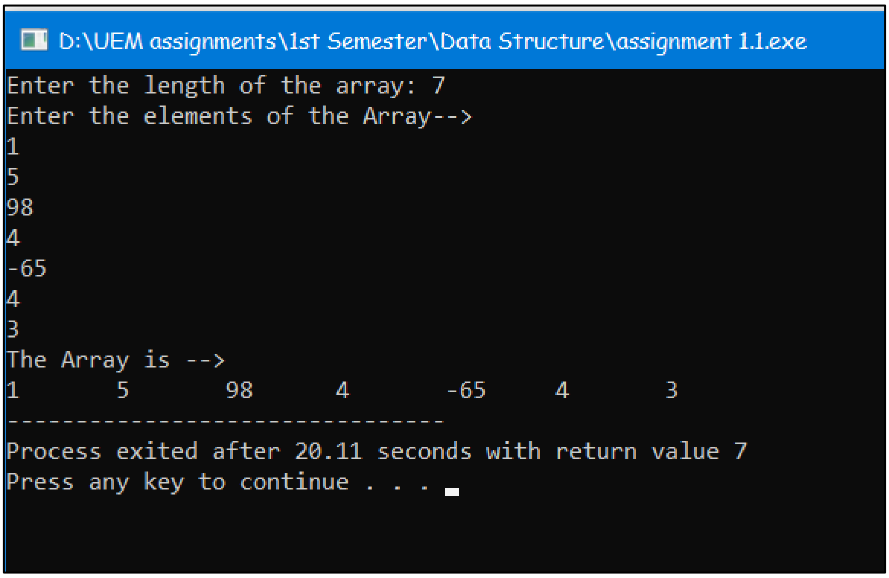
INDEX

Data Structure lab assignment - 1

- **Problem No: 1**
- **Problem Statement:** Write a C program to print an array.
- **Source Code:**

```
#include<stdio.h>
int main () {
    int n, i;
    printf("Enter the length of the array: ");
    scanf("%d", &n);
    int arr[n];
    printf("Enter the elements of the Array-->\n");
    for (i = 0; i < n; i++)
        scanf("%d", &arr[i]);
    printf("The Array is -->\n");
    for (i = 0; i < n; i++)
        printf("%d\t", arr[i]);
}
```

- **Output:**


D:\UEM assignments\1st Semester\Data Structure\assignment 1.1.exe

```
Enter the length of the array: 7
Enter the elements of the Array-->
1
5
98
4
-65
4
3
The Array is -->
1       5       98      4       -65     4       3
--------------------------------
Process exited after 20.11 seconds with return value 7
Press any key to continue . . .
```

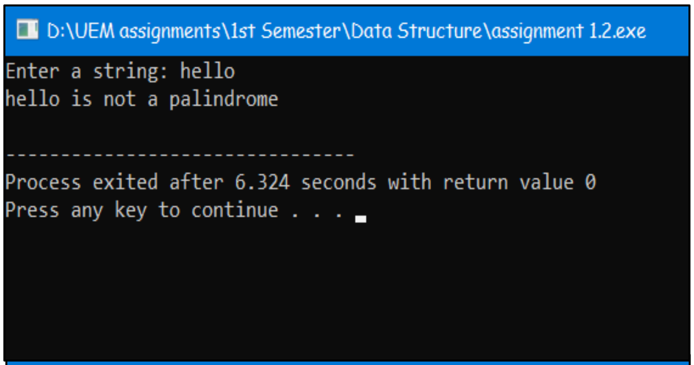
❖ Problem No: 2

Problem Statement: Write a C program to check whether a given string is Palindrome or not.

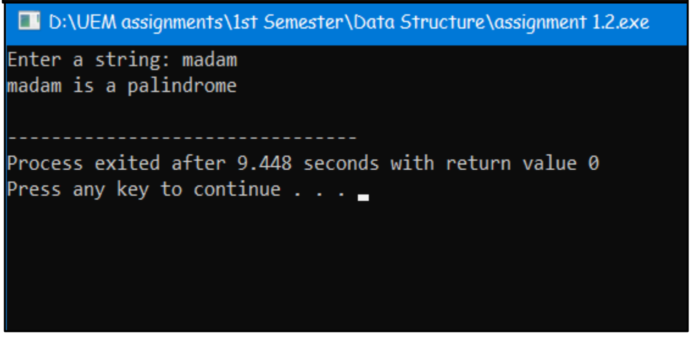
Source Code:

```
#include<stdio.h>
#include<string.h>
int main() {
    char str[100];
    int l = 0, h;
    printf("Enter a string: ");
    gets(str);
    h = strlen(str) - 1;
    while (h > l) {
        if (str[l++] != str[h--]) {
            printf("%s is not a palindrome\n", str);
            return 0;
        }
    }
    printf("%s is a palindrome\n", str);
    return 0;
}
```

Output:


D:\UEM assignments\1st Semester\Data Structure\assignment 1.2.exe

```
Enter a string: hello
hello is not a palindrome

--------------------------------
Process exited after 6.324 seconds with return value 0
Press any key to continue . . .
```


D:\UEM assignments\1st Semester\Data Structure\assignment 1.2.exe

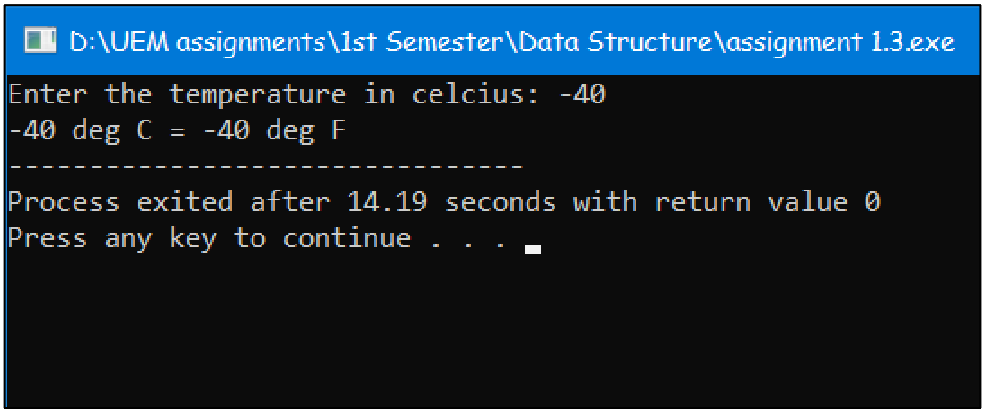
```
Enter a string: madam
madam is a palindrome

--------------------------------
Process exited after 9.448 seconds with return value 0
Press any key to continue . . .
```

❖ Problem No: 3

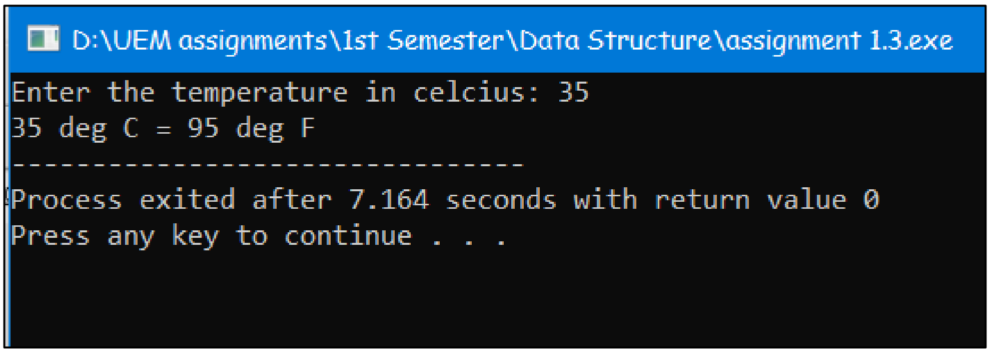
- **Problem Statement:** Write a C program to convert temperature from degree Centigrade to Fahrenheit.
- **Source Code:**

```
#include<stdio.h>
int main () {
	int tc, tf;
	printf("Enter the temperature in celcius: ");
	scanf("%d", &tc);
	tf = (tc * 9 / 5) + 32;
	printf("%d deg C = %d deg F", tc, tf);
	return 0;
}
```

- **Output:**


D:\UEM assignments\1st Semester\Data Structure\assignment 1.3.exe

```
Enter the temperature in celcius: -40
-40 deg C = -40 deg F
--------------------------------
Process exited after 14.19 seconds with return value 0
Press any key to continue . . .
```


D:\UEM assignments\1st Semester\Data Structure\assignment 1.3.exe

```
Enter the temperature in celcius: 35
35 deg C = 95 deg F
--------------------------------
Process exited after 7.164 seconds with return value 0
Press any key to continue . . .
```

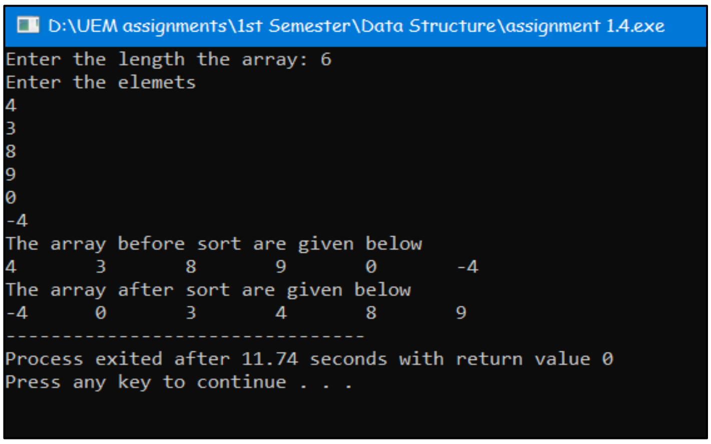
❖ Problem No: 4

Problem Statement: Write a C program to sort an array.

Source Code:

```
#include <stdio.h>
int main() {
    int i, j, temp, len;
    printf("Enter the length the array: ");
    scanf("%d", &len);
    int arr[len];
    printf("Enter the elemets \n");
    for (i = 0; i < len; i++)
        scanf("%d", &arr[i]);
    printf("The array before sort are given below \n");
    for (i = 0; i < len; i++)
        printf("%d\t", arr[i]);
    for (i = 0; i < len; i++)
        for (j = i + 1; j < len; j++)
            if (arr[i] > arr[j]) {
                temp =  arr[i];
                arr[i] = arr[j];
                arr[j] = temp;
            }
    printf("\nThe array after sort are given below \n");
    for (i = 0; i < len; i++)
        printf("%d\t", arr[i]);
      return 0;
}
```

Output:



D:\UEM assignments\1st Semester\Data Structure\assignment 1.4.exe

```
Enter the length the array: 6
Enter the elemets
4
3
8
9
0
-4
The array before sort are given below
4       3       8       9       0       -4
The array after sort are given below
-4      0       3       4       8       9
--------------------------------
Process exited after 11.74 seconds with return value 0
Press any key to continue . . .
```

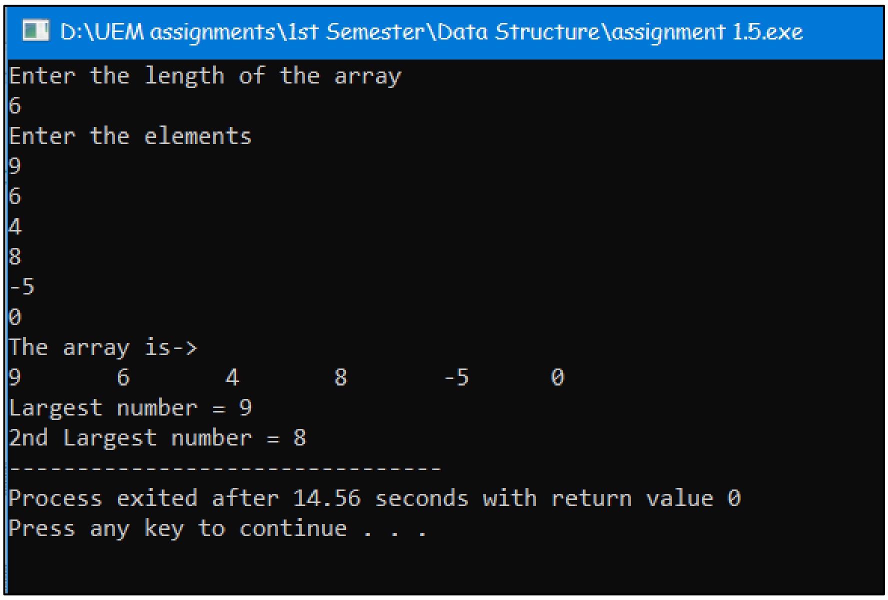
❖ Problem No: 5

- **Problem Statement:** Write a C program to print the largest and second largest element of the array.
- **Source Code:**

```
#include <stdio.h>
int main() {
    int n, max, max2, i, has_max2 = 0;
    printf("Enter the length of the array \n");
    scanf("%d", &n);
    int arr[n];
    printf("Enter the elements \n");
    for (i = 0; i < n; i++)
        scanf("%d", &arr[i]);
    printf ("The array is->\n");
    for (i = 0; i < n; i++)
        printf("%d\t", arr[i]);
    max = arr[0];
    for (i = 0; i < n; i++) {
        if (max < arr[i]) {
            max2 = max;
            max = arr[i];
        }
    }
    for (i = 0; i < n; i++) {
        if (arr[i] < max) {
            if (!has_max2) {
                has_max2 = 1;
                max2 = arr[i];
            }
            else if (arr[i] > max2)
                max2 = arr[i];
        }
    }
    if (has_max2 == 1)
```

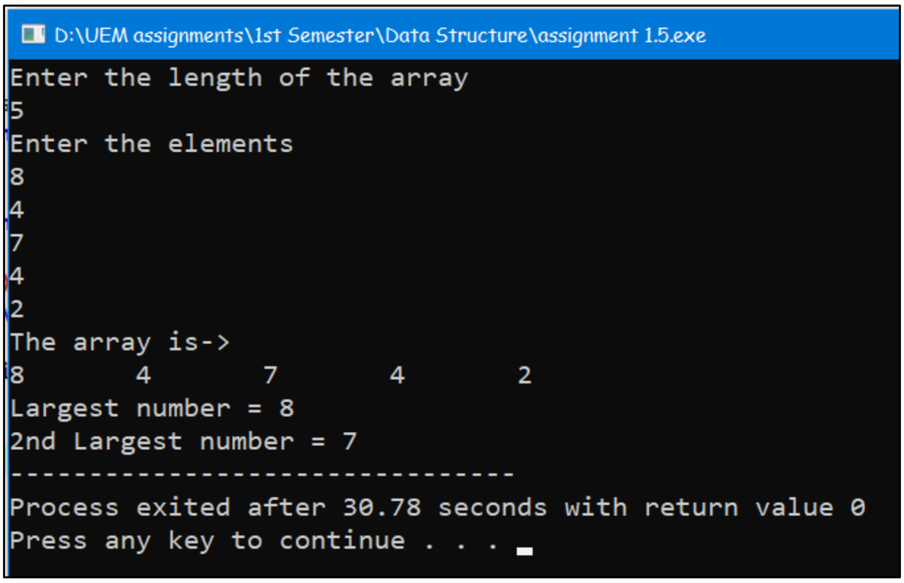
```
        printf("\nLargest number = %d\n2nd Largest number = %d", max,
max2);
    else
        printf("\nAll values are identical to %d", max);
    return 0;
    }
```

Output:



D:\UEM assignments\1st Semester\Data Structure\assignment 1.5.exe

```
Enter the length of the array
6
Enter the elements
9
6
4
8
-5
0
The array is->
9       6       4       8       -5      0
Largest number = 9
2nd Largest number = 8
--------------------------------
Process exited after 14.56 seconds with return value 0
Press any key to continue . . .
```



D:\UEM assignments\1st Semester\Data Structure\assignment 1.5.exe

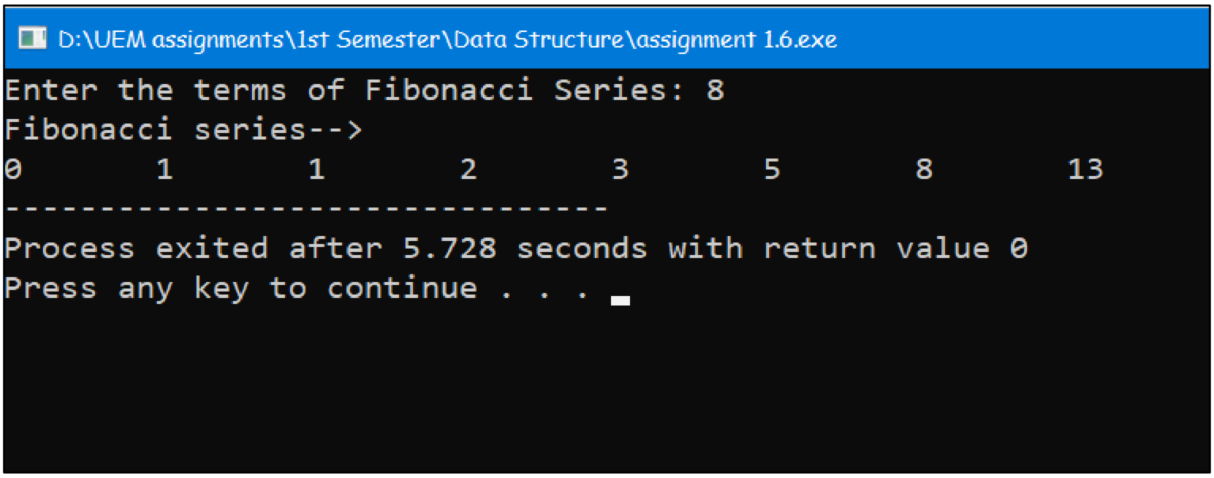
```
Enter the length of the array
5
Enter the elements
8
4
7
4
2
The array is->
8       4       7       4       2
Largest number = 8
2nd Largest number = 7
--------------------------------
Process exited after 30.78 seconds with return value 0
Press any key to continue . . .
```

❖ Problem No: 6

- **Problem Statement:** Write a C program to display Fibonacci series.
- **Source Code:**

```
#include <stdio.h>
int main() {
        int num, i, t1 = 0, t2 = 1, next = t1 + t2;
        printf("Enter the terms of Fibonacci Series: ");
        scanf("%d", &num);
        printf("Fibonacci series-->\n");
        printf("%d\t%d\t", t1, t2);
        for (i = 2; i < num; i++) {
                printf("%d\t", next);
                t1 = t2;
                t2 = next;
                next = t1 + t2;
        }
        return 0;
}
```

- **Output:**



D:\UEM assignments\1st Semester\Data Structure\assignment 1.6.exe

```
Enter the terms of Fibonacci Series: 8
Fibonacci series-->
0       1       1       2       3       5       8       13
--------------------------------
Process exited after 5.728 seconds with return value 0
Press any key to continue . . .
```

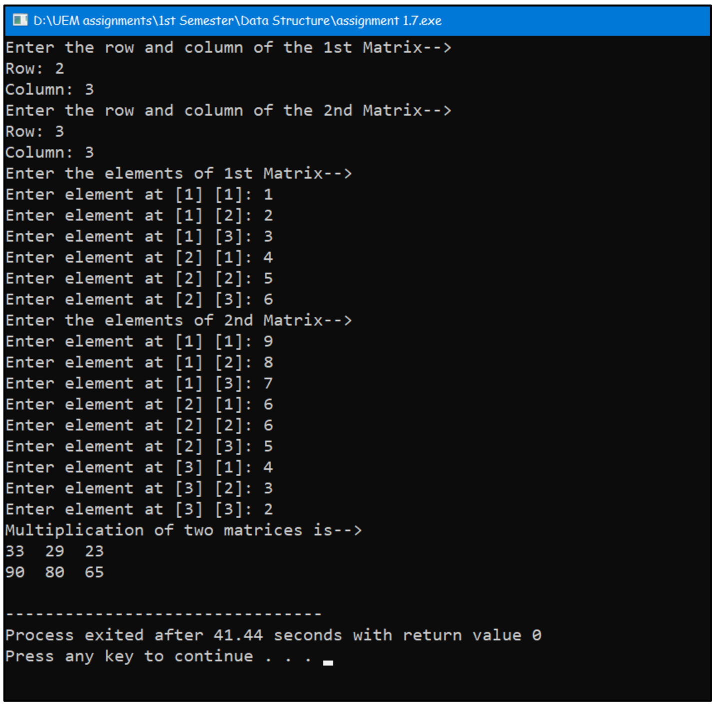
❖ Problem No: 7

- **Problem Statement:** Write a program that reads two 2D metrices from the console, verifies if metrics multiplication is possible or not. Then multiplies the metrices and prints the 3rd metrics.
- **Source Code:**

```
#include<stdio.h>

int main() {

      int row1, row2, column1, column2, i, j, k;

      printf("Enter the row and column of the 1st Matrix-->\n");

      printf("Row: ");

      scanf("%d", &row1);

      printf("Column: ");

      scanf("%d", &column1);

      printf("Enter the row and column of the 2nd Matrix-->\n");

      printf("Row: ");

      scanf("%d", &row2);

      printf("Column: ");

      scanf("%d", &column2);

      if (column1 != row2) {

            printf("1st matrix columns is not equal to 2nd matrix
row.\nMultiplication Can't possible.");

            return 0;

      }

      int matrix1 [row1][column1], matrix2 [row2][column2], result
[row1][column2];

      printf("Enter the elements of 1st Matrix-->\n");

      for (i = 0; i < row1; ++i)

            for (j = 0; j < column1; ++j) {

            printf("Enter element at [%d] [%d]: ", i + 1, j + 1);

            scanf("%d", &matrix1[i][j]);

            }

      printf("Enter the elements of 2nd Matrix-->\n");

      for (i = 0; i < row2; ++i)

      for (j = 0; j < column2; ++j) {

            printf("Enter element at [%d] [%d]: ", i + 1, j + 1);

            scanf("%d", &matrix2[i][j]);
```

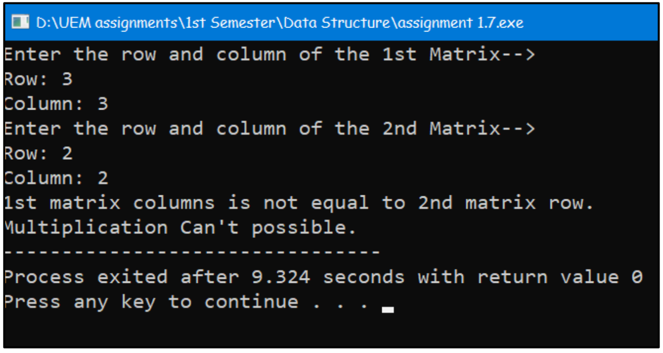
```
    }
    for (i = 0; i < row1; ++i)
    for (j = 0; j < column2; ++j)
        result[i][j] = 0;
  for (i = 0; i < row1; ++i)
    for (j = 0; j < column2; ++j)
        for (k = 0; k < column1; ++k)
            result[i][j] += matrix1[i][k] * matrix2[k][j];
   printf("Multiplication of two matrices is-->\n");
    for (i = 0; i < row1; i++) {
    for (j = 0; j < column2; j++)
        printf("%d  ", result[i][j]);
     printf("\n");
   }
    return 0;
}
```

Output:



D:\UEM assignments\1st Semester\Data Structure\assignment 1.7.exe

```
Enter the row and column of the 1st Matrix-->
Row: 2
Column: 3
Enter the row and column of the 2nd Matrix-->
Row: 3
Column: 3
Enter the elements of 1st Matrix-->
Enter element at [1] [1]: 1
Enter element at [1] [2]: 2
Enter element at [1] [3]: 3
Enter element at [2] [1]: 4
Enter element at [2] [2]: 5
Enter element at [2] [3]: 6
Enter the elements of 2nd Matrix-->
Enter element at [1] [1]: 9
Enter element at [1] [2]: 8
Enter element at [1] [3]: 7
Enter element at [2] [1]: 6
Enter element at [2] [2]: 6
Enter element at [2] [3]: 5
Enter element at [3] [1]: 4
Enter element at [3] [2]: 3
Enter element at [3] [3]: 2
Multiplication of two matrices is-->
33  29  23
90  80  65

--------------------------------
Process exited after 41.44 seconds with return value 0
Press any key to continue . . .
```



D:\UEM assignments\1st Semester\Data Structure\assignment 1.7.exe

```
Enter the row and column of the 1st Matrix-->
Row: 3
Column: 3
Enter the row and column of the 2nd Matrix-->
Row: 2
Column: 2
1st matrix columns is not equal to 2nd matrix row.
Multiplication Can't possible.
--------------------------------
Process exited after 9.324 seconds with return value 0
Press any key to continue . . .
```

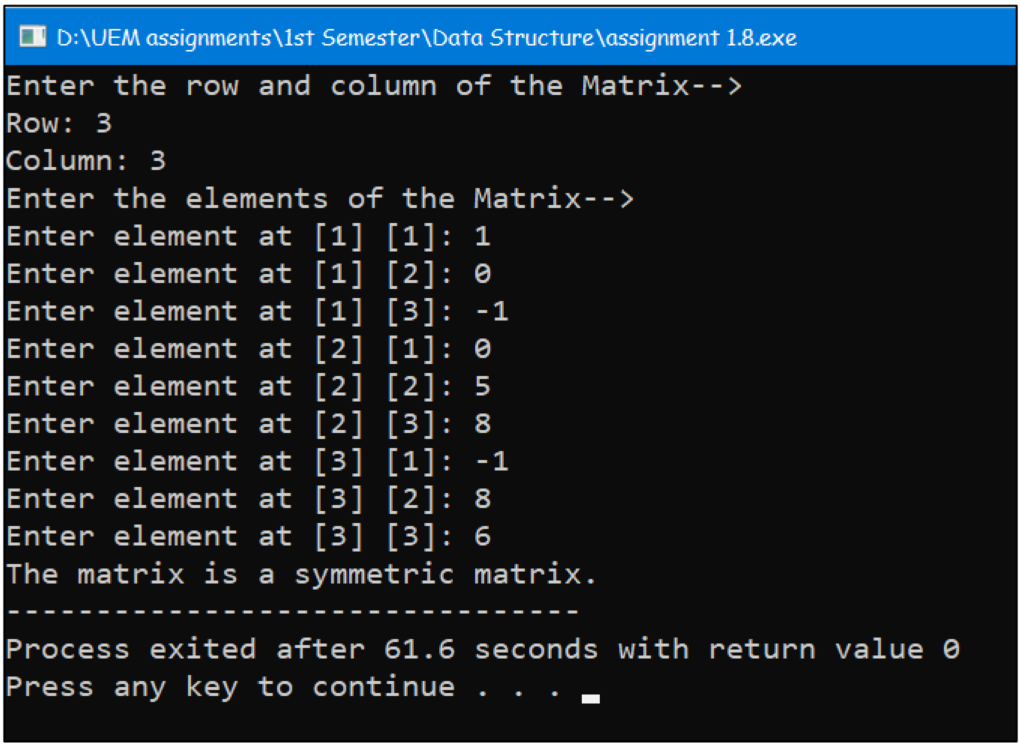
❖ Problem No: 8

Problem Statement: Write a program that reads a 2D metrics and checks if the metrics is a symmetric metrics or not.

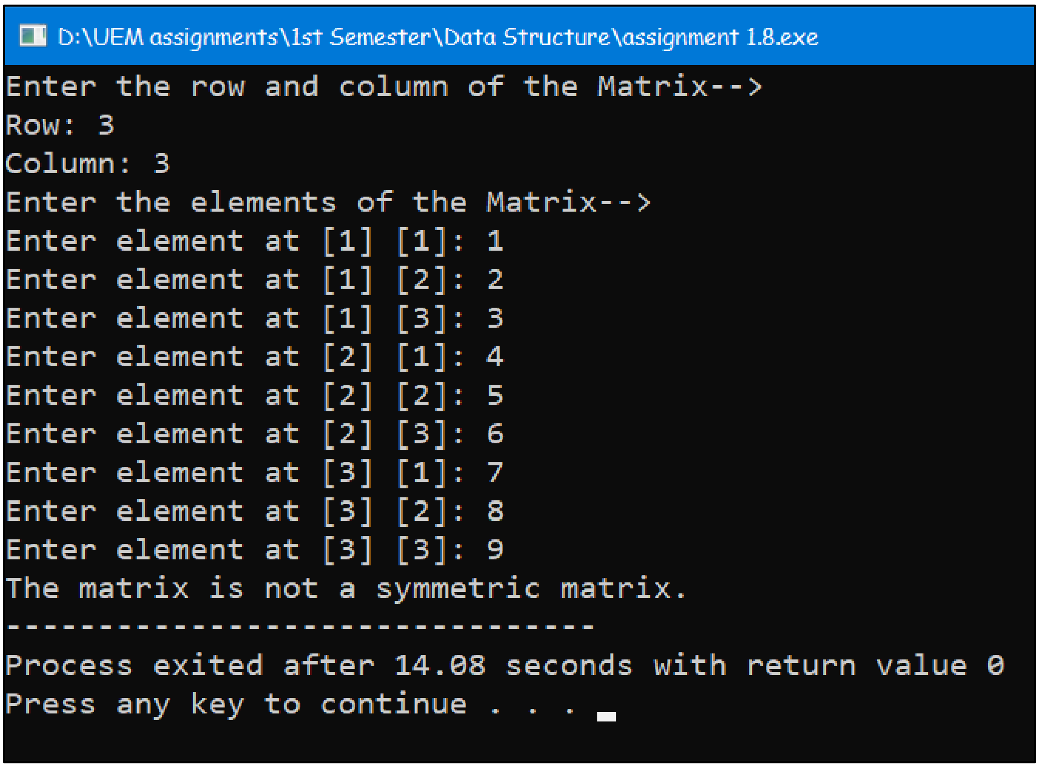
Source Code:

```
#include<stdio.h>
int main() {
   int row, column, i, j, flag = 0;
   printf("Enter the row and column of the Matrix-->\n");
   printf("Row: ");
   scanf("%d", &row);
   printf("Column: ");
   scanf("%d", &column);
   int matrix [row][column];
   printf("Enter the elements of the Matrix-->\n");
   for (i = 0; i < row; i++)
         for (j = 0; j < column; j++) {
         printf("Enter element at [%d] [%d]: ", i + 1, j + 1);
         scanf("%d", &matrix[i][j]);
         }
   for (i = 0; i < row; i++)
               for (j = 0; j < column; j++)
                     if (matrix [j][i] != matrix [i][j]) {
                           flag = 1;
                           break;
               }

    if (flag == 0)
         printf("The matrix is a symmetric matrix.");
    else
         printf("The matrix is not a symmetric matrix.");
   return 0;
}
```

Output:


D:\UEM assignments\1st Semester\Data Structure\assignment 1.8.exe

```
Enter the row and column of the Matrix-->
Row: 3
Column: 3
Enter the elements of the Matrix-->
Enter element at [1] [1]: 1
Enter element at [1] [2]: 0
Enter element at [1] [3]: -1
Enter element at [2] [1]: 0
Enter element at [2] [2]: 5
Enter element at [2] [3]: 8
Enter element at [3] [1]: -1
Enter element at [3] [2]: 8
Enter element at [3] [3]: 6
The matrix is a symmetric matrix.
--------------------------------
Process exited after 61.6 seconds with return value 0
Press any key to continue . . .
```


D:\UEM assignments\1st Semester\Data Structure\assignment 1.8.exe

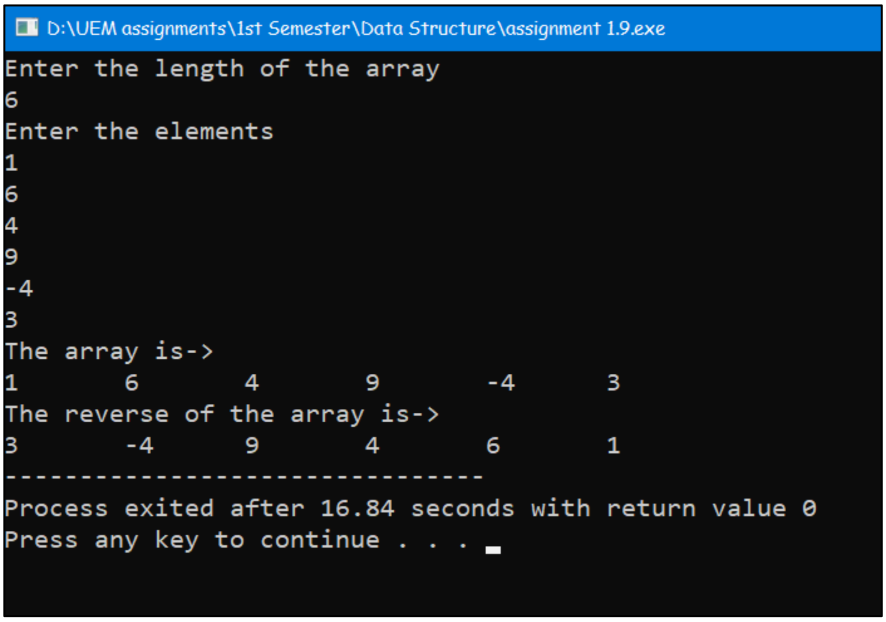
```
Enter the row and column of the Matrix-->
Row: 3
Column: 3
Enter the elements of the Matrix-->
Enter element at [1] [1]: 1
Enter element at [1] [2]: 2
Enter element at [1] [3]: 3
Enter element at [2] [1]: 4
Enter element at [2] [2]: 5
Enter element at [2] [3]: 6
Enter element at [3] [1]: 7
Enter element at [3] [2]: 8
Enter element at [3] [3]: 9
The matrix is not a symmetric matrix.
--------------------------------
Process exited after 14.08 seconds with return value 0
Press any key to continue . . .
```

❖ Problem No: 9

- **Problem Statement:** Write a C program to print reverse array.
- **Source Code:**

```
#include<stdio.h>
int main() {
    int len, i;
    printf("Enter the length of the array \n");
   scanf("%d", &len);
   int arr[len];
   printf("Enter the elements \n");
   for (i = 0; i < len; i++)
      scanf("%d", &arr[i]);
   printf ("The array is->\n");
   for (i = 0; i < len; i++)
      printf("%d\t", arr[i]);
   printf ("\nThe reverse of the array is->\n");
   for (i = len - 1; i >= 0; i--)
      printf("%d\t", arr[i]);
    return 0;
}
```

- **Output:**


D:\UEM assignments\1st Semester\Data Structure\assignment 1.9.exe

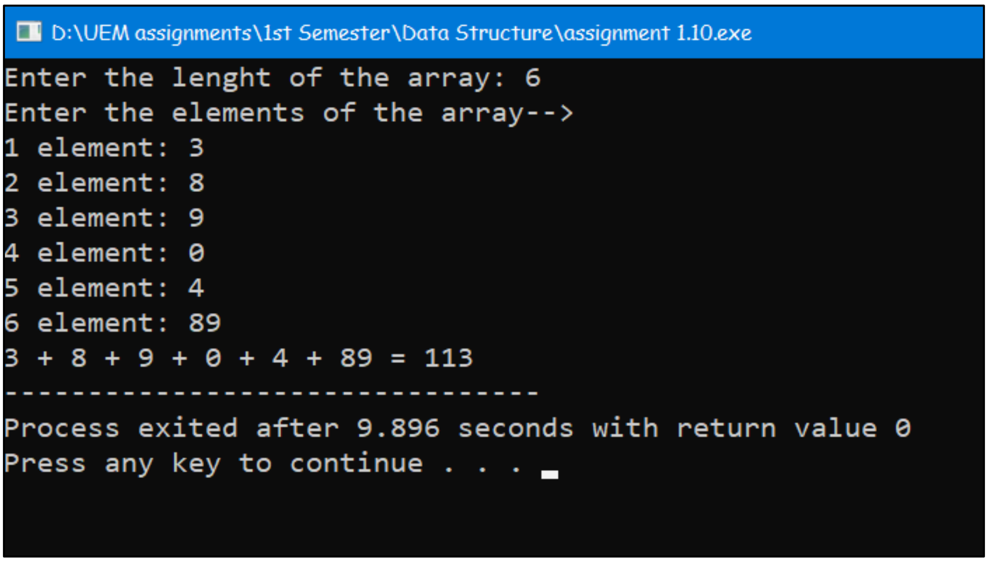
```
Enter the length of the array
6
Enter the elements
1
6
4
9
-4
3
The array is->
1       6       4       9       -4      3
The reverse of the array is->
3       -4      9       4       6       1
--------------------------------
Process exited after 16.84 seconds with return value 0
Press any key to continue . . .
```

❖ Problem No: 10

- **Problem Statement:** Write a C program to check the sum of all elements of an array.
- **Source Code:**

```
#include<stdio.h>
int main() {
      int len, i, sum = 0;
      printf("Enter the lenght of the array: ");
      scanf("%d", &len);
      int arr[len];
      printf("Enter the elements of the array-->\n");
      for (i = 0; i < len; i++) {
            printf("%d element: ", i + 1);
      scanf("%d", &arr[i]);
      }
      for (i = 0; i < len; i++) {
            sum += arr[i];
            printf("%d + ", arr[i]);
      }
      printf("\b\b= %d", sum);
      return 0;
}
```

- **Output:**



D:\UEM assignments\1st Semester\Data Structure\assignment 1.10.exe

```
Enter the lenght of the array: 6
Enter the elements of the array-->
1 element: 3
2 element: 8
3 element: 9
4 element: 0
5 element: 4
6 element: 89
3 + 8 + 9 + 0 + 4 + 89 = 113
--------------------------------
Process exited after 9.896 seconds with return value 0
Press any key to continue . . .
```

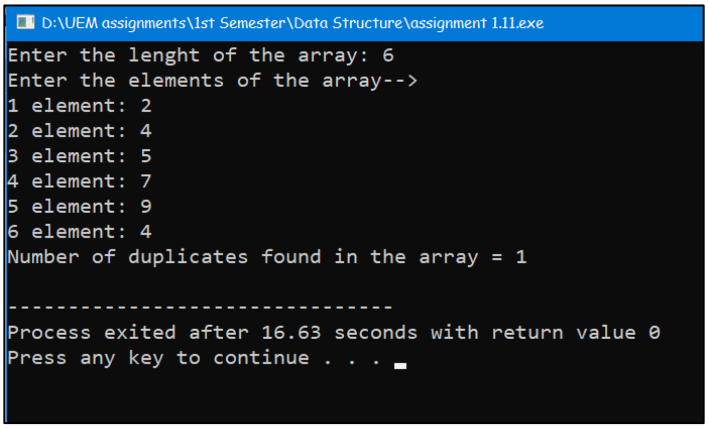
❖ Problem No: 11

Problem Statement: Write a C program to check duplicate number in an array.

Source Code:

```
#include <stdio.h>
int main() {
      int len, i, j, count = 0;
      printf("Enter the lenght of the array: ");
      scanf("%d", &len);
      int arr[len];
      printf("Enter the elements of the array-->\n");
      for (i = 0; i < len; i++) {
            printf("%d element: ", i + 1);
            scanf("%d", &arr[i]);
      }
      for (i = 0; i < len; i++)
            for (j = i + 1; j < len; j++)
            if (arr[i] == arr[j]) {
                  count++;
                  break;
                  }
      if (count == 0)
            printf("No duplicates found in the array.\n");
      else
            printf("Number of duplicates found in the array = %d\n",
count);
    return 0;
}
```

Output:



D:\UEM assignments\1st Semester\Data Structure\assignment 1.11.exe

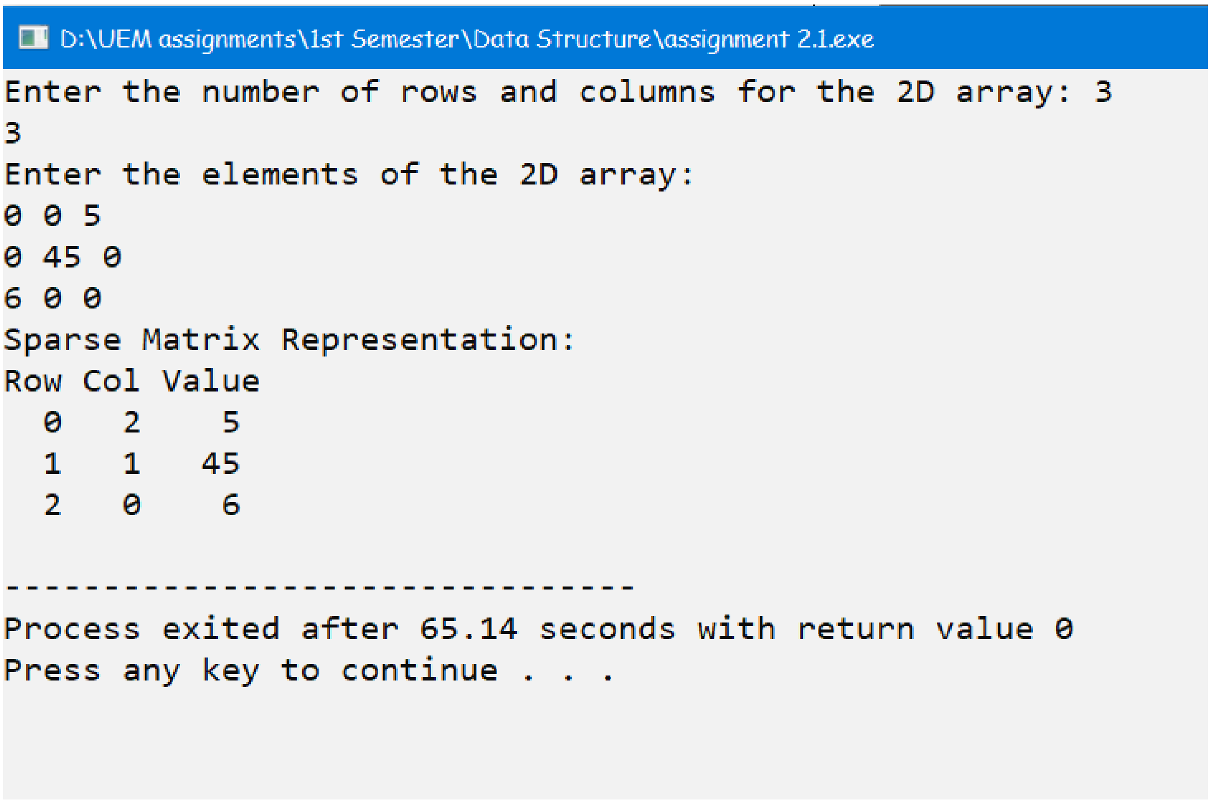
```
Enter the lenght of the array: 6
Enter the elements of the array-->
1 element: 2
2 element: 4
3 element: 5
4 element: 7
5 element: 9
6 element: 4
Number of duplicates found in the array = 1

--------------------------------
Process exited after 16.63 seconds with return value 0
Press any key to continue . . .
```

Data Structure lab assignment 2

- **Problem No: 1**
- **Problem Statement:** Write a C program to read a 2D array (with most of the elements as 0s) and then represent the same array as Sparse Metrics.
- **Source Code:**

```
#include <stdio.h>

#define MAX_ROWS 50

#define MAX_COLS 50

#define MAX_ELEMENTS 1000

struct Element {

    int row;  int col; int value;  };

void convertToSparse(int matrix[MAX_ROWS][MAX_COLS], int rows,
int cols) {

    struct Element sparse[MAX_ELEMENTS];

    int sparseIndex = 0;

    for (int i = 0; i < rows; i++) {

        for (int j = 0; j < cols; j++) {

            if (matrix[i][j] != 0) {

                sparse[sparseIndex].row = i;

                sparse[sparseIndex].col = j;

                sparse[sparseIndex].value = matrix[i][j];

                sparseIndex++;

   } } }

    printf("Sparse Matrix Representation:\n");

    printf("Row Col Value\n");

    for (int i = 0; i < sparseIndex; i++) {

        printf("%3d %3d %4d\n", sparse[i].row, sparse[i].col,
sparse[i].value);

    }}

int main() {

    int rows, cols;   int matrix[MAX_ROWS][MAX_COLS];

    printf("Enter the number of rows and columns for the 2D
array: ");

    scanf("%d %d", &rows, &cols);

    printf("Enter the elements of the 2D array:\n");
for (int i = 0; i < rows; i++) {
    for (int j = 0; j < cols; j++) {
        scanf("%d", &matrix[i][j]);}}
convertToSparse(matrix, rows, cols);
return 0;
   }
```

Output:



D:\UEM assignments\1st Semester\Data Structure\assignment 2.1.exe

```
Enter the number of rows and columns for the 2D array: 3
3
Enter the elements of the 2D array:
0 0 5
0 45 0
6 0 0
Sparse Matrix Representation:
Row Col Value
  0   2    5
  1   1   45
  2   0    6

--------------------------------
Process exited after 65.14 seconds with return value 0
Press any key to continue . . .
```

Problem No: 2 & 3

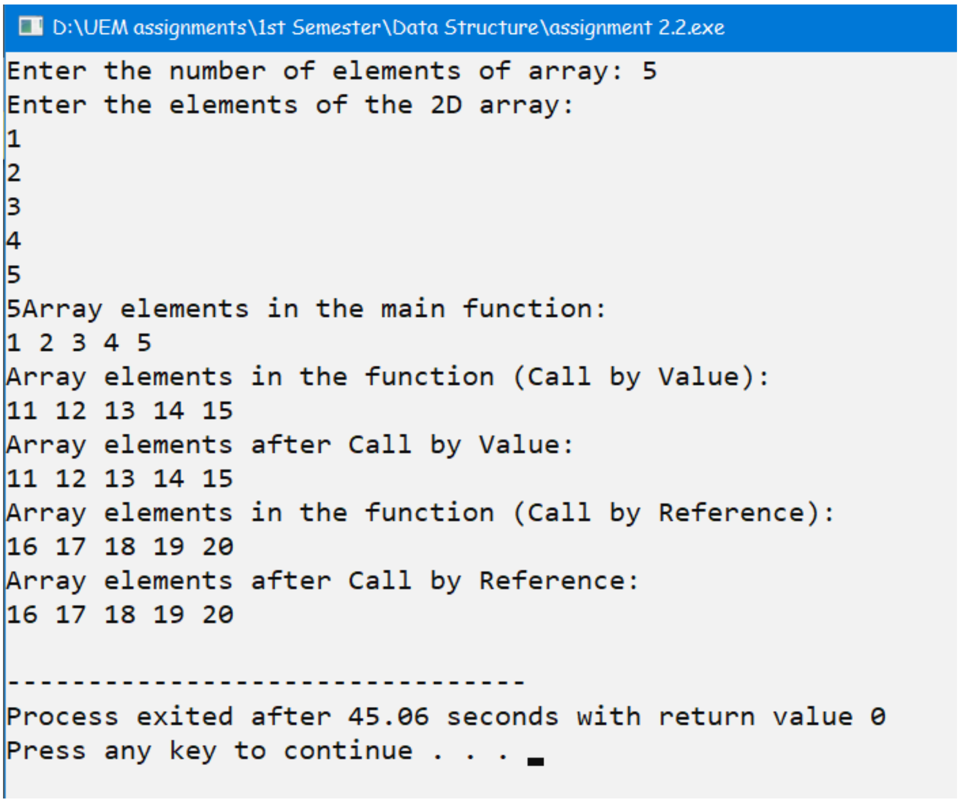
Problem Statement: Write a C program to pass an array to a function using Call by Value and Call by reference, update the array values in the function, print the array elements both in the function and in the calling function.

Source Code:

```
#include <stdio.h>
void modifyByValue(int arr[], int size) {
      int i;
    printf("Array elements in the function (Call by
Value):\n");
    for (i = 0; i < size; i++) {
        arr[i] += 10;
        printf("%d ", arr[i]);}
    printf("\n");}
void modifyByReference(int *arr, int size) {
      int i;
    printf("Array elements in the function (Call by
Reference):\n");
```

```
    for (i = 0; i < size; i++) {
        *arr += 5;
        arr++;
        printf("%d ", *(arr - 1));   } printf("\n");}
void displayArray(int arr[], int size, const char *message) {
    int i;
      printf("%s\n", message);
    for (i = 0; i < size; i++) {
        printf("%d ", arr[i]);   }
    printf("\n"); }
int main() {
      int n, i;
   printf("Enter the number of elements of array: ");
    scanf("%d", &n);
    int arr[n] ;
    printf("Enter the elements of the 2D array:\n");
    for (i = 0; i < n; i++) {
            scanf("%d", &arr[i]);   }
    int size = sizeof(arr) / sizeof(arr[0]);
    printf("%d",size);
    displayArray(arr, size, "Array elements in the main
function:");
    modifyByValue(arr, size);
    displayArray(arr, size, "Array elements after Call by
Value:");
    modifyByReference(arr, size);
    displayArray(arr, size, "Array elements after Call by
Reference:");
    return 0;
}
```

Output:



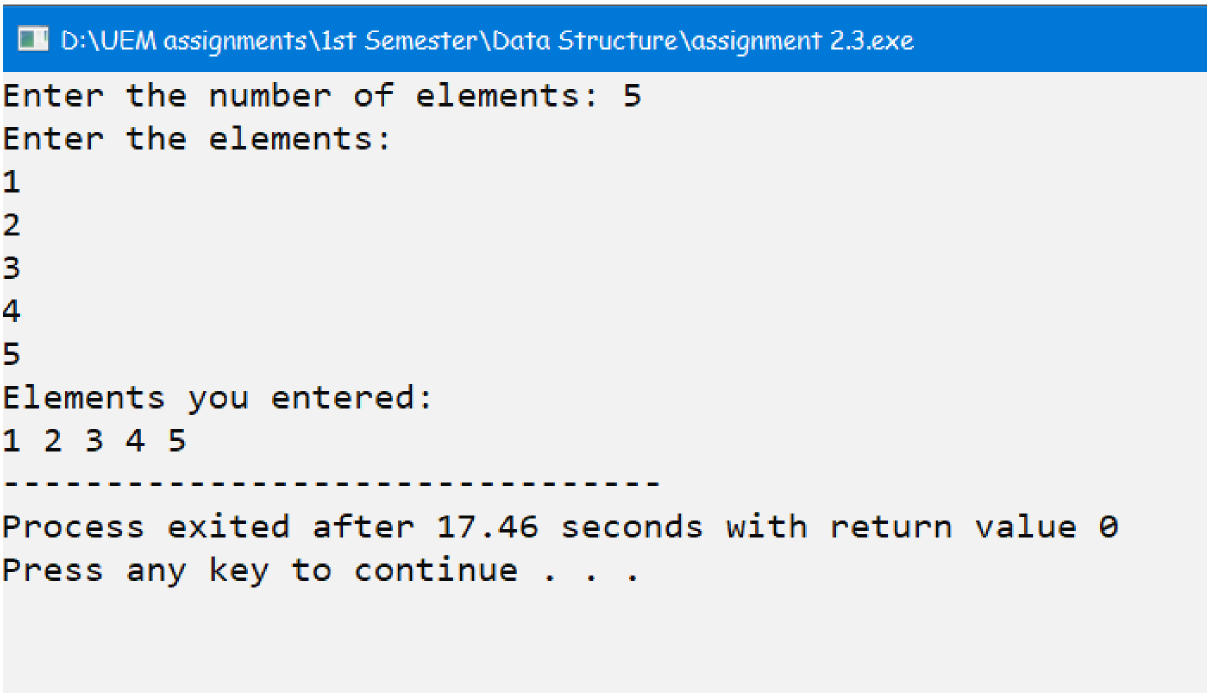
D:\UEM assignments\1st Semester\Data Structure\assignment 2.2.exe

```
Enter the number of elements of array: 5
Enter the elements of the 2D array:
1
2
3
4
5
5Array elements in the main function:
1 2 3 4 5
Array elements in the function (Call by Value):
11 12 13 14 15
Array elements after Call by Value:
11 12 13 14 15
Array elements in the function (Call by Reference):
16 17 18 19 20
Array elements after Call by Reference:
16 17 18 19 20

--------------------------------
Process exited after 45.06 seconds with return value 0
Press any key to continue . . .
```

- **Problem No: 4**
- **Problem Statement:** Write a program to display n number of elements. Memory should be allocated dynamically using malloc( ).
- **Source Code:**

```
#include <stdio.h>
#include <stdlib.h>
int main() {
    int n, i;
    printf("Enter the number of elements: ");
    scanf("%d", &n);
    int *arr = (int *)malloc(n * sizeof(int));
    if (arr == NULL) {
      printf("Memory allocation failed. Exiting...");
        return 1;
}
    printf("Enter the elements:\n");
    for (i = 0; i < n; i++) {
      scanf("%d", &arr[i]);
}
    printf("Elements you entered:\n");
    for (i = 0; i < n; i++) {
        printf("%d ", arr[i]);
}
    free(arr);
    return 0;
}
```

- **Output:**



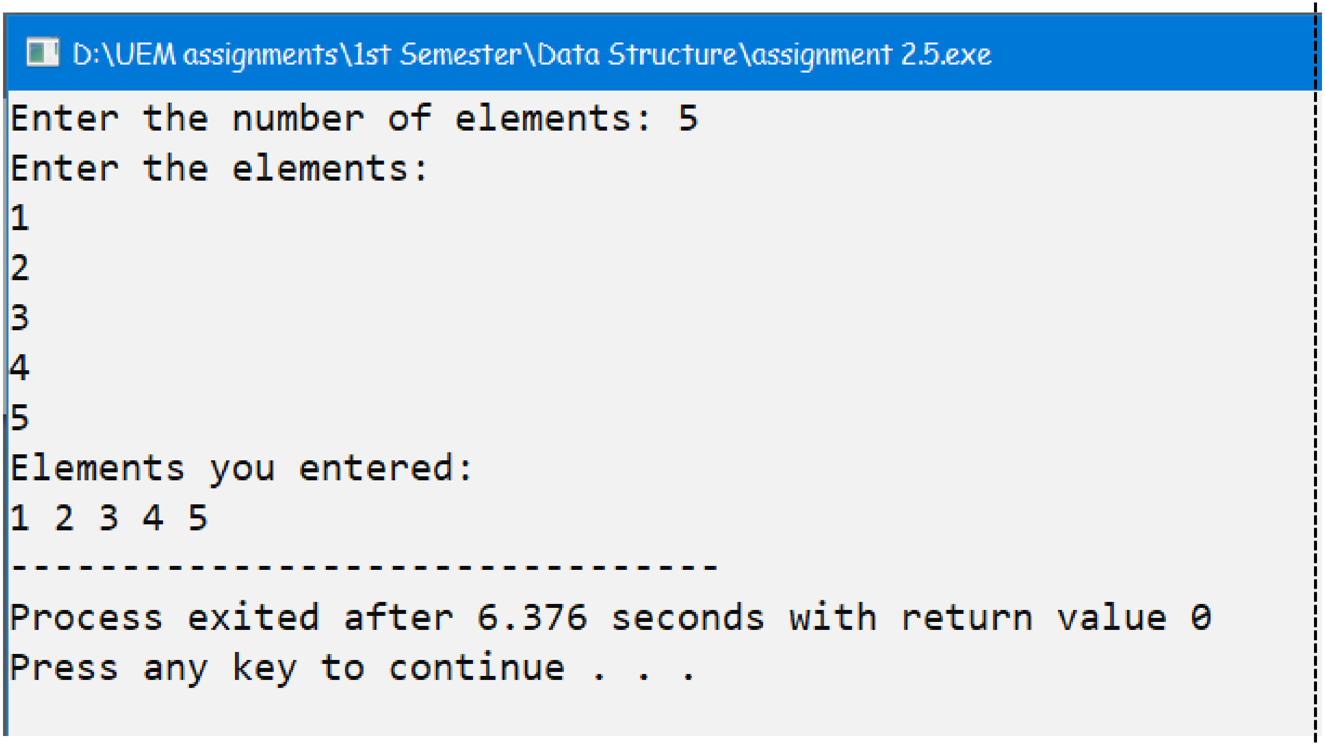
D:\UEM assignments\1st Semester\Data Structure\assignment 2.3.exe

```
Enter the number of elements: 5
Enter the elements:
1
2
3
4
5
Elements you entered:
1 2 3 4 5
--------------------------------
Process exited after 17.46 seconds with return value 0
Press any key to continue . . .
```

- **Problem No: 5**
- **Problem Statement:** Write a program to display n number of elements. Memory should be allocated dynamically using calloc( ).
- **Source Code:**

```
#include <stdio.h>
#include <stdlib.h>
int main() {
    int n, i;
    printf("Enter the number of elements: ");
    scanf("%d", &n);
    int *arr = (int *)calloc(n, sizeof(int));
    if (arr == NULL) { printf("Memory allocation failed.
Exiting...");
        return 1; }
    printf("Enter the elements:\n");
    for (i = 0; i < n; i++) {  scanf("%d", &arr[i]); }
    printf("Elements you entered:\n");
    for (i = 0; i < n; i++) {
        printf("%d ", arr[i]);  }
    free(arr);
    return 0;
}
```

- **Output:**



D:\UEM assignments\1st Semester\Data Structure\assignment 2.5.exe

```
Enter the number of elements: 5
Enter the elements:
1
2
3
4
5
Elements you entered:
1 2 3 4 5
--------------------------------
Process exited after 6.376 seconds with return value 0
Press any key to continue . . .
```

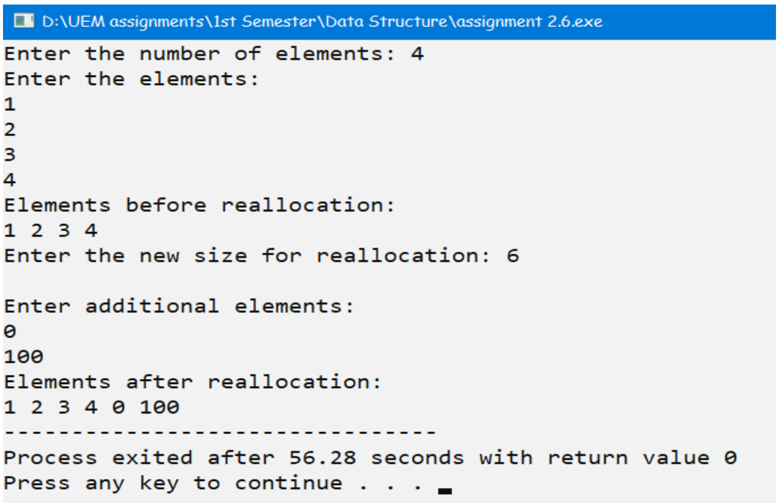
Problem No: 6

Problem Statement: Write a program to allocate memory using malloc( ) and then reallocate the previously allocated memory using realloc( ). Display the elements which have been taken after reallocation.

Source Code:

```
#include <stdio.h>
#include <stdlib.h>
int main() {
    int n, i;
    printf("Enter the number of elements: ");
    scanf("%d", &n);
    int *arr = (int *)malloc(n * sizeof(int));
    if (arr == NULL) {  printf("Memory allocation failed.
Exiting...");
        return 1; }
    printf("Enter the elements:\n");
    for (i = 0; i < n; i++) {
         scanf("%d", &arr[i]); }
    printf("Elements before reallocation:\n");
    for (i = 0; i < n; i++) {
        printf("%d ", arr[i]); }
    int newSize;
    printf("\nEnter the new size for reallocation: ");
    scanf("%d", &newSize);
    int *newArr = (int *)realloc(arr, newSize * sizeof(int));
    if (newArr == NULL) {
        printf("Memory reallocation failed. Exiting...");
        free(arr);
        return 1;
}
    printf("\nEnter additional elements:\n");
    for (i = n; i < newSize; i++) {
        scanf("%d", &newArr[i]);
}
    printf("Elements after reallocation:\n");
    for (i = 0; i < newSize; i++) {
        printf("%d ", newArr[i]);
}
   free(newArr);
    return 0;
}
```

Output:


D:\UEM assignments\1st Semester\Data Structure\assignment 2.6.exe

```
Enter the number of elements: 4
Enter the elements:
1
2
3
4
Elements before reallocation:
1 2 3 4
Enter the new size for reallocation: 6

Enter additional elements:
0
100
Elements after reallocation:
1 2 3 4 0 100
--------------------------------
Process exited after 56.28 seconds with return value 0
Press any key to continue . . .
```

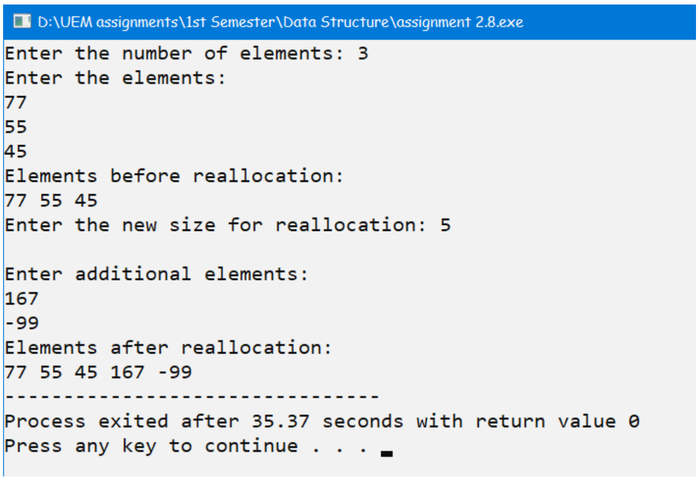
Problem No: 7

Problem Statement: Write a program to allocate memory using calloc( ) and then reallocate the previously allocated memory using realloc( ). Display the elements which have been taken after reallocation.

Source Code:

```c
#include <stdio.h>
#include <stdlib.h>
int main() {
    int n, i;
    printf("Enter the number of elements: ");
    scanf("%d", &n);
    int *arr = (int *)calloc(n, sizeof(int));
    if (arr == NULL) {
        printf("Memory allocation failed. Exiting...");
        return 1;
    }
    printf("Enter the elements:\n");
    for (i = 0; i < n; i++) {
        scanf("%d", &arr[i]);
    }
    printf("Elements before reallocation:\n");
    for (i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }
    int newSize;
    printf("\nEnter the new size for reallocation: ");
    scanf("%d", &newSize);
    int *newArr = (int *)realloc(arr, newSize * sizeof(int));
    if (newArr == NULL) {
        printf("Memory reallocation failed. Exiting...");
        free(arr);
        return 1;
    }
    printf("\nEnter additional elements:\n");
    for (i = n; i < newSize; i++) {
        scanf("%d", &newArr[i]);
    }
    printf("Elements after reallocation:\n");
    for (i = 0; i < newSize; i++) {
        printf("%d ", newArr[i]);
    }
    free(newArr);
    return 0;
}
```

Output:


D:\UEM assignments\1st Semester\Data Structure\assignment 2.8.exe

```
Enter the number of elements: 3
Enter the elements:
77
55
45
Elements before reallocation:
77 55 45
Enter the new size for reallocation: 5

Enter additional elements:
167
-99
Elements after reallocation:
77 55 45 167 -99
--------------------------------
Process exited after 35.37 seconds with return value 0
Press any key to continue . . .
```

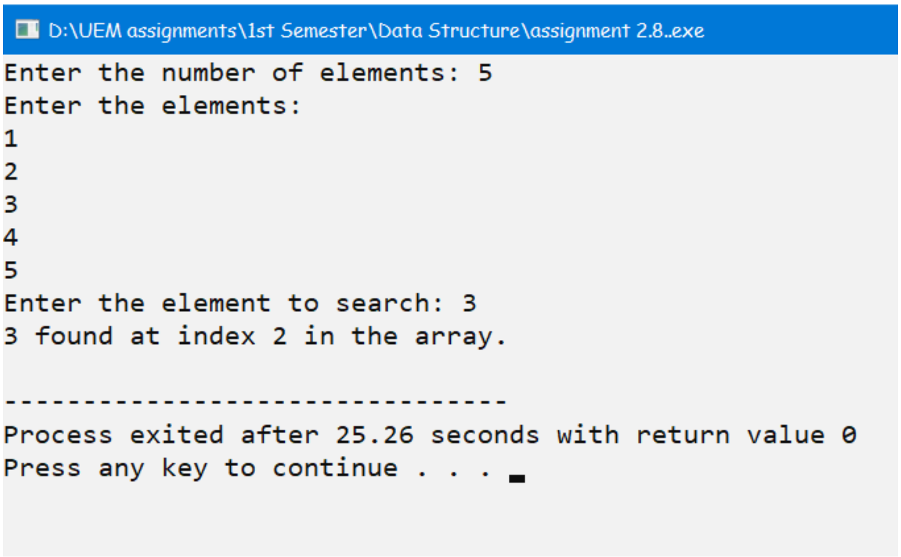
Problem No: 8

Problem Statement: Write a C program to search an element in an Array using dynamic memory allocation.

Source Code:

```
#include <stdio.h>
#include <stdlib.h>
int searchElement(int *arr, int size, int key) {
      int i;
    for (i = 0; i < size; i++) {
        if (arr[i] == key) {
            return i;
     }
 }
    return -1;
}
int main() {
    int n, key, i;
    printf("Enter the number of elements: ");
    scanf("%d", &n);
    int *arr = (int *)malloc(n * sizeof(int));
    if (arr == NULL) {
        printf("Memory allocation failed. Exiting...");
        return 1;
    }
    printf("Enter the elements:\n");
    for (i = 0; i < n; i++) {
        scanf("%d", &arr[i]);
    }
    printf("Enter the element to search: ");
    scanf("%d", &key);
    int index = searchElement(arr, n, key);
    if (index != -1) {
        printf("%d found at index %d in the array.\n", key,
index);
    } else {
        printf("%d not found in the array.\n", key);
    }
    free(arr);
    return 0;
}
```

Output:



D:\UEM assignments\1st Semester\Data Structure\assignment 2.8..exe

```
Enter the number of elements: 5
Enter the elements:
1
2
3
4
5
Enter the element to search: 3
3 found at index 2 in the array.

--------------------------------
Process exited after 25.26 seconds with return value 0
Press any key to continue . . .
```

Data Structure lab assignment 3

Problem No: 1

Problem Statement:

Write a Menu driven C program to accomplish the following functionalities in single linked list.

a) Create a single linked list.

b) Display the elements of a single linked list.

c) Insert a node at the beginning of a single linked list.

d) Insert a node at the end of a single linked list.

e) Insert a node before a given node of a single linked list.

f) Insert a node after a given node of a single linked list.

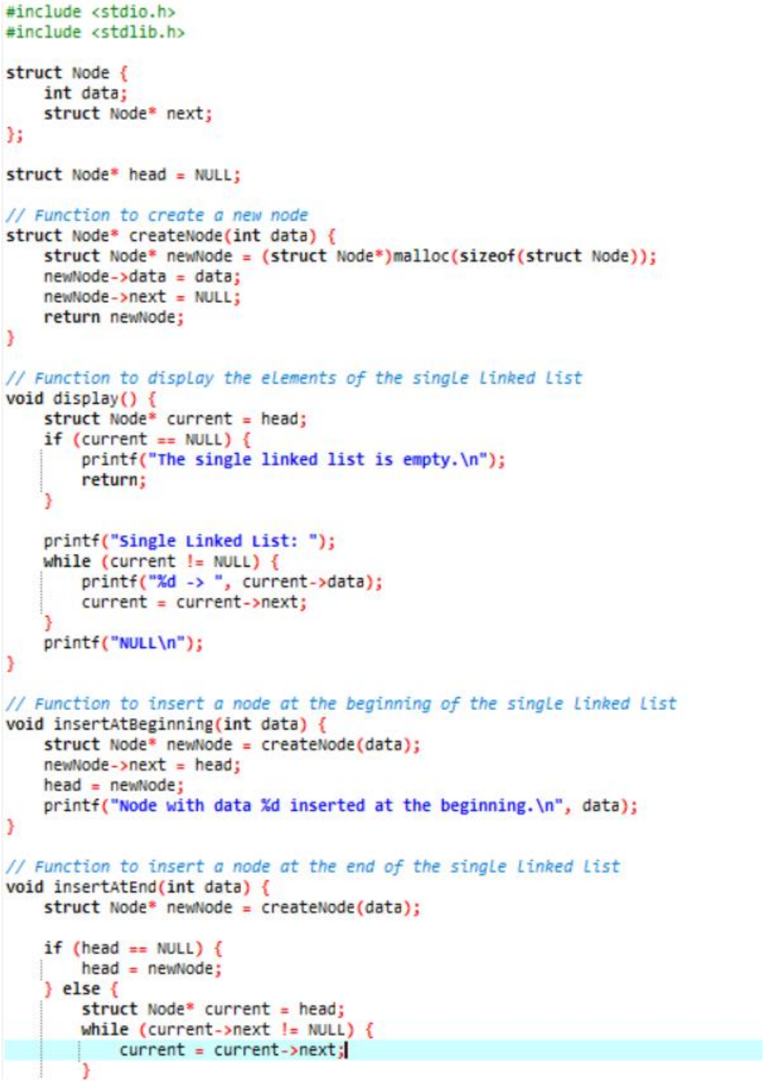
g) Delete a node from the beginning of a single linked list.

h) Delete a node from the end of a single linked list.

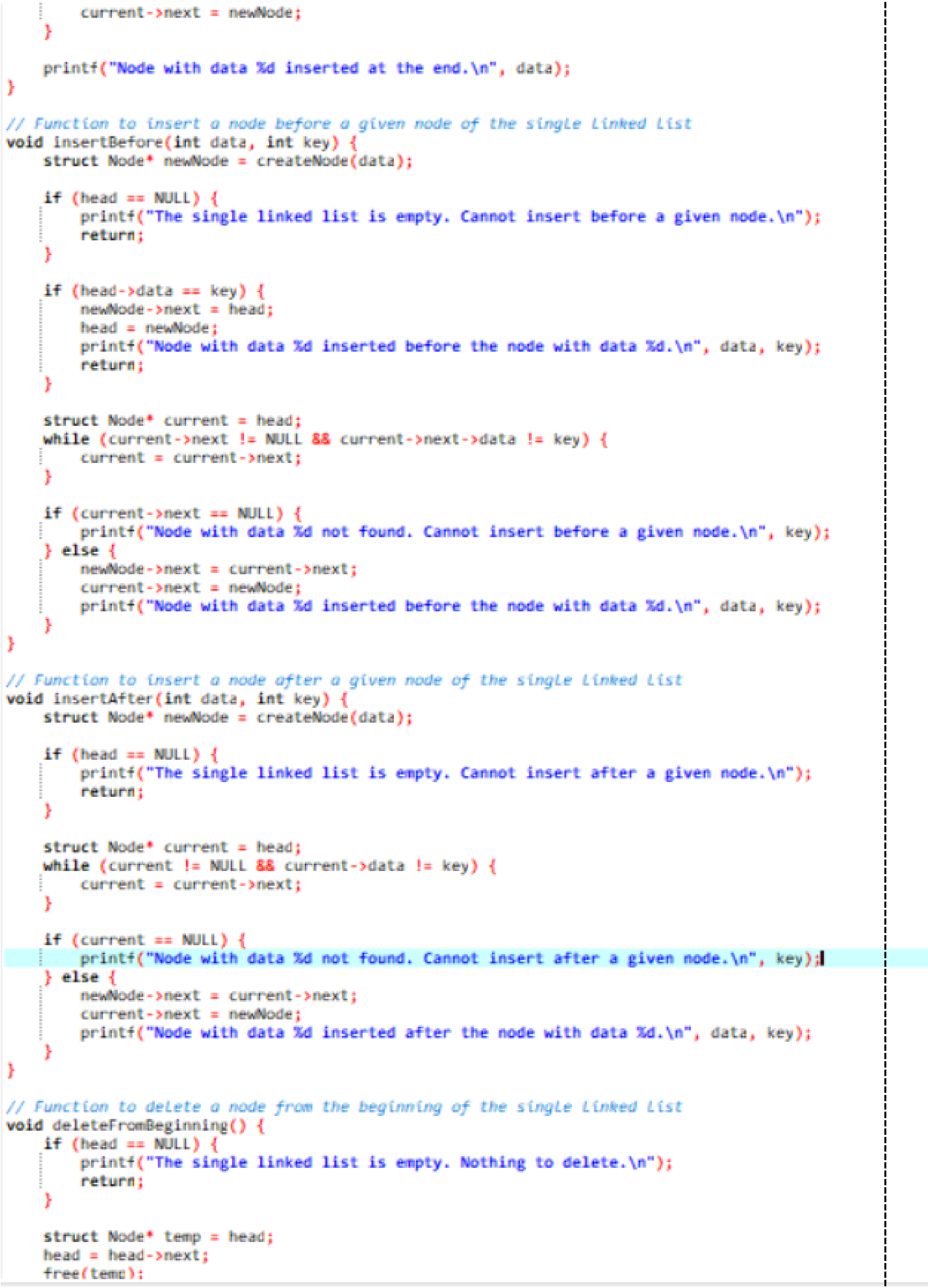
i) Delete a node after a given node of a single linked list.

j) Delete the entire single linked list.

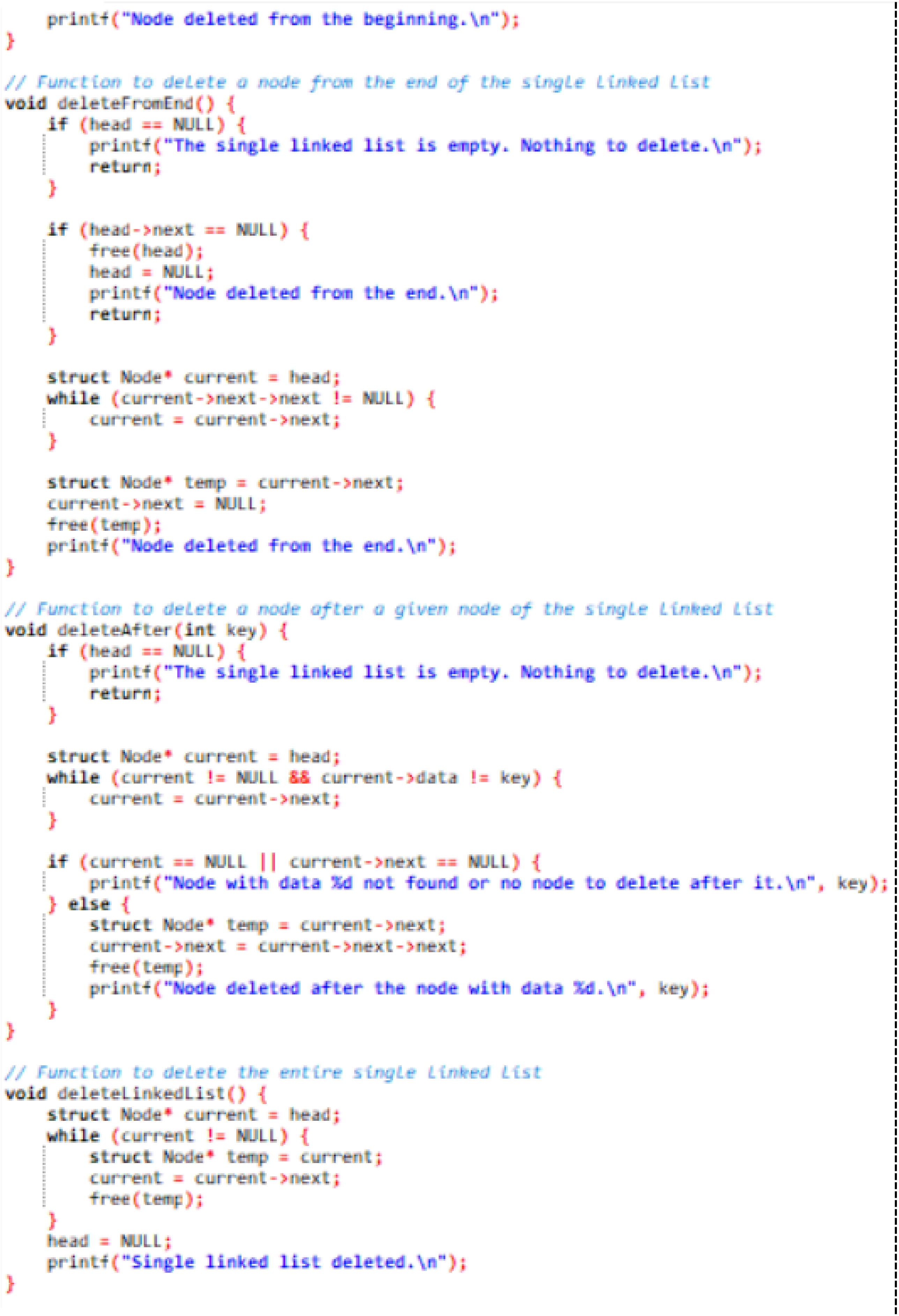
Source Code:



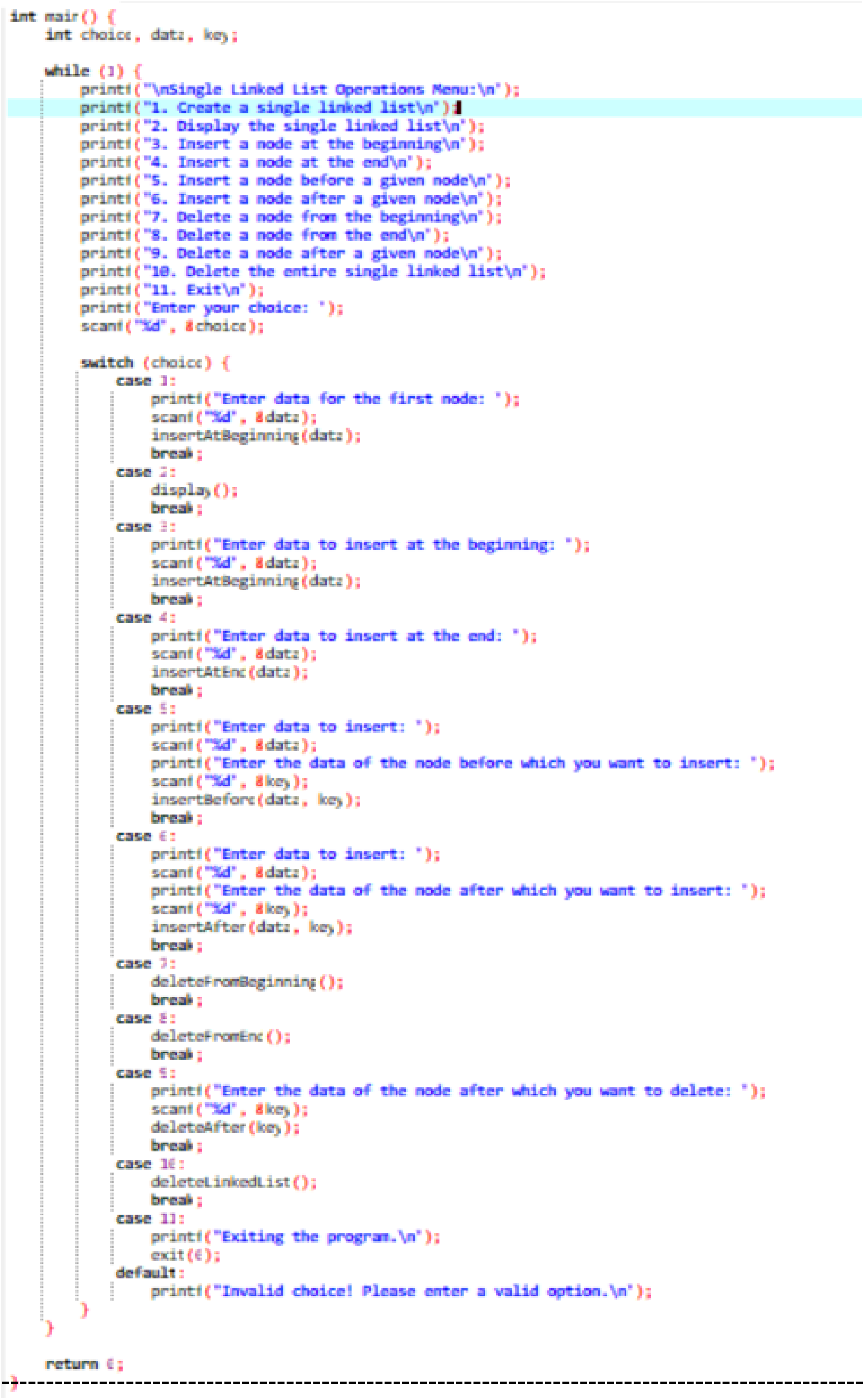
```c
#include <stdio.h>
#include <stdlib.h>

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

struct Node* head = NULL;

// 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 display the elements of the single linked list
void display() {
    struct Node* current = head;
    if (current == NULL) {
        printf("The single linked list is empty.\n");
        return;
    }

    printf("Single Linked List: ");
    while (current != NULL) {
        printf("%d -> ", current->data);
        current = current->next;
    }
    printf("NULL\n");
}

// Function to insert a node at the beginning of the single linked list
void insertAtBeginning(int data) {
    struct Node* newNode = createNode(data);
    newNode->next = head;
    head = newNode;
    printf("Node with data %d inserted at the beginning.\n", data);
}

// Function to insert a node at the end of the single linked list
void insertAtEnd(int data) {
    struct Node* newNode = createNode(data);

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



```
        current->next = newNode;
    }

    printf("Node with data %d inserted at the end.\n", data);
}

// Function to insert a node before a given node of the single linked list
void insertBefore(int data, int key) {
    struct Node* newNode = createNode(data);

    if (head == NULL) {
        printf("The single linked list is empty. Cannot insert before a given node.\n");
        return;
    }

    if (head->data == key) {
        newNode->next = head;
        head = newNode;
        printf("Node with data %d inserted before the node with data %d.\n", data, key);
        return;
    }

    struct Node* current = head;
    while (current->next != NULL && current->next->data != key) {
        current = current->next;
    }

    if (current->next == NULL) {
        printf("Node with data %d not found. Cannot insert before a given node.\n", key);
    } else {
        newNode->next = current->next;
        current->next = newNode;
        printf("Node with data %d inserted before the node with data %d.\n", data, key);
    }
}

// Function to insert a node after a given node of the single linked list
void insertAfter(int data, int key) {
    struct Node* newNode = createNode(data);

    if (head == NULL) {
        printf("The single linked list is empty. Cannot insert after a given node.\n");
        return;
    }

    struct Node* current = head;
    while (current != NULL && current->data != key) {
        current = current->next;
    }

    if (current == NULL) {
        printf("Node with data %d not found. Cannot insert after a given node.\n", key);
    } else {
        newNode->next = current->next;
        current->next = newNode;
        printf("Node with data %d inserted after the node with data %d.\n", data, key);
    }
}

// Function to delete a node from the beginning of the single linked list
void deleteFromBeginning() {
    if (head == NULL) {
        printf("The single linked list is empty. Nothing to delete.\n");
        return;
    }

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

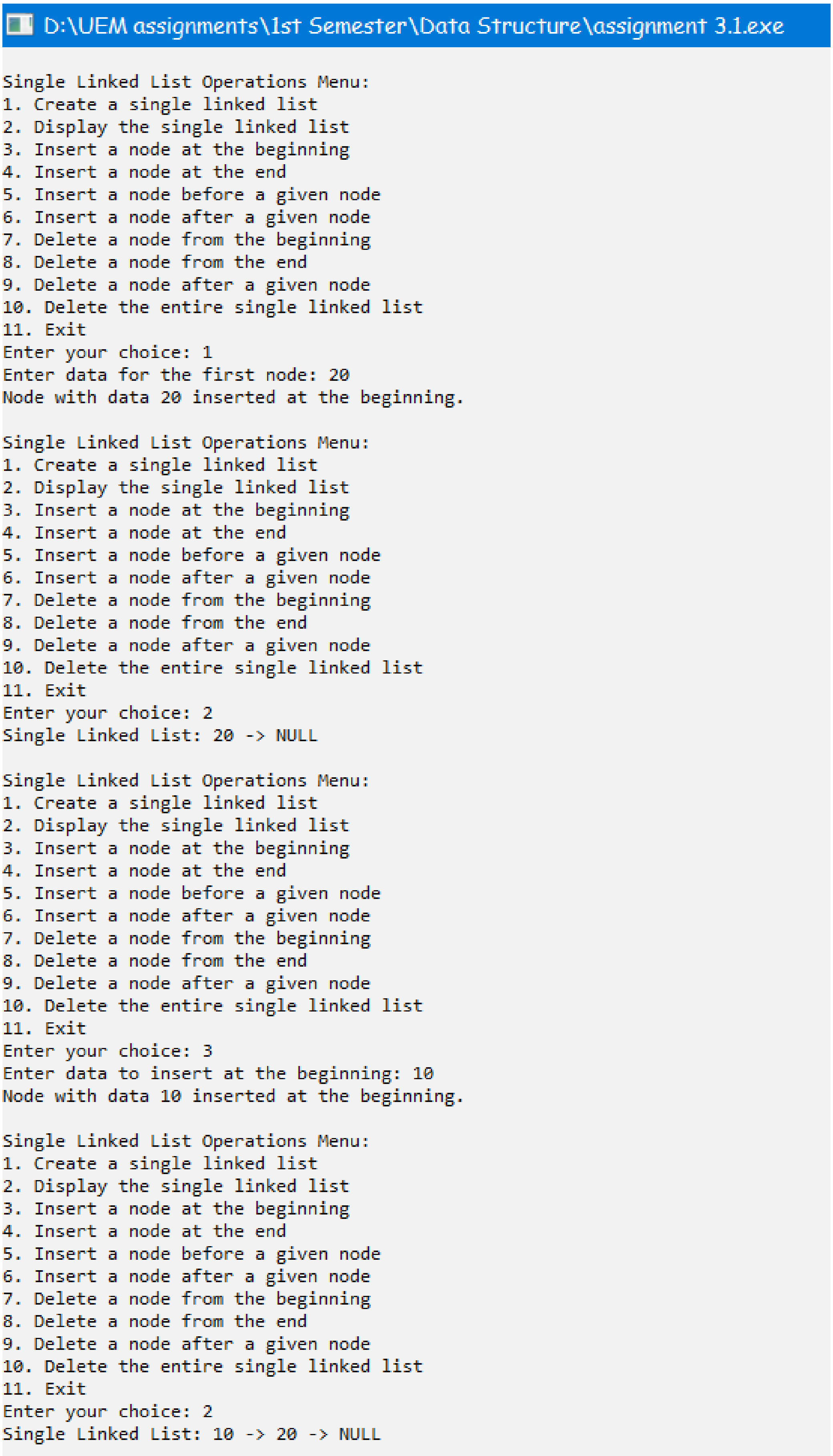


```
    printf("Node deleted from the beginning.\n");
}

// Function to delete a node from the end of the single linked list
void deleteFromEnd() {
    if (head == NULL) {
        printf("The single linked list is empty. Nothing to delete.\n");
        return;
    }

    if (head->next == NULL) {
        free(head);
        head = NULL;
        printf("Node deleted from the end.\n");
        return;
    }

    struct Node* current = head;
    while (current->next->next != NULL) {
        current = current->next;
    }

    struct Node* temp = current->next;
    current->next = NULL;
    free(temp);
    printf("Node deleted from the end.\n");
}

// Function to delete a node after a given node of the single linked list
void deleteAfter(int key) {
    if (head == NULL) {
        printf("The single linked list is empty. Nothing to delete.\n");
        return;
    }

    struct Node* current = head;
    while (current != NULL && current->data != key) {
        current = current->next;
    }

    if (current == NULL || current->next == NULL) {
        printf("Node with data %d not found or no node to delete after it.\n", key);
    } else {
        struct Node* temp = current->next;
        current->next = current->next->next;
        free(temp);
        printf("Node deleted after the node with data %d.\n", key);
    }
}

// Function to delete the entire single linked list
void deleteLinkedList() {
    struct Node* current = head;
    while (current != NULL) {
        struct Node* temp = current;
        current = current->next;
        free(temp);
    }
    head = NULL;
    printf("Single linked list deleted.\n");
}
```



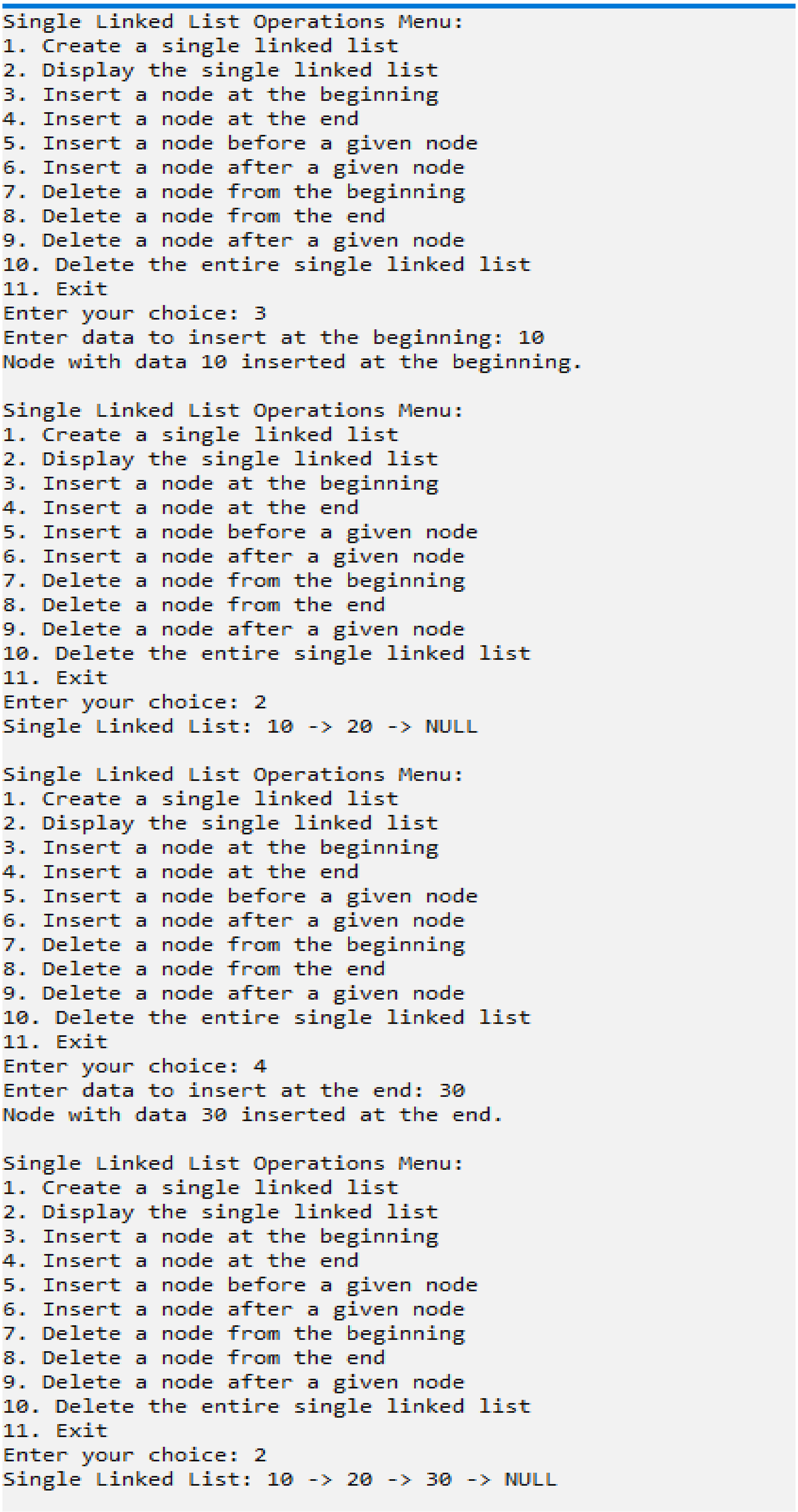
```
int main() {
    int choice, data, key;

    while (1) {
        printf("\nSingle Linked List Operations Menu:\n");
        printf("1. Create a single linked list\n");
        printf("2. Display the single linked list\n");
        printf("3. Insert a node at the beginning\n");
        printf("4. Insert a node at the end\n");
        printf("5. Insert a node before a given node\n");
        printf("6. Insert a node after a given node\n");
        printf("7. Delete a node from the beginning\n");
        printf("8. Delete a node from the end\n");
        printf("9. Delete a node after a given node\n");
        printf("10. Delete the entire single linked list\n");
        printf("11. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter data for the first node: ");
                scanf("%d", &data);
                insertAtBeginning(data);
                break;
            case 2:
                display();
                break;
            case 3:
                printf("Enter data to insert at the beginning: ");
                scanf("%d", &data);
                insertAtBeginning(data);
                break;
            case 4:
                printf("Enter data to insert at the end: ");
                scanf("%d", &data);
                insertAtEnd(data);
                break;
            case 5:
                printf("Enter data to insert: ");
                scanf("%d", &data);
                printf("Enter the data of the node before which you want to insert: ");
                scanf("%d", &key);
                insertBefore(data, key);
                break;
            case 6:
                printf("Enter data to insert: ");
                scanf("%d", &data);
                printf("Enter the data of the node after which you want to insert: ");
                scanf("%d", &key);
                insertAfter(data, key);
                break;
            case 7:
                deleteFromBeginning();
                break;
            case 8:
                deleteFromEnd();
                break;
            case 9:
                printf("Enter the data of the node after which you want to delete: ");
                scanf("%d", &key);
                deleteAfter(key);
                break;
            case 10:
                deleteLinkedList();
                break;
            case 11:
                printf("Exiting the program.\n");
                exit(0);
            default:
                printf("Invalid choice! Please enter a valid option.\n");
        }
    }

    return 0;
}
```

Output:

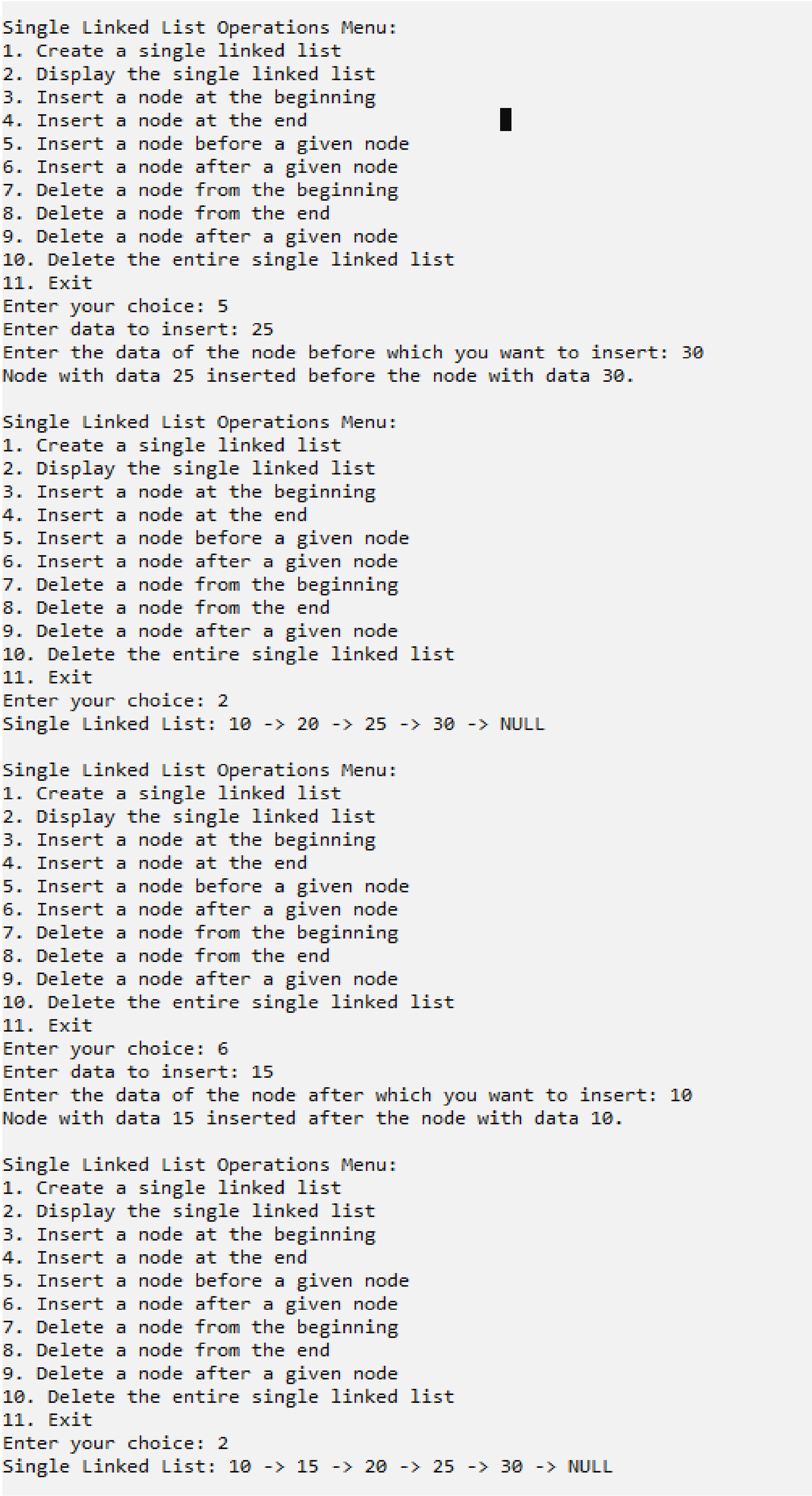


D:\UEM assignments\1st Semester\Data Structure\assignment 3.1.exe

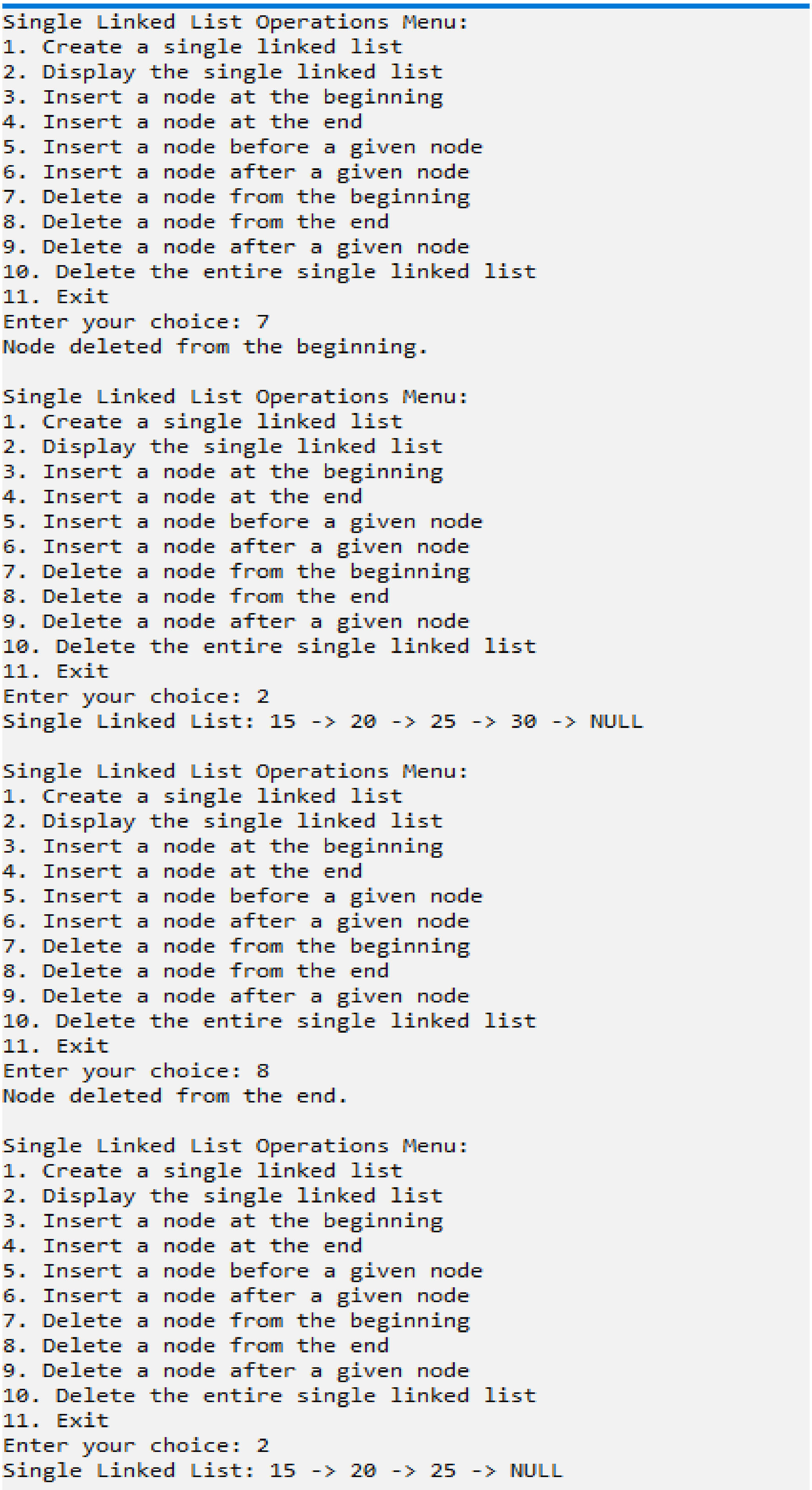
```
Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 1
Enter data for the first node: 20
Node with data 20 inserted at the beginning.

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 2
Single Linked List: 20 -> NULL

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 3
Enter data to insert at the beginning: 10
Node with data 10 inserted at the beginning.

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 2
Single Linked List: 10 -> 20 -> NULL
```



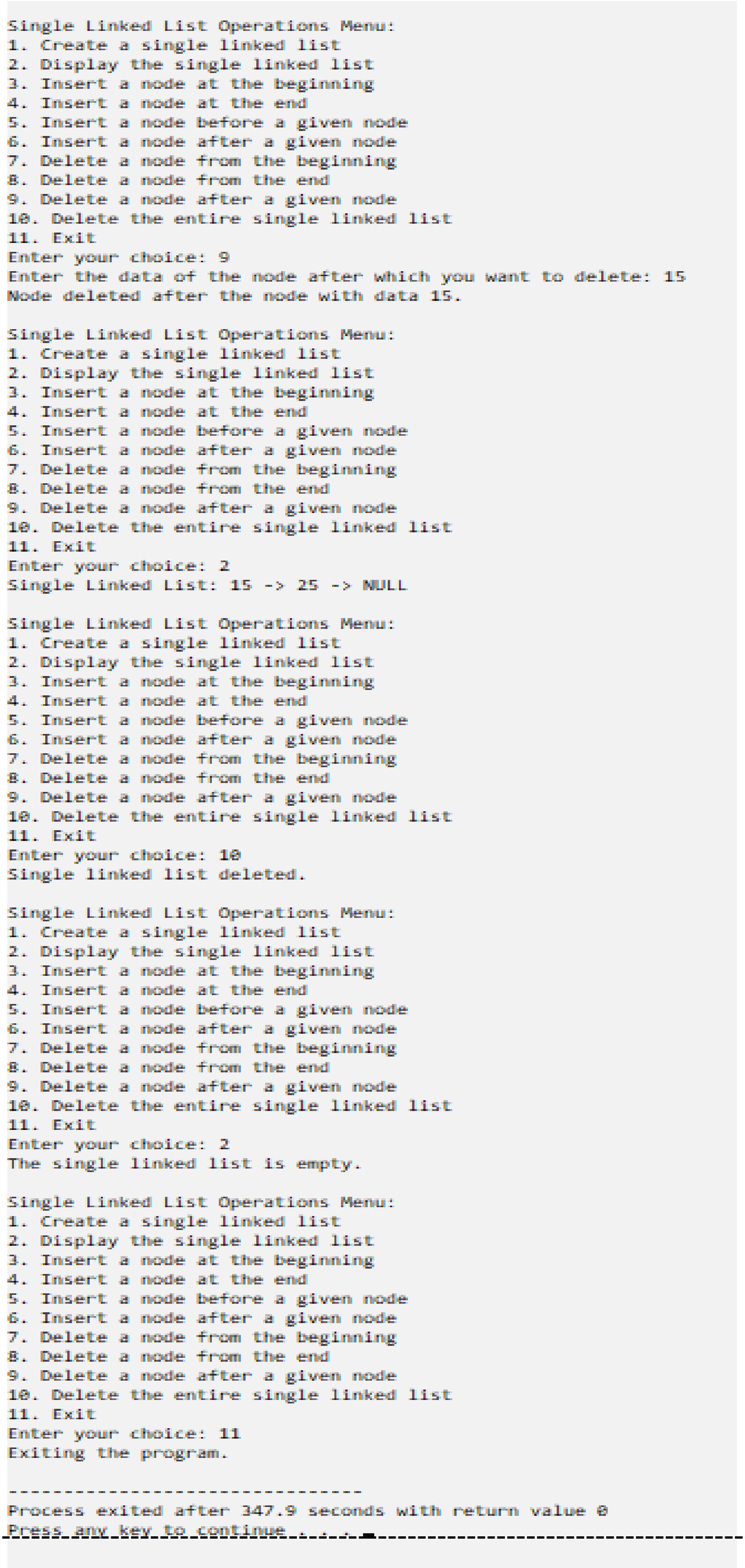
```
Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 3
Enter data to insert at the beginning: 10
Node with data 10 inserted at the beginning.

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 2
Single Linked List: 10 -> 20 -> NULL

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 4
Enter data to insert at the end: 30
Node with data 30 inserted at the end.

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 2
Single Linked List: 10 -> 20 -> 30 -> NULL
```



```
Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 5
Enter data to insert: 25
Enter the data of the node before which you want to insert: 30
Node with data 25 inserted before the node with data 30.

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 2
Single Linked List: 10 -> 20 -> 25 -> 30 -> NULL

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 6
Enter data to insert: 15
Enter the data of the node after which you want to insert: 10
Node with data 15 inserted after the node with data 10.

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 2
Single Linked List: 10 -> 15 -> 20 -> 25 -> 30 -> NULL
```



```
Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 7
Node deleted from the beginning.

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 2
Single Linked List: 15 -> 20 -> 25 -> 30 -> NULL

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 8
Node deleted from the end.

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 2
Single Linked List: 15 -> 20 -> 25 -> NULL
```



```
Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 9
Enter the data of the node after which you want to delete: 15
Node deleted after the node with data 15.

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 2
Single Linked List: 15 -> 25 -> NULL

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 10
Single linked list deleted.

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 2
The single linked list is empty.

Single Linked List Operations Menu:
1. Create a single linked list
2. Display the single linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Insert a node before a given node
6. Insert a node after a given node
7. Delete a node from the beginning
8. Delete a node from the end
9. Delete a node after a given node
10. Delete the entire single linked list
11. Exit
Enter your choice: 11
Exiting the program.

--------------------------------
Process exited after 347.9 seconds with return value 0
Press any key to continue . . . _
```

❖ Problem No: 2

Problem Statement: Write a Menu driven C program to accomplish the following functionalities in circular linked list.

a) Create a circular linked list.

b) Display the elements of a circular linked list.

c) Insert a node at the beginning of a circular linked list.

d) Insert a node at the end of a circular linked list.

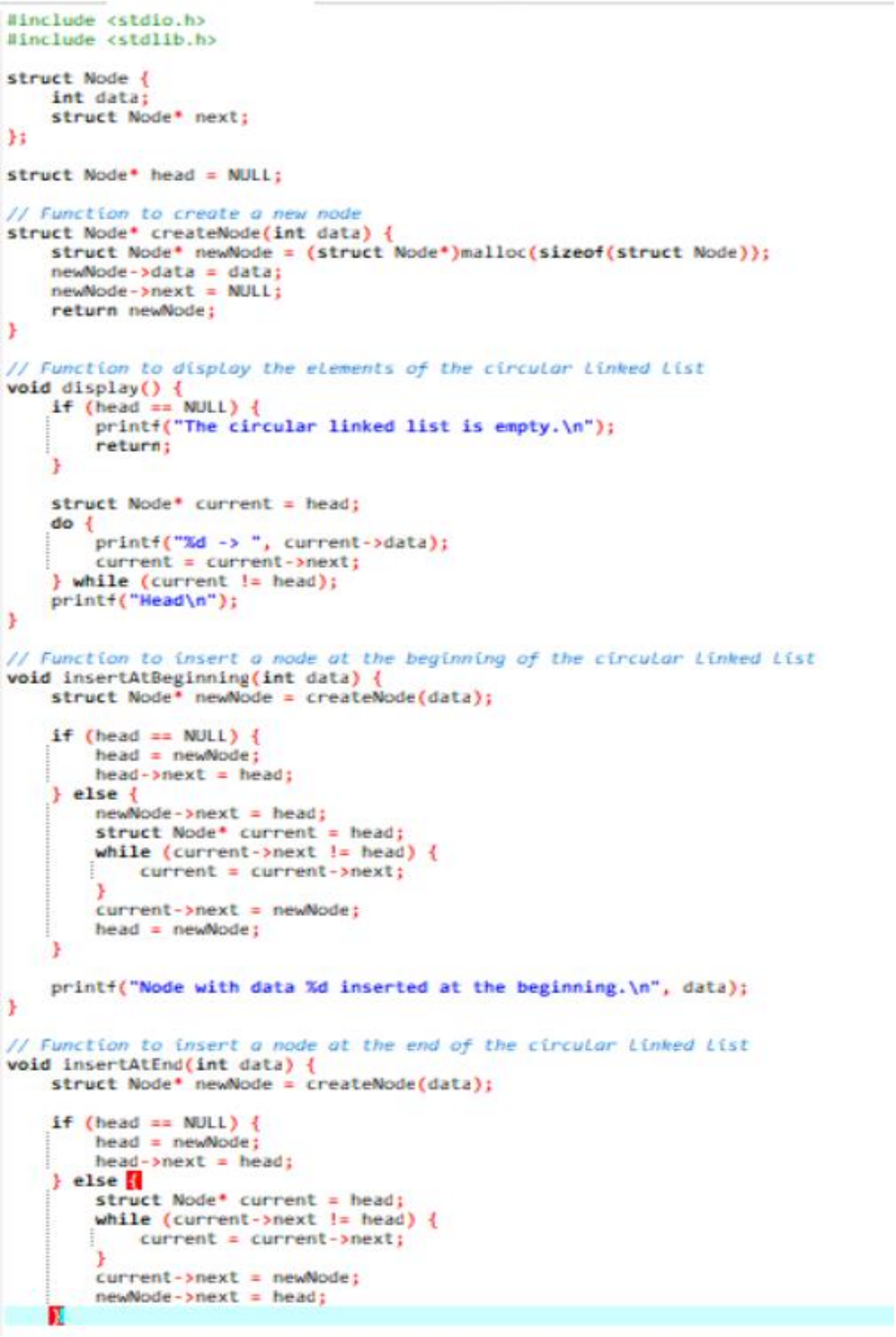
e) Delete a node from the beginning of a circular linked list.

f) Delete a node from the end of a circular linked list.

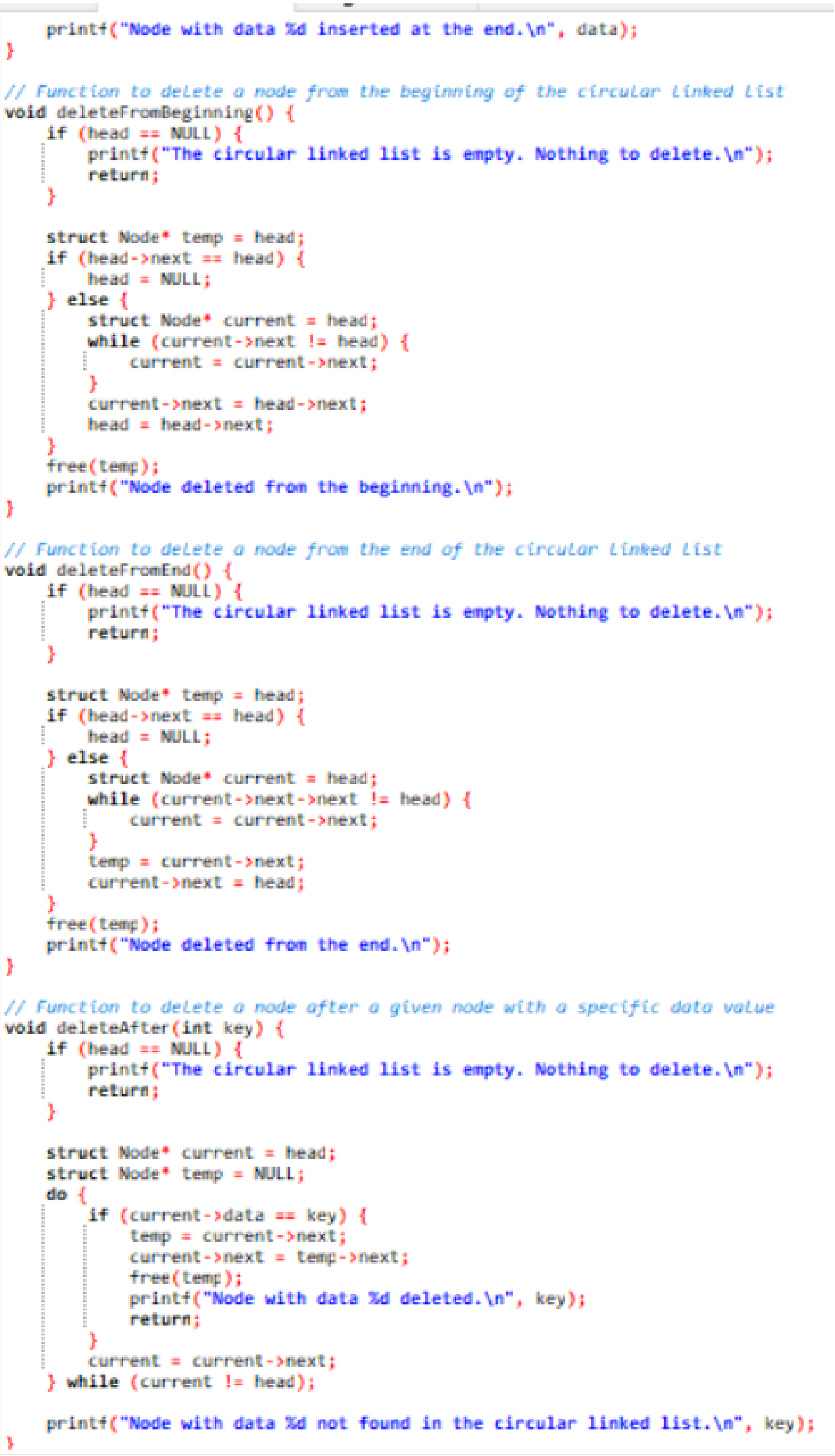
g) Delete a node after a given node of a circular linked list.

h) Delete the entire circular linked list.

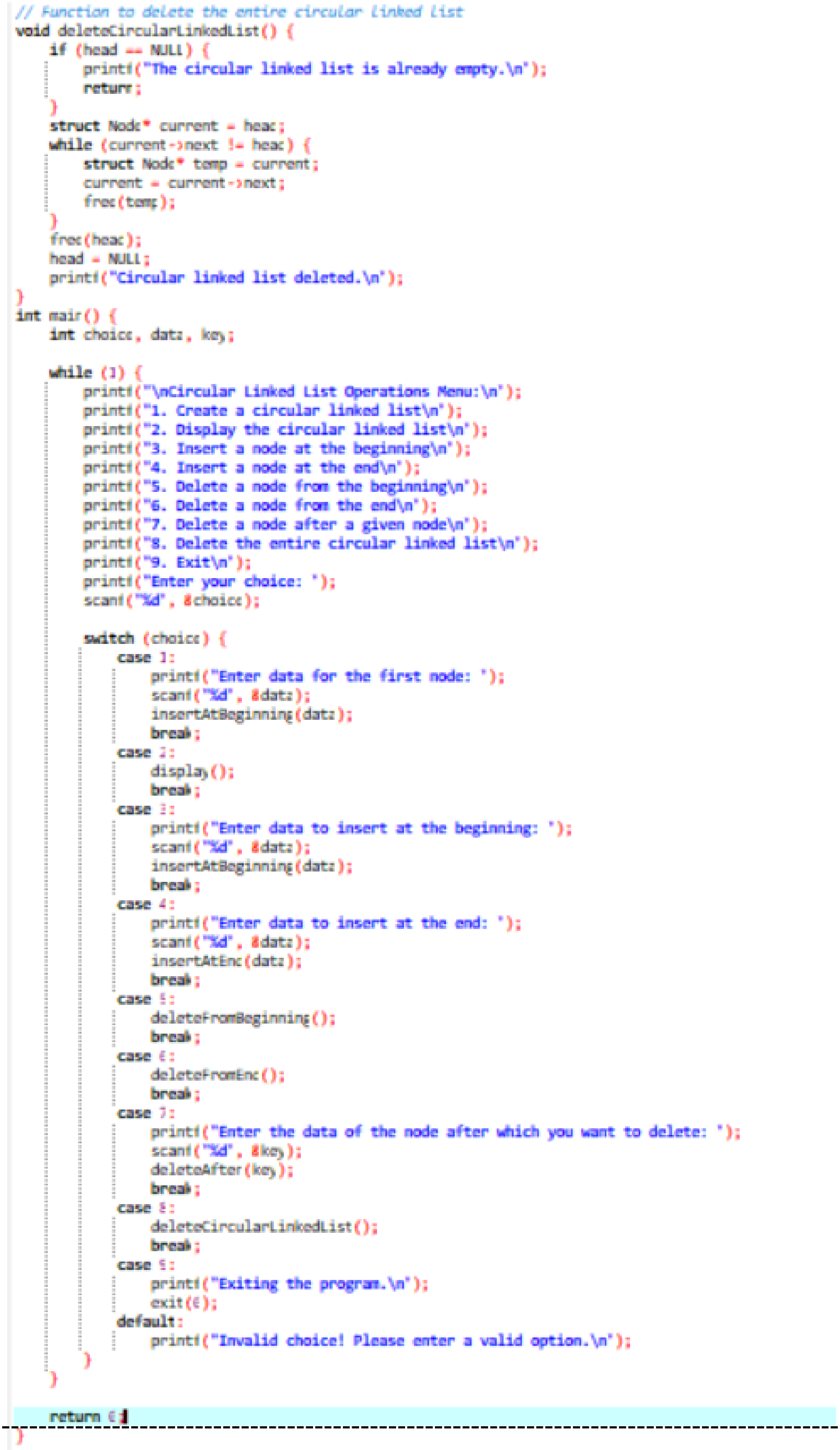
Source Code:



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

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

struct Node* head = NULL;

// 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 display the elements of the circular linked list
void display() {
    if (head == NULL) {
        printf("The circular linked list is empty.\n");
        return;
    }

    struct Node* current = head;
    do {
        printf("%d -> ", current->data);
        current = current->next;
    } while (current != head);
    printf("Head\n");
}

// Function to insert a node at the beginning of the circular linked list
void insertAtBeginning(int data) {
    struct Node* newNode = createNode(data);

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

    printf("Node with data %d inserted at the beginning.\n", data);
}

// Function to insert a node at the end of the circular linked list
void insertAtEnd(int data) {
    struct Node* newNode = createNode(data);

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

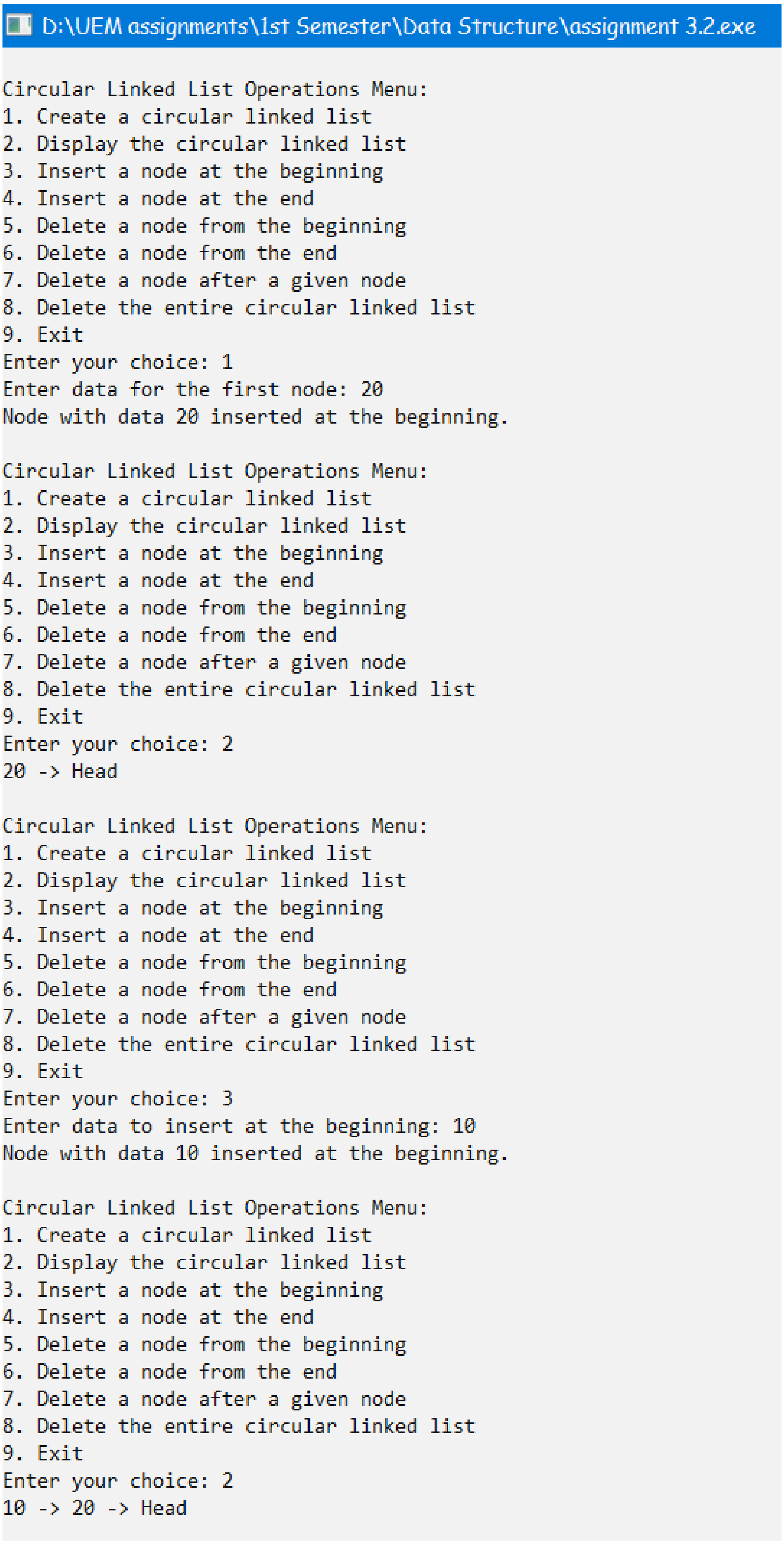


```
    printf("Node with data %d inserted at the end.\n", data);
}

// Function to delete a node from the beginning of the circular linked list
void deleteFromBeginning() {
    if (head == NULL) {
        printf("The circular linked list is empty. Nothing to delete.\n");
        return;
    }

    struct Node* temp = head;
    if (head->next == head) {
        head = NULL;
    } else {
        struct Node* current = head;
        while (current->next != head) {
            current = current->next;
        }
        current->next = head->next;
        head = head->next;
    }
    free(temp);
    printf("Node deleted from the beginning.\n");
}

// Function to delete a node from the end of the circular linked list
void deleteFromEnd() {
    if (head == NULL) {
        printf("The circular linked list is empty. Nothing to delete.\n");
        return;
    }

    struct Node* temp = head;
    if (head->next == head) {
        head = NULL;
    } else {
        struct Node* current = head;
        while (current->next->next != head) {
            current = current->next;
        }
        temp = current->next;
        current->next = head;
    }
    free(temp);
    printf("Node deleted from the end.\n");
}

// Function to delete a node after a given node with a specific data value
void deleteAfter(int key) {
    if (head == NULL) {
        printf("The circular linked list is empty. Nothing to delete.\n");
        return;
    }

    struct Node* current = head;
    struct Node* temp = NULL;
    do {
        if (current->data == key) {
            temp = current->next;
            current->next = temp->next;
            free(temp);
            printf("Node with data %d deleted.\n", key);
            return;
        }
        current = current->next;
    } while (current != head);

    printf("Node with data %d not found in the circular linked list.\n", key);
}
```



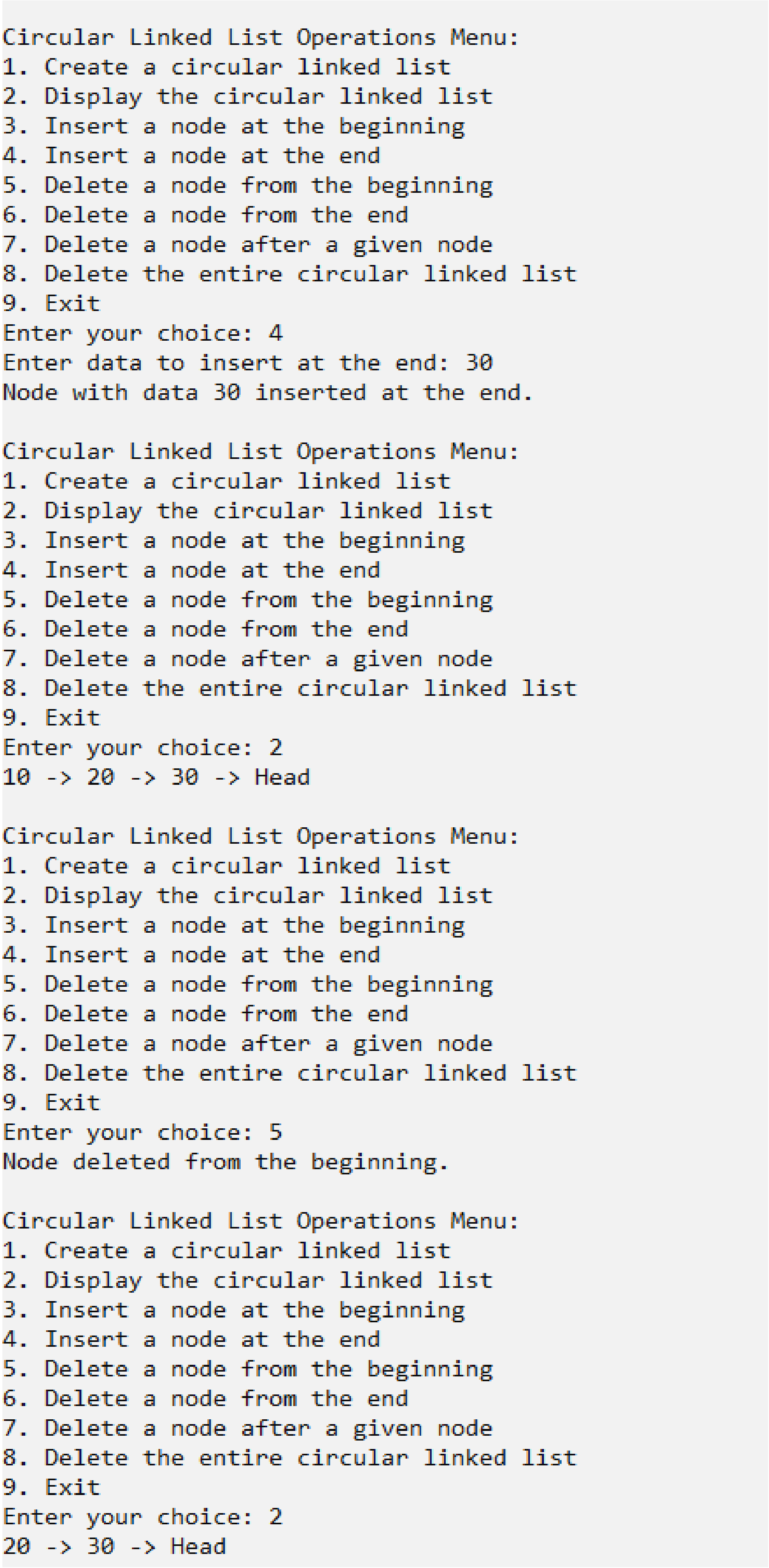
```
// Function to delete the entire circular linked list
void deleteCircularLinkedList() {
    if (head == NULL) {
        printf("The circular linked list is already empty.\n");
        return;
    }
    struct Node* current = head;
    while (current->next != head) {
        struct Node* temp = current;
        current = current->next;
        free(temp);
    }
    free(head);
    head = NULL;
    printf("Circular linked list deleted.\n");
}
int main() {
    int choice, data, key;

    while (1) {
        printf("\nCircular Linked List Operations Menu:\n");
        printf("1. Create a circular linked list\n");
        printf("2. Display the circular linked list\n");
        printf("3. Insert a node at the beginning\n");
        printf("4. Insert a node at the end\n");
        printf("5. Delete a node from the beginning\n");
        printf("6. Delete a node from the end\n");
        printf("7. Delete a node after a given node\n");
        printf("8. Delete the entire circular linked list\n");
        printf("9. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter data for the first node: ");
                scanf("%d", &data);
                insertAtBeginning(data);
                break;
            case 2:
                display();
                break;
            case 3:
                printf("Enter data to insert at the beginning: ");
                scanf("%d", &data);
                insertAtBeginning(data);
                break;
            case 4:
                printf("Enter data to insert at the end: ");
                scanf("%d", &data);
                insertAtEnd(data);
                break;
            case 5:
                deleteFromBeginning();
                break;
            case 6:
                deleteFromEnd();
                break;
            case 7:
                printf("Enter the data of the node after which you want to delete: ");
                scanf("%d", &key);
                deleteAfter(key);
                break;
            case 8:
                deleteCircularLinkedList();
                break;
            case 9:
                printf("Exiting the program.\n");
                exit(0);
            default:
                printf("Invalid choice! Please enter a valid option.\n");
        }
    }

    return 0;
}
```

Output:

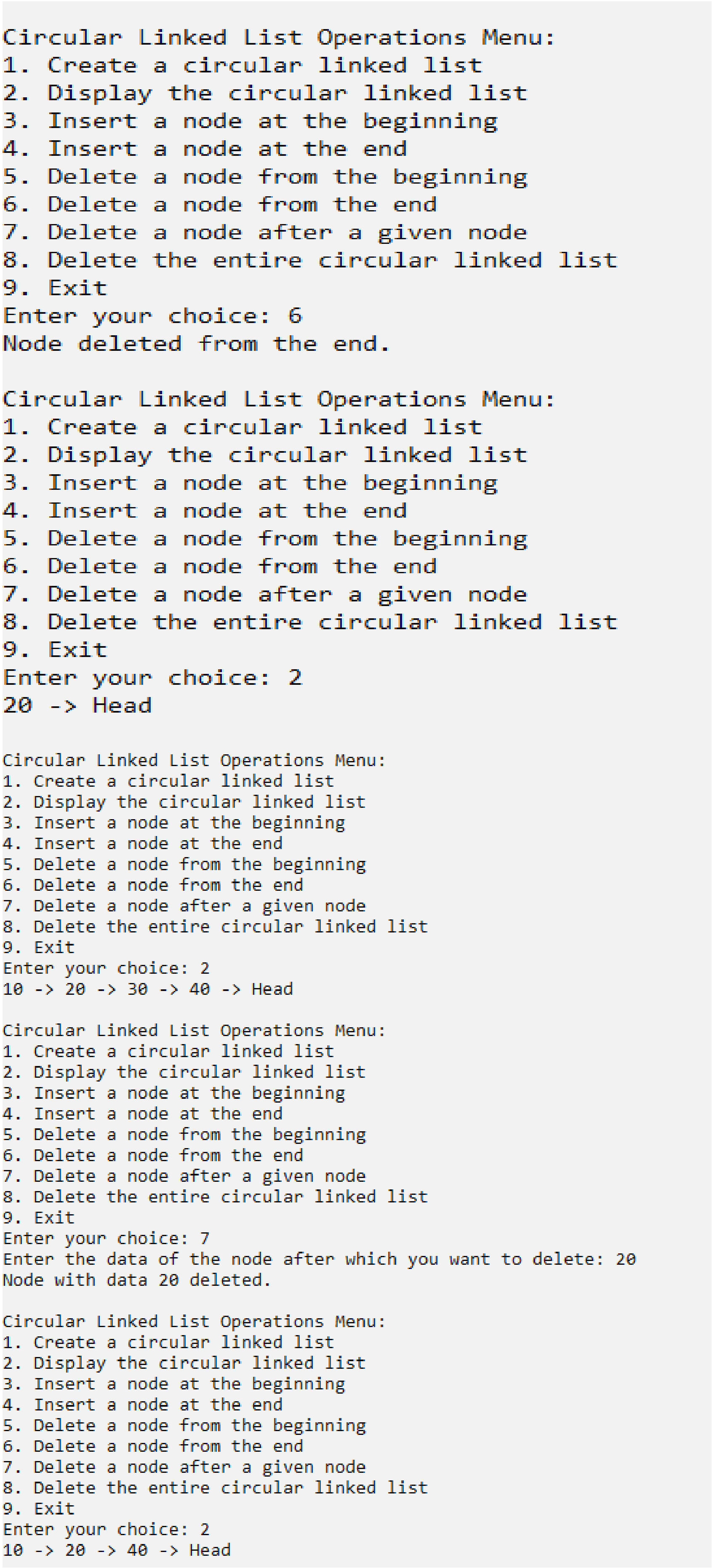


D:\UEM assignments\1st Semester\Data Structure\assignment 3.2.exe

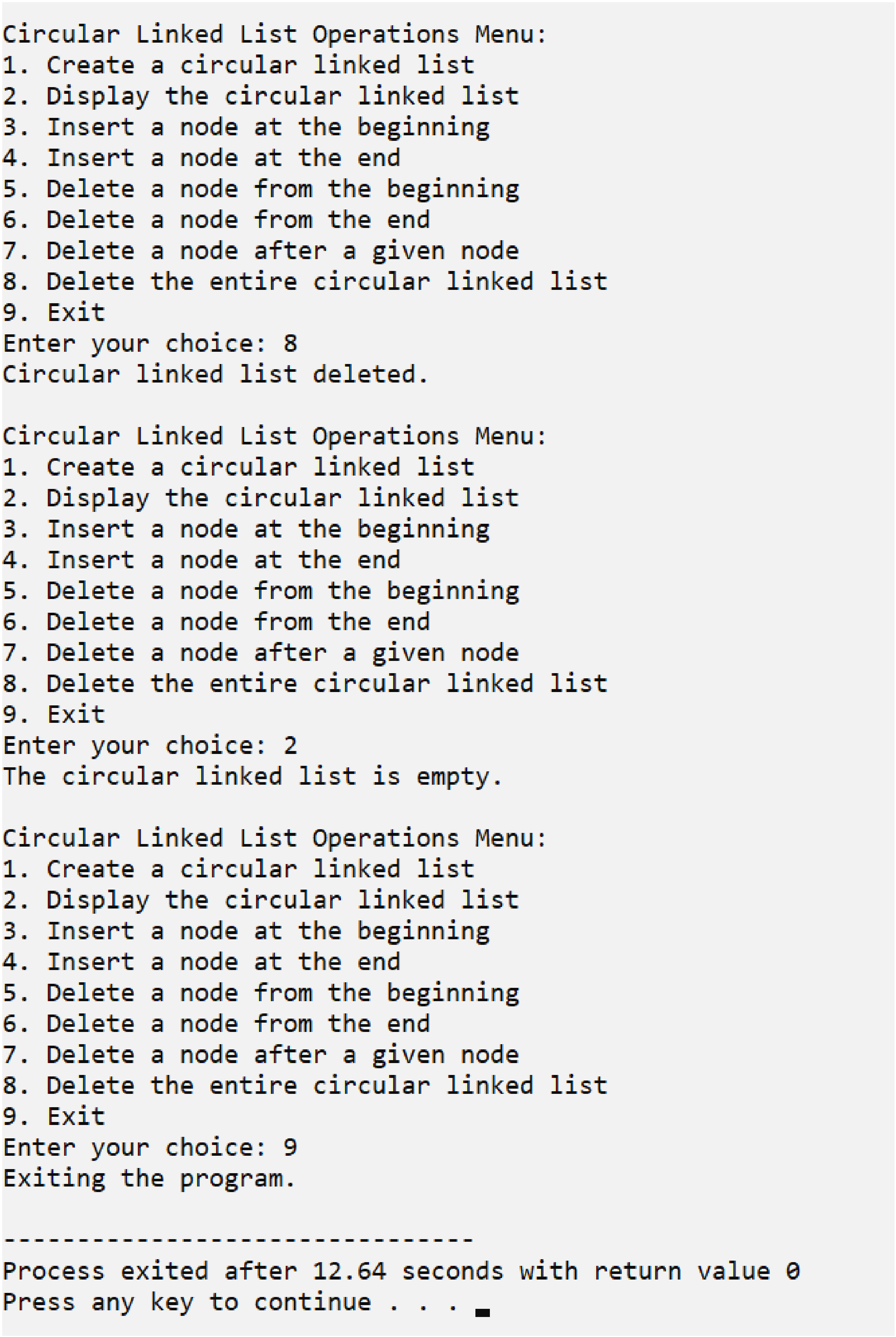
```
Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 1
Enter data for the first node: 20
Node with data 20 inserted at the beginning.

Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 2
20 -> Head

Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 3
Enter data to insert at the beginning: 10
Node with data 10 inserted at the beginning.

Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 2
10 -> 20 -> Head
```



```
Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 4
Enter data to insert at the end: 30
Node with data 30 inserted at the end.

Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 2
10 -> 20 -> 30 -> Head

Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 5
Node deleted from the beginning.

Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 2
20 -> 30 -> Head
```



```
Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 6
Node deleted from the end.

Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 2
20 -> Head

Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 2
10 -> 20 -> 30 -> 40 -> Head

Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 7
Enter the data of the node after which you want to delete: 20
Node with data 20 deleted.

Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 2
10 -> 20 -> 40 -> Head
```



```
Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 8
Circular linked list deleted.

Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 2
The circular linked list is empty.

Circular Linked List Operations Menu:
1. Create a circular linked list
2. Display the circular linked list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire circular linked list
9. Exit
Enter your choice: 9
Exiting the program.

--------------------------------
Process exited after 12.64 seconds with return value 0
Press any key to continue . . .
```

Data Structure lab assignment 4

Problem No: 1

Problem Statement: Write a Menu driven C program to accomplish the following functionalities in doubly linked list.

a) Create a doubly linked list.

b) Display the elements of a doubly linked list.

c) Insert a node at the beginning of a doubly linked list.

d) Insert a node at the end of a doubly linked list.

e) Insert a node before a given node of a doubly linked list.

f) Insert a node after a given node of a doubly linked list.

g) Delete a node from the beginning of a doubly linked list.

h) Delete a node from the end of a doubly linked list.

i) Delete a node after a given node of a doubly linked list.

j) Delete the entire doubly linked list.

Source Code:

```
#include <stdio.h>

#include <stdlib.h>
// Node structure for a doubly
linked list
struct Node {
    int data;
    struct Node* prev;
    struct Node* next;
};
struct Node* head = NULL;

// Function to create a new node
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;
}

// Function to display the doubly
linked list
void displayList() {
       struct Node * current =
head;
    printf("Doubly Linked
List:\nNULL <-> ");
    while (current != NULL) {
        printf("%d <-> ", current-
>data);
        current = current->next;
    }
    printf("NULL\n");
}

// Function to insert a node at the
beginning
void insertAtBeginning(int data) {
    struct Node* newNode =
createNode(data);
    if (head == NULL) {
       head = newNode;
        return;
    }
    newNode->next = head;
    head->prev = newNode;
}

// Function to insert a node at the
end
void insertAtEnd(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;
    newNode->prev = temp;
}

// Function to insert a node before
a given node
void insertBeforeNode(int data, int
key) {
    struct Node* newNode =
createNode(data);
    if (head == NULL) {
       head = newNode;
        return;
    }
    if (head->data == key) {
        newNode->next = head;
        head->prev = newNode;
        return;
    }
    struct Node* temp = head;
    while (temp->next != NULL &&
temp->next->data != key) {
        temp = temp->next;
    }
    if (temp->next == NULL) {
        printf("Key not found in
the list.\n");
        free(newNode);
        return;
    }
    newNode->next = temp->next;
    newNode->prev = temp;
    temp->next->prev = newNode;
    temp->next = newNode;
}

// Function to insert a node after
a given node
void insertAfterNode(int data, int
key) {
    struct Node* newNode =
createNode(data);
    if (head == NULL) {
        return;
    }
    struct Node* temp = head;
    while (temp != NULL && temp-
>data != key) {
        temp = temp->next;
    }
    if (temp == NULL) {
        printf("Key not found in
the list.\n");
        free(newNode);
        return;
    }
    newNode->next = temp->next;
    if (temp->next != NULL) {
        temp->next->prev = newNode;
    }
    newNode->prev = temp;
    temp->next = newNode;
}

// Function to delete a node from
the beginning
void deleteFromBeginning() {
    if (head == NULL) {
        printf("List is empty.
Nothing to delete.\n");
        return;
    }
    if (head -> next == NULL) {
       free(head);
       head = NULL;
        }
    struct Node* temp = head;
    head = head -> next;
    head -> prev = NULL;
    free(temp);
}

// Function to delete a node from
the end
void deleteFromEnd() {
    if (head == NULL) {
        printf("List is empty.
Nothing to delete.\n");
        return;
    }
    if (head->next == NULL) {
        free(head);
        return;
    }
    struct Node* temp = head;
    while (temp->next->next !=
NULL) {
        temp = temp->next;
    }
    free(temp->next);
    temp->next = NULL;
}

// Function to delete a node after
a given node
void deleteAfterNode(int key) {
    if (head == NULL) {
        printf("List is empty.
Nothing to delete.\n");
        return;
    }
    struct Node* temp = head;
    while (temp != NULL && temp-
>data != key) {
        temp = temp->next;
    }
    if (temp == NULL || temp->next
== NULL) {
        printf("Key not found or no
node after the key to delete.\n");
        return;
    }
    struct Node* nodeToDelete =
temp->next;
    temp->next = nodeToDelete-
>next;
    if (nodeToDelete->next != NULL)
{
        nodeToDelete->next->prev =
temp;
    }
    free(nodeToDelete);
}

// Function to delete the entire
list
void deleteList() {
    while (head != NULL) {
        struct Node* temp = head;
        head = head->next;
        free(temp);
    }
    printf("Entire list
deleted.\n");
}

int main() {
    int choice, data, key;

    do {
        printf("\nDoubly Linked
List Menu:\n");
        printf("1. Create a doubly
linked list\n");
        printf("2. Display the
list\n");
        printf("3. Insert at the
beginning\n");
        printf("4. Insert at the
end\n");
        printf("5. Insert before a
given node\n");
        printf("6. Insert after a
given node\n");
        printf("7. Delete from the
beginning\n");
        printf("8. Delete from the
end\n");
        printf("9. Delete after a
given node\n");
        printf("10. Delete the
entire list\n");
        printf("0. Exit\n");
        printf("Enter your choice:
");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                // Create a doubly
linked list
                printf("Enter data
for the first node: ");
                scanf("%d", &data);
                head =
createNode(data);
                break;
            case 2:
                // Display the
elements of the doubly linked list
                displayList();
                break;

            case 3:
                // Insert at the
beginning
                printf("Enter data
for the new node: ");
                scanf("%d", &data);

insertAtBeginning(data);
                break;

            case 4:
                // Insert at the
end
                printf("Enter data
for the new node: ");
                scanf("%d", &data);
                insertAtEnd(data);
                break;

            case 5:
                // Insert before a
given node
                printf("Enter data
for the new node: ");
                scanf("%d", &data);
                printf("Enter the
key value before which to insert:
");
                scanf("%d", &key);

insertBeforeNode(data, key);
                break;

            case 6:
                // Insert after a
given node
                printf("Enter data
for the new node: ");
                scanf("%d", &data);
                printf("Enter the
key value after which to insert:
");
                scanf("%d", &key);
```

```
insertAfterNode(data, key);
                break;

            case 7:
                // Delete from the
beginning

deleteFromBeginning();
                break;

            case 8:
                // Delete from the
end
                deleteFromEnd();
                break;

            case 9:
                // Delete after a
given node
                printf("Enter the
key value after which to delete:
");
                scanf("%d", &key);

deleteAfterNode(key);
                break;

            case 10:
                // Delete the
entire list
                deleteList();
                break;

            case 0:
                // Exit the program
                printf("Exiting the
program.\n");
                break;

            default:
                printf("Invalid
choice. Please enter a valid
option.\n");
        }
    } while (choice != 0);

    return 0;
}
```

Output:

```
Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 1
```

```
Enter data for the first node: 10

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
```

```
0. Exit
Enter your choice: 2
Doubly Linked List: 10 <-> NULL

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 3
Enter data for the new node: 45

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 2
Doubly Linked List: 45 <-> 10 <-> NULL

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 4
Enter data for the new node: 50

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 2
Doubly Linked List: 45 <-> 10 <-> 50 <-> NULL

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 5
Enter data for the new node: 34
Enter the key value before which to insert: 10

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 2
Doubly Linked List: 45 <-> 34 <-> 10 <-> 50 <->
NULL

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 6
Enter data for the new node: 22
Enter the key value after which to insert: 50

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
```

```
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 2
Doubly Linked List: 45 <-> 34 <-> 10 <-> 50 <-> 22 <-> NULL

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 7

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 2
Doubly Linked List: 34 <-> 10 <-> 50 <-> 22 <-> NULL

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 8

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 2
Doubly Linked List: 34 <-> 10 <-> 50 <-> NULL

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 9
Enter the key value after which to delete: 10

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 2
Doubly Linked List: 34 <-> 10 <-> NULL

Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 10
Entire list deleted.
```

```
Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 2
Doubly Linked List: NULL
```

```
Doubly Linked List Menu:
1. Create a doubly linked list
2. Display the list
3. Insert at the beginning
4. Insert at the end
5. Insert before a given node
6. Insert after a given node
7. Delete from the beginning
8. Delete from the end
9. Delete after a given node
10. Delete the entire list
0. Exit
Enter your choice: 0
Exiting the program.
```

Problem No: 2

Problem Statement: Write a Menu driven C program to accomplish the following functionalities in circular doubly linked list.

a) Create a circular doubly linked list.

b) Display the elements of a circular doubly linked list.

c) Insert a node at the beginning of a circular doubly linked list.

d) Insert a node at the end of a circular doubly linked list.

e) Delete a node from the beginning of a circular doubly linked list.

f) Delete a node from the end of a circular doubly linked list.

g) Delete a node after a given node of a circular doubly linked list.

h) Delete the entire circular doubly linked list.

Source Code:

```
#include <stdio.h>
#include <stdlib.h>
struct Node {
    int data;
    struct Node *prev;
    struct Node *next;
};
struct Node *head = NULL;

void createList() {
    int n, data;
    struct Node *newNode, *temp;
    printf("Enter the number of
nodes: ");
    scanf("%d", &n);

    if (n <= 0) {
        printf("Invalid number of
nodes.\n");
        return;
    }
    printf("Enter data for node
1: ");
    scanf("%d", &data);
    head = (struct Node
*)malloc(sizeof(struct Node));
    head->data = data;
    head->next = head;
    head->prev = head;
    temp = head;
    for (int i = 2; i <= n; i++)
{
        newNode = (struct Node
*)malloc(sizeof(struct Node));
        printf("Enter data for
node %d: ", i);
        scanf("%d", &data);
        newNode->data = data;
        newNode->next = head;
        newNode->prev = temp;
        temp->next = newNode;
        head->prev = newNode;
        temp = newNode;
    }
    printf("Circular doubly
linked list created
successfully.\n");
}
void displayList() {
    struct Node *temp;
    if (head == NULL) {
        printf("List is
empty.\n");
        return;
    }
    temp = head;
    printf("Circular doubly
linked list elements: ");
    do {
        printf("%d ", temp-
>data);
        temp = temp->next;
    } while (temp != head);
    printf("\n");
}
void insertAtBeginning() {
    int data;
    struct Node *newNode, *last;

    printf("Enter data to insert
at the beginning: ");
    scanf("%d", &data);

    newNode = (struct Node
*)malloc(sizeof(struct Node));
    newNode->data = data;

    if (head == NULL) {
        head = newNode;
        head->next = head;
        head->prev = head;
    } else {
        last = head->prev;
        newNode->next = head;
        newNode->prev = last;
        head->prev = newNode;
        last->next = newNode;
        head = newNode;
    }
    printf("Node inserted at the
beginning successfully.\n");
}
void insertAtEnd() {
    int data;
    struct Node *newNode, *last;

    printf("Enter data to insert
at the end: ");
    scanf("%d", &data);

    newNode = (struct Node
*)malloc(sizeof(struct Node));
    newNode->data = data;

    if (head == NULL) {
        head = newNode;
        head->next = head;
        head->prev = head;
    } else {
        last = head->prev;
        newNode->next = head;
        newNode->prev = last;
        head->prev = newNode;
        last->next = newNode;
```

```
    }
    printf("Node inserted at the
end successfully.\n");
}

void deleteFromBeginning() {
    struct Node *temp;

    if (head == NULL) {
        printf("List is empty,
nothing to delete.\n");
        return;
    } else if (head->next ==
head) {
        free(head);
        head = NULL;
    } else {
        temp = head;
        head = head->next;
        head->prev = temp->prev;
        temp->prev->next = head;
        free(temp);
    }
    printf("Node deleted from the
beginning successfully.\n");
}

void deleteFromEnd() {
    struct Node *temp;

    if (head == NULL) {
        printf("List is empty,
nothing to delete.\n");
        return;
    } else if (head->next ==
head) {
        free(head);
        head = NULL;
    } else {
        temp = head->prev;
        head->prev = temp->prev;
        temp->prev->next = head;
        free(temp);
    }
    printf("Node deleted from the
end successfully.\n");
}

void deleteAfterNode(int key) {
    struct Node *temp, *toDelete;
    temp = head;

    while (temp->data != key) {
        temp = temp->next;
        if (temp == head) {
            printf("Node with key
%d not found.\n", key);
            return;
        }
    }

    toDelete = temp->next;
    temp->next = toDelete->next;
    toDelete->next->prev = temp;
    free(toDelete);
    printf("Node after key %d
deleted successfully.\n", key);
}

void deleteList() {
    struct Node *current, *temp;
    if (head == NULL) {
        printf("List is already
empty.\n");
        return;
    }

    current = head;
    while (current->next != head)
{
        temp = current->next;
        free(current);
        current = temp;
    }
    free(head);
    head = NULL;
    printf("Circular doubly
linked list deleted
successfully.\n");
}

int main() {
    int choice, key;

    do {
        printf("\nCircular Doubly
Linked List Operations:\n");
        printf("1. Create a
circular doubly linked list\n");
        printf("2. Display the
elements of the list\n");
        printf("3. Insert a node
at the beginning\n");
        printf("4. Insert a node
at the end\n");
        printf("5. Delete a node
from the beginning\n");
        printf("6. Delete a node
from the end\n");
        printf("7. Delete a node
after a given node\n");
        printf("8. Delete the
entire list\n");
        printf("9. Exit\n");
        printf("Enter your
choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                createList();
                break;
            case 2:
                displayList();
                break;
            case 3:

insertAtBeginning();
                break;
            case 4:
                insertAtEnd();
                break;
            case 5:

deleteFromBeginning();
                break;
            case 6:
                deleteFromEnd();
                break;
            case 7:
                printf("Enter the
key after which the node should
be deleted: ");
                scanf("%d",
&key);

deleteAfterNode(key);
                break;
            case 8:
                deleteList();
                break;
            case 9:
                printf("Exiting
the program.\n");
                break;
            default:
                printf("Invalid
choice, please enter a valid
option.\n");
        }
    } while (choice != 9);

    return 0;
}
```

Output:

```
Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 1
Enter the number of nodes: 3
Enter data for node 1: 10
Enter data for node 2: 20
Enter data for node 3: 30
Circular doubly linked list created successfully.

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 2
Circular doubly linked list elements: 10 20 30

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 3
Enter data to insert at the beginning: 50
Node inserted at the beginning successfully.

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 2
Circular doubly linked list elements: 50 10 20 30

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 4
Enter data to insert at the end: 60
Node inserted at the end successfully.

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 2
Circular doubly linked list elements: 50 10 20 30 60

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 5
Node deleted from the beginning successfully.

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 2
Circular doubly linked list elements: 10 20 30 60

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 6
Node deleted from the end successfully.

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
```

```
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 2
Circular doubly linked list elements: 10 20 30

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 7
Enter the key after which the node should be deleted: 20
Node after key 20 deleted successfully.

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 2
Circular doubly linked list elements: 10 20

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 8
Circular doubly linked list deleted successfully.

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 2
List is empty.

Circular Doubly Linked List Operations:
1. Create a circular doubly linked list
2. Display the elements of the list
3. Insert a node at the beginning
4. Insert a node at the end
5. Delete a node from the beginning
6. Delete a node from the end
7. Delete a node after a given node
8. Delete the entire list
9. Exit
Enter your choice: 9
Exiting the program.
```

Data Structure lab assignment 5

- **Problem No: 1**
- **Problem Statement:** Write a Menu driven C program to accomplish the following functionalities in Queue using an Array:

  a. Insert an element into the queue using an array (Enqueue Operation).

  b. Delete an element from the queue using an array (Dequeue Operation).

  c. Return the value of the FRONT element of the queue (without deleting it from the queue) using an array (Peep operation).

  d. Display the elements of a queue using an array.
- **Source Code:**

```
#include <stdio.h>
#define MAX_SIZE 10
void enqueue(int element);
void dequeue();
void peep();
void display();
int queue[MAX_SIZE];
int front = -1, rear = -1;
int main() {
    int choice, element;
    do {
        printf("\nQueue Menu:\n");
        printf("1. Enqueue\n");
        printf("2. Dequeue\n");
        printf("3. Peep\n");
        printf("4. Display\n");
        printf("5. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        switch (choice) {
            case 1:
                printf("Enter element to enqueue: ");
                scanf("%d", &element);
                enqueue(element);
                break;
            case 2:
                dequeue();
                break;
            case 3:
                peep();
                break;
            case 4:
                display();
                break;
            case 5:
                printf("Exiting program. Goodbye!\n");
                break;
            default:
                printf("Invalid choice! Please enter a valid
option.\n");}
    } while (choice != 5);
    return 0;
}
void enqueue(int element) {
    if (rear == MAX_SIZE - 1) {
        printf("Queue is full. Cannot enqueue element.\n");
    } else {
        if (front == -1) {
            front = 0;
        }
        rear++;
        queue[rear] = element;
        printf("Enqueued %d\n", element);
    }}
void dequeue() {
    if (front == -1) {
        printf("Queue is empty. Cannot dequeue element.\n");
    } else {
        printf("Dequeued %d\n", queue[front]);
        if (front == rear) {
            front = rear = -1;
        } else {
            front++;
        }}}
void peep() {
    if (front == -1) {
        printf("Queue is empty. Peep operation not possible.\n");
    } else {
        printf("Front element: %d\n", queue[front]);
    }}
void display() {
    if (front == -1) {
        printf("Queue is empty. Nothing to display.\n");
    } else {
        printf("Queue elements: ");
        for (int i = front; i <= rear; i++) {
            printf("%d ", queue[i]);
        }
        printf("\n");
    }}
```

Output:

```
Queue Menu:
1. Enqueue
2. Dequeue
3. Peep
4. Display
5. Exit
Enter your choice: 1
Enter element to enqueue: 10
Enqueued 10

Queue Menu:
1. Enqueue
2. Dequeue
3. Peep
4. Display
5. Exit
Enter your choice: 1
Enter element to enqueue: 20
Enqueued 20
```

```
Queue Menu:
1. Enqueue
2. Dequeue
3. Peep
4. Display
5. Exit
Enter your choice: 4
Queue elements: 10 20

Queue Menu:
1. Enqueue
2. Dequeue
3. Peep
4. Display
5. Exit
Enter your choice: 3
Front element: 10
```

```
Queue Menu:
1. Enqueue
2. Dequeue
3. Peep
4. Display
5. Exit
Enter your choice: 2
Dequeued 10

Queue Menu:
1. Enqueue
2. Dequeue
3. Peep
4. Display
5. Exit
Enter your choice: 4
Queue elements: 20

Queue Menu:
1. Enqueue
2. Dequeue
3. Peep
4. Display
5. Exit
Enter your choice: 5
Exiting program. Goodbye!
```

Problem No: 2

Problem Statement: Write a Menu driven C program to accomplish the following functionalities in Queue using Linked List:

e. Insert an element into the queue using a Linked List (Enqueue Operation).

f. Delete an element from the queue using a Linked List (Dequeue Operation).

g. Return the value of the FRONT element of the queue (without deleting it from the queue) using a Linked List (Peep operation).

h. Display the elements of a queue using a Linked List.

Source Code:

```
#include <stdio.h>
#include <stdlib.h>
struct Node {
    int data;
    struct Node *next;
};
struct Queue {
    struct Node *front, *rear;
};
struct Queue *createQueue() {
    struct Queue *queue = (struct Queue *)malloc(sizeof(struct
Queue));
    queue->front = queue->rear = NULL;
    return queue;
}
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;
}
void dequeue(struct Queue *queue) {
    if (queue->front == NULL) {
        printf("Queue is empty. Cannot dequeue.\n");
        return;
    }
    struct Node *temp = queue->front;
    queue->front = queue->front->next;
    if (queue->front == NULL) {
        queue->rear = NULL;
    }
    free(temp);
}
int peek(struct Queue *queue) {
    if (queue->front == NULL) {
        printf("Queue is empty. Peek operation cannot be 
performed.\n");
        return -1;
    }
    return queue->front->data;
}
void displayQueue(struct Queue *queue) {
    struct Node *temp = queue->front;
    if (temp == NULL) {
        printf("Queue is empty.\n");
        return;
    }
    printf("Queue elements: ");
    while (temp != NULL) {
        printf("%d ", temp->data);
        temp = temp->next;
    }
    printf("\n");
}
int main() {
    struct Queue *queue = createQueue();
    int choice, element;
    do {
        printf("\nQueue Operations using Linked List:\n");
        printf("1. Insert element into the queue (Enqueue)\n");
        printf("2. Delete element from the queue (Dequeue)\n");
        printf("3. Return value of the FRONT element (Peek)\n");
        printf("4. Display elements of the queue\n");
        printf("5. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        switch (choice) {
            case 1:
                printf("Enter the element to enqueue: ");
                scanf("%d", &element);
                enqueue(queue, element);
                printf("Element enqueued successfully.\n");
                break;
            case 2:
                dequeue(queue);
                printf("Element dequeued successfully.\n");
                break;
            case 3:
                element = peek(queue);
                if (element != -1) {
                    printf("Front element of the queue: %d\n",
element);
                }
                break;
            case 4:
                displayQueue(queue);
                break;
            case 5:
                printf("Exiting the program.\n");
                break;
            default:
                printf("Invalid choice, please enter a valid
option.\n");
        }
    } while (choice != 5);
    return 0;
}
```

Output:

```
Queue Operations using Linked List:
1. Insert element into the queue (Enqueue)
2. Delete element from the queue (Dequeue)
3. Return value of the FRONT element (Peek)
4. Display elements of the queue
5. Exit
Enter your choice: 1
Enter the element to enqueue: 34
Element enqueued successfully.

Queue Operations using Linked List:
1. Insert element into the queue (Enqueue)
2. Delete element from the queue (Dequeue)
3. Return value of the FRONT element (Peek)
4. Display elements of the queue
5. Exit
Enter your choice: 1
Enter the element to enqueue: 45
Element enqueued successfully.

Queue Operations using Linked List:
1. Insert element into the queue (Enqueue)
2. Delete element from the queue (Dequeue)
3. Return value of the FRONT element (Peek)
4. Display elements of the queue
5. Exit
Enter your choice: 1
Enter the element to enqueue: 23
Element enqueued successfully.
Queue Operations using Linked List:
1. Insert element into the queue (Enqueue)
2. Delete element from the queue (Dequeue)
3. Return value of the FRONT element (Peek)
4. Display elements of the queue
5. Exit
Enter your choice: 2
Element dequeued successfully.

Queue Operations using Linked List:
1. Insert element into the queue (Enqueue)
2. Delete element from the queue (Dequeue)
3. Return value of the FRONT element (Peek)
4. Display elements of the queue
5. Exit
Enter your choice: 3
Front element of the queue: 45

Queue Operations using Linked List:
1. Insert element into the queue (Enqueue)
2. Delete element from the queue (Dequeue)
3. Return value of the FRONT element (Peek)
4. Display elements of the queue
5. Exit
Enter your choice: 4
Queue elements: 45 23

Queue Operations using Linked List:
1. Insert element into the queue (Enqueue)
2. Delete element from the queue (Dequeue)
```

```
3. Return value of the FRONT element (Peek)
4. Display elements of the queue
5. Exit
Enter your choice: 5
Exiting the program
```

Problem No: 3

Problem Statement: Write a Menu driven C program to accomplish the following functionalities in Circular Queue using Array:

i. Insert an element into the circular queue.

j. Delete an element from the circular queue.

k. Return the value of the FRONT element of the circular queue (without deleting it from the queue).

l. Display the elements of a circular queue using the circular queue.

Source Code:

```c
#include <stdio.h>
#include <stdlib.h>
#define MAX_SIZE 10
struct CircularQueue {
    int items[MAX_SIZE];
    int front, rear;
};
struct CircularQueue *createQueue() {
    struct CircularQueue *queue = (struct CircularQueue
*)malloc(sizeof(struct CircularQueue));
    queue->front = -1;
    queue->rear = -1;
    return queue;
}
int isFull(struct CircularQueue *queue) {
    if ((queue->front == 0 && queue->rear == MAX_SIZE - 1) ||
(queue->front == queue->rear + 1)) {
        return 1;
    }
    return 0;
}
int isEmpty(struct CircularQueue *queue) {
    if (queue->front == -1) {
        return 1;
    }
    return 0;
}
void enqueue(struct CircularQueue *queue, int value) {
    if (isFull(queue)) {
        printf("Queue is full. Cannot enqueue.\n");
        return;
    }
    if (queue->front == -1) {
        queue->front = 0;
    }
    queue->rear = (queue->rear + 1) % MAX_SIZE;
    queue->items[queue->rear] = value;
    printf("Element enqueued successfully.\n");
}
void dequeue(struct CircularQueue *queue) {
    if (isEmpty(queue)) {
        printf("Queue is empty. Cannot dequeue.\n");
        return;
    }
    printf("Dequeued element: %d\n", queue->items[queue-
>front]);
    if (queue->front == queue->rear) {
        queue->front = queue->rear = -1;
    } else {
        queue->front = (queue->front + 1) % MAX_SIZE;
    }}
int peek(struct CircularQueue *queue) {
    if (isEmpty(queue)) {
        printf("Queue is empty. Peek operation cannot be
performed.\n");
        return -1;
    }
    return queue->items[queue->front];
}
void displayQueue(struct CircularQueue *queue) {
    int i;
    if (isEmpty(queue)) {
        printf("Queue is empty.\n");
        return;
    }
    printf("Circular Queue elements: ");
    i = queue->front;
    do {
        printf("%d ", queue->items[i]);
        i = (i + 1) % MAX_SIZE;
    } while (i != (queue->rear + 1) % MAX_SIZE);
    printf("\n");
}
int main() {
    struct CircularQueue *queue = createQueue();
    int choice, element;
    do {
        printf("\nCircular Queue Operations using Array:\n");
        printf("i. Insert element into the queue (Enqueue)\n");
        printf("j. Delete element from the queue (Dequeue)\n");
        printf("k. Return value of the FRONT element
(Peek)\n");
        printf("l. Display elements of the queue\n");
        printf("m. Exit\n");
        printf("Enter your choice: ");
        scanf(" %c", &choice);

        switch (choice) {
            case 'i':
                printf("Enter the element to enqueue: ");
                scanf("%d", &element);
                enqueue(queue, element);
                break;
            case 'j':
                dequeue(queue);
                break;
            case 'k':
                element = peek(queue);
                if (element != -1) {
                    printf("Front element of the queue: %d\n",
element);
                }
                break;
            case 'l':
                displayQueue(queue);
                break;
            case 'm':
                printf("Exiting the program.\n");
                break;
            default:
                printf("Invalid choice, please enter a valid
option.\n");
        }
    } while (choice != 'm');
    return 0;
}
```

Output:

```
Circular Queue Operations using Array:
i. Insert element into the queue (Enqueue)
j. Delete element from the queue (Dequeue)
k. Return value of the FRONT element (Peek)
l. Display elements of the queue
m. Exit
Enter your choice: i
Enter the element to enqueue: 22
Element enqueued successfully.

Circular Queue Operations using Array:
i. Insert element into the queue (Enqueue)
j. Delete element from the queue (Dequeue)
k. Return value of the FRONT element (Peek)
l. Display elements of the queue
m. Exit
Enter your choice: i
Enter the element to enqueue: 44
Element enqueued successfully.

Circular Queue Operations using Array:
i. Insert element into the queue (Enqueue)
j. Delete element from the queue (Dequeue)
k. Return value of the FRONT element (Peek)
l. Display elements of the queue
m. Exit
Enter your choice: i
Enter the element to enqueue: 66
```

```
Element enqueued successfully.

Circular Queue Operations using Array:
i. Insert element into the queue (Enqueue)
j. Delete element from the queue (Dequeue)
k. Return value of the FRONT element (Peek)
l. Display elements of the queue
m. Exit
Enter your choice: j
Dequeued element: 22

Circular Queue Operations using Array:
i. Insert element into the queue (Enqueue)
j. Delete element from the queue (Dequeue)
k. Return value of the FRONT element (Peek)
l. Display elements of the queue
m. Exit
Enter your choice: k
Front element of the queue: 44

Circular Queue Operations using Array:
i. Insert element into the queue (Enqueue)
j. Delete element from the queue (Dequeue)
k. Return value of the FRONT element (Peek)
l. Display elements of the queue
m. Exit
Enter your choice: l
Circular Queue elements: 44 66

Circular Queue Operations using Array:
i. Insert element into the queue (Enqueue)
j. Delete element from the queue (Dequeue)
k. Return value of the FRONT element (Peek)
l. Display elements of the queue
m. Exit
Enter your choice: m
Exiting the program.
```

Data Structure lab assignment 6

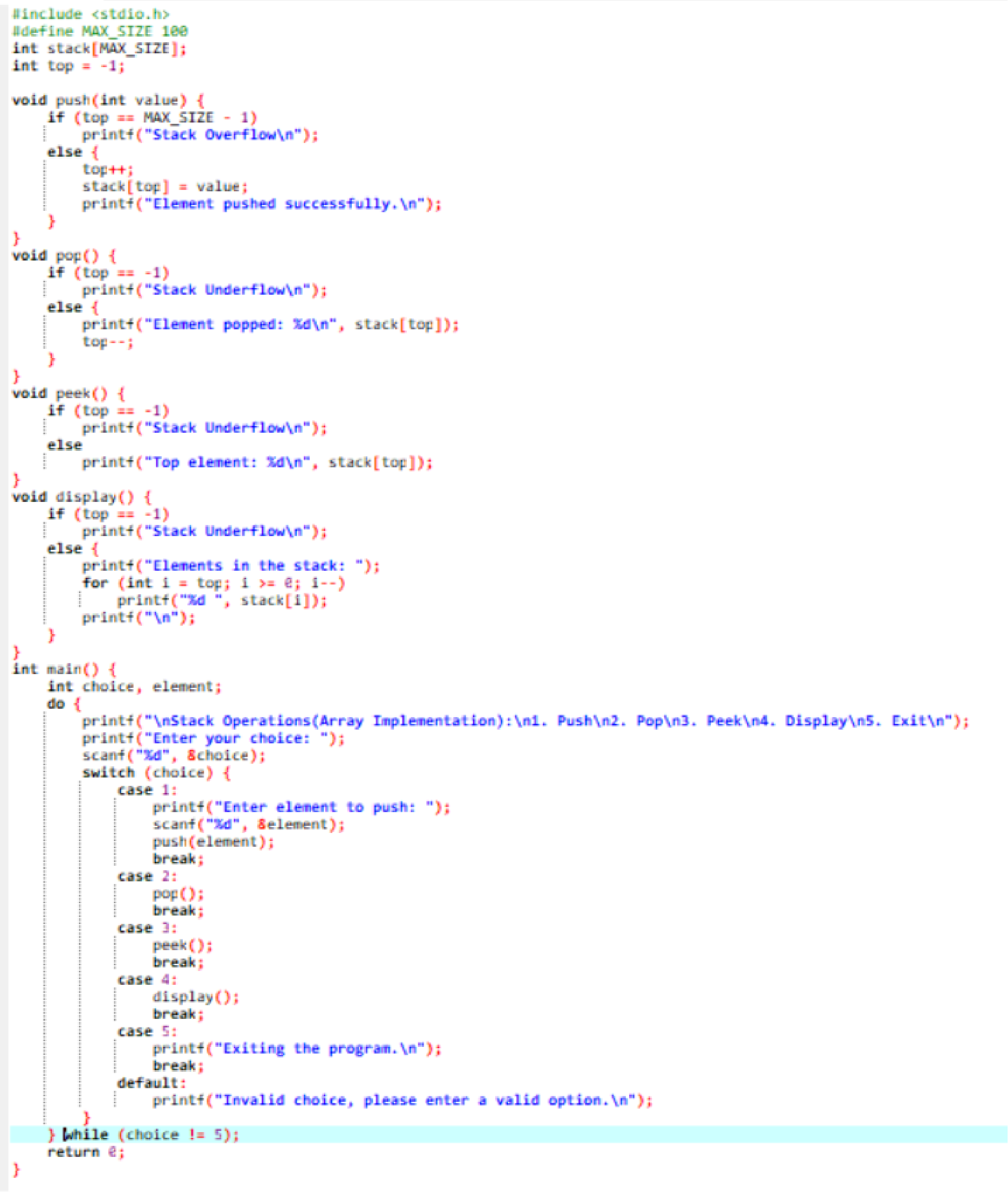
- **Problem No: 1**
- **Problem Statement:** Write a Menu driven C program to accomplish the following functionalities in Stack using an Array:

  a. Insert an element into the stack using an array (Push Operation).

  b. Delete an element from the stack using an array (Pop Operation).

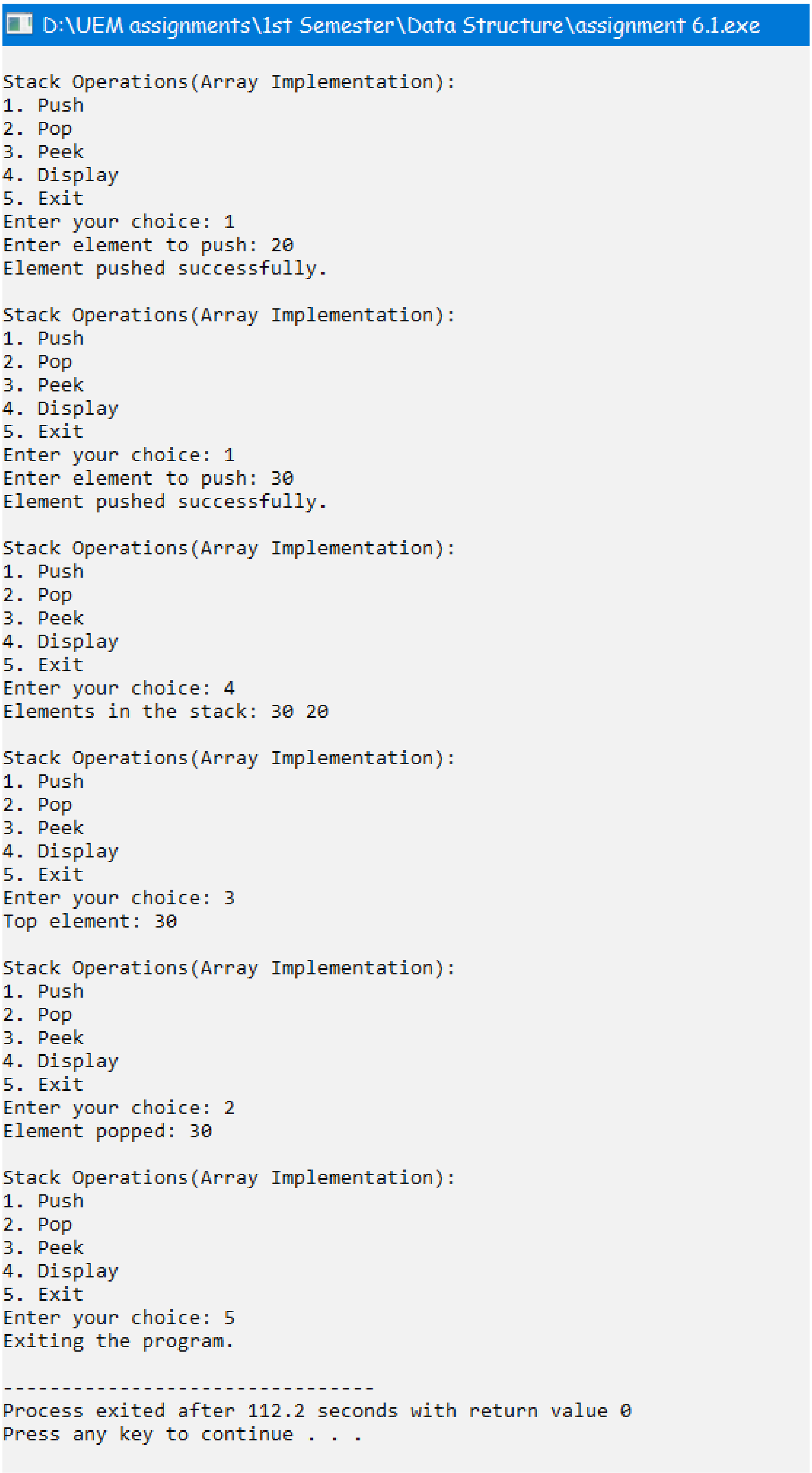
  c. Return the value of the topmost element of the stack (without deleting it from the stack) using an array.

  d. Display the elements of a stack using an array.
- **Source Code:**



```c
#include <stdio.h>
#define MAX_SIZE 100
int stack[MAX_SIZE];
int top = -1;

void push(int value) {
    if (top == MAX_SIZE - 1)
        printf("Stack Overflow\n");
    else {
        top++;
        stack[top] = value;
        printf("Element pushed successfully.\n");
    }
}
void pop() {
    if (top == -1)
        printf("Stack Underflow\n");
    else {
        printf("Element popped: %d\n", stack[top]);
        top--;
    }
}
void peek() {
    if (top == -1)
        printf("Stack Underflow\n");
    else
        printf("Top element: %d\n", stack[top]);
}
void display() {
    if (top == -1)
        printf("Stack Underflow\n");
    else {
        printf("Elements in the stack: ");
        for (int i = top; i >= 0; i--)
            printf("%d ", stack[i]);
        printf("\n");
    }
}
int main() {
    int choice, element;
    do {
        printf("\nStack Operations(Array Implementation):\n1. Push\n2. Pop\n3. Peek\n4. Display\n5. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        switch (choice) {
            case 1:
                printf("Enter element to push: ");
                scanf("%d", &element);
                push(element);
                break;
            case 2:
                pop();
                break;
            case 3:
                peek();
                break;
            case 4:
                display();
                break;
            case 5:
                printf("Exiting the program.\n");
                break;
            default:
                printf("Invalid choice, please enter a valid option.\n");
        }
    } while (choice != 5);
    return 0;
}
```

Output:



D:\UEM assignments\1st Semester\Data Structure\assignment 6.1.exe

```
Stack Operations(Array Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 1
Enter element to push: 20
Element pushed successfully.

Stack Operations(Array Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 1
Enter element to push: 30
Element pushed successfully.

Stack Operations(Array Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 4
Elements in the stack: 30 20

Stack Operations(Array Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 3
Top element: 30

Stack Operations(Array Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 2
Element popped: 30

Stack Operations(Array Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 5
Exiting the program.

--------------------------------
Process exited after 112.2 seconds with return value 0
Press any key to continue . . .
```

Problem No: 2

Problem Statement: Write a Menu driven C program to accomplish the following functionalities in Stack using Linked List:

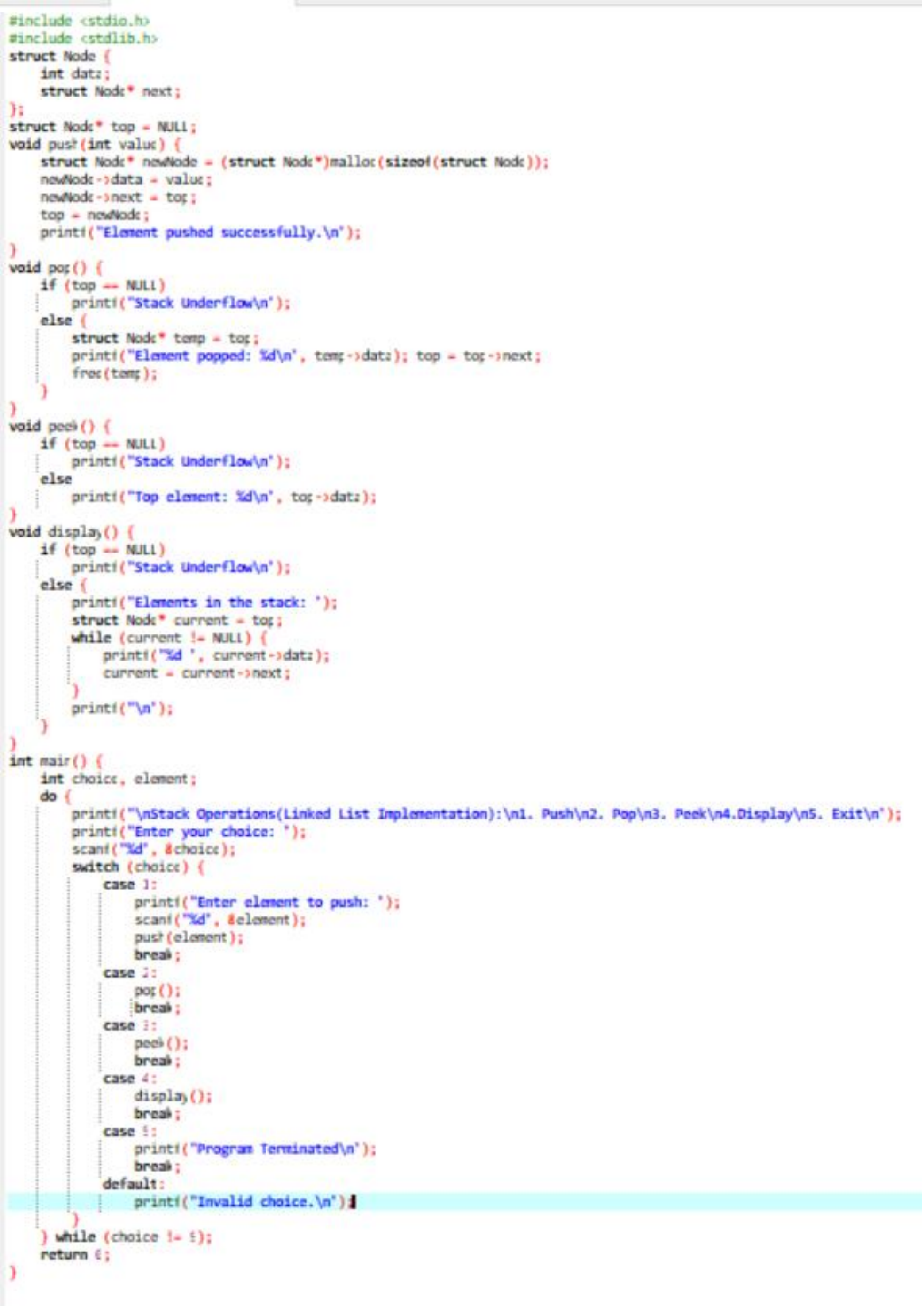
a. Insert an element into the stack using a Linked List (Push Operation).

b. Delete an element from the stack using a Linked List (Pop Operation).

c. Return the value of the topmost element of the stack (without deleting it from the stack) using a Linked List.

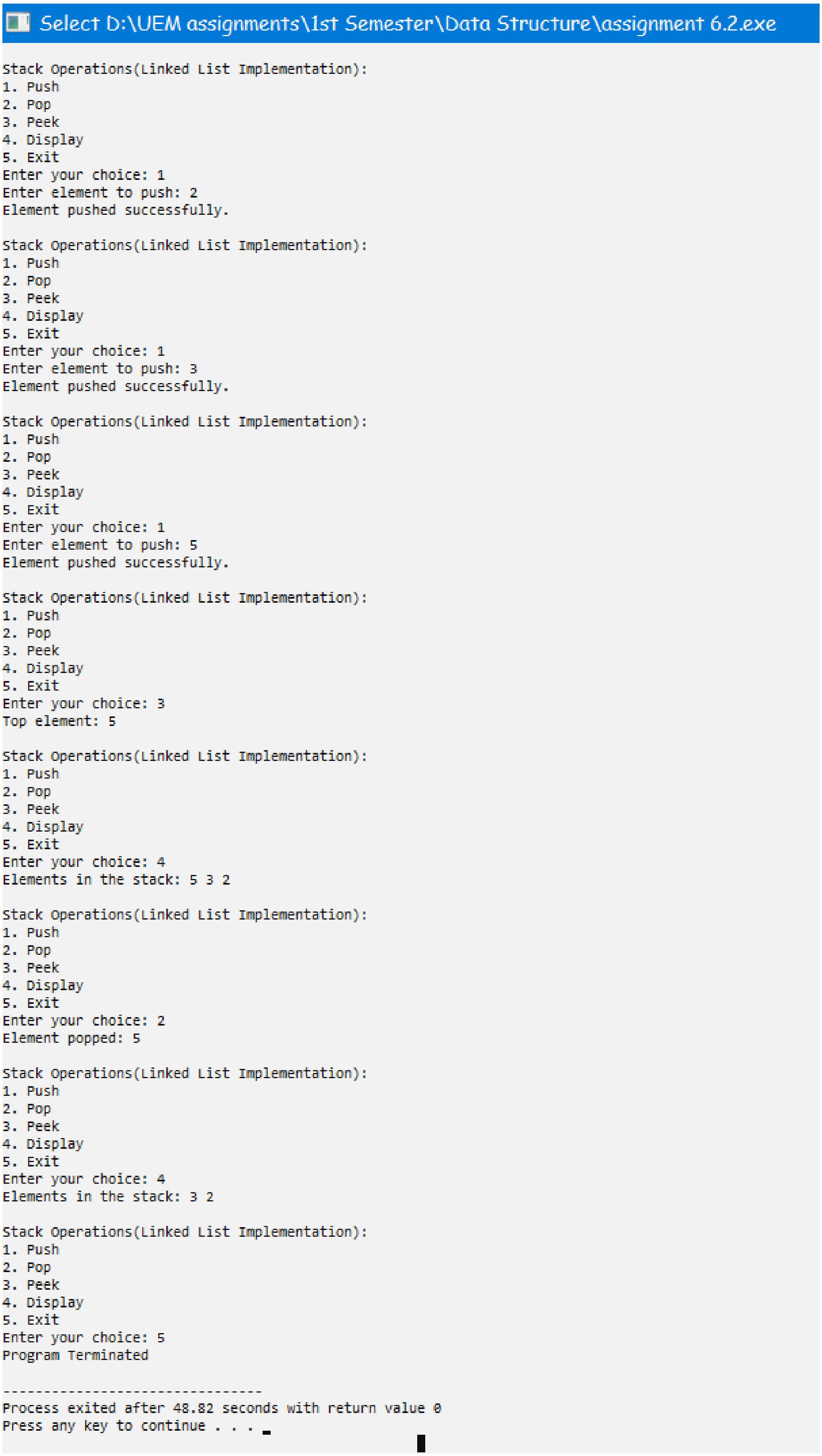
d. Display the elements of the stack using a Linked List.

Source Code:



```c
#include <stdio.h>
#include <stdlib.h>
struct Node {
    int data;
    struct Node* next;
};
struct Node* top = NULL;
void push(int value) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = value;
    newNode->next = top;
    top = newNode;
    printf("Element pushed successfully.\n");
}
void pop() {
    if (top == NULL)
        printf("Stack Underflow\n");
    else {
        struct Node* temp = top;
        printf("Element popped: %d\n", temp->data); top = top->next;
        free(temp);
    }
}
void peek() {
    if (top == NULL)
        printf("Stack Underflow\n");
    else
        printf("Top element: %d\n", top->data);
}
void display() {
    if (top == NULL)
        printf("Stack Underflow\n");
    else {
        printf("Elements in the stack: ");
        struct Node* current = top;
        while (current != NULL) {
            printf("%d ", current->data);
            current = current->next;
        }
        printf("\n");
    }
}
int main() {
    int choice, element;
    do {
        printf("\nStack Operations(Linked List Implementation):\n1. Push\n2. Pop\n3. Peek\n4.Display\n5. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        switch (choice) {
            case 1:
                printf("Enter element to push: ");
                scanf("%d", &element);
                push(element);
                break;
            case 2:
                pop();
                break;
            case 3:
                peek();
                break;
            case 4:
                display();
                break;
            case 5:
                printf("Program Terminated\n");
                break;
            default:
                printf("Invalid choice.\n");
        }
    } while (choice != 5);
    return 0;
}
```

Output:


Select D:\UEM assignments\1st Semester\Data Structure\assignment 6.2.exe

```
Stack Operations(Linked List Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 1
Enter element to push: 2
Element pushed successfully.

Stack Operations(Linked List Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 1
Enter element to push: 3
Element pushed successfully.

Stack Operations(Linked List Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 1
Enter element to push: 5
Element pushed successfully.

Stack Operations(Linked List Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 3
Top element: 5

Stack Operations(Linked List Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 4
Elements in the stack: 5 3 2

Stack Operations(Linked List Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 2
Element popped: 5

Stack Operations(Linked List Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 4
Elements in the stack: 3 2

Stack Operations(Linked List Implementation):
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 5
Program Terminated

--------------------------------
Process exited after 48.82 seconds with return value 0
Press any key to continue . . .
```

Problem No: 3

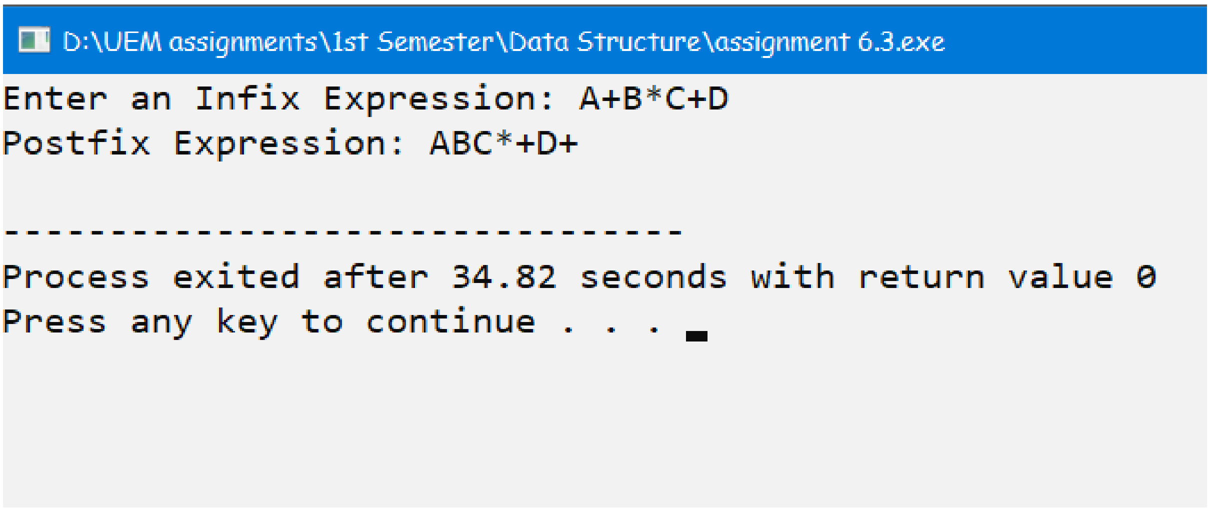
Problem Statement:

Write a program to convert an infix expression into its equivalent postfix notation.

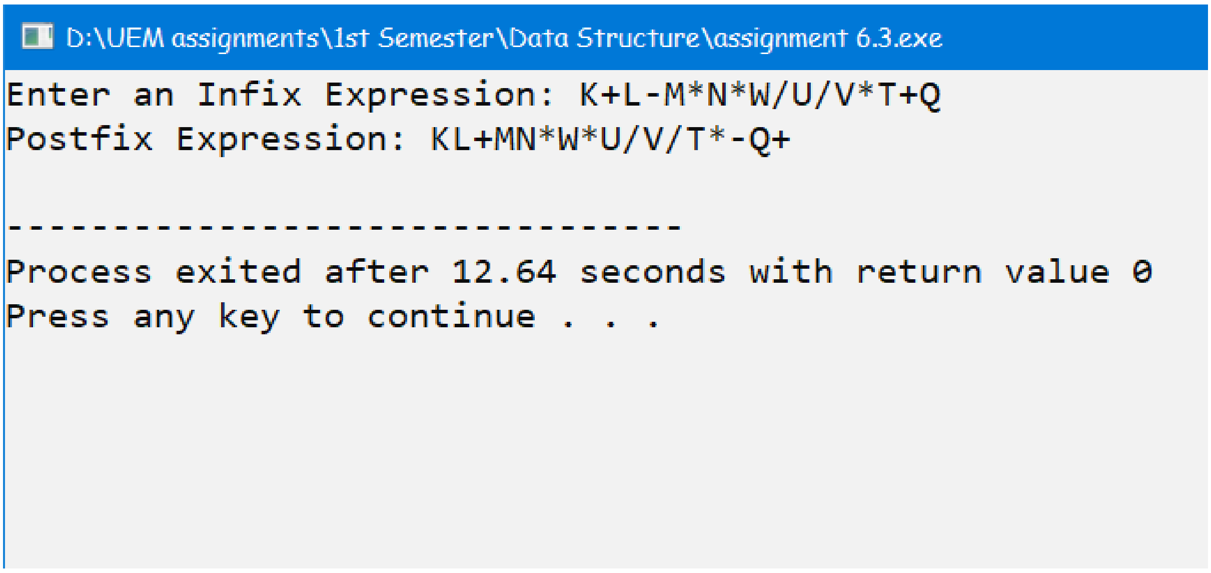
Source Code:

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#define MAX_SIZE 100
char stack[MAX_SIZE];
int top = -1;
int precedence(char ch) {
      if (ch == '+' || ch == '-')
            return 1;
      else if (ch == '*' || ch == '/')
            return 2;
      else
            return 0;
}
void push(char ch) {
      if (top == MAX_SIZE - 1) {
            printf("Stack Overflow\n");
            exit(1);
      }
      else {
            top++;
            stack[top] = ch;
      }
}
char pop() {
      if (top == -1) {
            printf("Stack Underflow\n");
            exit(1);
      } else
            return stack[top--];
}
void infixToPostfix(char* infix) {
      char postfix[MAX_SIZE];
      int i = 0, j = 0;
      while (infix[i] != '\0') {
            char token = infix[i];
            if (token >= 'a' && token <= 'z' || token >= 'A' &&
token <= 'Z')
                  postfix[j++] = token;
            else if (token == '(')
                  push(token);
            else if (token == ')') {
                  while (stack[top] != '(')
                        postfix[j++] = pop();
                  top--;
            } else {
                  while (top != -1 && precedence(stack[top]) >=
precedence(token))
                        postfix[j++] = pop();
            push(token);
        }
        i++;
    }
    while (top != -1)
        postfix[j++] = pop();
    postfix[j] = '\0';
    printf("Postfix Expression: %s\n", postfix);
}
int main() {
    char infix[MAX_SIZE];
    printf("Enter an Infix Expression: ");
    scanf("%s", infix);
    infixToPostfix(infix);
    return 0;
}
```

Output:


D:\UEM assignments\1st Semester\Data Structure\assignment 6.3.exe

```
Enter an Infix Expression: A+B*C+D
Postfix Expression: ABC*+D+

--------------------------------
Process exited after 34.82 seconds with return value 0
Press any key to continue . . .
```


D:\UEM assignments\1st Semester\Data Structure\assignment 6.3.exe

```
Enter an Infix Expression: K+L-M*N*W/U/V*T+Q
Postfix Expression: KL+MN*W*U/V/T*-Q+

--------------------------------
Process exited after 12.64 seconds with return value 0
Press any key to continue . . .
```

Problem No: 4

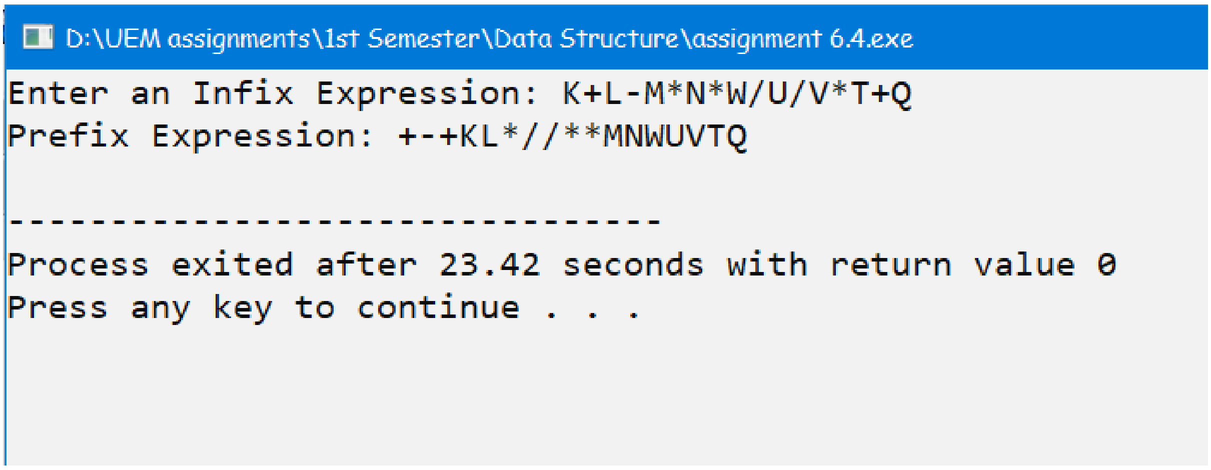
Problem Statement: Write a program to convert an infix expression into its equivalent prefix notation.

Source Code:

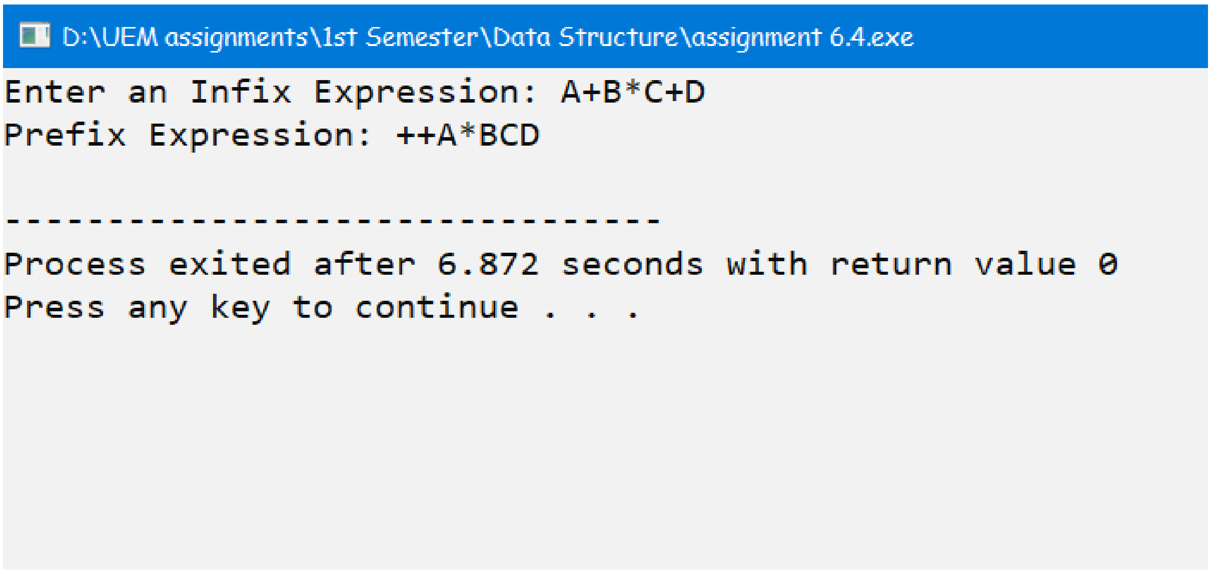
```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#define MAX_SIZE 100
char stack[MAX_SIZE];
int top = -1;
int precedence(char ch) {
      if (ch == '+' || ch == '-')
            return 1;
      else if (ch == '*' || ch == '/')
            return 2;
      else
            return 0;
}
void push(char ch) {
      if (top == MAX_SIZE - 1) {
            printf("Stack Overflow\n");
            exit(1);
      } else {
            top++;
            stack[top] = ch;
      }
}
char pop() {
      if (top == -1) {
            printf("Stack Underflow\n");
            exit(1);
      } else
            return stack[top--];
}
void infixToPrefix(char* infix) {
      int length = strlen(infix), i;
      char prefix[MAX_SIZE];
      int j = 0;
      for (i = length - 1; i >= 0; i--) {
            char token = infix[i];
            if (token >= 'a' && token <= 'z' || token >= 'A' &&
token <= 'Z')
                  prefix[j++] = token;
            else if (token == ')')
                  push(token);
            else if (token == '(') {
                  while (stack[top] != ')')
                        prefix[j++] = pop();
                  top--;
            } else {
                  while (top != -1 && precedence(stack[top]) >
precedence(token))
                        prefix[j++] = pop();
                  push(token);
            }
```

```
        }
        while (top != -1)
            prefix[j++] = pop();
        for (i = 0; i < j / 2; i++) {
            char temp = prefix[i];
            prefix[i] = prefix[j - i - 1];
            prefix[j - i - 1] = temp;
        }
        prefix[j] = '\0';
        printf("Prefix Expression: %s\n", prefix);
    }
    int main() {
        char infix[MAX_SIZE];
        printf("Enter an Infix Expression: ");
        scanf("%s", infix);
        infixToPrefix(infix);
        return 0;
    }
```

Output:


D:\UEM assignments\1st Semester\Data Structure\assignment 6.4.exe

```
Enter an Infix Expression: K+L-M*N*W/U/V*T+Q
Prefix Expression: +-+KL*//**MNWUVTQ

--------------------------------
Process exited after 23.42 seconds with return value 0
Press any key to continue . . .
```

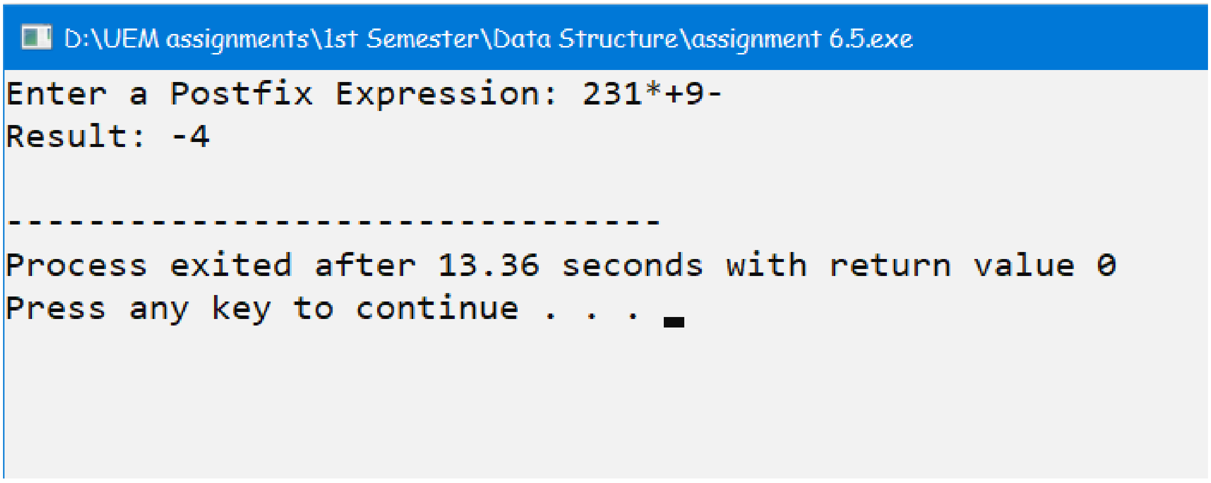

D:\UEM assignments\1st Semester\Data Structure\assignment 6.4.exe

```
Enter an Infix Expression: A+B*C+D
Prefix Expression: ++A*BCD

--------------------------------
Process exited after 6.872 seconds with return value 0
Press any key to continue . . .
```

- **Problem No: 5**
- **Problem Statement:** Write a program to evaluate a postfix expression.
- **Source Code:**

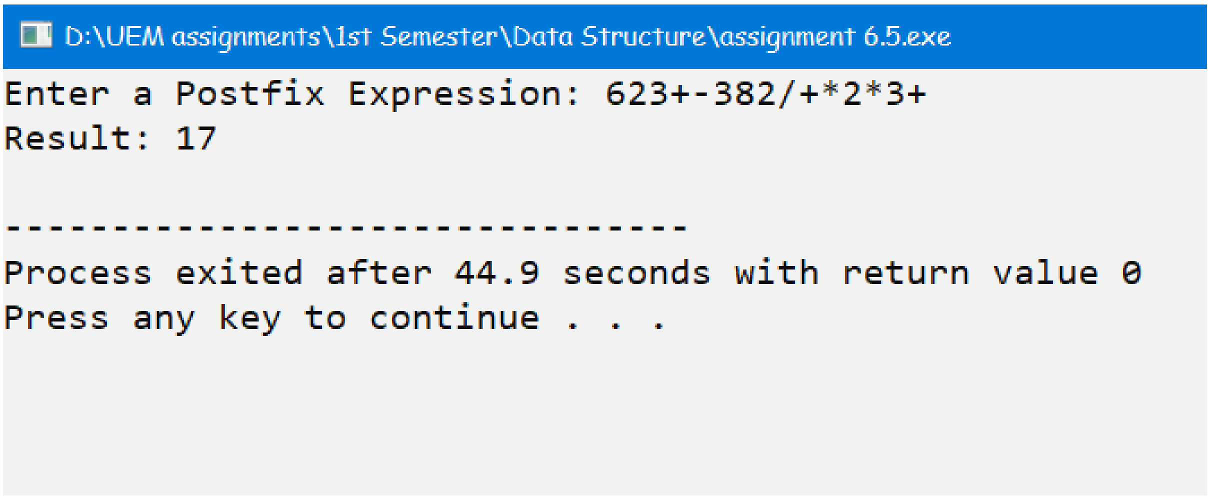
```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#define MAX_SIZE 100
int stack[MAX_SIZE];
int top = -1;
void push(int value) {
    if (top == MAX_SIZE - 1) {
        printf("Stack Overflow\n");
        exit(1);
    } else {
        top++;
        stack[top] = value;
    }
}
int pop() {
    if (top == -1) {
        printf("Stack Underflow\n");
        exit(1);
    } else
        return stack[top--];
}
int evaluatePostfix(char* postfix) {
    int i, a, b;
    for (i = 0; postfix[i] != '\0'; i++) {
        char token = postfix[i];
        if (token >= '0' && token <= '9')
            push(token - '0');
        else {
            a = pop();
            b = pop();
            switch (token) {
                case '+':
                    push(b + a);
                    break;
                case '-':
                    push(b - a);
                    break;
                case '*':
                    push(b * a);
                    break;
                case '/':
                    push(b / a);
                    break;
            }
        }
    }
    return stack[top];
}
int main() {
      char postfix[MAX_SIZE];
      printf("Enter a Postfix Expression: ");
      scanf("%s", postfix);
      int result = evaluatePostfix(postfix);
      printf("Result: %d\n", result);
      return 0;
}
```

Output:



D:\UEM assignments\1st Semester\Data Structure\assignment 6.5.exe

```
Enter a Postfix Expression: 231*+9-
Result: -4

--------------------------------
Process exited after 13.36 seconds with return value 0
Press any key to continue . . .
```



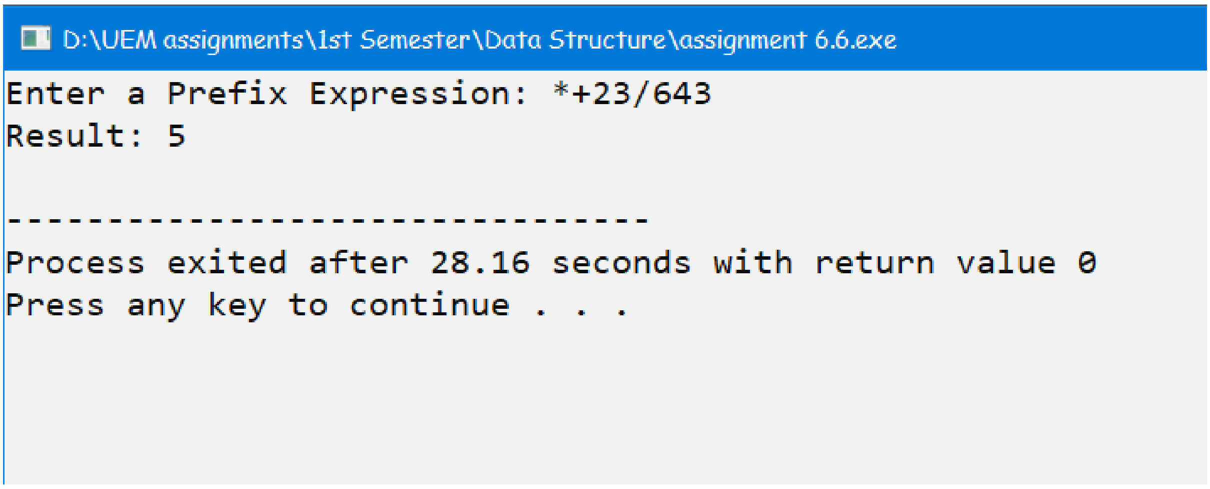
D:\UEM assignments\1st Semester\Data Structure\assignment 6.5.exe

```
Enter a Postfix Expression: 623+-382/+*2*3+
Result: 17

--------------------------------
Process exited after 44.9 seconds with return value 0
Press any key to continue . . .
```

- **Problem No: 6**
- **Problem Statement:** Write a program to evaluate a prefix expression.
- **Source Code:**

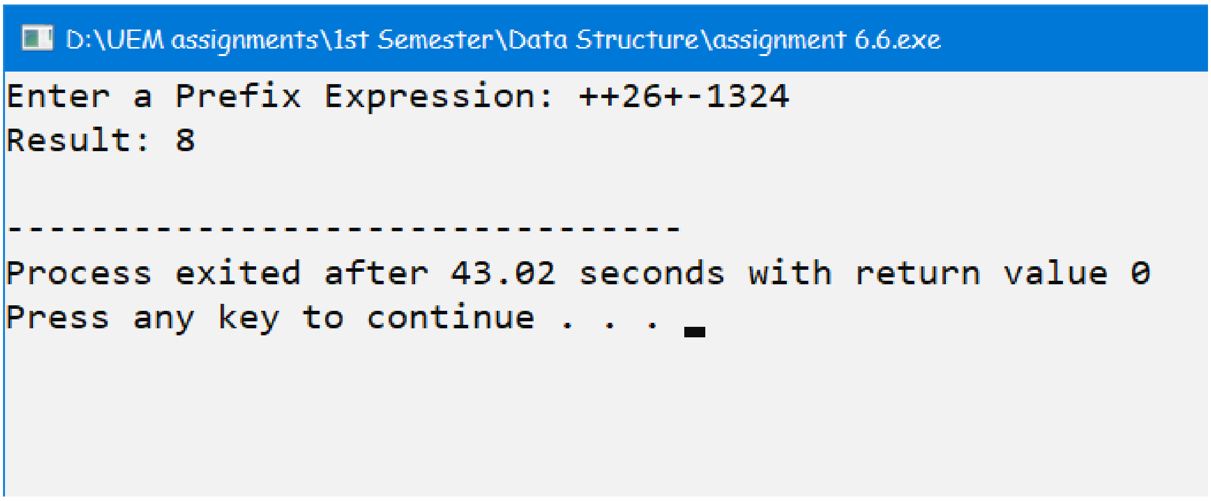
```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#define MAX_SIZE 100
int stack[MAX_SIZE];
int top = -1;
void push(int value) {
    if (top == MAX_SIZE - 1) {
        printf("Stack Overflow\n");
        exit(1);
    } else {
        top++;
        stack[top] = value;
    }
}
int pop() {
    if (top == -1) {
        printf("Stack Underflow\n");
        exit(1);
    } else
        return stack[top--];
}
int evaluatePrefix(char* prefix) {
    int length = strlen(prefix), i;
    for (i = length - 1; i >= 0; i--) {
        char token = prefix[i];
        if (token >= '0' && token <= '9')
            push(token - '0');
        else {
            int a = pop();
            int b = pop();
            switch (token) {
                case '+':
                    push(a + b);
                    break;
                case '-':
                    push(a - b);
                    break;
                case '*':
                    push(a * b);
                    break;
                case '/':
                    push(a / b);
                    break;
            }
        }
    }
    return stack[top];
}
int main() {
	char prefix[MAX_SIZE];
	printf("Enter a Prefix Expression: ");
	scanf("%s", prefix);
	int result = evaluatePrefix(prefix);
	printf("Result: %d\n", result);
	return 0;
}
```

- **Output:**



D:\UEM assignments\1st Semester\Data Structure\assignment 6.6.exe

```
Enter a Prefix Expression: *+23/643
Result: 5

--------------------------------
Process exited after 28.16 seconds with return value 0
Press any key to continue . . .
```



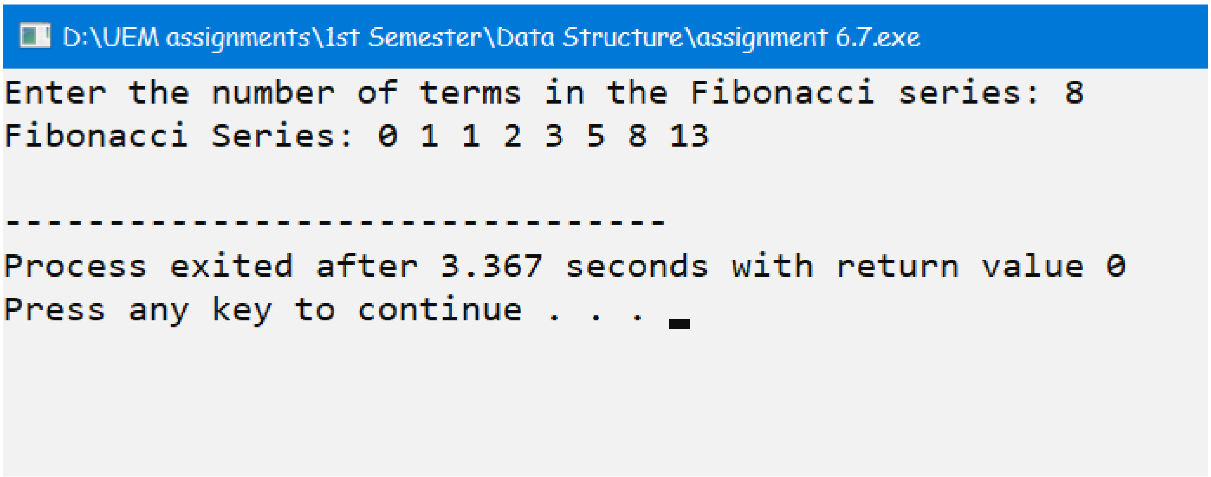
D:\UEM assignments\1st Semester\Data Structure\assignment 6.6.exe

```
Enter a Prefix Expression: ++26+-1324
Result: 8

--------------------------------
Process exited after 43.02 seconds with return value 0
Press any key to continue . . .
```

- **Problem No: 7**
- **Problem Statement:** Write a program to print the Fibonacci series using recursion.
- **Source Code:**

```
#include <stdio.h>
int fibonacci(int n) {
      if (n <= 1)
            return n;
      else
            return fibonacci(n - 1) + fibonacci(n - 2);
}
int main() {
      int n, i;
      printf("Enter the number of terms in the Fibonacci
series: ");
      scanf("%d", &n);
      printf("Fibonacci Series: ");
      for (i = 0; i < n; i++)
            printf("%d ", fibonacci(i));
      printf("\n");
      return 0;
}
```

- **Output:**



D:\UEM assignments\1st Semester\Data Structure\assignment 6.7.exe

```
Enter the number of terms in the Fibonacci series: 8
Fibonacci Series: 0 1 1 2 3 5 8 13

--------------------------------
Process exited after 3.367 seconds with return value 0
Press any key to continue . . .
```

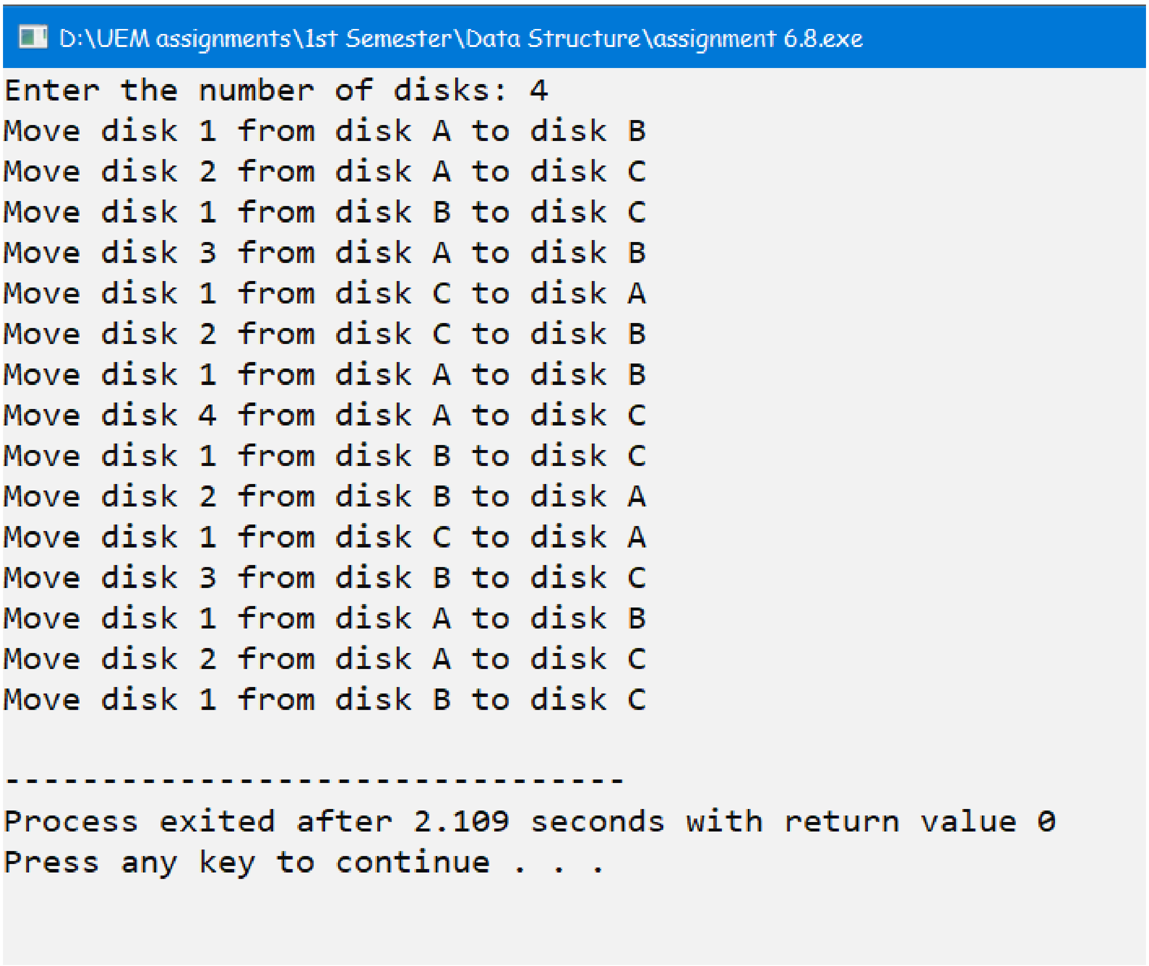
Problem No: 8

Problem Statement: Write a program to solve the tower of Hanoi problem using recursion.

Source Code:

```
 #include <stdio.h>
void towerOfHanoi(int n, char source, char aux, char dest) {
	if (n == 1){
		printf("Move disk 1 from disk %c to disk %c\n", 
source, dest);
		return;
	}
	towerOfHanoi(n - 1, source, dest, aux);
	printf("Move disk %d from disk %c to disk %c\n", n, 
source, dest);
	towerOfHanoi(n - 1, aux, source, dest);
}
int main() {
	int num_disks;
	printf("Enter the number of disks: ");
	scanf("%d", &num_disks);
	towerOfHanoi(num_disks, 'A', 'B', 'C');
	return 0;
}
```

Output:



D:\UEM assignments\1st Semester\Data Structure\assignment 6.8.exe

```
Enter the number of disks: 4
Move disk 1 from disk A to disk B
Move disk 2 from disk A to disk C
Move disk 1 from disk B to disk C
Move disk 3 from disk A to disk B
Move disk 1 from disk C to disk A
Move disk 2 from disk C to disk B
Move disk 1 from disk A to disk B
Move disk 4 from disk A to disk C
Move disk 1 from disk B to disk C
Move disk 2 from disk B to disk A
Move disk 1 from disk C to disk A
Move disk 3 from disk B to disk C
Move disk 1 from disk A to disk B
Move disk 2 from disk A to disk C
Move disk 1 from disk B to disk C

--------------------------------
Process exited after 2.109 seconds with return value 0
Press any key to continue . . .
```