Introduction to C#, Visual Studio and Windows Presentation Foundation

Lecture #3: C#, Visual Studio, and WPF

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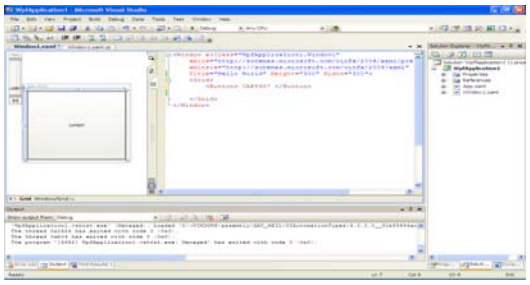
C#

- Combination of C++ and Java
  - no pointer manipulation
  - built in data structures – Lists, Hash tables
  - some higher level constructs
    - foreach
  - C# not difficult
  - .NET high learning curve
  - Intellisense makes things much easier
- Quick C# Reference

Visual Studio 2008

- Good IDE
  - debugging
  - Intellisense
- Handles WPF well
- Visual UI designer
  - Integrates with XAML



Windows Presentation Foundation (WPF)

- Latest UI development platform from MSFT
- Integration of
  - INK!!!!
  - 2D graphics
  - 3D graphics
  - video/audio/animation
- Declarative/Procedural programming model
  - XAML
  - C#/Visual Basic/etc…
- Uses retained mode
  - implies scenegraph

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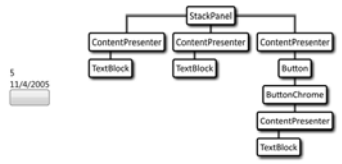
blogs.msdn.com/mgrayson/

WPF Features and Machinery

- Control library
  - buttons, sliders, menus, toolbars
  - tool tips, popups, scroll bars, etc…
  - user defined as well
- Layout panels
  - canvas, stack, wrap, doc panels
  - grid – most flexible
- Actions
  - events
  - commands
  - triggers
- Styles, skins, themes, templates

Logical and Visual Trees in WPF

- UIs are constructed from a tree of objects (logical tree)
- Visual tree expands logical tree
  - nodes broken down into visual components
  - not all logical tree nodes appear in visual tree
    - System.Windows.Media.Visual
    - System.Windows.Media.Visual3D

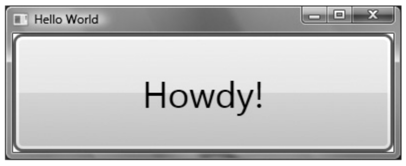


Extensible Application Markup Language (XAML)

- Set of semantics on top of XML
- Tags always defined in context namespace
- Easy to read and write
  - similar to HTML, XHTML
  - declarative
  - want to integrate graphic designers
- Independent of WPF
- Ideal for rapid UI prototyping
  - set up UI then write procedural code

WPF Example – Button

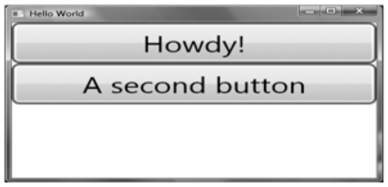
```
<Window
xmlns='http://schemas.microsoft.com/winfx/2006/xaml/presentation
'Title='Hello World'>
<Button>Howdy!</Button>
</Window>
```



Examples adapted from *Essential Windows Presentation Foundation* by Chris Anderson, Addison Wesley, 2007.

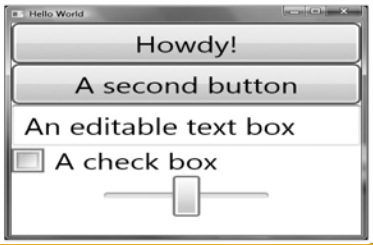
WPF Example – Stack Panel

```
<Window
xmlns='http://schemas.microsoft.com/winfx/2006/xaml/presentation'
Title='Hello World' >
   <StackPanel>
      <Button>Howdy!</Button>
      <Button>A second button</Button>
   </StackPanel>
</Window>
```



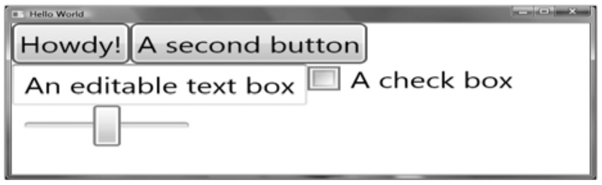
WPF Example – More Controls

```
<Window
xmlns='http://schemas.microsoft.com/winfx/2006/xaml/presentation'
Title='Hello World' >
   <StackPanel>
      <Button>Howdy!</Button>
      <Button>A second button</Button>
      <TextBox>An editable text box</TextBox>
      <CheckBox>A check box</CheckBox>
      <Slider Width='75' Minimum='0' Maximum='100' Value='50' />
  </StackPanel>
</Window>
```



WPF Example – Wrap Layout

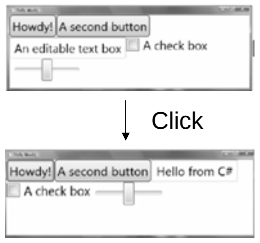
```
<Window
xmlns='http://schemas.microsoft.com/winfx/2006/xaml/presentation'
Title='Hello World' >
   <WrapPanel>
      <Button>Howdy!</Button>
      <Button>A second button</Button>
      <TextBox>An editable text box</TextBox>
      <CheckBox>A check box</CheckBox>
      <Slider Width='75' Minimum='0' Maximum='100' Value='50' />
   </WrapPanel>
</Window>
```



WPF Example – Events

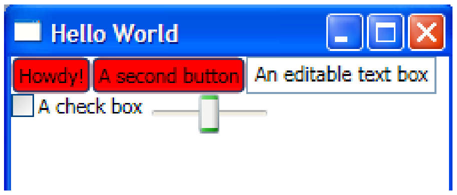
```
<Window
    x:Class='CAP5937Test.MyWindow'
    xmlns:x='http://schemas.microsoft.com/winfx/2006/xaml'
    xmlns='http://schemas.microsoft.com/winfx/2006/xaml/presentation'
    Title='Hello World' >
     <WrapPanel>
        <Button Click='HowdyClicked'>Howdy!</Button>
        <Button>A second button</Button>
        <TextBox x:Name='_text1'>An editable text box</TextBox>
        <CheckBox>A check box </CheckBox>
        <Slider Width='75' Minimum='0' Maximum='100' Value='50' />
     </WrapPanel>
</Window>
```

```
using System;
using System.Windows.Controls;
using System.Windows;
namespace CAP5937Test
 {
     public partial class MyWindow : Window {
           public MyWindow() {
               InitializeComponent();
     }
           void HowdyClicked(object sender, RoutedEventArgs e) {
               _text1.Text = "Hello from C#"; }
        }
 }
```



WPF Example – Resource Binding

```
…
<Window.Resources>
    <SolidColorBrush x:Key='bg' Color='Red' />
</Window.Resources>
    <WrapPanel>
        <Button Background='{StaticResource bg}'
         Click="HowdyClicked"> Howdy!</Button>
        <Button Background='{StaticResource bg}'>A second
button</Button>
…
```

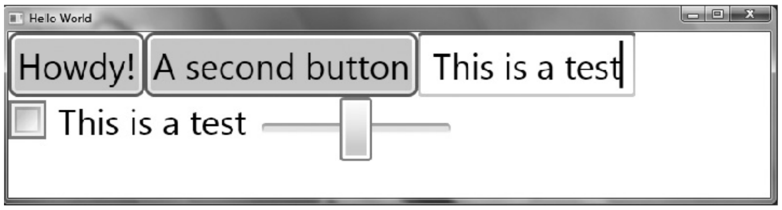


Why use Resource Binding?

- A 3D model can't be added multiple times
  - Must be loaded multiple times or declared as a resource
- Reduces memory footprint, load time

WPF Example – Property Binding

```
…
<Button Background='{StaticResource bg}'>A second button</Button>
<TextBox x:Name='_text1'>An editable text box</TextBox>
<CheckBox Content='{Binding ElementName=_text1,Path=Text}' />
…
```



WPF Actions

- 3 principles
  - element composition
  - loose coupling
  - declarative actions
- Uses events, commands, and triggers
- Utilize routed events – traverse visual tree
- Semantic events vs. physical events
  - Click vs. MouseDown

WPF Events

- Declare events in XAML/implement in code
- Routed events
  - Direct – fire on single source
  - Tunneling – travel from root to target element
  - Bubbling – opposite of tunneling
- Tunneling version prefixed with *Preview*
- *Handled* property can break traversal

Event Ordering Example

```
<Window ...
PreviewMouseRightButtonDown='WindowPreviewRightButtonDown'
MouseRightButtonDown='WindowRightButtonDown' >
  <GroupBox PreviewMouseRightButtonDown='GroupBoxPreviewRightButtonDown'
   MouseRightButtonDown='GroupBoxRightButtonDown' >
   <StackPanel>
          <Button>One</Button>
          <Button PreviewMouseRightButtonDown='ButtonTwoPreviewRightButtonDown'
           MouseRightButtonDown='ButtonTwoRightButtonDown' > Two </Button>
   </StackPanel>
  </GroupBox>
</Window>
```

Ordering ⟶

1. *Window* PreviewMouseRightButtonDown
2. *GroupBox* PreviewMouseRightButtonDown
3. *Button* PreviewMouseRightButtonDown
4. *Button* MouseRightButtonDown
5. *GroupBox* MouseRightButtonDown
6. *Window* MouseRightButtonDown

Commands

- Provide single name to signify an action
  - define command
  - define command implementation
  - create trigger for command
- Uses `ICommand` interface

```
public interface ICommand {
        event EventHandler CanExecuteChanged;
        bool CanExecute(object parameter);
        void Execute(object parameter);
}
```

Command Example

```
public class Exit : ICommand {
  public bool CanExecute(object parameter) {
     return true; }

  public event EventHandler CanExecuteChanged;

  public void Execute(object parameter) {
     Application.Current.Shutdown(); }
}
```

```
public partial class Window1 : Window {
    public static readonly ICommand ExitCommand =
    new Exit();
    …
}

<MenuItem Header='_File'>
    <MenuItem Header='E_xit'
       Command='{x:Static l:Window1.ExitCommand}' />
    </MenuItem>
</MenuItem>
```

```
<MenuItem Header='_File'>
  <MenuItem Header='E_xit'>
    <MenuItem.Command>
      <l:Exit />
    </MenuItem.Command>
  </MenuItem>
</MenuItem>
...
<Hyperlink>
    <Hyperlink.Command>
        <l:Exit />
    </Hyperlink.Command>
...
</Hyperlink>
```

Triggers

- Designed for markup
- Signaled by
  - state of a display property (Trigger)
  - state of a data property (DataTrigger)
    - used only within a data template
  - an event (EventTrigger)
- Cause set of actions when signaled
- MultiTrigger and MultiDataTrigger

Event Trigger Example

```
<Window.Triggers>
       <EventTrigger RoutedEvent='FrameworkElement.Loaded'>
           <EventTrigger.Actions>
               <BeginStoryboard>
                   <BeginStoryboard.Storyboard>
                       <Storyboard>
                           <DoubleAnimation
                                  From='-25'
                                  To='25'
                                  Storyboard.TargetName='rotation'
                                  Storyboard.TargetProperty='Angle'
                                  AutoReverse='True'
                                  Duration='0:0:2.5'
                                  RepeatBehavior='Forever'/>
                       </Storyboard>
                   </BeginStoryboard.Storyboard>
               </BeginStoryboard>
           </EventTrigger.Actions>
       </EventTrigger>
   </Window.Triggers>
```

Interfaces

- IEnumerable
- ICloneable
- IComparable
- ICollection
- IDisposable
- ...

Readings

- Skim WPF Recipes in C#, Chapters 1-12