Programming 3 Advanced

Attributes, Tuples, Anonymous Classes
Events Workshop

Tomasz Herman

Faculty of Mathematics and Information Science
Warsaw University of Technology

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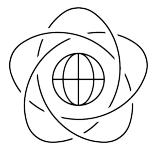
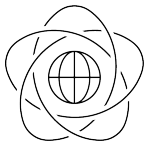


Outline

1. Attributes
2. Anonymous Types
3. Tuples



Attributes

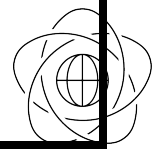
```
1  [Description("""
2      Attributes add metadata to your program.
3      Metadata is information about the types defined
4          in a program.
5      You can apply one or more attributes to entire
6          assemblies, modules, or smaller program
7          elements such as classes and properties.
8      Attributes can accept arguments in the same way
9          as methods and properties.
10     Your program can examine its own metadata or the
11         metadata in other programs by using reflection.
12     """)]
13 public static void AttributesIntroduction() {}
```

Documentation

https://learn.microsoft.com/en-us/dotnet/csharp/advanced-topics/reflection-and-attributes/

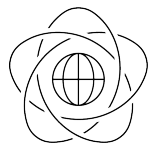
Attributes Targets

```
1  [assembly: AssemblyDescription("Attributes demonstration")]
2
3  [field: NonSerialized]
4  private static bool Property { get; } = false;
5
6  [Description("By default it applies to a method")]
7  private static int Method1() { return 0; }
8
9  [method: Description("Explicitely applied to a method")]
10 private static int Method2() { return 0; }
11
12 private static int Method3(
13     [Description("Applied to a parameter")] string parameter)
14 { return 0; }
15
16 [return: Description("Applied to a return value")]
17 private static int Method4() { return 0; }
```



Multiple Attributes

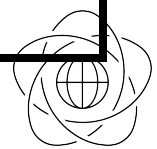
```
1  [Description("Multiple attributes applied to a method"),
2   Conditional("DEBUG")]
3  private static void Method5() { }
4
5  [Description("Multiple attributes applied to a method")]
6  [Conditional("DEBUG")]
7  private static void Method6() { }
```



Caller Attributes

Caller Info

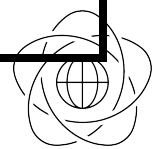
```
1  public static void CallerInfo()
2  {
3      Logger.Log("Hello, World!");
4      // [CallerInfo] /some/path/Program.cs:3: Hello, World!
5  }
6
7  public static void Log(string message,
8      [CallerMemberName] string memberName = "",
9      [CallerFilePath] string sourceFilePath = "",
10     [CallerLineNumber] int sourceLineNo = 0)
11 {
12     Console.WriteLine(
13       $"[{memberName}] {sourceFilePath}:{sourceLineNo}: {message}"
14     );
15 }
```



Caller Attributes

Caller Argument Expression

```
1  public static void CallerArgument()
2  {
3      Assertion.Assert("Hello, World!" is { Length: < 5 });
4      // Assertion failed: "Hello, World!" is { Length: < 5 }
5  }
6
7  public static void Assert(bool condition,
8      [CallerArgumentExpression(nameof(condition))]
9      string? message = null)
10 {
11     if (!condition)
12     {
13         Console.Error.WriteLine($"Assertion failed: {message}");
14     }
15 }
```



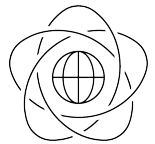
Anonymous Types

An anonymous type is a simple class created by the compiler

```
1  var bob = new { Name = "Bob", Age = 23 };
2  Console.WriteLine(
3    $"{bob.GetType()} is {bob.Name} and {bob.Age} years old.");
```

Documentation

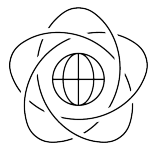
https://learn.microsoft.com/en-us/dotnet/csharp/fundamentals/types/anonymous-types



Inferring Property Names

The property name can be inferred from an identifier

```
1  int age = 23;
2  var bob = new { Name = "Bob", age, age.ToString().Length };
3  Console.WriteLine($"His {nameof(bob.Name)} is {bob.Name}");
4  Console.WriteLine($"His {nameof(bob.age)} is {bob.age}");
5  Console.WriteLine(
6    $"His {nameof(bob.Length)} is {bob.Length}");
```



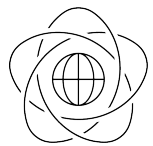
Equals is overridden to perform structural equality comparison

While == operator performs referential comparison

```
1 var a = new { X = 1, Y = 2, Z = 3 };
2 var b = new { X = 1, Y = 2, Z = 3 };
3 Console.WriteLine(a.Equals(b)); // True
4 Console.WriteLine(a == b); // False
```

GetHashCode and ToString

Anonymous types also override the GetHashCode and ToString methods.

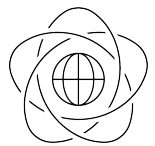


Non-destructive Mutation

C# 10

`with` **keyword allows to create a copy of another anonymous type.**

```
1  var a = new { X = 1, Y = 2, Z = 3 };
2  var b = a with { X = 10, Y = 20 };
3  Console.WriteLine($"a = (X = {a.X}, Y = {a.Y}, Z = {a.Z})");
4  Console.WriteLine($"b = (X = {b.X}, Y = {b.Y}, Z = {b.Z})");
```



Tuples

Tuples are value types, with mutable (read/write) elements

```
1  (double, int) t1 = (4.5, 3);
2  Console.WriteLine(
3    $"Tuple with elements {t1.Item1} and {t1.Item2}.");
4  // Output:
5  // Tuple with elements 4.5 and 3.
6
7  (double Sum, int Count) t2 = (4.5, 3);
8  Console.WriteLine(
9    $"Sum of {t2.Count} elements is {t2.Sum}.");
10 // Output:
11 // Sum of 3 elements is 4.5.
```

Documentation

https://learn.microsoft.com/en-us/dotnet/csharp/language-reference/builtin-types/value-tuples

Tuple Field Names

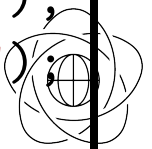
```
1  var t = (Sum: 4.5, Count: 3);
2  Console.WriteLine($"Sum of {t.Count} elements is {t.Sum}.");
3  (double Sum, int Count) d = (4.5, 3);
4  Console.WriteLine($"Sum of {d.Count} elements is {d.Sum}.");
```

It may be inferred from the name of the corresponding variable

```
1  var sum = 4.5;
2  var count = 3;
3  var t = (sum, count);
4  Console.WriteLine($"Sum of {t.count} elements is {t.sum}.");
```

The default names of tuple fields are Item1, Item2, Item3...

```
1  var a = 1;
2  var t = (a, b: 2, 3);
3  Console.WriteLine($"The 1st element is {t.Item1} ({t.a}).");
4  Console.WriteLine($"The 2nd element is {t.Item2} ({t.b}).");
5  Console.WriteLine($"The 3rd element is {t.Item3}.");
```



Tuple

Backing type

C# tuples are backed by System.ValueTuple type

```
1 ValueTuple<string, int> bob = ("Bob", 23);
2 (string, int) alice = ("Alice", 42);
3 (string name, int age) chad = ValueTuple.Create("Chad", 19);
4 alice = bob = chad;
```

Non default field names

At compile time, the compiler replaces non-default field names with the corresponding default names. As a result, explicitly specified or inferred field names aren't available at run time.
With methods/properties that return named tuple types, the compiler emits the element names by applying a custom attribute called TupleElementNamesAttribute to the member's return type.

Tuple equality

Tuple types support the == and != operators.

```
1  (int a, byte b) left = (5, 10);
2  (long a, int b) right = (5, 10);
3  Console.WriteLine(left == right);  // output: True
4  Console.WriteLine(left != right);  // output: False
5
6  var t1 = (A: 5, B: 10);
7  var t2 = (B: 5, A: 10);
8  Console.WriteLine(t1 == t2);  // output: True
9  Console.WriteLine(t1 != t2);  // output: False
```

Equals and GetHashCode

Tuples also override the Equals and GetHashCode method, making it practical to use tuples as keys in dictionaries.

Tuple Deconstructtion

```
1  var bob = ("Bob", 23);
2  {   // Deconstructs tuple fields into separate variables
3      (string name, int age) = bob;
4  }
5  {   // Might use existing variables
6      string name; int age;
7      (name, age) = bob;
8  }
9  {   // Might use var to deduct types
10     var (name, age) = bob;
11 }
```