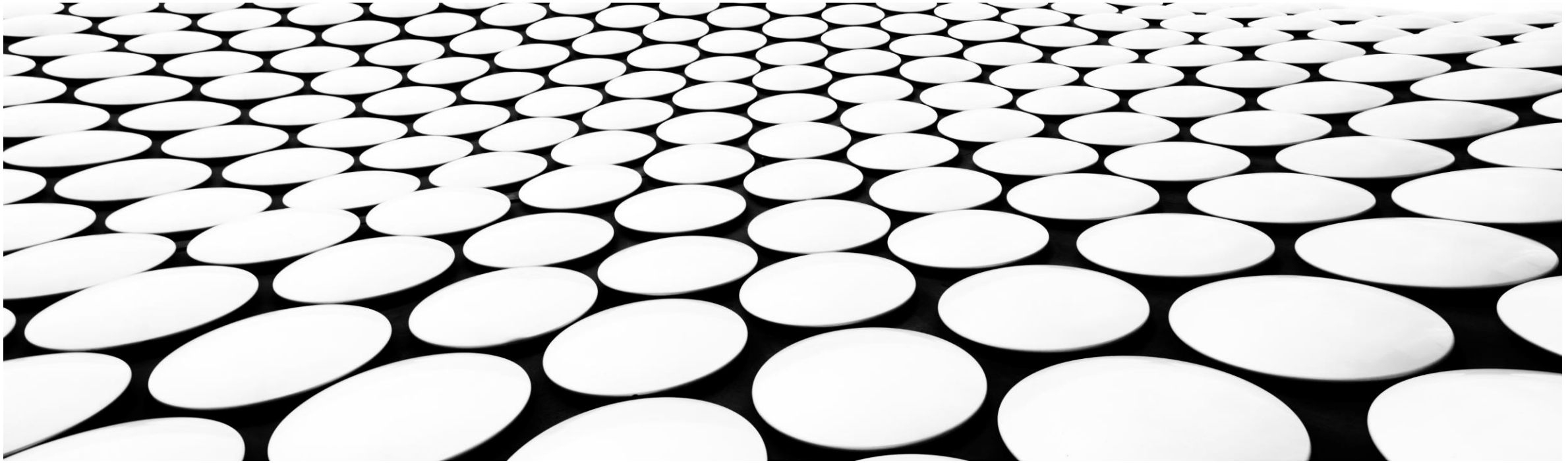
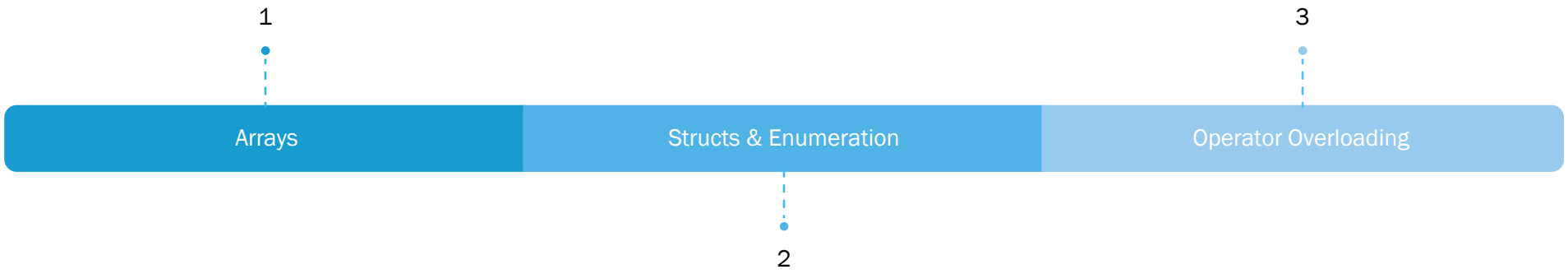
C# - FEATURES

ARCTECH INFO



C# FEATURES



ARRAYS

- Arrays are used to store multiple values in a single variable, instead of declaring separate variables for each value.
- To declare an array, define the variable type with square brackets:
  - string[] cars;
- To declare and initialize an array, use curly braces
  - string[] cars = {"Volvo", "BMW", "Ford", "Mazda"};
  - int[] ages = new int[3] { 10, 20, 30 };
  - int[] ages1 = new int[] { 10, 20, 30 };
  - int[] ages2 = { 10, 20, 30 };
  - int[] ages3 = new int[10];
- For late initialization, new is required.

ARRAYS ELEMENTS

- Access array elements
  - Console.WriteLine(cars[0])
- Changes array elements
  - Cars[0] = “Audi”
- Array Length
  - Console.WriteLine(cars.Length);
- Loop Through an Array
  - for and foreach

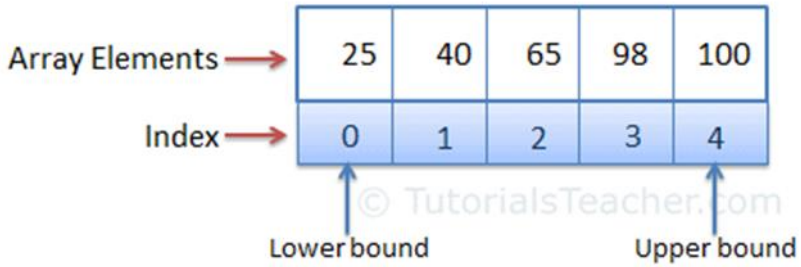
ARRAYS ACTIONS

- System namespace
  - Array.Sort(nums); // sorts array
  - Array.Reverse(nums); // sorts array in descending order
  - Array.ForEach(nums, n => Console.WriteLine(n)); // iterates array
  - Array.BinarySearch(nums, 5);// binary search
- System.Linq namespace
  - Min, Max, and Sum
  - int[] myNumbers = {5, 1, 8, 9};
  - Console.WriteLine(myNumbers.Max()); // returns the largest value

PASSING ARRAYS TO FUNCTIONS

- An array can be passed as an argument to a method parameter. Arrays are reference types, so the method can change the value of the array elements.
- {
  int[] nums = {10, 20, 30};
  UpdateArray(nums);
  }
  public static void UpdateArray(int[] arr)
  {
  …
  }

TYPES OF ARRAYS

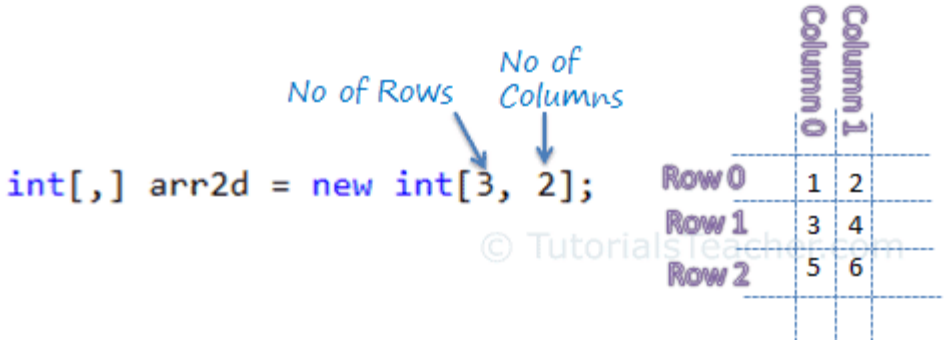


- Single Dimensional
- C# supports multidimensional arrays up to 32 dimensions.
  - The multidimensional array can be declared by adding commas in the square brackets.
  - E.g. [,] declares two-dimensional array,
  - [, ,] declares three-dimensional array, [, , ,] declares four-dimensional array, and so on.
  - So, in a multidimensional array, no of commas = No of Dimensions - 1.
  - `int[,] arr2d; // two-dimensional array`
  - `int[, ,] arr3d; // three-dimensional array`
  - `int[, , ,] arr4d ; // four-dimensional array`
  - `int[, , , ,] arr5d; // five-dimensional array`
- Jagged Arrays

TWO DIMENSIONAL ARRAYS

```
int[,] arr2d = new int[3,2]{
                                {1, 2},
                                {3, 4},
                                {5, 6}
                            };
```

```
// or
int[,] arr2d = {
                        {1, 2},
                        {3, 4},
                        {5, 6}
                    };
```




```
arr2d[0, 0]; //returns 1
arr2d[0, 1]; //returns 2
arr2d[1, 0]; //returns 3
arr2d[1, 1]; //returns 4
arr2d[2, 0]; //returns 5
arr2d[2, 1]; //returns 6
```

3D ARRAYS

```
int[, ,] arr3d1 = new int[1, 2, 2]{
                { { 1, 2}, { 3, 4} }
            };

int[, ,] arr3d2 = new int[2, 2, 2]{
                { {1, 2}, {3, 4} },
                { {5, 6}, {7, 8} }
            };

int[, ,] arr3d3 = new int[2, 2, 3]{
                { { 1, 2, 3}, {4, 5, 6} },
                { { 7, 8, 9}, {10, 11, 12} }
            };
```

```
arr3d2[0, 0, 0]; // returns 1
arr3d2[0, 0, 1]; // returns 2
arr3d2[0, 1, 0]; // returns 3
arr3d2[0, 1, 1]; // returns 4
arr3d2[1, 0, 0]; // returns 5
arr3d2[1, 0, 1]; // returns 6
arr3d2[1, 1, 0]; // returns 7
arr3d2[1, 1, 1]; // returns 8
```

JAGGED ARRAYS

- A jagged array is an array of array.
- Jagged arrays store arrays instead of literal values.
- A jagged array is initialized with two square brackets [][].
- The first bracket specifies the size of an array, and the second bracket specifies the dimensions of the array which is going to be stored.

- `int[][] jArray1 = new int[2][];`
  `// can include two single-dimensional arrays`
- `int[][,] jArray2 = new int[3][,];`
  `// can include three two-dimensional arrays`
- jArray1 can store up to two single-dimensional arrays.
- jArray2 can store up to three two-dimensional, arrays [,] specifies the two-dimensional array.

STRUCTURES AND ENUMERATION

- C# supports two kinds of value types, namely,
  - predefined types
  - userdefined types.
- predefined data types are int, double, etc.
- C# allows us to define our own complex value types
  - known as user defined value types
- There are two kind of value types we can define in C#
  - Structures
  - Enumeration
- Value type variables store their data on the stack.

STRUCTURES

- Structures are similar to classes in C#.
- structs are used when simple composite data types are required.
- Because they are value types, they are stored on the stack,
- Advantages of struct compared to class which are stored on the heap
  - created much more quickly than heap-allocated types.
  - instantly and automatically deallocated once they go out of scope.
  - It is easy to copy value type variables on the stack.
  - The performance of programs may be enhanced by judicious use of structs

STRUCTURE

- Defining a struct

```
struct Student
{
 public string Name;
 public int RollNumber;
 public float TotalMarks;
}
```

- Assigning Values to members

```
s1.Name = "John";
s1.RollNumber = 999 ;
s1.TotalMarks = 575.50 ;
```

- Copying a struct

```
Student s2; // s2 is declared
s2 = s1 ;
```

CLASS VS STRUCT

Class	Structure
Classes are of reference types.	Structs are of value types.
All the reference types are allocated on heap memory.	All the value types are allocated on stack memory.
Allocation of large reference type is cheaper than allocation of large value type.	Allocation and de-allocation is cheaper in value type as compared to reference type.
Classes can contain constructor or destructor.	Structure does not contain parameter less constructor or destructor but can contain Parameterized constructor or static constructor.
Classes used new keyword for creating instances.	Struct can create an instance, with or without new keyword.
A Class can inherit from another class.	A Struct is not allowed to inherit from another struct or class.
The data member of a class can be protected.	The data member of struct can’t be protected.
Function member of the class can be virtual or abstract.	Function member of the struct cannot be virtual or abstract.
Two variable of class can contain the reference of the same object and any operation on one variable can affect another variable.	Each variable in struct contains its own copy of data(except in ref and out parameter variable) and any operation on one variable has no effect another variable.

STRUCTURE DECLARATION

- A struct object can be created with or without the new operator
  - same as primitive type variables.
- Coordinate point = new Coordinate();
  - initialized member variables with default values.
- Coordinate point;
  - You can also declare a variable of struct type without using new keyword
  - In this case all the members remain unassigned
  - You must assign values to each member before accessing,
    - else you will get a compile-time error

STRUCT SUMMARY

- struct can include constructors, constants, fields, methods, properties, indexers, operators, events & nested types.
- struct cannot include a parameter-less constructor or a destructor.
- struct can implement interfaces, same as class.
- struct cannot inherit another structure or class, and it cannot be the base of a class.
- struct members cannot be specified as abstract, sealed, virtual, or protected.

ENUMERATOR

- Used to assign constant names to a group of numeric integer values.
- It makes constant values more readable,
  - for example, WeekDays.Monday is more readable than number 0 when referring to the day in a week.
- Is defined using the enum keyword.
- All the constant names can be declared inside the curly brackets and separated by a comma.

ENUM VALUES

- The following defines an enum for the weekdays.

```
enum WeekDays
{
    Monday,     // 0
    Tuesday,    // 1
    Wednesday,  // 2
    Thursday,   // 3
    Friday,     // 4
    Saturday,   // 5
    Sunday      // 6
}
```

- If values are not assigned to enum members, then Monday=0, Tuesday=1, etc.

- You can assign your own values to the enum member too. Example:

```
enum Categories
{
    Electronics,        // 0
    Food,               // 1
    Automotive = 6,     // 6
    Arts,               // 7
    BeautyCare = 100,   // 100
    Fashion             // 101
}
```

ENUM TYPE

- enum can be of any numeric data type such as
  - byte,
  - sbyte,
  - short,
  - ushort,
  - Int (default),
  - uint,
  - long, or
  - ulong.

- The following defines a byte enum

```
enum Categories: byte
{
    Electronics = 1,
    Food = 5,
    Automotive = 6,
    Arts = 10,
    BeautyCare = 11,
    Fashion = 15
}
```

ENUM USAGE

Access an Enum

- An enum can be accessed using the dot syntax: enum.member

```
Console.WriteLine(WeekDays.Monday);
Console.WriteLine(WeekDays.Tuesday);
Console.WriteLine(WeekDays.Wednesday);
Console.WriteLine(WeekDays.Thursday);
Console.WriteLine(WeekDays.Friday);
Console.WriteLine(WeekDays.Saturday);
Console.WriteLine(WeekDays.Sunday);
```

Conversion

- Explicit casting is required to convert from an enum type to its underlying integral type.

```
Console.WriteLine(WeekDays.Friday);
// output: Friday

int day = (int) WeekDays.Friday;
// enum to int conversion

Console.WriteLine(day);
// output: 4

var wd = (WeekDays) 5;
// int to enum conversion

Console.WriteLine(wd);
// output: Saturday

string wDay = "Sunday";
var wd2 = (WeekDays)Enum.Parse(typeof(WeekDays), wDay);
// string to enum conversion
```

OPERATOR OVERLOADING

- What is Overloading?
- Types of Overloading.
- Operator Overloading.
- Types of Operator Overloading.

WHAT IS OVERLOADING?

- Each C# operator has a predefined meaning.
- Most of them are given additional meaning through the concept called operator overloading.
- Main idea behind operator overloading is to use C# operators with class objects.
- It is a form of polymorphism and different to overriding
- Two Types of overloading are
  - 1. Method Overloading
    - Multiple functions with same Name but different types / number of parameters.
  - 2. Operator Overloading.
    - is a way of redefining the meaning of C# operators
    - Done with special functions.

OPERATOR OVERLOADING

- All unary and binary operators have pre-defined implementations
- These are automatically available in any expressions.
- User defined implementations can also be introduced in C#.
- The mechanism of giving a special meaning to a standard C# operator is known as operator overloading.
- Operator overloading is only applicable with respect to a user defined data type such as classes or structures

ALLOWED OPERATORS

Operators	Overloadability
+, -, *, /, %, &, |, <<, >>	All C# binary operators can be overloaded.
+, -, !, ~, ++, --, true, false	All C# unary operators can be overloaded.
==, !=, <, >, <= , >=	All relational operators can be overloaded, but only as pairs.
&&, ||	Can't be overloaded.
[] (Array index operator)	Can't be overloaded.
() (Conversion operator)	Can't be overloaded.
+=, -=, *=, /=, %=	These compound assignment operators can be overloaded. But in C#, these operators are automatically overloaded when the respective binary operator is overloaded.
=, . , ?:, ->, new, is, as, sizeof	Can't be overloaded.

OVERLOADING OPERATORS SYNTAX

- Syntax:

```
public static <ReturnValue> operator <op> (argument list)
{
}
```

- Example:

```
public static Point operator + (Point operator)
{
}
```

- Usage:

```
Point p1;
Point p1 = -p1;
```

TYPES OF OPERATOR OVERLOADING.

- Unary Operator Overloading.
  - You can declare your own version of the increment (++) and decrement (--) operators.
  - • They must be public, static and unary.
  - • They can be used in prefix and postfix forms
- Binary Operator Overloading.
  - At least one parameter must be of the enclosing type.
  - You may overload as many times as you like with different parameter types.
  - You may return any type.
  - “ref” or “out” parameters not allowed

UNARY OPERATOR OVERLOADING

- Unary operator works with single parameter.

```
struct Point
{
	int x;
	int y;
	public static Point operator+(Point p)
	{
		return new Point(p.x, p.y);
	}
	public static Point operator-(Point p)
	{
		return new Point(-p.x, -p.y);
	}
	...
}
```

BINARY OPERATOR OVERLOADING

- works with two parameter.
- Binary operators are of two types
  - Arithmetic/Bitwise Operators
    - + - * / % ^ & | << >>
  - Comparison Operators
    - == != < <= > >=

```
struct Point
{
	int x;
	int y;
	public static Point operator+(Point p, Point q)
	{
		return new Point(p.x + q.x, p.y + q.y);
	}
	public static Point operator-(Point p, Point q)
	{
		return new Point(p.x - q.x, p.y - q.y);
	}
	...
}
```

DETERMINING EQUALITY

- Two kinds of comparison for objects:
- Identity and equality
  - System.Object.Equals method
  - Equality operator(==)
- C# has an "Equals" method which can be used to compare two objects.
- Objects can also be compared using ==

EQUALS

- Even if test1 and test2 contain the same value for FirstName and LastName, the "Equals" method returns False.
- That is because default implementation of Equals method does not check for Equality; it checks for Identity.
- This means test1 and test2 must refer to the exact same object, then only it will return True, otherwise, it will return False.
- As test2 and test3 are referring to the same object, it returns True.
- As per the program we can conclude that default implementation of Equals checks for Identity which means it will return True only if two variables are referring to the same object.

```
class TestEquality
{
        public string FirstName { get; set; }
        public string LastName { get; set; }
}
TestEquality test1 = new TestEquality();
test1.FirstName = "Tom";
test1.LastName = "Cruise";

TestEquality test2 = new TestEquality();
test2.FirstName = "Tom";
test2.LastName = "Cruise";

TestEquality test3 = test2;
bool areEqual = test1.Equals(test2);
Console.WriteLine("Are test1 and test2 are Equal:" + areEqual);

areEqual = test2.Equals(test3);
Console.WriteLine("Are test2 and test3 are Equal:" + areEqual);
```

EQUALS METHOD

- Default implementation of Equals in Object class

```
public virtual bool Equals(Object obj)
{
    //If both the references points to the same object then only return true
    if (this == obj)
    {
        return true;
    }
    return false;
}
```

- We can override the Equals method

== & != OPERATOR

- The default implementation returns the result of comparing the two references for equality or non-equality.
- Since the predefined reference type equality operators accept operands of type object, they apply to all types that do not declare applicable operator == and operator != members.
- We can overload the == operator

ADVANTAGES OF OPERATOR OVERLOADING

- readability of the code improves.
- the code becomes explicit in nature,
- looking at the code, fellow developers can easily guess what is going on.
- With operator overloading the code looks more conventional and becomes easy to follow.
- The method defining operator overloading, should always be static and public.
  - Otherwise, compiler errors out with message