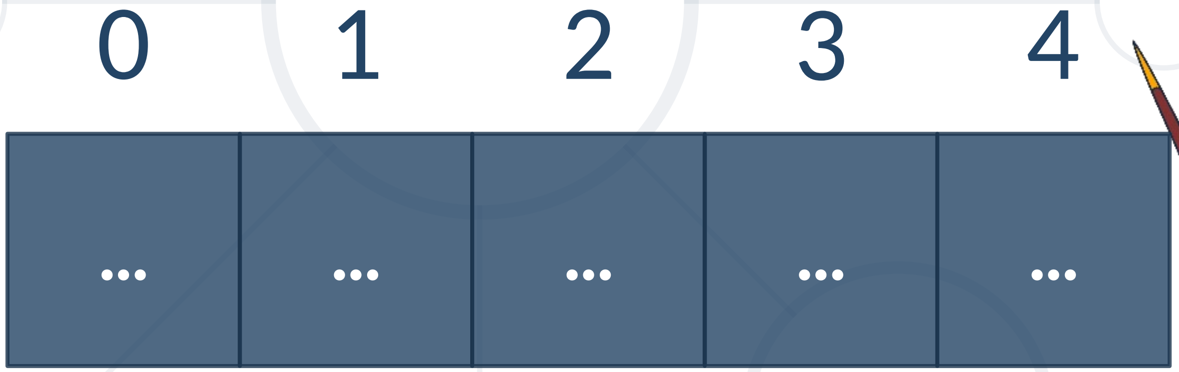
Stacks and Queues

Processing Sequences of Elements



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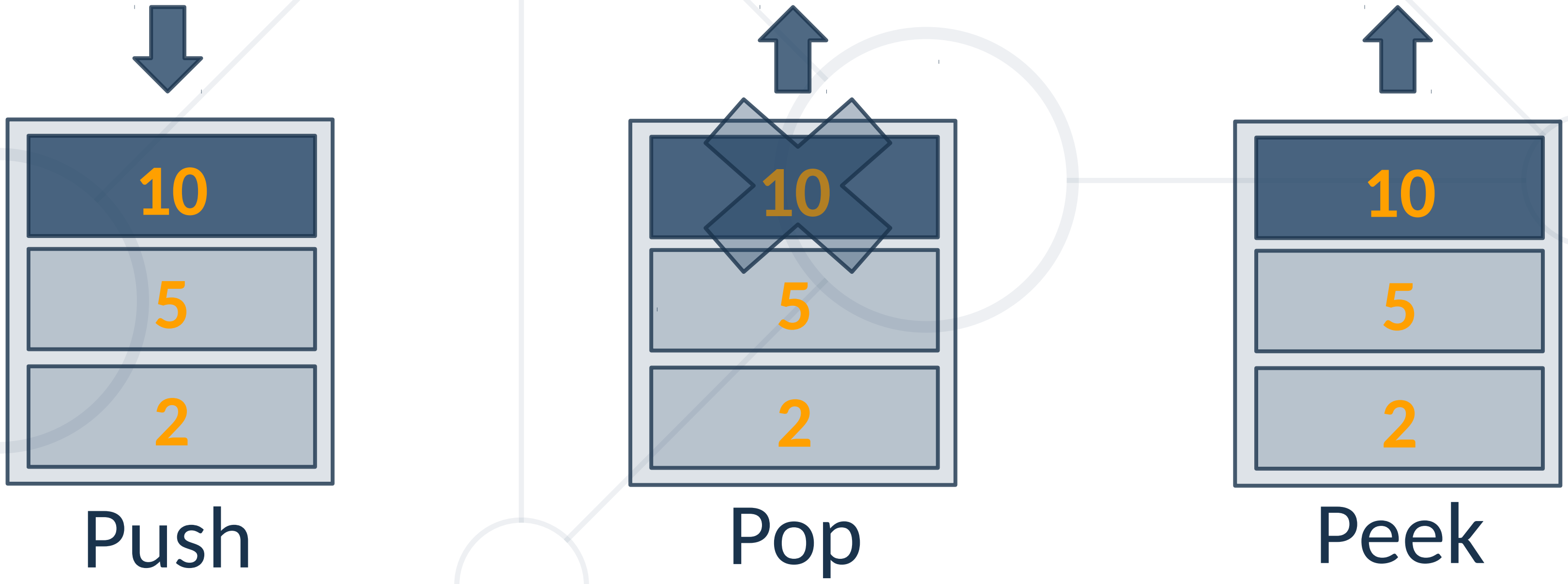
#csharp-advanced

Stack<T>
Overview and Working with Stack

Stack – Abstract Data Type

- Stacks provide the following functionality:
  - Pushing an element at the top of the stack
  - Popping element from the top of the stack
  - Getting the topmost element without removing it



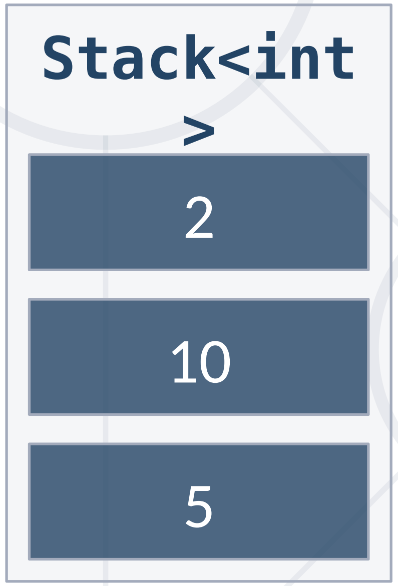
Push() – Adds an element on top of the Stack

5

`Stack<int>`

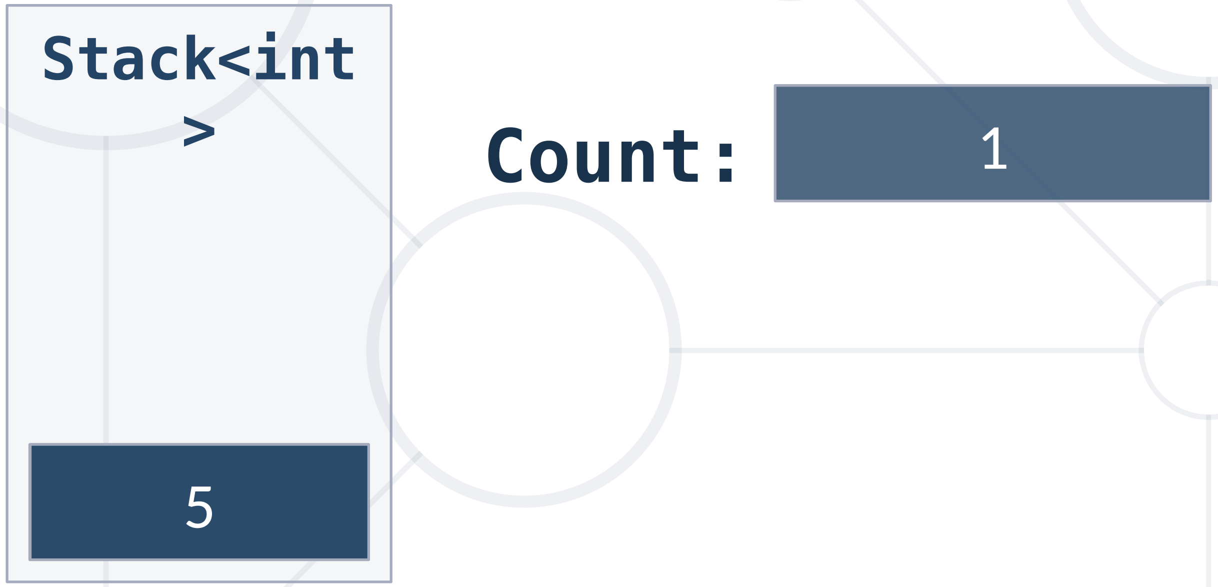
Count: 3

Pop() – Returns and removes the last element



`Count:` 2

Peek() – Returns the last element



Problem: Reverse Strings

- Create a program that:
  - Reads an input string
  - Reverses it using a Stack

```
I Love C#             →  #C evoL I
Stacks and Queues     →  seueuQ dna skcatS
```

Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Solution: Reverse Strings

```
var input = Console.ReadLine();
var stack = new Stack<char>();
foreach (var ch in input)
{
  stack.Push(ch);
}
while (stack.Count != 0)
{
  Console.Write(stack.Pop());
}
Console.WriteLine();
```

Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Stack – Utility Methods

```csharp
Stack<int> stack = new
Stack<int>();

int count = stack.Count;
bool exists = stack.Contains(2);
int[] array = stack.ToArray();
stack.Clear();
stack.TrimExcess();
```

Retains order of elements

Remove all elements

Resize the internal array

Problem: Simple Calculator

- Implement a simple calculator that can evaluate simple expressions (only addition and subtraction)

`2 + 5 + 10 – 2 - 1`	`14`
`2 – 2 + 5`	`5`
`2 – 1 + 5`	`6`
`2 – 0 + 5`	`7`

Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Solution: Simple Calculator

```
var input = Console.ReadLine();
var values = input.Split(' ');
var stack = new Stack<string>(values.Reverse());
while (stack.Count > 1)
{
  int first = int.Parse(stack.Pop());
  string operator = stack.Pop();
  int second = int.Parse(stack.Pop());
  //TODO: Add switch for operation (look next
slide)
}
Console.WriteLine(stack.Pop());
```

Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Solution: Simple Calculator

```
switch (operator)
{
  case "+":
    stack.Push((first +
second).ToString());
    break;
  case "-":
    stack.Push((first -
second).ToString());
    break;
}
```

Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Problem: Stack Sum

- Calculate the sum in the stack
- Before that you will receive commands
  - Add – adds the two numbers
  - Remove – removes count numbers

```
1 2 3 4
adD 5 6
REmove 3
eNd
```

```
Sum: 6
```

```
3 5 8 4 1
9
add 19 32
remove 10
add 89 22
end
```

```
Sum: 192
```

Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Solution: Stack Sum

```
var input =
Console.ReadLine().Split().Select(int.Parse).ToArr
ay();
Stack<int> stack = new Stack<int>(input);
var commandInfo = Console.ReadLine().ToLower();

while (commandInfo != "end"){
  var tokens = commandInfo.Split();
  var command = tokens[0].ToLower();
  if (command == "add")
    // Parse the numbers and add them
}
```

Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Solution: Stack Sum

```
else if(command == "remove") {
    var countOfRemovedNums = int.Parse(tokens[1]);
    if (stack.Count < countOfRemovedNums)
{ continue; }
    for (int i = 0; i < countOfRemovedNums; i++) {
      stack.Pop();
    }
  }
  commandInfo = Console.ReadLine().ToLower();
}
var sum = stack.Sum();
Console.WriteLine($"Sum: {sum}");
```

Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Problem: Matching Brackets

- We are **given an arithmetic expression** with brackets (**with nesting**)
- **Extract all sub-expressions** in brackets

```
1 + (2 - (2 + 3) * 4 / (3 + 1))
* 5
```

```
(2 + 3)
(3 + 1)
(2 - (2 + 3) * 4 / (3 +
1))
```

Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Solution: Matching Brackets

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```
var input = Console.ReadLine();
var stack = new Stack<int>();
for (int i = 0; i < input.Length; i++) {
  char ch = input[i];
  if (ch == '(') {
    stack.Push(i);
  } else if (ch == ')') {
    int startIndex = stack.Pop();
    string contents = input.Substring(
                         startIndex, i - startIndex
+ 1);
    Console.WriteLine(contents);
}
```

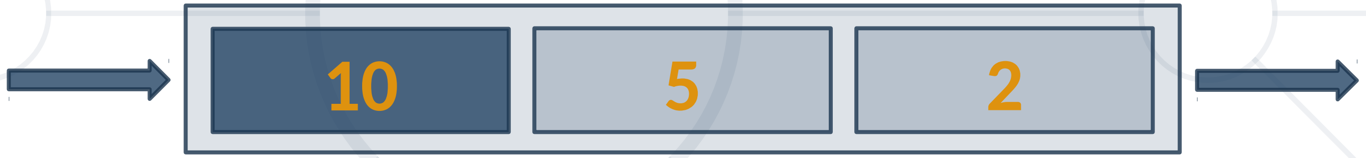
Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Queue<T>

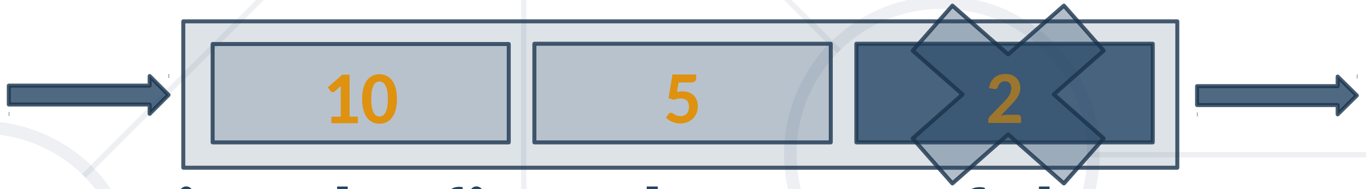
Overview and Working with Queue

Queue – Abstract Data Type

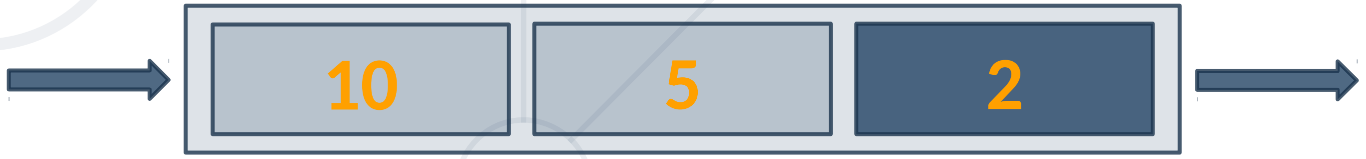
- Queues provide the following functionality:
  - Adding an element at the end of the queue



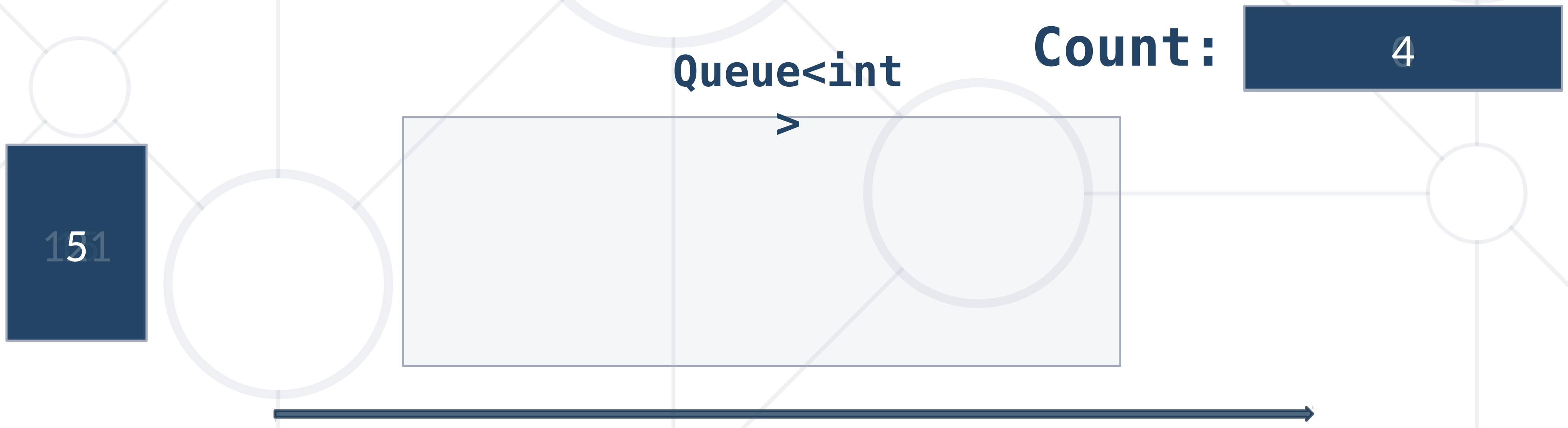
  - Removing the first element from the queue



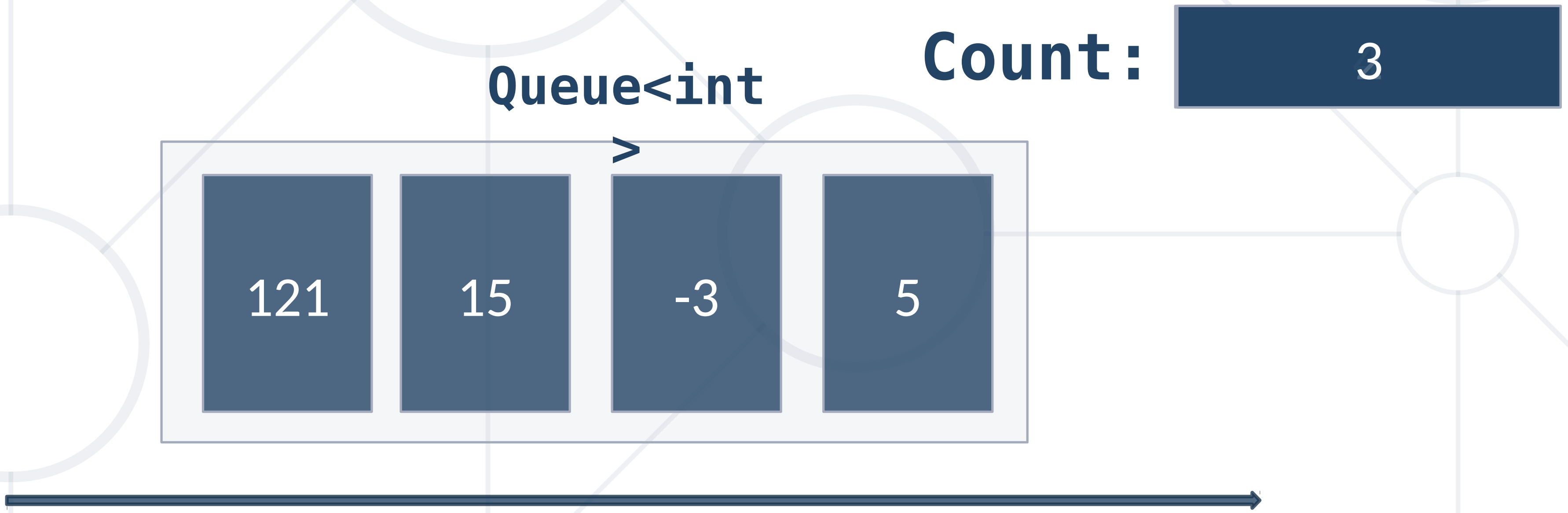
  - Getting the first element of the queue without removing it



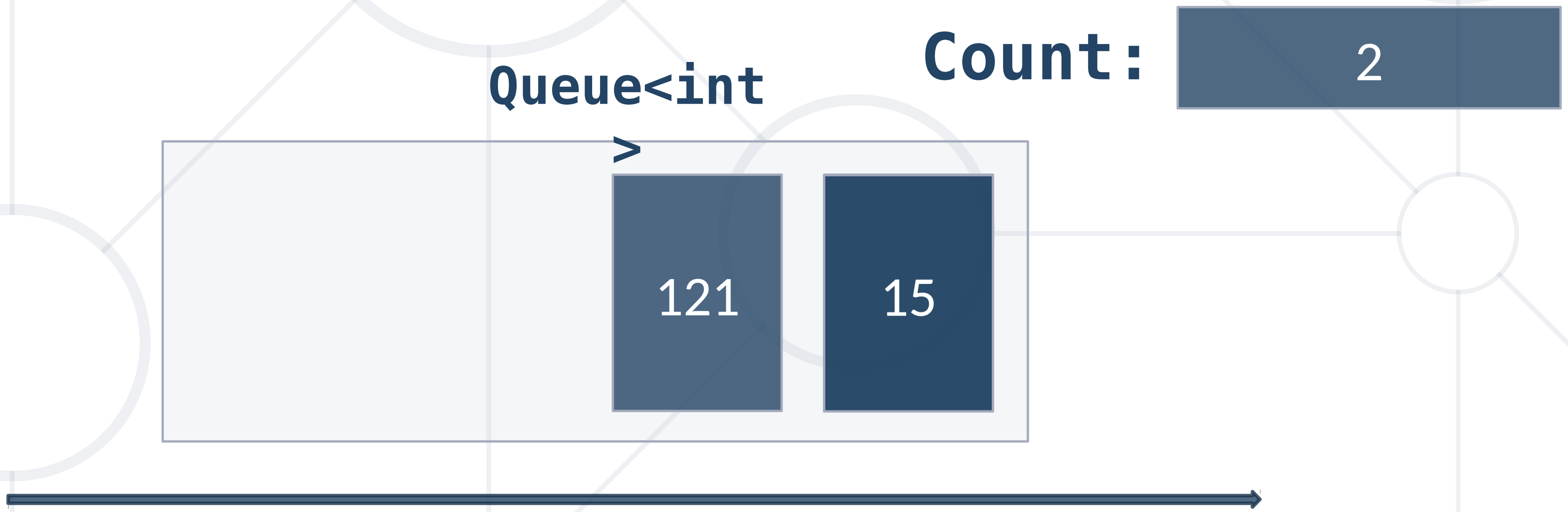
Enqueue() – Adds an element to the front



Dequeue() – Returns and removes the first element



Peek() – Returns the first element



Problem: Hot Potato

- Children **form a circle** and pass a hot potato **clockwise**
- Every nth toss **a child is removed** until **only one remains**
- **Upon removal** the potato is passed **along**
- Print the child that remains last

```
Mimi Pepi
Toshko
2
```

→

```
Removed Pepi
Removed Mimi
Last is
Toshko
```

Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Solution: Hot Potato

```
var children = Console.ReadLine().Split(' ');
var number = int.Parse(Console.ReadLine());
Queue<string> queue = new
Queue<string>(children);
while (queue.Count != 1) {
  for (int i = 1; i < number; i++) {
    queue.Enqueue(queue.Dequeue());
  }
  Console.WriteLine($"Removed
{queue.Dequeue()}");
}
Console.WriteLine($"Last in
{queue.Dequeue()}");
```

Copies elements from the specified collection and keeps their order

Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Queue – Utility Methods

```
Queue<int> queue = new
Queue<int>();

int count = queue.Count;
bool exists = queue.Contains(2);
int[] array = queue.ToArray();
queue.Clear();
queue.TrimExcess();
```

Retains order of elements

Remove all elements

Resize the internal array

Problem: Traffic Jam

- Cars are **queuing up** at a **traffic light**
- Every **green light** n cars pass the crossroads
- After the **end command**, print **how many cars** have **passed**

```
3
Pesho's car
Gosho's car
Mercedes CLS
Nekva troshka
green
BMW X5
green
end
```

```
Pesho's car passed!
Gosho's car passed!
Mercedes CLS passed!
Nekva troshka passed!
BMW X5 passed!
5 cars passed the crossroads.
```

Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Solution: Traffic Jam

```
int n = int.Parse(Console.ReadLine());
var queue = new Queue<string>();
int count = 0;
string command;
while ((command = Console.ReadLine()) != "end")
{
  if (command == "green")
    //TODO: Add green light logic
  else
    queue.Enqueue(command);
}
Console.WriteLine($"{count} cars passed the
crossroads.");
```

Check your solution here: https://judge.softuni.bg/Contests/1445/Stacks-and-Queues-Lab

Summary

- Stack<T>
  - **LIFO** data structure
- Queue<T>
  - **FIFO** data structure
- Working with **built-in methods**

Questions?

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