Module 3

Stack and Queue

Content

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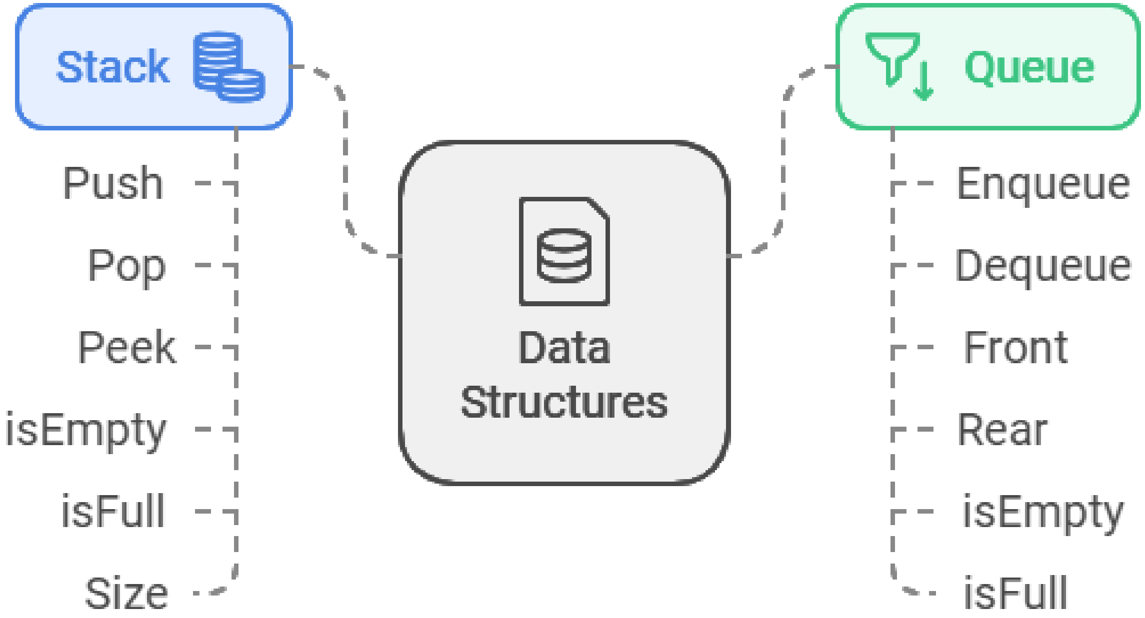
- Stack Structure
- Push Operation
- Pop Operation
- Peek Operation
- isEmpty Operation
- isFull Operation
- Size Operation

Queue ->

- Queue Structure
- Dequeue Operation
- Front Operation
- Rear Operation
- isEmpty Operation
- isFull Operation
- Size Operation

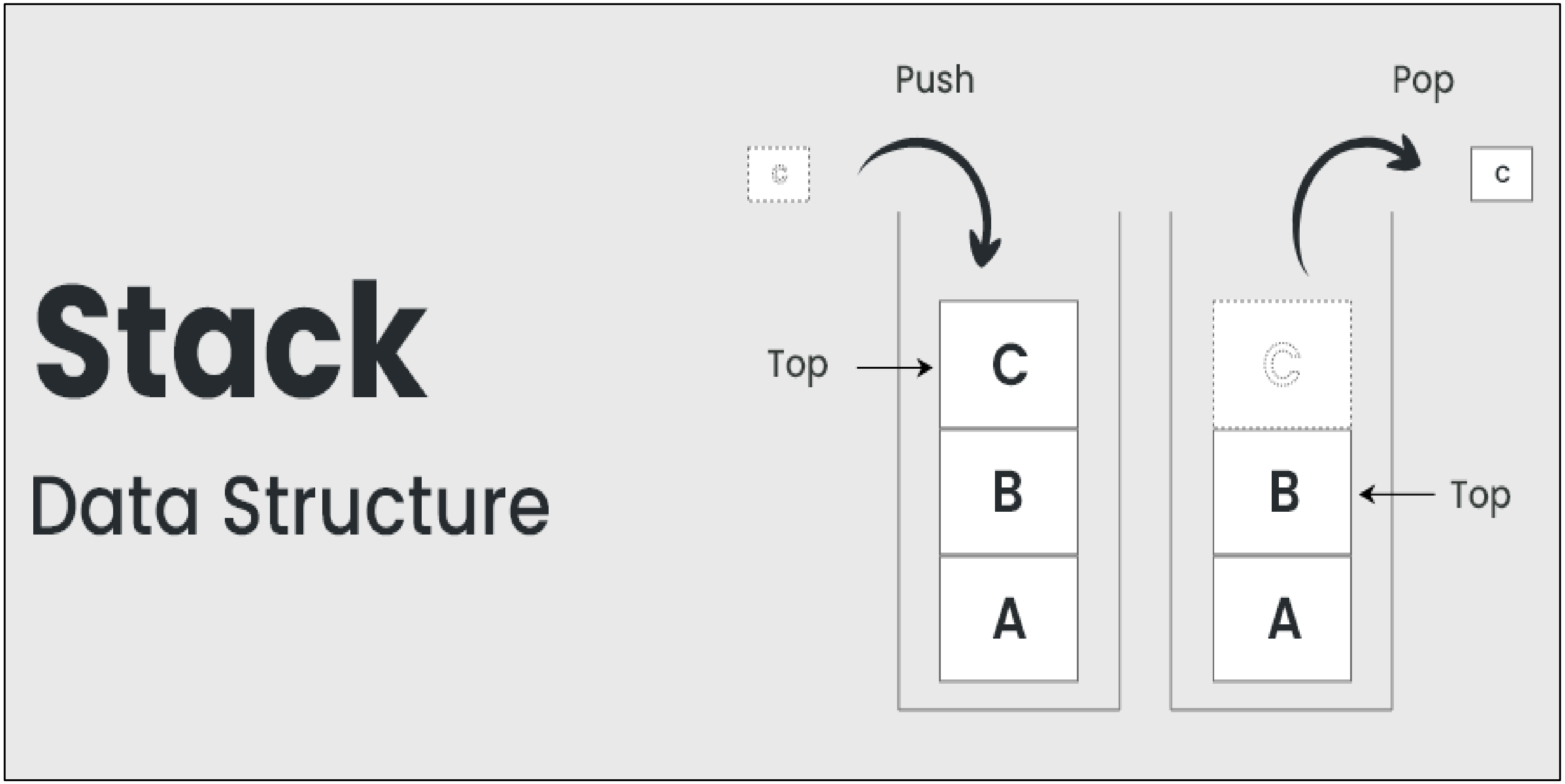
Objective



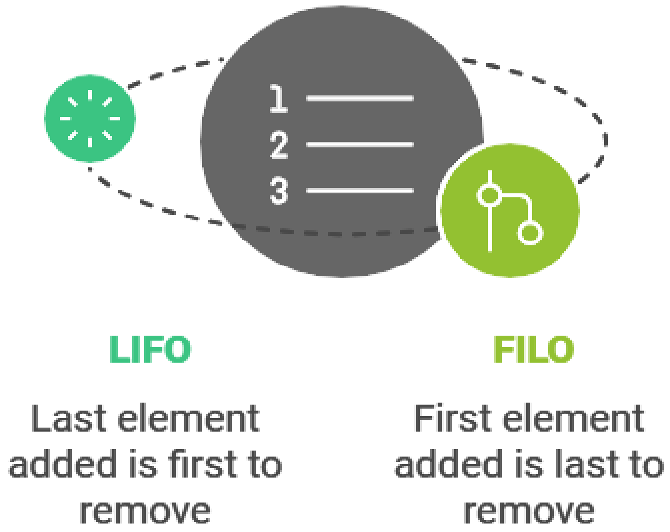
Stack
Push
Pop
Peek
isEmpty
isFull
Size
Data Structures
Queue
Enqueue
Dequeue
Front
Rear
isEmpty
isFull

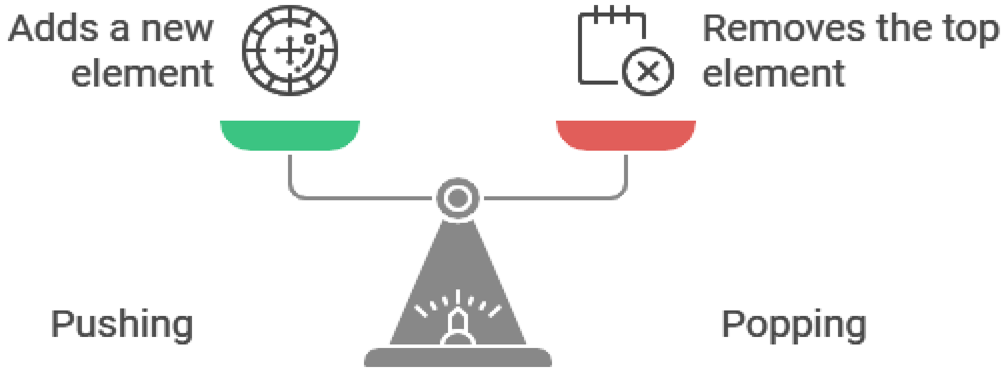
Part 1: Stack Structure

I. Stack Structure



I. Stack Structure



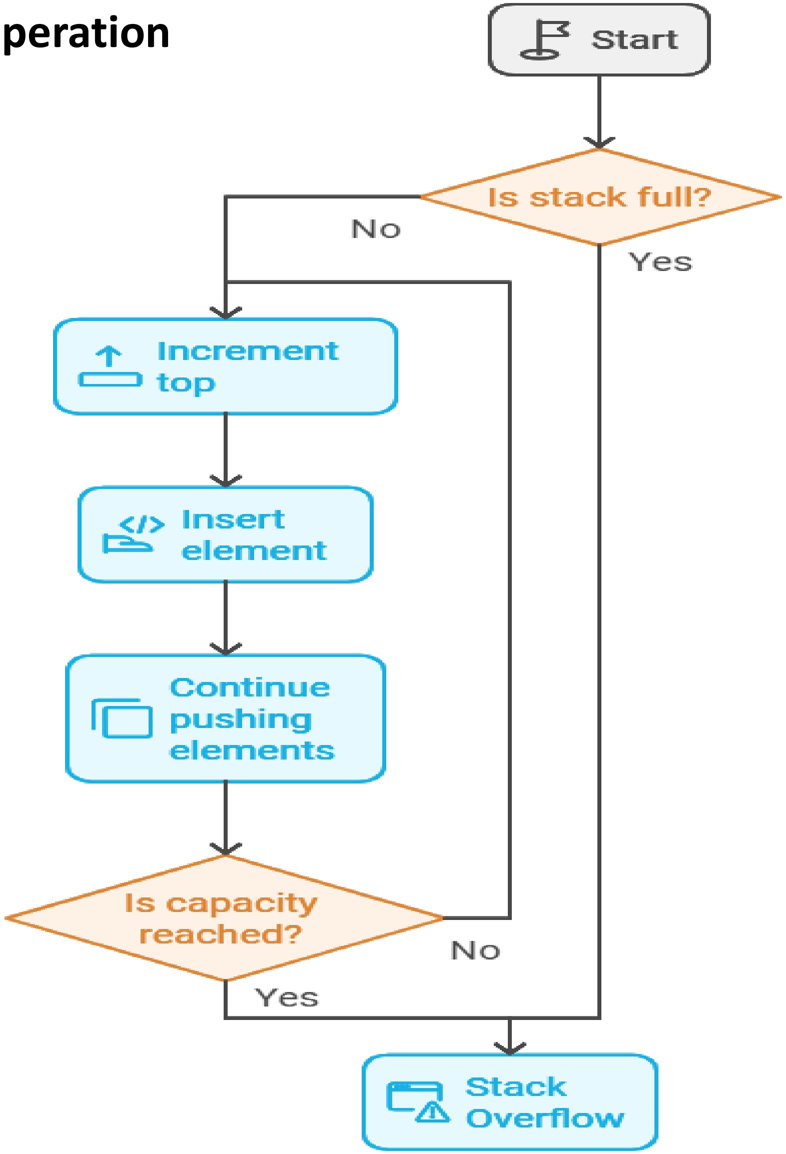


I. Stack Structure

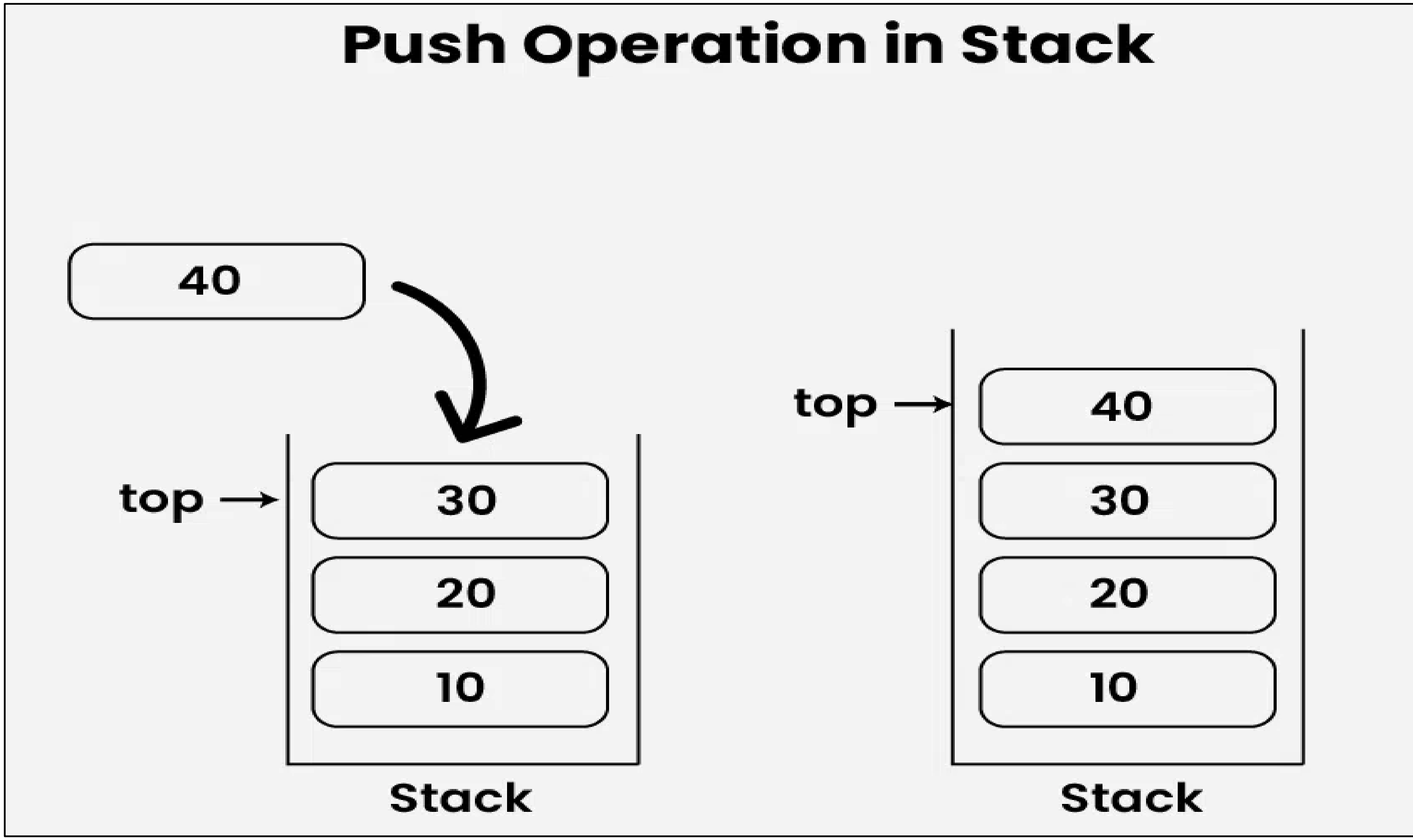
Operations on Stack Structures

II. Push Operation

Algorithm for Push Operation



II. Push Operation



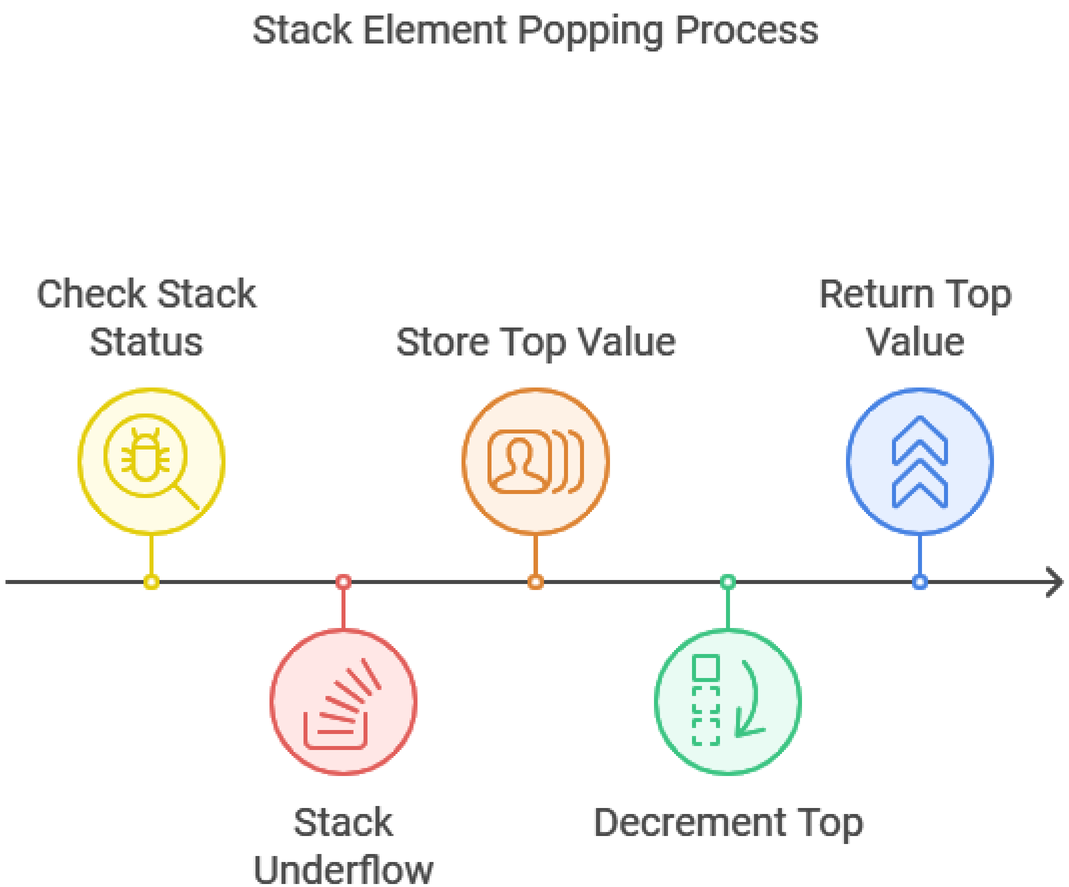
II. Push Operation

```
using System.Collections.Generic; using System;
class Program {
   static void Main()
   {   Stack<int> s = new Stack<int>(); // Creating a stack of integers
      s.Push(1); // Pushing 1 to the stack top
      s.Push(2); // Pushing 2 to the stack top
      s.Push(3); // Pushing 3 to the stack top
      s.Push(4); // Pushing 4 to the stack top
      s.Push(5); // Pushing 5 to the stack top
      // Printing the stack
      while (s.Count > 0) { // Peek() gets the top element without removing it
         Console.Write( s.Peek() + " ");
         s.Pop(); // Pop() removes the top element       }
   } // The above loop prints "5 4 3 2 1"
}
```

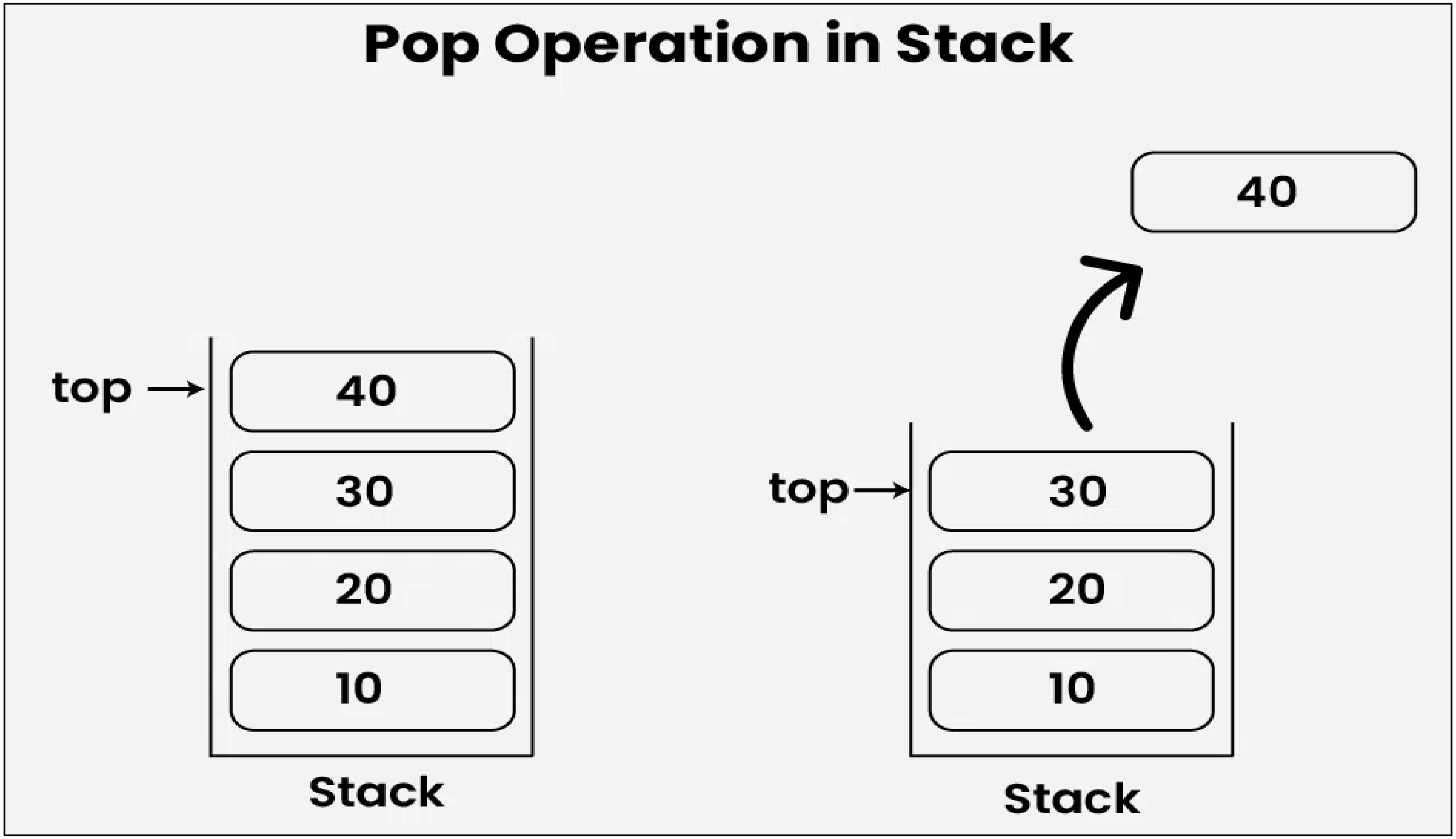
Output: 5 4 3 2 1

III. Pop Operation

Algorithm for Pop Operation:



III. Pop Operation



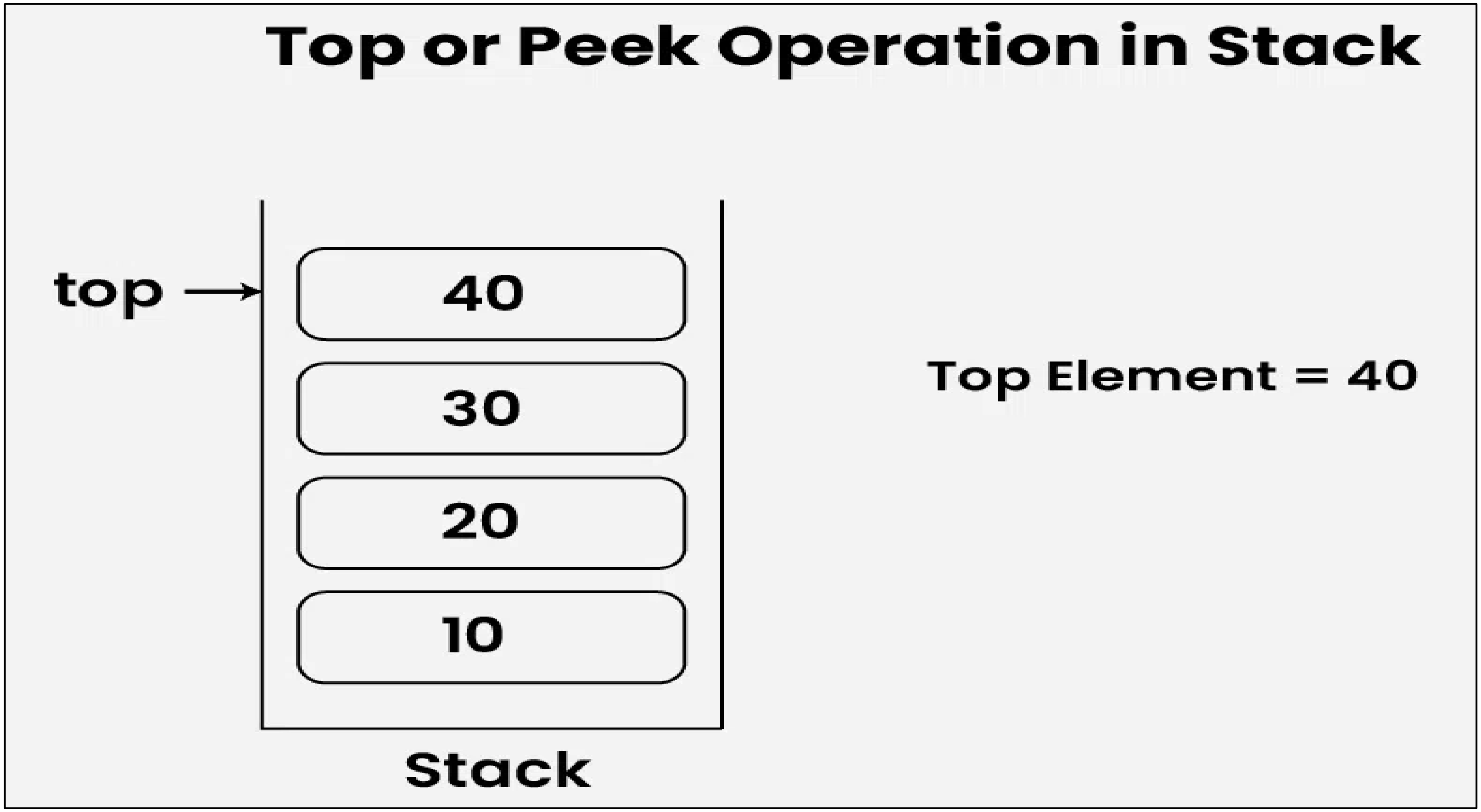
III. Pop Operation

```
using System.Collections.Generic; using System;
class Program {
   static void Main()
   {   // Creating a stack of integers
      Stack<int> s = new Stack<int>();
      // Pushing elements onto the stack
      s.Push(1); // This pushes 1 to the stack top
      s.Push(2); // This pushes 2 to the stack top
      s.Push(3); // This pushes 3 to the stack top
      s.Push(4); // This pushes 4 to the stack top
      s.Push(5); // This pushes 5 to the stack top
      // Removing elements from the stack using Pop function
      while (s.Count > 0) {
         Console.Write(s.Peek() + " "); // Displaying the top element without removing it
         s.Pop();    }   } // Removes the top element from the stack
}
```

Output: 5 4 3 2 1

IV. Top or Peek Operation

Algorithm for Top Operation:



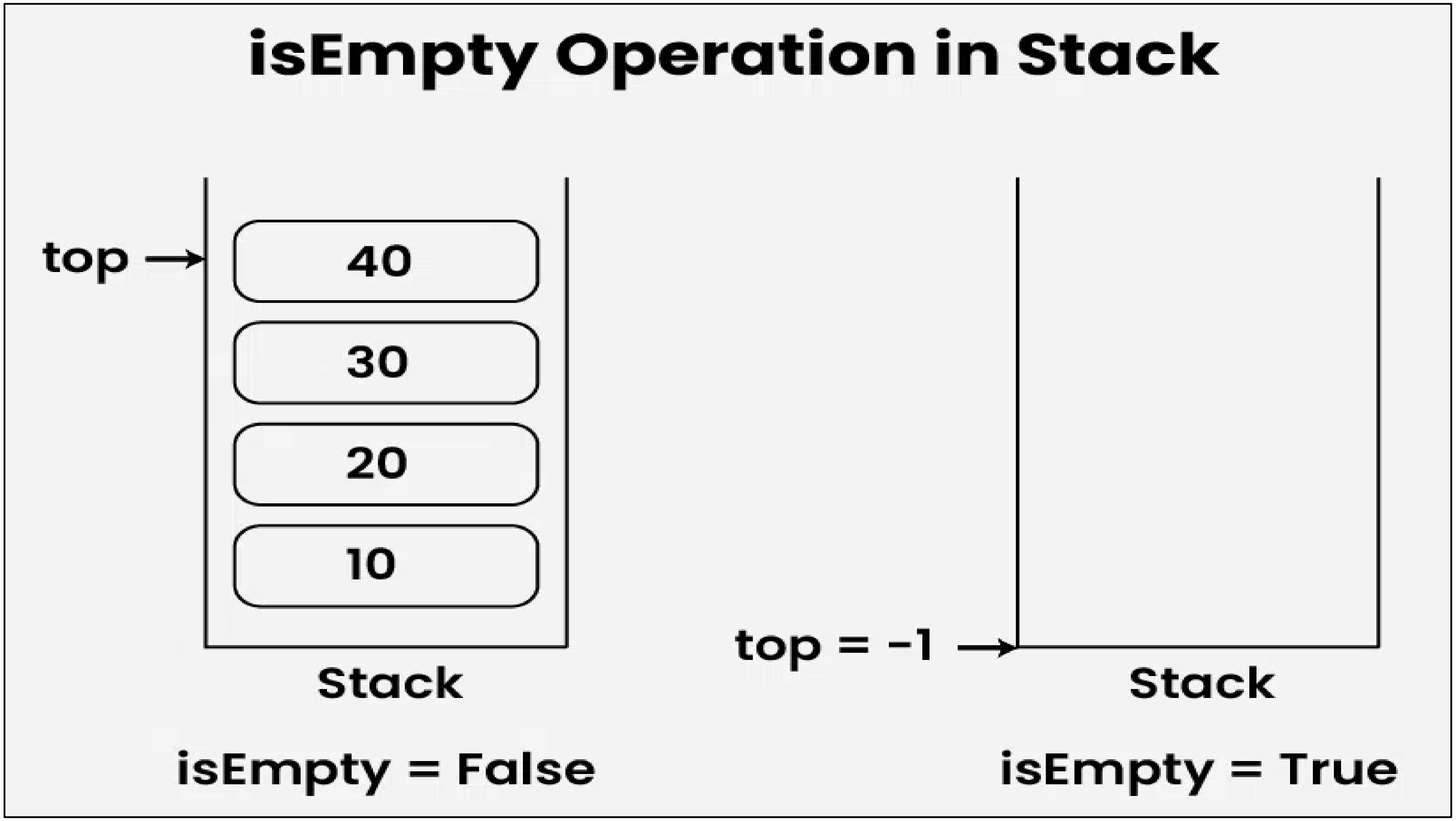
IV. Top or Peek Operation

```
using System.Collections.Generic; using System;
class Program
{   static int TopElement(Stack<int> s)
   {       return s.Peek();       }
   static void Main()
   {   Stack<int> s = new Stack<int>(); // creating a stack of integers
       s.Push(1); // This pushes 1 to the stack top
       Console.WriteLine(TopElement(s)); // Prints 1 since 1 is present at the stack top
       s.Push(2); // This pushes 2 to the stack top
       Console.WriteLine(TopElement(s)); // Prints 2 since 2 is present at the stack top
       s.Push(3); // This pushes 3 to the stack top
       Console.WriteLine(TopElement(s)); }// Prints 3 since 3 is present at the stack top
}
```

Output: 1
2
3

V. isEmpty Operation

Algorithm for isEmpty Operation:



V. isEmpty Operation

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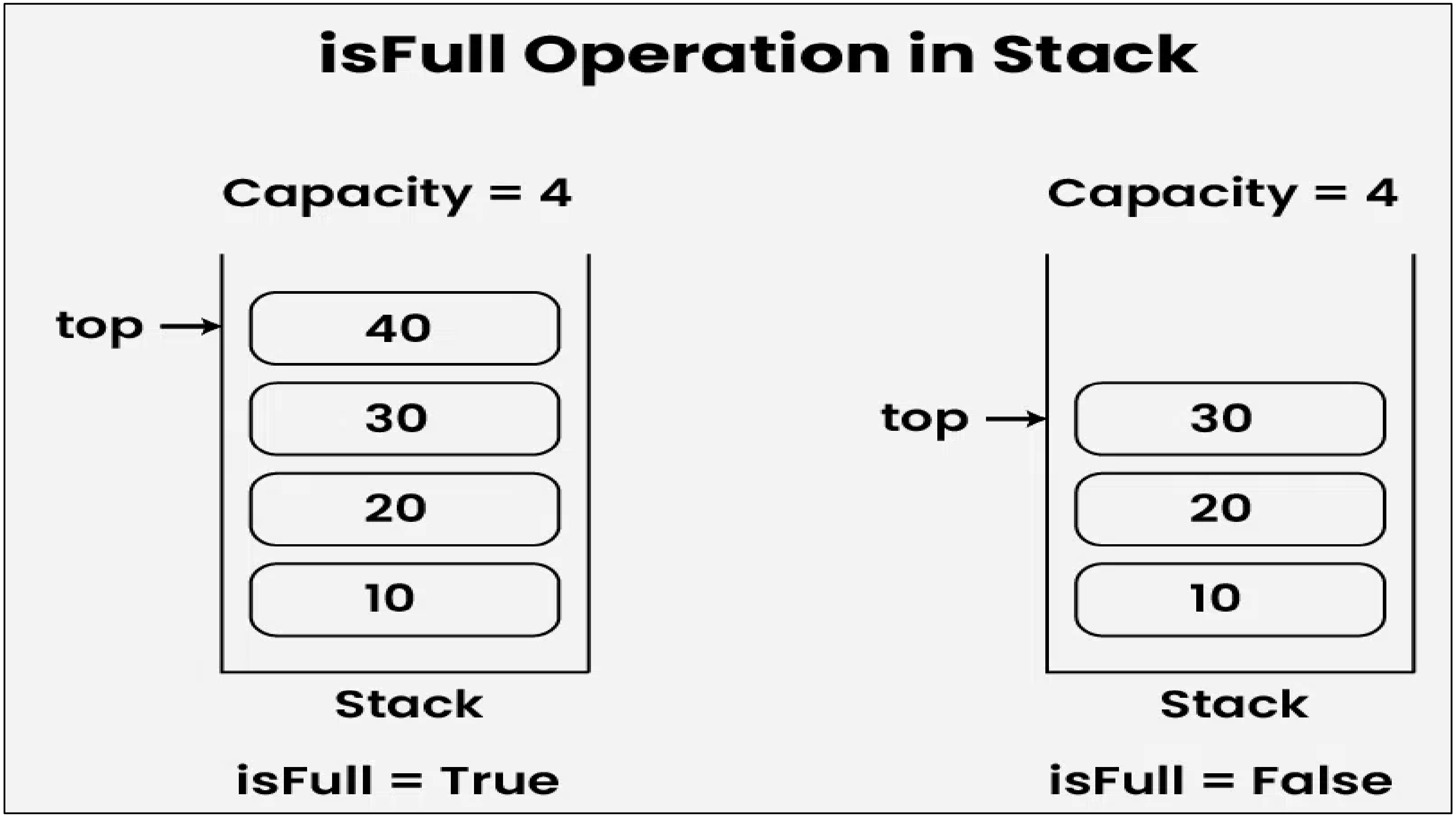
```
using System.Collections.Generic; using System;
class Program
{   static bool IsEmpty(Stack<int> s) // Function to check if a stack is empty
    {    return s.Count == 0;    }
    static void Main()
    {   Stack<int> s = new Stack<int>();
        // Check if the stack is empty
        if (IsEmpty(s))      { Console.WriteLine("Stack is empty.");          }
        else                 { Console.WriteLine("Stack is not empty.");    }
        // Push a value (1) onto the stack
        s.Push(1);       // Check if the stack is empty after pushing a value
        if (IsEmpty(s))      { Console.WriteLine("Stack is empty.");          }
        else                 { Console.WriteLine("Stack is not empty.");    }   }
}
```

Output: Stack is empty.
Stack is not empty.

VI. isFull Operation:

Algorithm for isFull Operation:



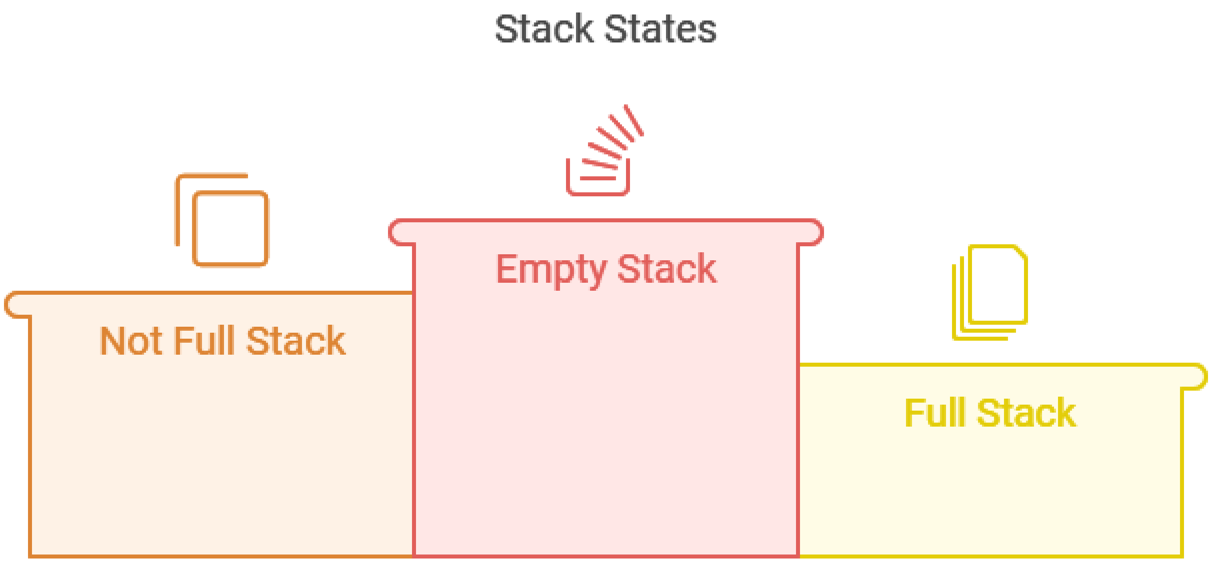
VI. isFull Operation:

```
using System.Collections.Generic; using System;
internal class Program
{     static bool IsFull(Stack<int> s)
      {          return s.Count == 5;       }
      static void Main(string[] args)
      {    Stack<int> s = new Stack<int>(); // Check if the stack is empty
        if (IsFull(s))        { Console.WriteLine("Stack is full.");          }
          else                { Console.WriteLine("Stack is not full.");     }
          // Push a value (1) onto the stack
          s.Push(1);   s.Push(2);   s.Push(3);   s.Push(4);   s.Push(5);
          // Check if the stack is empty after pushing a value
          if (IsFull(s))      { Console.WriteLine("Stack is full.");          }
          else                { Console.WriteLine("Stack is not full.");     }
          Console.Read();  }
     }
}
```

Output: Stack is not full.
Stack is full.

VII. Size Operation

Algorithm for Size Operation:



VII. Size Operation

```
using System.Collections.Generic; using System;
public class Program
{   public static void Main(string[] args)
   {       Stack<int> s = new Stack<int>(); // creating a stack of integers
       Console.WriteLine(s.Count); // Prints 0 since the stack is empty
       s.Push(1); // This pushes 1 to the stack top
       s.Push(2); // This pushes 2 to the stack top
       // Prints 2 since the stack contains two elements
       Console.WriteLine(s.Count);
       s.Push(3); // This pushes 3 to the stack top
       Console.WriteLine(s.Count);
       // Prints 3 since the stack contains three elements
   }
}
```

Output: 0

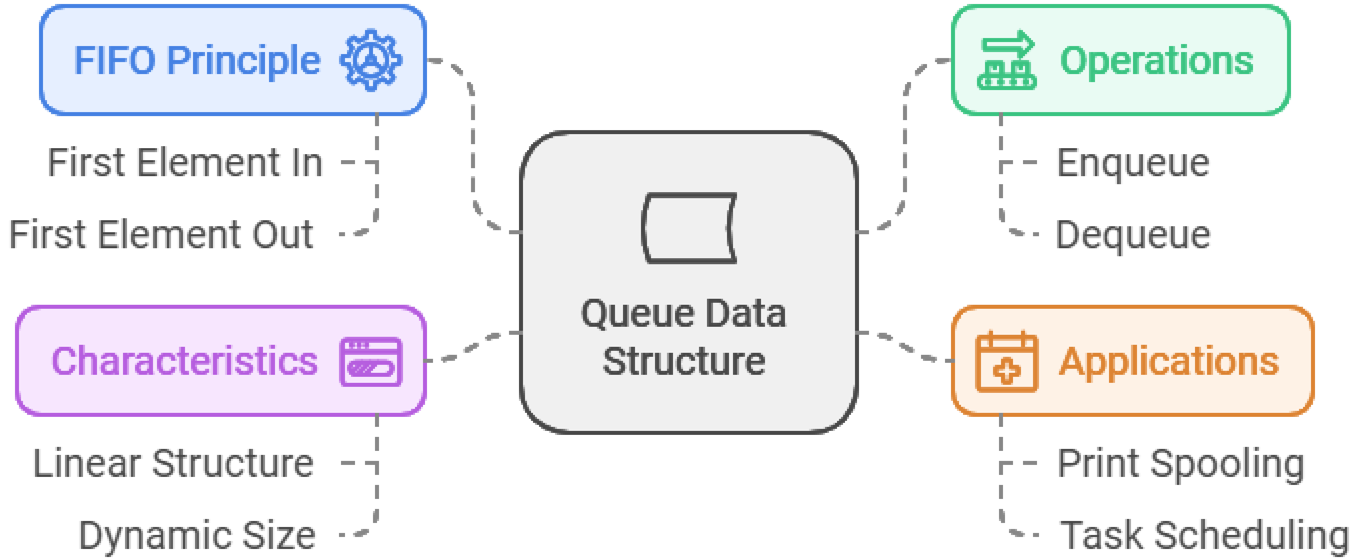
2

3

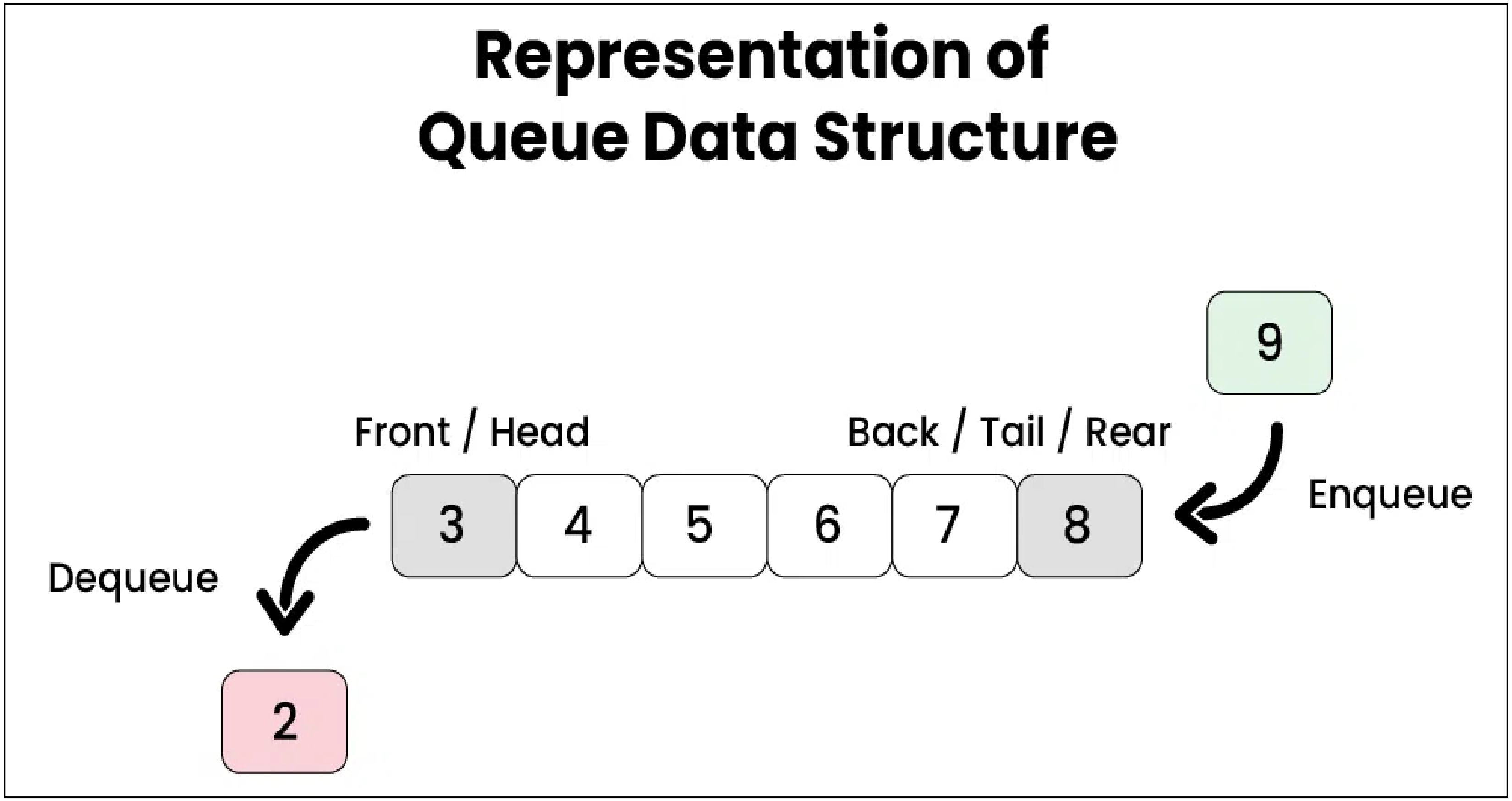
Part 2: Queue Structure

I. Queue Structure

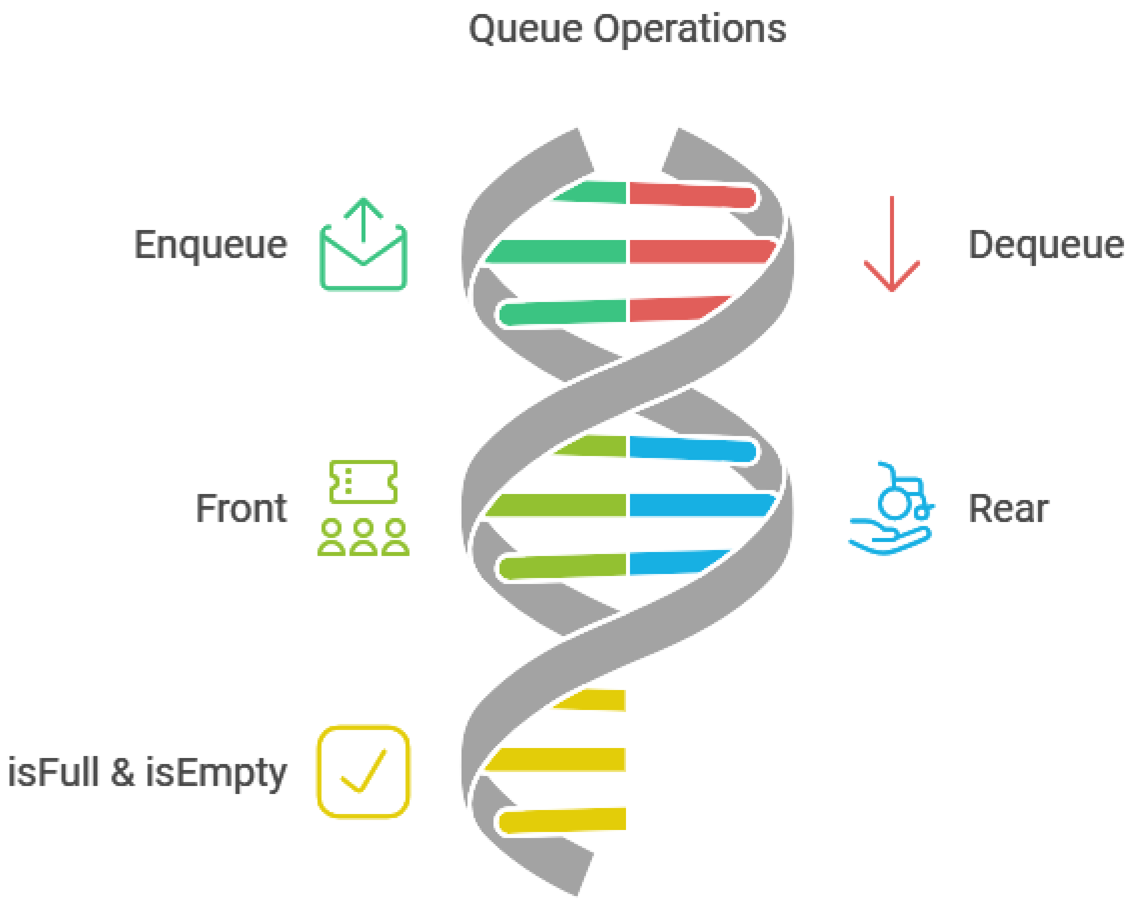
FIFO Principle of Queue Data Structure:



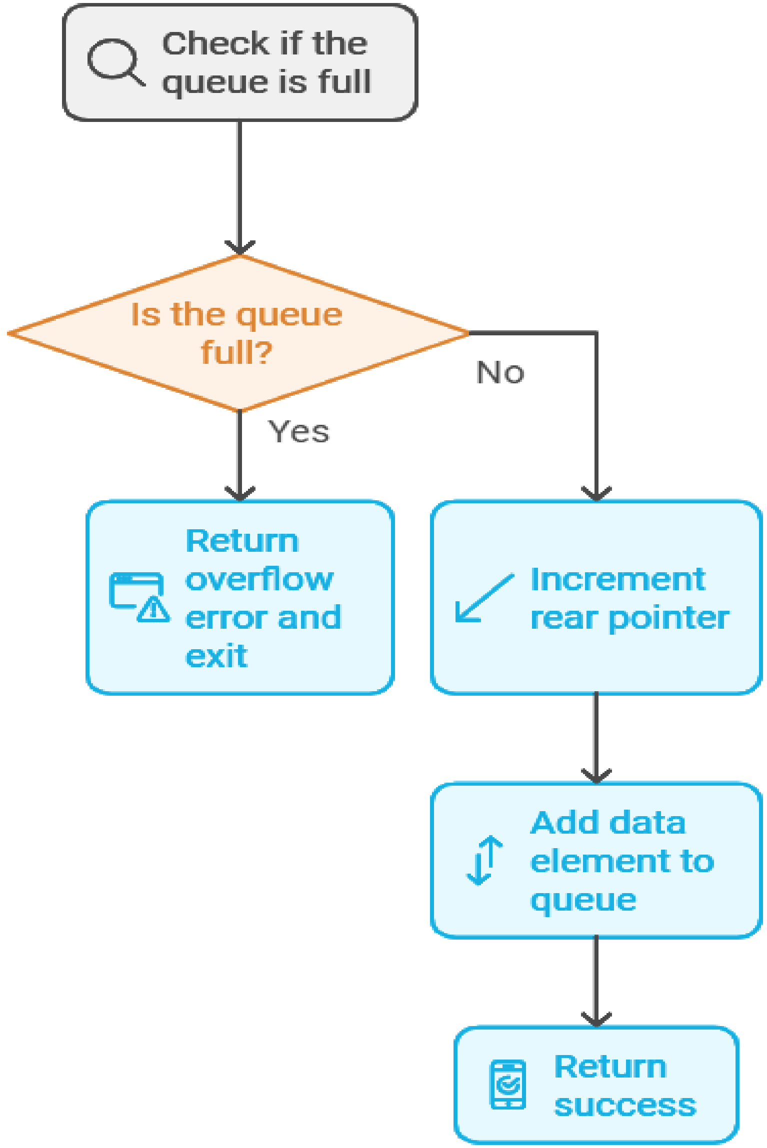
I. Queue Structure



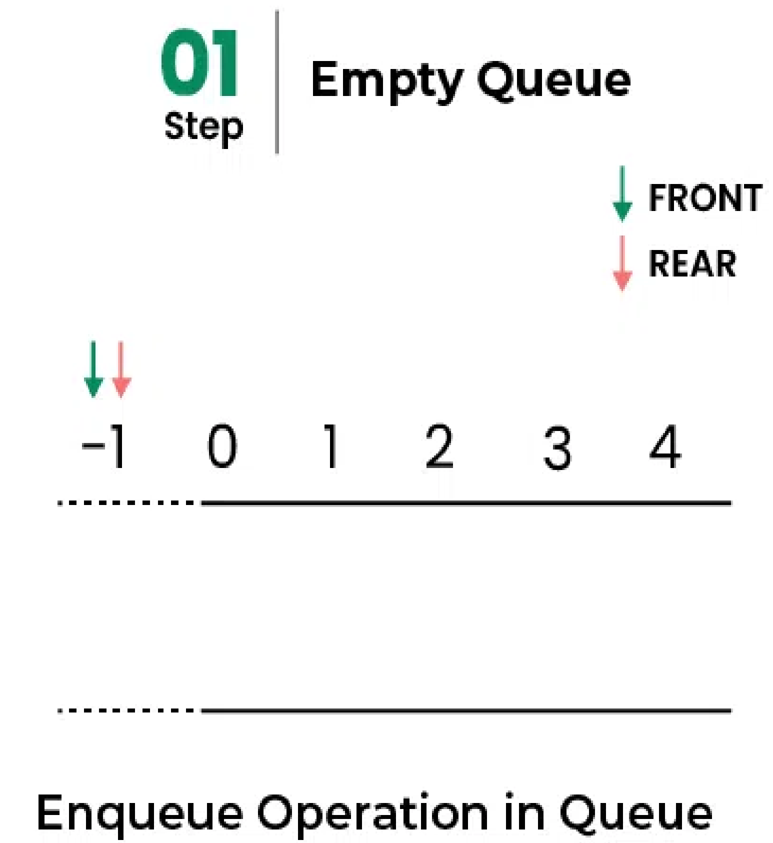
I. Queue Structure

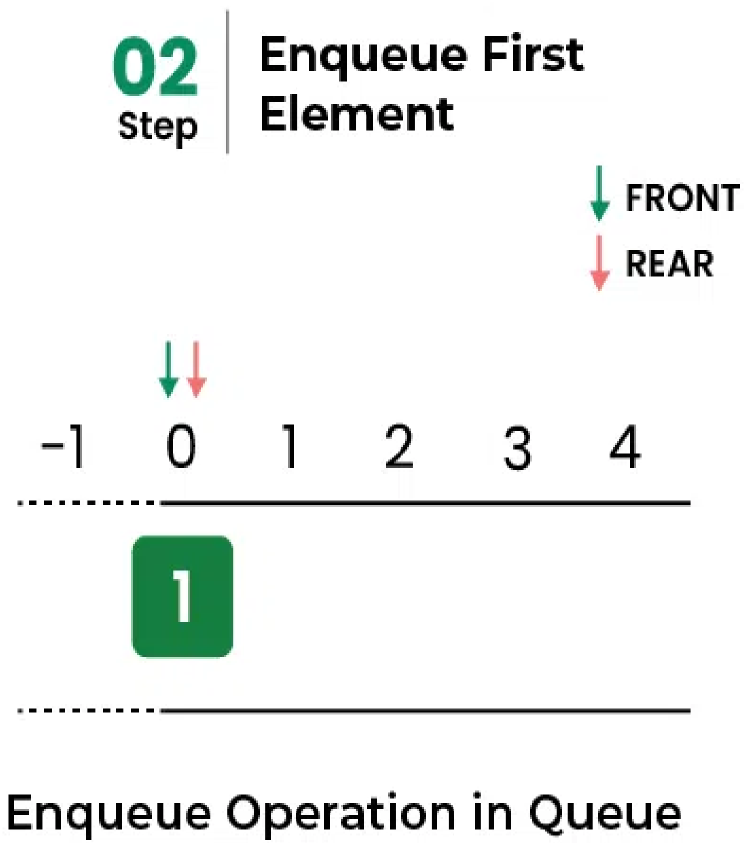


II. Enqueue Operation



II. Enqueue Operation

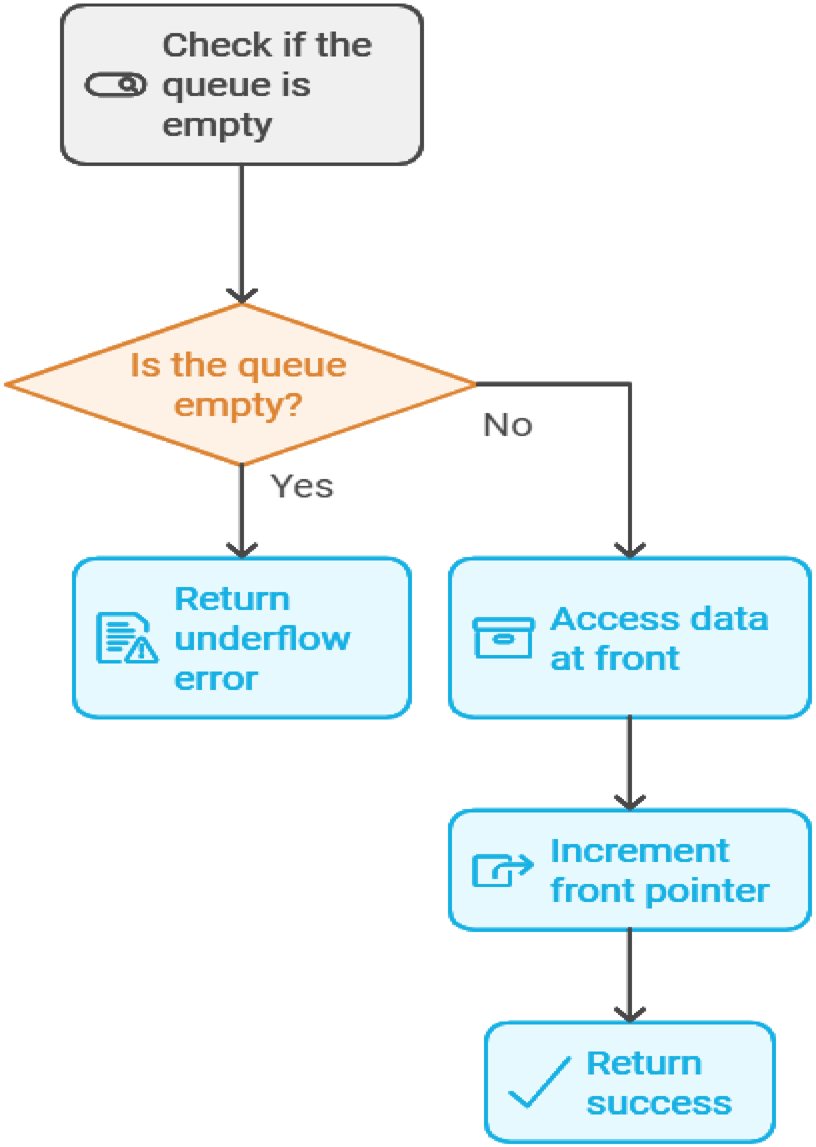




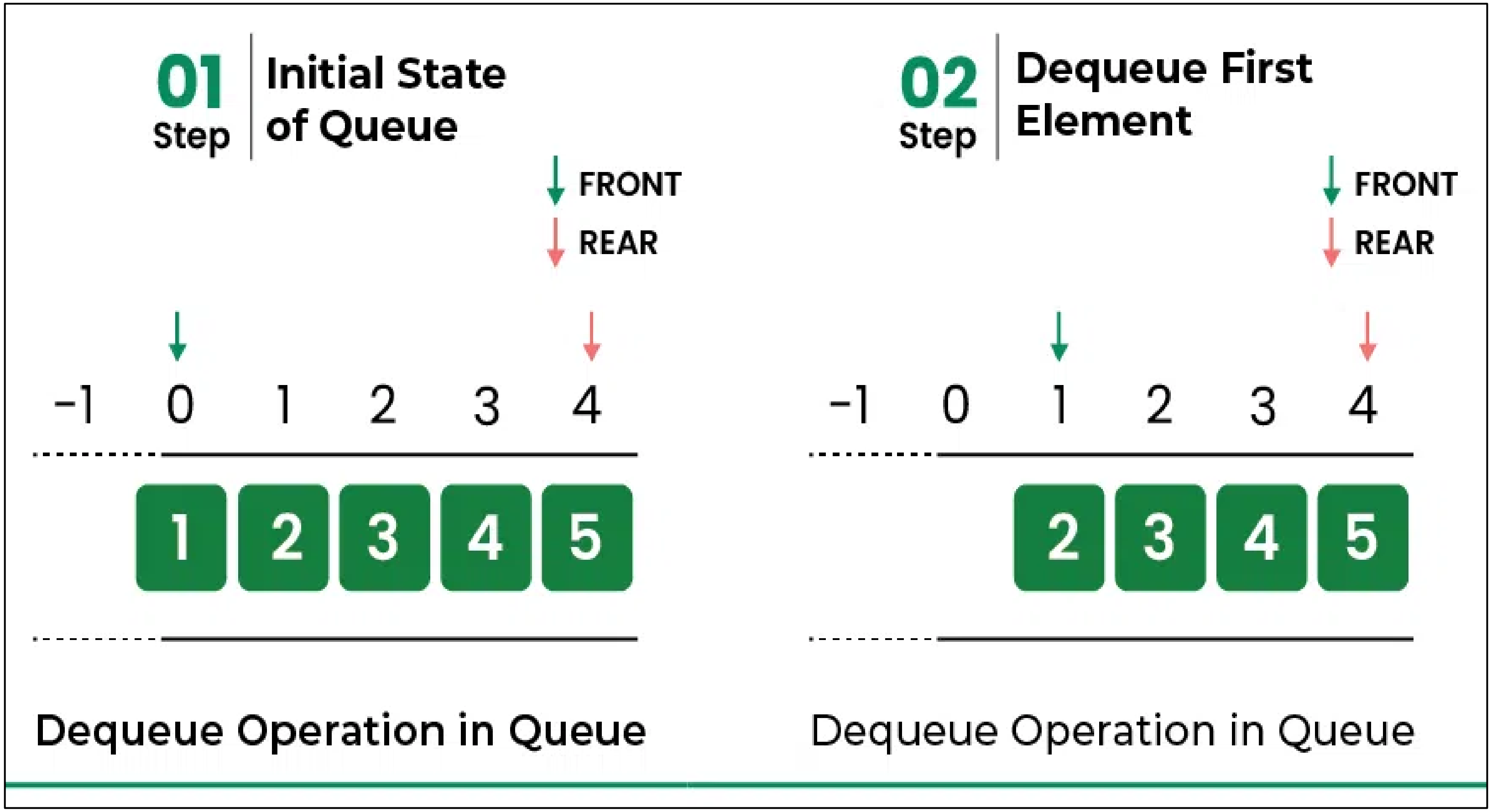
II. Enqueue Operation

```
// Function to add an item to the queue.
// It changes rear and size
public void enqueue(int item)
{
    if (rear == max - 1) {
        Console.WriteLine("Queue Overflow");
        return;
    }
    else {
        ele[++rear] = item;
    }
}
```

III. Dequeue Operation



III. Dequeue Operation



III. Dequeue Operation

```
// Function to remove an item from queue.
// It changes front and size
public int dequeue()
{
    if (front == rear + 1) {
        Console.WriteLine("Queue is Empty");
        return -1;
    }  else {
        int p = ele[front++];
        return p;
    }
}
```

IV. Front Operation

- This operation returns the element at the front end without removing it.

```
//  Function to get front of queue
public int front()
{    if (isempty())
        return INT_MIN;
    return arr[front];
}
```

V. Rear Operation

- This operation returns the element at the front rear without removing it.

```
static int Rear(Queue<int> myQueue)
{
    if (myQueue.Count == 0) {
        Console.WriteLine("Queue is empty.");
        return -1;
    }
    int rearElement = -1;
    while (myQueue.Count > 0) {
        rearElement = myQueue.Dequeue();
    }
    return rearElement;
}
```

VI. IsEmpty Operation

- This operation returns a boolean value that indicates whether the queue is empty or not.

```
// This function will check whether
// the queue is empty or not:
bool isEmpty()
{
    if (front == -1)
        return true;
    else
        return false;
}
```

VI. IsFull Operation

- This operation returns a boolean value that indicates whether the queue is full or not.

```
// Function to add an item to the queue.
//It changes rear and size
public bool isFull(int item)
{    return (rear == max - 1);
}
```

Implementation of Queue Data Structure:

Queue can be implemented using following data structures: Implementation of Queue using Arrays.

Implementation

```
// C# program for array implementation of queue using System;
namespace GFG { // A class to represent a linear queue
class Queue {
    private int[] ele; private int front; private int rear;    private int max;
    public Queue(int size)
    {   ele = new int[size]; front = 0; rear = -1; max = size;
    }// Function to add an item to the queue. It changes rear and size
    public void enqueue(int item)
    {    if (rear == max - 1) {
            Console.WriteLine("Queue Overflow"); return;
        }else { ele[++rear] = item;     }
    }// Function to remove an item from queue. It changes front and size
    public int dequeue()
    {   if (front == rear + 1) {
            Console.WriteLine("Queue is Empty"); return -1; }
```

Implementation

```
else { Console.WriteLine(ele[front]+ " dequeued from queue");
         int p = ele[front++];
         Console.WriteLine("Front item is {0}", ele[front]);
         Console.WriteLine("Rear item is {0} ", ele[rear]);  return p;   }
   }// Function to print queue.
public void printQueue()
   {  if (front == rear + 1) {   Console.WriteLine("Queue is Empty");    return;
      }else {    for (int i = front; i <= rear; i++) {
            Console.WriteLine(ele[i]+ " enqueued to queue");  } } } }// Driver code
class Program {
   static void Main()
   {   Queue Q = new Queue(5);
      Q.enqueue(10);       Q.enqueue(20);
      Q.enqueue(30);       Q.enqueue(40);
      Q.printQueue();      Q.dequeue();   }  }  }
```

Implementation

Output:

10 enqueued to queue

20 enqueued to queue

30 enqueued to queue

40 enqueued to queue

10 dequeued from queue .

Front item is 20

Rear item is 40

Quizzes

1. What is a stack data structure?
2. What are the basic operations of a stack?
3. What is the output of the following code:

```
Stack stack = new Stack(5);
stack.Push(1); stack.Push(2);  stack.Push(3);
Console.WriteLine(stack.Peek()); // Output: 3
Console.WriteLine(stack.Pop());  // Output: 3
Console.WriteLine(stack.IsEmpty()); // Output: False
```

4. What is the output of the following code:

```
Stack st = new Stack();
st.Push('A'); st.Push('B'); st.Push('C'); st.Push('D');
Console.WriteLine("Current stack: ");
foreach (char c in st) {     Console.Write(c + " ");   }
```

Quizzes

5. What is a queue data structure?
6. What are the basic operations of a queue?
7. What is the output of the following code:

```
Queue queue = new Queue(5);
queue.Enqueue(1); queue.Enqueue(2); queue.Enqueue(3);
Console.WriteLine(queue.Peek()); // Output: 1
Console.WriteLine(queue.Dequeue()); // Output: 1
Console.WriteLine(queue.IsEmpty()); // Output: False
```

8. What is the output of the following code:

```
Queue q = new Queue();
q.Enqueue("Two"); q.Enqueue("One");
while (q.Count > 0) // remove elements
Console.WriteLine(q.Dequeue());
```

9. What is the different between stack and queue?


THANK
YOU!