Module 13

”Advanced C# Language Features”

TEKNOLOGISK
INSTITUT

Agenda

- Indexers
- Extension Methods
- Anonymous Types
- Value Tuples
- Local Functions
- Lab 13
- Discussion and Review

Defining Indexers

- You can create "array-like" indexing of your own classes using *indexers*

```
class Garage
{
   private List<Car> list;
   ...
   public Car this[ int index ]
   {
      get { return list[ index ]; }
      set { list[ index ] = value;
   }
}
```

```
Garage garage = new Garage();
Console.WriteLine( garage[1] );
garage[1] = new Car("Goofy", 87);
foreach( Car car in garage )
{
   Console.WriteLine( car );
}
```

- This is basically the syntax of a special property named **`this`** but with square brackets used instead of parentheses

Indexing Objects Using Strings

- You can create indexers on your own types with any indexing type – not just integers!

```
public Car this[ string index ]
{
   get { return list.Find( c => c.PetName == index ); }
   set {
      int i = list.FindIndex( c => c.PetName == index );
      if( i >= 0 ) { list[ i ] = value; }
      else { list.Add( value ); }
   }
}
```

```
Garage garage = new Garage();
Console.WriteLine( garage[ "Zippy" ] );
garage[ "Goofy" ] = new Car( "Goofy", 87 );
```

- Note that indexers can be overloaded in the same manner as methods!

Variations on Indexers

- Indexers can be multi-dimensional

```
class GridWrapper : IEnumerable
{
   private int[ , ] grid = new int[ 3, 3
   public int this[ int row, int column ]
      get { return grid[ row, column ]; }
      set { grid[ row, column ] = value;
   }
}
```

```
GridWrapper gw = ...;
gw[ 0, 0 ] = 87;

foreach( int i in gw )
{
   Console.WriteLine( i );
}
```

- Indexers can be members of interfaces

```
public interface IMyStringContainer<T>
{
   string this[ T index ] { get; set; }
}
```

- Indexers can be virtual and generic

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Defining Extension Methods

- *Extension methods* let you extend types with your own methods
  - Even if you don’t have the source or the types are not yours

```
static class MyExtensions
{
   public static string ToMyTimestamp( this DateTime dt )
   {
      return dt.ToString( "yyyy-MM-dd HH:mm:ss.fff" );
   }
}
```

- Must be **static** and defined in a **static** class
- The first parameter contains **this** and determines the type being extended

- Extension methods can have any number of parameters

Invoking Extension Methods

- Extension methods can be invoked at the instance level

```
DateTime dt = DateTime.Now;
Console.WriteLine( dt.ToMyTimestamp() );
```

- Alternatively, the method can be invoked statically

```
DateTime dt = DateTime.Now;
Console.WriteLine( MyExtensions.ToMyTimestamp( dt ) );
```

- Visual Studio has special IntelliSense for extension methods

Using Extension Methods

- The static class containing the extension methods must be in scope for the extension methods to be used

- Extension methods are indeed extending – not inheriting!
  - No access to private or protected members
  - All access is through the supplied parameter

```
public static string ToMyTimestamp( this DateTime dt )
{
   return dt.ToString( "yyyy-MM-dd HH:mm:ss.fff" );
}
```

- Can extend interfaces as well, but implementation must be provided

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Creating Anonymous Types

- Combining implicitly typed variables with object initializer syntax provides an excellent shorthand for defining simple classes called *anonymous types*

```
var myEquipment = new { Manufacturer = "Nintendo",
                        Make = "Wii",
                        Controllers = 4 };
Console.WriteLine( "I have a {0} {1} with {2} controllers",
   myEquipment.Manufacturer,
   myEquipment.Make,
   myEquipment.Controllers );
```

- The compiler autogenerates an anonymous class for us to use
- This class inherits from **`object`**

- Members are read-only!

Equality of Anonymous Types

- Anonymous types come with their own overrides of **`object`** methods
  - `ToString()`
  - `Equals()`
  - `GetHashCode()`

- The `==` and `!=` operators are however not overloaded with `Equals()`!
  - The exact references are still compared

Restrictions to Anonymous Types

- Anonymous types can be nested arbitrarily

```
var myFancyEquipment = new
{
   Manufacturer = "Microsoft",
   Make = "Xbox One",
   XboxLive = new { Name = "Komatoze",
                    Membership = MembershipType.Gold }
};
```

- Some restrictions do apply to anonymous types
  - Type name is auto-generated and cannot be changed
  - Always derive directly from **`object`**
  - Fields and properties of anonymous types are always read-only
  - Anonymous types are implicitly sealed
  - No possibility of custom methods, operators, overrides, or events

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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} conso
nants in \"{input}\"");
```

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 ... ");
```

```
(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

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

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

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)

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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 and avoids allocations

Quiz: Advanced C# Language Features – Right or Wrong?

```
class Garage
{
   public Car this[ int i, int j ] { ... }
   ...
}
```

```
static class DateTimeExtensions
{
   public static string ToMyTimestamp( DateTime dt ) { ... }
}
```

```
static class PersonExtensions
{
   public static string GetName( this Person p, bool upperCase ) { ... }
}
```

```
Car myCar = new { Color = "Navy", Make = "Saab", CurrentSpeed = 55 };
```

Lab 13: Advanced C# Language Features

Discussion and Review

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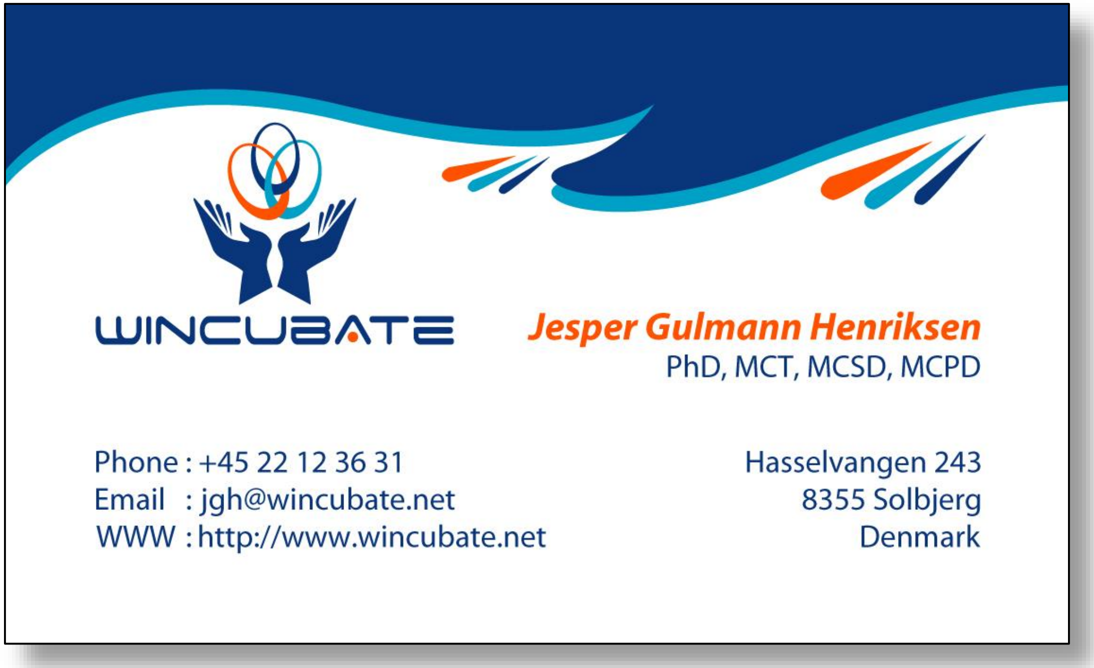

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