Node *top=NULL, *front=NULL, *rear=NULL;
struct Node *frontC=NULL, *rearC=NULL;

/* STACK */
void push(int x){
    struct Node* n=malloc(sizeof(struct Node));
    n->data=x; n->next=top; top=n;
}
void pop(){
    if(!top) return;
    struct Node* t=top; top=top->next; free(t);
}
void displayStack(){
    struct Node* t=top;
    while(t){ printf("%d ",t->data); t=t->next; }
}

/* QUEUE */
void enqueue(int x){
    struct Node* n=malloc(sizeof(struct Node));
    n->data=x; n->next=NULL;
    if(!rear) front=rear=n;
    else{ rear->next=n; rear=n; }
}
void dequeue(){
```

```

if(!front) return;
struct Node* t=front;
front=front->next;
if(!front) rear=NULL;
free(t);

}

void displayQueue(){

struct Node* t=front;
while(t){ printf("%d ",t->data); t=t->next; }

}

/* CIRCULAR QUEUE */

void enqueueC(int x){

struct Node* n=malloc(sizeof(struct Node));
n->data=x;
if(!frontC){

frontC=rearC=n;
rearC->next=frontC;

} else {

rearC->next=n;
rearC=n;
rearC->next=frontC;

}

}

void dequeueC(){

if(!frontC) return;
if(frontC==rearC){

free(frontC);
frontC=rearC=NULL;
return;

}

struct Node* t=frontC;
frontC=frontC->next;
rearC->next=frontC;

```

```

free(t);
}

void displayC(){
    if(!frontC) return;
    struct Node* t=frontC;
    do{
        printf("%d ",t->data);
        t=t->next;
    } while(t!=frontC);
}

int main(){
    int ch, val;

    while(1){
        printf("\n\n1.Push(Stack)\n2.Pop(Stack)\n3.DisplayStack");
        printf("\n4.Enqueue(Queue)\n5.Dequeue(Queue)\n6.DisplayQueue");
        printf("\n7.Enqueue(Circular Queue)\n8.Dequeue(CQ)\n9.Display CQ");
        printf("\n10.Exit\nEnter choice: ");
        scanf("%d",&ch);

        if(ch==10) break;

        switch(ch){
            case 1: printf("Enter value: "); scanf("%d",&val); push(val); break;
            case 2: pop(); break;
            case 3: displayStack(); break;

            case 4: printf("Enter value: "); scanf("%d",&val); enqueue(val); break;
            case 5: dequeue(); break;
            case 6: displayQueue(); break;

            case 7: printf("Enter value: "); scanf("%d",&val); enqueueC(val); break;
            case 8: dequeueC(); break;
        }
    }
}

```

```
    case 9: displayC(); break;
}
}

return 0;
}
```

```
4.Enqueue(Queue)
5.Dequeue(Queue)
6.Display Queue
7.Enqueue(Circular Queue)
8.Dequeue(CQ)
9.Display CQ
10.Exit
Enter choice: 1
Enter value: 2
```

```
1.Push(Stack)
2.Pop(Stack)
3.Display Stack
4.Enqueue(Queue)
5.Dequeue(Queue)
6.Display Queue
7.Enqueue(Circular Queue)
8.Dequeue(CQ)
9.Display CQ
10.Exit
Enter choice: 3
2
```

Q11:Write a program to perform concatenation of two linked lists.

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

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

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

void insert(struct Node** head, int x) {
    struct Node* n = createNode(x);
    n->next = *head;
    *head = n;
}

struct Node* concatenate(struct Node* a, struct Node* b) {
    if (a == NULL) return b;
}
```

```
struct Node* temp = a;

while (temp->next != NULL)

    temp = temp->next;

    temp->next = b;

return a;

}
```

```
void display(struct Node* head) {

    while (head) {

        printf("%d ", head->data);

        head = head->next;

    }

}

int main() {

    struct Node *list1 = NULL, *list2 = NULL;

    insert(&list1,30);

    insert(&list1,20);

    insert(&list1,10);

    insert(&list2,60);

    insert(&list2,50);

    insert(&list2,40);
```

```
printf("List 1: ");
display(list1);
printf("\nList 2: ");
display(list2);

list1 = concatenate(list1, list2);

printf("\nConcatenated List: ");
display(list1);

return 0;
}
```

```
List 1: 10 20 30
List 2: 40 50 60
Concatenated List: 10 20 30 40 50 60

==== Code Execution Successful ===
```

Q12:Write a program to perform the operations of the Double linked list:

- **Insertion**
- **Deletion**
- **Display**

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

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

struct Node* head = NULL;

void insert(int x) {
    struct Node* n = malloc(sizeof(struct Node));
    n->data = x;
    n->prev = NULL;
    n->next = head;
    if (head != NULL)
        head->prev = n;
    head = n;
}
```

```
void delete(int x) {  
    struct Node* temp = head;  
  
    while (temp && temp->data != x)  
        temp = temp->next;  
  
    if (!temp) return;  
  
    if (temp->prev)  
        temp->prev->next = temp->next;  
    else  
        head = temp->next;  
  
    if (temp->next)  
        temp->next->prev = temp->prev;  
  
    free(temp);  
}
```

```
void display() {  
    struct Node* temp = head;  
    while (temp) {  
        printf("%d ", temp->data);  
    }
```

```
temp = temp->next;  
}  
  
}  
  
int main() {  
    insert(10);  
    insert(20);  
    insert(30);  
  
    printf("Doubly Linked List after insertion: ");  
    display();  
  
    delete(20);  
    printf("\nDoubly Linked List after deletion: ");  
    display();  
  
    return 0;  
}
```

```
* Doubly Linked List after insertion: 30 20 10  
Doubly Linked List after deletion: 30 10  
  
==== Code Execution Successful ===
```

Q13:Write a program to perform tree traversal methods.

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

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

struct Node* create(int x) {
    struct Node* n = malloc(sizeof(struct Node));
    n->data = x;
    n->left = n->right = NULL;
    return n;
}

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

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

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

```
int main() {  
    struct Node* root = create(10);  
  
    root->left=create(20);  
  
    root->right = create(30);  
  
    root->left->left=create(40);  
  
    root->left->right=create(50);
```

```
    printf("Inorder: ");  
    inorder(root);
```

```
printf("\nPreorder: ");  
preorder(root);  
  
printf("\nPostorder: ");  
postorder(root);  
  
return 0;  
}
```

```
Inorder: 40 20 50 10 30  
Preorder: 10 20 40 50 30  
Postorder: 40 50 20 30 10  
  
==== Code Execution Successful ===
```

Q14:Write a program to perform insertion and deletion in the Binary Search Tree.

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

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

struct Node* create(int x) {
    struct Node* n = malloc(sizeof(struct Node));
    n->data = x;
    n->left = n->right = NULL;
    return n;
}

struct Node* insert(struct Node* root, int x) {
    if (!root) return create(x);
    if (x < root->data)
        root->left = insert(root->left, x);
    else
        root->right = insert(root->right, x);
    return root;
}
```

```
}
```

```
struct Node* minValueNode(struct Node* root) {
```

```
    while (root->left)
```

```
        root = root->left;
```

```
    return root;
```

```
}
```

```
struct Node* delete(struct Node* root, int x) {
```

```
    if (!root) return root;
```

```
    if (x < root->data)
```

```
        root->left = delete(root->left, x);
```

```
    else if (x > root->data)
```

```
        root->right = delete(root->right, x);
```

```
    else {
```

```
        if (!root->left) {
```

```
            struct Node* t = root->right;
```

```
            free(root);
```

```
            return t;
```

```
}
```

```
        else if (!root->right) {
```

```
            struct Node* t = root->left;
```

```
            free(root);
```

```

        return t;

    }

struct Node* t = minValueNode(root->right);

root->data = t->data;

root->right = delete(root->right, t->data);

}

return root;

}

```

```

void inorder(struct Node* root) {

if (!root) return;

inorder(root->left);

printf("%d ", root->data);

inorder(root->right);

}

```

```

int main() {

struct Node* root = NULL;

root = insert(root, 50);

root = insert(root, 30);

root = insert(root, 70);

root = insert(root, 20);

root = insert(root, 40);

```

```
printf("BST Inorder (After Insertion): ");  
inorder(root);  
  
root = delete(root, 30);  
  
printf("\nBST Inorder (After Deletion): ");  
inorder(root);  
  
return 0;  
}
```

```
BST Inorder (After Insertion): 20 30 40 50 70  
BST Inorder (After Deletion): 20 40 50 70  
  
==== Code Execution Successful ===
```

Q15:Write a program to represent an undirected graph using the adjacency matrix to implement the graph and perform the operations with menu-driven options for the following tasks:

- 1. Create graph**
- 2. Insert an edge**
- 3. Print Adjacency Matrix**
- 4. List all vertices that are adjacent to a specified vertex.**
- 6. Exit program**

```
#include <stdio.h>

int graph[20][20];
int n;

void createGraph() {
    int i, j;
    printf("Enter number of vertices: ");
    scanf("%d", &n);

    printf("Enter adjacency matrix (%d x %d):\n", n, n);
    for (i = 0; i < n; i++)
        for (j = 0; j < n; j++)
            scanf("%d", &graph[i][j]);
}

void insertEdge() {
```

```
int u, v;  
  
printf("Enter edge (u v): ");  
  
scanf("%d %d", &u, &v);  
  
  
graph[u][v] = 1;  
  
graph[v][u] = 1;  
  
}
```

```
void printMatrix() {  
  
    int i, j;  
  
    printf("Adjacency Matrix:\n");  
  
    for (i = 0; i < n; i++) {  
  
        for (j = 0; j < n; j++)  
  
            printf("%d ", graph[i][j]);  
  
        printf("\n");  
  
    }  
  
}
```

```
void adjacentVertices() {  
  
    int v, i;  
  
    printf("Enter vertex: ");  
  
    scanf("%d", &v);  
  
  
    printf("Vertices adjacent to %d: ", v);
```

```

for (i = 0; i < n; i++)
    if (graph[v][i] == 1)
        printf("%d ", i);

}

int main() {
    int ch;

    while (1) {
        printf("\n1.Create Graph\n2.Insert Edge\n3.Print Matrix\n4.Adjacent Vertices\n5.Exit\n");
        printf("Enter choice: ");
        scanf("%d", &ch);

        switch (ch) {
            case 1: createGraph(); break;
            case 2: insertEdge(); break;
            case 3: printMatrix(); break;
            case 4: adjacentVertices(); break;
            case 5: return 0;
            default: printf("Invalid Choice");
        }
    }
}

```

```
Enter number of vertices: 2
Enter adjacency matrix (2 x 2):
1 2
3 4

1.Create Graph
2.Insert Edge
3.Print Matrix
4.Adjacent Vertices
5.Exit
Enter choice: 4
Enter vertex: 4
Vertices adjacent to 4:
1.Create Graph
2.Insert Edge
3.Print Matrix
4.Adjacent Vertices
5.Exit
Enter choice:
3
Adjacency Matrix:
1 2
3 4
```