Backend Development

Chapter 1: C# Programming languages

C# Fundamentals

What is C# ?

- C# (C-Sharp) is a programming language developed by Microsoft that runs on the .NET Framework.
- C# has roots from the C family, and the language is close to other popular languages like C++ and Java.
- The first version was released in year 2002. The latest version, **C# 12**, was released in November 2023.
- C# is used to develop web applications, desktop applications, mobile apps, games and much more.
- A modern, object-oriented programming language developed by Microsoft.
- Part of the .NET ecosystem.
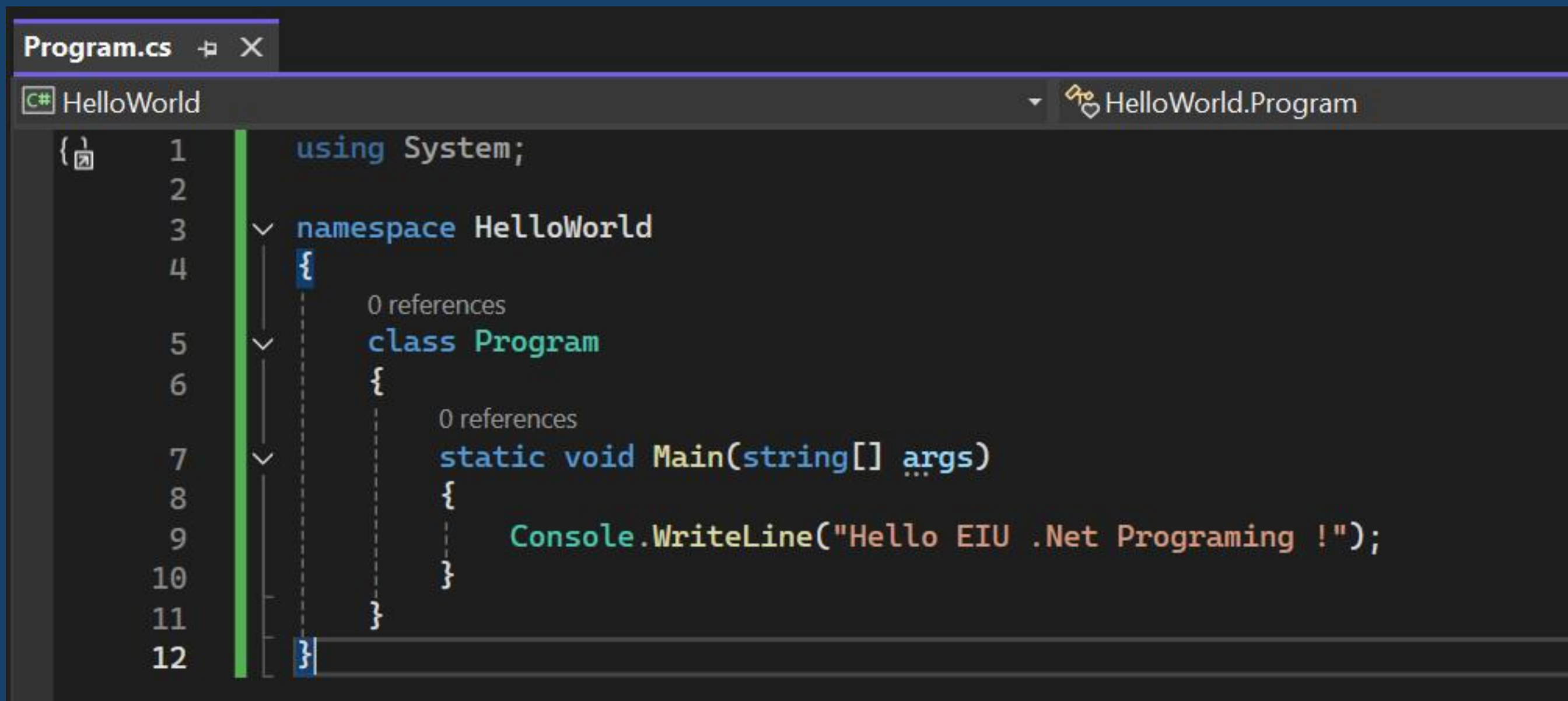- Combines the best of C++ and Java.

The Basic C# file when create a console project that called "Program.cs"

```csharp
using System;

namespace HelloWorld
{
    class Program
    {
        static void Main(string[] args)
        {
            Console.WriteLine("Hello EIU .Net Programing !");
        }
    }
}
```

Example explained
- **Line 1:** using System means that we can use classes from the System namespace.
- **Line 2:** A blank line. C# ignores white space. However, multiple lines makes the code more readable.
- **Line 3:** namespace is used to organize your code, and it is a container for classes and other namespaces.
- **Line 4:** The curly braces {} marks the beginning and the end of a block of code.
- **Line 5:** class is a container for data and methods, which brings functionality to your program. Every line of code that runs in C# must be inside a class. In our example, we named the class Program.
- **Line 7:** Another thing that always appear in a C# program is the Main method. Any code inside its curly brackets {} will be executed. You don't have to understand the keywords before and after Main. You will get to know them bit by bit while reading this tutorial.
- **Line 9:** Console is a class of the System namespace, which has a WriteLine() method that is used to output/print text. In our example, it will output "Hello World!".
If you omit the using System line, you would have to write System.Console.WriteLine() to print/output text.

How can we comment code in the C# programming language ?

```
/* Comment
 * for
 multiple
line */


// Comment for single line
```

```
17
18
19    ∨    /* This is the comment for multiple line
20          *
21          * Console.WriteLine("Hello EIU .Net Programing !"); */
22
23
24          // This is the comment for single line
25          //Console.WriteLine("Hello EIU .Net Programing !");
26                                                              }
27                                             }
28                                    }
```

int - stores integers (whole numbers), without decimals, such as 123 or -123
double - stores floating point numbers, with decimals, such as 19.99 or -19.99
char - stores single characters, such as 'a' or 'B'. Char values are surrounded by single quotes
string - stores text, such as "Hello World". String values are surrounded by double quotes
bool - stores values with two states: true or false

Syntax

type variableName = value;

string subjectName = "EIU .Net Programming";
int myNum = 99;

Constants

- Cannot declare a constant variable without assigning the value
- Eead-only
- Cannot overwrite existing values

```
21
22      const int myNum = 2024;
23      myNum = 2023; // error
24
```

How to use variables

```
string name = "Taylor Swift";
Console.WriteLine("Hello " + name);
```

```
string firstName = ".NET ";
string lastName = "Programming";
string fullName = firstName + lastName;
Console.WriteLine(fullName);
```

```
int x = 99;
int y = 1;
Console.WriteLine(x + y); // Print the value of x + y
```

Identifiers and clean variables

```
// Good
bool isDeleted = false;

// OK, but not so easy to understand what d actually is
bool d = false;
```

Data Type	Size	Description
int	4 bytes	Stores whole numbers from -2,147,483,648 to 2,147,483,647
long	8 bytes	Stores whole numbers from -9,223,372,036,854,775,808 to 9,223,372,036,854,775,807
float	4 bytes	Stores fractional numbers. Sufficient for storing 6 to 7 decimal digits
double	8 bytes	Stores fractional numbers. Sufficient for storing 15 decimal digits
bool	1 bit	Stores true or false values
char	2 bytes	Stores a single character/letter, surrounded by single quotes
string	2 bytes per character	Stores a sequence of characters, surrounded by double quotes

```
int myNum = 5;                 // Integer (whole number)
double myDoubleNum = 5.99D;    // Floating point number
char myLetter = 'D';           // Character
bool myBool = true;            // Boolean
string myText = "Hello";       // String
```

Type casting is when you assign a value of one data type to another type.

Implicit Casting (automatically) - converting a smaller type to a larger type size
char -> int -> long -> float -> double

Explicit Casting (manually) - converting a larger type to a smaller size type
double -> float -> long -> int -> char

```
//Implicit Casting
int myInt = 9;
double myDouble = myInt;        // Automatic casting: int to double

Console.WriteLine(myInt);        // Outputs 9
Console.WriteLine(myDouble);     // Outputs 9
```

```
//Explicit Casting
double myDouble = 9.78;
int myInt = (int)myDouble;       // Manual casting: double to int

Console.WriteLine(myDouble);     // Outputs 9.78
Console.WriteLine(myInt);        // Outputs 9
```

```csharp
// Type your username and press enter
Console.WriteLine("Enter username:");

// Create a string variable and get user input from the keyboard and store it in the variable
string userName = Console.ReadLine();

// Print the value of the variable (userName), which will display the input value
Console.WriteLine("Username is: " + userName);
```

Handle error for user Input

```
Console.WriteLine("Enter your age:");
int age = Console.ReadLine();
Console.WriteLine("Your age is: " + age);
```

```
Code       Description
❌  CS0029   Cannot implicitly convert type 'string' to 'int'
```

```
Console.WriteLine("Enter your age:");
int age = Convert.ToInt32(Console.ReadLine());
Console.WriteLine("Your age is: " + age);
```

```
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Enter your age:
18
Your age is: 18
```

Operators are used to perform operations on variables and values.

Operator	Name	Description	Example
+	Addition	Adds together two values	x + y
-	Subtraction	Subtracts one value from another	x - y
*	Multiplication	Multiplies two values	x * y
/	Division	Divides one value by another	x / y
%	Modulus	Returns the division remainder	x % y
++	Increment	Increases the value of a variable by 1	x++
--	Decrement	Decreases the value of a variable by 1	x--

Assignment Operators

- Assignment operators are used to assign values to variables.

Operator	Example	Same As
=	x = 5	x = 5
+=	x += 3	x = x + 3
-=	x -= 3	x = x - 3
*=	x *= 3	x = x * 3
/=	x /= 3	x = x / 3
%=	x %= 3	x = x % 3
&=	x &= 3	x = x & 3
|=	x |= 3	x = x | 3
^=	x ^= 3	x = x ^ 3
>>=	x >>= 3	x = x >> 3
<<=	x <<= 3	x = x << 3

Comparison Operators

- Comparison operators are used to compare two values (or variables). This is important in programming, because it helps us to find answers and make decisions.

Operator	Name	Example
==	Equal to	x == y
!=	Not equal	x != y
>	Greater than	x > y
<	Less than	x < y
>=	Greater than or equal to	x >= y
<=	Less than or equal to	x <= y

```
int x = 5;
int y = 3;
Console.WriteLine(x > y); // returns True because 5 is greater than 3
```

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True

Logical Operators
- Logical operators are used to determine the logic between variables or values

Operator	Name	Description	Example
&&	Logical and	Returns True if both statements are true	x < 5 && x < 10
||	Logical or	Returns True if one of the statements is true	x < 5 || x < 4
!	Logical not	Reverse the result, returns False if the result is true	!(x < 5 && x < 10)

A string variable contains a collection of characters surrounded by double quotes
A string in C# is actually an object, which contain properties and methods that can perform certain operations on strings.
Length:

```
string txt = "ABCDEFGHIJKLMNOPQRSTUVWXYZ";
Console.WriteLine("The length of the txt string is: " + txt.Length);
```

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```
The length of the txt string is: 26
```

Uppercase or lowercase:

```
string txt = "Hello World";
Console.WriteLine(txt.ToUpper());   // Outputs "HELLO WORLD"
Console.WriteLine(txt.ToLower());   // Outputs "hello world"
```

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```
HELLO WORLD
hello world
```

String Concatenation
The "+" operator can be used between strings to combine them.
This is called concatenation:

```
string firstName = ".NET ";
string lastName = "Programming";
string name = firstName + lastName;
Console.WriteLine(name);
```

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```
.NET Programming
```

String Interpolation

```
string firstName = ".NET ";
string lastName = "Programming";
string name = $"My course is: {firstName} {lastName}";
Console.WriteLine(name);
```

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```
My course is: .NET  Programming
```

Special Characters

The strings must be written within quotes, C# will misunderstand this string, and generate an error:

```
string txt = "I'm learning the ".NET Programming" course.";
```

Escape character	Result	Description
\'	'	Single quote
\"	"	Double quote
\\	\	Backslash

```
string txt = "I'm learning the \".NET Programming\" course.";
Console.WriteLine(txt);
```

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```
I'm learning the ".NET Programming" course.
```

10. BOOLEANS

C# has a bool data type, which can take the values true or false.

```csharp
bool isDotNetFun = true;
bool isFishTasty = false;
Console.WriteLine(isDotNetFun);   // Outputs True
Console.WriteLine(isFishTasty);   // Outputs False
```

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```
True
False
```

Boolean Expression

- A Boolean expression returns a boolean value: True or False, by comparing values/variables.
- Useful to build logic, and find answers.

```
int x = 10;
int y = 9;
Console.WriteLine(x > y); // returns True, because 10 is higher than 9
```

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True

Boolean Expression

More Example:

```
int x = 10;
Console.WriteLine(x == 10); // returns True, because the value of x is equal to 10
Console.WriteLine(10 == 15); // returns False, because 10 is not equal to 15
int myAge = 25;
int votingAge = 18;
if (myAge >= votingAge)
{
    Console.WriteLine("Old enough to vote!");
}
else
{
    Console.WriteLine("Not old enough to vote.");
}
```

Conditions

C# supports the usual logical conditions from mathematics:

- Less than: a < b
- Less than or equal to: a <= b
- Greater than: a > b
- Greater than or equal to: a >= b
- Equal to a == b
- Not Equal to: a != b

C# has the following conditional statements:

- Use if to specify a block of code to be executed, if a specified condition is true
- Use else to specify a block of code to be executed, if the same condition is false
- Use else if to specify a new condition to test, if the first condition is false
- Use switch to specify many alternative blocks of code to be executed

The If Statements

```
if (condition)
{
    // block of code to be executed if the condition is True
}

if (20 > 18)
{
    Console.WriteLine("20 is greater than 18");
}

int x = 20;
int y = 18;
if (x > y)
{
    Console.WriteLine("x is greater than y");
}
```

The Else Statement

```
if (condition)
{
    // block of code to be executed if the condition is True
}
else
{
    // block of code to be executed if the condition is False
}


int time = 20;
if (time < 18)
{
    Console.WriteLine("Good day.");
}
else
{
    Console.WriteLine("Good evening.");
}
// Outputs "Good evening."
```

The Else If Statement

```
if (condition1)
{
    // block of code to be executed if condition1 is True
}
else if (condition1)
{
    // block of code to be executed if the condition1 is false and condition2 is True
}
else
{
    // block of code to be executed if the condition1 is false and condition2 is False
}

int time = 22;
if (time < 10)
{
    Console.WriteLine("Good morning.");
}
else if (time < 20)
{
    Console.WriteLine("Good day.");
}
else
{
    Console.WriteLine("Good evening.");
}
// Outputs "Good evening."
```

Short Hand If...Else

variable = (condition) ? expressionTrue : expressionFalse;

```
int time = 20;
string result = (time < 18) ? "Good day." : "Good evening.";
Console.WriteLine(result);
```

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Good evening.

Use the switch statement to select one of many code blocks to be executed.

```
switch(expression)
{
  case 1:
    // code block
    break;
  case 2:
    // code block
    break;
  default:
    // code block
    break;
}
```

Example:
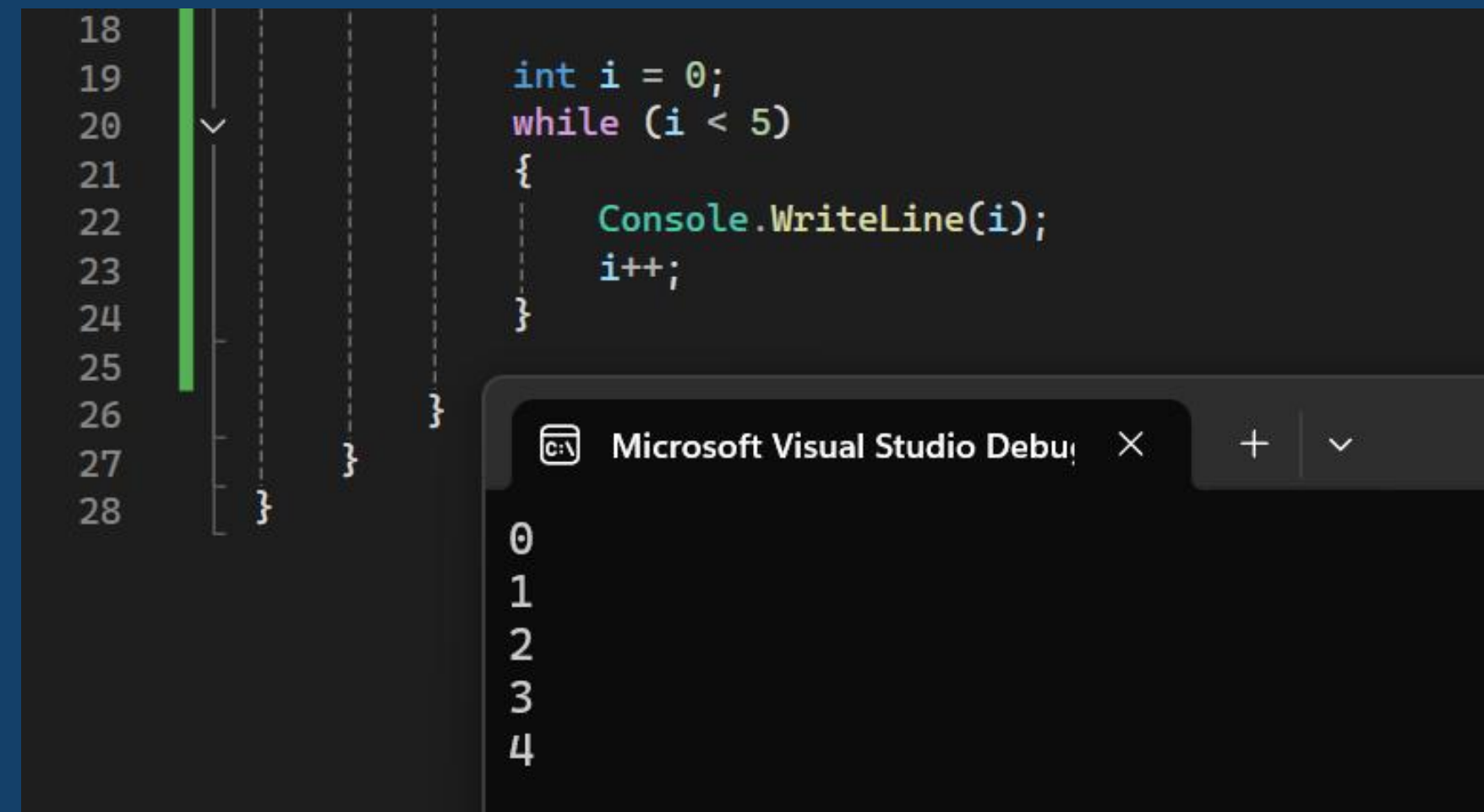
```csharp
int day = 4;
switch (day)
{
    case 1:
        Console.WriteLine("Monday");
        break;
    case 2:
        Console.WriteLine("Tuesday");
        break;
    case 3:
        Console.WriteLine("Wednesday");
        break;
    case 4:
        Console.WriteLine("Thursday");
        break;
    case 5:
        Console.WriteLine("Friday");
        break;
    case 6:
        Console.WriteLine("Saturday");
        break;
    case 7:
        Console.WriteLine("Sunday");
        break;
}
// Outputs "Thursday" (day 4)
```

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Thursday

While Loop
Syntax:

```
while (condition)
{
    // code block to be executed
}
```
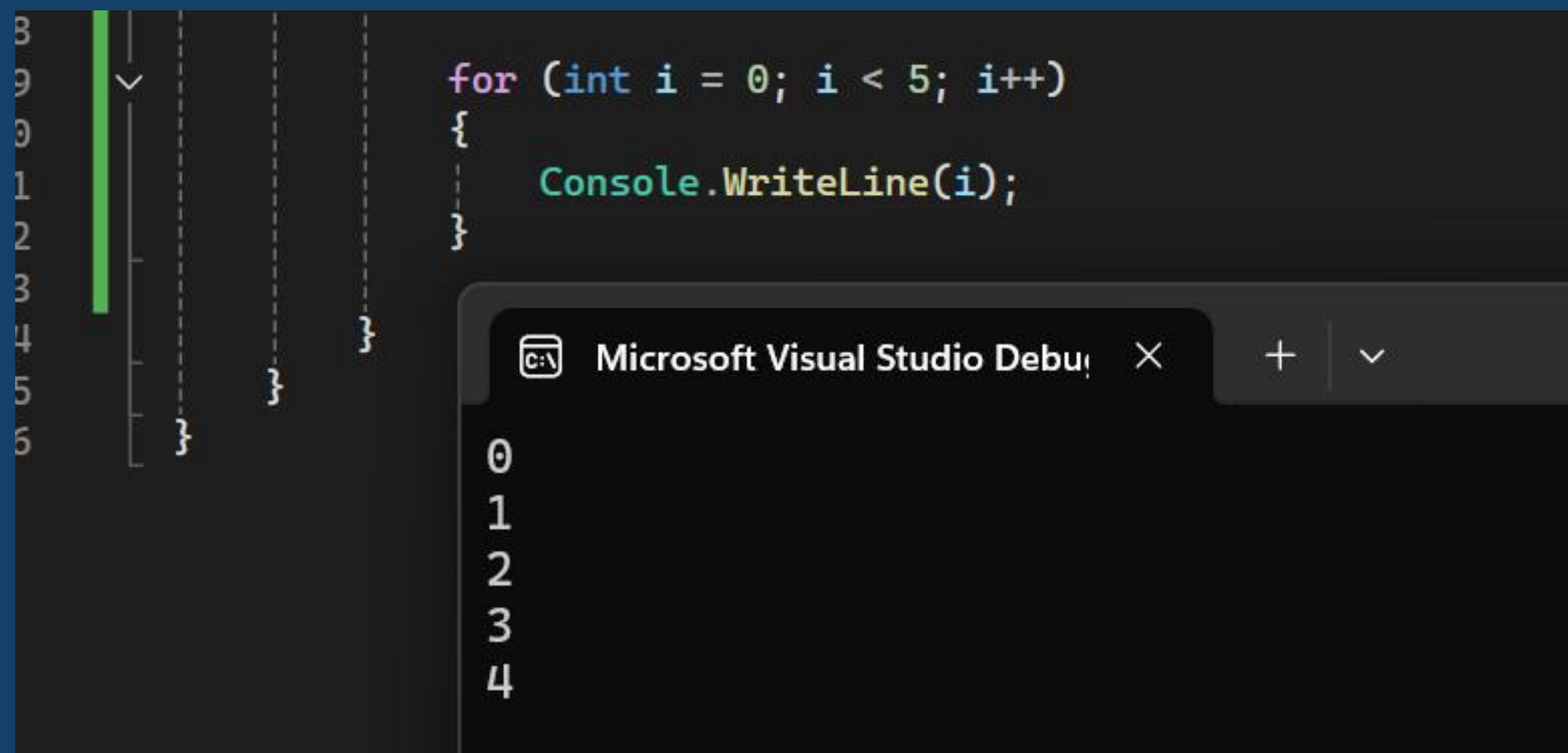
For Loop
Syntax:

for (statement 1; statement 2; statement 3)
{
  // code block to be executed
}

```
for (int i = 0; i < 5; i++)
{
    Console.WriteLine(i);
}
```
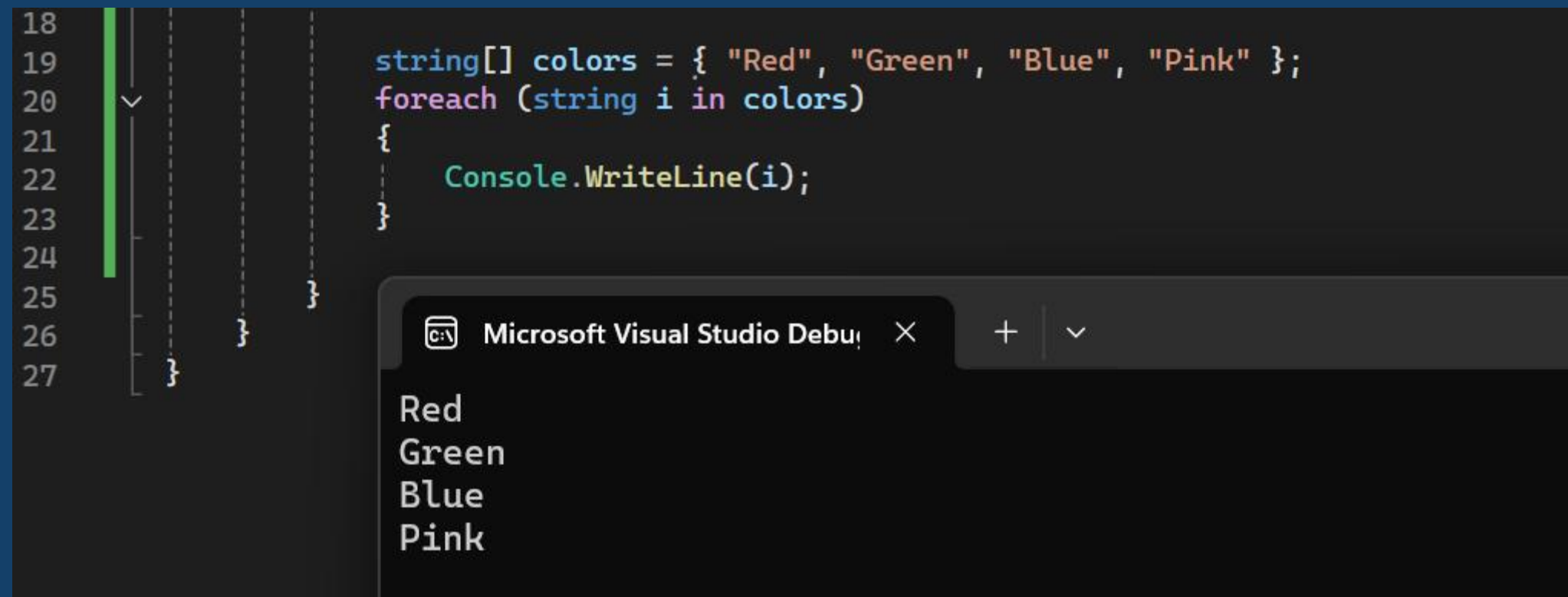
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```
0
1
2
3
4
```

Foreach Loop
Syntax:

```
foreach (type variableName in arrayName)
{
  // code block to be executed
}
```

Break and Continue
- **BREAK:** The break statement can also be used to jump out of a loop.
- **CONTINUE:** The continue statement breaks one iteration (in the loop), if a specified condition occurs, and continues with the next iteration in the loop.

Arrays are used to store multiple values in a single variable, instead of declaring separate variables for each value

```
string[] carsList = { "Volvo", "BMW", "Ford", "Mazda" };
int[] myNum = { 10, 20, 30, 40 };
```

Access the Elements of an Array:

```
string[] cars = { "Volvo", "BMW", "Ford", "Mazda" };
Console.WriteLine(cars[0]);
// Outputs Volvo
```

Change an Array Element:

```
cars[0] = "Huyndai";
```

Array Length:

```
string[] cars = { "Volvo", "BMW", "Ford", "Mazda" };
Console.WriteLine(cars.Length);
// Outputs 4
```
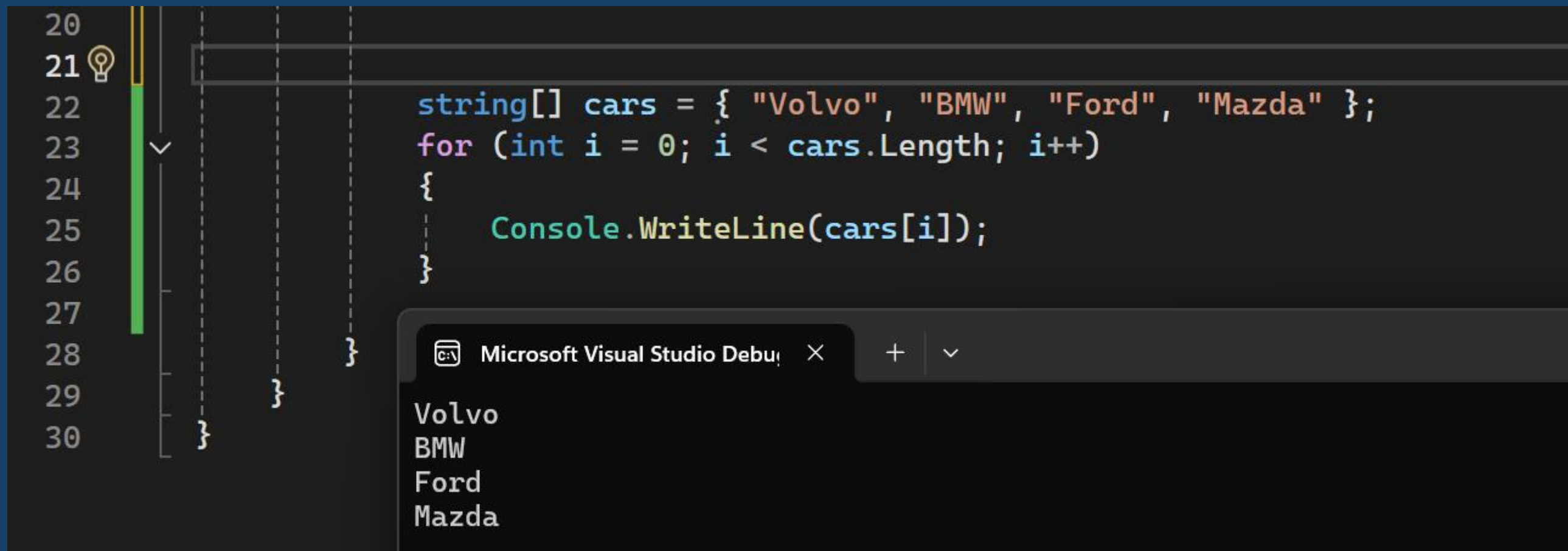
Other Ways to Create an Array

```csharp
// Create an array of four elements, and add values later
string[] carsClassA = new string[4];

// Create an array of four elements and add values right away
string[] carsClassB = new string[4] { "Volvo", "BMW", "Ford", "Mazda" };

// Create an array of four elements without specifying the size
string[] carsClassC = new string[] { "Volvo", "BMW", "Ford", "Mazda" };

// Create an array of four elements, omitting the new keyword, and without specifying the size
string[] carsClassD = { "Volvo", "BMW", "Ford", "Mazda" };
```

Loop Through Arrays

```
20
21
22      string[] cars = { "Volvo", "BMW", "Ford", "Mazda" };
23      for (int i = 0; i < cars.Length; i++)
24      {
25          Console.WriteLine(cars[i]);
26      }
27
28                  }
29              }
30      }
```

```
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Volvo
BMW
Ford
Mazda
```

```
class Program
{
  static void MyMethod()
  {
    // code to be executed
  }
}
```

MyMethod(): is the name of the method
static means that the method belongs to the Program class and not an object of the Program class.
void means that this method does not have a return value. You can choose another type like int, string, array, object,….

Call a Method

```csharp
using System;
using HelloWorldx;

namespace HelloWorld
{
    0 references
    class Program
    {
        1 reference
        static void MyMethod()
        {
            Console.WriteLine("I just got executed!");
        }

        0 references
        static void Main(string[] args)
        {

            MyMethod();

        }
    }
}
```

Method Parameters

```csharp
class Program
{
    3 references
    static void MyMethod(string fname)
    {
        Console.WriteLine(fname + " is a CIT's member");
    }

    0 references
    static void Main(string[] args)
    {

        MyMethod("Cuong");
        MyMethod("Xuan");
        MyMethod("Thuy");
    }
}
```

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```
Cuong is a CIT's member
Xuan is a CIT's member
Thuy is a CIT's member
```
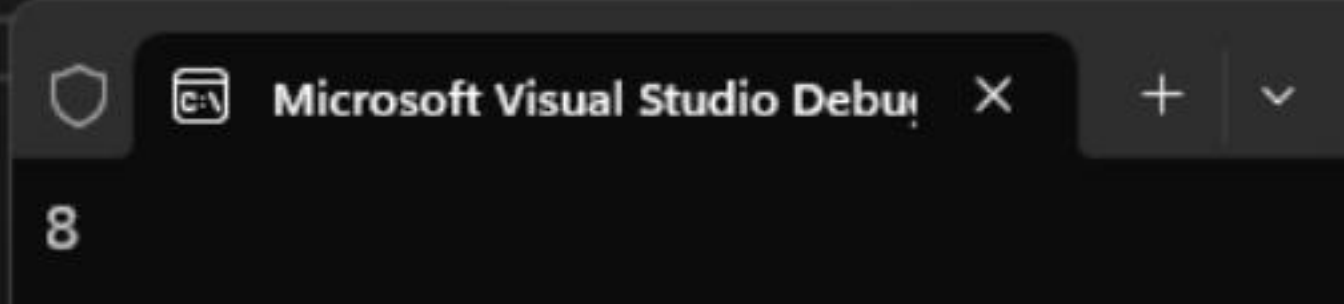
Default Parameter Value

Return Values

```
1 reference
static int MyMethod(int x)
{
    return 5 + x;
}


0 references
static void Main(string[] args)
{
    Console.WriteLine(MyMethod(3));
}


// Outputs 8 (5 + 3)
```

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8

Named Arguments

Object-oriented programming with C#
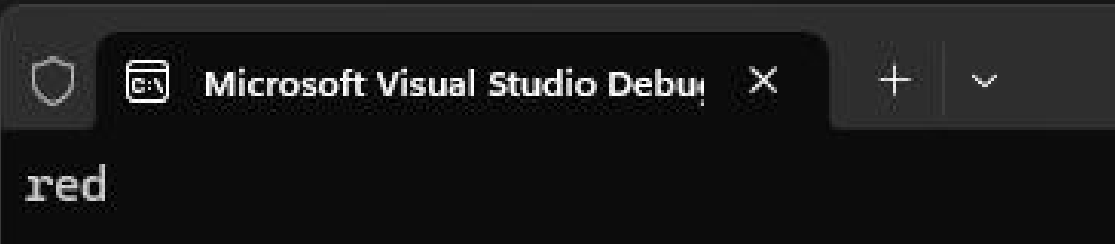
- OOP stands for Object-Oriented Programming.
- Object-oriented programming has several advantages over procedural programming:
  - OOP is faster and easier to execute
  - OOP provides a clear structure for the programs
  - OOP makes the code easier to maintain, modify and debug
  - OOP makes it possible to create full reusable applications with less code and shorter development time
- Classes and objects are the two main aspects of object-oriented programming.
- A class is a template for objects, and an object is an instance of a class

To create a class, use the class keyword:

```csharp
// Create a class named "Car" with a variable color:
0 references
class Car
{
    string color = "red";
}
```

Create an Object: Create an object called "myObj" and use it to print the value of color:

```csharp
class Car
{
    string color = "red";

    0 references
    static void Main(string[] args)
    {
        Car myObj = new Car();
        Console.WriteLine(myObj.color);
    }
}
```

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red

Fields and methods inside classes are often referred to as "Class Members":

```
 6    class MyClass
 7    {
 8        // Class members
 9        string color = "red";        // field
10        int maxSpeed = 200;          // field
      0 references
11        public void fullThrottle()   // method
12        {
13            Console.WriteLine("The car is going as fast as it can!");
14        }
15    }
```

Fields

Variables inside a class are called fields, you can access them by creating an object of the class, and by using the dot syntax (.).

The following example will create an object of the Car class, with the name myObj. Then we print the value of the fields color and maxSpeed:

```csharp
17    class Car
18    {
19        string color = "red";
20        int maxSpeed = 200;
21

      0 references
22    static void Main(string[] args)
23    {
24        Car myObj = new Car();
25        Console.WriteLine(myObj.color);
26        Console.WriteLine(myObj.maxSpeed);
27    }
28    }
```

Object Methods

Methods normally belong to a class, and they define how an object of a class behaves.

Just like with fields, you can access methods with the dot syntax. However, note that the method must be public. And remember that we use the name of the method followed by two parentheses () and a semicolon ; to call (execute) the method:

```csharp
2 references
class Car
{
    string color;                        // field
    int maxSpeed;                        // field

    1 reference
    public void fullThrottle()    // method
    {
        Console.WriteLine("The car is going as fast as it can!");
    }


    0 references
    static void Main(string[] args)
    {
        Car myObj = new Car();
        myObj.fullThrottle();   // Call the method
    }
}
```

A constructor is a special method that is used to initialize objects. The advantage of a constructor, is that it is called when an object of a class is created. It can be used to set initial values for fields:

```csharp
// Create a Car class
3 references
class Car
{
    public string model;  // Create a field

    // Create a class constructor for the Car class
    1 reference
    public Car()
    {
        model = "Mustang"; // Set the initial value for model
    }

    0 references
    static void Main(string[] args)
    {
        Car Ford = new Car();  // Create an object of the Car Class (this will call the constructor)
        Console.WriteLine(Ford.model);  // Print the value of model
    }
}

// Outputs "Mustang"
```
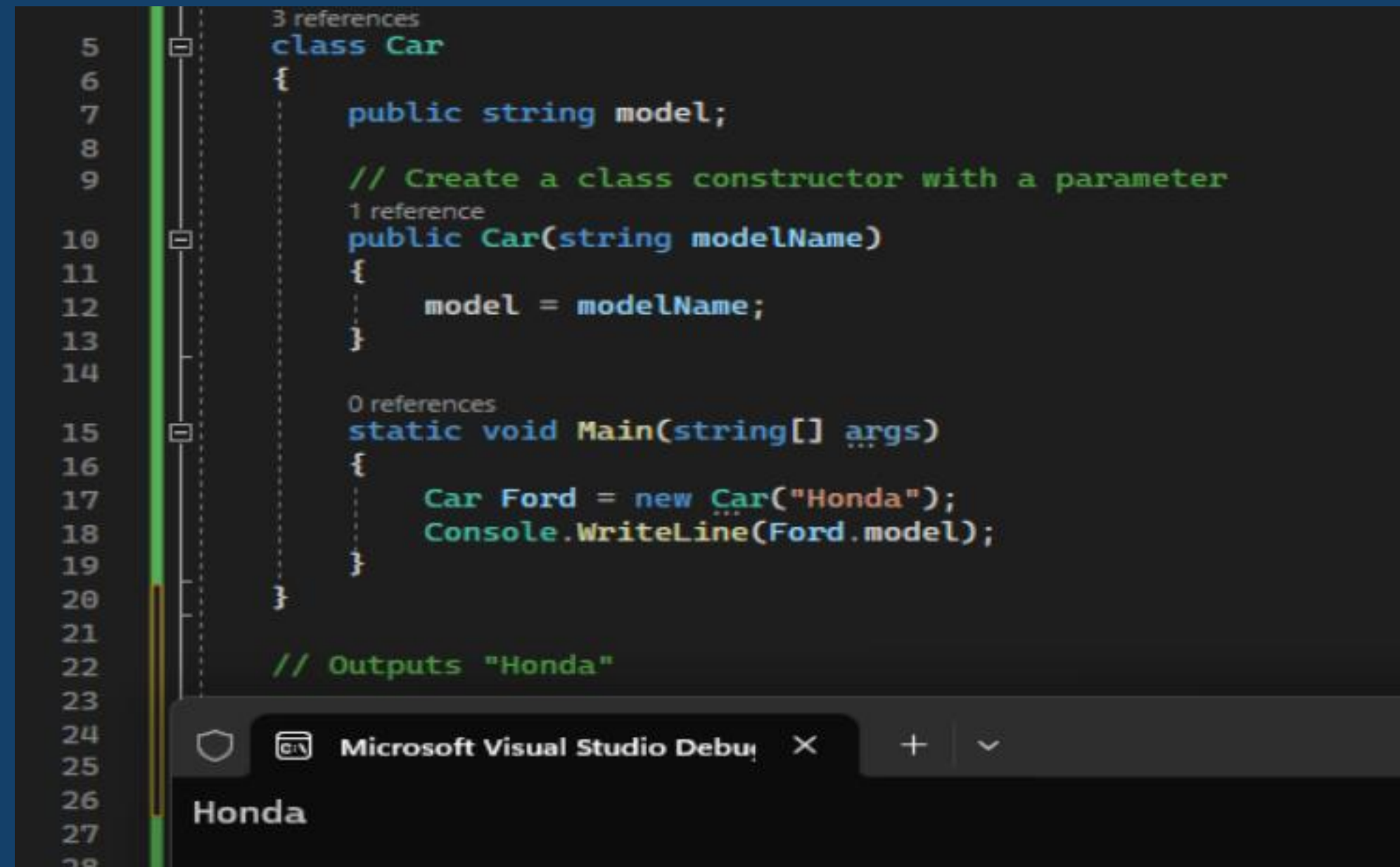
Constructor Parameters

Constructors can also take parameters, which is used to initialize fields.

The following example adds a string modelName parameter to the constructor. Inside the constructor we set model to modelName (model=modelName). When we call the constructor, we pass a parameter to the constructor ("Mustang"), which will set the value of model to "Mustang":

```csharp
class Car
{
    public string model;

    // Create a class constructor with a parameter
    public Car(string modelName)
    {
        model = modelName;
    }

    static void Main(string[] args)
    {
        Car Ford = new Car("Honda");
        Console.WriteLine(Ford.model);
    }
}

// Outputs "Honda"
```

Honda

public string color;

The public keyword is an access modifier, which is used to set the access level/visibility for classes, fields, methods and properties.

C# has the following access modifiers:

Modifier	Description
public	The code is accessible for all classes
private	The code is only accessible within the same class
protected	The code is accessible within the same class, or in a class that is inherited from that class.
internal	The code is only accessible within its own assembly, but not from another assembly.

Private Modifier

If you declare a field with a private access modifier, it can only be accessed within the same class.

If you try to access it outside the class, an error will occur.


```csharp
2 references
class Car
{
    private string model = "Mustang";

    0 references
    static void Main(string[] args)
    {
        Car myObj = new Car();
        Console.WriteLine(myObj.model);
    }
}
// output is Mustang
```

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Mustang

```csharp
2 references
class Car
{
    private string model = "Mustang";
}

0 references
class Program
{
    0 references
    static void Main(string[] args)
    {
        Car myObj = new Car();
        Console.WriteLine(myObj.model);
    }
}
```

Code	Description
❌ CS0122	'Car.model' is inaccessible due to its protection level

WHY ACCESS MODIFIERS?

To control the visibility of class members (the security level of each individual class and class member).

To achieve "Encapsulation" - which is the process of making sure that "sensitive" data is hidden from users. This is done by declaring fields as private.

Properties and Encapsulation

Encapsulation mean is to make sure that "sensitive" data is hidden from users. To achieve this, you must:

- Declare fields/variables as private
- Provide public get and set methods, through properties, to access and update the value of a private field

Properties

- Private variables can only be accessed within the same class (an outside class has no access to it)
- A property is like a combination of a variable and a method, and it has two methods: a get and a set method:

```csharp
class Program
{
    2 references
    class Course
    {
        private string nameCourse; // field

        2 references
        public string NameCourse    // property
        {
            get { return nameCourse; }    // get method
            set { nameCourse = value; }   // set method
        }
    }
    0 references
    static void Main(string[] args)
    {
        Course myObj = new Course();
        myObj.NameCourse = ".NET Programming"; // Using properties to access field
        Console.WriteLine(myObj.NameCourse);
    }
}
```

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.NET Programming

Automatic Properties (Short Hand)
C# also provides a way to use short-hand / automatic properties, where you do not have to define the field for the property, and you only have to write get; and set; inside the property.

The result is the same; the only difference is less code.

```csharp
namespace HelloWorld
{
    0 references
    class Program
    {
        2 references
        class Course
        {
            2 references
            public string NameCourse   // property
                { get; set; }  // GET SET method
        }
        0 references
        static void Main(string[] args)
        {
            Course myObj = new Course();
            myObj.NameCourse = ".NET Programming"; // Using properties to access field
            Console.WriteLine(myObj.NameCourse);
        }
    }
}
```

Microsoft Visual Studio Debug   ✕   +   ⌄

.NET Programming

Inheritance (Derived and Base Class)
In C#, it is possible to inherit fields and methods from one class to another. We group the "inheritance concept" into two categories:

Derived Class (child) - the class that inherits from another class
Base Class (parent) - the class being inherited from

To inherit from a class, use the " : " symbol.

Example:

```csharp
1 reference
class Vehicle  // base class (parent)
{
    public string brand = "Ford";  // Vehicle field
    1 reference
    public void honk()            // Vehicle method
    {
        Console.WriteLine("Tuut, tuut!");
    }
}
2 references
class Car : Vehicle  // derived class (child)
{
    public string modelName = "Mustang";  // Car field
}
0 references
class Program
{
    0 references
    static void Main(string[] args)
    {
        // Create a myCar object
        Car myCar = new Car();

        // Call the honk() method (From the Vehicle class) on the myCar object
        myCar.honk();

        // Display the value of the brand field (from the Vehicle class)
        // and the value of the modelName from the Car class
        Console.WriteLine(myCar.brand + " " + myCar.modelName);
    }
}
```

```
Microsoft Visual Studio Debug    ✕    +    ⌄

Tuut, tuut!
Ford Mustang

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ocess 24612) exited with code 0 (0x0).
To automatically close the console when debugging stops, enab
le when debugging stops.
Press any key to close this window . . .
```
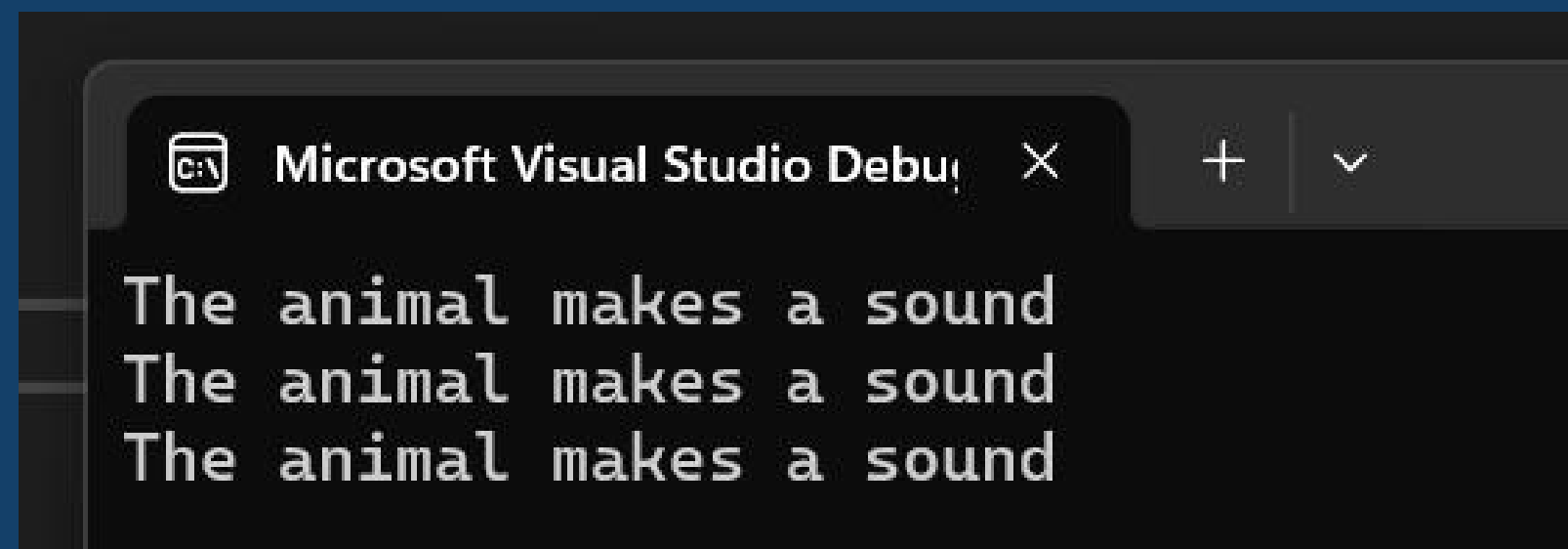
Polymorphism and Overriding Methods

Polymorphism means "many forms", and it occurs when we have many classes that are related to each other by inheritance.

```csharp
6 references
class Animal  // Base class (parent)
{
    3 references
    public void animalSound()
    {
        Console.WriteLine("The animal makes a sound");
    }
}
1 reference
class Pig : Animal  // Derived class (child)
{
    0 references
    public void animalSound()
    {
        Console.WriteLine("The pig says: wee wee");
    }
}
1 reference
class Dog : Animal  // Derived class (child)
{
    0 references
    public void animalSound()
    {
        Console.WriteLine("The dog says: bow wow");
    }
}
```

```csharp
0 references
class Program
{
    0 references
    static void Main(string[] args)
    {
        Animal myAnimal = new Animal();  // Create a Animal object
        Animal myPig = new Pig();  // Create a Pig object
        Animal myDog = new Dog();  // Create a Dog object
        myAnimal.animalSound();
        myPig.animalSound();
        myDog.animalSound();
    }
}
```

```
Microsoft Visual Studio Debug

The animal makes a sound
The animal makes a sound
The animal makes a sound
```

C# provides an option to override the base class method, by adding the virtual keyword to the method inside the base class, and by using the override keyword for each derived class methods

```csharp
6 references
class Animal  // Base class (parent)
{
    5 references
    public virtual void animalSound()
    {
        Console.WriteLine("The animal makes a sound");
    }
}

1 reference
class Pig : Animal  // Derived class (child)
{
    4 references
    public override void animalSound()
    {
        Console.WriteLine("The pig says: wee wee");
    }
}

1 reference
class Dog : Animal  // Derived class (child)
{
    4 references
    public override void animalSound()
    {
        Console.WriteLine("The dog says: bow wow");
    }
}
```

```csharp
class Program
{
    0 references
    static void Main(string[] args)
    {
        Animal myAnimal = new Animal();  // Create a Animal object
        Animal myPig = new Pig();  // Create a Pig object
        Animal myDog = new Dog();  // Create a Dog object

        myAnimal.animalSound();
        myPig.animalSound();
        myDog.animalSound();
    }
}
```

Microsoft Visual Studio Debug

```
The animal makes a sound
The pig says: wee wee
The dog says: bow wow
```

The abstract keyword is used for classes and methods:

Abstract class: is a restricted class that cannot be used to create objects (to access it, it must be inherited from another class).

Abstract method: can only be used in an abstract class, and it does not have a body. The body is provided by the derived class (inherited from).
An abstract class can have both abstract and regular methods:

```csharp
2 references
abstract class AnimalAbstract
{
    0 references
    public abstract void animalSound();
    0 references
    public void sleep()
    {
        Console.WriteLine("Zzz");
    }
}
AnimalAbstract myObj = new AnimalAbstract();
```

class HelloWorld.Sample.AnimalAbstract

CS0144: Cannot create an instance of the abstract type or interface 'Sample.AnimalAbstract'

IDE0090: 'new' expression can be simplified

Show potential fixes (Alt+Enter or Ctrl+.)

Example:

```csharp
// Abstract class
1 reference
abstract class Animal
{
    // Abstract method (does not have a body)
    2 references
    public abstract void animalSound();
    // Regular method
    1 reference
    public void sleep()
    {
        Console.WriteLine("Zzz");
    }
}

// Derived class (inherit from Animal)
2 references
class Pig : Animal
{
    2 references
    public override void animalSound()
    {
        // The body of animalSound() is provided here
        Console.WriteLine("The pig says: wee wee");
    }
}
```

```csharp
class Program
{
    0 references
    static void Main(string[] args)
    {
        Pig myPig = new Pig(); // Create a Pig object
        myPig.animalSound();  // Call the abstract method
        myPig.sleep();  // Call the regular method
    }
}
```
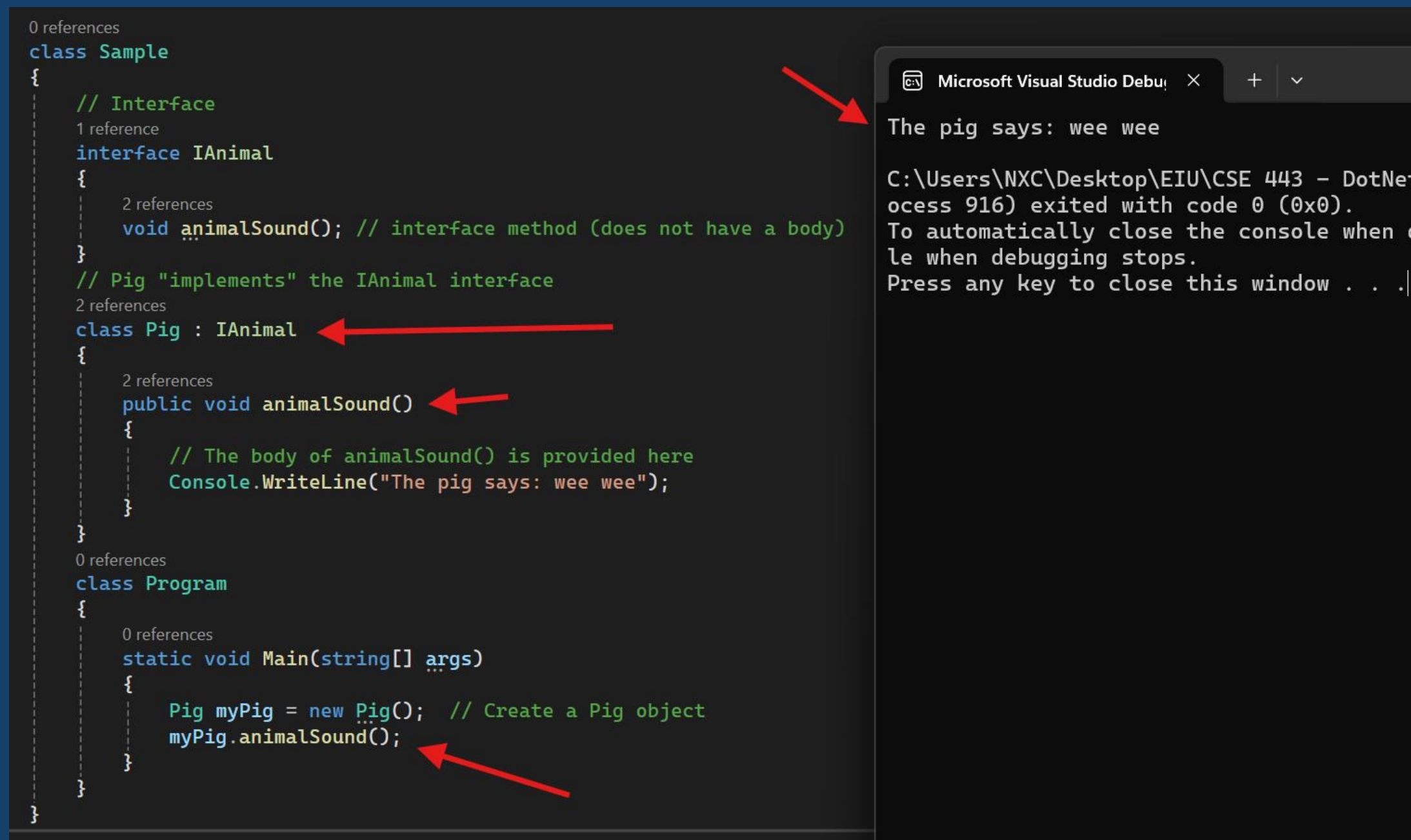
Microsoft Visual Studio Debug

```
The pig says: wee wee
Zzz
```

Another way to achieve abstraction in C#, is with interfaces.

An interface is a completely "abstract class", which can only contain abstract methods and properties (with empty bodies):

```csharp
0 references
class Sample
{
    // Interface
    1 reference
    interface IAnimal
    {
        2 references
        void animalSound(); // interface method (does not have a body)
    }
    // Pig "implements" the IAnimal interface
    2 references
    class Pig : IAnimal
    {
        2 references
        public void animalSound()
        {
            // The body of animalSound() is provided here
            Console.WriteLine("The pig says: wee wee");
        }
    }
    0 references
    class Program
    {
        0 references
        static void Main(string[] args)
        {
            Pig myPig = new Pig();  // Create a Pig object
            myPig.animalSound();
        }
    }
}
```

```
Microsoft Visual Studio Debug    ×    +   ∨

The pig says: wee wee

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ocess 916) exited with code 0 (0x0).
To automatically close the console when d
le when debugging stops.
Press any key to close this window . . .
```

Example in the real project:

```
namespace NXC.Interface;

//this interface to define a common interface
//as a Repository design pattern we'll define a common interface and the other interface will be implement from this
//some common method like a getAll, getById, insert, update, delete ...
71 references | Cường Nguyễn, 62 days ago | 1 author, 1 change
public interface IRepository<T> where T : class
{
    99+ references | Cường Nguyễn, 62 days ago | 1 author, 1 change
    Task<TemplateApi<T>> GetAllAsync(int pageNumber, int pageSize);
    99+ references | Cường Nguyễn, 62 days ago | 1 author, 1 change
    Task<TemplateApi<T>> GetById(Guid id);
    78 references | Cường Nguyễn, 62 days ago | 1 author, 1 change
    Task<TemplateApi<T>> GetAllAvailable(int pageNumber, int pageSize);
    99+ references | Cường Nguyễn, 62 days ago | 1 author, 1 change
    Task<TemplateApi<T>> Update(T model, Guid idUserCurrent, string fullName);
    99+ references | Cường Nguyễn, 62 days ago | 1 author, 1 change
    Task<TemplateApi<T>> Insert(T model, Guid idUserCurrent, string fullName);
    99+ references | Cường Nguyễn, 62 days ago | 1 author, 1 change
    Task<TemplateApi<T>> RemoveByList(List<Guid> ids, Guid idUserCurrent, string fullName);
    78 references | Cường Nguyễn, 62 days ago | 1 author, 1 change
    Task<TemplateApi<T>> HideByList(List<Guid> ids, bool isLock, Guid idUserCurrent, string fullName);
}
```

Example in the real project:

```csharp
namespace NXC.Interface.Interfaces;

5 references | Cường Nguyễn, 62 days ago | 1 author, 1 change
public interface IEmployeeRepository : IRepository<EmployeeDto>
{
    #region ===[ CRUD TABLE Employee ]===========================================================

    2 references | Cường Nguyễn, 62 days ago | 1 author, 1 change
    Task<TemplateApi<EmployeeAndBenefits>> GetEmployeeAndBenefits(Guid idEmployee);
    2 references | Cường Nguyễn, 62 days ago | 1 author, 1 change
    Task<TemplateApi<EmployeeAndAllowance>> GetEmployeeAndAllowance(Guid idEmployee);
    2 references | Cường Nguyễn, 62 days ago | 1 author, 1 change
    Task<TemplateApi<EmployeeDto>> GetEmployeeResigned(int pageNumber, int pageSize);
    2 references | Cường Nguyễn, 62 days ago | 1 author, 1 change
    Task<TemplateApi<EmployeeDto>> FilterEmployee(FilterEmployeeModel model,int pageNumber, int pageSize);

    2 references | Cường Nguyễn, 62 days ago | 1 author, 1 change
    Task<TemplateApi<EmployeeDto>> UpdateEmployeeType(Guid idEmployee, Guid typeOfEmployee,
        Guid idUserCurrent, string fullName);

    #endregion
}
```

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Thank You