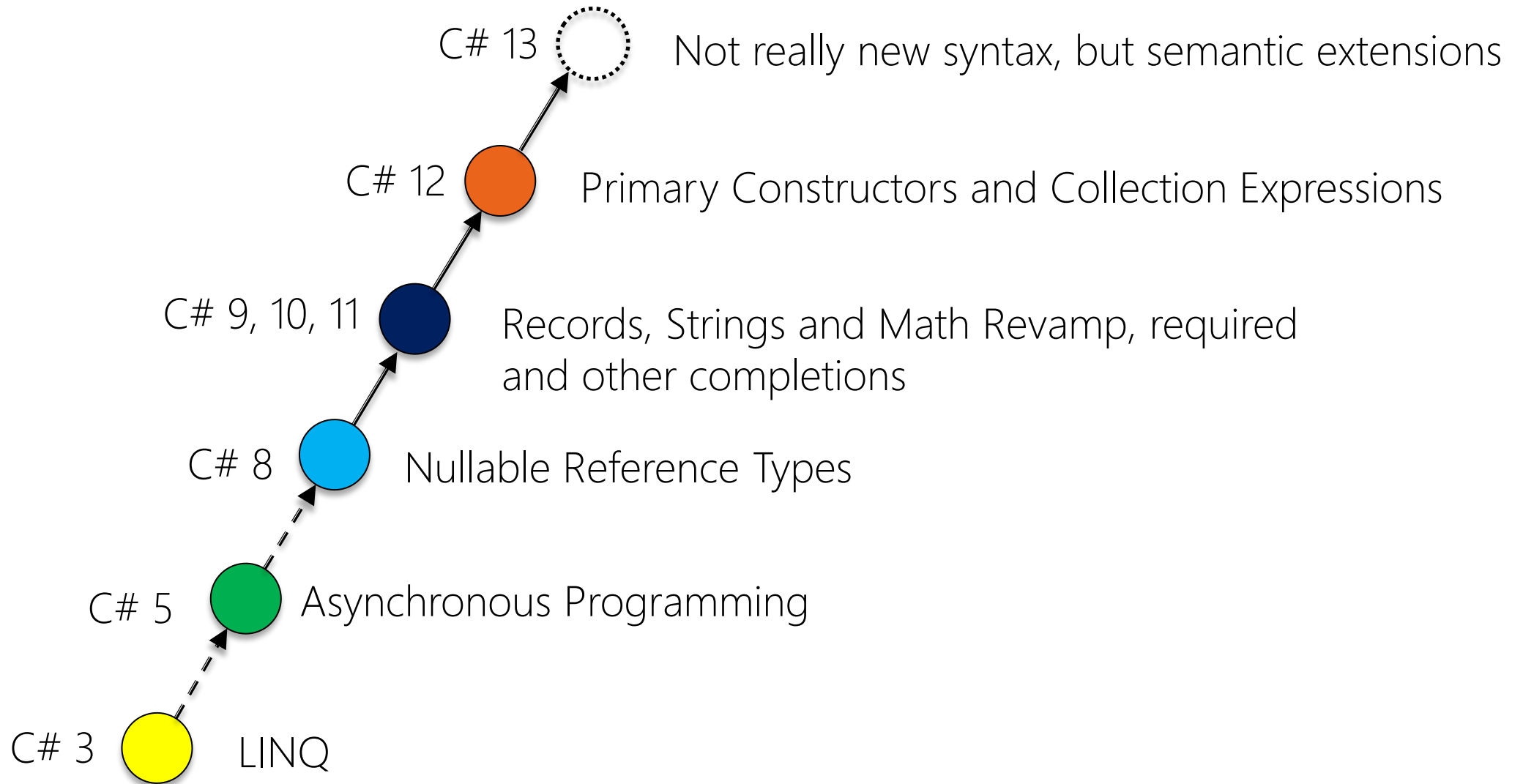


Module 07:

"The Brand New C# 13"



Major Evolutions of C#



Agenda

- ▶ Introduction
- ▶ **Method Improvements**
- ▶ Statement Improvements
- ▶ Expression Improvements
- ▶ Object-Oriented Improvements
- ▶ Summary



Param Collections

- ▶ The **params** modifier can now be used with any collection type or interface

```
record class Pizza
{
    ...
    public Pizza(params IEnumerable<Topping> toppings)
    {
        _toppings = toppings;
    }
}
```

```
Pizza meatLover = new(Topping.Beef, Topping.Kebab, Topping.Bacon);
```

- ▶ Including concrete types `List<T>`, `Span<T>`, `ReadOnlySpan<T>`, ...
- ▶ Types implementing interfaces `IEnumerable<T>`, `ICollection<T>`, `IReadOnlyCollection<T>`, `IReadOnlyList<T>`, `IList<T>` ...



Extended to Custom Collection Types

- ▶ Also works for any custom type
 - Implementing **IEnumerable<T>**
 - Public **Add()** method

```
public class SequencePacker<T> : IEnumerable<T>
{
    ...

    public void Add(T element)
    {
        ...
    }
}
```



Overload Resolution

- ▶ C# 12 in general improved overload resolution to chose the best overload available
- ▶ In C# 13 library authors can manually prioritize to avoid ambiguities using the **OverloadResolutionPriority** attribute

```
class ObjectHandler
{
    public static void Handle<T>(ImmutableArray<T> elements) { ... }

    [OverloadResolutionPriority(1)]
    public static void Handle<T>(params ReadOnlySpan<T> elements) { ... }
}
```

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New Lock Type

- ▶ .NET 9 introduces a new **System.Threading.Lock** type

```
public sealed class Lock
{
    public void Enter() { ... }
    public void Exit() { ... }
    public Scope EnterScope() { ... }

    public ref struct Scope
    {
        public void Dispose() { ... }
    }
}
```

```
Lock l = new();

using (var scope = l.EnterScope())
{
    //
    // Critical region ...
    //
}
```

- ▶ Decided solely to being a lock – Better than Monitor-based approach!



The **lock** keyword vs. "Good" Old **Monitor**?

- ▶ The lock keyword is integrated into the C# language, but uses the ancient **Monitor** type

```
object l = new();
```

```
lock (l)
```

```
{
```

```
//
```

```
// Critical region ...
```

```
//
```

```
}
```



```
bool lockTaken = false;
```

```
try
```

```
{
```

```
    Monitor.Enter(l, ref lockTaken);
```

```
}
```

```
finally
```

```
{
```

```
    if (lockTaken) { Monitor.Exit(l); }
```

```
}
```

- ▶ Fortunately, C# 13 solves this with
 - Type-dependent compilation
 - Proper warnings for unintended use

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Implicit Index Access in Object Initializers

- ▶ The "index from end expression" operator `^` from C# 8 is now allowed in object initializer expressions, e.g.
 - Collection initializers

```
Thingy thingy = new()
{
    Elements =
    {
        [^2] = "Hello",
        [^1] = "World",
        [0] = "Booyah!",
        [1] = "Foobar"
    }
};
```

Character Literal Escape Sequence

- ▶ You can now use `\e` as a character literal escape sequence for unicode ESCAPE character U+001B.

```
Console.WriteLine("\eBooyah!! Nicely Escaped!");
```

- ▶ Much better alternative than using `\x1b` or `\u001b`



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Partial Properties and Indexers

- ▶ Partial classes and methods were introduced in C# 2 and improved in C# 9
- ▶ In C# 13 both properties and indexers are now allowed to be partial
 - But must have an implementation part!

```
partial class Customer
{
    ...
    public partial string FavoriteFood
    {
        get;
        set;
    }
}
```

```
partial class Customer
{
    public partial string FavoriteFood
    {
        get ⇒ _favoriteFood;
        set
        {
            ...
            _favoriteFood = value;
        }
    }
}
```

Revisting Ref Structs

- ▶ Structs can be enforced as “always stack allocated” using **ref struct**

```
ref struct Point3D
{
    public double X { get; }
    public double Y { get; }
    public double Z { get; }
    ...
}
```

- ▶ These values can never be allocated on the heap
 - Cannot be boxed
 - Cannot be declared members of a class or (non-ref) struct
 - Cannot be local variables in async methods
 - Cannot be declared local variables in iterators
 - Cannot be captured in lambda expressions or local functions



Ref Structs and Interfaces

- ▶ Up to C# 12 ref structs were never allowed to implement interfaces
 - Problem: Implementing interfaces allows converting to them!
 - Special "duck-typing" allowed **IDisposable** to be "implemented" (remember **Scope** in **Lock**?)
- ▶ In C# 13 ref structs can implement interfaces, but with restrictions
 - **Cannot be converted to the interface it implements**
 - Must implement all interface member – also those with default implementations

```
ref struct Point3D : IDisplayable
{
    public double X { get; }
    public double Y { get; }
    public double Z { get; }

    public readonly void Display() { Console.WriteLine(ToString()); }
}
```


allows ref struct

- ▶ C# 13 introduces a new "anti-constraint" for ref structs and generics

```
static class DisplayHelper
{
    public static void Display<T>(this d)
        where T : IDisplayable, allows ref struct
    {
        d.Display();
    }
}
```

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