Dependency in action

A look at how dependency is used in modern programming languages

Antony Harfield
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Tessella
Technology & Consulting

My current work

A bit of history

- A long time ago, before .NET existed…

The rise of WPF

- Windows Presentation Foundation is Microsoft's latest API for creating Windows applications
- Much richer interfaces than existing Windows Forms UIs
- Because it uses DirectX
- WPF 3.5 (in .NET Framework 3.5) is considered mature – reasonable VisualStudio integration

What can you do with WPF?

- Groovy user interfaces!
  - The usual GUI components
  - Rich drawing model for 2D and 3D
  - Animation, audio, video
  - Styles, templating, layouts
- In a variety of formats:
  - Traditional windows application
  - Packaged web app
  - Silverlight RIAs (Rich Internet Applications)

How do you write WPF applications?

- User interfaces can be written in XML, using a language called XAML
- Code behind in any of the CLR languages (C#, VB.NET, etc)

- Or you could write it all in code – but XAML is much cleaner and allows you to separate your presentation logic from your business logic

WPF Example

```
<Window x:Class="CoolShapedWindow.Mickey"
   xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
   xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
   Title="Mickey" AllowsTransparency="True" WindowStyle="None"
    Background="Transparent">
   <Grid>
      <Image Source="famousmouse.png"
           MouseLeftButtonDown="Image_MouseLeftButtonDown"
           MouseRightButtonDown="Image_MouseRightButtonDown"/>
   </Grid>
</Window>
```

CoolShapedWindow.exe

EM technologies and WPF

- What is the connection between WPF and EDEN/DOSTE/ADM?

- Dependency!
- Or more precisely, Microsoft's implementation of .NET dependency properties

Normal properties

- In OOP, classes usually have fields and methods
- But in .NET classes also have 'properties' that wrap getters and setters:

```
private String name;
public String Name {
        get { return name; }
        set { name = Value; }
}
```

Dependency properties

- Look like normal properties, but…
- Support change notification -> dependency
  - Bind one property to another
  - Triggered actions
- Default value inheritance
- Efficient storage

Dependency properties

- Most properties in WPF are dependency properties
- Therefore you can create dependencies between almost every aspect of your GUI
- You can create dependency properties in your custom classes so that you can make your GUI 'depend' upon your business objects

Binding

- A ‘binding’ is what creates the actual dependency
- For example:

```
<Slider Name=“SourceSlider" Value="20" />

 <TextBlock Name=“TargetTextBlock“
       Text="Hello Warwick!“
       FontSize="{Binding ElementName=SourceSlider, Path=Value}"/>
```

GettingStartedWithDataBinding.exe

Binding

- Equivalent binding in code:

```
Binding binding = new Binding();
binding.Source = SourceSlider;
binding.Path = new PropertyPath(“Value”);
binding.Mode = BindingMode.OneWay;
TargetTextBlock.SetBinding(FontSize, binding);
```

- Binding is nothing new: it has been used to bind domain objects to user interfaces for some time
- But (I think) WPF has brought out (or will bring out) the power of binding…

Examples

- Simple dependency
- Two way dependency
- Triggers
- Animation

Examples

```
<Window …
  Title="{Binding ElementName=MyTextBox, Path=Text}">

   <StackPanel>
     <TextBox Name="MyTextBox" />

     <TextBlock Name="MyTextBlock" Text="{Binding
  ElementName=MyTextBox, Path=Text}" />
…
```

GettingStartedWithDataBinding.exe

Examples (two-way binding)

```
<Slider Name="FontSizeSlider" Minimum="10" Maximum="50"
  Value="20" Margin="3" />
<TextBlock Name="MyTextBlock" Text="Hello World!"
  FontSize="{Binding ElementName=FontSizeSlider, Path=Value,
  Mode=TwoWay}" Margin="3" />
<StackPanel Orientation="Horizontal">
   <Button Click="Click_SetSliderValue" Margin="5">Set Slider
  Value</Button>
   <Button Click="Click_SetTextBlockFontSize" Margin="5">Set
  TextBlock FontSize</Button>
</StackPanel>
```

GettingStartedWithDataBinding.exe

Examples (triggers)

```
<Style.Triggers>
     <Trigger Property="Control.IsMouseOver" Value="True">
         <Setter Property="Control.Foreground" Value="White" />
         <Setter Property="Control.Background" Value="Red" />
     </Trigger>
</Style.Triggers>
```

UsingTriggers.exe

Examples (animation)

```
<Button Name="MyButton" HorizontalAlignment="Center" Width="100" Height="30">
   <Button.Triggers>
     <EventTrigger RoutedEvent="Mouse.MouseEnter">
       <BeginStoryboard>
         <Storyboard>
           <DoubleAnimation Storyboard.TargetProperty="Width"  To="120" Duration="0:0:1" />
           <DoubleAnimation Storyboard.TargetProperty="Height" To="50"  Duration="0:0:1" />
         </Storyboard>
       </BeginStoryboard>
     </EventTrigger>
     <EventTrigger RoutedEvent="Mouse.MouseLeave">
       <BeginStoryboard>
         <Storyboard>
           <DoubleAnimation Storyboard.TargetProperty="Width"  To="100" Duration="0:0:1" />
           <DoubleAnimation Storyboard.TargetProperty="Height" To="30"  Duration="0:0:1" />
         </Storyboard>
       </BeginStoryboard>
     </EventTrigger>
   </Button.Triggers>
   Button 1
 </Button>
 <ProgressBar Minimum="100" Maximum="120" Value="{Binding ElementName=MyButton, Path=Width}" Height="20"/>
```

UsingAnimations.exe

EM / WPF comparisons

1. Types of dependency
   - WPF has 4 types of binding:
     - One time
     - One way
     - Two way
     - One way to source – nasty
   - EM has one type of dependency
     - E.g. a = b + c

EM / WPF comparisons

2. Complexity of definitions
   - WPF makes it easier to do one-to-one bindings, but ‘multi-bindings’ require a bit code
     - If you want to do a = f(x,y,z) then you need to write an IMultiValueConverter class for your function f
   - EM languages allow functional definitions for dependencies
     - Simply create a definition a = f(x,y,z)

EM / WPF comparisons

3. Triggered actions
   - Unable you to write (ADM-like) definitions such as ‘when this condition occurs, make this state change’
   - WPF has good support (see button hover example)
   - Triggers are fundamental concepts in EM

EM / WPF comparisons

4. User interface layout
   - WPF is really the first technology that encourages laying out your user interface with dependency
     - Make the size and position of your components dependent on each other
   - EM has been doing this for a while, but the graphics were quite primitive
     - Visual effects in WPF are impressive (full power of DirectX)

EM / WPF comparisons

5. Transformations
   - WPF has some support
     - E.g. ‘VisualBrush’ that uses dependency/binding to paint components that are transformed
   - In DoNaLD (Definitive Notation for Line Drawing), there are transformations that fully use the power of dependency

EM / WPF comparisons

6. Animations
   - Very similar ways of doing animation
     - Create an iterator
     - Make positions, sizes, colours, styles dependent on the iterator (or some other component that is dependent on the iterator)

EM / WPF comparisons

7. Interactivity
   - The biggest area of difference!
   - WPF is compiled from XAML/C#
     - The dependencies are fixed
   - EM technologies are interactive environments
     - Dependencies can be changed on-the-fly

EM / WPF summary

- WPF has excellent graphical capabilities
- WPF’s dependency properties allow developers to build software artefacts a little bit more like Empirical Modellers
- BUT…
- The complexity of the definitions and types of dependency could be much better
- It is never going to be an interactive environment

Flex has dependency too

But not dependency properties…

```
<?xml version="1.0" encoding="utf-8"?>
<mx:Application
   xmlns:mx="http://www.adobe.com/2006/mxml"
   layout="vertical">
   <mx:TextInput id="input" />
   <mx:Label text="{input.text}" />
</mx:Application>
```

Binding1.swf

Animation through dependency (Flex)

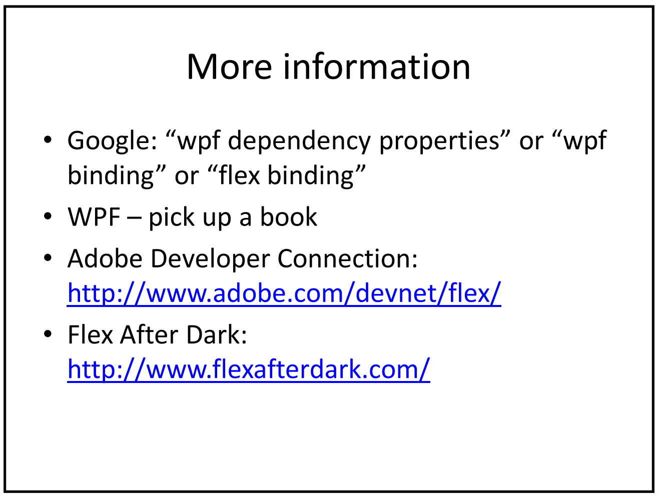
```
<?xml version="1.0" encoding="utf-8"?>
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml"
    creationComplete="init()" layout=“absolute”>
    <mx:Script>
        [Bindable]
        public var counter:int = 0;

        public function init() {
                setInterval(function(){ counter++; }, 1000);
        }
    </mx:Script>
    <mx:Text text="Hello" x="{counter}" scaleY="{counter/10}“
        color="{counter*1024}" />
</mx:Application>
```

FlexDependencyAnimation.swf

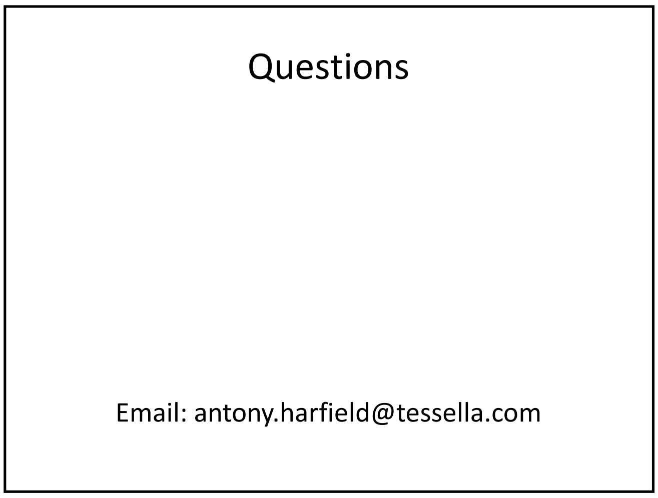
Running the examples

- To run the WPF examples you will need Visual Studio 2008
  - Create new project -> WPF Application
- To run the Flex examples you can download a trial version of Flex Builder from Adobe



More information

- Google: “wpf dependency properties” or “wpf binding” or “flex binding”
- WPF – pick up a book
- Adobe Developer Connection: http://www.adobe.com/devnet/flex/
- Flex After Dark: http://www.flexafterdark.com/



Questions

Email: antony.harfield@tessella.com