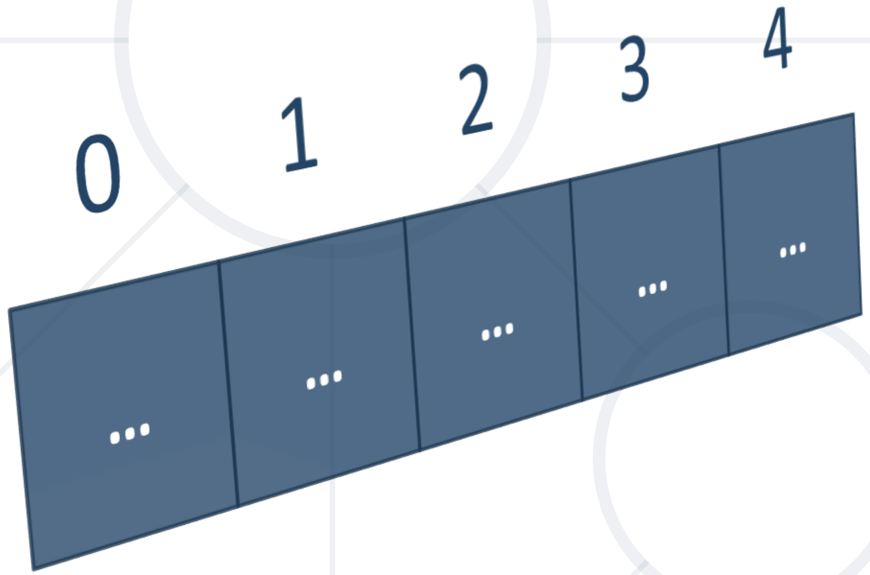
Arrays

Fixed-Size Sequences of Elements



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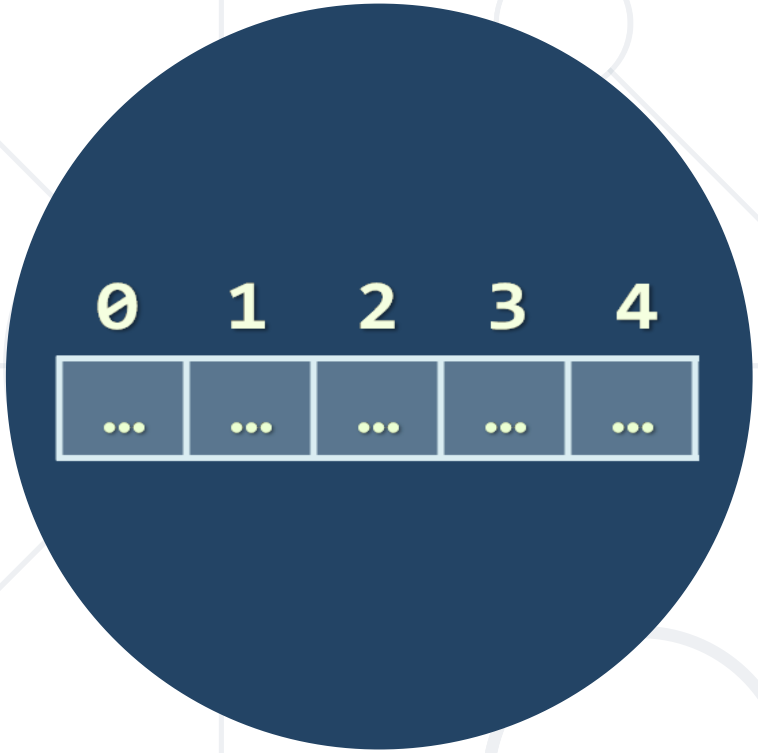
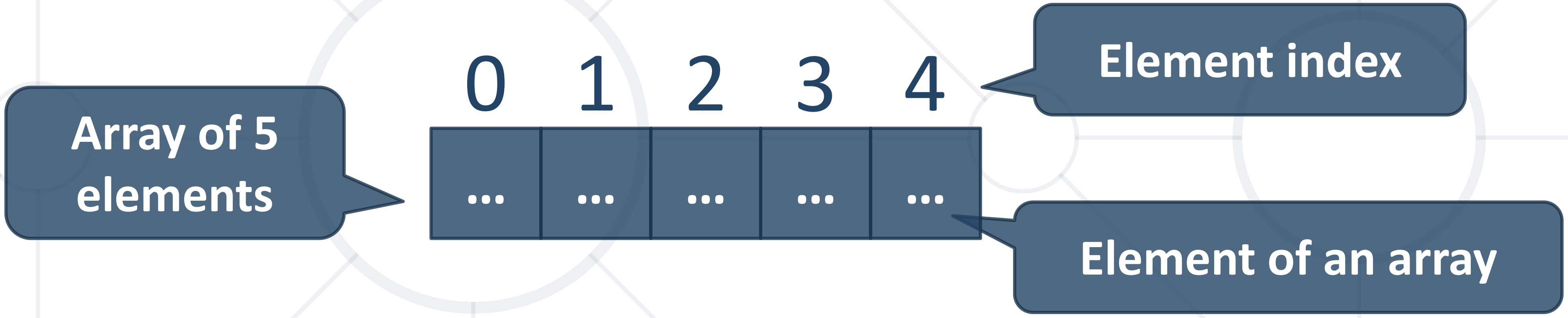


Working with Arrays of Elements

What Are Arrays?

- In programming, an **array** is a **sequence of elements**



- Elements are numbered from **0** to **Length-1**
- Elements are of the **same type** (e.g. integers)
- Arrays have **fixed size** (**Array.Length**) and cannot be resized

Creating Arrays

- Use the **new** keyword
  - It is used to create the array and initialize the array elements to their default values
- Allocating an **array** of 10 **integers**:

```
int[] numbers = new int[10];
```

All elements are initially = 0

- An array that stores **string** elements can be declared in the same way:

```
string[] names = new string[10];
```

All elements are initially = null

Working with Arrays

- **Assigning values** to the array elements
  - The **Length** holds the number of array elements

```
for (int i = 0; i < numbers.Length; i++)
  numbers[i] = 1;
```

- **Accessing** array elements by index
  - The **[]** operator accesses elements by index

```
numbers[5] = numbers[2] + numbers[7];
numbers[10] = 1; // IndexOutOfRangeException
```

Days of Week – Example

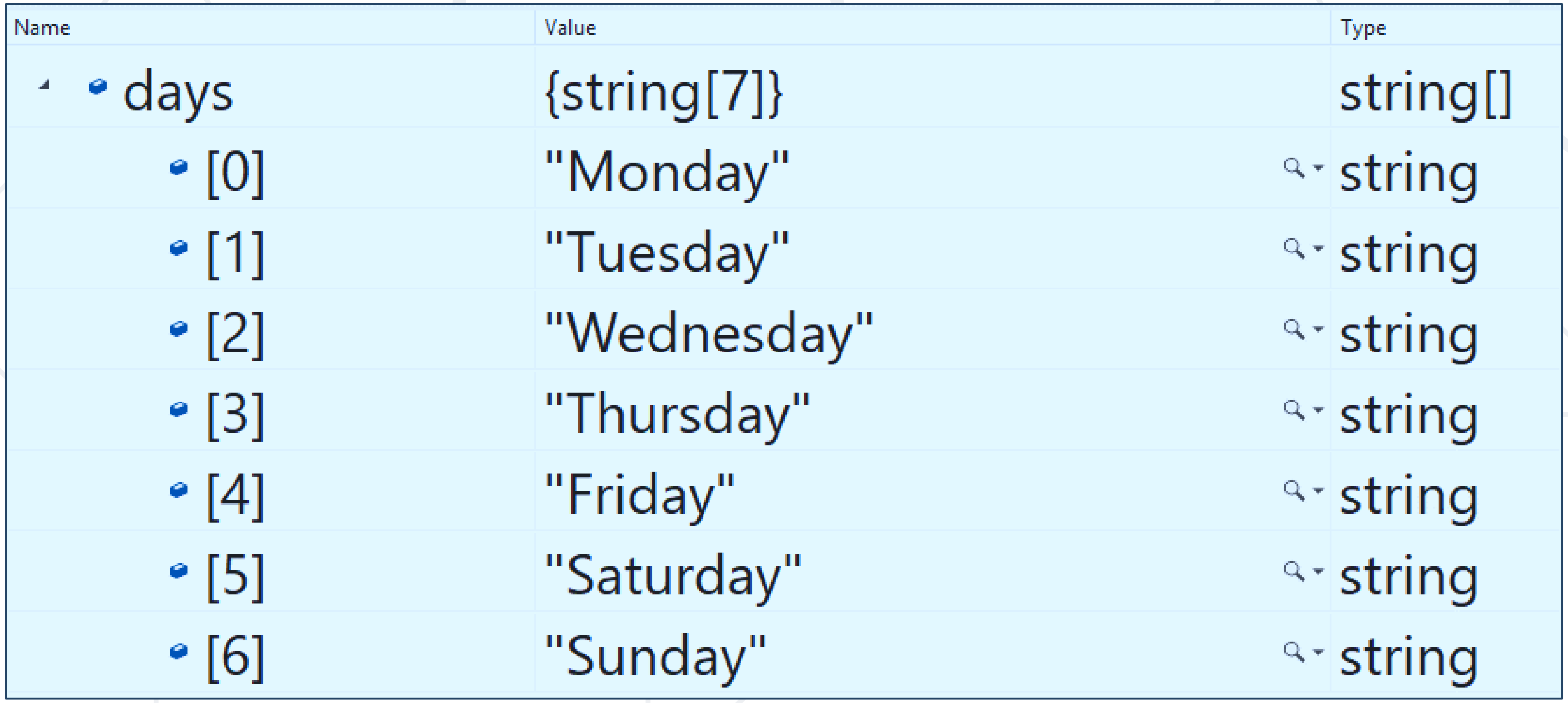
- The days of week can be stored in **array of strings**:

```
string[] days = {
  "Monday",
  "Tuesday",
  "Wednesday",
  "Thursday",
  "Friday",
  "Saturday",
  "Sunday"
};
```

Operator	Notation in C#
days[0]	Monday
days[1]	Tuesday
days[2]	Wednesday
days[3]	Thursday
days[4]	Friday
days[5]	Saturday
days[6]	Sunday

Problem: Day of Week

- Enter a **day number** [1…7] and print the **day name** (in English) or "**Invalid day!**"



Name	Value	Type
days	{string[7]}	string[]
[0]	"Monday"	string
[1]	"Tuesday"	string
[2]	"Wednesday"	string
[3]	"Thursday"	string
[4]	"Friday"	string
[5]	"Saturday"	string
[6]	"Sunday"	string

Solution: Day of Week

```
string[] days = { "Monday", "Tuesday", "Wednesday",
"Thursday", "Friday", "Saturday", "Sunday" };
int day = int.Parse(Console.ReadLine());

if (day >= 1 && day <= 7)
  Console.WriteLine(days[day - 1]);
else
  Console.WriteLine("Invalid day!");
```

The first day in our array stays at index 0, not 1.

Check your solution here: https://judge.softuni.org/Contests/Practice/Index/3171#0

Using a for Loop or String.Split()

Reading Arrays from the Console

- First, read from the console the array **length**:

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

- Next, create an array of given size **n** and read its **elements**:

```
int[] arr = new int[n];
for (int i = 0; i < n; i++)
{
  arr[i] = int.Parse(Console.ReadLine());
}
```

Reading Array Values from a Single Line

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

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

```
string values = Console.ReadLine();
string[] items = values.Split();
int[] arr = new int[items.Length];

for (int i = 0; i < items.Length; i++)
  arr[i] = int.Parse(items[i]);
```

Split( ) splits by space into string[]

Shorter: Reading Array from a Single Line

- Read an **array** of integers:

using System.LINQ;

```
var inputLine = Console.ReadLine();
string[] items = inputLine.Split(', ');
int[] arr = items.Select(int.Parse).ToArray();
```

```
int[] arr = Console.ReadLine().Split(', ')
   .Select(int.Parse).ToArray();
```

Or even shorter

Printing Arrays On the Console

- To **print** all array elements, a **for-loop** can be used
  - Separate elements with white space or a new line

```
string[] arr = {"one", "two"};
// == new string [2] {"one", "two"};
// Process all array elements
for (int index = 0; index < arr.Length; index++)
{
  // Print each element on a separate line
  Console.WriteLine("arr[{0}] = {1}", index, arr[index]);
}
```

Problem: Print Numbers in Reverse Order

- Read an array of integers (**n** lines of integers), **reverse** it and print its elements on a single line, space-separated:

```
3
10
20
30
```

$\rightarrow$

```
30 20 10
```

```
4
-1
20
99
5
```

$\rightarrow$

```
5 99 20 -1
```

Solution: Print Numbers in Reverse Order

```
// Read the array (n lines of integers)
var n = int.Parse(Console.ReadLine());
var arr = new int[n];
for (int i = 0; i < n; i++) {
  arr[i] = int.Parse(Console.ReadLine()); }
// Print the elements from the last to the first
for (int i = n-1; i >= 0; i--) {
  Console.Write(arr[i] + " "); }
Console.WriteLine();
```

Check your solution here: https://judge.softuni.org/Contests/Practice/Index/3171#1

Problem: Rounding Numbers

- Read an **array of real numbers** (space separated), round them in "away from 0" style and print the output as in the examples:

```
0.9 1.5 2.4 2.5 3.14
```

```
0.9 => 1
1.5 => 2
2.4 => 2
2.5 => 3
3.14 => 3
```

```
-5.01 -1.599 -2.5 -1.50 0
```

```
-5.01 => -5
-1.599 => -2
-2.5 => -3
-1.50 => -2
0 => 0
```

Solution: Rounding Numbers

- **Rounding** turns each value to the nearest integer

```
double[] nums = Console.ReadLine().Split()
  .Select(double.Parse).ToArray();
int[] roundedNums = new int[nums.Length];
for (int i = 0; i < nums.Length; i++) {
  roundedNums[i] = (int)Math
    .Round(nums[i], MidpointRounding.AwayFromZero); }
// TODO: Print each number
```

2.5 => 3

Check your solution here: https://judge.softuni.org/Contests/Practice/Index/3171#2

Printing Arrays with for / String.Join(…)

- Use for-loop:

```
int[] arr = { 10, 20, 30, 40, 50};
for (int i = 0; i < arr.Length; i++) {
  Console.WriteLine(arr[i]); }
```

- Use `string.Join(separator, array)`:

```
int[] arr = { 1, 2, 3 };
Console.WriteLine(string.Join(", ", arr)); // 1, 2, 3
string[] strings = { "one", "two" };
Console.WriteLine(string.Join(" - ", strings)); // one - two
```

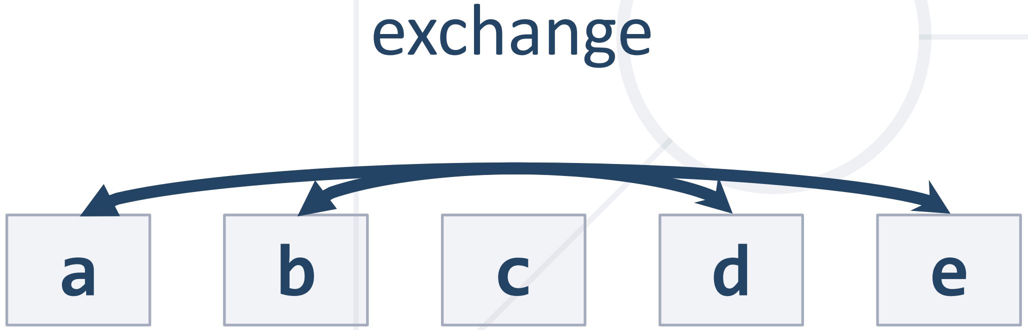
Problem: Reverse Array of Strings

- Read an **array of strings** (space separated values), **reverse it** and **print** its elements:

```
a b c d e  ->  e d c b a
```

```
-1 hi ho w  ->  w ho hi -1
```

- Reversing array elements:



Solution: Reverse Array of Strings

```
var items = Console.ReadLine().Split(' ').ToArray();
for (int i = 0; i < items.Length / 2; i++)
{
   var oldElement = items[i];
   items[i] = items[items.Length - 1 - i];
   items[items.Length - 1 - i] = oldElement;
}

Console.WriteLine(string.Join(" ", items));
```

Check your solution here: https://judge.softuni.org/Contests/Practice/Index/3171#3

Iterate Through Collections

Foreach Loop

- Iterates through **all elements** in a collection
- **Cannot** access the current index
- **Read-only**

```
foreach (var item in collection)
{
    // Process the value here
}
```

Print an Array with Foreach

```
int[] numbers = { 1, 2, 3, 4, 5 };
foreach (int number in numbers)
{
  Console.Write($"{number} ");
}
```

```
1 2 3 4 5
```

Summary

- Arrays hold a **sequence** of elements
  - Elements are numbered from `0` to `length-1`
- Creating (allocating) an array: **new[]**
- Accessing array elements by **index**
- Printing array elements: `string.Join()`

Questions?

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