Module 7

"Properties and Static Methods"

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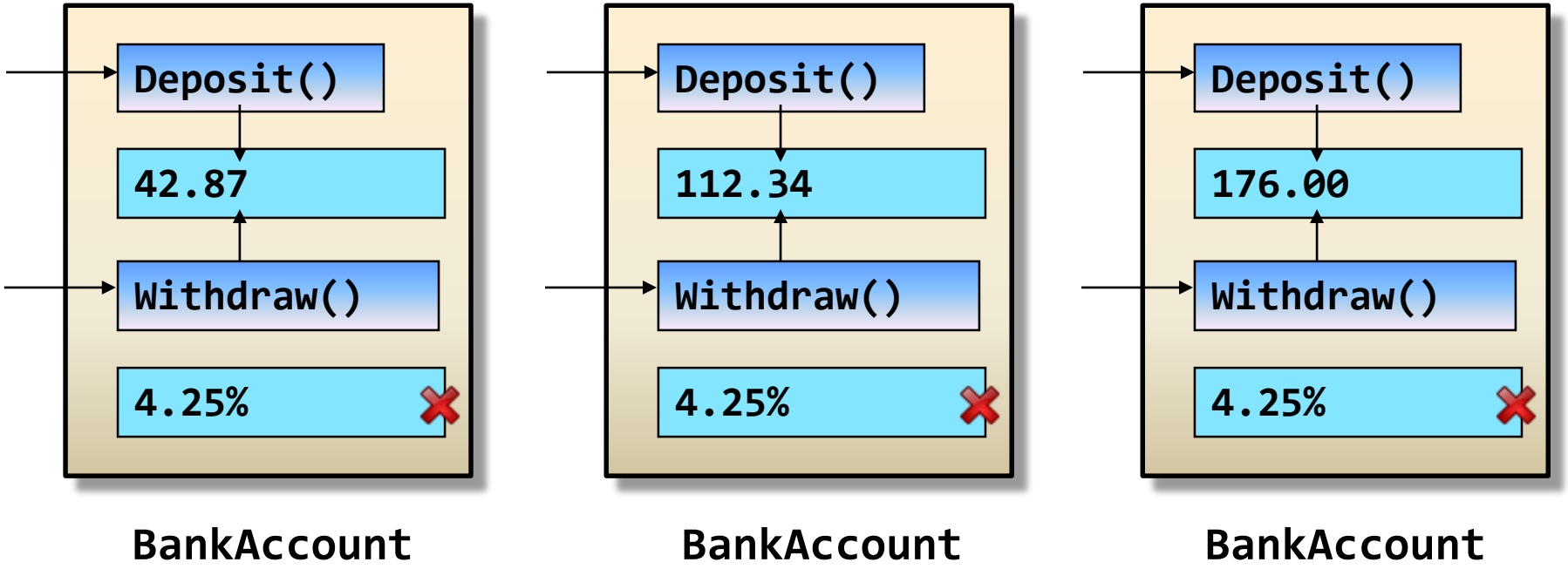
Agenda

- Static Classes and Members
- Properties and Initializers
- Lab 7
- Discussion and Review

Introducing Static Data

- Static data captures information shared between all the objects of a class



Static Data

- With instance data each object maintains an independent copy
- Class data can be *static*, i.e. shared among all instances

```
class BankAccount
{
   private decimal _currentBalance;
   public static decimal CurrentInterestRate = 0.04m;

   public BankAccount( decimal balance )
   {
      _currentBalance = balance;
   }
}
```

- Refers to the same physical in-memory location!

Static Methods

- Static data should be manipulated by static methods

```
class BankAccount
{
   ...
   public static decimal CurrentInterestRate = 0.04m;

   public static void SetInterestRate( decimal interestRate )
   {
      CurrentInterestRate = interestRate;
   }
}
```

- Invoke static methods via class name instead of instance name!

```
BankAccount.SetInterestRate( 0.06m );
```

Static Constructors

- Initializing static data should be done in static constructors

```
class BankAccount
{
   public static decimal CurrentInterestRate;

   static BankAccount()
   {
      CurrentInterestRate = 0.04m; // This could be dynamic!
   }
}
```

- Only one static constructor for each class
- Has no access modifier and no parameters
- Invoked by the runtime system before first instance constructor
- Invoked <u>exactly once</u> regardless of number of objects created

Static Classes

- Classes themselves can also be static

```
static class TimeUtility
{
   public static void PrintTime()
   {
      Console.WriteLine( DateTime.Now.ToShortTimeString() );
   }
   public static void PrintDate()
   {
      Console.WriteLine( DateTime.Today.ToShortDateString() );
   }
}
```

- Cannot be instantiated

```
TimeUtility tu = new TimeUtility();
```

- Can only contain static fields and methods

Static Usings

- Static members can now be imported with **`using static`**

```
using static System.Console;

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

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- **Properties and Initializers**
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Properties

- Encapsulation is achieved by *Properties*

```
class Button
{
   public string Caption
   {
      get { return _caption; }
      set { _caption = value; }
   }
   private string _caption;
}
```

```
Button button = new Button();
button.Caption = "Click!!";

Console.WriteLine( button.Caption );
```

- Two specific accessors
  - get is invoked when retrieving the value
  - set is invoked when setting the value

Visibility of Get/Set

- Access modifiers can be set for **get** and **set** separately

```
class Button
{
   public string Caption
   {
      get { return _caption; }
      private set { _caption = value; }
   }
   private string _caption;
}
```

```
Button button = new Button();
Console.WriteLine( button.Caption );

button.Caption = "Click!!";
```

Read-Only and Write-Only Properties

- Property can be made read-only by omitting **`set`**
- Property can be made write-only by omitting **`get`**

```
class Button
{
   public string Caption
   {
      get { return _caption; }
      // No set!
   }
   private string _caption;
}
```

```
class Login
{
   public string Password
   {
      // No get!
      set { _password = value; }
   }
   private string _password;
}
```

- Properties can also be static

Defining Automatic Properties

- Automatic properties ease the burden of defining “trivial” properties

```
class Car
{
   public string PetName
   {
      get { return _petName; }
      set { _petName = value; }
   }
   private string _petName = string.Empty;
}
```

```
class Car
{
   public string PetName { get; set; }
}
```

Auto-property Initializers

- Since C# 6.0 Initializers can be supplied for the automatic properties

```
class Car
{
    public string PetName { get; set; } = "Chuck";
    public int CurrentSpeed { get; set; } = 0;
}
```

- Otherwise, default value of an automatic property is the usual "zero-whitewash"
  - Reference types are null
  - Integers are 0
  - Booleans are false
  - …
- Note: Structs still cannot have initializers!

Getter-only Auto-properties

- Moreover, the automatic properties can in C# 6.0 be getter- or setter-only

```
class Car
{
    public string PetName { get; } = "Chuck";
    public int CurrentSpeed { get; set; } = 0;
    public DateTime LastUpdated { 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!

Restricting Access to Automatic Properties

- Use access modifiers on <u>at most one(!)</u> of the get or set accessors

```
class Car
{
   public string PetName { private get; private set; }
}
```

```
class Car
{
   public string PetName { get; private set; }
}
```

- Note: Neither get nor set can be more visible than the parent property

Object Initializer Syntax

- Object initializer syntax can be used to assign values for public properties and fields during construction

```
Point p = new Point { X = 42, Y = 87 };
Console.WriteLine( "p is {0}", p );
```

- Custom constructors can be invoked as well

```
Point q = new Point( 16, 24 ) { X = 112 };
Console.WriteLine( "q is {0}", q );
```

- Object initializers execute after constructors
- Object initializers can initialize any subset of available properties and fields

Initializing Inner Types and Collections

- Inner types can now be conveniently initialized

```
public class Rectangle
{
   public Point TopLeft { get; set; }
   public Point BottomRight { get; set; }
   ...
}
```

```
Rectangle r = new Rectangle
{
   TopLeft = new Point { X = 10, Y = 10 },
   BottomRight = new Point { X = 90, Y = 90 }
};
Console.WriteLine( r );
```

Constant Data

- Data is deemed constant by using the **`const`** keyword

```
class MyMathClass
{
   public const double Pi = 3.14;
}
```

```
Console.WriteLine( MyMathClass.Pi );

MyMathClass.Pi = 22 / 7;
```

- Such data cannot be changed!

- Curious fact: Constant fields are implicitly static

Read-only Data

- Read-only data can <u>only be set in constructors</u>

```
class MyMathClass
{
   public MyMathClass()
   {
      if( DateTime.Today.Day % 2 == 0 )
      {
         TodaysPi = 3.14;
      }
      else
      {
         TodaysPi = 22.0 / 7;
      }
   }
   public readonly double TodaysPi;
}
```

```
MyMathClass m = new MyMathClass();
Console.WriteLine( m.TodaysPi );

m.TodaysPi = 4.00;
```

```
public void SetTodaysPi( double tp )
{
   TodaysPi = tp;
}
```

Methods vs. Properties

- Properties are somewhere in between public member variables and methods
- Methods
  - Defined and invoked using parenthesis
  - Might take parameters
- Properties
  - Defined and invoked without parenthesis
  - No additional parameters: Gets or sets a single value

```
class BankAccount
{   ...
    public decimal GetBalance()
    {
        return _balance;
    }
}
```

```
BankAccount ba = ...;
decimal d = ba.GetBalance();
```

```
class BankAccount
{   ...
    public decimal Balance
    {
        get { return _balance; }
    }
}
```

```
BankAccount ba = ...;
decimal d = ba.Balance;
```

Quiz: Properties and Static Members – Right or Wrong?

```
class Car
{
   public static int SpeedLimit;
   public string PetName;
   public int CurrentSpeed;
}
```

```
class Point
{
   public int X { get; set; }
   public int Y { get; set; }
}
```

```
class Person
{
   public int Id { private get; }
}
```

```
Car c;
c.SpeedLimit = 50;
```

```
Car c = new Car();
c.SpeedLimit = 50;
```

```
Car.SpeedLimit = 50;
```

```
Point p = new Point();
p.X = 42;
p.Y = 87;
```

```
Point p = new Point{ X = 42 };
```

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Lab 7: Encapsulating Data

Discussion and Review

- Static Classes and Members
- Properties and Initializers

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