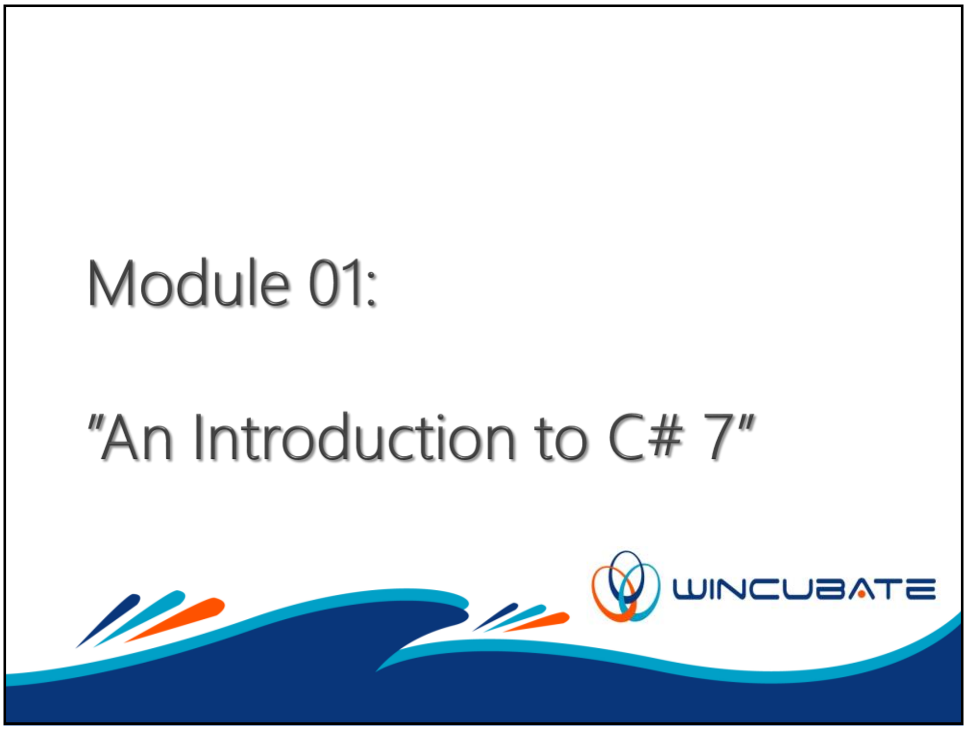
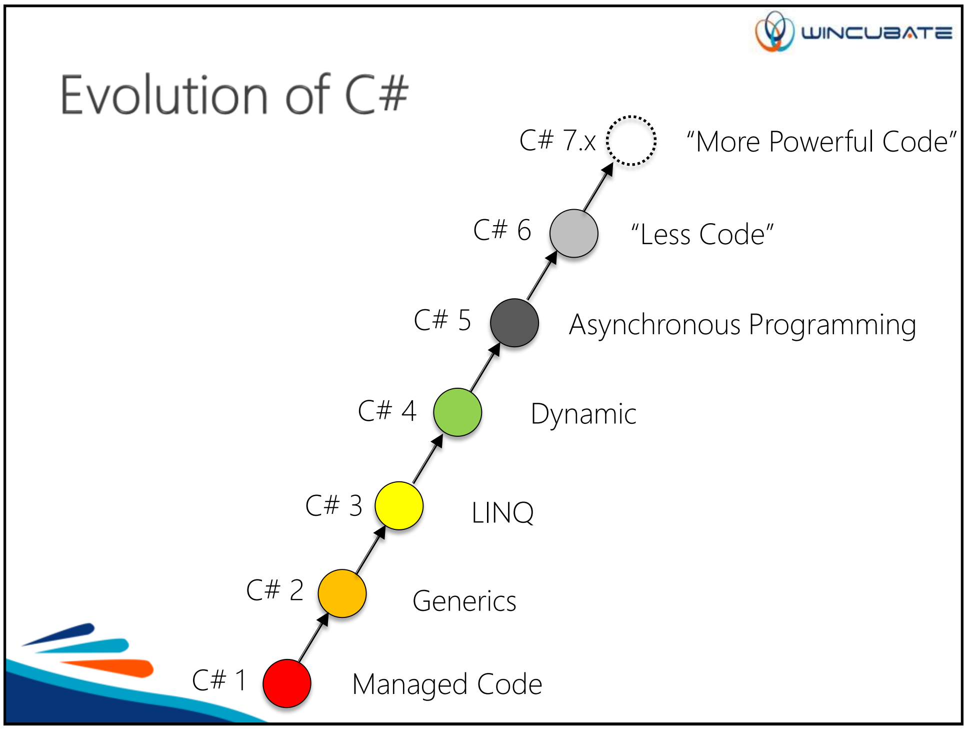


Module 01:

"An Introduction to C# 7"



Evolution of C#

Agenda

- Introduction
- **Value Tuples and Syntax**
- Pattern Matching
- Method Improvements
- Expression Improvements

Introducing Tuples

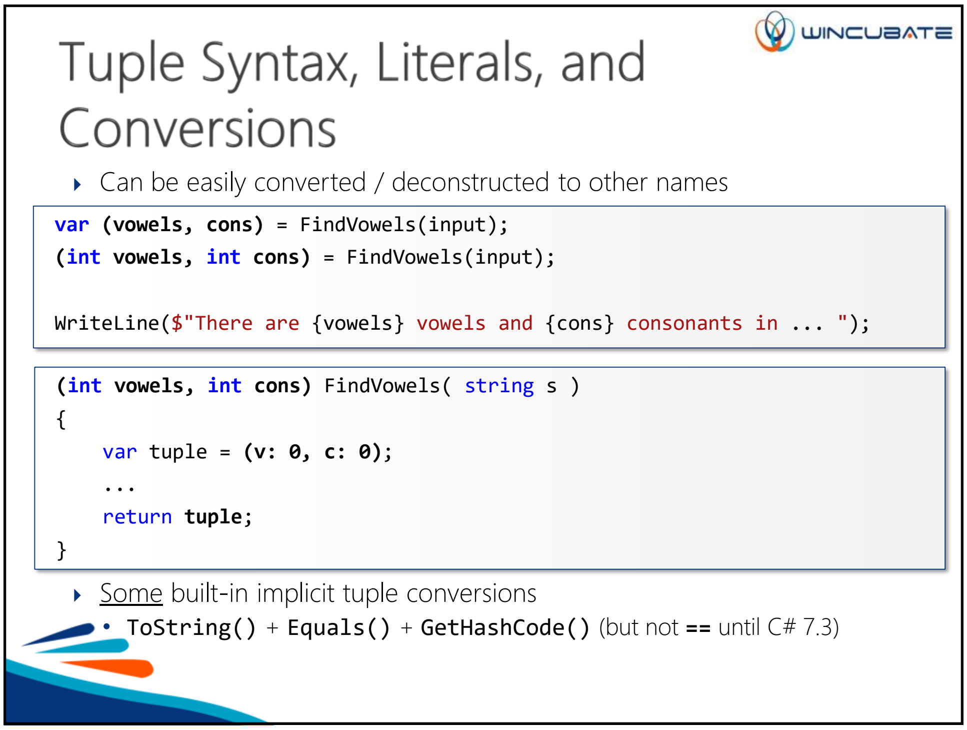
- Not the `Tuple<T1,T2>` type already in .NET 4.0
  - Instead it is a value type with dedicated syntax

```
(int, int) FindVowels( string s )
{
   int v = 0;
   int c = 0;
   foreach (char letter in s)
   {
      ...
   }
   return (v, c);
}
```

```
string input = ReadLine();

var t = FindVowels(input);
WriteLine($"There are {t.Item1} vowels and
 {t.Item2} consonants in \"{input}\"");
```

- Note
  - In .NET 4.6.* projects you must manually add reference to the `System.ValueTuple` nuget package



Tuple Syntax, Literals, and Conversions

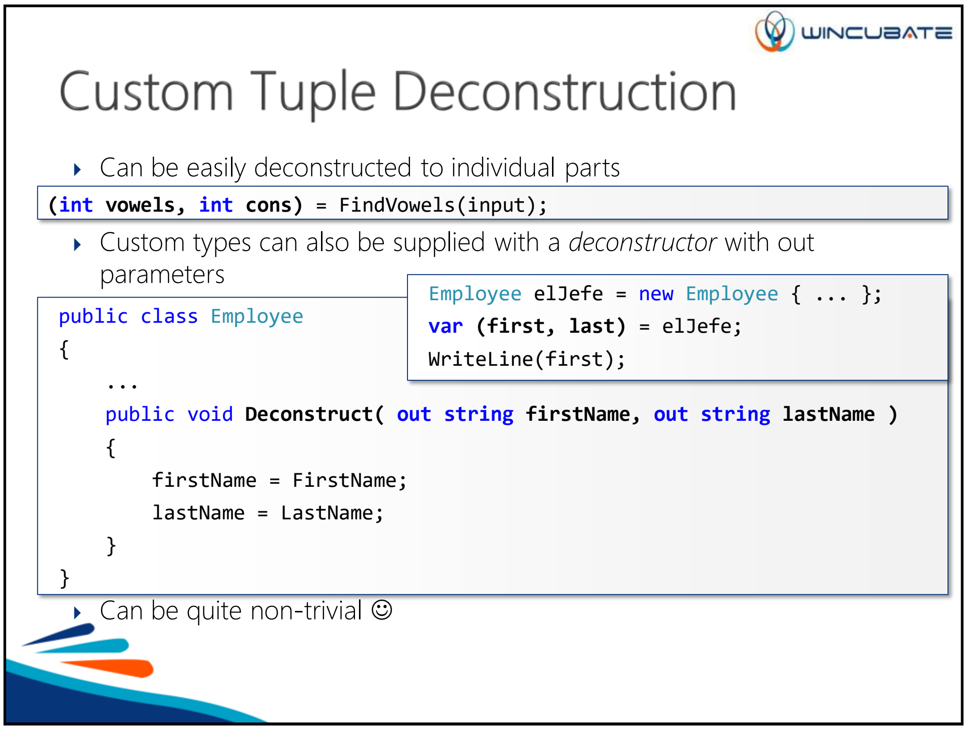
- Can be easily converted / deconstructed to other names

```
var (vowels, cons) = FindVowels(input);
(int vowels, int cons) = FindVowels(input);

WriteLine($"There are {vowels} vowels and {cons} consonants in ... ");
```

```
(int vowels, int cons) FindVowels( string s )
{
    var tuple = (v: 0, c: 0);
    ...
    return tuple;
}
```

- Some built-in implicit tuple conversions
  - `ToString()` + `Equals()` + `GetHashCode()` (but not **==** until C# 7.3)



Custom Tuple Deconstruction

- Can be easily deconstructed to individual parts

```
(int vowels, int cons) = FindVowels(input);
```

- Custom types can also be supplied with a *deconstructor* with out parameters

```
Employee elJefe = new Employee { ... };
var (first, last) = elJefe;
WriteLine(first);
```

```
public class Employee
{
    ...
    public void Deconstruct( out string firstName, out string lastName )
    {
        firstName = FirstName;
        lastName = LastName;
    }
}
```

- Can be quite non-trivial ☺

Agenda

- Introduction
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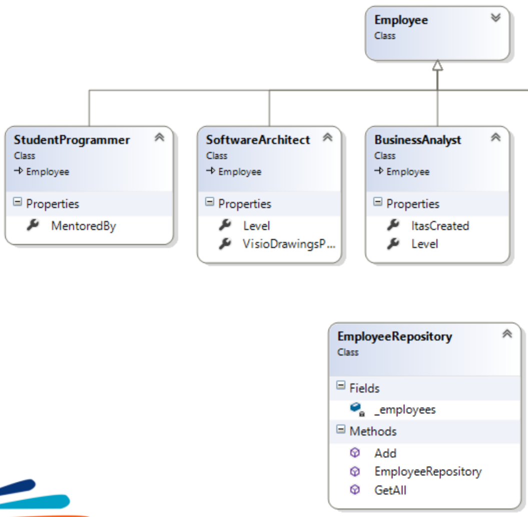
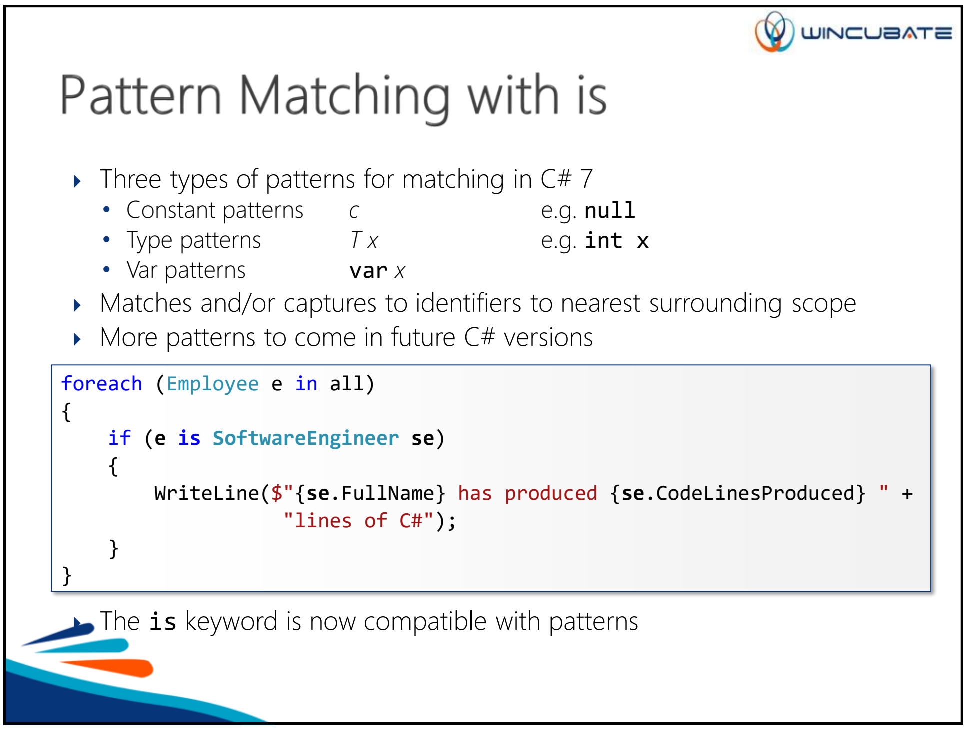
Example: Employee





Pattern Matching with is

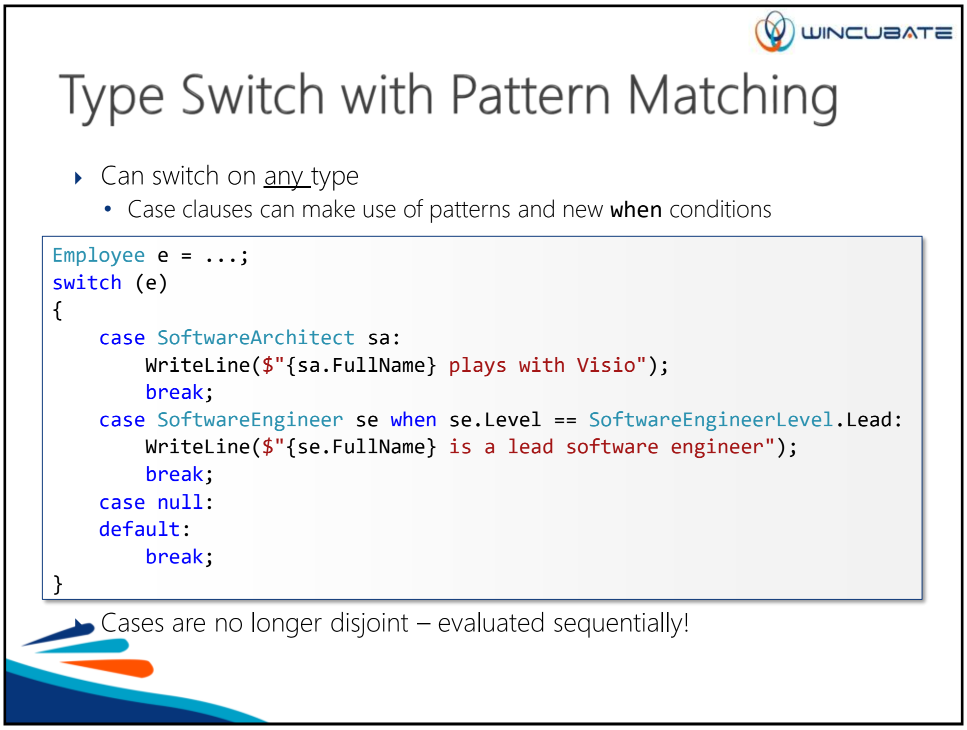
- Three types of patterns for matching in C# 7

• Constant patterns	*c*	e.g. `null`
• Type patterns	*T x*	e.g. `int x`
• Var patterns	`var` *x*	

- Matches and/or captures to identifiers to nearest surrounding scope
- More patterns to come in future C# versions

```
foreach (Employee e in all)
{
    if (e is SoftwareEngineer se)
    {
        WriteLine($"{se.FullName} has produced {se.CodeLinesProduced} " +
                  "lines of C#");
    }
}
```

- The **is** keyword is now compatible with patterns



Type Switch with Pattern Matching

- Can switch on <u>any</u> type
  - Case clauses can make use of patterns and new **when** conditions

```
Employee e = ...;
switch (e)
{
    case SoftwareArchitect sa:
        WriteLine($"{sa.FullName} plays with Visio");
        break;
    case SoftwareEngineer se when se.Level == SoftwareEngineerLevel.Lead:
        WriteLine($"{se.FullName} is a lead software engineer");
        break;
    case null:
    default:
        break;
}
```

- Cases are no longer disjoint – evaluated sequentially!

Agenda

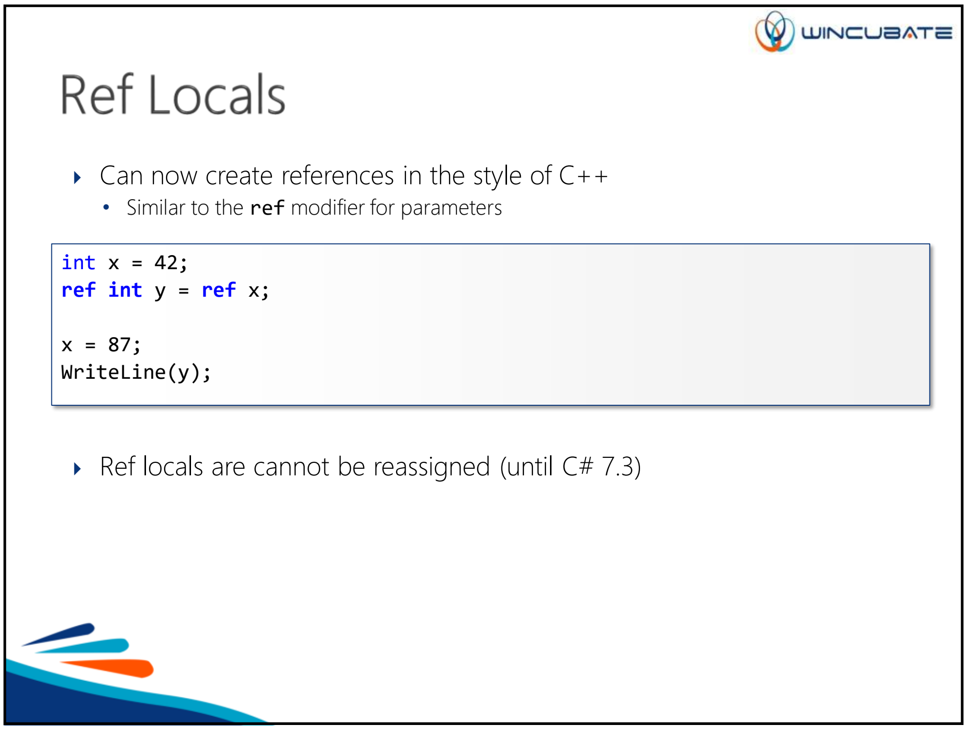
- Introduction
- Value Tuples and Syntax
- Pattern Matching
- **Method Improvements**
- Expression Improvements

Local Functions

- Methods within methods can now be defined

```
(int vowels, int cons) FindVowels( string s )
{
    ...
    foreach (char letter in s)
    {
        bool IsVowel( char letter )
        {
            ...
        }
       ...
    }
    return tuple;
}
```

- Has some advantages
  - Captures local variables
  - Avoids allocations



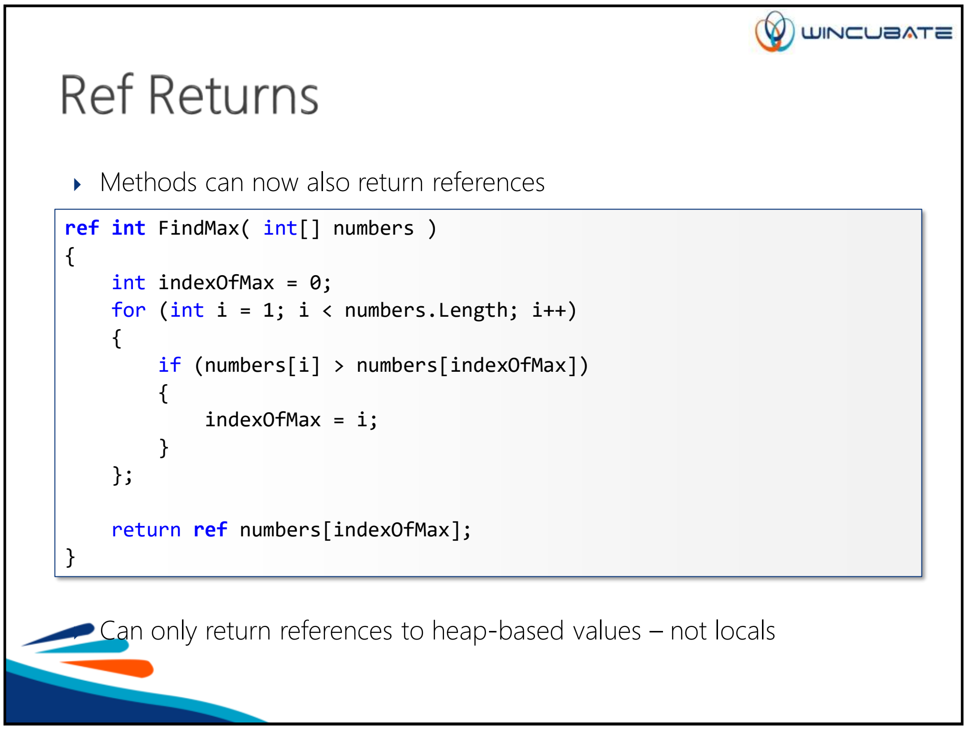
Ref Locals

- Can now create references in the style of C++
  - Similar to the **`ref`** modifier for parameters

```
int x = 42;
ref int y = ref x;

x = 87;
WriteLine(y);
```

- Ref locals are cannot be reassigned (until C# 7.3)



Ref Returns

- Methods can now also return references

```
ref int FindMax( int[] numbers )
{
    int indexOfMax = 0;
    for (int i = 1; i < numbers.Length; i++)
    {
        if (numbers[i] > numbers[indexOfMax])
        {
            indexOfMax = i;
        }
    };

    return ref numbers[indexOfMax];
}
```

- Can only return references to heap-based values – not locals

Agenda

- Introduction
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- **Expression Improvements**

More Expression-bodied Members

- Earlier only getters and methods could be expression-bodied

```
public class Person
{
    ...
    public Person( string name ) => Names.Add(_id, name);

    ~Person() => Names.Remove(_id);

    public string Name
    {
        get => Names[_id];
        set => Names[_id] = value;
    }
}
```

- New in C# 7.0
  - Constructors
  - Destructors
  - Setters

Throw Expressions

- In C# 6 one could not easily just throw an exception in an expression-bodied member
- C# 7 allows **`throw`** expressions as subexpressions
  - Also outside of expression-bodied members..!

```
public class EmployeeRepository : IEmployeeRepository
{
    private readonly IList<Employee> _employees;
    ...
    public void Add( Employee employee ) =>
        _employees.Add(employee ??
            throw new ArgumentNullException(nameof(employee)));
}
```

- Note that a **`throw`** expression does not have an expression type as such…

Declaration Expressions: `out var`

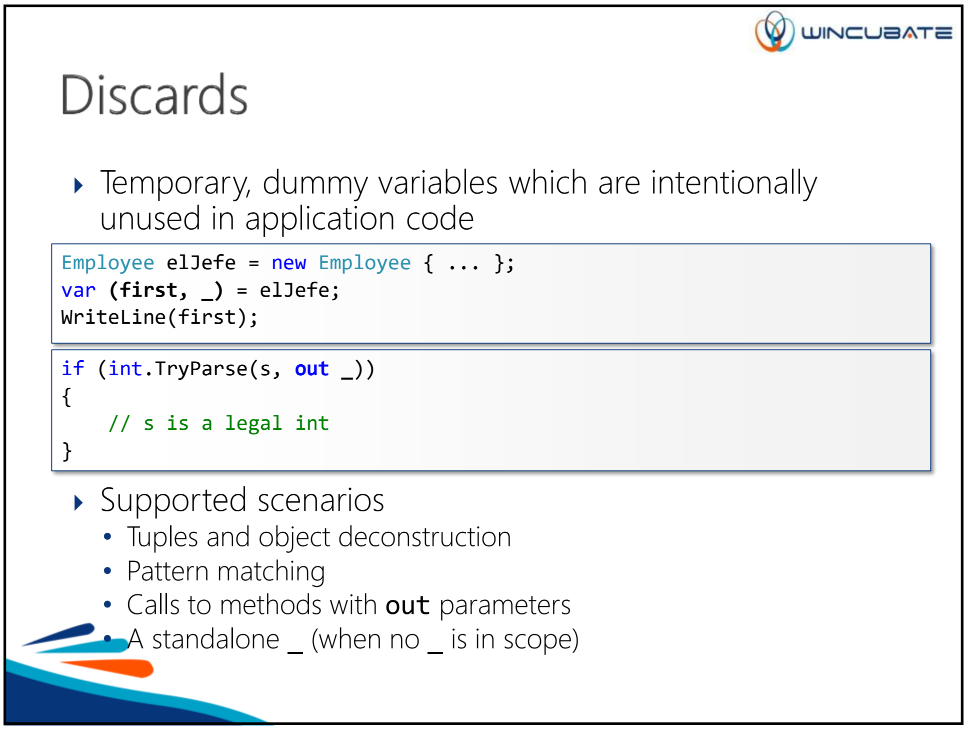
- Introduces local variable in nearest surrounding scope
  - Limitation of general declaration expressions which were scrapped for C# 6

```
string s = ReadLine();
int result;
if (int.TryParse(s, out result))
{
    WriteLine(result);
}
```

- VS 2017 has a handy refactoring for this

```
string s = ReadLine();
if (int.TryParse(s, out int result))
{
    WriteLine(result);
}
```

- Note: **`return var`** is still not in C# 7 ☺



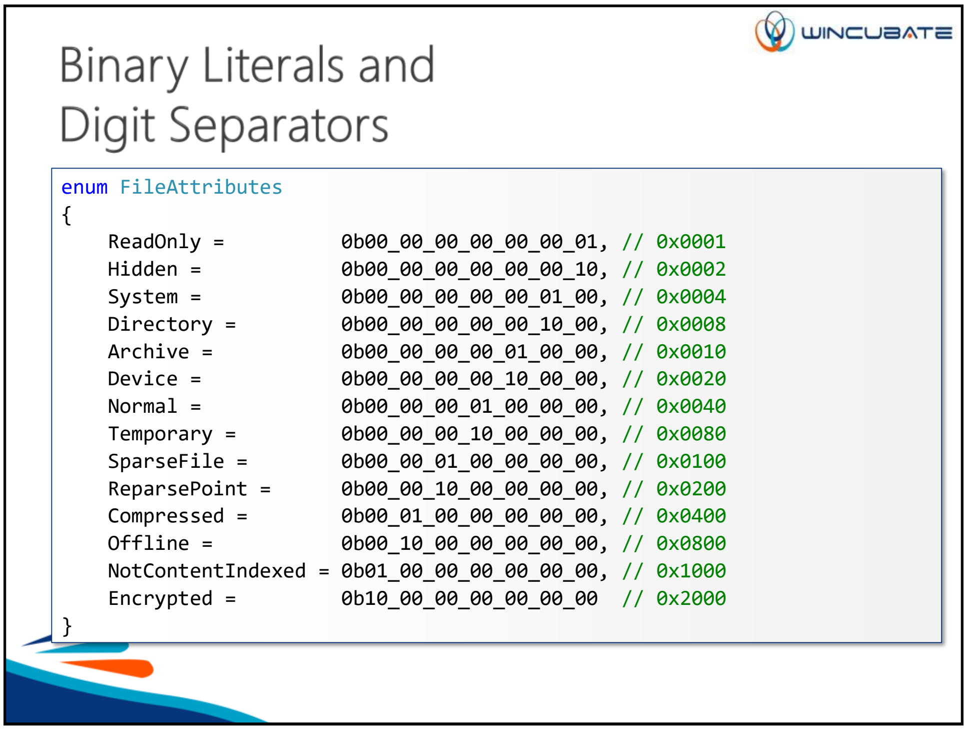
Discards

- Temporary, dummy variables which are intentionally unused in application code

```
Employee elJefe = new Employee { ... };
var (first, _) = elJefe;
WriteLine(first);
```

```
if (int.TryParse(s, out _))
{
    // s is a legal int
}
```

- Supported scenarios
  - Tuples and object deconstruction
  - Pattern matching
  - Calls to methods with **out** parameters
  - A standalone _ (when no _ is in scope)



Binary Literals and Digit Separators

```
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, // 0x0008
    Archive =           0b00_00_00_00_01_00_00, // 0x0010
    Device =            0b00_00_00_00_10_00_00, // 0x0020
    Normal =            0b00_00_00_01_00_00_00, // 0x0040
    Temporary =         0b00_00_00_10_00_00_00, // 0x0080
    SparseFile =        0b00_00_01_00_00_00_00, // 0x0100
    ReparsePoint =      0b00_00_10_00_00_00_00, // 0x0200
    Compressed =        0b00_01_00_00_00_00_00, // 0x0400
    Offline =           0b00_10_00_00_00_00_00, // 0x0800
    NotContentIndexed = 0b01_00_00_00_00_00_00, // 0x1000
    Encrypted =         0b10_00_00_00_00_00_00  // 0x2000
}
```

Summary

- Introduction
- Value Tuples and Syntax
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- Method Improvements
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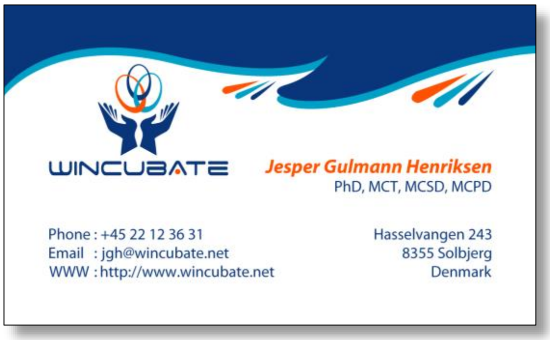
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