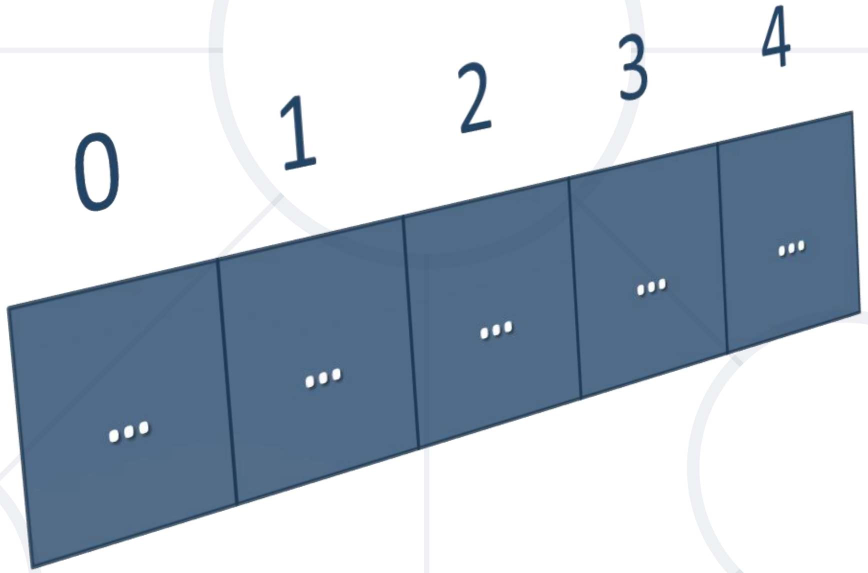
Lists

Processing Variable-Length Sequences of Elements



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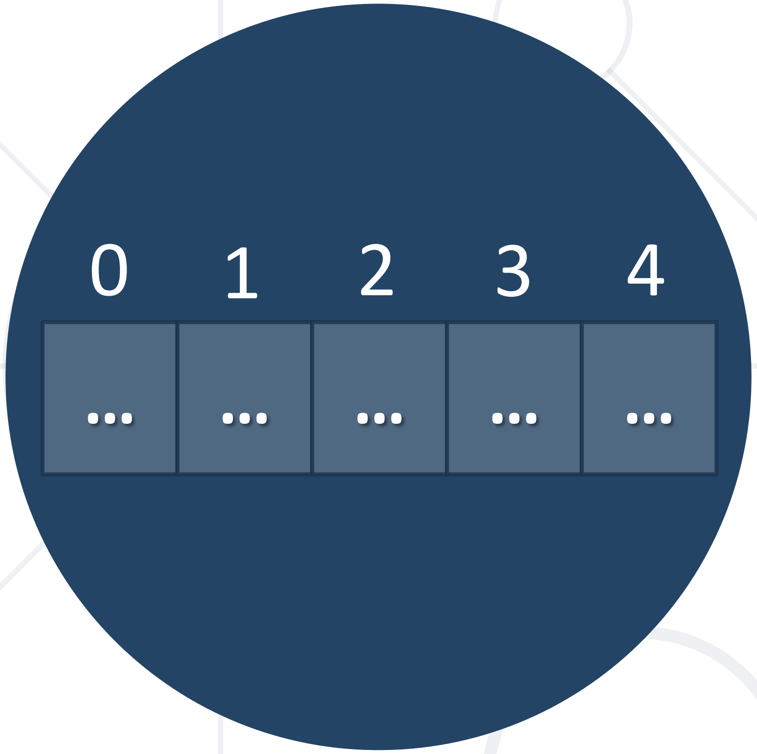


Lists

List<T> – Overview

- `List<T>` holds a list of elements of the same type

```
List<string> names = new List<string>();
// Create an empty list of strings
names.Add("Peter");
names.Add("Maria");
// Add elements
foreach (var name in names)
   Console.WriteLine(name);
Console.WriteLine(string.Join(", ", names));
// Print elements
```

Creating Lists

- Use the **new** keyword
  - Create an empty list of integers

```
List<int> numbers = new List<int>();
```

  - Using a target-type **new** expression

```
List<string> names = new() {"Peter", "Ana", "Maria"};
```

List<T> – Basic Methods

- Provides operations to **add** / **insert** / **remove** / **find** elements
  - `Add(element)` – adds an element to the `List<T>`
  - `Count` – number of elements in the `List<T>`
  - `Remove(element)` – removes an element (returns `true` / `false`)

List<T> – Basic Methods

- `Insert(index, element)` – inserts an element to a given index
- `Contains(element)` – determines whether an element is in the list
- `Sort()` – sorts the array/list in ascending order

Add() – Appends an Element

10

20

30

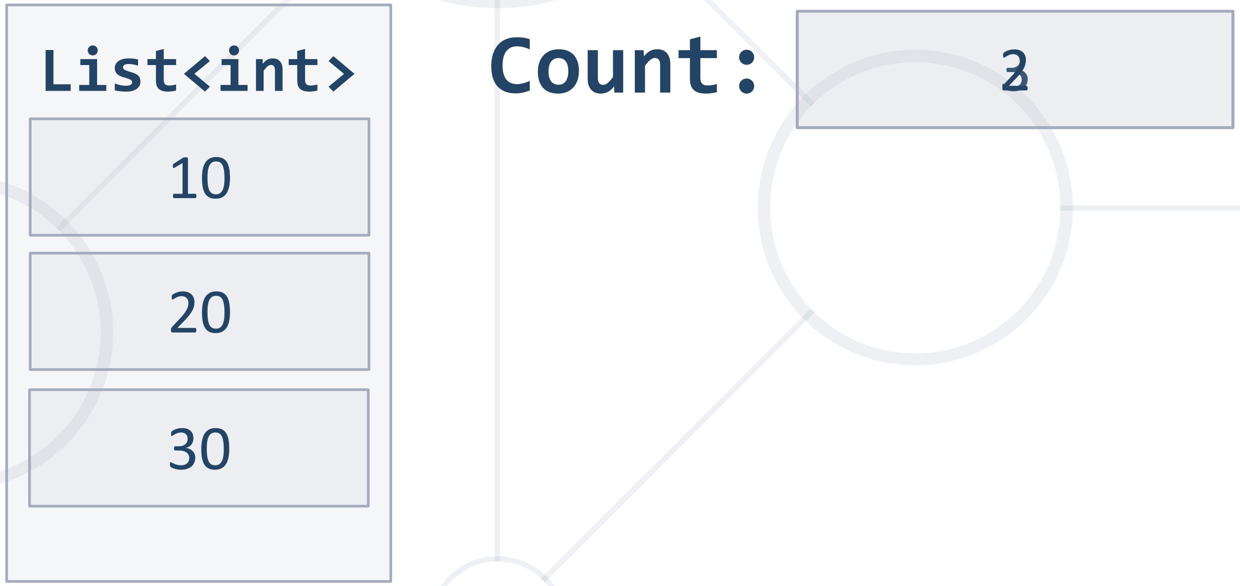
- We create an empty list and start adding elements
- The count increases each time we add an element

`List<int>`

Count: 0

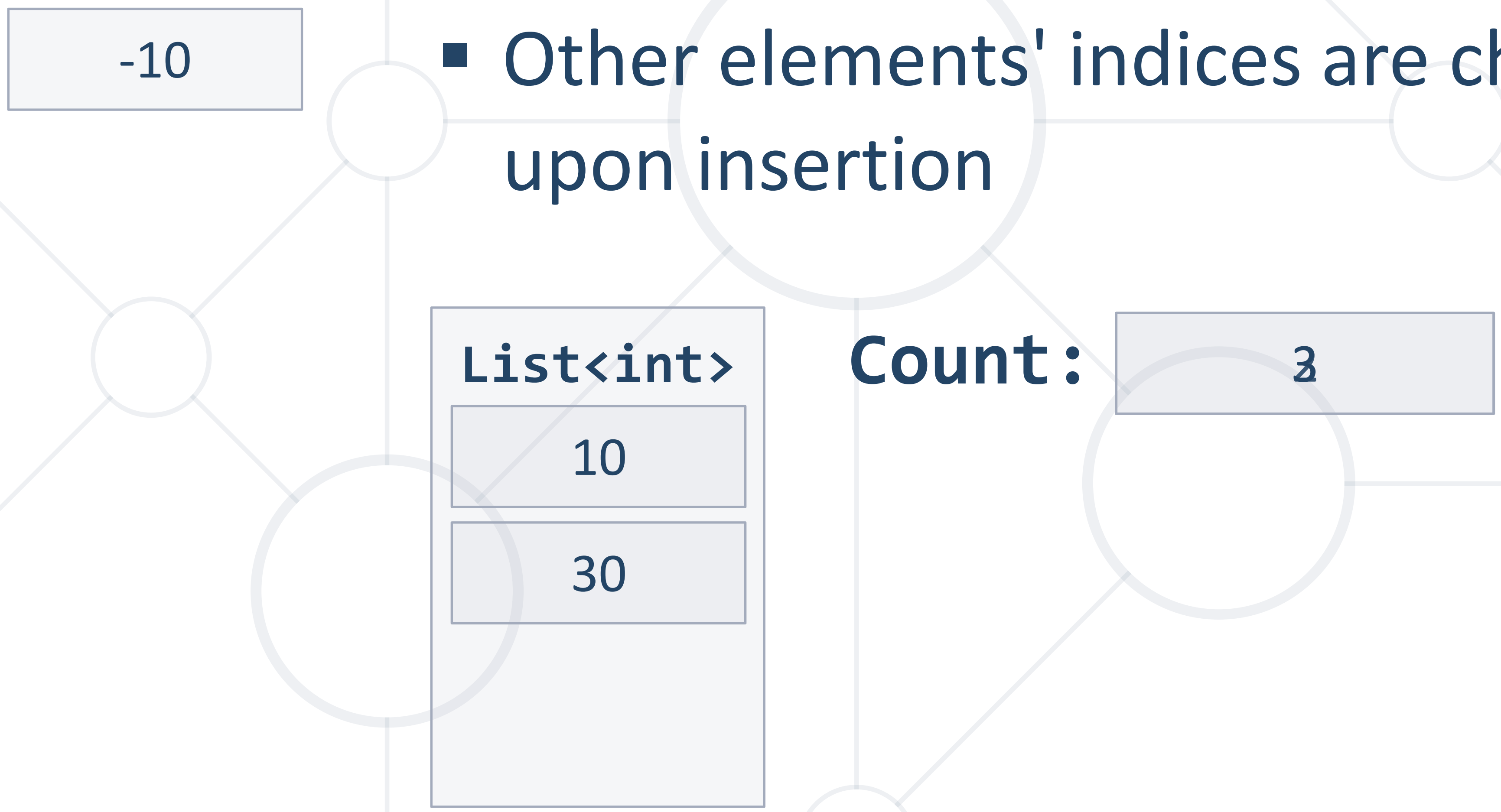
Remove() – Deletes an Element

- We remove an element from the List
- The count decreases each time we remove an element



Insert() – Inserts an Element at Position

- We insert an element at index 1
- Other elements' indices are changed upon insertion



List<T> – Basic Methods Example

```
List<int> nums = new List<int>
                          { 10, 20, 30, 40, 50, 60 };
nums.Remove(30);
nums.Add(100);
nums.Insert(0, -100);
Console.WriteLine(string.Join(", ", nums));
Console.WriteLine($"Count: {nums.Count}");
```

```
-100, 10, 20, 40, 50, 60, 100
Count: 7
```

Reading Lists from the Console

Using for Loop or String.Split()

Reading Lists from the Console

- First, read from the console the list's **length**

```
int n = int.Parse(Console.ReadLine());
```

- Next, create a list of a given size **n** and read its **elements**

```
List<int> list = new List<int>();
for (int i = 0; i < n; i++)
{
   int number = int.Parse(Console.ReadLine());
   list.Add(number));
}
```

Reading List Values from a Single Line

- Lists can be read from a **single line** of **space separated values**

```
2 8 30 25 40 72 -2 44 56
```

```
string values = Console.ReadLine();
List<string> items = values.Split(' ').ToList();
List<int> nums = new List<int>();
for (int i = 0; i < items.Count; i++)
  nums.Add(int.Parse(items[i]));
```

Convert a collection into `List`

```
List<int> items = Console.ReadLine()
  .Split(' ').Select(int.Parse).ToList();
```

Read a `List` of integers

Printing Lists On the Console

- Printing a list using a **for** loop

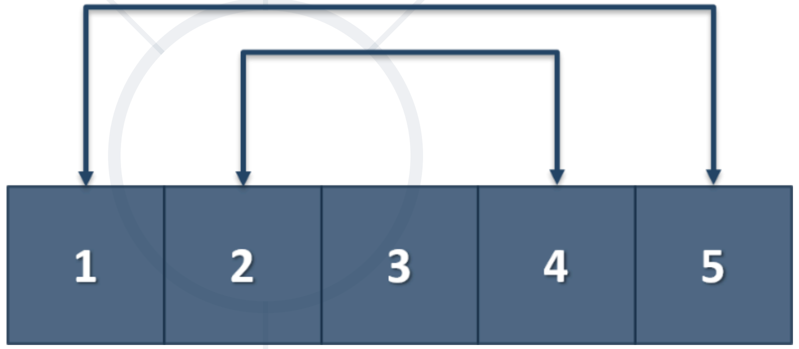
```
List<string> list = new List<string>() {
  "one", "two", "three", "four", "five", "six"};
for (int index = 0; index < list.Count; index++)
  Console.WriteLine("arr[{0}] = {1}", index, list[index]);
```

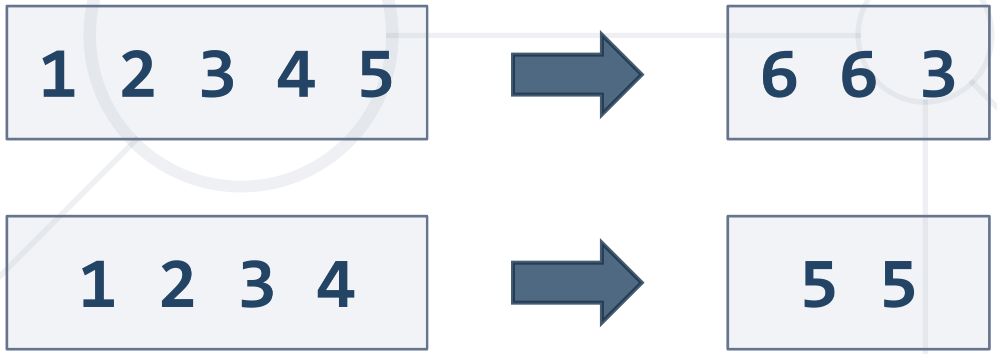
- Printing a list using a **string.Join(…)**

```
List<string> list = new List<string>() {
  "one", "two", "three", "four", "five", "six"};
Console.WriteLine(string.Join("; ", list));
```

Problem: Gauss' Trick

- Write a program that sums all numbers in a list in the following order
  - first + last, first + 1 + last - 1, first + 2 + last - 2, … first + n, last – n
- Examples





Check your solution here: https://alpha.judge.softuni.org/contests/lists-lab/1210/practice#1

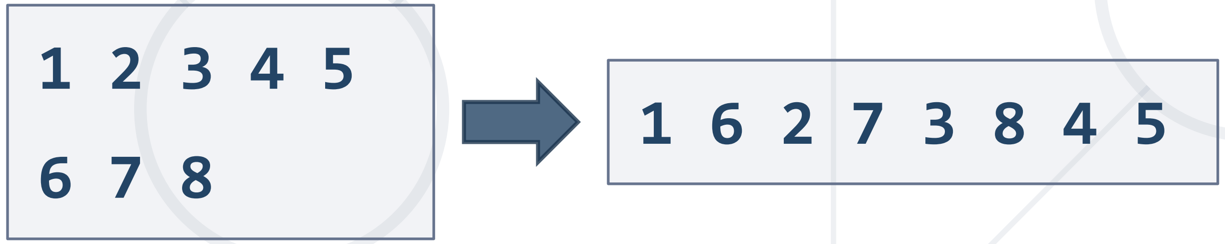
Solution: Gauss' Trick

```
List<int> numbers = Console.ReadLine()
                          .Split().Select(int.Parse).ToList();
int originalLength = numbers.Count;
for (int i = 0; i < originalLength / 2; i++)
{
  numbers[i] += numbers[numbers.Count - 1];
  numbers.RemoveAt(numbers.Count - 1);
}
Console.WriteLine(string.Join(" ", numbers));
```

Check your solution here: https://alpha.judge.softuni.org/contests/lists-lab/1210/practice#1

Problem: Merging Lists

- You receive two lists with numbers. Print a result list, which contains the numbers from both of the lists
  - If the length of the two lists are not equal, just add the remaining elements at the end of the list:
  - list1[0], list2[0], list1[1], list2[1], …



```
1 2 3 4 5
6 7 8
```

```
1 6 2 7 3 8 4 5
```

Check your solution here: https://alpha.judge.softuni.org/contests/lists-lab/1210/practice#2

Solution: Merging Lists

```
// TODO: Read the input
List<int> resultNums = new List<int>();
for (int i = 0; i < Math.Min(nums1.Count, nums2.Count); i++)
// TODO: Add numbers in resultNums
if (nums1.Count > nums2.Count)
  resultNums.AddRange(GetRemainingElements(nums1, nums2));
else if (nums2.Count > nums1.Count)
  resultNums.AddRange(GetRemainingElements(nums2, nums1));
Console.WriteLine(string.Join(" ", resultNums));
```

Check your solution here: https://alpha.judge.softuni.org/contests/lists-lab/1210/practice#2

Solution: Merging Lists

```
static List<int> GetRemainingElements(List<int> longerList,
List<int> shorterList)
{
    List<int> nums = new List<int>();
    for (int i = shorterList.Count; i < longerList.Count; i++)
        nums.Add(longerList[i]);
    return nums;
}
```

Check your solution here: https://alpha.judge.softuni.org/contests/lists-lab/1210/practice#2

Live Exercises

Reading and Manipulating Lists

Sorting Lists and Arrays

Sorting Lists

- Sorting a list == reorder its elements incrementally: **Sort()**
  - Items must be **comparable,** e.g., numbers, strings, dates, …

```
List<string> names = new List<string>()
 {"Peter", "Michael", "George", "Victor", "John" };
names.Sort();

Console.WriteLine(string.Join(", ", names));
// George, John, Michael, Peter, Victor
names.Sort();
names.Reverse();
Console.WriteLine(string.Join(", ", names));
// Victor, Peter, Michael, John, George
```

Sort in natural (ascending) order

Reverse the sorted result

Problem: List of Products

- Read a number n and n lines of products. Print a numbered list of all the products ordered by name.
- Examples:

```
4
Potatoes
Tomatoes
Onions
Apples
```

```
1.Apples
2.Onions
3.Potatoes
4.Tomatoes
```

Check your solution here: https://alpha.judge.softuni.org/contests/lists-lab/1210/practice#3

Solution: List of Products

```
int n = int.Parse(Console.ReadLine());
List<string> products = new List<string>();
for (int i = 0; i < n; i++)
{
  string currentProduct = Console.ReadLine();
  products.Add(currentProduct);
}
products.Sort();
for (int i = 0; i < products.Count; i++)
  Console.WriteLine($"{i + 1}.{products[i]}");
```

Problem: Remove Negatives and Reverse

- Read a list of integers, remove all negative numbers from it.
  - Print the remaining elements in reversed order
  - In case of no elements left in the list, print "empty"

`10 -5 7 9 -33 50`	→	`50 9 7 10`
`7 -2 -10 1`	→	`1 7`
`-1 -2 -3`	→	`empty`

Check your solution here: https://alpha.judge.softuni.org/contests/lists-lab/1210/practice#4

Solution: Remove Negatives and Reverse

```
List<int> nums = // TODO: Read the List from the console.
for (int i = 0; i < nums.Count; i++)
  if (nums[i] < 0) { nums.RemoveAt(i--); }

nums.Reverse();
if (nums.Count == 0)
 Console.WriteLine("empty");
else
 Console.WriteLine(string.Join(" ", nums));
```

Check your solution here: https://alpha.judge.softuni.org/contests/lists-lab/1210/practice#4

Live Exercises

Sorting Lists

Summary

- Lists hold a sequence of elements (variable-length)
- Can add / remove / insert elements at runtime
- Creating (allocating) a list: new List<T>()
- Accessing list elements by index
- Printing list elements: string.Join(…)