Module 08

"New Features in C# 6.0"

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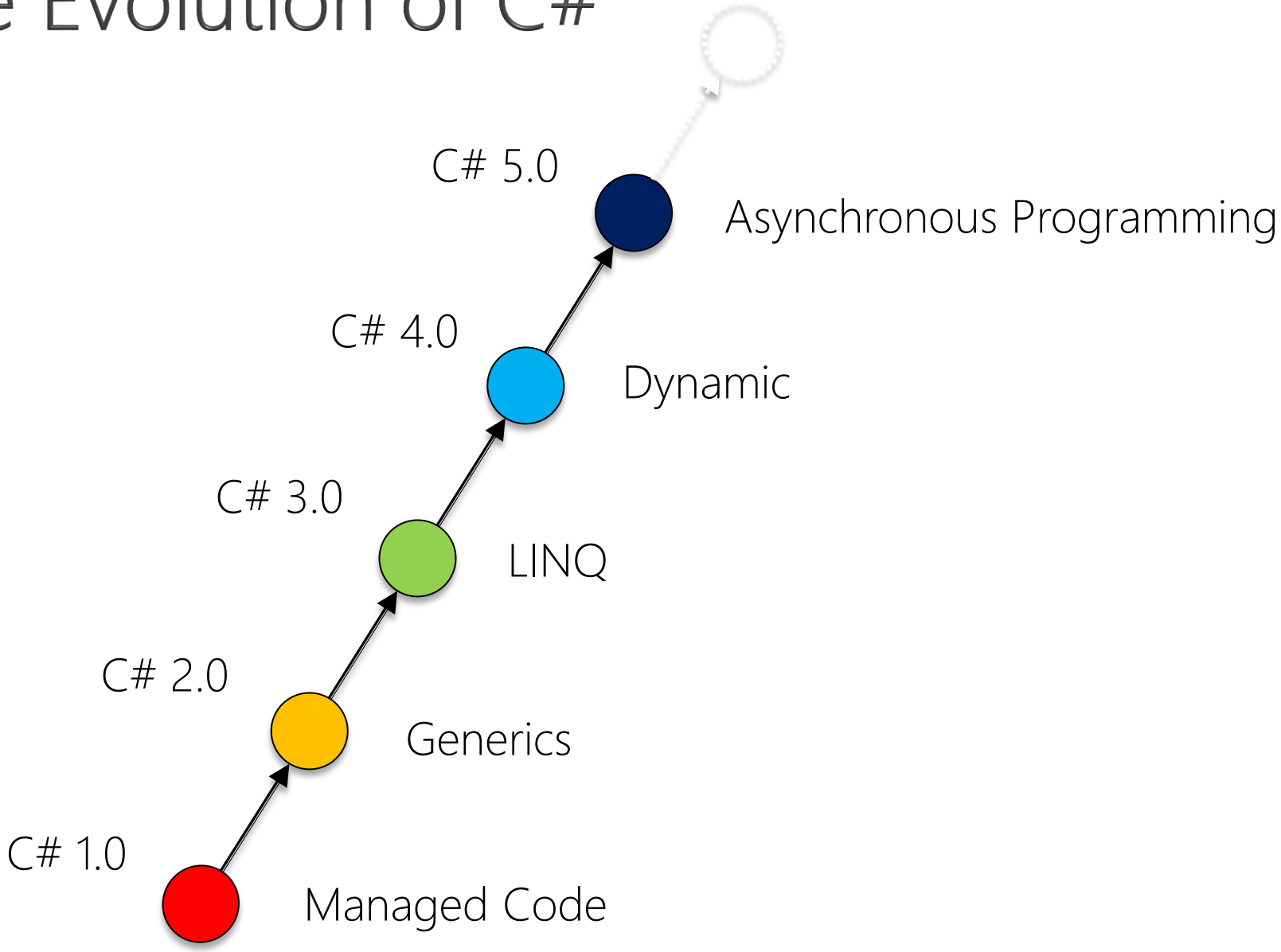
Agenda

- Introduction
- Namespace-level Features
- Expression-level Features
- Statement-level Features
- Member Declaration Features
- Scrapped Features for C# 6.0 *(If Time Permits…)*
- Lab 8
- Discussion and Review

The Evolution of C#



What is new in C# 6.0?

"Less code!" ☺

… but no major additions in terms of languages features

However…

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.NET Compiler Platform (Formerly known as "Roslyn")

- Project running at Microsoft for more than 4 years
  - Reimplementation of C# and VB.NET compilers
- Provides an syntax tree representation of programs
- "Compiler-as-a-Service"
- At Build 2014 Microsoft announced the open-sourcing of the C# and VB.NET compilers
  - Everyone can "fork" the compiler, but…
- Contains a really useful Diagnostic Analyzer API

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Static Usings

- Static members can now be imported with **`using static`**
  - Rules similar to using extension methods

```
using static System.Console;

class Program
{
   static void Main(string[] args)
   {
      WriteLine( "Hello, World!" );
   }
}
```

- Extension methods are static methods, but intended as instance members

```
using static System.Linq.Enumerable;
...
IEnumerable<int> numbers = Range( 0, 100 );     // OK!
var query = Where( numbers, i => i % 2 == 0 ); // Not OK!
```

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Null-conditional Operator

- C# 6.0 introduces a new null-conditional operator **`?.`**
  - Also known as the "Elvis operator" ☺
  - Works for reference types and nullable types

```
Person p = ...;
string s = p?.FullName;  // Full name (or null if person == null)
```

- Right-hand side only evaluated if left-hand side is not null
  - Propagates null through expression

- Interacts brilliantly with the null-coalescing operator **`??`**

```
string s = p?.FullName ?? "No name";
```

- Resolves the well-known design flaw for events
  - Note: **`.Invoke()`** must be explicitly applied for delegates

String Interpolation

- C# 6.0 offers easier formatting of strings

```
public class Person
{
  public string FirstName { get; set; }
  public string LastName { get; set; }

  public string FullName
  {
     get
     {
        return $"{FirstName} {LastName}";
     }
  }
}
```

- Very flexible
  - Works with virtually any expression
  - Respects usual formatting controls

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`nameof` Expressions

- The `nameof` operator provides "reflection-style" access to the name of the syntactical structure

```
public void Add( Person p )
{
   if( p == null )
   {
      throw new ArgumentNullException( nameof( p ) );
   }
   _persons.Add(p);
}
```

- Works with more elaborate dotted names

```
Console.WriteLine( nameof( Person.FullName ) );
```

- Continues the trend of Caller Info Attributes of C# 5.0
  - Eases implementation of `INotifyPropertyChanged` etc.

Index Initializers

- Index initializers are now provided for collection initializers

```
var lineUp = new Dictionary<int, Person>
{
    [19] = new Person { FirstName = "Kim", LastName = "Aabech" },
    [11] = new Person { FirstName = "Jesper", LastName = "Lange" },
    [14] = new Person { FirstName = "Ahmed", LastName = "Yasin" }
};
```

- Intended for scenarios such as **`JObject`** initialization

```
var json = new JObject {
   ["FirstName"] = FirstName,
   ["LastName"] = LastName,
   ["Age"] = Age
};
```

- Note:
  - `{…,…}` maps to the **`Add()`** method
  - `[…] = …` maps to the underlying indexer

Add() Extension Methods

- Collection initializer syntax is now extensible via extension methods

```
public static class QueueExtensions
{
   public static void Add<T>(this Queue<T> queue, T t)
   {
      queue.Enqueue(t);
   }
}
```

```
var persons = new Queue<Person>
{
   new Person { FirstName = "Kim", LastName = "Aabech" },
   new Person { FirstName = "Jesper", LastName = "Lange" },
   new Person { FirstName = "Ahmed", LastName = "Yasin" }
};
```

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Exception Filters

- Exception filters facilitates the handling of exceptions matching a specific type and/or predicate

```
var from = Bank.CreateAccount(100);
var to = Bank.CreateAccount(100);

try
{
   Bank.TransferFunds(from, 200, to);
}
catch (InsufficientFundsException e) when (e.Account?.IsVIP == true)
{
   // Handle VIP account
}
```

- Distinct clauses can match same exception type but with different conditions

`await` in `catch` and `finally`

- C# 6.0 now allows **`await`** inside
  - `catch`
  - `finally`

```
try
{
   Bank.TransferFunds(from, 200, to);
}
catch (InsufficientFundsException e) when (e.Account?.IsVIP == true)
{
   // Handle VIP account
   await logger.LogExceptionAsync(e);
}
finally
{
   await logger.LogAsync("Completed processing of accounts");
}
```

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Auto-property Initializers

- Initializers can now be supplied for the automatic properties introduced in C# 3.0

```
public class Person
{
    public string FirstName { get; set; } = "Jens";
    public string LastName { get; set; } = "Jensen";
    public int Age { get; set; } = 0;
}
```

- Equivalent to initializers on fields
  - ...but doesn't use setter!
  - Run before constructors
  - Cannot refer to **`this`** because happen before object is fully constructed

- Note: Structs still cannot have initializers!

Getter-only Auto-properties

- Moreover, the automatic properties can now be getter- or setter-only

```
public class StockChangedEventArgs : EventArgs
{
   public string Ticker { get; }
   public double StockValue { get; }
   public DateTime TimeStamp { get; } = DateTime.Now;
}
```

- This is a really important mechanism for putting mutable and immutable data types on equal terms!

- Underlying field is created as `readonly`
  - Can still be assigned from the constructor
  - … but elsewhere not!

- Note: Can still have initializers!

Expression-bodied Members

- All functionality-based members can have expression bodies
  - Methods
  - Properties
  - Indexers

```
public class Person
{
   public string FirstName { get; set; } = "Jens";
   public string LastName { get; set; } = "Jensen";
   public int Age { get; set; } = 0;

   public string FullName => $"{FirstName} {LastName}";

   public override string ToString() =>
      $"{Name} is {Age} year{(Age == 1 ? "" : "s")} old";
}
```

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Scrapped Features for C# 6.0

- Beware! Many articles, videos, blog posts etc. are no longer current…!

- Contrary to what you might read, the following features have all been scrapped from C# 6.0
  - Parameterless Constructors for Structs
  - Primary Constructors
  - Declaration Expressions
  - `var` return value (and `out var`)
  - `IEnumerable` with `params`
  - Event Initializers
  - Binary Literals and Numeric Separators
  - …

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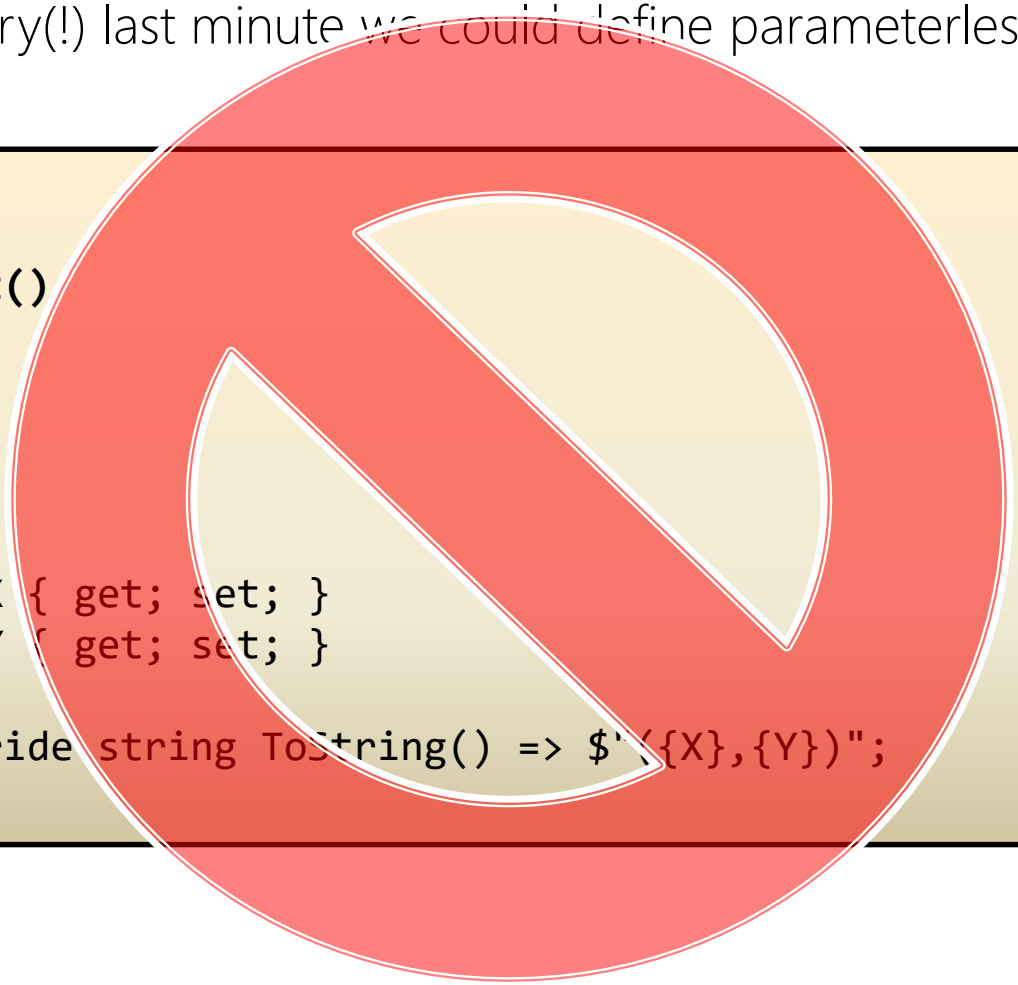
Scrapped: Parameterless Constructors for Structs

- Until the very(!) last minute we could define parameterless constructors for structs…

```
struct Point
{
   public Point()
   {
      X = -1;
      Y = -1;
   }

   public int X { get; set; }
   public int Y { get; set; }

   public override string ToString() => $"({X},{Y})";
}
```

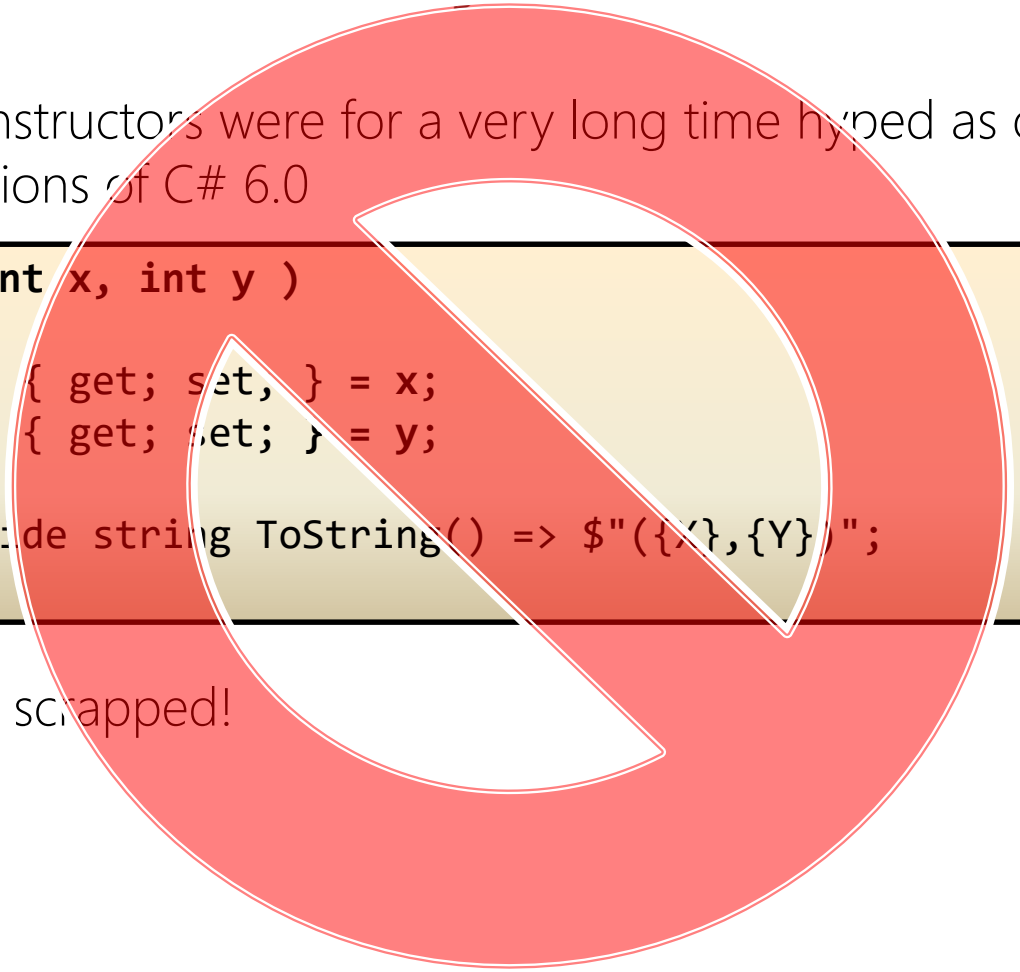


Scrapped: Primary Constructors

- Primary constructors were for a very long time hyped as one of the major additions of C# 6.0

```
struct Point( int x, int y )
{
   public int X { get; set; } = x;
   public int Y { get; set; } = y;

   public override string ToString() => $"({X},{Y})";
}
```



- But – alas – scrapped!

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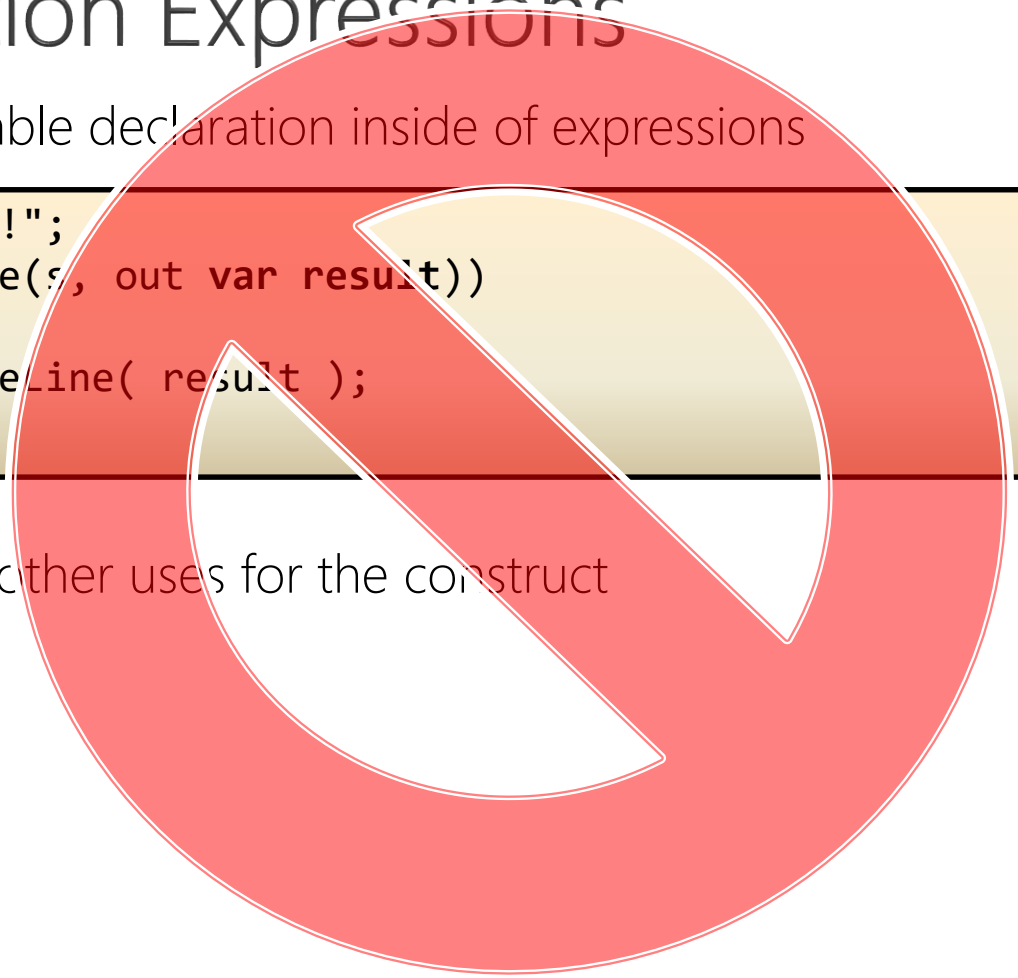
Scrapped: Declaration Expressions

- Allows variable declaration inside of expressions

```
string s = "Yay!";
if (int.TryParse(s, out var result))
{
   Console.WriteLine( result );
}
```

- Very many other uses for the construct

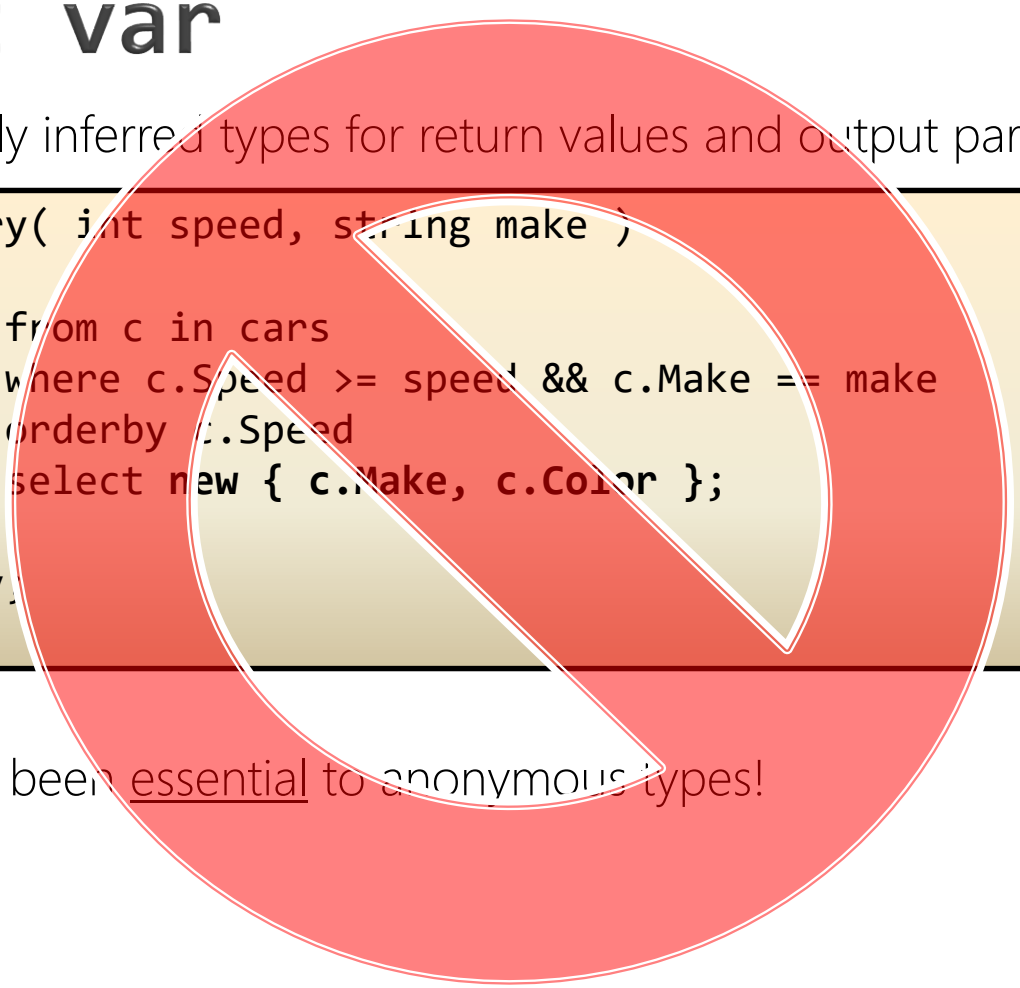


Scrapped: **var** return value and **out var**

- Automatically inferred types for return values and output parameters

```
var ComputeQuery( int speed, string make )
{
   var query = from c in cars
               where c.Speed >= speed && c.Make == make
               orderby c.Speed
               select new { c.Make, c.Color };

   return query;
}
```



- Would have been essential to anonymous types!

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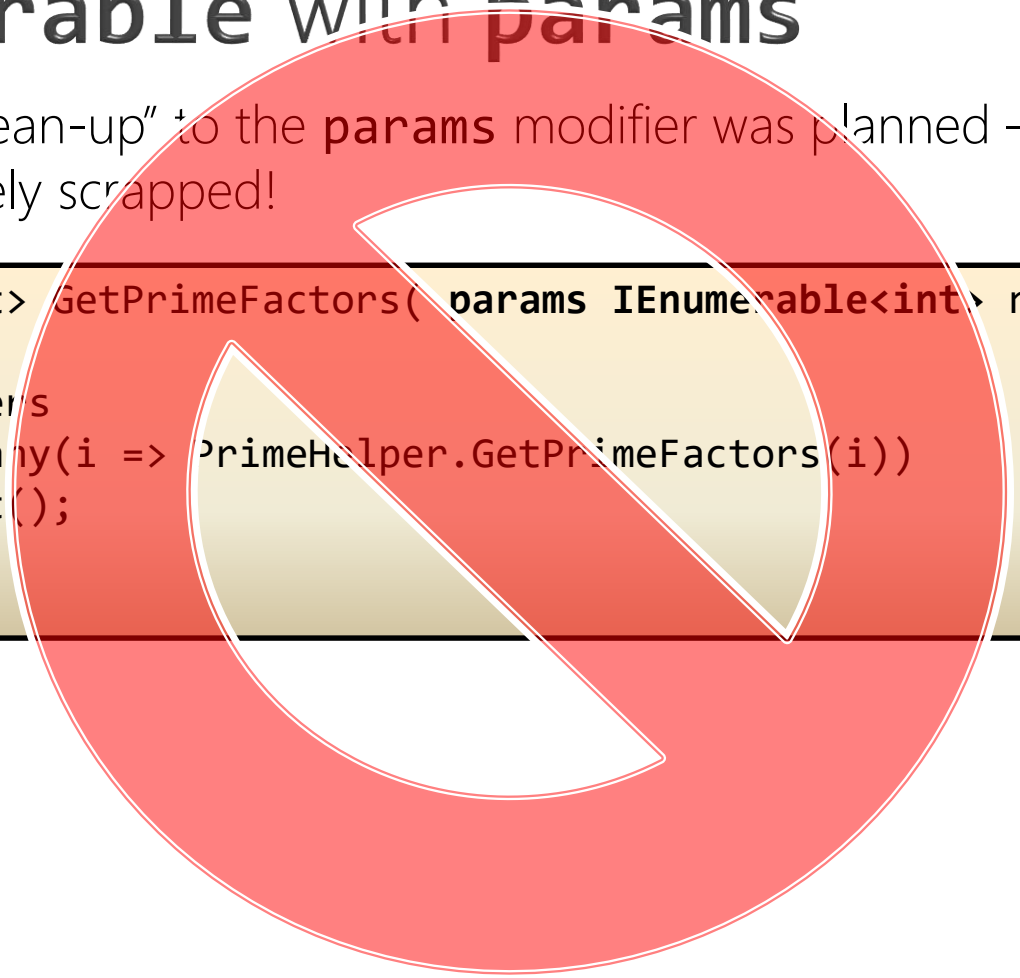
Scrapped: **IEnumerable** with **params**

- A minor "clean-up" to the **params** modifier was planned – but unfortunately scrapped!

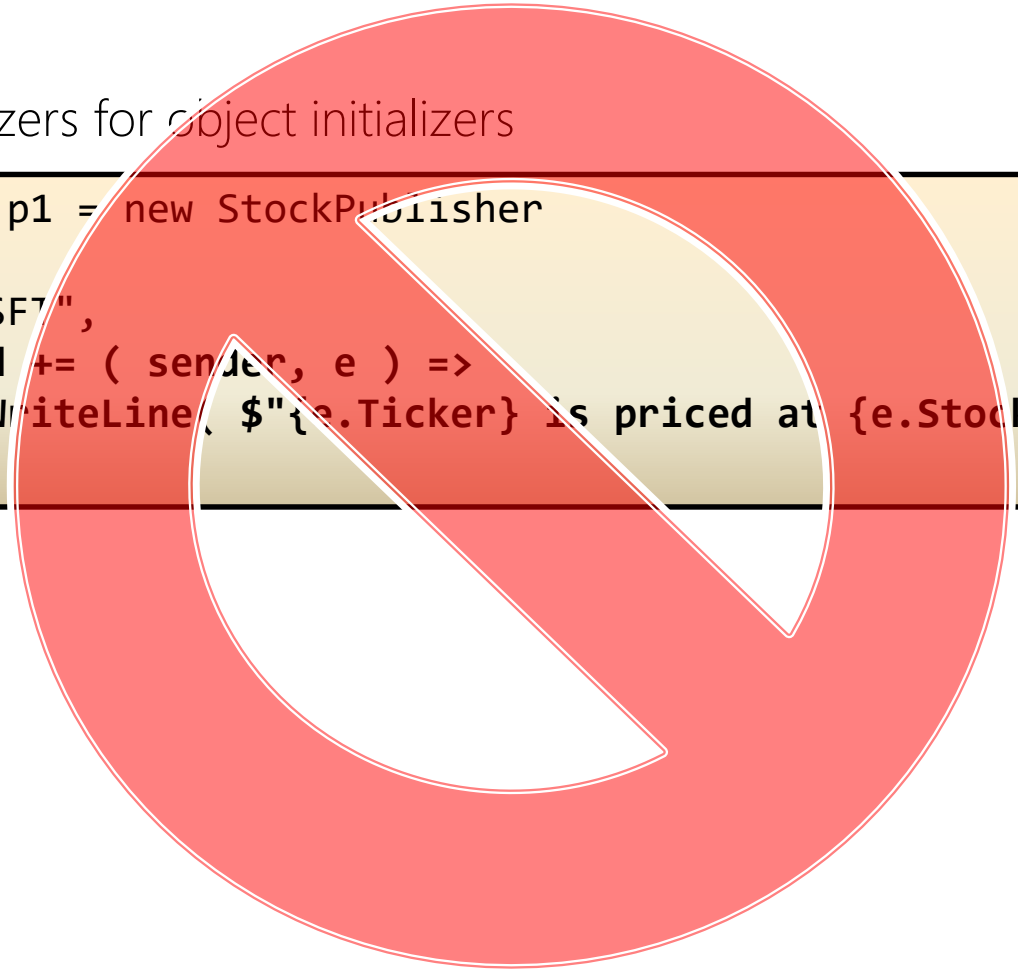
```
IEnumerable<int> GetPrimeFactors( params IEnumerable<int> numbers)
{
   return numbers
      .SelectMany(i => PrimeHelper.GetPrimeFactors(i))
      .Distinct();
}
```



Scrapped: Event Initializers

- Event initializers for object initializers

```
StockPublisher p1 = new StockPublisher
{
   Ticker = "MSFT",
   StockChanged += ( sender, e ) =>
      Console.WriteLine( $"{e.Ticker} is priced at {e.StockValue:f2}")
}
```



Scrapped: Binary Literals and Numeric Separators

- Event initializers for object initializers

```
public enum FileAttributes
{
    ReadOnly =          0b00_00_00_00_00_00_01, // 0x0001
    Hidden =            0b00_00_00_00_00_00_10, // 0x0002
    System =            0b00_00_00_00_00_01_00, // 0x0004
    Directory =         0b00_00_00_00_00_10_00, // 0x0010
    Archive =           0b00_00_00_00_01_00_00, // 0x0020
    Device =            0b00_00_00_00_10_00_00, // 0x0040
    Normal =            0b00_00_00_01_00_00_00, // 0x0080
    Temporary =         0b00_00_00_10_00_00_00, // 0x0100
    SparseFile =        0b00_00_01_00_00_00_00, // 0x0200
    ReparsePoint =      0b00_00_10_00_00_00_00, // 0x0400
    Compressed =        0b00_01_00_00_00_00_00, // 0x0800
    Offline =           0b00_10_00_00_00_00_00, // 0x1000
    NotContentIndexed = 0b01_00_00_00_00_00_00, // 0x2000
    Encrypted =         0b10_00_00_00_00_00_00  // 0x4000
}
```

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Lab 8: Write Less Code in C# 6.0

- Lab 8.1

Discussion and Review

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