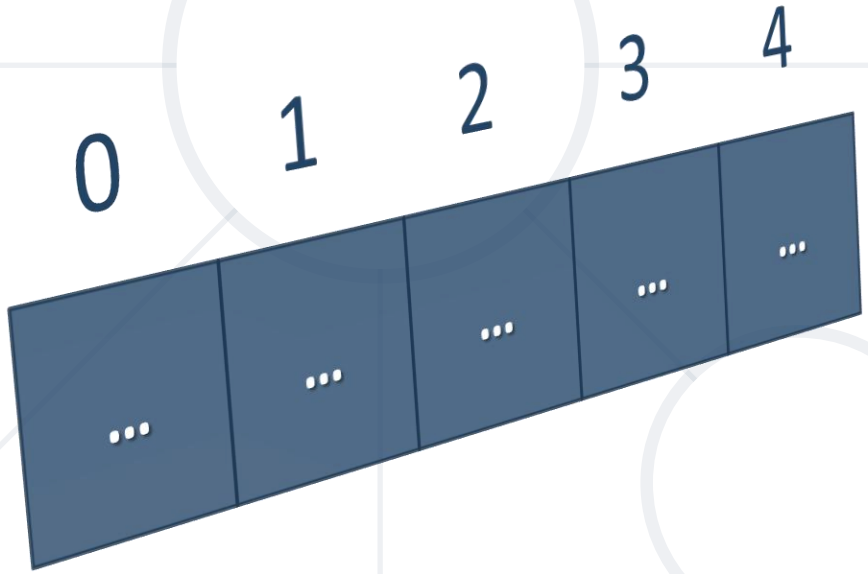
# Arrays

## Fixed-Size Sequences of Elements

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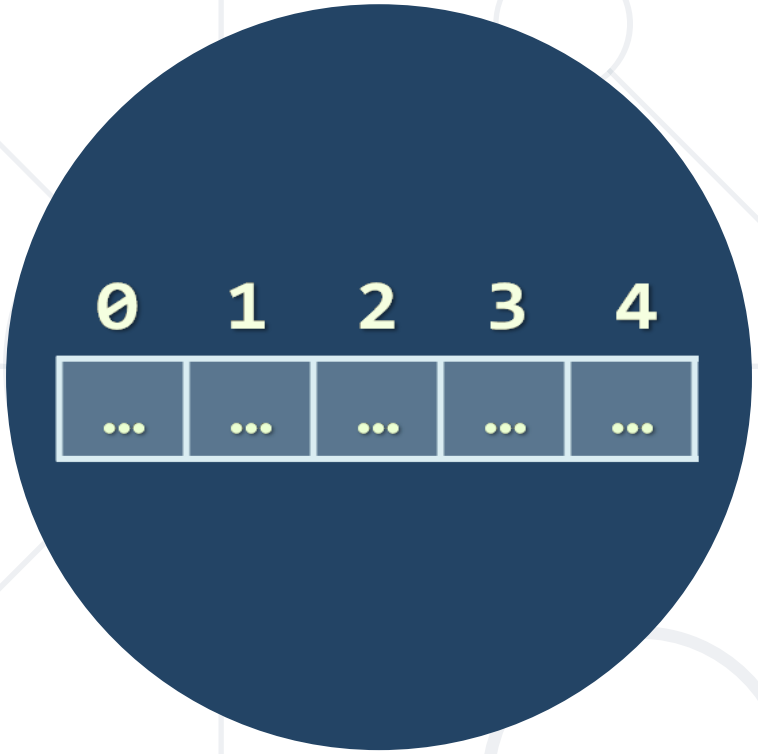



# Arrays

# 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;
```

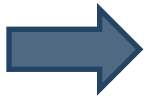
- **Accessing** array elements by index
  - The **[]** operator accesses elements by index

```
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 |

Check your solution here: https://alpha.judge.softuni.org/contests/arrays-lab/1202/practice#0

# 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 is on index 0, not 1.

Check your solution here: https://alpha.judge.softuni.org/contests/arrays-lab/1202/practice#0

# Reading Arrays

## Using a For Loop or string.Split()

# Reading Arrays from the Console

- First, read from the console the array's **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

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

uses System.LINQ;

Or shorter

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

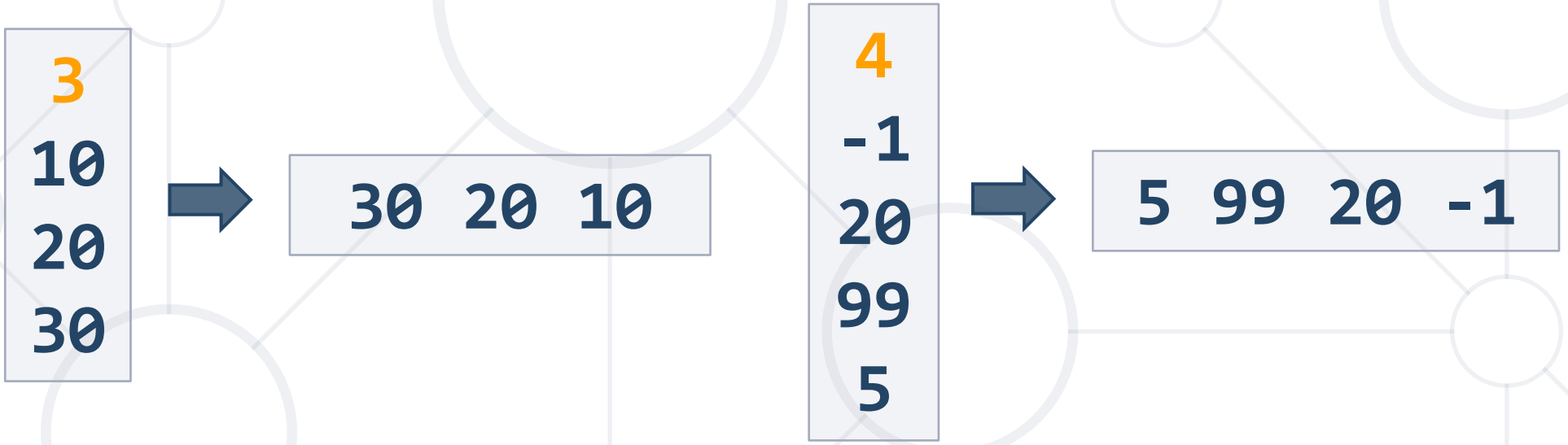
# Printing Arrays On the Console

- 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:




Check your solution here: https://alpha.judge.softuni.org/contests/arrays-lab/1202/practice#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://alpha.judge.softuni.org/contests/arrays-lab/1202/practice#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
```

Check your solution here: https://alpha.judge.softuni.org/contests/arrays-lab/1202/practice#2

# 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://alpha.judge.softuni.org/contests/arrays-lab/1202/practice#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)`

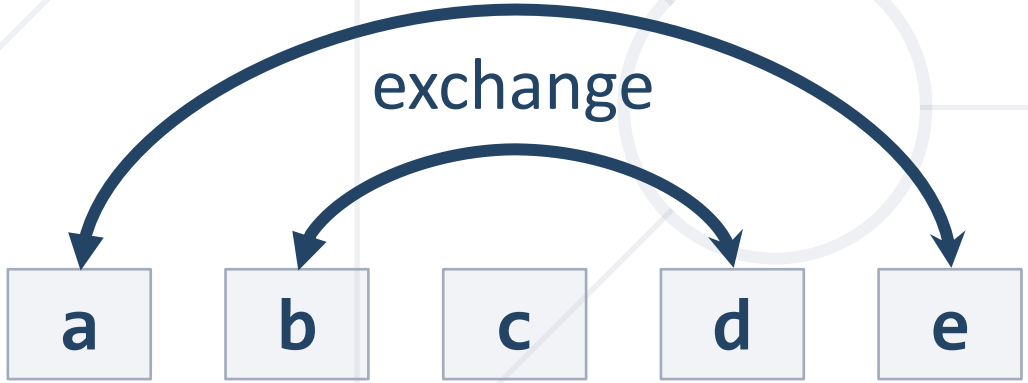
```
int[] arr = { 1, 2, 3 };
Console.WriteLine(string.Join(", ", arr)); // 1, 2, 3
string[] strings = { "one", "two" };
Console.WriteLine(string.Join(" - ", strings)); // one - two
```

# 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:




Check your solution here: https://alpha.judge.softuni.org/contests/arrays-lab/1202/practice#3

# 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://alpha.judge.softuni.org/contests/arrays-lab/1202/practice#3

# Foreach Loop

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} ");
}
```

# Summary

- Arrays hold a sequence of elements
  - Elements are numbered from `0` to `length-1`
- Creating (allocating) an array
- Accessing array elements by index
- Printing array elements