DATA STRUCTURE LAB FILE

School of Computer Applications

Department of Computer Applications

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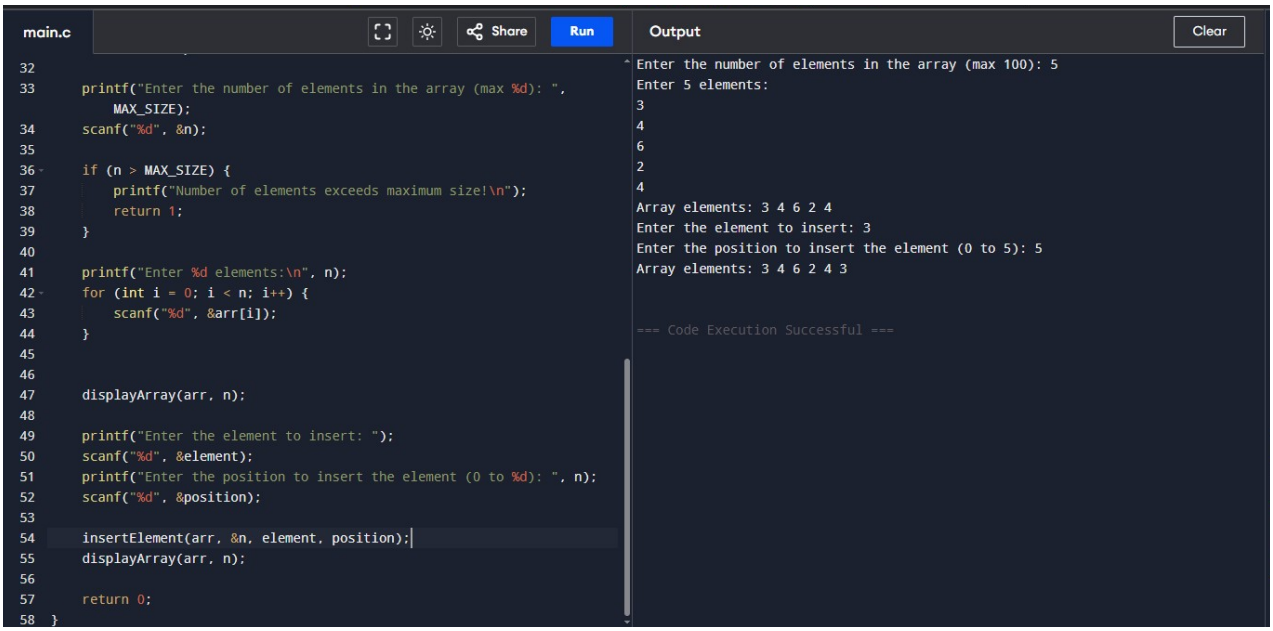
1. Write a program in c to implement insertion in 1d Arrays?

INPUT:

```
#include <stdio.h>
#define MAX_SIZE 100
void insertElement(int arr[], int *n, int element, int position)
{
    if (position < 0 || position > *n) {
        printf("Invalid position! Please enter a position between
0 and %d.\n", *n);
        return;
    }
    for (int i = *n; i > position; i--) {
        arr[i] = arr[i - 1];
    }
    arr[position] = element;
    (*n)++;
}
void displayArray(int arr[], int n) {
    printf("Array elements: ");
    for (int i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }
    printf("\n");
}
```

```
int main() {
    int arr[MAX_SIZE];
    int n;
    int element, position;
    printf("Enter the number of elements in the array (max %d):
", MAX_SIZE);
    scanf("%d", &n);

    if (n > MAX_SIZE) {
        printf("Number of elements exceeds maximum size!\n");
        return 1;
    }
    printf("Enter %d elements:\n", n);
    for (int i = 0; i < n; i++) {
        scanf("%d", &arr[i]);
    }
    displayArray(arr, n);
    printf("Enter the element to insert: ");
    scanf("%d", &element);
    printf("Enter the position to insert the element (0 to %d):
", n);
    scanf("%d", &position);
    insertElement(arr, &n, element, position);
    displayArray(arr, n);
    return 0;
}
```

OUTPUT:


main.c
Share
Run
Output
Clear
printf("Enter the number of elements in the array (max %d): ", MAX_SIZE);
scanf("%d", &n);
if (n > MAX_SIZE) {
printf("Number of elements exceeds maximum size!\n");
return 1;
}
printf("Enter %d elements:\n", n);
for (int i = 0; i < n; i++) {
scanf("%d", &arr[i]);
}
displayArray(arr, n);
printf("Enter the element to insert: ");
scanf("%d", &element);
printf("Enter the position to insert the element (0 to %d): ", n);
scanf("%d", &position);
insertElement(arr, &n, element, position);
displayArray(arr, n);
return 0;
}
Enter the number of elements in the array (max 100): 5
Enter 5 elements:
3
4
6
2
4
Array elements: 3 4 6 2 4
Enter the element to insert: 3
Enter the position to insert the element (0 to 5): 5
Array elements: 3 4 6 2 4 3
=== Code Execution Successful ===

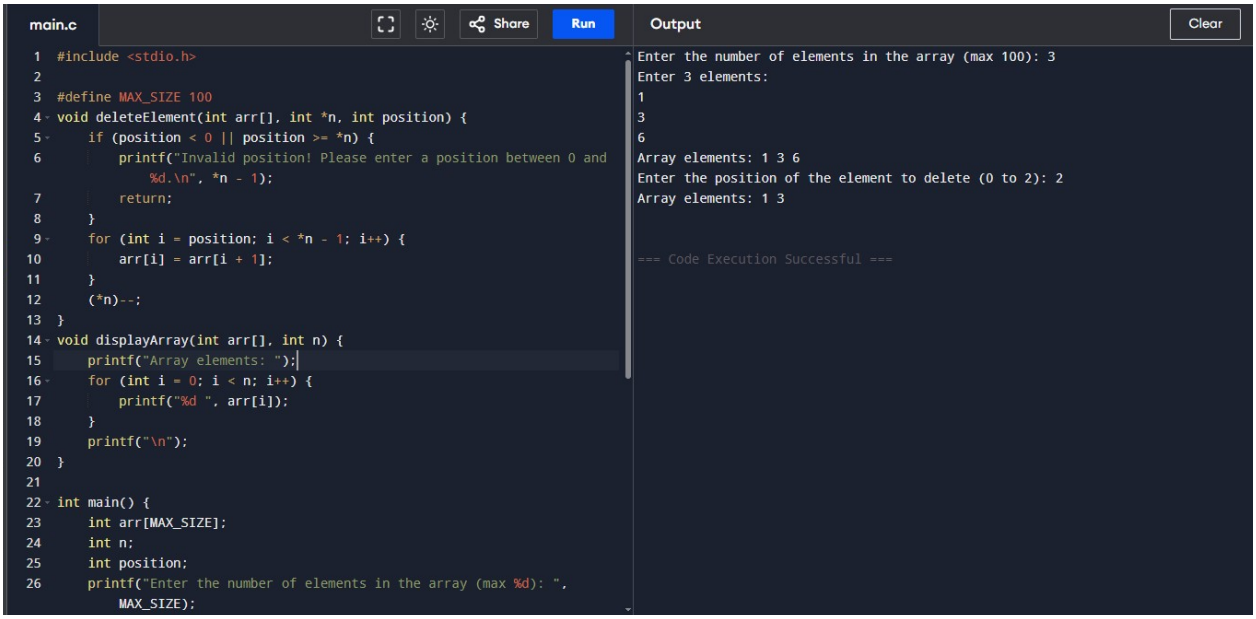
2. Write a program in C to implement deletion in 1D Arrays?

INPUT:

```
#include <stdio.h>
#define MAX_SIZE 100
void deleteElement(int arr[], int *n, int position) {
    if (position < 0 || position >= *n) {
        printf("Invalid position! Please enter a position between
0 and %d.\n", *n - 1);
        return;
    }
    for (int i = position; i < *n - 1; i++) {
        arr[i] = arr[i + 1];
    }
    (*n)--;
}
void displayArray(int arr[], int n) {
    printf("Array elements: ");
    for (int i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }
    printf("\n");
}

int main() {
    int arr[MAX_SIZE];
    int n;
    int position;
    printf("Enter the number of elements in the array (max %d):
", MAX_SIZE);
    scanf("%d", &n);
    if (n > MAX_SIZE) {
        printf("Number of elements exceeds maximum size!\n");
        return 1;
    }
    printf("Enter %d elements:\n", n);
    for (int i = 0; i < n; i++) {
        scanf("%d", &arr[i]);
    }
    displayArray(arr, n);
    printf("Enter the position of the element to delete (0 to
%d): ", n - 1);
```

```
    scanf("%d", &position);
    deleteElement(arr, &n, position);
    displayArray(arr, n);

    return 0;
}
```

OUTPUT:

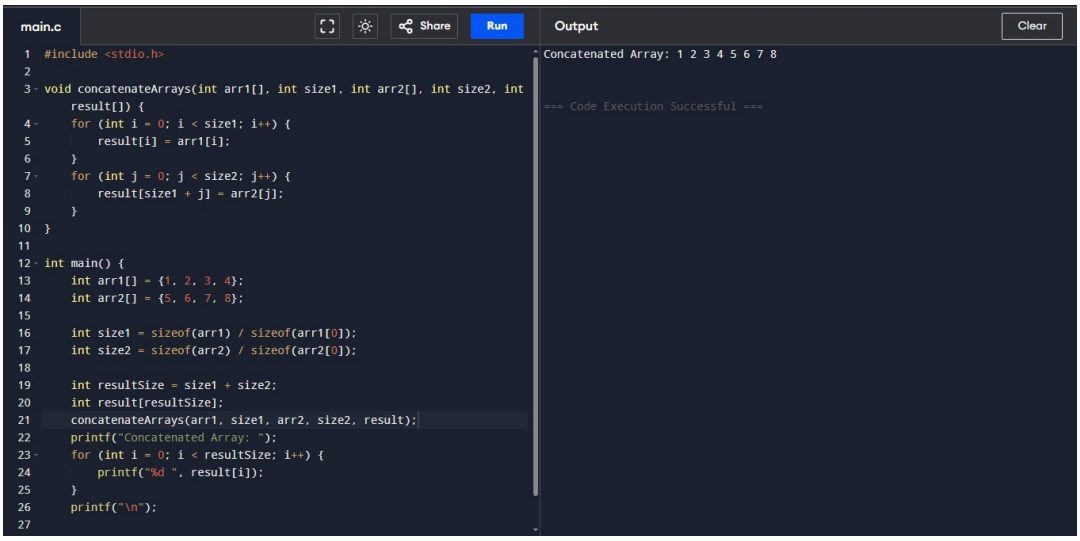


3. Write a program in C to concatenate two arrays?

INPUT:

```
#include <stdio.h>
void concatenateArrays(int arr1[], int size1, int arr2[], int
size2, int result[]) {
    for (int i = 0; i < size1; i++) {
        result[i] = arr1[i];
    }
    for (int j = 0; j < size2; j++) {
        result[size1 + j] = arr2[j];
    }
}
int main() {
    int arr1[] = {1, 2, 3, 4};
    int arr2[] = {5, 6, 7, 8};

    int size1 = sizeof(arr1) / sizeof(arr1[0]);
    int size2 = sizeof(arr2) / sizeof(arr2[0]);
    int resultSize = size1 + size2;
    int result[resultSize];
    concatenateArrays(arr1, size1, arr2, size2, result);
    printf("Concatenated Array: ");
    for (int i = 0; i < resultSize; i++) {
        printf("%d ", result[i]);
    }
    printf("\n");

    return 0;
}
```

OUTPUT:



4. Write a program C to implement the following operations on 2D Array (addition, subtraction, multiplication, transportation)?

INPUT:

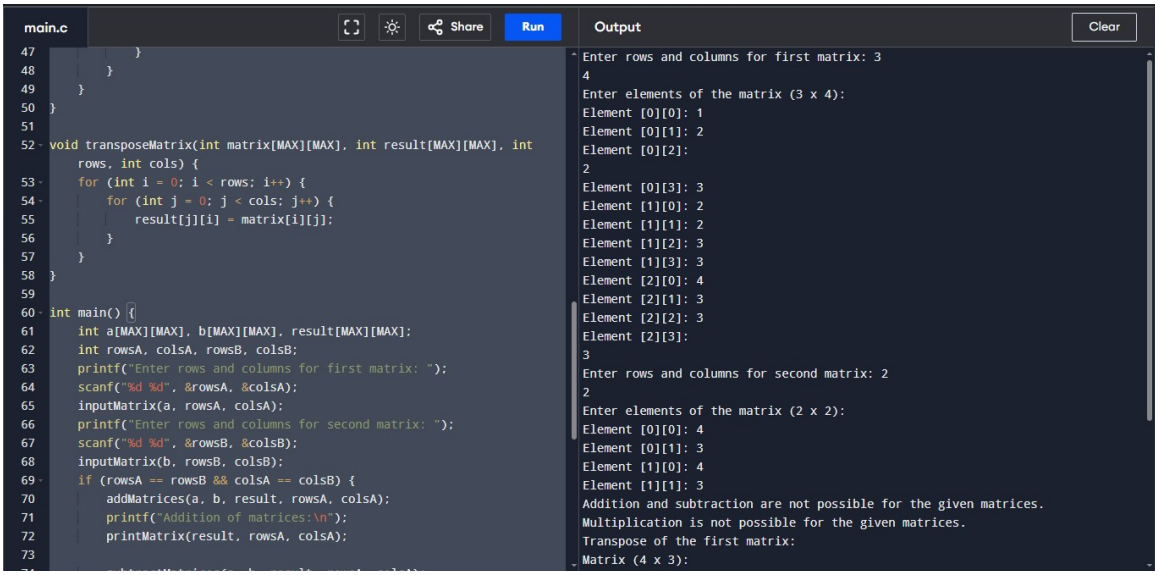
```
#include <stdio.h>
#define MAX 10
void inputMatrix(int matrix[MAX][MAX], int rows, int cols) {
    printf("Enter elements of the matrix (%d x %d):\n", rows, cols);
    for (int i = 0; i < rows; i++) {
        for (int j = 0; j < cols; j++) {
            printf("Element [%d][%d]: ", i, j);
            scanf("%d", &matrix[i][j]);
        }
    }
}

void printMatrix(int matrix[MAX][MAX], int rows, int cols) {
```

```
    printf("Matrix (%d x %d):\n", rows, cols);
    for (int i = 0; i < rows; i++) {
        for (int j = 0; j < cols; j++) {
            printf("%d ", matrix[i][j]);
        }
        printf("\n");
    }
}

void addMatrices(int a[MAX][MAX], int b[MAX][MAX], int
result[MAX][MAX], int rows, int cols) {
    for (int i = 0; i < rows; i++) {
        for (int j = 0; j < cols; j++) {
            result[i][j] = a[i][j] + b[i][j];
        }
    }
}

void subtractMatrices(int a[MAX][MAX], int b[MAX][MAX], int
result[MAX][MAX], int rows, int cols) {
    for (int i = 0; i < rows; i++) {
        for (int j = 0; j < cols; j++) {
            result[i][j] = a[i][j] - b[i][j];
        }
    }
}

void multiplyMatrices(int a[MAX][MAX], int b[MAX][MAX], int
result[MAX][MAX], int rowsA, int colsA, int colsB) {
    for (int i = 0; i < rowsA; i++) {
        for (int j = 0; j < colsB; j++) {
            result[i][j] = 0;
            for (int k = 0; k < colsA; k++) {
                result[i][j] += a[i][k] * b[k][j];
            }
        }
    }
}

void transposeMatrix(int matrix[MAX][MAX], int result[MAX][MAX],
int rows, int cols) {
```

```
    for (int i = 0; i < rows; i++) {
        for (int j = 0; j < cols; j++) {
            result[j][i] = matrix[i][j];
        }
    }
}

int main() {
    int a[MAX][MAX], b[MAX][MAX], result[MAX][MAX];
    int rowsA, colsA, rowsB, colsB;
    printf("Enter rows and columns for first matrix: ");
    scanf("%d %d", &rowsA, &colsA);
    inputMatrix(a, rowsA, colsA);
    printf("Enter rows and columns for second matrix: ");
    scanf("%d %d", &rowsB, &colsB);
    inputMatrix(b, rowsB, colsB);
    if (rowsA == rowsB && colsA == colsB) {
        addMatrices(a, b, result, rowsA, colsA);
        printf("Addition of matrices:\n");
        printMatrix(result, rowsA, colsA);

        subtractMatrices(a, b, result, rowsA, colsA);
        printf("Subtraction of matrices:\n");
        printMatrix(result, rowsA, colsA);
    } else {
        printf("Addition and subtraction are not possible for the
given matrices.\n");
    }
    if (colsA == rowsB) {
        multiplyMatrices(a, b, result, rowsA, colsA, colsB);
        printf("Multiplication of matrices:\n");
        printMatrix(result, rowsA, colsB);
    } else {
        printf("Multiplication is not possible for the given
matrices.\n");
    }
    transposeMatrix(a, result, rowsA, colsA);
    printf("Transpose of the first matrix:\n");
    printMatrix(result, colsA, rowsA);

    transposeMatrix(b, result, rowsB, colsB);
```

```
    printf("Transpose of the second matrix:\n");
    printMatrix(result, colsB, rowsB);

    return 0;
}
```

OUTPUT:



5. Write a program in C to implement operations on Stack using array?

INPUT:

```
#include <stdio.h>
#include <stdlib.h>
#define MAX 100
struct Stack {
    int top;
    int items[MAX];
};
void initStack(struct Stack* s) {
    s->top = -1;
}
int isFull(struct Stack* s) {
    return s->top == MAX - 1;
}
int isEmpty(struct Stack* s) {
    return s->top == -1;
}
```

```
void push(struct Stack* s, int item) {
    if (isFull(s)) {
        printf("Stack Overflow! Cannot push %d\n", item);
    } else {
        s->items[++(s->top)] = item;
        printf("%d pushed to stack\n", item);
    }
}
int pop(struct Stack* s) {
    if (isEmpty(s)) {
        printf("Stack Underflow! Cannot pop from empty stack\n");
        return -1;
    } else {
        return s->items[(s->top)--];
    }
}
void display(struct Stack* s) {
    if (isEmpty(s)) {
        printf("Stack is empty\n");
    } else {
        printf("Stack elements are:\n");
        for (int i = s->top; i >= 0; i--) {
            printf("%d\n", s->items[i]);
        }
    }
}
int main() {
    struct Stack s;
    initStack(&s);
    int choice, value;
    do {
        printf("\nStack Operations:\n");
        printf("1. Push\n");
        printf("2. Pop\n");
        printf("3. Display\n");
        printf("4. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        switch (choice) {
            case 1:
                printf("Enter value to push: ");
```

```
                scanf("%d", &value);
                push(&s, value);
                break;
            case 2:
                value = pop(&s);
                if (value != -1) {
                    printf("Popped value: %d\n", value);
                }
                break;
            case 3:
                display(&s);
                break;
            case 4:
                printf("Exiting...\n");
                break;
            default:
                printf("Invalid choice! Please try again.\n");
        }
    } while (choice != 4);
    return 0;
}
```

OUTPUT:

main.c

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

#define MAX 100 // Maximum size of the stack

// Stack structure
struct Stack {
    int top;
    int items[MAX];
};

// Function to initialize the stack
void initStack(struct Stack* s) {
    s->top = -1; // Stack is initially empty
}

// Function to check if the stack is full
int isFull(struct Stack* s) {
    return s->top == MAX - 1;
}

// Function to check if the stack is empty
int isEmpty(struct Stack* s) {
    return s->top == -1;
}
```

Output

```
Stack Operations:
1. Push
2. Pop
3. Display
4. Exit
Enter your choice: 2
Stack Underflow! Cannot pop from empty stack

Stack Operations:
1. Push
2. Pop
3. Display
4. Exit
Enter your choice: 1
Enter value to push: 3
3 pushed to stack

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

6. Write a program in C to implement operations on queue using array?

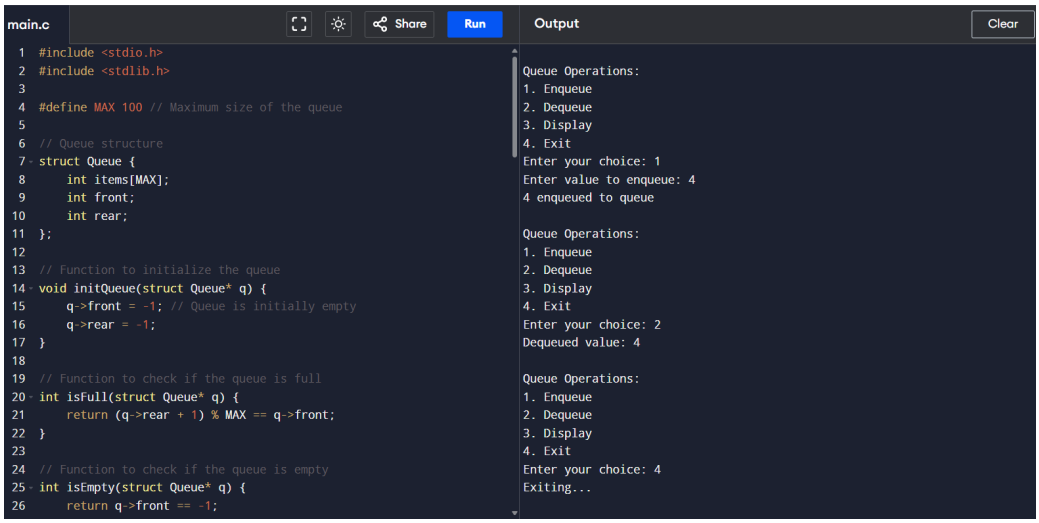
INPUT:

```c
#include <stdio.h>
#include <stdlib.h>
#define MAX 100
struct Queue {
    int items[MAX];
    int front;
    int rear;
};
void initQueue(struct Queue* q) {
    q->front = -1;
    q->rear = -1;
}
int isFull(struct Queue* q) {
    return (q->rear + 1) % MAX == q->front;
}
int isEmpty(struct Queue* q) {
    return q->front == -1;
}
void enqueue(struct Queue* q, int item) {
    if (isFull(q)) {
        printf("Queue Overflow! Cannot enqueue %d\n", item);
    } else {
        if (isEmpty(q)) {
```

```
            q->front = 0;
        }
        q->rear = (q->rear + 1) % MAX;
        q->items[q->rear] = item;
        printf("%d enqueued to queue\n", item);
    }
}
int dequeue(struct Queue* q) {
    if (isEmpty(q)) {
        printf("Queue Underflow! Cannot dequeue from empty
queue\n");
        return -1;
    } else {
        int item = q->items[q->front];
        if (q->front == q->rear) {
            q->front = -1;
            q->rear = -1;
        } else {
            q->front = (q->front + 1) % MAX; // Circular
increment
        }
        return item;
    }
}
void display(struct Queue* q) {
    if (isEmpty(q)) {
        printf("Queue is empty\n");
    } else {
        printf("Queue elements are:\n");
        int i = q->front;
        while (1) {
            printf("%d\n", q->items[i]);
            if (i == q->rear) break;
            i = (i + 1) % MAX;
        }
    }
}
int main() {
    struct Queue q;
    initQueue(&q);
```

```
    int choice, value;

    do {
        printf("\nQueue Operations:\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 enqueue: ");
                scanf("%d", &value);
                enqueue(&q, value);
                break;
            case 2:
                value = dequeue(&q);
                if (value != -1) {
                    printf("Dequeued value: %d\n", value); }
                break;
            case 3:
                display(&q);
                break;
            case 4:
                printf("Exiting...\n");
                break;
            default:
                printf("Invalid choice! Please try again.\n");
        }
    } while (choice != 4);
    return 0;
}
```

OUTPUT:



7. Write a program in C to implement operations on circular queue using array?

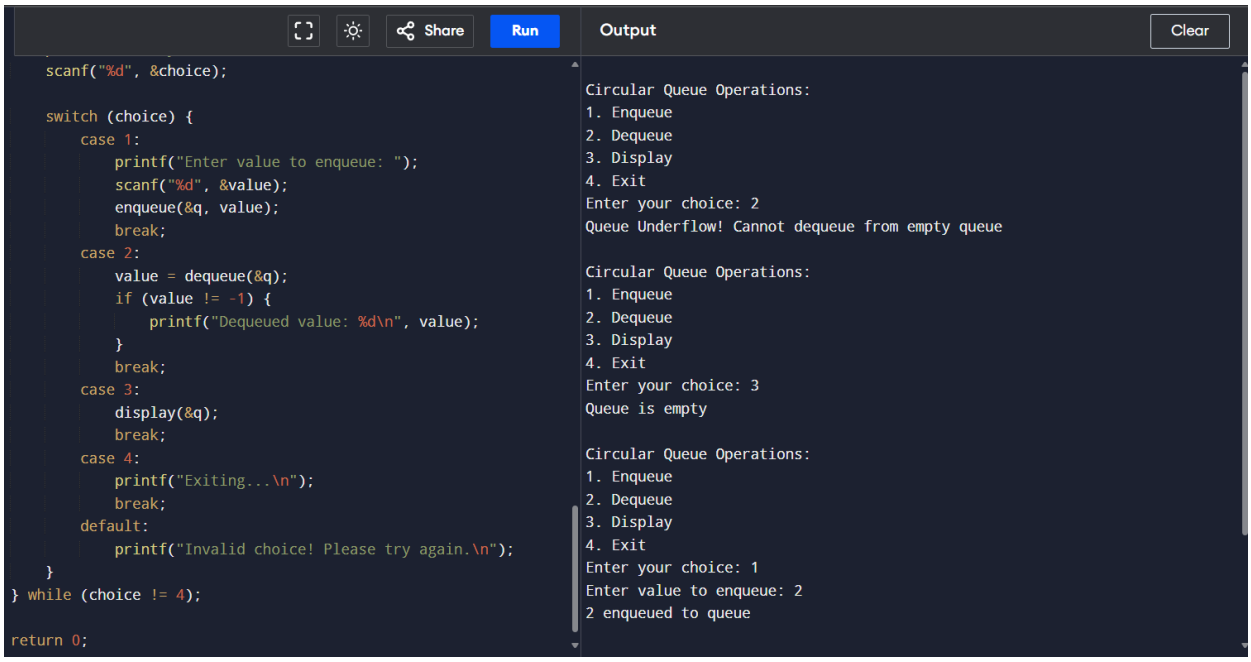
INPUT:

```
#include <stdio.h>
#include <stdlib.h>
#define MAX 100
struct CircularQueue {
    int items[MAX];
    int front;
    int rear;
};
void initQueue(struct CircularQueue* q) {
    q->front = -1;
    q->rear = -1;
}
int isFull(struct CircularQueue* q) {
    return (q->rear + 1) % MAX == q->front;
}
int isEmpty(struct CircularQueue* q) {
    return q->front == -1;
}
void enqueue(struct CircularQueue* q, int item) {
    if (isFull(q)) {
        printf("Queue Overflow! Cannot enqueue %d\n", item);
    } else {
        if (isEmpty(q)) {
            q->front = 0;
        }
        q->rear = (q->rear + 1) % MAX;
```

```
        q->items[q->rear] = item;
        printf("%d enqueued to queue\n", item);
    }
}
int dequeue(struct CircularQueue* q) {
    if (isEmpty(q)) {
        printf("Queue Underflow! Cannot dequeue from empty
queue\n");
        return -1; // Return -1 to indicate queue is empty
    } else {
        int item = q->items[q->front];
        if (q->front == q->rear) {
            q->front = -1;
            q->rear = -1;
        } else {
            q->front = (q->front + 1) % MAX;
        }
        return item;
    }
}
void display(struct CircularQueue* q) {
    if (isEmpty(q)) {
        printf("Queue is empty\n");
    } else {
        printf("Queue elements are:\n");
        int i = q->front;
        while (1) {
            printf("%d\n", q->items[i]);
            if (i == q->rear) break;
            i = (i + 1) % MAX;
        }
    }
}
int main() {
    struct CircularQueue q;
    initQueue(&q);
    int choice, value;
    do {
        printf("\nCircular Queue Operations:\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 enqueue: ");
                scanf("%d", &value);
                enqueue(&q, value);
                break;
            case 2:
                value = dequeue(&q);
                if (value != -1) {
                    printf("Dequeued value: %d\n", value);
                }
                break;
            case 3:
                display(&q);
                break;
            case 4:
                printf("Exiting...\n");
                break;
            default:
                printf("Invalid choice! Please try again.\n");
        }
    } while (choice != 4);
    return 0;
}
```

OUTPUT:



8. Write a program in c to implement insertion in a linked list (beg, mid, end)?

INPUT:

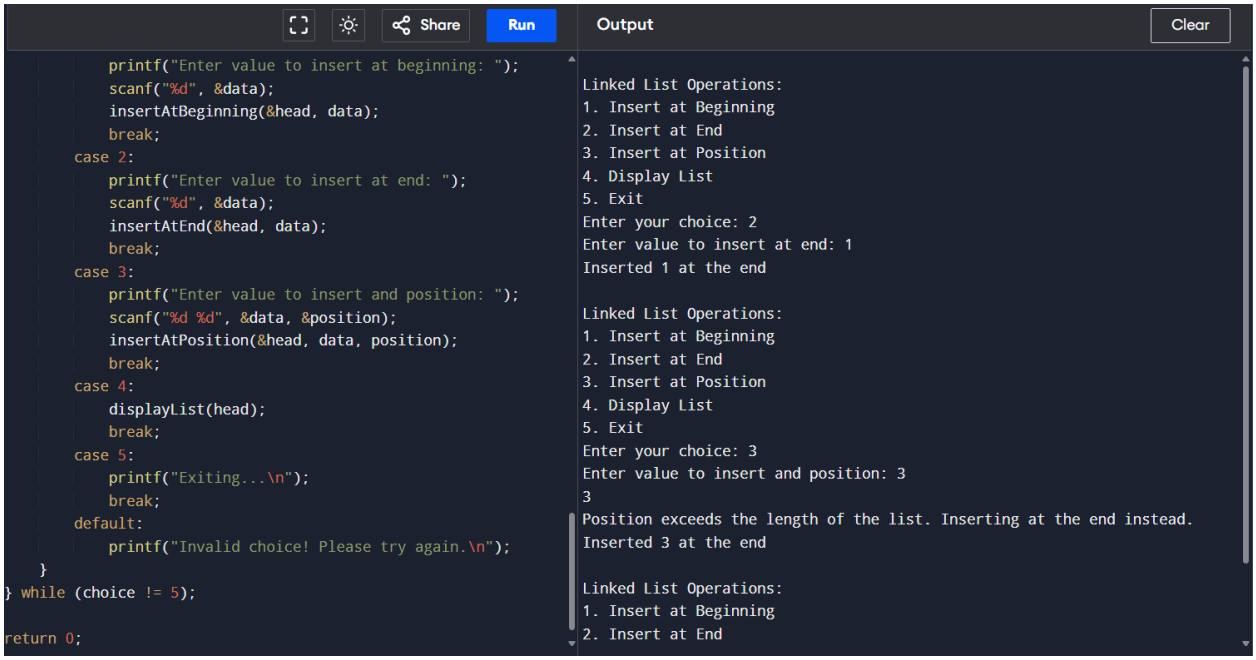
```
#include <stdio.h>
#include <stdlib.h>
struct Node {
    int data;
    struct Node* next;
};
struct Node* createNode(int data) {
```

```
    struct Node* newNode = (struct Node*)malloc(sizeof(struct
Node));
    newNode->data = data;
    newNode->next = NULL;
    return newNode;
}
void insertAtBeginning(struct Node** head, int data) {
    struct Node* newNode = createNode(data);
    newNode->next = *head;
    *head = newNode;
    printf("Inserted %d at the beginning\n", data);
}
void insertAtEnd(struct Node** head, int data) {
    struct Node* newNode = createNode(data);
    if (*head == NULL) {
        *head = newNode;
        printf("Inserted %d at the end\n", data);
        return;
    }
    struct Node* temp = *head;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = newNode;
    printf("Inserted %d at the end\n", data);
}
void insertAtPosition(struct Node** head, int data, int
position) {
    if (position < 1) {
        printf("Position should be >= 1\n");
        return;
    }
    if (position == 1) {
        insertAtBeginning(head, data);
        return;
    }
    struct Node* newNode = createNode(data);
    struct Node* temp = *head;
    for (int i = 1; i < position - 1 && temp != NULL; i++) {
        temp = temp->next;
    }
```

```
    if (temp == NULL) {
        printf("Position exceeds the length of the list.
Inserting at the end instead.\n");
        insertAtEnd(head, data);
    } else {
        newNode->next = temp->next;
        temp->next = newNode;
        printf("Inserted %d at position %d\n", data, position);
    }
}
void displayList(struct Node* head) {
    if (head == NULL) {
        printf("The list is empty.\n");
        return;
    }
    struct Node* temp = head;
    printf("Linked List: ");
    while (temp != NULL) {
        printf("%d -> ", temp->data);
        temp = temp->next;
    }
    printf("NULL\n");
}
int main() {
    struct Node* head = NULL;
    int choice, data, position;
    do {
        printf("\nLinked List Operations:\n");
        printf("1. Insert at Beginning\n");
        printf("2. Insert at End\n");
        printf("3. Insert at Position\n");
        printf("4. Display List\n");
        printf("5. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        switch (choice) {
            case 1:
                printf("Enter value to insert at beginning: ");
                scanf("%d", &data);
                insertAtBeginning(&head, data);
                break;
```

```
            case 2:
                printf("Enter value to insert at end: ");
                scanf("%d", &data);
                insertAtEnd(&head, data);
                break;
            case 3:
                printf("Enter value to insert and position: ");
                scanf("%d %d", &data, &position);
                insertAtPosition(&head, data, position);
                break;
            case 4:
                displayList(head);
                break;
            case 5:
                printf("Exiting...\n");
                break;
            default:
                printf("Invalid choice! Please try again.\n");
        }
    } while (choice != 5);
    return 0;
}
```

OUTPUT:



9. Write a program in C to implement deletion from a linked list?

INPUT:

```
#include <stdio.h>
#include <stdlib.h>
struct Node {
    int data;
    struct Node* next;
};
struct Node* createNode(int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct
Node));
    newNode->data = data;
    newNode->next = NULL;
    return newNode;
}
void insertEnd(struct Node** head, int data) {
    struct Node* newNode = createNode(data);
    if (*head == NULL) {
        *head = newNode;
        return;
    }
    struct Node* temp = *head;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = newNode;
}
void displayList(struct Node* head) {
    struct Node* temp = head;
    while (temp != NULL) {
        printf("%d -> ", temp->data);
        temp = temp->next;
    }
    printf("NULL\n");
}
void deleteFromBeginning(struct Node** head) {
    if (*head == NULL) {
        printf("List is empty. Nothing to delete.\n");
        return;
```

```
    }
    struct Node* temp = *head;
    *head = (*head)->next;
    free(temp);
}

void deleteFromEnd(struct Node** head) {
    if (*head == NULL) {
        printf("List is empty. Nothing to delete.\n");
        return;
    }
    struct Node* temp = *head;
    struct Node* prev = NULL;
    if (temp->next == NULL) {
        free(temp);
        *head = NULL;
        return;
    }
    while (temp->next != NULL) {
        prev = temp;
        temp = temp->next;
    }
    free(temp);
    prev->next = NULL;
}
void deleteFromMiddle(struct Node** head, int position) {
    if (*head == NULL) {
        printf("List is empty. Nothing to delete.\n");
        return;
    }

    struct Node* temp = *head;
    if (position == 0) {
        deleteFromBeginning(head);
        return;
    }
    for (int i = 0; temp != NULL && i < position - 1; i++) {
        temp = temp->next;
    }
    if (temp == NULL || temp->next == NULL) {
```

```
        printf("Position %d does not exist in the list.\n",
position);
        return;
    }
    struct Node* next = temp->next->next;
    free(temp->next);
    temp->next = next;
}
int main() {
    struct Node* head = NULL;

    insertEnd(&head, 10);
    insertEnd(&head, 20);
    insertEnd(&head, 30);
    insertEnd(&head, 40);
    insertEnd(&head, 50);
    printf("Linked List before deletion:\n");
    displayList(head);
    printf("Deleting from the beginning:\n");
    deleteFromBeginning(&head);
    displayList(head);
    printf("Deleting from the end:\n");
    deleteFromEnd(&head);
    displayList(head);
    printf("Deleting from the middle (position 1):\n");
    deleteFromMiddle(&head, 1);
    displayList(head);
    while (head != NULL) {
        struct Node* temp = head;
        head = head->next;
        free(temp);
    }

    return 0;
}
```

OUTPUT:

main.c

Share Run

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

// Define the structure for a node in the linked list
struct Node {
    int data;
    struct Node* next;
};

// Function to create a new node
struct Node* createNode(int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node
        ));
    newNode->data = data;
    newNode->next = NULL;
    return newNode;
}

// Function to insert a node at the end of the linked list
void insertEnd(struct Node** head, int data) {
    struct Node* newNode = createNode(data);
    if (*head == NULL) {
        *head = newNode;
        return;
    }
    struct Node* temp = *head;
```

Output

```
Linked List before deletion:
10 -> 20 -> 30 -> 40 -> 50 -> NULL
Deleting from the beginning:
20 -> 30 -> 40 -> 50 -> NULL
Deleting from the end:
20 -> 30 -> 40 -> NULL
Deleting from the middle (position 1):
20 -> 40 -> NULL


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