Worksheet – 4

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Cyber Security And Digital Forensics

Task 1: Solve the following programming problems:

1. STL Container Practice: Write a program using STL containers that: (40 marks)
    1. Uses vector<string> to store names (5 Marks)
    2. Uses map<string, int> to store age against each name (5 Marks)
    3. Implements functions to:
        1. Add new name-age pair (10 marks)
        2. Find all people above certain age (10 marks)
        3. Sort and display names alphabetically (10 marks)

```
#include <iostream>
#include <vector>
#include <map>
#include <algorithm>

using namespace std;



class PeopleManagement
{

private:

  vector<string> names;
  map<string, int> ageMap;
```

```
public:

  void addPerson(const string& name, int age)

  {
    if (ageMap.find(name) == ageMap.end())

      {
        names.push_back(name);
        ageMap[name] = age;

      cout << " Person Added: " << name << " (" << age << " years old)\n"<<endl;
      }

    else

      {
        cout << "Entered Name already exists IN FILE . Updating age for " << name <<
    ".\n"<<endl;

        ageMap[name] = age;
      }
  }

  void findPeopleAboveAge(int ageThreshold)
```

```
{
   cout << "\n THE PEOPLES  older than:   " << ageThreshold << ":\n"<<endl;

   bool found = false;
   for (const auto& name : names)

     {
       if (ageMap[name] > ageThreshold)

       {
          cout << name << ":: - " << ageMap[name] << " in years\n"<<endl;

          found = true;
       }

   }
   if (!found)

     {

       cout << "No matching people found above age Enterd " << ageThreshold << ".\n";
     }
}

void displaySortedNames()
```

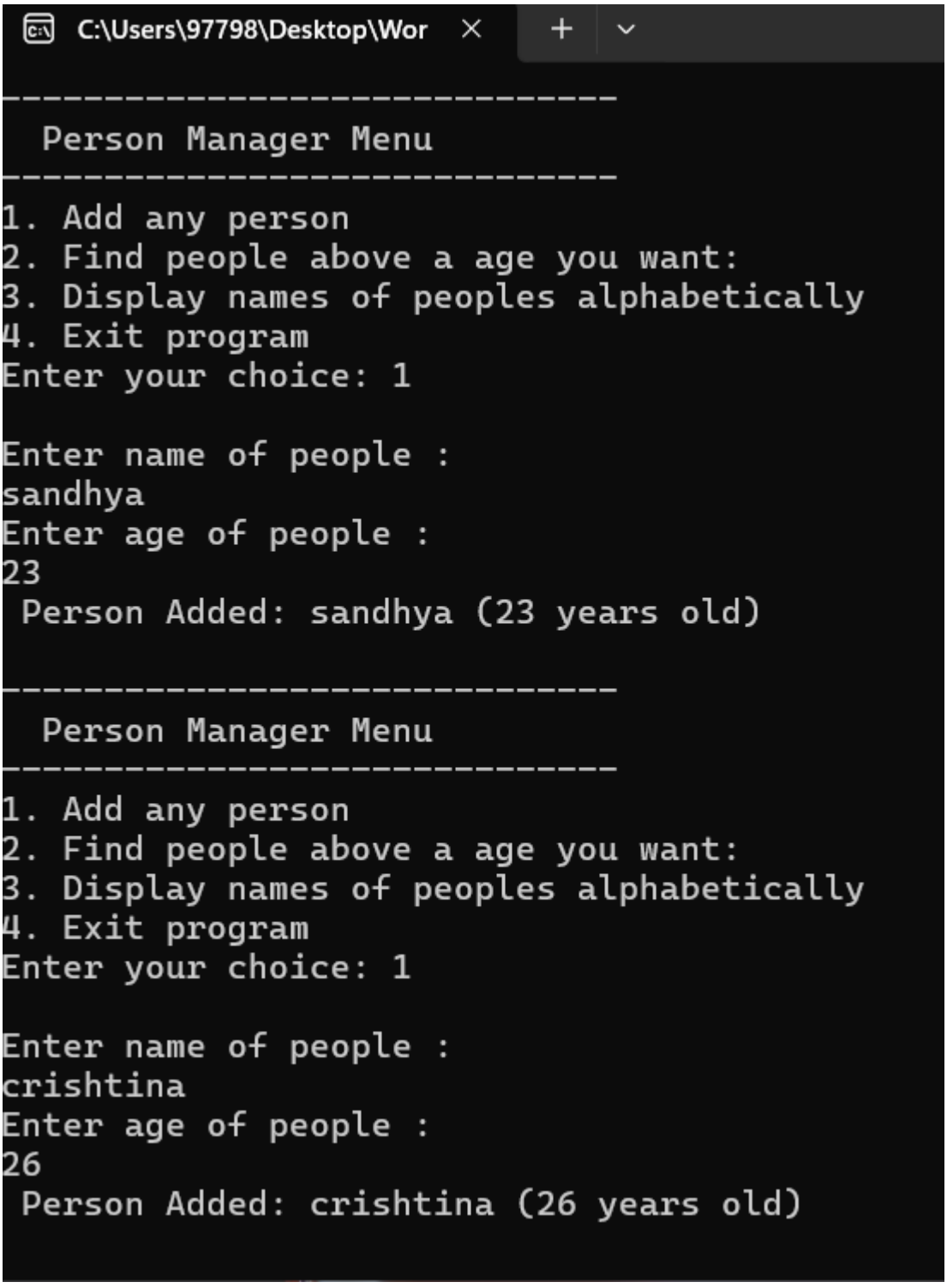
```
{

   vector<string> sortedNames = names;

   sort(sortedNames.begin(), sortedNames.end());

   cout << "\nNames of peoples in alphabetical order:\n";

   for (const auto& name : sortedNames)

      {

         cout << name << " - " << ageMap[name] << " years\n";

      }
}

void displayMenu()

{
   cout<<"-----------------------------";
   cout << "\n  Person Manager Menu \n";
   cout<<"-----------------------------"<<endl;

   cout << "1. Add any person\n";

   cout << "2. Find people above a age you want: \n";
```

```
    cout << "3. Display names of peoples alphabetically\n";

    cout << "4. Exit program \n";

    cout << "Enter your choice: ";
}

void handleMenuChoice(int choice)

{
    switch (choice)

    {
        case 1:

            {

                string name;
                int age;

                cout << "Enter name of people : "<<endl;
                cin >> name;

                cout << "Enter age of people : "<<endl;
                cin >> age;
```

```
        addPerson(name, age);
        break;
    }

case 2:

    {
        int ageThreshold;

        cout << "Enter age threshold you want :  "<<endl;
        cin >> ageThreshold;

        findPeopleAboveAge(ageThreshold);
        break;
    }

case 3:

    displaySortedNames();

    break;

case 4:

    cout << "Exiting the program...\n"<<endl;
```

```
            break;

        default:

            cout << "Invalid choice. Please make correct choice.\n"<<endl;
      }
   }
};



int main()

{
   PeopleManagement m;

   int choice;

   do
     {
        m.displayMenu();

        cin >> choice;
        cout<<endl;

        m.handleMenuChoice(choice);
```

```
        }

    while (choice != 4);



    return 0;
}
```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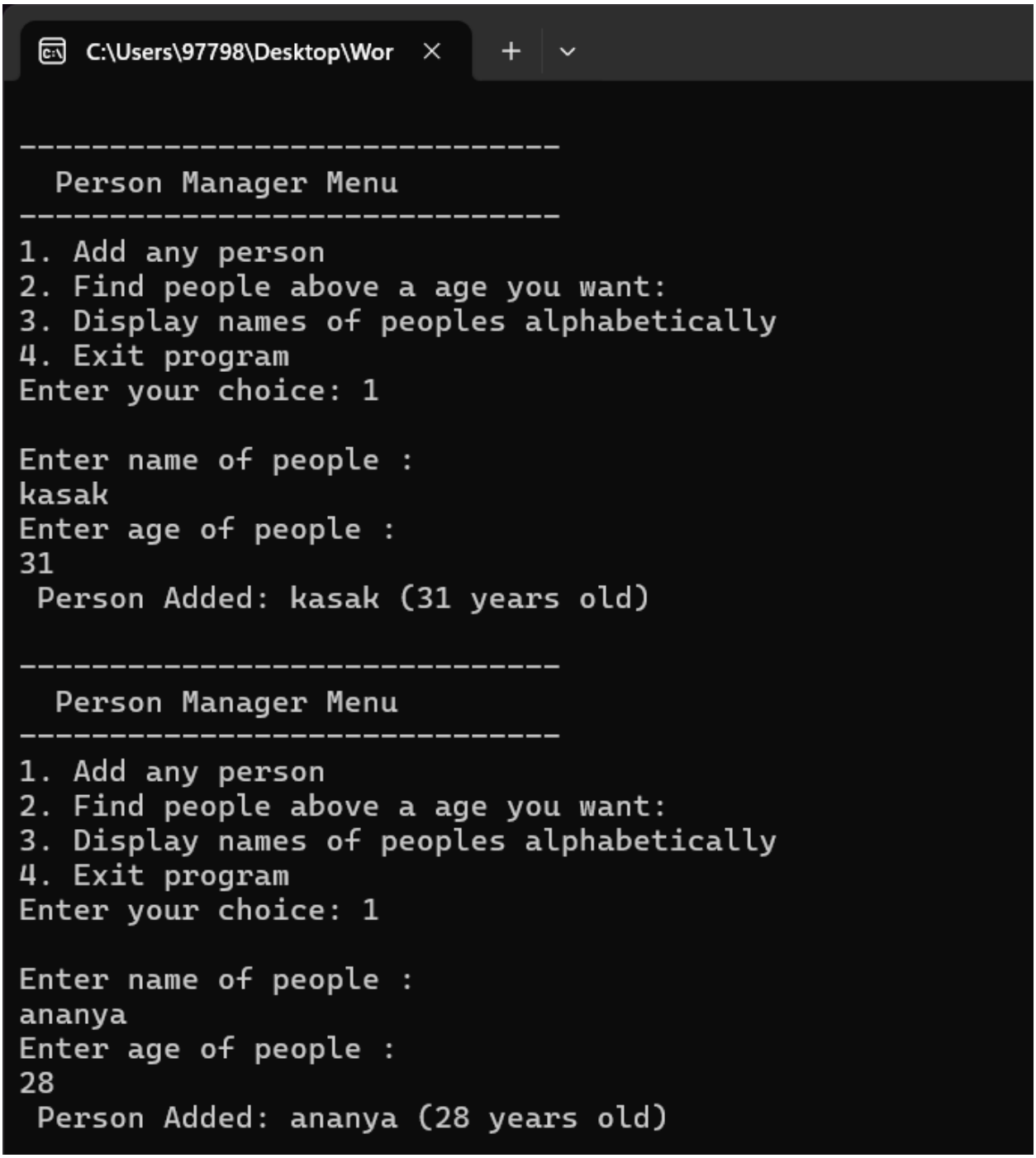
Person Manager Menu
1. Add any person
2. Find people above a age you want:
3. Display names of peoples alphabetically
4. Exit program
Enter your choice: 1
Enter name of people :
sandhya
Enter age of people :
23
Person Added: sandhya (23 years old)
Person Manager Menu
1. Add any person
2. Find people above a age you want:
3. Display names of peoples alphabetically
4. Exit program
Enter your choice: 1
Enter name of people :
crishtina
Enter age of people :
26
Person Added: crishtina (26 years old)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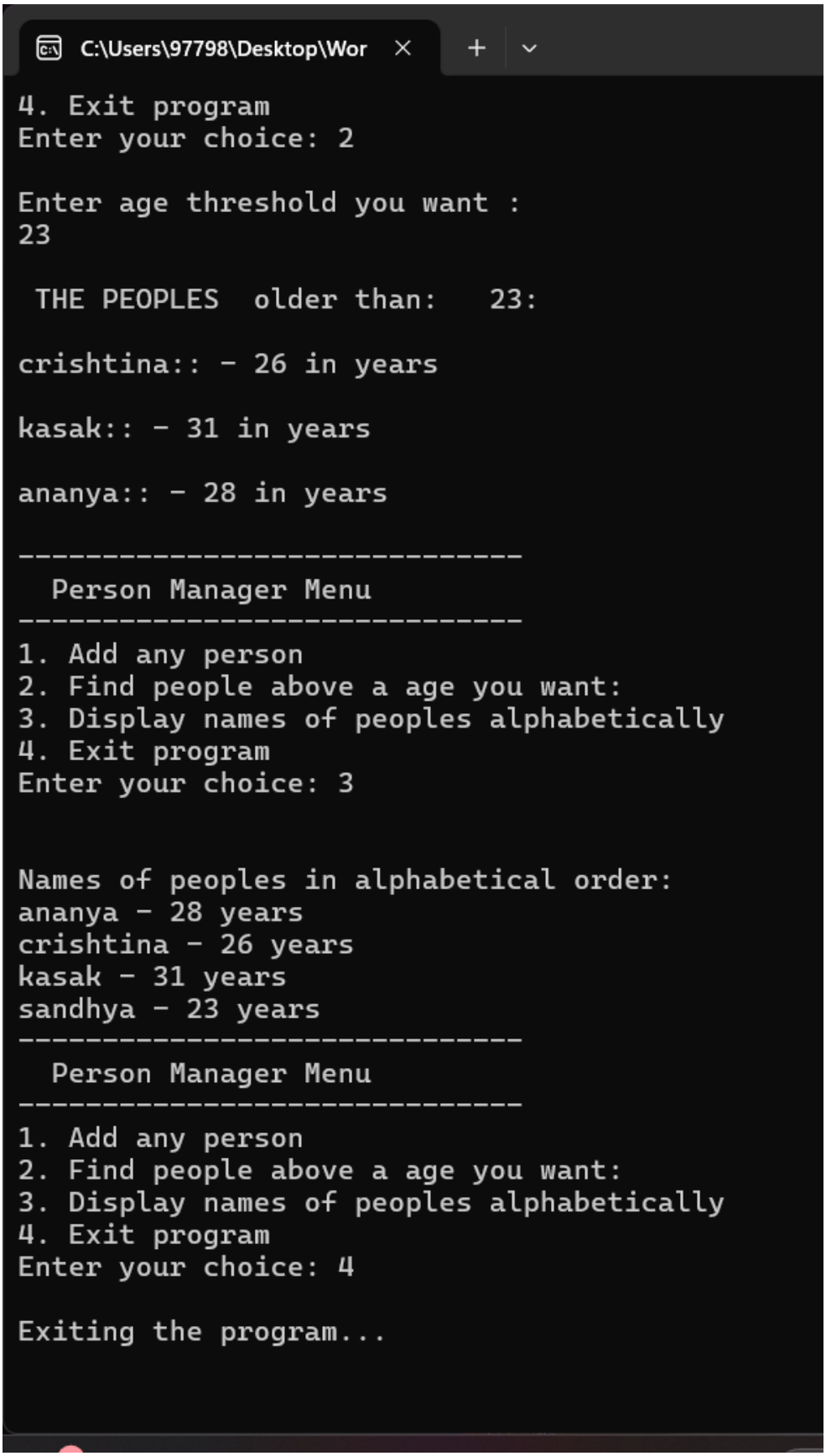
Person Manager Menu
----
1. Add any person
2. Find people above a age you want:
3. Display names of peoples alphabetically
4. Exit program
Enter your choice: 1
Enter name of people :
kasak
Enter age of people :
31
Person Added: kasak (31 years old)

Person Manager Menu
----
1. Add any person
2. Find people above a age you want:
3. Display names of peoples alphabetically
4. Exit program
Enter your choice: 1
Enter name of people :
ananya
Enter age of people :
28
Person Added: ananya (28 years old)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4. Exit program
Enter your choice: 2
Enter age threshold you want :
23
THE PEOPLES older than: 23:
crishtina:: - 26 in years
kasak:: - 31 in years
ananya:: - 28 in years
Person Manager Menu
1. Add any person
2. Find people above a age you want:
3. Display names of peoples alphabetically
4. Exit program
Enter your choice: 3
Names of peoples in alphabetical order:
ananya - 28 years
crishtina - 26 years
kasak - 31 years
sandhya - 23 years
Person Manager Menu
1. Add any person
2. Find people above a age you want:
3. Display names of peoples alphabetically
4. Exit program
Enter your choice: 4
Exiting the program...

2. Stack Problem: Implement a stack using arrays (not STL) that: (20 marks)
    1. Has basic push and pop operations
    2. Has a function to find middle element
    3. Has a function to reverse only bottom half of stack
    4. Maintain stack size of 10

```
#include <iostream>
using namespace std;

class Stack

{

private:

  int arr[10];
  int top;

public:
  Stack()

    {
      top = -1;

    }

  bool isFull()

    {
      return top == 9;
    }

  bool isEmpty()

    {

      return top == -1;
```

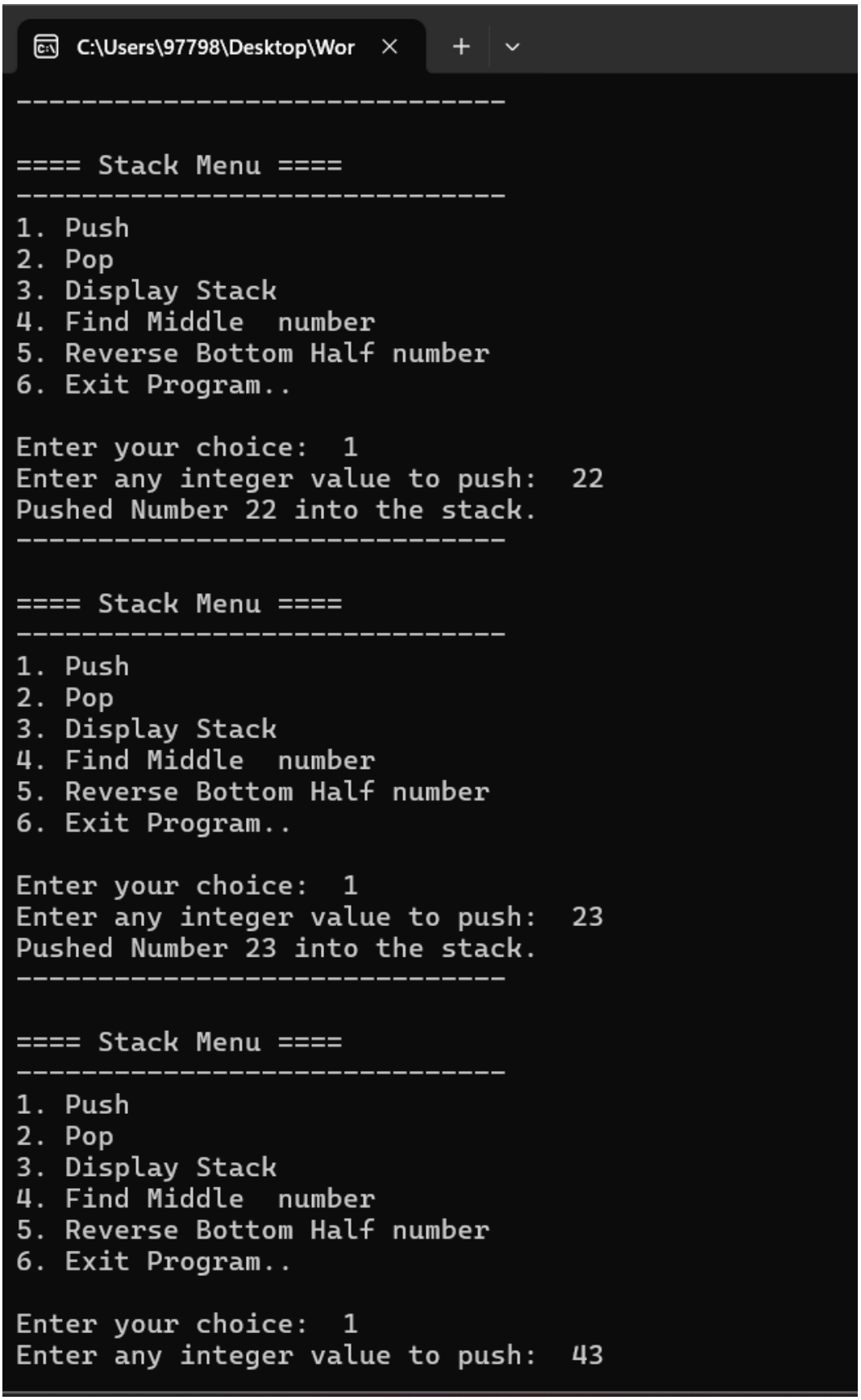
```
    }

  void push(int value)

  {
    if (isFull())

      {
        cout << "Stack has Overflow! Cannot push more elements " << value <<
endl;
        return;
      }

    arr[++top] = value;

    cout << "Pushed Number " << value << " into the stack.\n";
  }

  void pop()

  {
    if (isEmpty())

      {
        cout << "Stack Underflow!\n";

        return;
      }

      cout << "Popped " << arr[top--] << " from stack.\n";
  }

  void display()

  {
    if (isEmpty())

      {
```

```
        cout << "your Stack is empty.\n";

        return;
      }

      cout << "Showing Stack from top to bottom:\n";

   for (int i = top; i >= 0; i--)

      {

      cout << arr[i] << " ";
      }

   cout << endl;
}

void findMiddle()
{
   if (isEmpty())

      {

         cout << "Stack has no any middle numbers: \n";

         return;
      }

   int middleIndex = top / 2;

   cout << "The Middle element: " << arr[middleIndex] << endl;

}

void reverseBottomHalf()

{
   if (top < 1)
```

```
        {
            cout << "No any elements to reverse bottom half.\n";
            return;
        }
    int n = top + 1;
    int mid = n / 2;
    for (int i = 0; i < mid / 2; i++)
        {
            swap(arr[i], arr[mid - 1 - i]);
        }
        cout << "Bottom half of stack is reversed.\n";
  }
};

int main()
{
  Stack s;
  int choice, value;
  do
    {
      cout<<"------------------------------"<<endl;
      cout << "\n==== Stack Menu ====\n";
      cout<<"------------------------------"<<endl;
```

```
    cout << "1. Push\n";

    cout << "2. Pop \n";

    cout << "3. Display Stack \n";

    cout << "4. Find Middle  number\n";

    cout << "5. Reverse Bottom Half number \n";

    cout << "6. Exit Program..\n"<<endl;

    cout << "Enter your choice:  ";

    cin >> choice;

  switch (choice)

  {
    case 1:

        cout << "Enter any integer value to push:  ";
        cin >> value;

        s.push(value);

        break;

    case 2:

        s.pop();

        break;

    case 3:

        s.display();
```

```
            break;
        case 4:
            s.findMiddle();
            break;
        case 5:
            s.reverseBottomHalf();
            break;
        case 6:
            cout << "Exiting program...\n";
            break;
        default:
        cout << "Invalid choice ! make correct choice.\n";
      }
   }
   while (choice != 6);
   return 0;
}
```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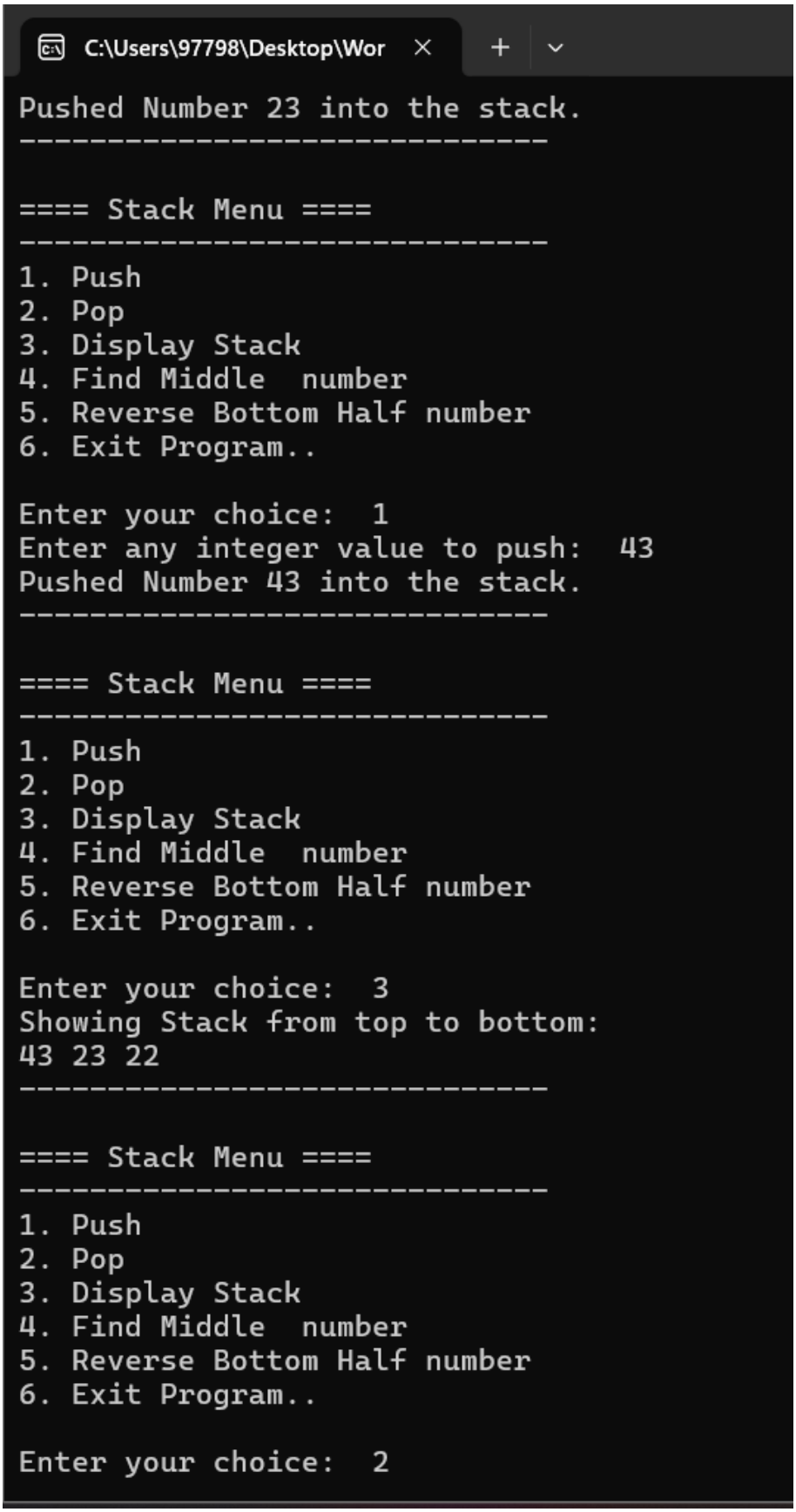
==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 1
Enter any integer value to push: 22
Pushed Number 22 into the stack.

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 1
Enter any integer value to push: 23
Pushed Number 23 into the stack.

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 1
Enter any integer value to push: 43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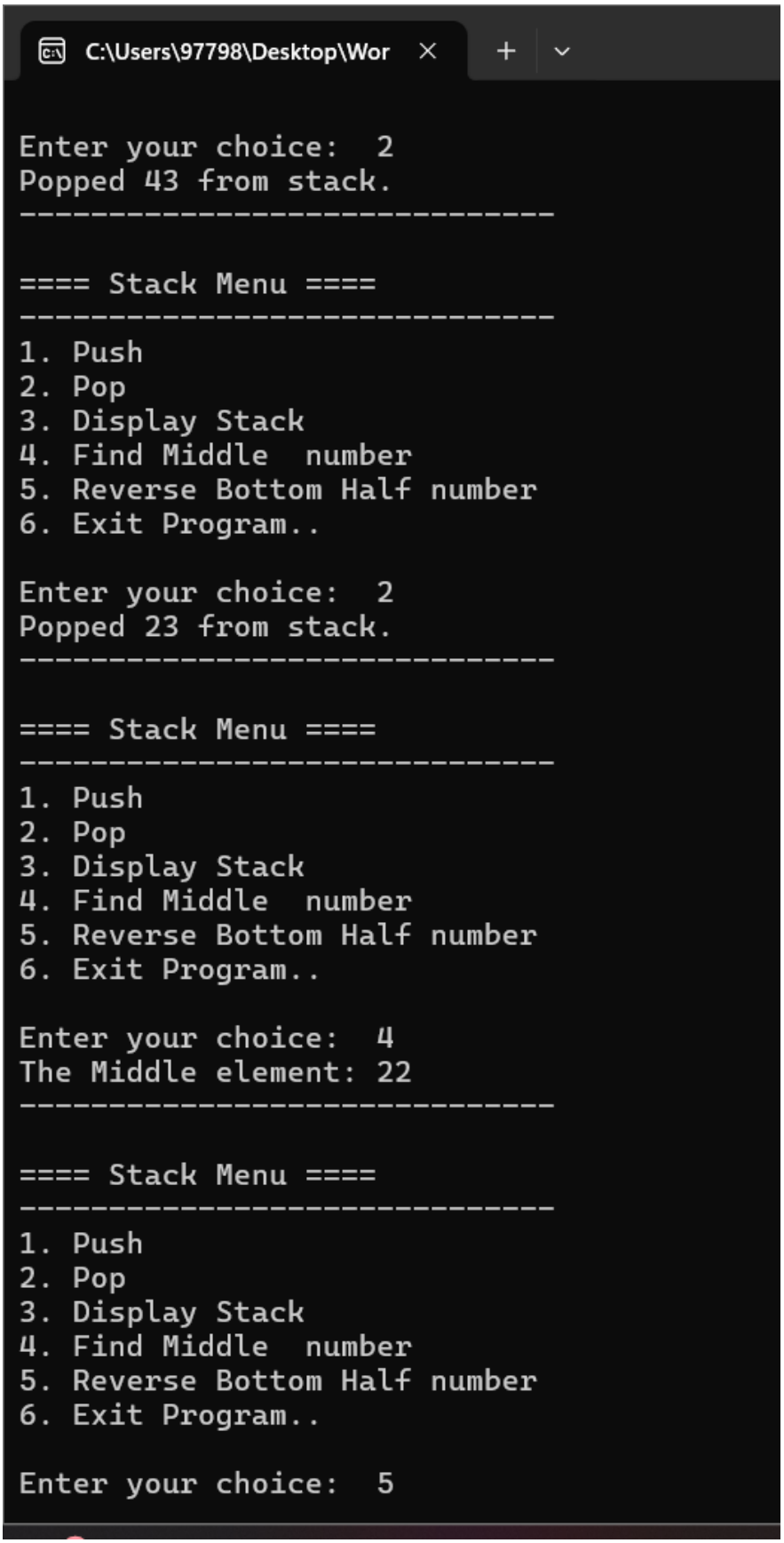
Pushed Number 23 into the stack.

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 1
Enter any integer value to push: 43
Pushed Number 43 into the stack.

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 3
Showing Stack from top to bottom:
43 23 22

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 2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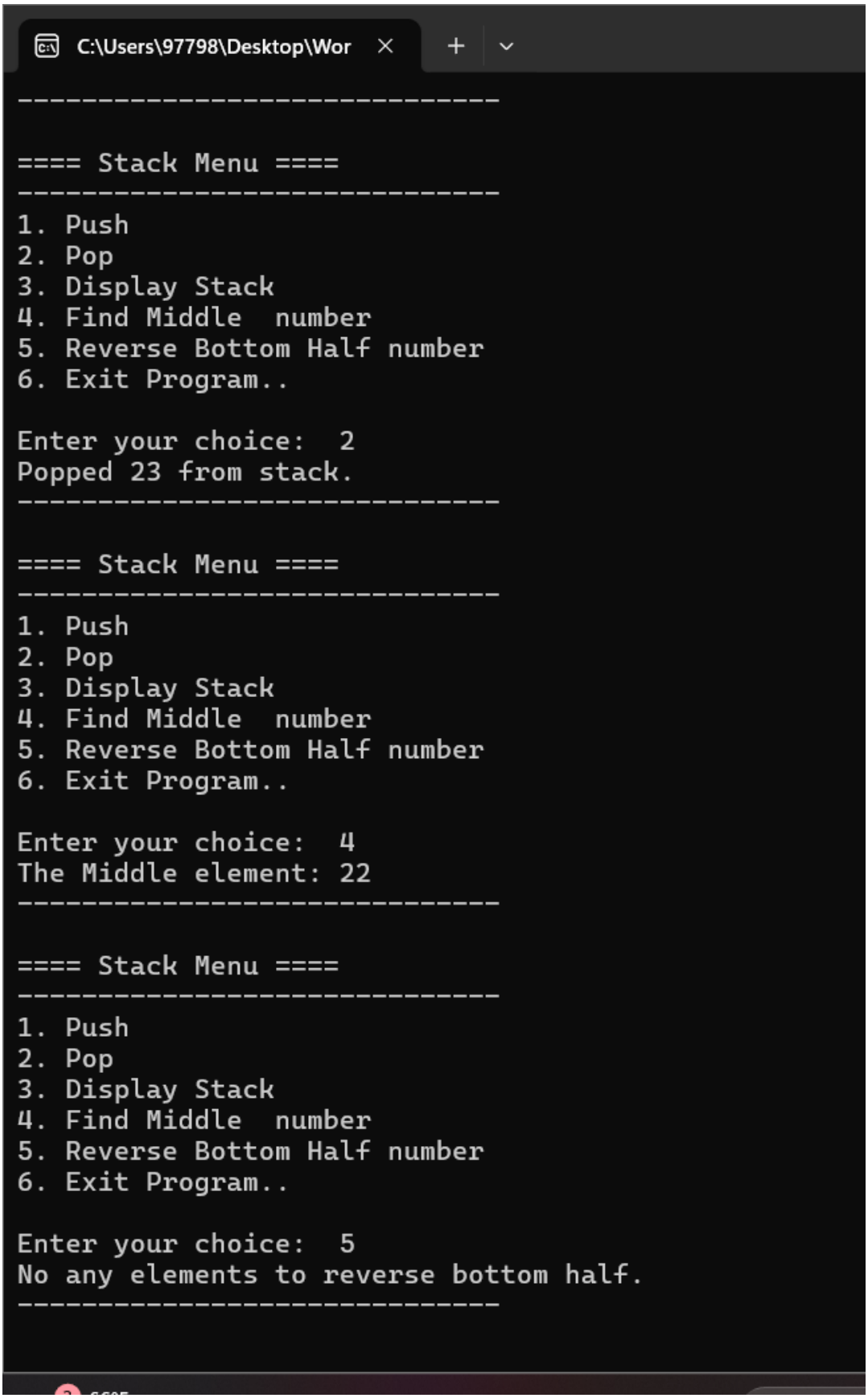
Enter your choice: 2
Popped 43 from stack.

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 2
Popped 23 from stack.

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 4
The Middle element: 22

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 5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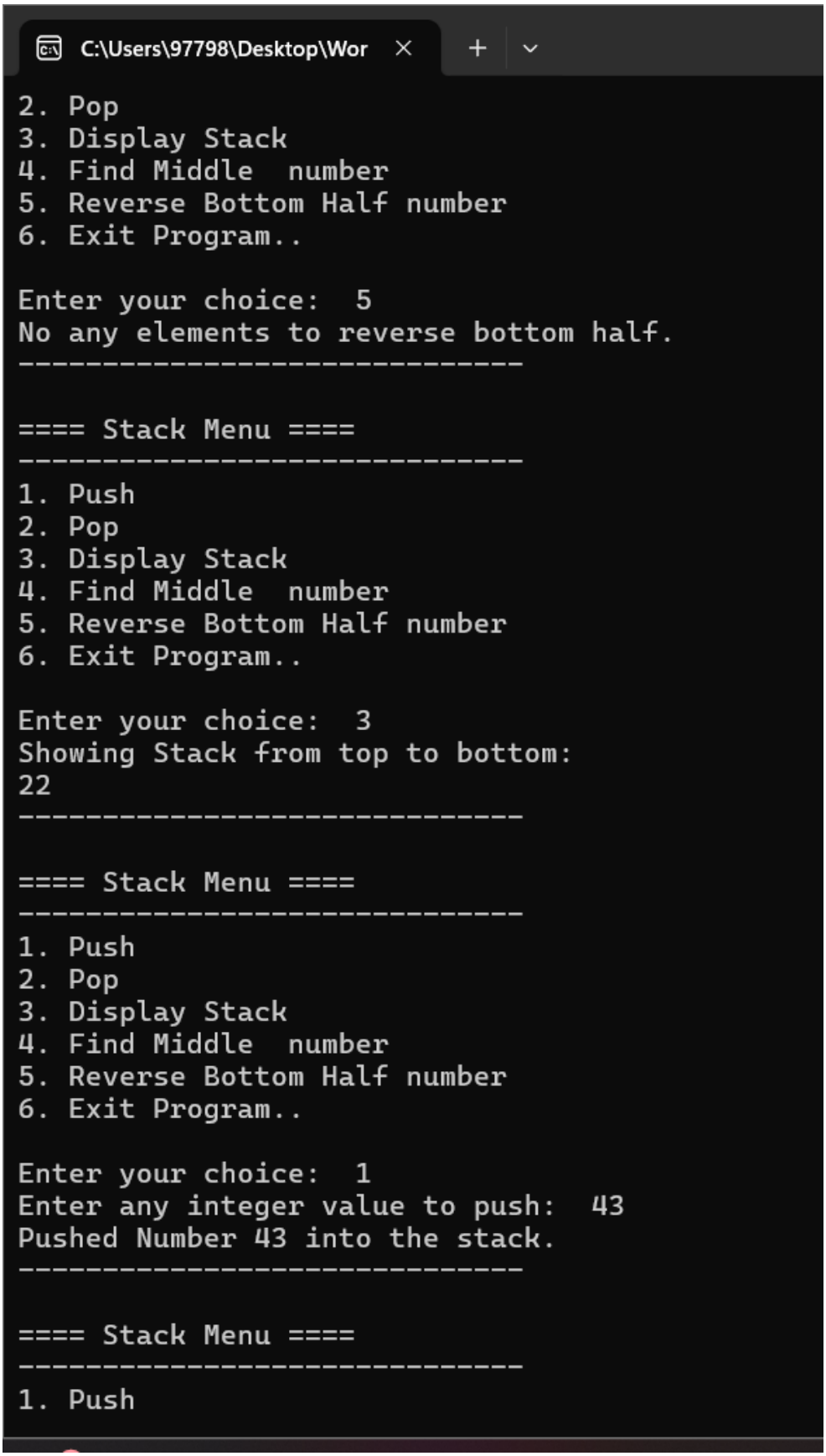
==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 2
Popped 23 from stack.

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 4
The Middle element: 22

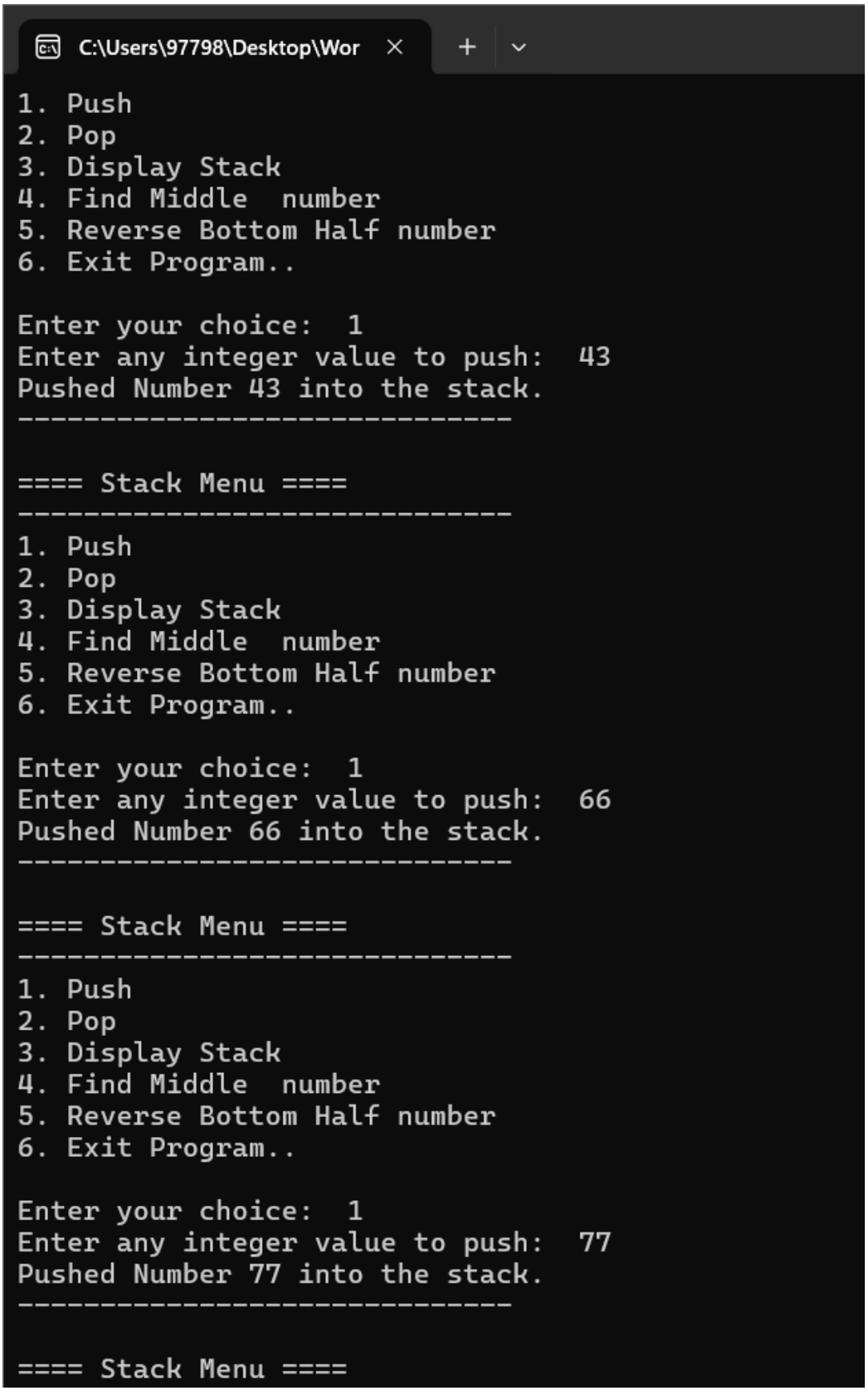
==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 5
No any elements to reverse bottom half.


C:\Users\97798\Desktop\Wor
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 5
No any elements to reverse bottom half.

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 3
Showing Stack from top to bottom:
22

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 1
Enter any integer value to push: 43
Pushed Number 43 into the stack.

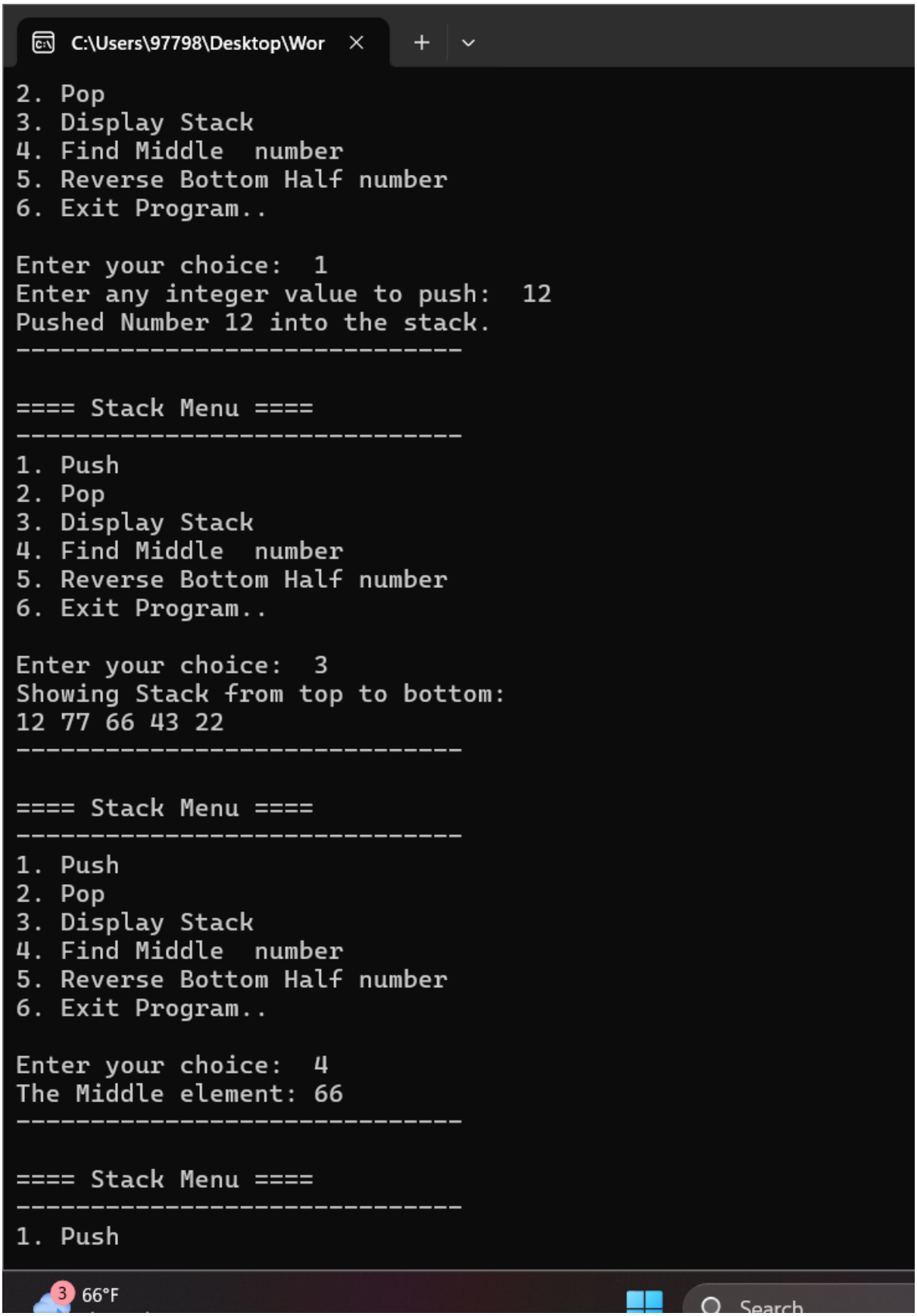
==== Stack Menu ====
---
1. Push


C:\Users\97798\Desktop\Wor
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 1
Enter any integer value to push: 43
Pushed Number 43 into the stack.

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 1
Enter any integer value to push: 66
Pushed Number 66 into the stack.

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 1
Enter any integer value to push: 77
Pushed Number 77 into the stack.

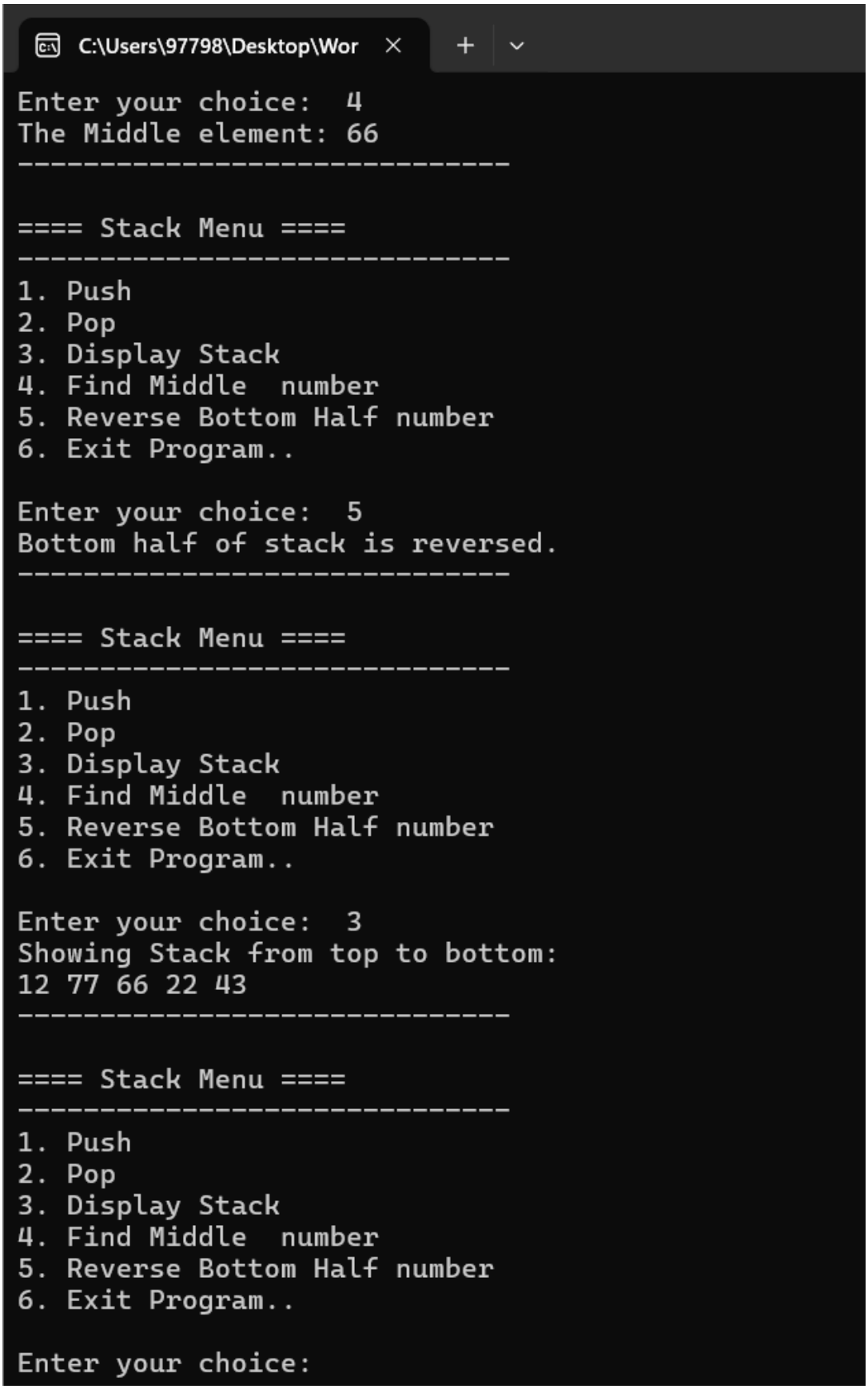
==== Stack Menu ====


C:\Users\97798\Desktop\Wor
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 1
Enter any integer value to push: 12
Pushed Number 12 into the stack.

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 3
Showing Stack from top to bottom:
12 77 66 43 22

==== Stack Menu ====
---
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 4
The Middle element: 66

==== Stack Menu ====
---
1. Push
3
66°F
Search


C:\Users\97798\Desktop\Wor
Enter your choice: 4
The Middle element: 66

==== Stack Menu ====
----
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 5
Bottom half of stack is reversed.

==== Stack Menu ====
----
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice: 3
Showing Stack from top to bottom:
12 77 66 22 43

==== Stack Menu ====
----
1. Push
2. Pop
3. Display Stack
4. Find Middle number
5. Reverse Bottom Half number
6. Exit Program..
Enter your choice:

1. Queue Problem: Implement a queue using arrays (not STL) that: (20 marks)
    1. Has basic enqueue and dequeue operations
    2. Has a function to reverse first K elements
    3. Has a function to interleave first half with second half
    4. Handle queue overflow/underflow

```
#include <iostream>

using namespace std;


#define SIZE 10


class Queue


{


private:


  int arr[SIZE];

  int front, rear;


public:

  Queue()


    {
```

```
    front = rear = -1;
  }

bool isEmpty()

  {

    return front == -1;
  }

bool isFull()

  {

    return (rear + 1) % SIZE == front;

  }

void enqueue(int value)

{
  if (isFull())

    {
      cout << "Queue Overflow! Cannot enqueue " << value << endl;
```

```
        return;
    }

  if (isEmpty())

    {
        front = rear = 0;
    }

  else

    {

        rear = (rear + 1) % SIZE;

    }

  arr[rear] = value;
  cout << "Enqueued: " << value << endl;

}

void dequeue()

{
  if (isEmpty())
```

```
    {
        cout << "Queue Underflow!\n";
        return;
    }

  cout << "Dequeued: " << arr[front] << endl;

  if (front == rear)
    {

    front = rear = -1;
  }

  else

    {

        front = (front + 1) % SIZE;
    }
}

void display()

{
  if (isEmpty())
```

```
    {
        cout << "Queue is empty.\n";

        return;
    }

  cout << "Queue: ";

  int i = front;
  while (true)

    {
        cout << arr[i] << " ";

        if (i == rear) break;

            i = (i + 1) % SIZE;
    }

  cout << endl;
}

int size()

{
  if (isEmpty()) return 0;
```

```
    if (rear >= front) return rear - front + 1;

    return SIZE - front + rear + 1;
}

void reverseFirstK(int k)

{
    if (k > size() || k <= 0)

        {
            cout << "Invalid value of K.\n";

            return;
        }

    int temp[SIZE];

    int count = 0;

    int i = front;

    for (int j = k - 1; j >= 0; --j)

        {
```

```
        temp[j] = arr[i];

        i = (i + 1) % SIZE;

        count++;
    }

    i = front;

    for (int j = 0; j < k; ++j)

        {

            arr[i] = temp[j];

            i = (i + 1) % SIZE;
        }

    cout << "Reversed first " << k << " elements.\n";
}

void interleave()

{
    int n = size();
```

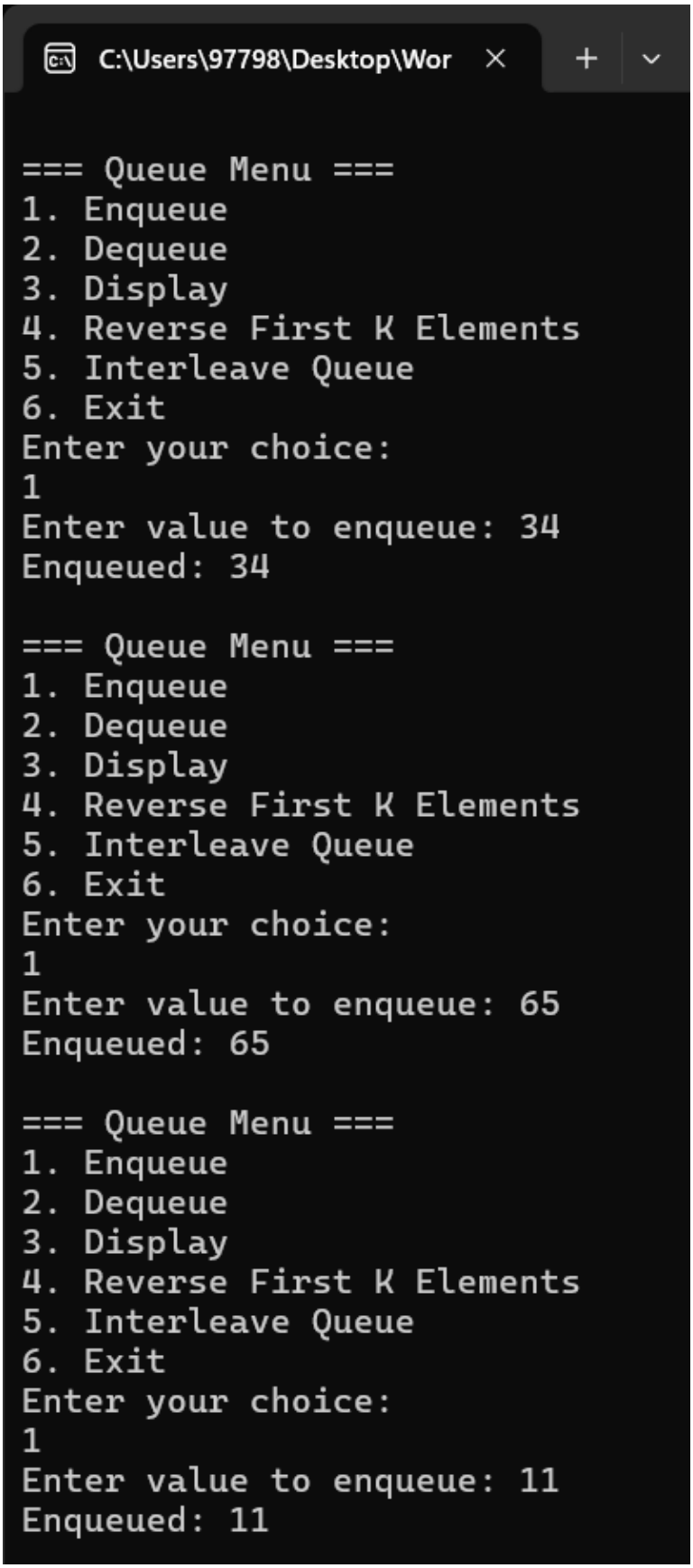
```
if (n % 2 != 0)

  {
     cout << "Queue size must be even to interleave.\n";

     return;
  }



int firstHalf[n/2], secondHalf[n/2];

int i = front;

for (int j = 0; j < n / 2; ++j)

  {

     firstHalf[j] = arr[i];

     i = (i + 1) % SIZE;
  }

for (int j = 0; j < n / 2; ++j)

  {
```

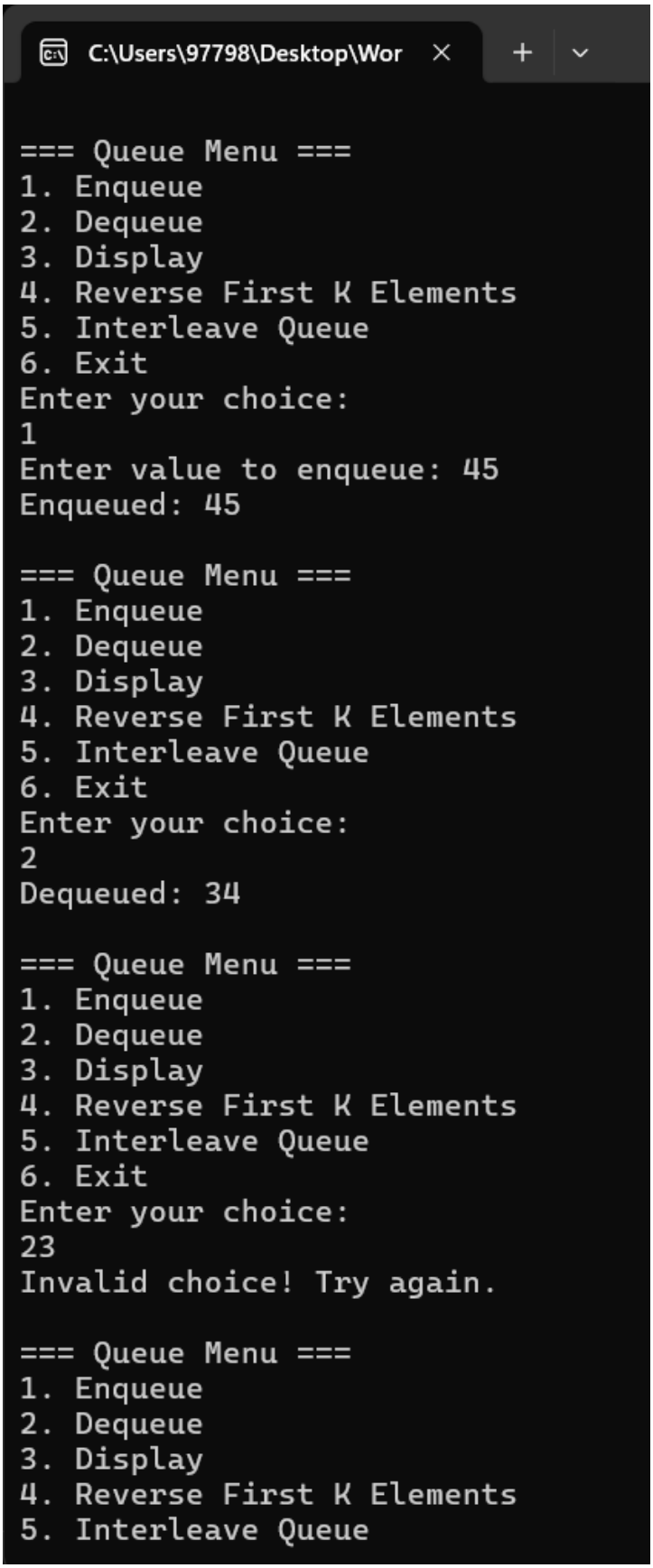
```
            secondHalf[j] = arr[i];

            i = (i + 1) % SIZE;
        }

    i = front;
    for (int j = 0; j < n / 2; ++j)

        {
            arr[i] = firstHalf[j];

            i = (i + 1) % SIZE;

            arr[i] = secondHalf[j];

            i = (i + 1) % SIZE;
        }

        cout << "Interleaved first half with second half.\n";
  }
};

int main()

{
  Queue q;
```

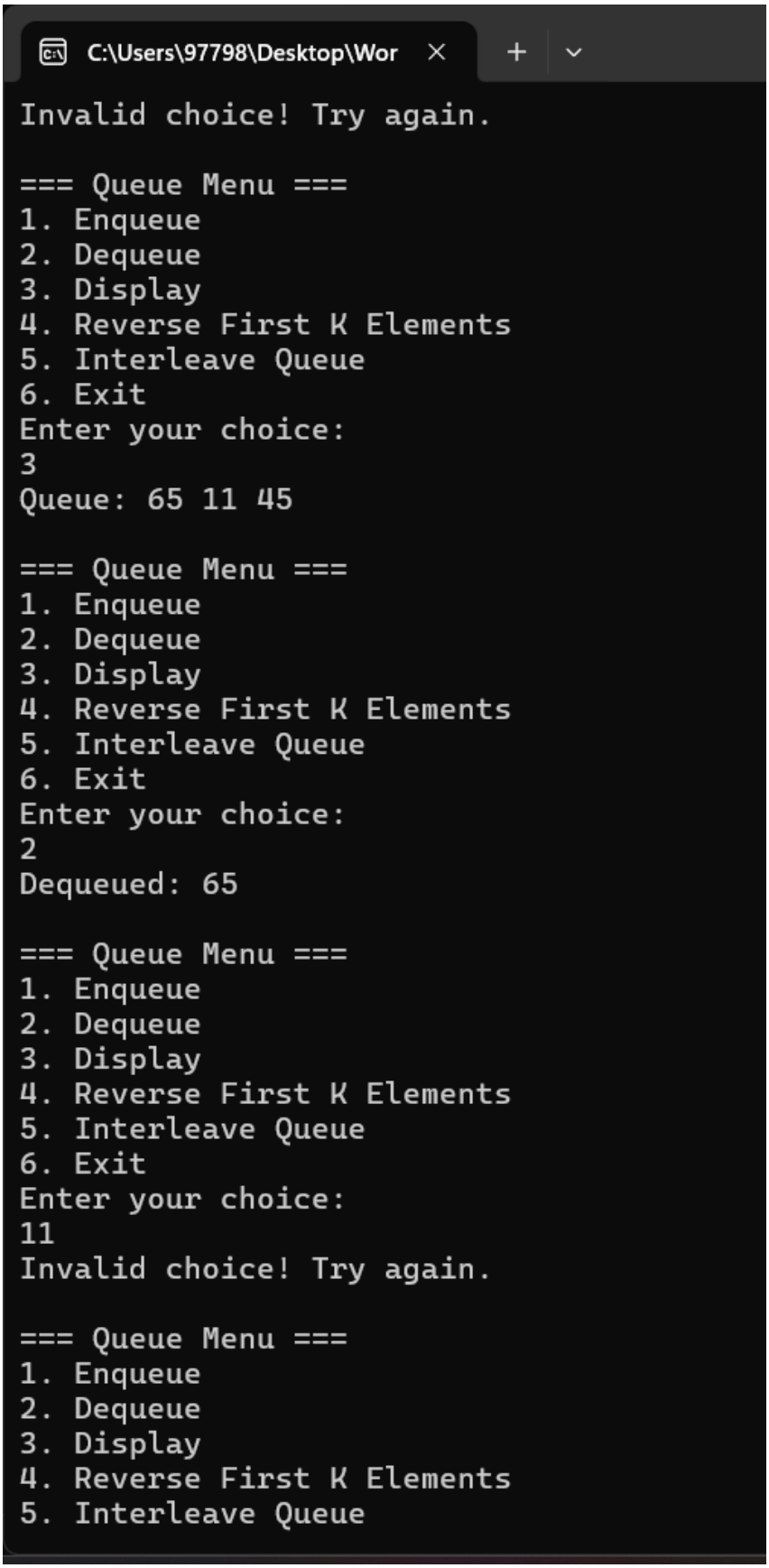
```
int choice, value, k;

do

  {
     cout << "\n=== Queue Menu ===\n";

     cout << "1. Enqueue\n";
     cout << "2. Dequeue\n";

     cout << "3. Display\n";
     cout << "4. Reverse First K Elements\n";

     cout << "5. Interleave Queue\n";
     cout << "6. Exit\n";
     cout << "Enter your choice: "<<endl;

     cin >> choice;

   switch (choice)

   {

     case 1:
```

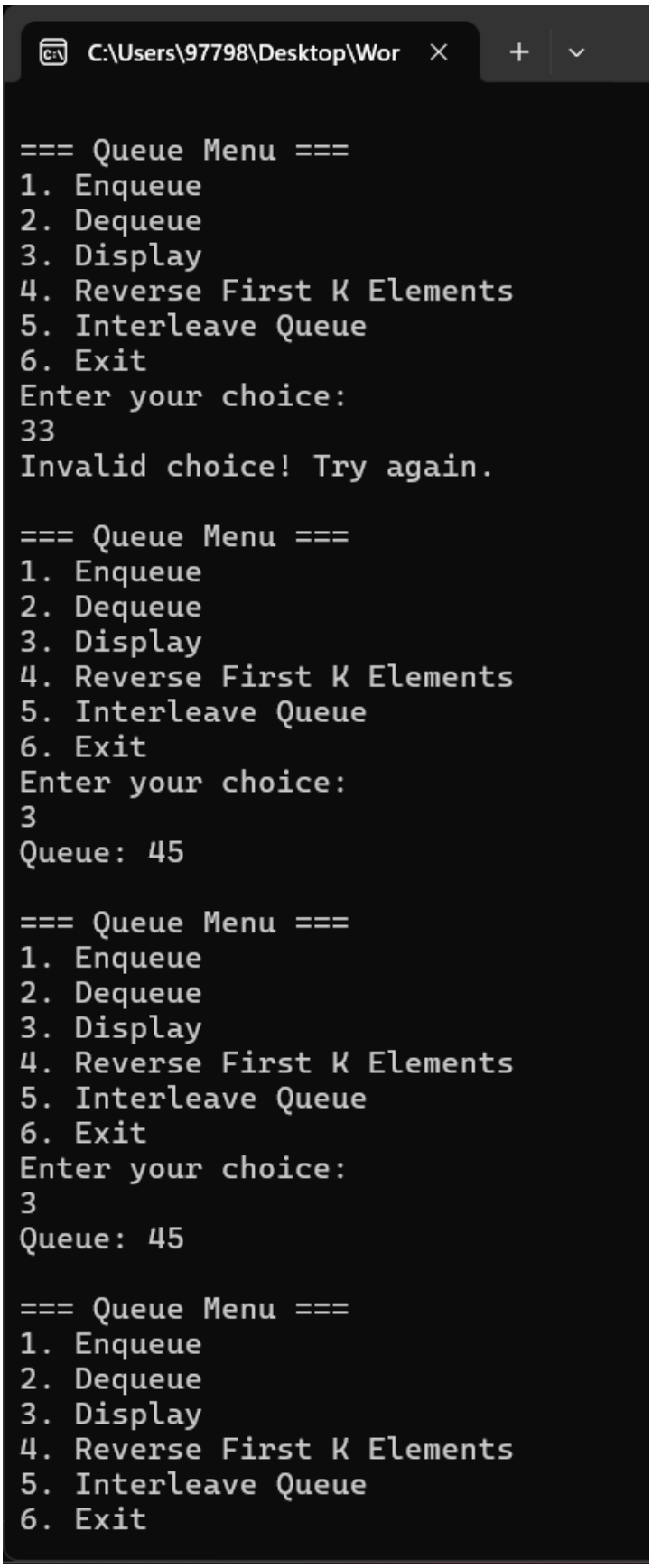
```
    cout << "Enter value to enqueue: ";
    cin >> value;

    q.enqueue(value);
    break;

case 2:

    q.dequeue();
    break;

case 3:

    q.display();
    break;

case 4:

    cout << "Enter value of K: ";
    cin >> k;

    q.reverseFirstK(k);
    break;

case 5:
```

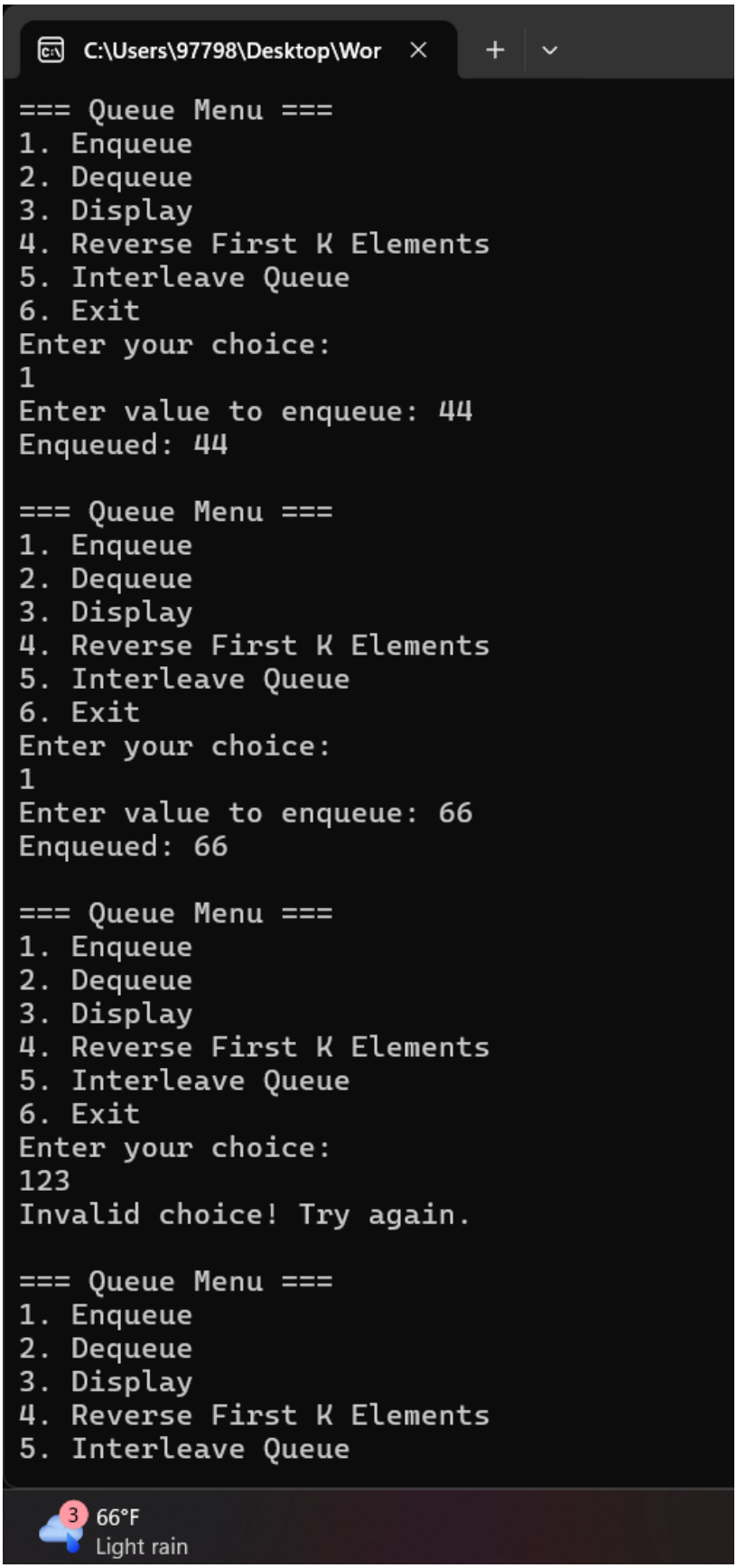
```
            q.interleave();
            break;

        case 6:

            cout << "Exiting program.\n";
            break;

        default:

            cout << "Invalid choice! Try again.\n";
        }

    } while (choice != 6);

    return 0;
}
```

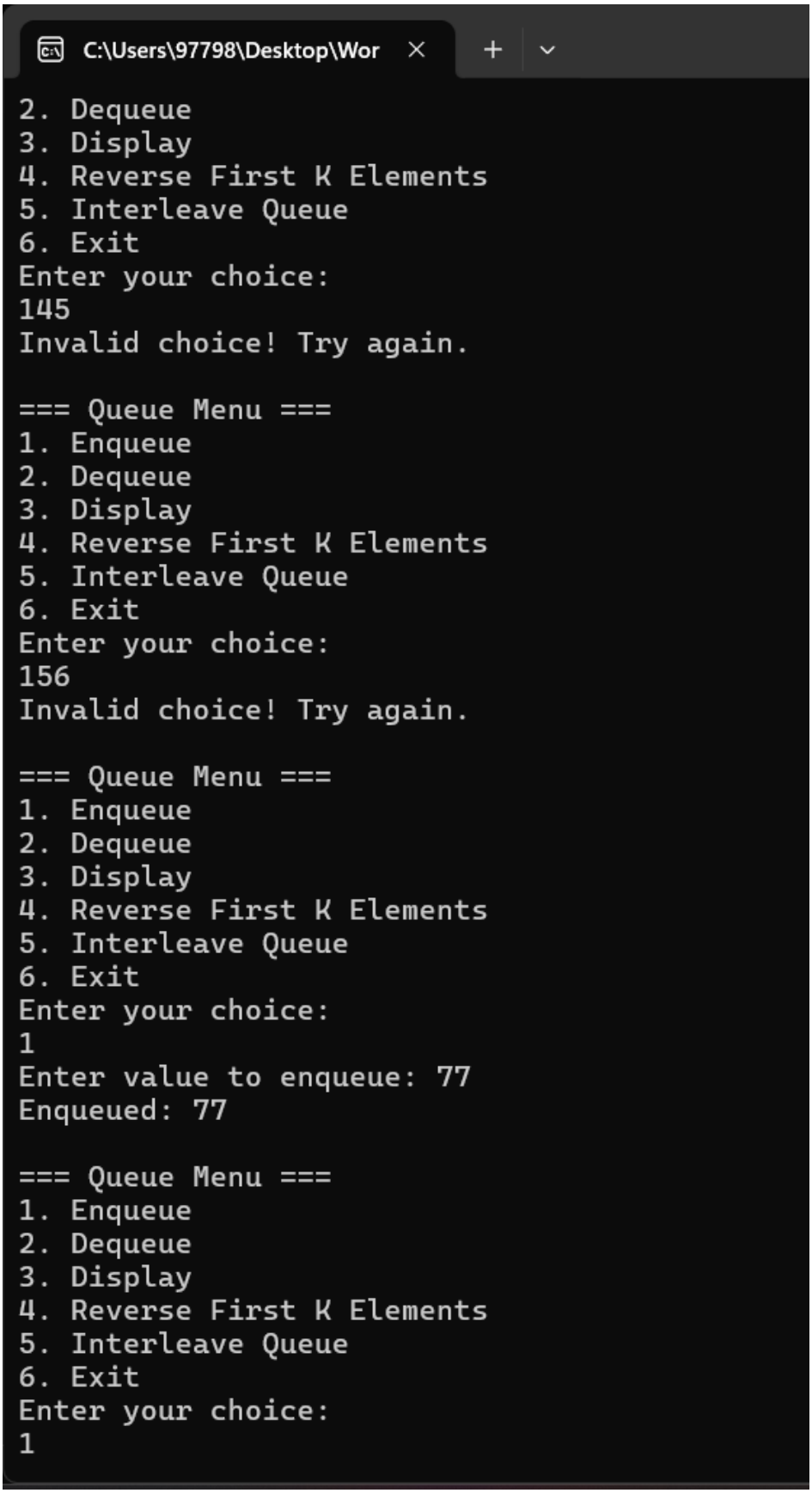

C:\Users\97798\Desktop\Wor
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
1
Enter value to enqueue: 34
Enqueued: 34
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
1
Enter value to enqueue: 65
Enqueued: 65
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
1
Enter value to enqueue: 11
Enqueued: 11

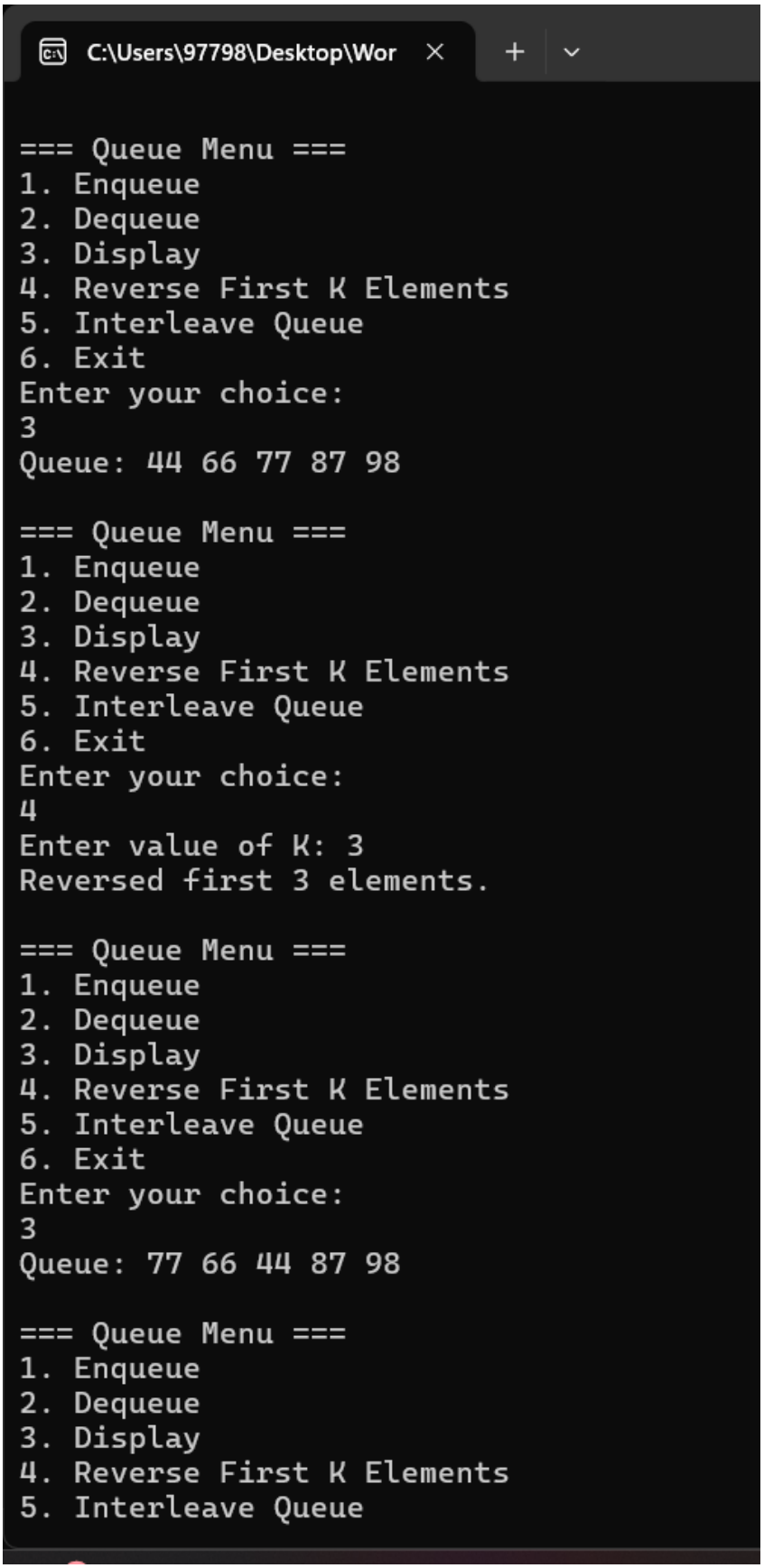

C:\Users\97798\Desktop\Wor
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
1
Enter value to enqueue: 45
Enqueued: 45
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
2
Dequeued: 34
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
23
Invalid choice! Try again.
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue

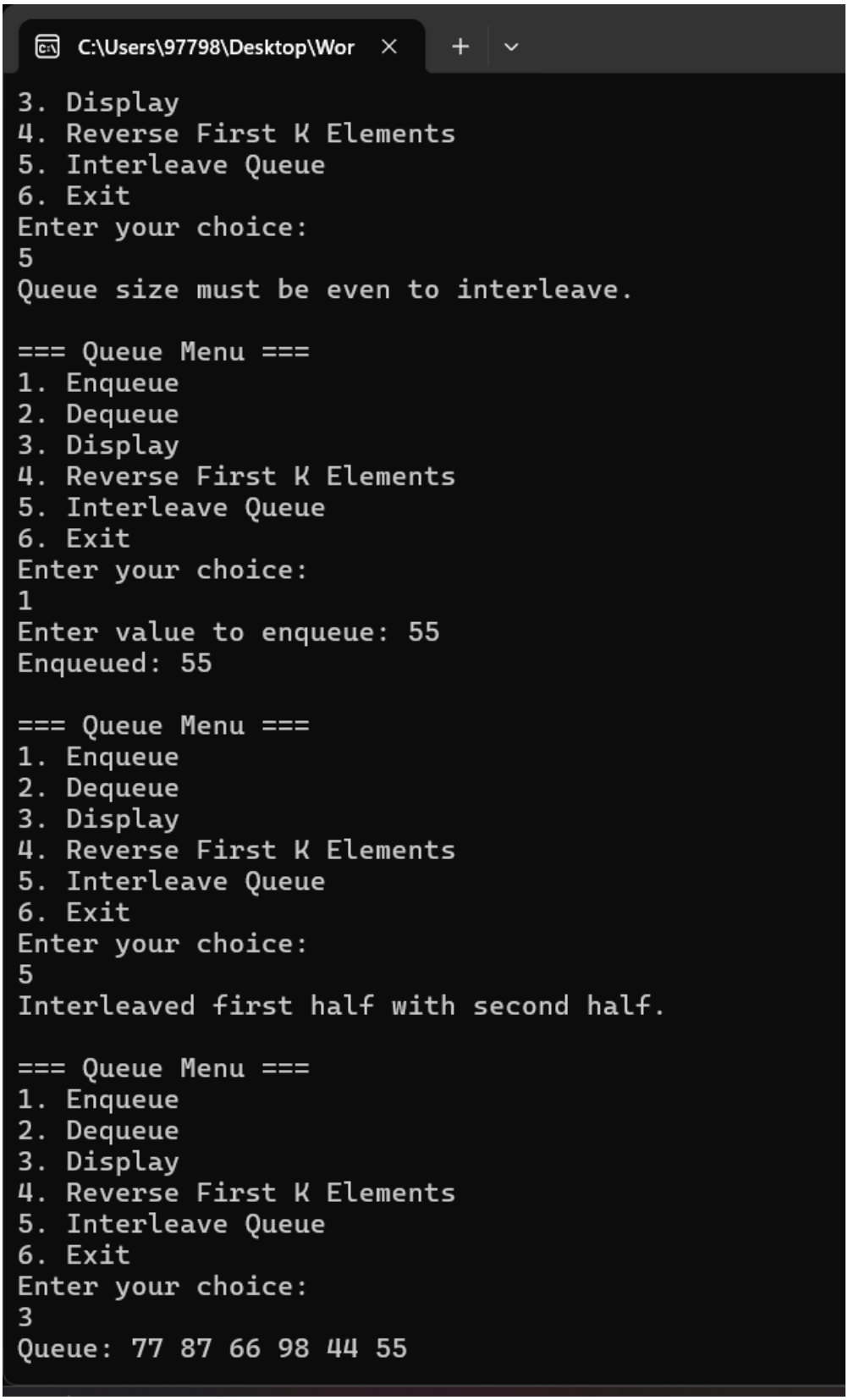

C:\Users\97798\Desktop\Wor
Invalid choice! Try again.
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
3
Queue: 65 11 45
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
2
Dequeued: 65
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
11
Invalid choice! Try again.
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue

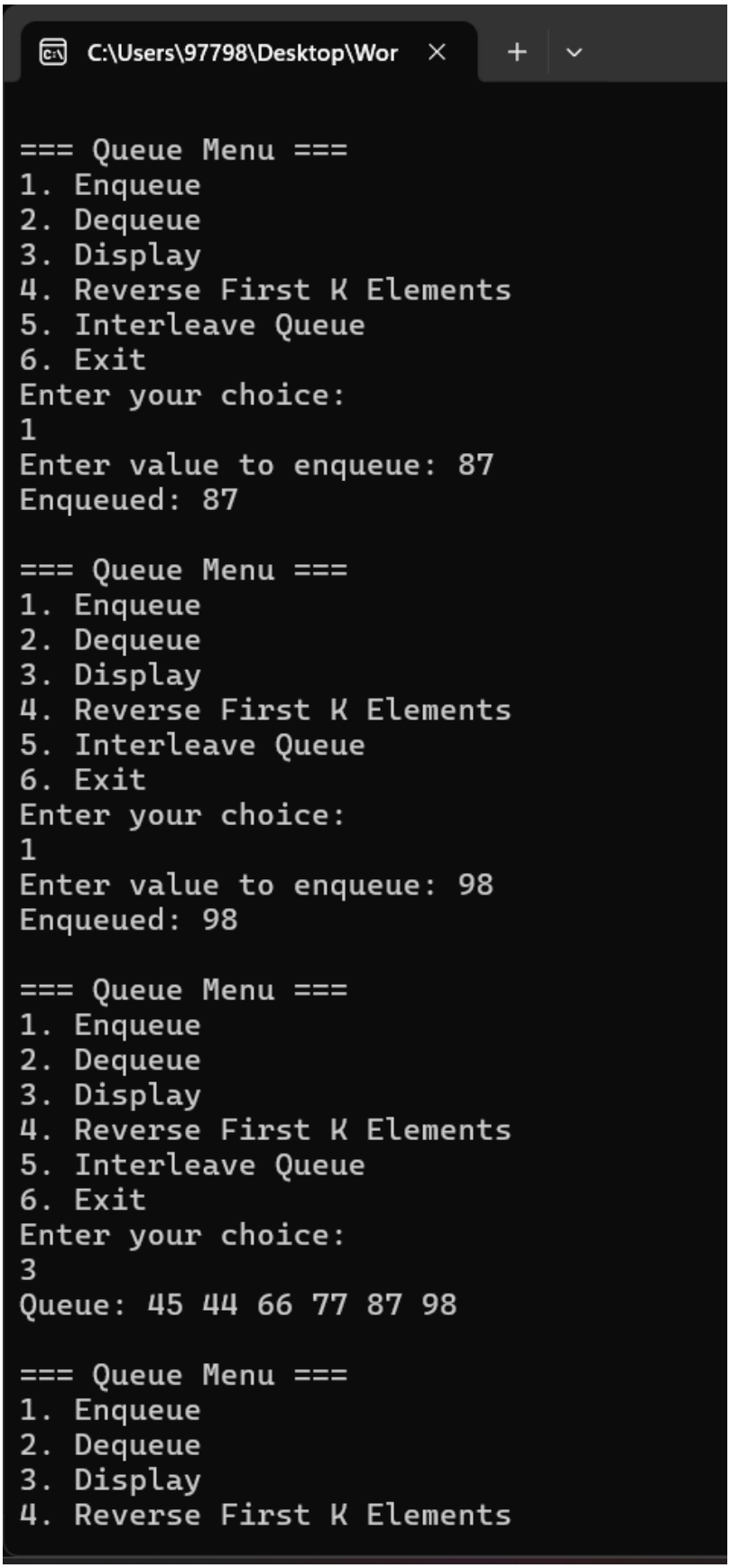

C:\Users\97798\Desktop\Wor
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
33
Invalid choice! Try again.
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
3
Queue: 45
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
3
Queue: 45
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit


C:\Users\97798\Desktop\Wor
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
1
Enter value to enqueue: 44
Enqueued: 44
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
1
Enter value to enqueue: 66
Enqueued: 66
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
123
Invalid choice! Try again.
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
3
66°F
Light rain


C:\Users\97798\Desktop\Wor
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
145
Invalid choice! Try again.
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
156
Invalid choice! Try again.
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
1
Enter value to enqueue: 77
Enqueued: 77
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
1


C:\Users\97798\Desktop\Wor
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
3
Queue: 44 66 77 87 98
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
4
Enter value of K: 3
Reversed first 3 elements.
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
3
Queue: 77 66 44 87 98
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue


C:\Users\97798\Desktop\Wor
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
5
Queue size must be even to interleave.
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
1
Enter value to enqueue: 55
Enqueued: 55
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
5
Interleaved first half with second half.
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
3
Queue: 77 87 66 98 44 55


C:\Users\97798\Desktop\Wor
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
1
Enter value to enqueue: 87
Enqueued: 87
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
1
Enter value to enqueue: 98
Enqueued: 98
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements
5. Interleave Queue
6. Exit
Enter your choice:
3
Queue: 45 44 66 77 87 98
=== Queue Menu ===
1. Enqueue
2. Dequeue
3. Display
4. Reverse First K Elements

4. Linked List Problem: Create a singly linked list (not STL) that: (20 marks)
    5. Has functions to insert at start/end/position
    6. Has a function to detect and remove loops
    7. Has a function to find nth node from end
    8. Has a function to reverse list in groups of K nodes

```
#include <iostream>
using namespace std;

class Node
{

public:

  int data;
  Node* next;

  Node(int val)

    {
      data = val;

      next = nullptr;
```

```
    }
};

class LinkedList

{

private:

  Node* head;

public:

  LinkedList()

    {
      head = nullptr;
    }

  void insertAtStart(int val)

  {
    Node* newNode = new Node(val);
    newNode->next = head;
    head = newNode;
  }
```

```
void insertAtEnd(int val)

{
   Node* newNode = new Node(val);
   if (!head)

      {

         head = newNode;
         return;
      }

      Node* temp = head;

      while (temp->next)

      temp = temp->next;

      temp->next = newNode;
   }

void insertAtPosition(int pos, int val)

{
   if (pos < 1)
```

```
  {
    cout << "Invalid position selected!\n";

    return;
  }

if (pos == 1)

  {
    insertAtStart(val);
    return;
  }


Node* newNode = new Node(val);
Node* temp = head;


for (int i = 1; temp != nullptr && i < pos - 1; ++i)
  temp = temp->next;

if (!temp)

  {
    cout << "Position are out of bounds.\n";
```

```
        return;
      }

      newNode->next = temp->next;

      temp->next = newNode;
   }

void detectAndRemoveLoop()

{
   Node *slow = head, *fast = head;
   bool loopFound = false;

   while (fast && fast->next)

      {
         slow = slow->next;

         fast = fast->next->next;
      if (slow == fast)

         {
            loopFound = true;

            break;
```

```
    }
}

if (!loopFound)

  {
    cout << "No loops are detected.\n";

    return;
  }

slow = head;

Node* prev = nullptr;

while (slow != fast)

  {
    prev = fast;
    slow = slow->next;
    fast = fast->next;
  }

if (prev)

  prev->next = nullptr;
```

```
    cout << "Loop has been detected and removed.\n";
}

void findNthFromEnd(int n)

{
    Node *mainPtr = head, *refPtr = head;

    int count = 0;

    while (count < n)

      {

      if (!refPtr)

      {

         cout << "The given list is shorter than " << n << " nodes.\n";
         return;

      }

      refPtr = refPtr->next;
      count++;
```

```
    }

    while (refPtr)

      {

         mainPtr = mainPtr->next;

         refPtr = refPtr->next;
      }

    cout << "The " << n << "th number node from end is: " << mainPtr->data << endl;
}

Node* reverseInGroups(Node* node, int k)

{

    Node* prev = nullptr;
    Node* current = node;
    Node* next = nullptr;
    int count = 0;

    while (current && count < k)

      {
```

```
        next = current->next;
        current->next = prev;
        prev = current;
        current = next;

        count++;
      }

   if (next)

      node->next = reverseInGroups(next, k);

   return prev;
}

void reverseInGroups(int k)

{
   head = reverseInGroups(head, k);
   cout << "List reversed in groups of:  " << k << ".\n";
}

void display()

{
   Node* temp = head;
```

```
    cout << "Linked List or Data : ";

    while (temp)

      {
        cout << temp->data << " -> ";

        temp = temp->next;
      }

    cout << "_____NULL_____\n";
}

void createLoop(int pos)

{
    if (pos <= 0) return;

    Node* loopNode = head;

    for (int i = 1; i < pos && loopNode; ++i)

      loopNode = loopNode->next;

    Node* temp = head;
```

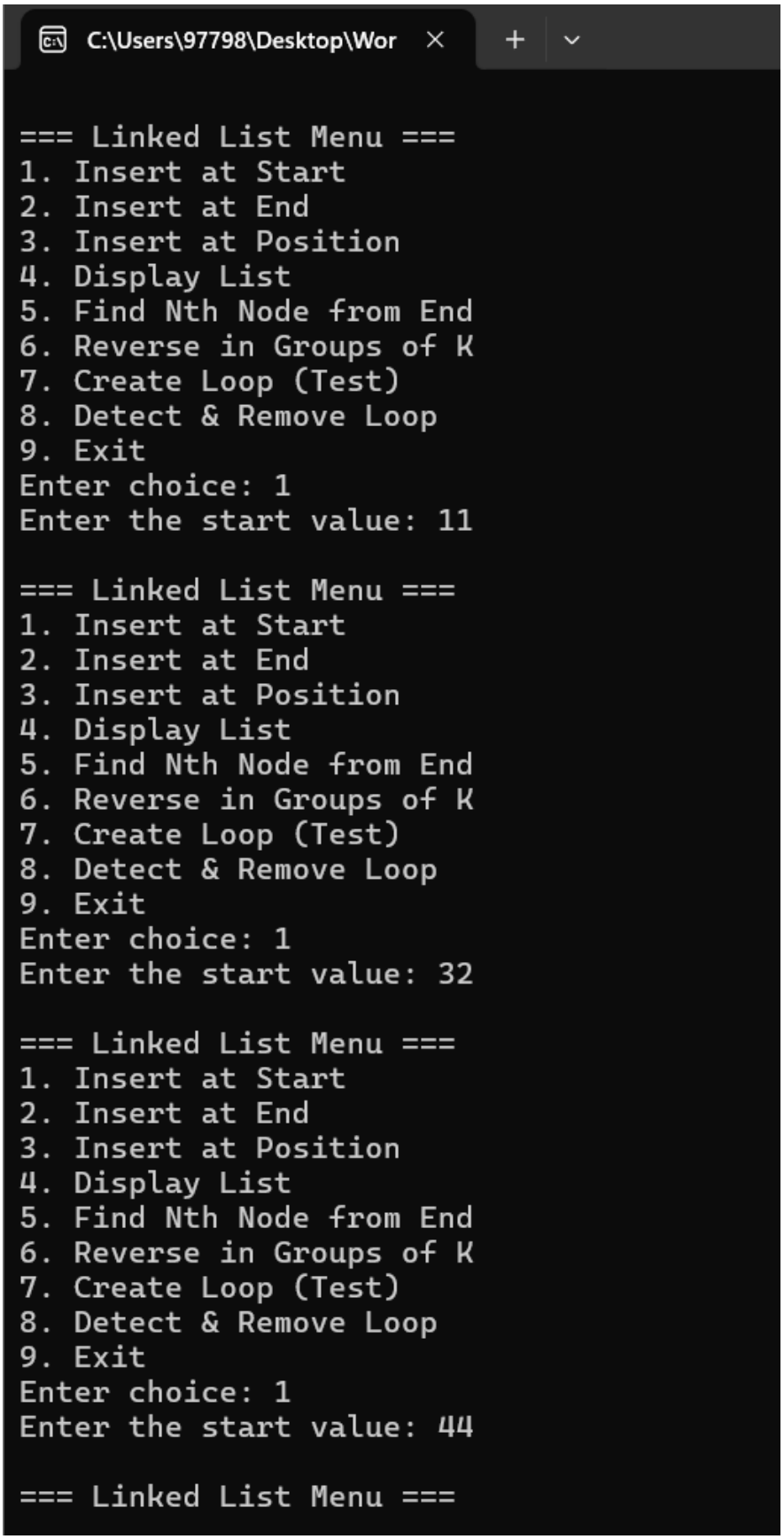
```
        while (temp->next)

            temp = temp->next;

        temp->next = loopNode;

        cout << "the Loop is created at position:  " << pos << ".\n";
    }
};

int main()

{
    LinkedList list;

    int choice, val, pos, k;

    do

        {
            cout << "\n=== Linked List Menu ===\n";
            cout << "1. Insert at Start\n";
            cout << "2. Insert at End\n";
            cout << "3. Insert at Position\n";
            cout << "4. Display List\n";
            cout << "5. Find Nth Node from End\n";
```

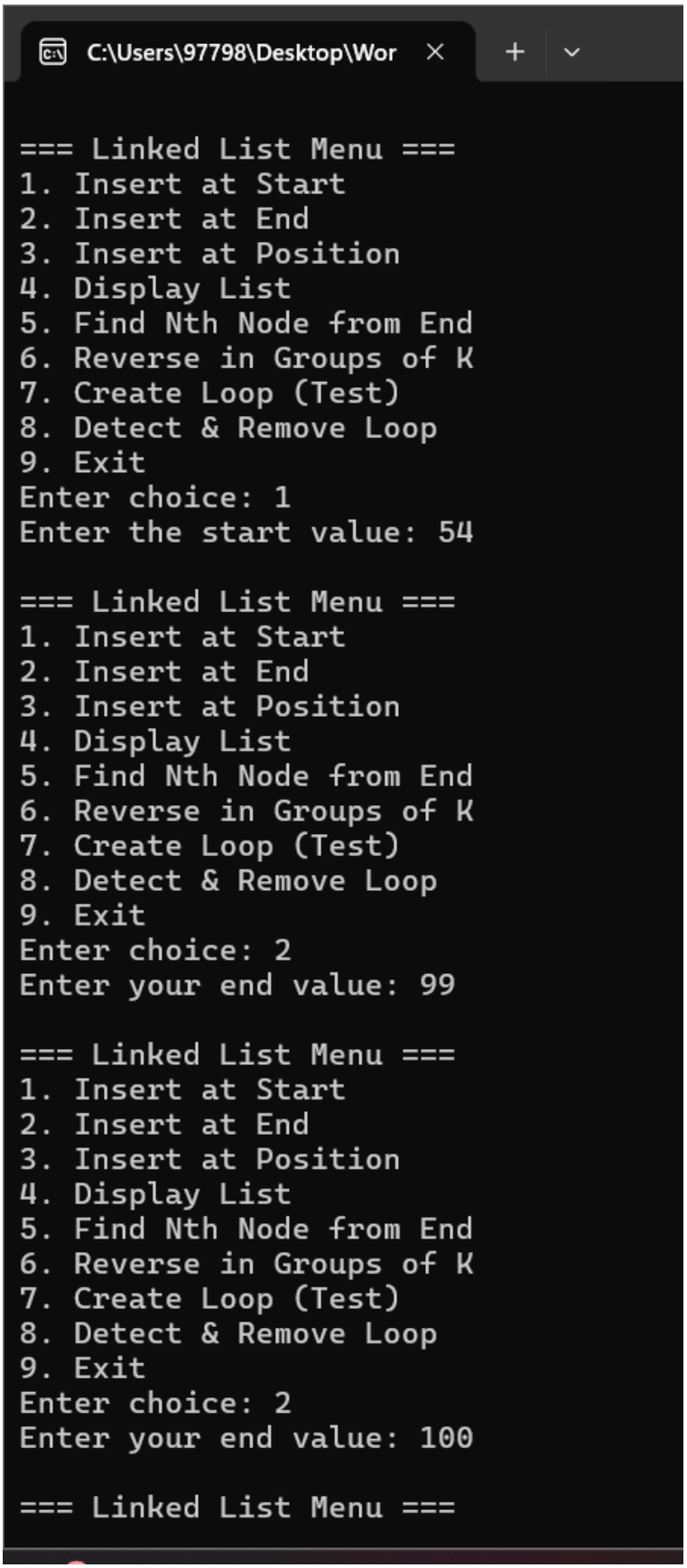
```
    cout << "6. Reverse in Groups of K\n";
    cout << "7. Create Loop (Test)\n";
    cout << "8. Detect & Remove Loop\n";
    cout << "9. Exit\n";
    cout << "Enter choice: ";

    cin >> choice;

switch (choice)

{

case 1:

    cout << "Enter the start value: ";
    cin >> val;

    list.insertAtStart(val);
    break;

case 2:

    cout << "Enter your end value: ";
    cin >> val;

    list.insertAtEnd(val);
```

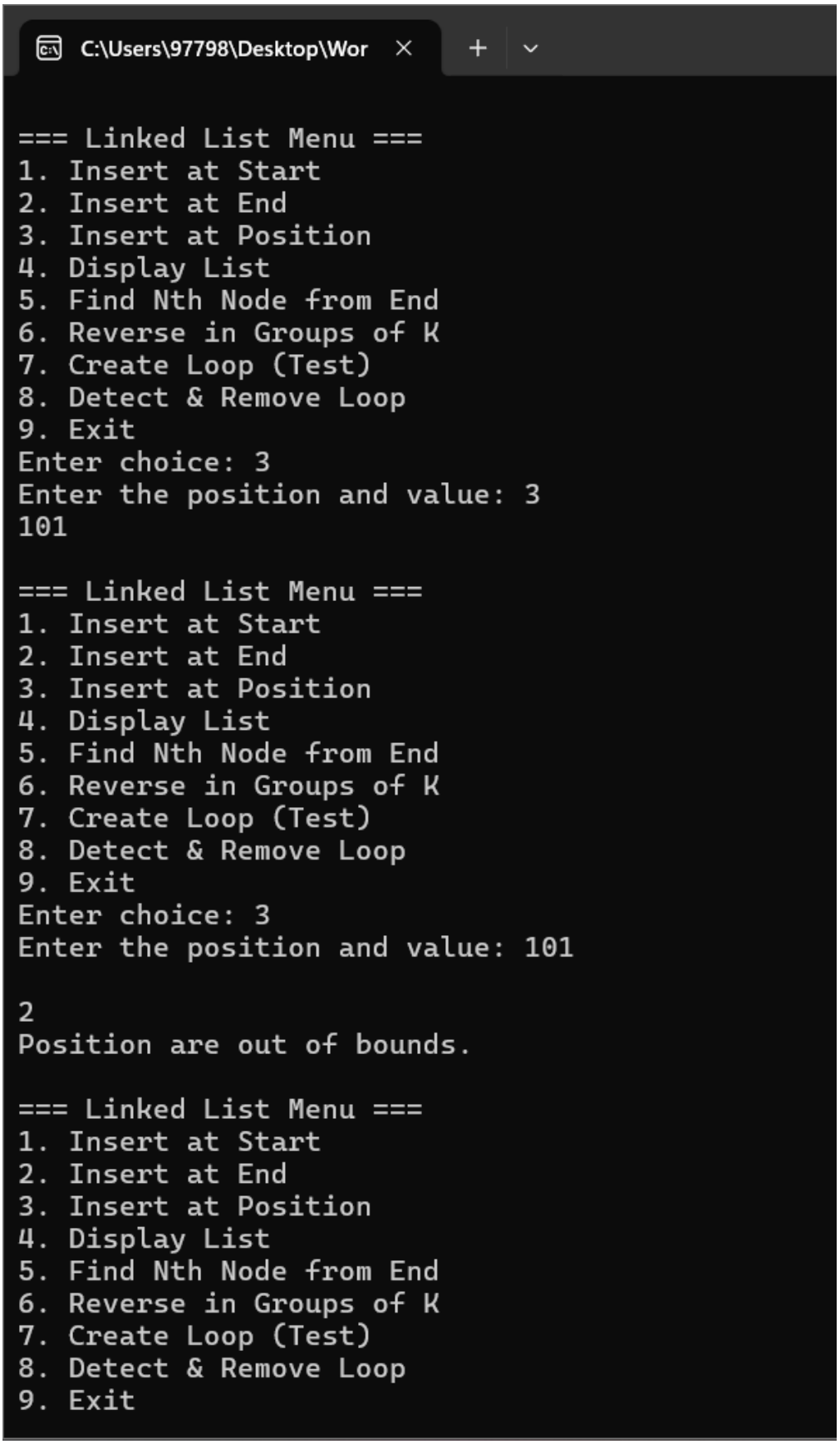
```
    break;

case 3:

    cout << "Enter the position and value: ";
    cin >> pos >> val;

    list.insertAtPosition(pos, val);
    break;

case 4:

    list.display();
    break;

case 5:

    cout << "Enter Value of N: ";
    cin >> pos;

    list.findNthFromEnd(pos);
    break;

case 6:

    cout << "Enter value of K: ";
```

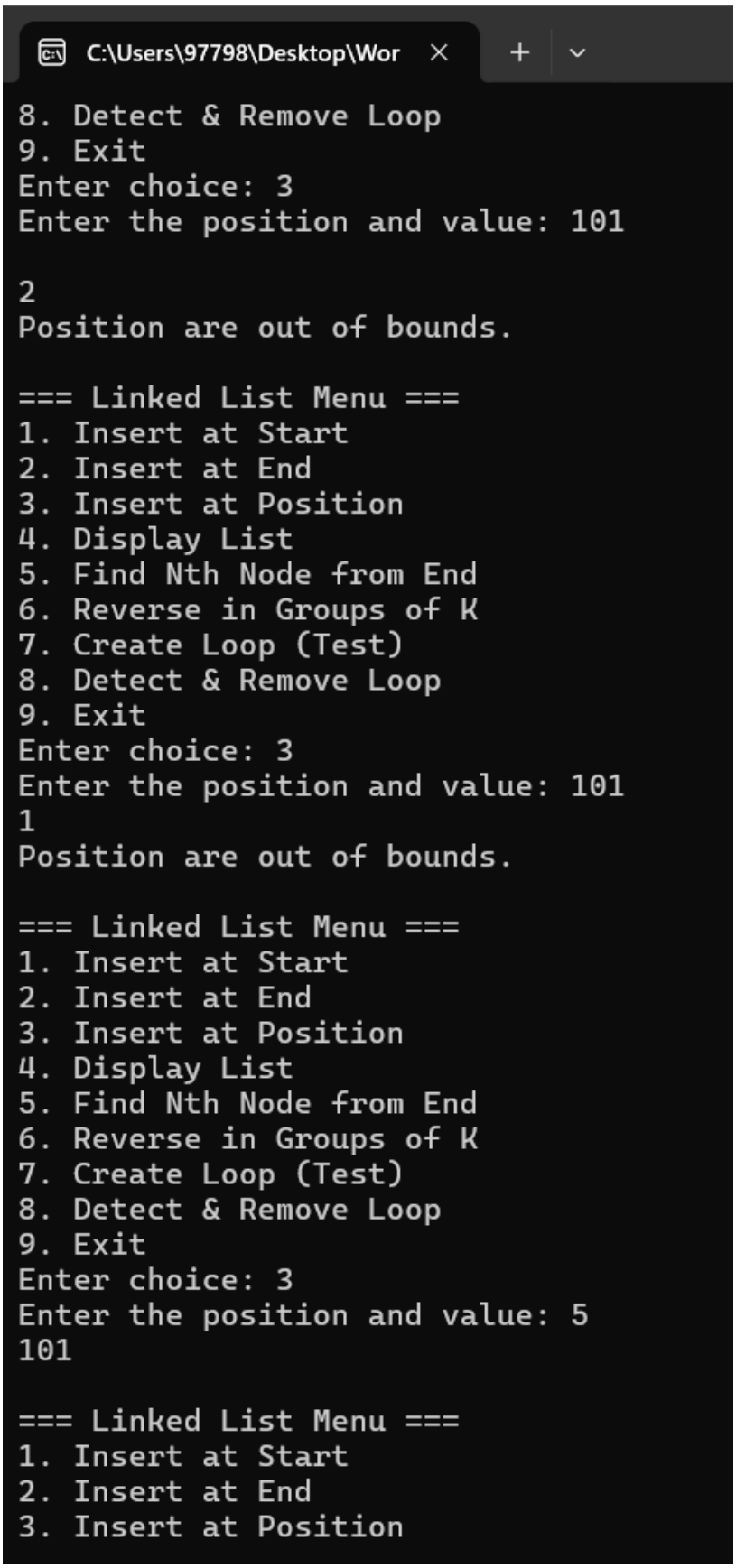
```
            cin >> k;

            list.reverseInGroups(k);
            break;

        case 7:

            cout << "Enter any position to set loop back to: ";
            cin >> pos;

            list.createLoop(pos);
            break;

        case 8:

            list.detectAndRemoveLoop();
            break;

        case 9:

            cout << "Exiting the program...\n";
            break;

        default:

            cout << "Invalid choice!! select correct number.\n";
```

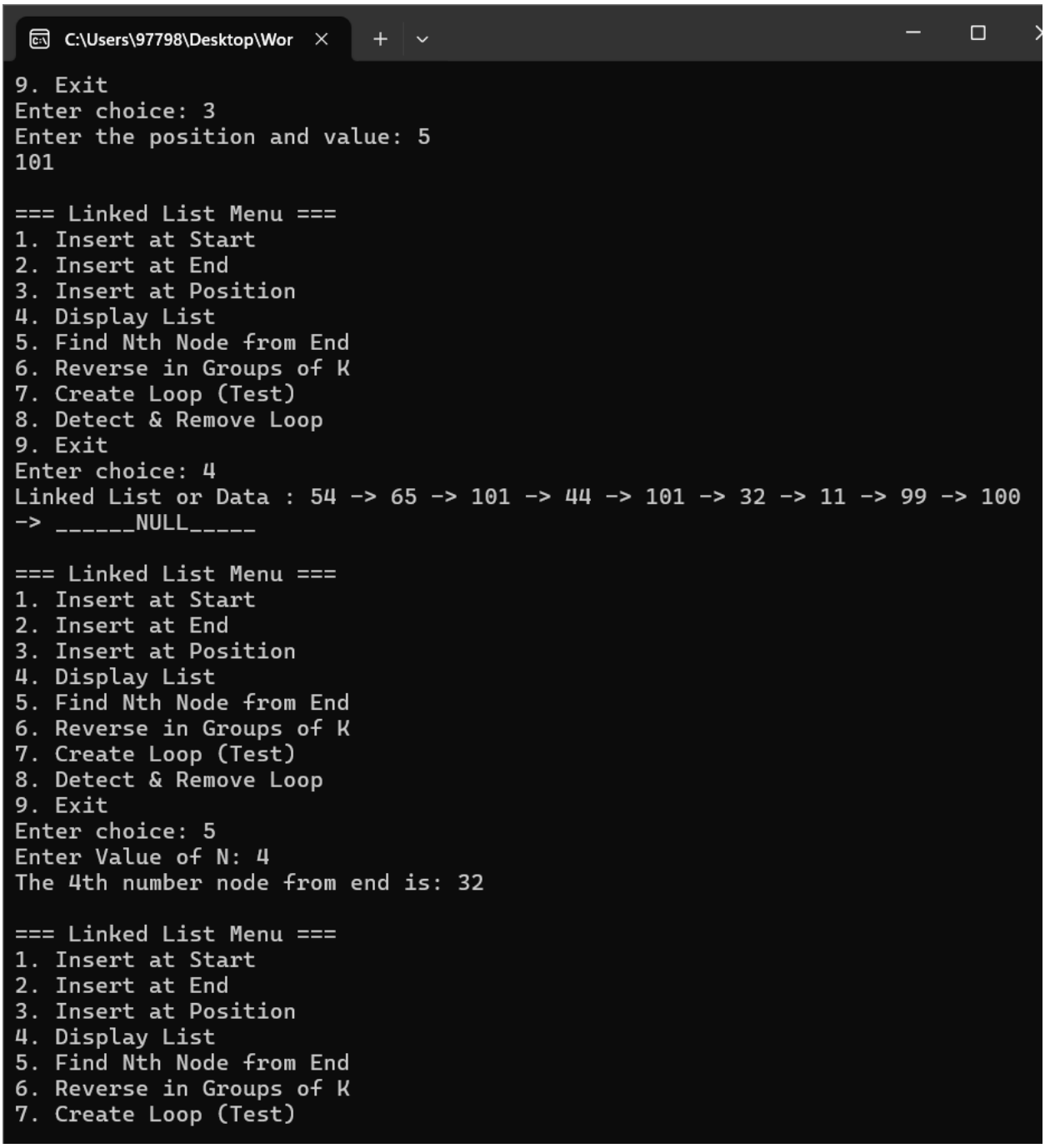
```
        }


    }


     while (choice != 9);


    return 0;
}
```

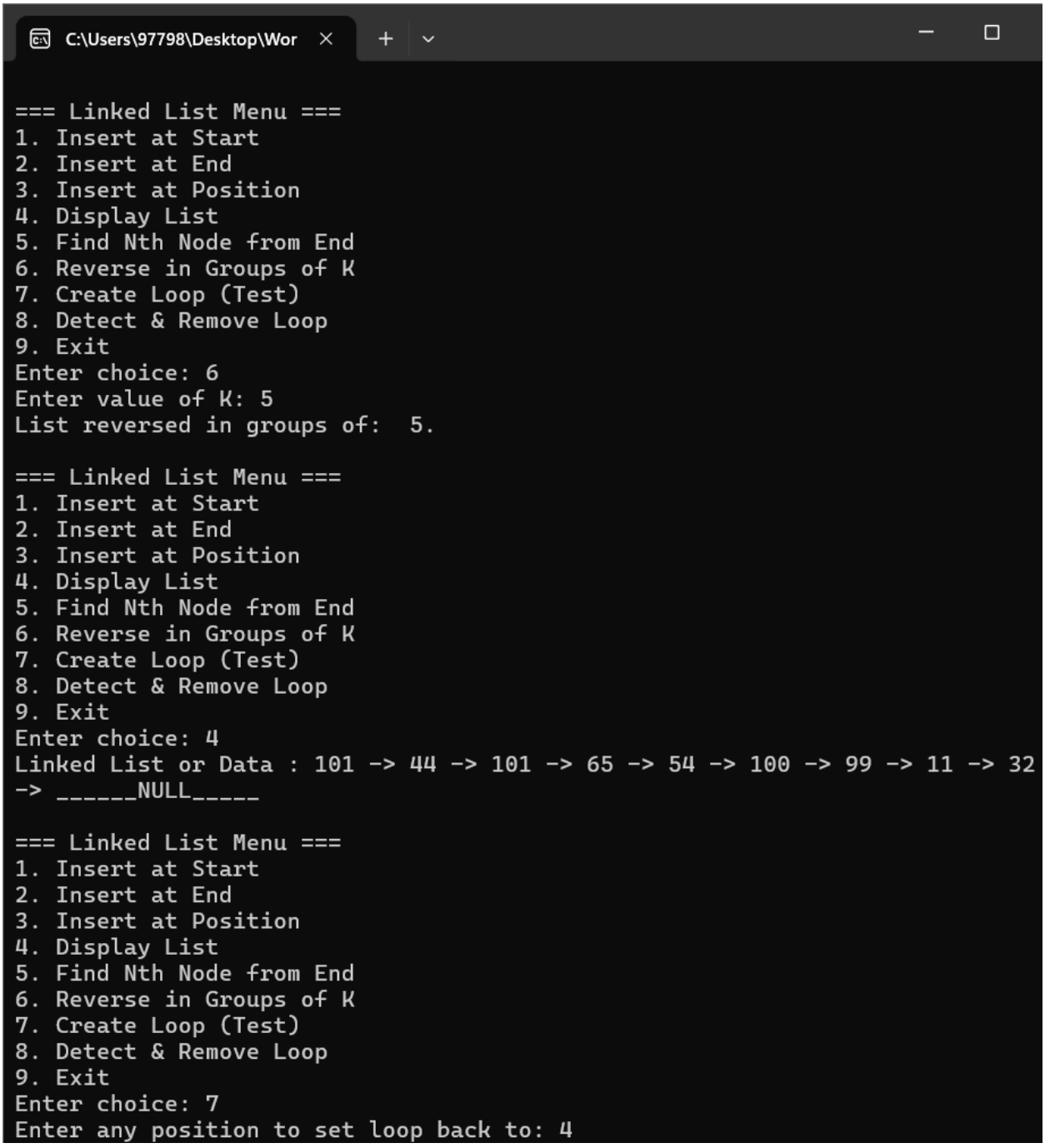

C:\Users\97798\Desktop\Wor
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 1
Enter the start value: 11
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 1
Enter the start value: 32
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 1
Enter the start value: 44
=== Linked List Menu ===

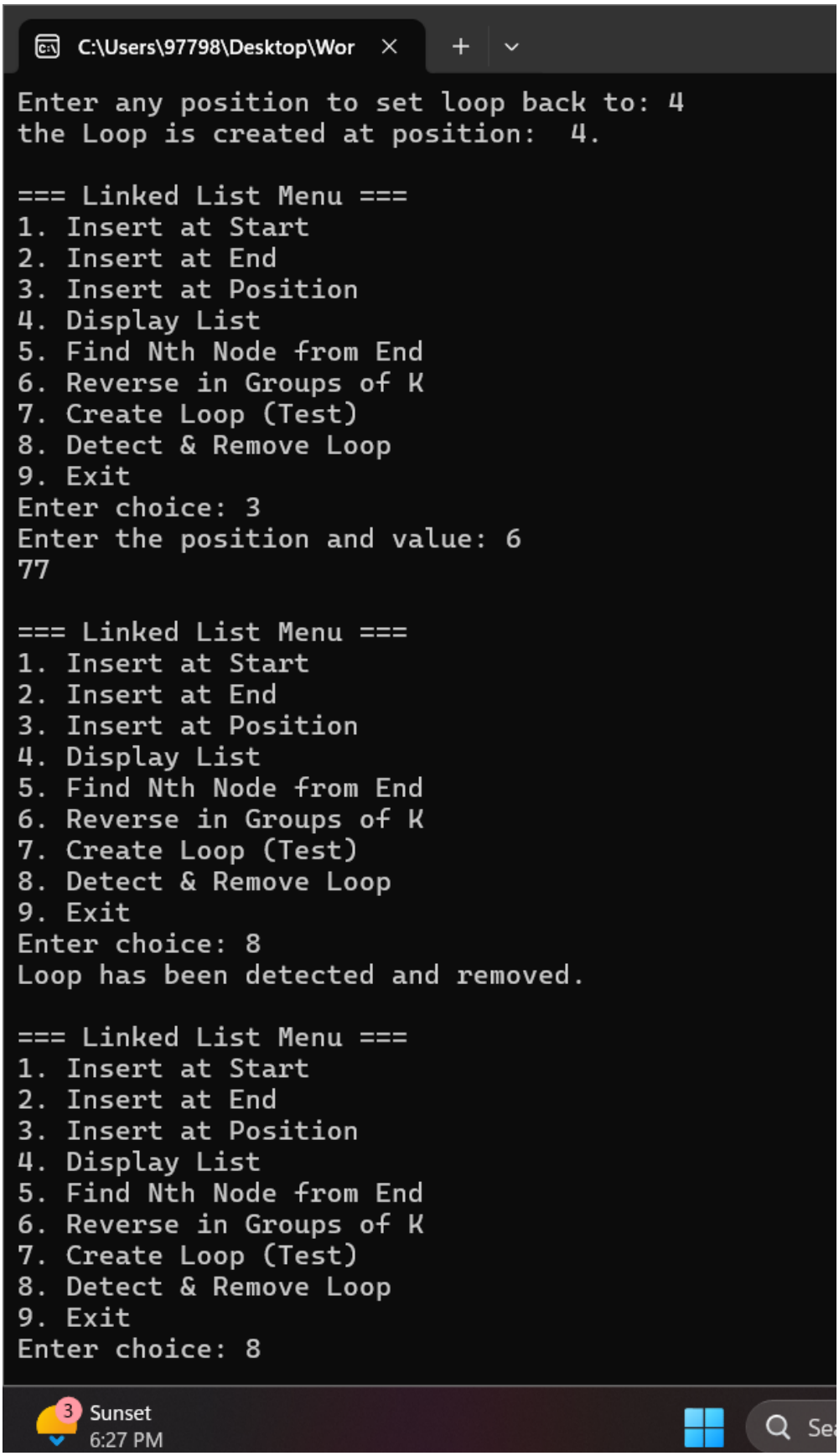

C:\Users\97798\Desktop\Wor
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 1
Enter the start value: 54
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 2
Enter your end value: 99
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 2
Enter your end value: 100
=== Linked List Menu ===


C:\Users\97798\Desktop\Wor
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 3
Enter the position and value: 3
101
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 3
Enter the position and value: 101
2
Position are out of bounds.
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit


C:\Users\97798\Desktop\Wor
8. Detect & Remove Loop
9. Exit
Enter choice: 3
Enter the position and value: 101
2
Position are out of bounds.
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 3
Enter the position and value: 101
1
Position are out of bounds.
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 3
Enter the position and value: 5
101
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position


C:\Users\97798\Desktop\Wor
9. Exit
Enter choice: 3
Enter the position and value: 5
101
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 4
Linked List or Data : 54 -> 65 -> 101 -> 44 -> 101 -> 32 -> 11 -> 99 -> 100
-> ______NULL_____
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 5
Enter Value of N: 4
The 4th number node from end is: 32
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)


C:\Users\97798\Desktop\Wor
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 6
Enter value of K: 5
List reversed in groups of: 5.
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 4
Linked List or Data : 101 -> 44 -> 101 -> 65 -> 54 -> 100 -> 99 -> 11 -> 32
-> ______NULL_____
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 7
Enter any position to set loop back to: 4


C:\Users\97798\Desktop\Wor
Enter any position to set loop back to: 4
the Loop is created at position: 4.
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 3
Enter the position and value: 6
77
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 8
Loop has been detected and removed.
=== Linked List Menu ===
1. Insert at Start
2. Insert at End
3. Insert at Position
4. Display List
5. Find Nth Node from End
6. Reverse in Groups of K
7. Create Loop (Test)
8. Detect & Remove Loop
9. Exit
Enter choice: 8
3
Sunset
6:27 PM