Module 04:

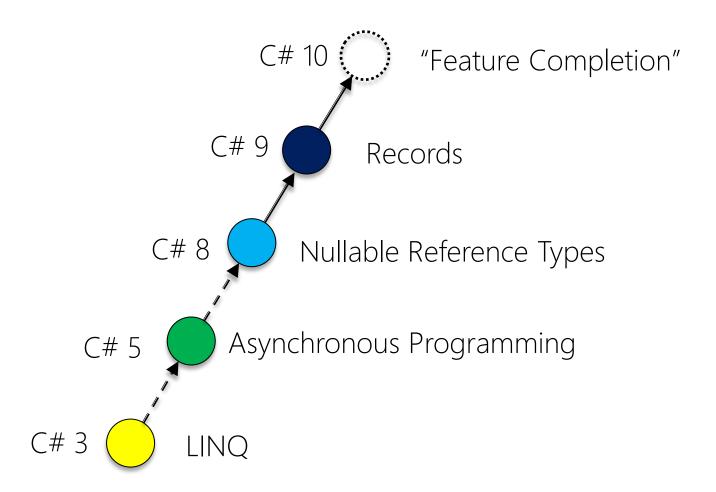
"An Introduction to C# 10"







Major Evolutions of C#







Agenda

- Introduction
- Namespace Improvements
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File-scoped Namespace Declarations

▶ In spirit of the using directive, the namespace declarations have been "horizontally optimized" similarly

```
namespace Wincubate.CS10.Shapes;
interface IShape
   double Area { get; }
class Rectangle : IShape
```

How often do you have multiple namespaces in same file?



Global Using Directives

Project-wide using directives are now supported

```
global using System.Text.Json;
namespace Wincubate.CS10.Shapes;
record Rectangle(double Width, double Height) : IShape
{
   public double Area => Width * Height;
   public string Serialize() => JsonSerializer.Serialize(this);
}
```

Also works for using static





Implicit Usings

▶ Implicit usings are enabled in project file for new projects

```
<Project Sdk="Microsoft.NET.Sdk">
 <PropertyGroup>
   <OutputType>Exe
   <TargetFramework>net6.0</TargetFramework>
   <RootNamespace>Wincubate.CS10.A
   <ImplicitUsings>enable</ImplicitUsings>
   <Nullable>enable</Nullable>
 </PropertyGroup>
</Project>
```

__NET libraries supply default implicit **using**s



Custom Implicit Usings

You can configure your custom implicit usings

An alternative to GlobalUsings.cs or similar





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C# 9 Object-oriented Topology

Value Types:

> struct

Reference Types:

> class

• record

Anonymous Types





C# 10 Object-oriented Topology

- Value Types:
- > struct
 - record struct

- Reference Types:
- > class
 - record class

Anonymous Types





Record Structs and Record Classes

Use record struct for "value-type records"

```
Money m1 = new(87, 25);
Money m2 = new(87, 25);

Console.WriteLine(m1 == m2);

record struct Money( int Euro, int Cents)
{
    public int TotalCents => Euro * 100 + Cents;
}
```

Use record or record class for "reference-type records"





Comments on Record Structs

record class

- Immutable for primary constructor parameters
- Mutable for other properties

record struct

- Mutable for primary constructor parameters
- Mutable for other properties
- ▶ However, thinking back to C# 7.x:

readonly record struct

- Immutable for primary constructor parameters
- Other properties are not allowed to be mutable!



C# 10 Additions to Structs

Default constructors and initializers are allowed in C# 10

```
struct Money
    public int Euro { get; set; } = 99;
    public int Cents { get; set; } = 99;
    public Money()
        Euro = 1;
        Cents = 0;
```

<u>Note</u>: Beware of relation to default keyword and/or non-default constructors



C# 9 Non-destructive Mutation

Value Types:

> struct

Reference Types:

▶ class

record class with

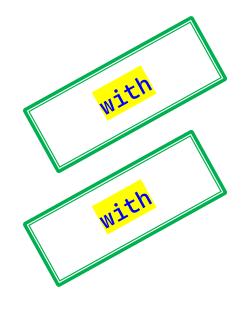
Anonymous Types





C# 10 Non-destructive Mutation

- Value Types:
- > struct
- record struct



- Reference Types:
- ▶ class
- record class with

• Anonymous Types with





Non-destructive Mutation Extended

▶ C# 9 with expressions allowed for all structs in C# 10

```
struct Money
{
    public int Euro { get; set; };
    public int Cents { get; set; };
}

Money m1 = new(87, 25);
Money m2 = m1 with { Cents = 87 };
```

▶ C# 9 with expressions also allowed for anonymous types

```
var p1 = new { FirstName = "Bruce", LastName = "Wayne" };
var p2 = p1 with { LastName = "Campbell" };
```



Fixing the C# 9 Record Bug ©

- ▶ The bug with **ToString()** and inheritance from C# 9?
- "Fixed" in C# 10 by marking synthesized method as sealed

```
record Album(
    string Artist, string Name,
    DateTime? ReleaseDate, int NumberOfDiscs = 1)
    : Record(Artist, Name, ReleaseDate)
{
    // New ToString() is *not* synthesized here
}
```



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Pattern-matching Enhancements

- ▶ C# 7, 8, and 9 introduced a total of 12 patterns and enhancements
- ▶ C# 10 introduces just one: Extended Property Pattern
 - Type{ p1.p2: v }

```
record class Company(string Name, Company? OwnedBy = default);
```

```
var query = companies
.Where(c => c is { OwnedBy.OwnedBy.Name: "Sharp10" })
;
```





Lambda Natural Type Inference

Lambda expressions are now given a natural type when inferred

```
var parseToInt = (string s) => int.Parse(s);
int i = parseToInt("87");

var writeInt = (int i) => Console.WriteLine(i);
writeInt(176);
```

- Type needs to conform to either
 - a generic Func , or
 - a generic or non-generic Action
- What do you think will happen if it does not...?
- Are there any other quirky cases...?





Lambda Explicit Return Type

Lambda expressions may declare a return type when the compiler can't infer it

```
var choose = object (bool b) => b ? 1 : "two";
Console.WriteLine(choose(false));
```

- Makes lambda expressions as similar to methods and local functions as possible
- Easier to use lambda expressions without declaring a variable of a delegate type
- Work seamlessly with the new ASP.NET Core Minimal APIs.





Attributes on Lambda Expressions

- ▶ In C# 10 attributes can be added to
 - a lambda expression
 - its parameters
 - Its return value.

```
// Attribute on lambda expression itself
Func<string, int> parse = [Developer("JGH")] (s) => int.Parse(s);

// Attribute on parameter
Action<string?> info =([Developer("JGH")] s) => Console.WriteLine(s);

// Attribute on return type
Func<int, int> compute = [return: Developer("JGH")] (i) => i + 87;
```



Constant Interpolated Strings

Strings interpolated from constants can now be const

```
static class DeveloperInfoConstants
{
    public const string Name = "JGH";
    public const string Company = "Wincubate ApS";

    public const string Message = $"{Name} / {Company}";
}
```

- Finally! Now interpolated strings can be used in
 - Attributes
 - API Routes
 - ...



String Interpolation Optimized

- ▶ In C# 10 string interpolation has been optimized at a number of places, e.g.
 - Debug.Assert()

```
int i = 0;
while( i < 100 )
{
    // Does not compute string if not necessary
    Debug.Assert(i >= 0, $"{DateTime.Now} - {GetLogMessage()}");
    i++;
}
```

- API is open for "everyone" to build their own special interpolation handlers
 - If You Must: See Lab 04.4 for tutorial





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Mixed Deconstruction

- ▶ In C# 9 deconstructions we could either
 - Declare and initialize *all* new variables, or
 - Assign to all existing variables
- In C# 10 this restriction is relaxed

```
record Person(string FirstName, string LastName)
{
    public string FullName => $"{FirstName} {LastName}";
}

string f = string.Empty;
(f, string l) = person;
```





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Caller Info Attributes Revisited

- ▶ C# 5.0 introduced three types of caller info attributes
 - [CallerMemberName]
 - [CallerFilePath]
 - [CallerLineNumber]

```
void Log(
    [CallerMemberName] string? callerName = null,
    [CallerFilePath] string? callerFilePath = null,
    [CallerLineNumber] int callerLine = -1
)
{ ... }
```

- Applicable to default parameters
- Compiler replaces values at <u>compilation</u> time



Caller Argument Expressions

▶ C# 10 adds a CallerArgumentExpression attribute

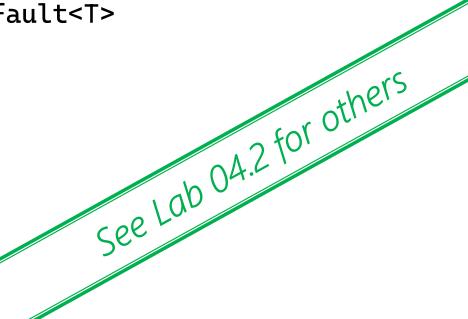
Excellent for developer-centric logs etc.





LINQ Additions in .NET 6

- ElementAt<T> and ElementAtOrDefault<T>
 - New support for Index
- Take<T>
 - New support for Range
- - New support for supplying default
- > Zip<T>
 - New support for three enumerables
- New Chunk<T> method
- New DistinctBy<T>, MinBy<T> and MaxBy<T> methods
- New UnionBy<T>, IntersectBy<T>, and ExceptBy<T>
- New TryGetNonEnumeratedCount<T>







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Improved Definite Assignment

More accurate warnings for definite assignment and null-state analysis

```
if ((c != null && c.GetValue(out object obj1)) == true)
   representation = obj1.ToString(); // Undesired error
if (c?.GetValue(out object obj2) == true)
   representation = obj2.ToString(); // Undesired error
if (c?.GetValue(out object obj3) ?? false)
   representation = obj3.ToString(); // Undesired error
```



Enhanced Line Pragmas

- ▶ C# 10 supports a new format for the **#line** pragma
- You likely won't use the new format, but you'll see its effects in e.g. Razor

```
#line (1, 1) - (5, 60) 10 "partial-class.g.cs" /*34567*/int b = 0;
```

- ▶ For the "uninitiated": ◎ ◎ ◎
 - The **#line** directive might be used in an automated, intermediate step in the build process. For example, if lines were removed from the original source code file, but you still wanted the compiler to generate output based on the original line numbering in the file, you could remove lines and then simulate the original line numbering with **#line**.



More Granular AsyncMethodBuilder Attribute



- ▶ Since C# 7: Add **AsyncMethodBuilder** attribute to a type that can be an async return type
 - Available in System.Runtime.CompilerServices
 - specifies the type that builds the async method implementation when the specified type is returned from an async method
- ▶ In C# 10: AsyncMethodBuilder allowed on individual async methods

```
[AsyncMethodBuilder(typeof(MyAsyncTaskMethodBuilder<>))]
public async Task<R> ComputeAsync()
{
    await Task.Delay(1000);
    return new R("Yay!");
}
```



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