Lab no: 3 Madan Bhandari Memorial College **Date:2024/01/26**

Title: Write a program to show the basic operation of Queue.

Queue:

A queue is a linear data structure in Data Structures and Algorithms (DSA) that follows the **First In, First Out (FIFO)** principle. This means that the first element added to the queue is the first one to be removed.

Key Queue Operations:

1. **Enqueue: Adds an element to the rear of the queue.**
    - **Example: Queue → [A, B],**
      Enqueue C → [A, B, C]

2. **Dequeue: Removes the front element from the queue.**
    - **Example: Queue → [A, B, C],**
      Dequeue → [B, C] (removes A)

3. **Front/Peek: Returns the front element without removing it.**
    - **Example: Queue → [A, B, C],**
      Peek → A

4. **IsEmpty: Checks if the queue is empty.**
    - **Example: Queue → [A, B, C],**
      IsEmpty → false

5. **Size: Returns the number of elements in the queue.**
    - **Example: Queue → [A, B, C],**
      Size → 3

Compiler: DEV C++

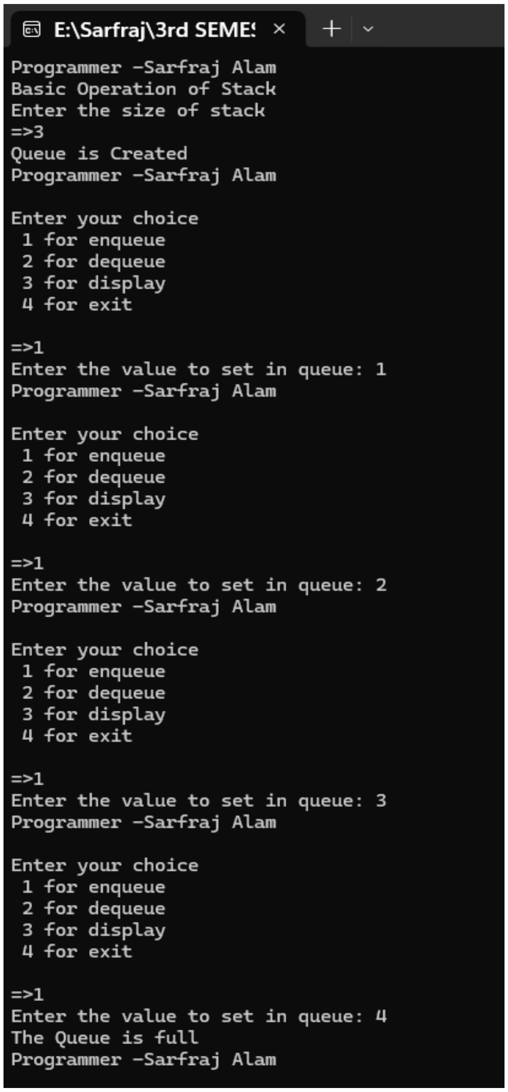
Language : C

Source Code:

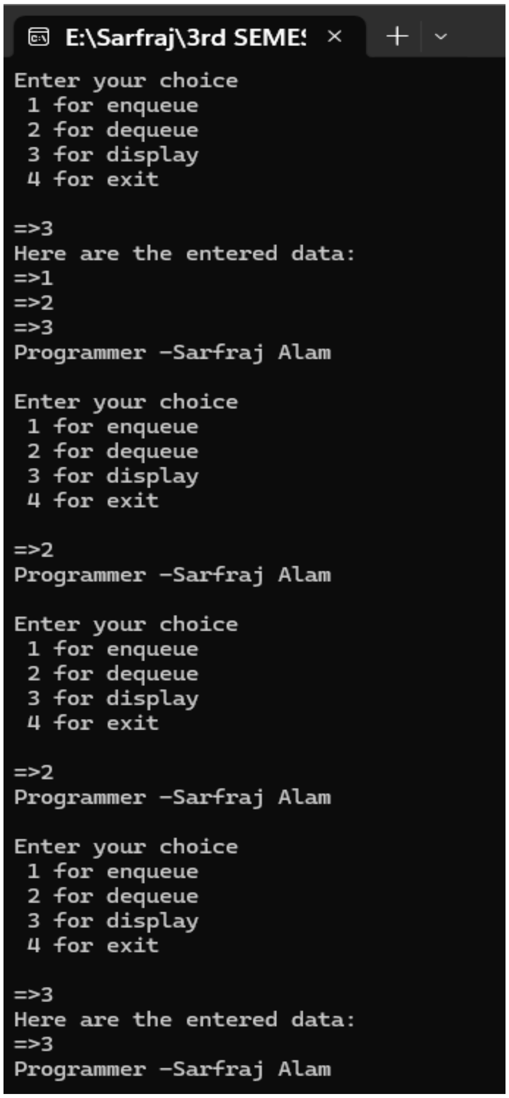
```
#include<iostream>
using namespace std;
class queue{

 int* arr;
 int front;
 int rear;
 int n;

 public:
 queue(int size)    //construct || initialize of queue
 {
  cout<<"Queue is Created"<<endl;
  arr=new int[size];
  front=-1;
  rear=-1;
  n=size;
 }
void enqueue(int x){
  if(rear == n-1){    //could have compare with n only but as rear start with 1 so we had to compare with n-1
    cout<<"The Queue is full"<<endl;
  }
  else{
    rear++;
    arr[rear]=x;
    if (front==-1)
    {
       front++;
    }
  }
}
void dequeue(){
  if(front==-1 || front>rear) {
    cout<<"The Queue is Empty"<<endl;
  }
  else{
    front++;
  }
}
void Display(){
  if(front==-1 || front>rear) {
    cout<<"The Queue is Empty"<<endl;
  }
  else{
    cout<<"Here are the entered data:"<<endl;
    for (int i=front; i < rear+1; i++)
    {
      cout<<"=>"<<arr[i]<<endl;
    }
  }
}
};

int main(){
int size;
int in,n;
  cout<<"Programmer -Sarfraj Alam"<<endl;
  cout << "Basic Operation of Stack" << endl;
```

```
 cout << "Enter the size of stack\n=>";
 cin >> size;
 queue q(size);
 while (true)
 {
  cout<<"Programmer -Sarfraj Alam"<<endl;
  cout << "\nEnter your choice\n 1 for enqueue\n 2 for dequeue\n 3 for display\n 4 for exit\n\n=>"; //Menu for the operation
  cin >> n;
  switch (n)
       {
    case 1:
     cout<<"Enter the value to set in queue: ";    //For enqeue operation
     cin>>in;
     q.enqueue(in);
     break;
    case 2:    //For dequeue Operation
     q.dequeue();
     break;
    case 3:    //For Display Operation
     q.Display();
     break;
    case 4:
         exit(0);
        default:
         cout<<"Inavalid choice. Please try again."<<endl;
       }
 }
 return 0;
}
```

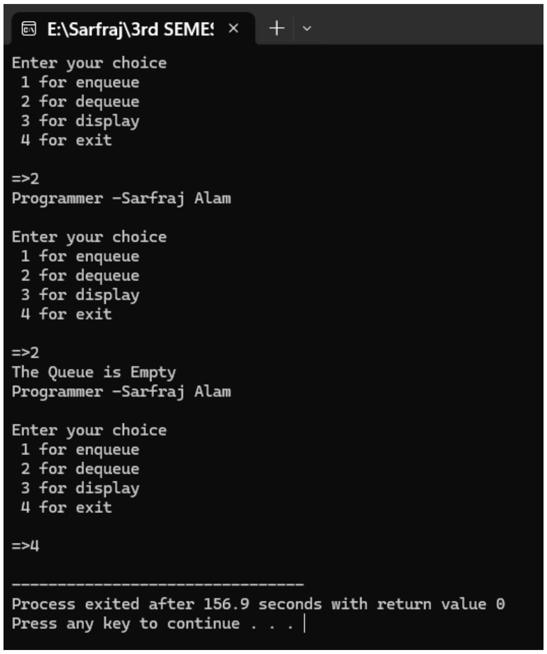
Output



```
Programmer -Sarfraj Alam
Basic Operation of Stack
Enter the size of stack
=>3
Queue is Created
Programmer -Sarfraj Alam

Enter your choice
 1 for enqueue
 2 for dequeue
 3 for display
 4 for exit

=>1
Enter the value to set in queue: 1
Programmer -Sarfraj Alam

Enter your choice
 1 for enqueue
 2 for dequeue
 3 for display
 4 for exit

=>1
Enter the value to set in queue: 2
Programmer -Sarfraj Alam

Enter your choice
 1 for enqueue
 2 for dequeue
 3 for display
 4 for exit

=>1
Enter the value to set in queue: 3
Programmer -Sarfraj Alam

Enter your choice
 1 for enqueue
 2 for dequeue
 3 for display
 4 for exit

=>1
Enter the value to set in queue: 4
The Queue is full
Programmer -Sarfraj Alam
```



```
Enter your choice
 1 for enqueue
 2 for dequeue
 3 for display
 4 for exit

=>3
Here are the entered data:
=>1
=>2
=>3
Programmer -Sarfraj Alam

Enter your choice
 1 for enqueue
 2 for dequeue
 3 for display
 4 for exit

=>2
Programmer -Sarfraj Alam

Enter your choice
 1 for enqueue
 2 for dequeue
 3 for display
 4 for exit

=>2
Programmer -Sarfraj Alam

Enter your choice
 1 for enqueue
 2 for dequeue
 3 for display
 4 for exit

=>3
Here are the entered data:
=>3
Programmer -Sarfraj Alam
```



```
Enter your choice
 1 for enqueue
 2 for dequeue
 3 for display
 4 for exit

=>2
Programmer -Sarfraj Alam

Enter your choice
 1 for enqueue
 2 for dequeue
 3 for display
 4 for exit

=>2
The Queue is Empty
Programmer -Sarfraj Alam

Enter your choice
 1 for enqueue
 2 for dequeue
 3 for display
 4 for exit

=>4

--------------------------------
Process exited after 156.9 seconds with return value 0
Press any key to continue . . .
```

Lab no: 4 **Date:2024/01/26**

Title: Write a program to switch between recursive programs

Recursion & Recursive Program:

A recursive program is one that solves a problem by calling itself. In recursion, a function calls itself to divide a problem into smaller subproblems. Each recursive call processes a simpler version of the problem, and the base case is used to stop the recursion once the problem is simple enough to solve directly. Different type of recursive programs are :-

Factorial :

The factorial of a number n is the product of all positive integers less than or equal to n. It's defined as:

- n! = n * (n-1) * (n-2) * ... * 1
- Recursive case: n! = n * (n-1)!

Fibonacci Sequence:

The Fibonacci sequence is defined as:

- F(0) = 0, F(1) = 1
- F(n) = F(n-1) + F(n-2) for n > 1

GCD (Greatest Common Divisor)

- **Euclidean Algorithm**: GCD of two numbers a and b is found using:
  - GCD(a, b) = GCD(b, a % b)

Tower of Hanoi

1. Move n-1 disks from source to auxiliary peg.
2. Move the nth disk from source to target peg.
3. Move the n-1 disks from auxiliary peg to target peg.

Compiler: DEV C++

Language : C++

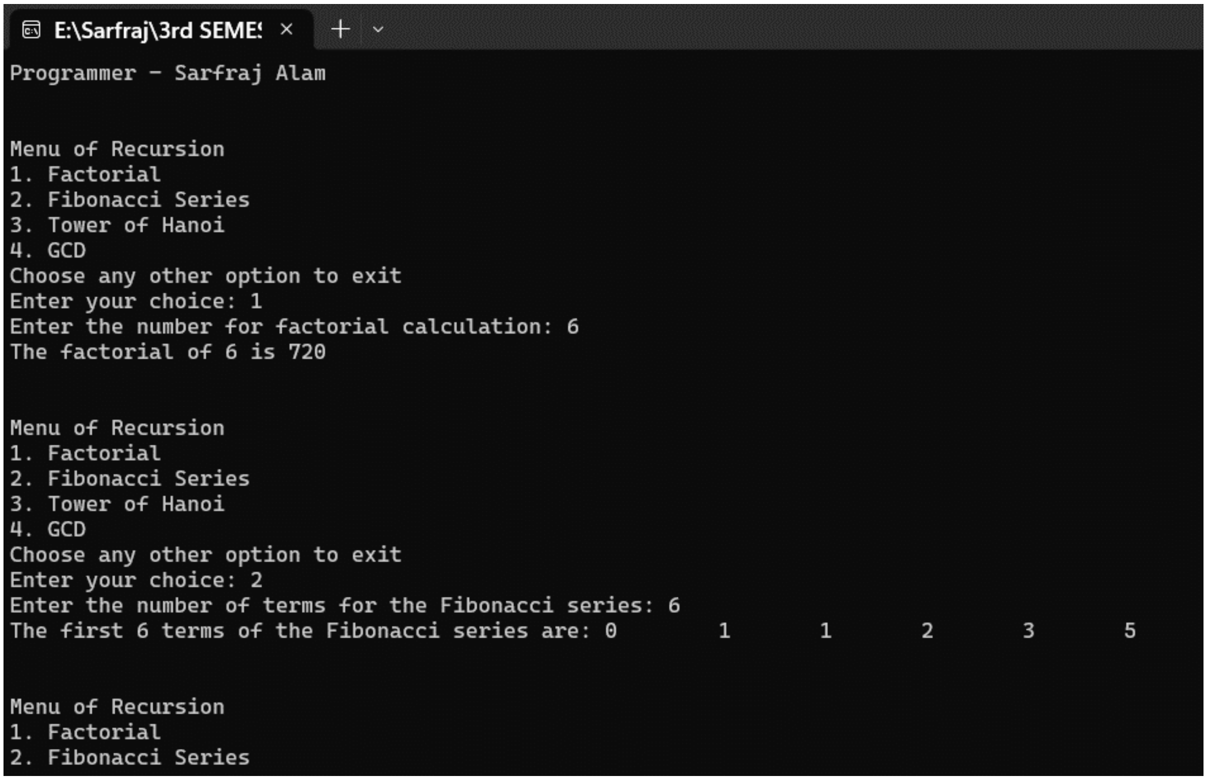
Source Code:

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

// Function prototypes
int fact(int);
int fib(int);
void TOH(int n, char source, char helper, char target);
int GCD(int, int);

int counter = 1;

int main() {
    cout << "Programmer - Sarfraj Alam" << endl;
    int choice;

    while (true) {
        cout << "\n\nMenu of Recursion\n";
        cout << "1. Factorial\n";
        cout << "2. Fibonacci Series\n";
        cout << "3. Tower of Hanoi\n";
        cout << "4. GCD\n";
        cout << "Choose any other option to exit\n";
        cout << "Enter your choice: ";
        cin >> choice;

        switch (choice) {
            case 1: {
                int n;
    cout << "Enter the number for factorial calculation: ";
    cin >> n;
    if (n < 0) {
        cout << "Factorial is not defined for negative numbers." << endl;
    } else {
        cout << "The factorial of " << n << " is " << fact(n) << endl;
    }
    break;
}

case 2: {
    int n;
    cout << "Enter the number of terms for the Fibonacci series: ";
    cin >> n;
    if (n < 1) {
        cout << "Please enter a positive integer greater than 0." << endl;
    } else {
        cout << "The first " << n << " terms of the Fibonacci series are: ";
        for (int i = 0; i < n; i++) {
            cout << fib(i) << "\t";  // Corrected fib(1) to fib(i)
        }
        cout << endl;
    }
    break;
}

case 3: {
    int nodisk;
    cout << "Enter the number of disks for Tower of Hanoi: ";
    cin >> nodisk;
```

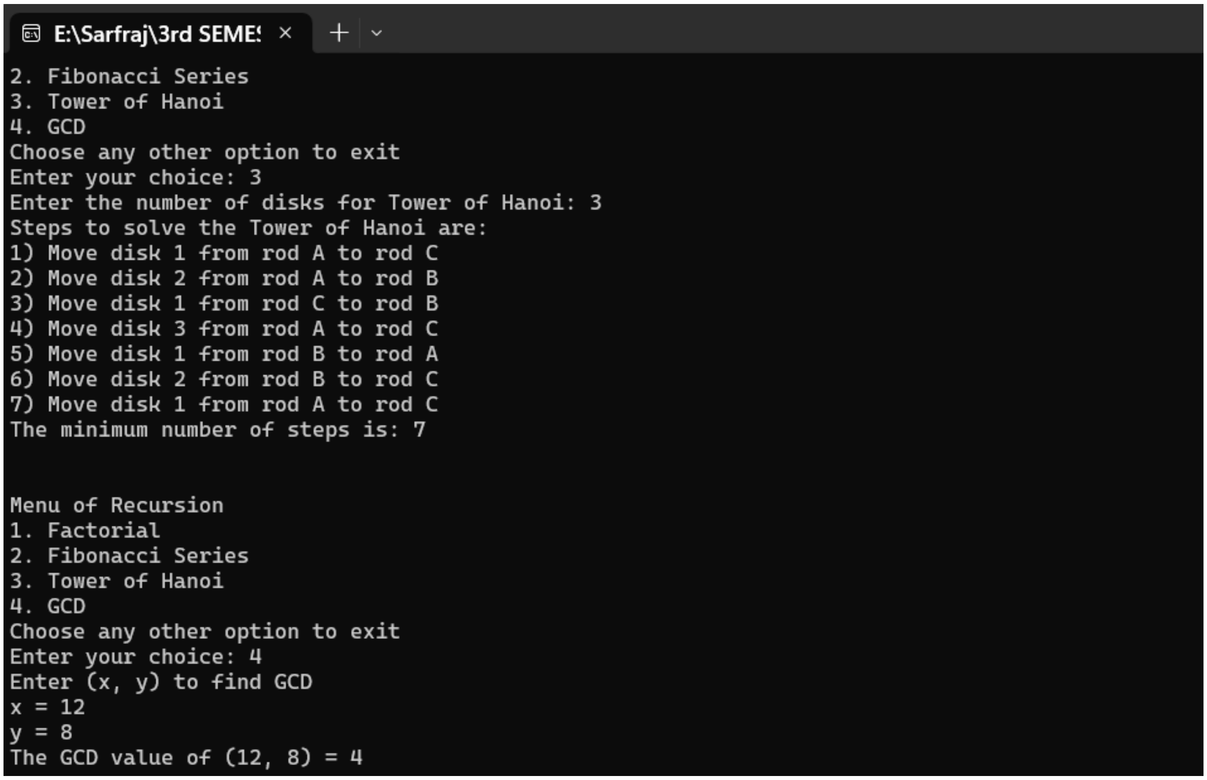
```
                if (nodisk < 1) {
                    cout << "Number of disks must be at least 1." << endl;
                } else {
                    char a = 'A', b = 'B', c = 'C';
                    counter = 1;  // Reset counter for each run
                    cout << "Steps to solve the Tower of Hanoi are:\n";
                    TOH(nodisk, a, b, c);
                    cout << "The minimum number of steps is: " << (1 << nodisk) - 1 << endl;
                }
                break;
            }

            case 4: {
                int x, y;
                cout << "Enter (x, y) to find GCD\n";
                cout << "x = ";
                cin >> x;
                cout << "y = ";
                cin >> y;
                cout << "The GCD value of (" << x << ", " << y << ") = " << GCD(x, y) << endl;
                break;
            }

            default:
                cout << "Exiting the program. Goodbye!" << endl;
                return 0;
        }
    }
}
```

```
// Factorial using recursion
int fact(int n) {
    if (n == 0 || n == 1)
        return 1;
    else
        return n * fact(n - 1);
}

// Fibonacci using recursion
int fib(int n) {
    if (n == 0)
        return 0;
    else if (n == 1)
        return 1;
    else
        return fib(n - 1) + fib(n - 2);
}

// Tower of Hanoi using recursion
void TOH(int n, char source, char helper, char target) {
    if (n == 1) {
        cout << counter << ") Move disk 1 from rod " << source << " to rod " << target << endl;
        counter++;
        return;
    }
    TOH(n - 1, source, target, helper);
    cout << counter << ") Move disk " << n << " from rod " << source << " to rod " << target
<< endl;
    counter++;
    TOH(n - 1, helper, source, target);
```

```
}

// GCD using recursion
int GCD(int a, int b) {
    if (b == 0)
        return a;
    else
        return GCD(b, a % b);
}
```



```
Programmer - Sarfraj Alam


Menu of Recursion
1. Factorial
2. Fibonacci Series
3. Tower of Hanoi
4. GCD
Choose any other option to exit
Enter your choice: 1
Enter the number for factorial calculation: 6
The factorial of 6 is 720


Menu of Recursion
1. Factorial
2. Fibonacci Series
3. Tower of Hanoi
4. GCD
Choose any other option to exit
Enter your choice: 2
Enter the number of terms for the Fibonacci series: 6
The first 6 terms of the Fibonacci series are: 0        1       1       2       3       5


Menu of Recursion
1. Factorial
2. Fibonacci Series
```



```
2. Fibonacci Series
3. Tower of Hanoi
4. GCD
Choose any other option to exit
Enter your choice: 3
Enter the number of disks for Tower of Hanoi: 3
Steps to solve the Tower of Hanoi are:
1) Move disk 1 from rod A to rod C
2) Move disk 2 from rod A to rod B
3) Move disk 1 from rod C to rod B
4) Move disk 3 from rod A to rod C
5) Move disk 1 from rod B to rod A
6) Move disk 2 from rod B to rod C
7) Move disk 1 from rod A to rod C
The minimum number of steps is: 7


Menu of Recursion
1. Factorial
2. Fibonacci Series
3. Tower of Hanoi
4. GCD
Choose any other option to exit
Enter your choice: 4
Enter (x, y) to find GCD
x = 12
y = 8
The GCD value of (12, 8) = 4
```