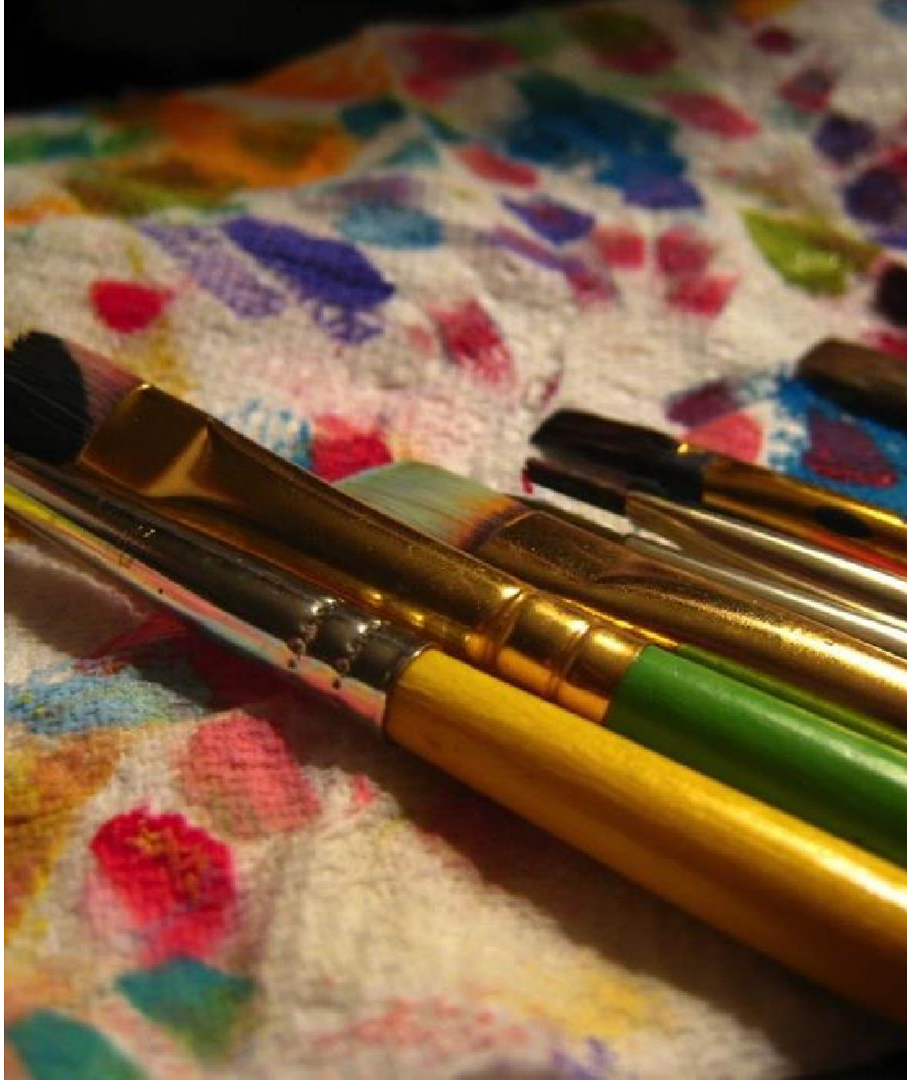
XAML in Xamarin.Forms

Objectives

1. Examine XAML syntax
2. Add Behavior to XAML-based pages
3. Explore XAML capabilities



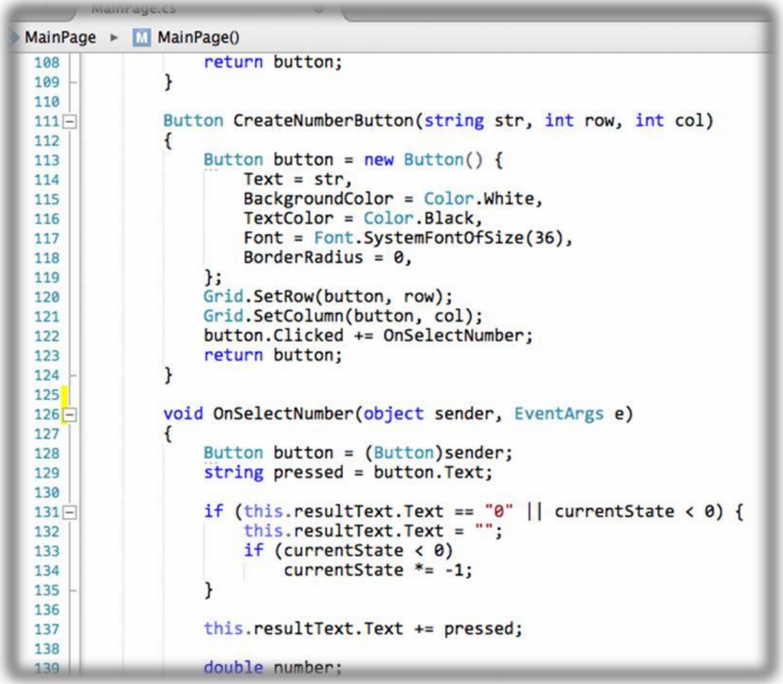
Examine XAML syntax

Tasks

- Choose between XAML and C# to define your UI
- Define a UI in Xamarin.Forms using XAML

Motivation

- Creating UI in code has some disadvantages
  - Significant portion of code-behind is UI setup and layout
  - Mixing UI and behavior in one file makes design and behavior harder to understand / evolve
  - Prohibits use of a UI designer because a developer is needed for any UI change



```
        return button;
    }

    Button CreateNumberButton(string str, int row, int col)
    {
        Button button = new Button() {
            Text = str,
            BackgroundColor = Color.White,
            TextColor = Color.Black,
            Font = Font.SystemFontOfSize(36),
            BorderRadius = 0,
        };
        Grid.SetRow(button, row);
        Grid.SetColumn(button, col);
        button.Clicked += OnSelectNumber;
        return button;
    }

    void OnSelectNumber(object sender, EventArgs e)
    {
        Button button = (Button)sender;
        string pressed = button.Text;

        if (this.resultText.Text == "0" || currentState < 0) {
            this.resultText.Text = "";
            if (currentState < 0)
                currentState *= -1;
        }

        this.resultText.Text += pressed;

        double number;
```

Advantages of markup

- HTML has taught us that markup languages are a great way to define user interfaces because they are:
  - Toolable
  - Human readable
  - Extensible

```
OOCTYPE html PUBL
tml xmlns="http://
ead>
  <meta name="TITL
  <meta http-equiv
  <meta name="keywo
  <meta name="desc
```

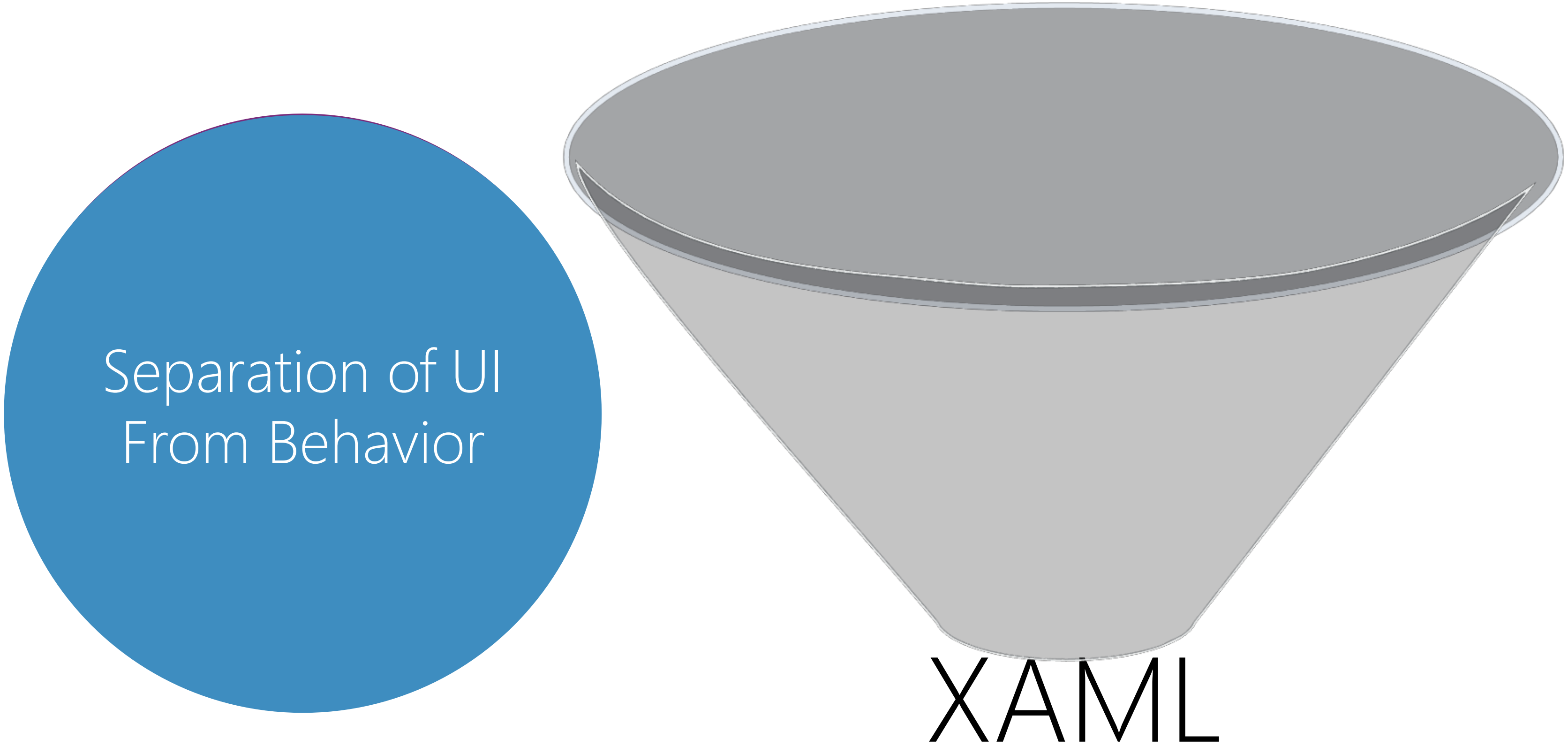
What is XAML?

- Extensible Application Markup Language (XAML) is a markup language created by Microsoft specifically to describe UI

XAML

Xamarin Forms + XAML = Sweetness!

XAML benefits

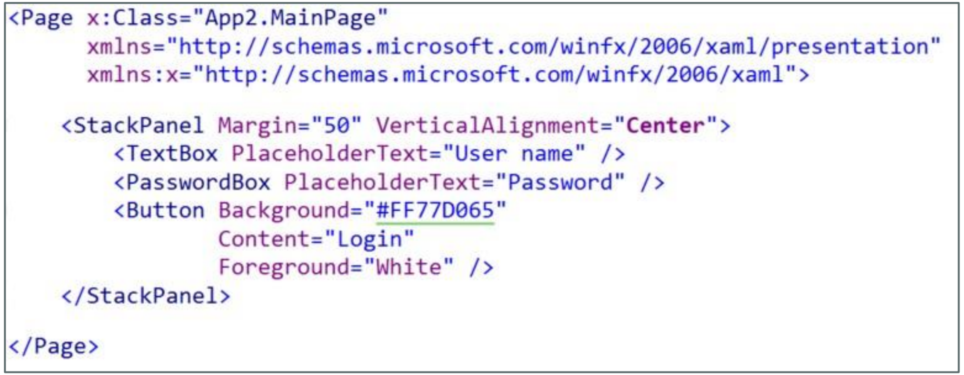


Separation of UI From Behavior

XAML

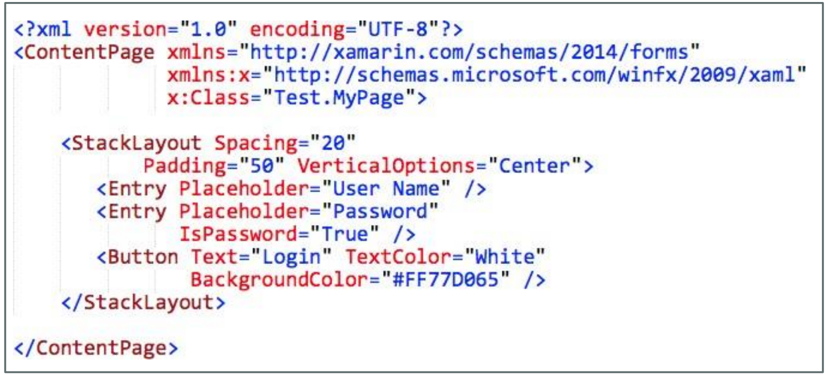
Microsoft XAML vs. Xamarin.Forms

- Xamarin.Forms conforms to the XAML 2009 specification; it differs from traditional Microsoft XAML mainly in the controls and layout containers



```
<Page x:Class="App2.MainPage"
      xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
      xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml">

    <StackPanel Margin="50" VerticalAlignment="Center">
        <TextBox PlaceholderText="User name" />
        <PasswordBox PlaceholderText="Password" />
        <Button Background="#FF77D065"
                Content="Login"
                Foreground="White" />
    </StackPanel>

</Page>
```

Microsoft XAML (WinRT)



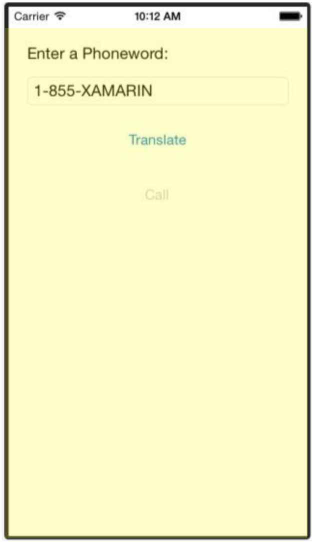
```
<?xml version="1.0" encoding="UTF-8"?>
<ContentPage xmlns="http://xamarin.com/schemas/2014/forms"
             xmlns:x="http://schemas.microsoft.com/winfx/2009/xaml"
             x:Class="Test.MyPage">

    <StackLayout Spacing="20"
           Padding="50" VerticalOptions="Center">
       <Entry Placeholder="User Name" />
       <Entry Placeholder="Password"
              IsPassword="True" />
       <Button Text="Login" TextColor="White"
               BackgroundColor="#FF77D065" />
    </StackLayout>

</ContentPage>
```

Xamarin.Forms

Feature	Supported in Xamarin.Forms
XAML 2009 compliance	✓
Shapes (Rectangle, Ellipse, Path, etc.)	`BoxView`
Resources, Styles and Triggers	✓
Data binding	✓ *not all features
Data templates	✓
Control templates	Custom renderers
Render Transforms	✓
Animations	Code-only
Custom XAML behaviors	✓
Custom markup extensions	✓
Value converters	✓

Adding a XAML Page

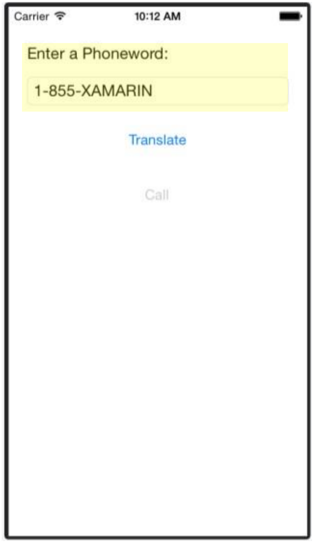
- There are two Item Templates available to add XAML content



Enter a Phoneword:

1-855-XAMARIN

`ContentPage` is an
entire screen of content



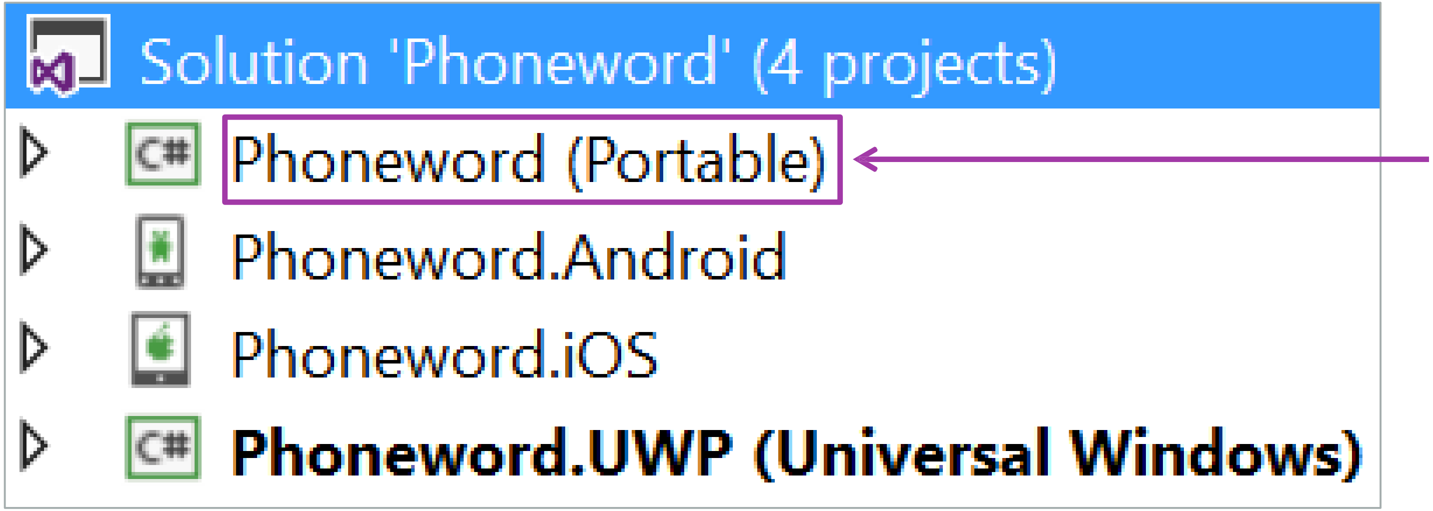
Enter a Phoneword:

1-855-XAMARIN

`ContentView` is a composite
control (smaller than a page)

Where do the XAML pages go?

- Add XAML content to the platform-independent project in your application – this is shared UI and code for all your target platforms



Solution 'Phoneword' (4 projects)

Phoneword (Portable)

Phoneword.Android

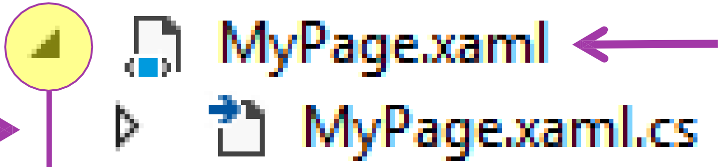
Phoneword.iOS

Phoneword.UWP (Universal Windows)

XAML pages go here

XAML-page structure

- XAML pages have two related files that work together to define the class



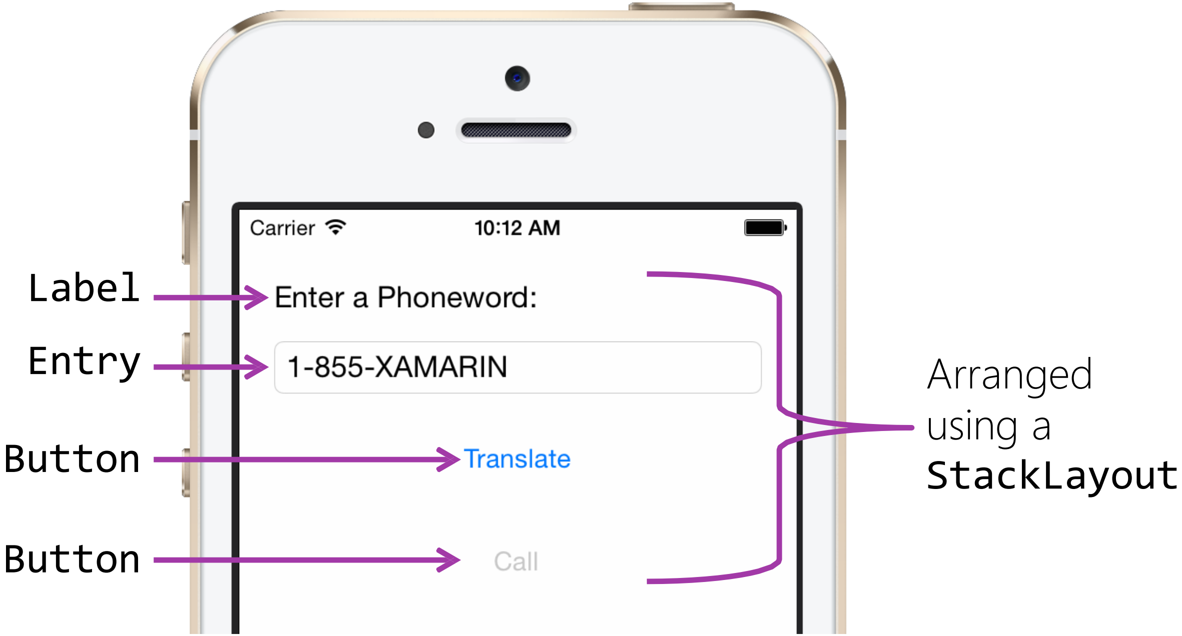
XAML file (UI)

C# file (behavior)

Disclosure arrow *collapses* the C# file and indicates these files go together

Example: creating a XAML UI

- Our goal is to build the UI for a "Phoneword" app that translates a text phone number to its numeric equivalent



Label

Entry

Button

Button

Arranged using a `StackLayout`

Describing a screen in XAML

- XAML is used to construct object graphs, in this case a visual **`Page`**

```
<?xml version="1.0" encoding="UTF-8" ?>
<ContentPage ...>
   <StackLayout Padding="20" Spacing="10">
      <Label Text="Enter a Phoneword:" />
      <Entry Placeholder="Number" />
      <Button Text="Translate" />
      <Button Text="Call" IsEnabled="False" />
   </StackLayout>
</ContentPage>
```

XML based: case sensitive, open tags must be closed, etc.

Describing a screen in XAML

- XAML is used to construct object graphs, in this case a visual **Page**

Element tags create objects

```
<?xml version="1.0" encoding="UTF-8" ?>
<ContentPage ...>
   <StackLayout Padding="20" Spacing="10">
      <Label Text="Enter a Phoneword:" />
      <Entry Placeholder="Number" />
      <Button Text="Translate" />
      <Button Text="Call" IsEnabled="False" />
   </StackLayout>
</ContentPage>
```

Describing a screen in XAML

- XAML is used to construct object graphs, in this case a visual **Page**

```
<?xml version="1.0" encoding="UTF-8" ?>
<ContentPage ...>
   <StackLayout Padding="20" Spacing="10">
      <Label Text="Enter a Phoneword:" />
      <Entry Placeholder="Number" />
      <Button Text="Translate" />
      <Button Text="Call" IsEnabled="False" />
   </StackLayout>
</ContentPage>
```

Attributes set properties or events

Describing a screen in XAML

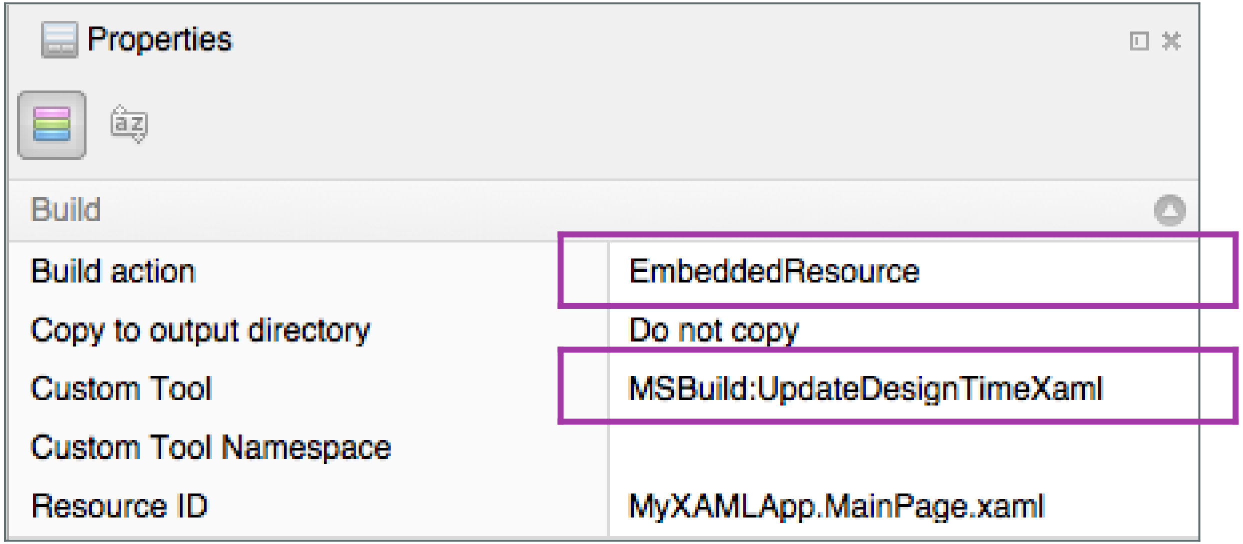
- XAML is used to construct object graphs, in this case a visual **Page**

```
<?xml version="1.0" encoding="UTF-8" ?>
<ContentPage ...>
   <StackLayout Padding="20" Spacing="10">
      <Label Text="Enter a Phoneword:" />
      <Entry Placeholder="Number" />
      <Button Text="Translate" />
      <Button Text="Call" IsEnabled="False" />
   </StackLayout>
</ContentPage>
```

Child nodes used to establish relationship

XAML build type

- XAML files are stored as *embedded resources* and have a special build type of `MSBuild:UpdateDesignTimeXaml`



Build

Build action	EmbeddedResource
Copy to output directory	Do not copy
Custom Tool	MSBuild:UpdateDesignTimeXaml
Custom Tool Namespace	
Resource ID	MyXAMLApp.MainPage.xaml

XAML + Code Behind

- XAML and code behind files are tied together

```
<?xml version="1.0" encoding="UTF-8" ?>
<ContentPage x:Class="Phoneword.MainPage"  ...>
```

```
namespace Phoneword
{
   public partial class MainPage : ContentPage
   {
      ...
   }
}
```

`x:Class` Identifies the full name of the class defined in the code behind file

XAML initialization

- Code behind constructor has call to **`InitializeComponent`** which is responsible for loading the XAML and creating the objects

```
public partial class MainPage : ContentPage
{
    public MainPage ()
    {
        InitializeComponent ();
    }
}
```

implementation of method generated by XAML compiler as a result of the **`x:Class`** tag – added to hidden file (same partial class)

Demonstration

Creating a XAML-based application

Property Conversions

❖ XML attributes only allow for string values – works fine for intrinsic types

```
<Label Text="This is a Label" IsVisible="True" Opacity="0.75"
   FontAttributes="Bold,Italic" FontSize="Large"
   Margin="5,20,5,0" TextColor="#fffc0d34" />
```

`Text` is a `string` which is just set directly

Property Conversions

❖ XML attributes only allow for string values – works fine for intrinsic types

```
<Label Text="This is a Label" IsVisible="True" Opacity="0.75"
   FontAttributes="Bold,Italic" FontSize="Large"
   Margin="5,20,5,0" TextColor="#fffc0d34" />
```

`IsVisible` is a `bool` which is converted from the value using `Boolean.TryParse`

Property Conversions

- XML attributes only allow for string values – works fine for intrinsic types

```
<Label Text="This is a Label" IsVisible="True" Opacity="0.75"
   FontAttributes="Bold,Italic" FontSize="Large"
   Margin="5,20,5,0" TextColor="#fffc0d34" />
```

`Opacity` is a `double` which is converted from the value using `Double.TryParse`

Property Conversions

- XML attributes only allow for string values – works fine for intrinsic types

```
<Label Text="This is a Label" IsVisible="True" Opacity="0.75"
   FontAttributes="Bold,Italic" FontSize="Large"
   Margin="5,20,5,0" TextColor="#fffc0d34" />
```

Enumerations are parsed with **`Enum.TryParse`** and support **`[Flags]`** with comma-separated values

Property Conversions

- XML attributes only allow for string values – works fine for intrinsic types

```
<Label Text="This is a Label" IsVisible="True" Opacity="0.75"
   FontAttributes="Bold,Italic" FontSize="Large"
   Margin="5,20,5,0" TextColor="#fffc0d34" />
```

```
[TypeConverter(typeof(ThicknessTypeConverter))]
public struct Thickness
{
    ...
}
```

Property Conversions

- XML attributes only allow for string values – works fine for intrinsic types

```
<Label Text="This is a Label" IsVisible="True" Opacity="0.75"
   FontAttributes="Bold,Italic" FontSize="Large"
   Margin="5,20,5,0" TextColor="#fffc0d34" />
```

`Margin` is of type `Thickness`

Property Conversions

- XML attributes only allow for string values – works fine for intrinsic types

```
<Label Text="This is a Label" IsVisible="True" Opacity="0.75"
   FontAttributes="Bold,Italic" FontSize="Large"
   Margin="5,20,5,0" TextColor="#fffc0d34" />
```

Colors can be specified as a known value (e.g. "Red", "Green", …) or as a hex value (RGB or aRGB)

Setting Complex Properties

- When a more complex object needs to be created and assigned, you can use the *Property Element* syntax

- This changes the style to use an element tag (create-an-object) as part of the assignment

```
<BoxView Color="Transparent">
   <BoxView.GestureRecognizers>
      <TapGestureRecognizer
        NumberOfTapsRequired="2"
        ... />
   </BoxView.GestureRecognizers>
</BoxView>
```

Property value is set as a child tag of the `<Type.PropertyName>` element

Setting Attached Properties

- Attached Properties provide runtime "attached" data for a visual element

- Used by layout containers to provide container-specific values on each child

```
<Grid>
 <Label Text="Position" />
 <Entry Grid.Column="1"  />
</Grid>
```

Set in XAML with **`OwnerType.Property="Value"`** form, can also use property-element syntax for more complex values

Content Properties

- Some types have a *default* property which is set when child content is added to the element

- This is the *Content Property* and is identified through a `[ContentAttribute]` applied to the class

```
<ContentPage ...>
 <Label>
    This is the Text
 </Label>
</ContentPage>
```

These create the same UI

```
<ContentPage ...>
 <ContentPage.Content>
   <Label>
     <Label.Text>
       This is the Text
     </Label.Text>
   </Label>
 </ContentPage.Content>
</ContentPage>
```

Identifying Types

- XAML creates objects when it encounters an element tag, XML namespaces are used to correlate .NET types to tags

Default namespace includes most of the Xamarin.Forms types you use

```
<ContentPage ...
    xmlns="http://xamarin.com/schemas/2014/forms"
    xmlns:x="http://schemas.microsoft.com/winfx/2009/xaml">

   <StackLayout   ... />

<ContentPage>
```

`x:` namespace includes XAML types and known CLR types (**`Int32`**, **`String`**, etc.)

Custom Types

- XAML can create any public object, including ones with parameterized constructors – you just need to tell it where the type lives

Must supply the namespace, and *possibly* the assembly, the type is defined in

```
<scg:List x:TypeArguments="x:String"
 xmlns:scg="clr-namespace:System.Collections.Generic;assembly=mscorlib">
   <x:String>One</x:String>
   <x:String>Two</x:String>
   <x:String>Three</x:String>
</scg:List>
```

`xmlns` definition can be placed on a single element, or a parent element to use with any children

Individual Exercise

Create a XAML-based version of Calculator

Add Behavior to XAML-based pages

Tasks

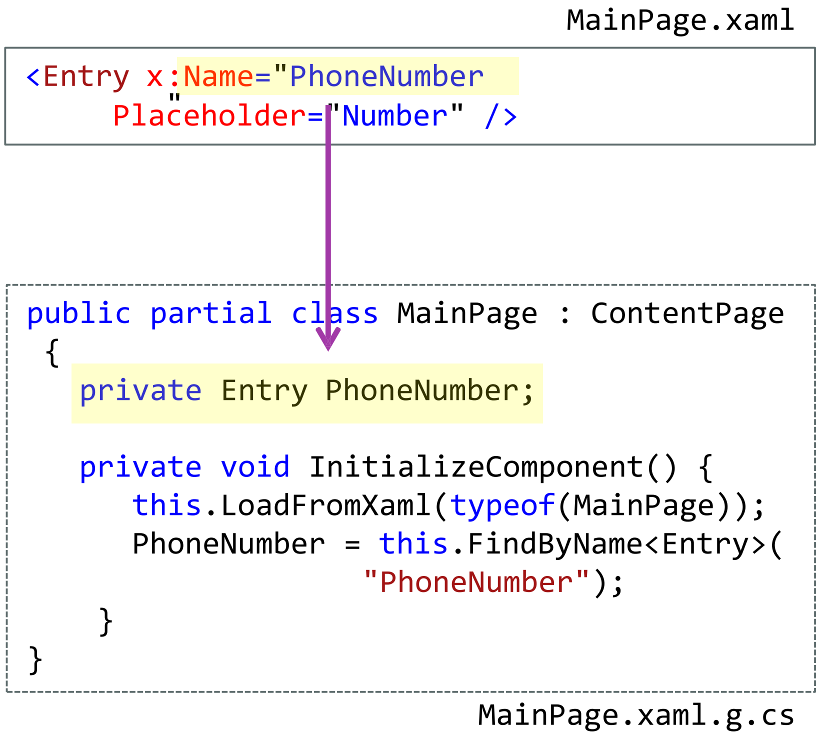
- Access XAML defined elements in the associated code-behind
- Handle events on XAML defined views

Naming Elements in XAML

- Use **`x:Name`** to assign field name
  - allows you to reference element in XAML and code behind

- Adds a private field to the XAML-generated partial class (.g.cs)

- Name must conform to C# naming conventions and be unique in the file



MainPage.xaml

```
<Entry x:Name="PhoneNumber
               "
     Placeholder="Number" />
```

```
public partial class MainPage : ContentPage
 {
   private Entry PhoneNumber;

   private void InitializeComponent() {
      this.LoadFromXaml(typeof(MainPage));
      PhoneNumber = this.FindByName<Entry>(
                        "PhoneNumber");
    }
}
```

MainPage.xaml.g.cs

Working with named elements

- Can work with named elements as if you defined them in code, but keep in mind the field is not set until *after* **`InitializeComponent`** is called

Can wire up events, set properties, even add new elements to layout

```
public partial class MainPage : ContentPage
{
    public MainPage () {
        InitializeComponent ();
        PhoneNumber.TextChanged += OnTextChanged;
    }

    void OnTextChanged(object sender, TextChangedEventArgs e)
    {
       ...
}   }
```

Sharing elements

- Generated field is always private, but **Page** owner can wrap in a public property to allow external access

```
public partial class MainPage : ContentPage
{
    public Entry PhoneNumberEntry
    {
       get { return this.PhoneNumber; }
    }
    ...
}
```

should *not* provide a setter – replacing the field's value will not change the actual element on the screen

Handling events in XAML

- Can also wire up events in XAML – event handler *must be defined* in the code behind file and have proper signature or it's a runtime failure

```
<Entry Placeholder="Number"  TextChanged="OnTextChanged"  />
```

```
public partial class MainPage : ContentPage
{
   ...
   void OnTextChanged(object sender, TextChangedEventArgs e) {
      ...
   }
}
```

Handling events in code behind

- Many developers prefer to wire up all events in code behind by naming the XAML elements and adding event handlers in code
  - Keeps the UI layer "pure" by pushing all behavior + management into the code behind
  - Names are validated at compile time, but event handlers are not
  - Easier to see how logic is wired up

- Pick the approach that works for your team / preference

Individual Exercise

Adding Behavior to XAML Calculator

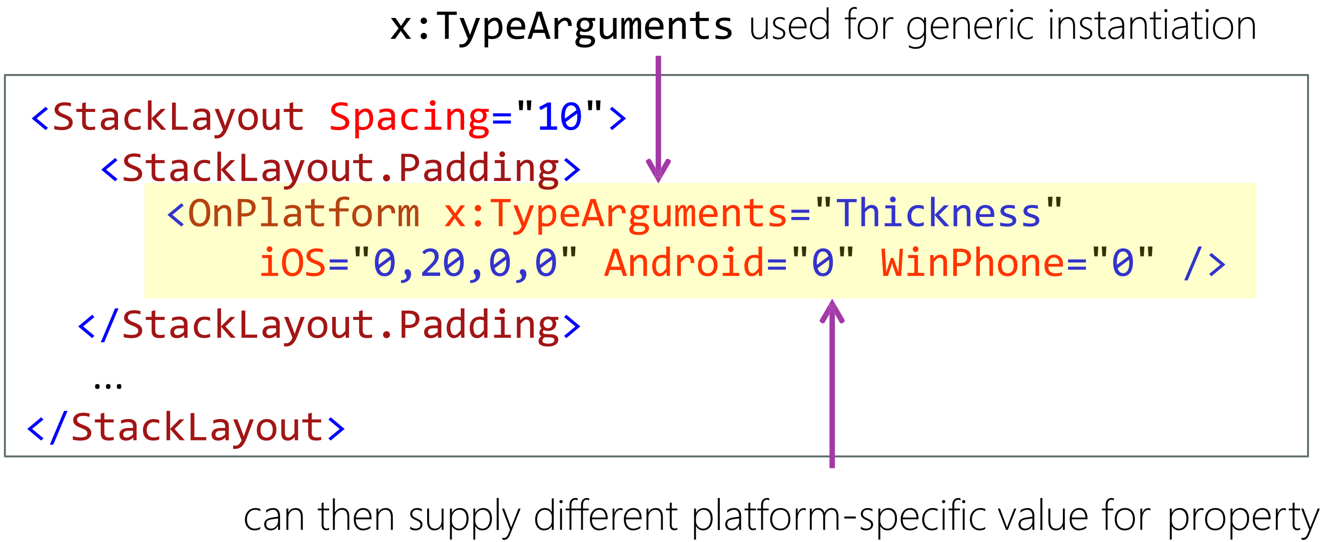
Explore XAML capabilities

Tasks

- Using device-specific values to define your app's UI
- Use Markup Extensions in XAML
- Using `ContentView` to share XAML across multiple Pages
- Compile XAML to improve performance

Using device-specific values

- XAML is a static (compile-time) definition of the UI; can provide different values for each platform just like we do in code with **`Device.OnPlatform`**



`x:TypeArguments` used for generic instantiation

```
<StackLayout Spacing="10">
   <StackLayout.Padding>
      <OnPlatform x:TypeArguments="Thickness"
          iOS="0,20,0,0" Android="0" WinPhone="0" />
  </StackLayout.Padding>
   …
</StackLayout>
```

can then supply different platform-specific value for property

Using runtime values

- XAML defines a way to set properties to values known at runtime called *markup extensions*, these conform to the **`IMarkupExtension`** interface

```
public interface IMarkupExtension
{
   object ProvideValue(IServiceProvider serviceProvider);
}
```

method is called during the XAML load process to retrieve a runtime value
and apply it to the property

Using Markup Extensions

- Markup Extensions are identified by "**`{extension_here}`**" curly braces

parser expects to find a class named **`BindingExtension`** that implements **`IMarkupExtension`** when it encounters the curly brace as the first character

```
<StackLayout BindingContext="{Binding Details}">
  <Label Text="{}{Want a Curly Brace Here!}" />
   ...
</StackLayout>
```

literal curly braces need to be escaped properly to avoid a parser error

Reading static properties

- A very useful markup extension is **`x:Static`** which lets you get the value of public static fields or properties

```
public static class Constants
{
    public static string Title = "Hello, Forms";
    public static Thickness Padding = new Thickness(5, Device.OnPlatform(20, 0, 0), 5, 0);
    public static Color TextColor = Color.Yellow;
}
```

```
<ContentPage ... Padding="{x:Static me:Constants.Padding}">
   <Label Text="{x:Static me:Constants.Title}"
          TextColor="{x:Static me:Constants.TextColor}" />
</ContentPage>
```

Other built-in Markup Extensions

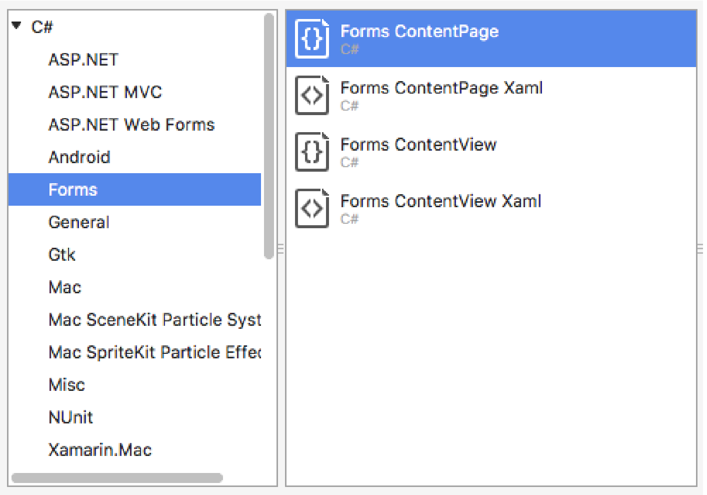
- Use resource values with `{StaticResource}` and `{DynamicResource}`
- Supply a `null` value with `{x:Null}`
- Lookup a `Type` with `{x:Type}`
- Create an array with `{x:Array}`
- Create data bindings with `{Binding}`

```
<ListView SelectedItem="{x:Null}">
  <ListView.ItemsSource>
    <x:Array Type="{x:Type x:Int32}">
        <x:Int32>10</x:Int32>
        <x:Int32>20</x:Int32>
        <x:Int32>30</x:Int32>
    </x:Array>
  </ListView.ItemsSource>
</ListView>
```

Sharing XAML fragments

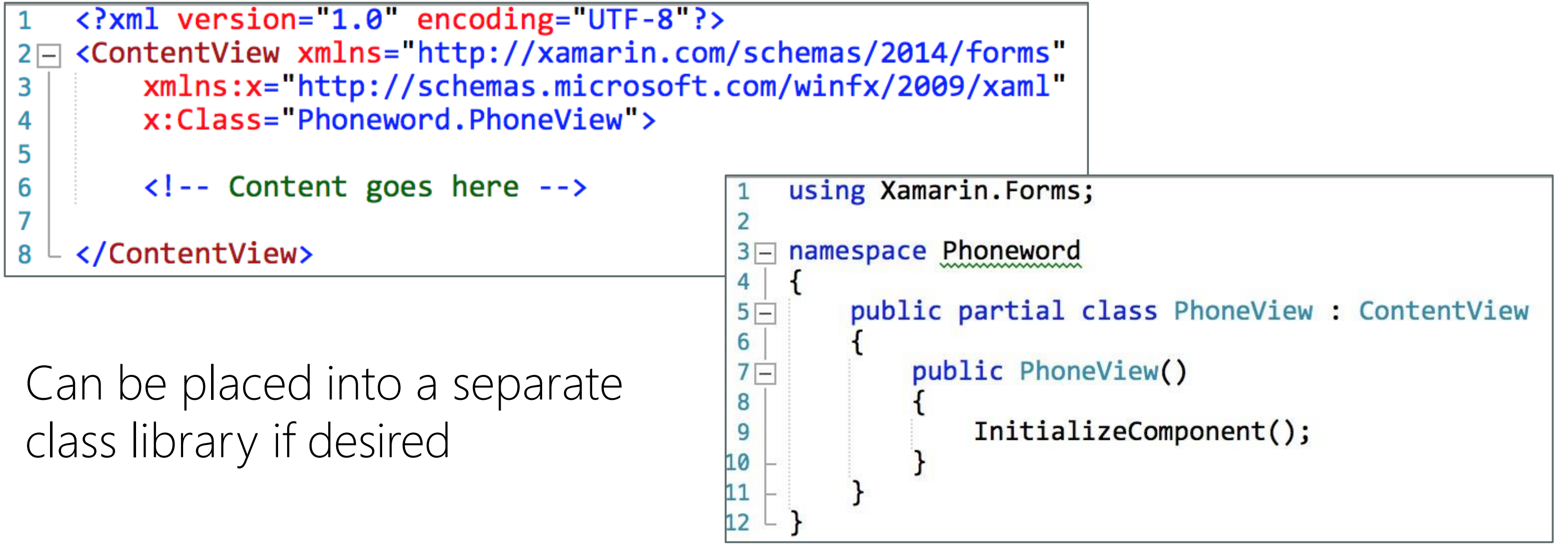
- Can be useful to split XAML into different files
  - Reuse useful UI pieces
  - Refactor large pages

- `ContentView` allows for this
  - Similar to Android Fragments
  - … or User Controls in Windows



ContentView structure

- ContentView combines a piece of XAML with code behind behavior - just like **ContentPage, can name elements, wire up events, etc.**



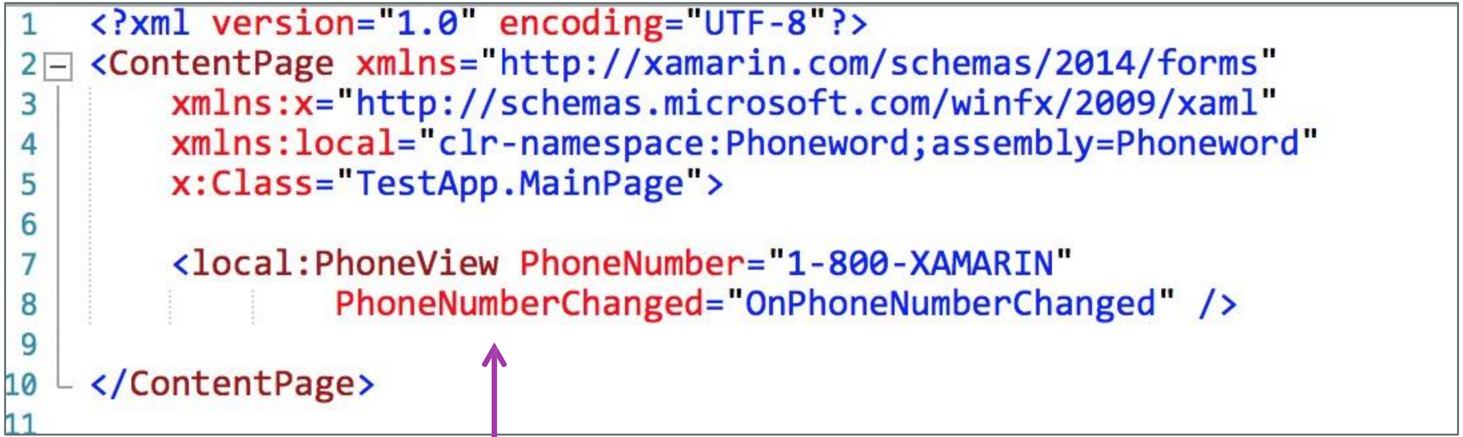
```xml
<?xml version="1.0" encoding="UTF-8"?>
<ContentView xmlns="http://xamarin.com/schemas/2014/forms"
    xmlns:x="http://schemas.microsoft.com/winfx/2009/xaml"
    x:Class="Phoneword.PhoneView">

    <!-- Content goes here -->

</ContentView>
```

```csharp
using Xamarin.Forms;

namespace Phoneword
{
    public partial class PhoneView : ContentView
    {
        public PhoneView()
        {
            InitializeComponent();
        }
    }
}
```

Can be placed into a separate class library if desired

Using a ContentView

- **`ContentView`** is not displayed on it's own - must be added to a **`Page`**



```
<?xml version="1.0" encoding="UTF-8"?>
<ContentPage xmlns="http://xamarin.com/schemas/2014/forms"
    xmlns:x="http://schemas.microsoft.com/winfx/2009/xaml"
    xmlns:local="clr-namespace:Phoneword;assembly=Phoneword"
    x:Class="TestApp.MainPage">

    <local:PhoneView PhoneNumber="1-800-XAMARIN"
            PhoneNumberChanged="OnPhoneNumberChanged" />

</ContentPage>

```

`ContentView` can expose it's own properties and events to provide customization or "hooks" into the logic

XAML resources

- By default, your XAML files are included as a plain-text resource in the generated assembly which is parsed at runtime to generate the page

```
private void InitializeComponent()
{
    this.LoadFromXaml(typeof(MainPage));
}
```

This **Page** method looks up the embedded resource by name, parses it, and creates each object found; it returns the root created object

Compiling XAML

- XAML can be optionally compiled to intermediate language (IL)
  - Provides compile-time validation of your XAML files
  - Reduces the load time for pages
  - Reduces the assembly size by removing text-based .xaml files

Enabling XAMLC

- XAMLC (the XAML compiler) is disabled by default to ensure backwards compatibility; can be enabled through a .NET attribute

```
using Xamarin.Forms.Xaml;

[assembly: XamlCompilationAttribute(
                 XamlCompilationOptions.Compile)]
```

Can enable the compiler for all XAML files in the assembly

Enabling XAMLC

- XAMLC (the XAML compiler) is disabled by default to ensure backwards compatibility; can be enabled through a .NET attribute

```
using Xamarin.Forms.Xaml;

[XamlCompilationAttribute(XamlCompilationOptions.Compile)]
public partial class MainPage : ContentPage {
```

… or on a specific XAML-based class

What does XAMLC do?

- Attribute presence causes MSBuild command to be run which parses the XAML and generates **`InitializeComponent`** to create the page in code

```
private void InitializeComponent()
{
   Label label = new Label();
   StackLayout stackLayout = new StackLayout();
   stackLayout.SetValue(VisualElement.BackgroundColorProperty,
        new ColorTypeConverter().ConvertFrom("Red"));
   stackLayout.SetValue(Layout.PaddingProperty,
        new ThicknessTypeConverter().ConvertFrom("10"));
   stackLayout.SetValue(StackLayout.SpacingProperty, 5);
   label.SetValue(Label.TextProperty, "Hello, Forms");
   stackLayout.Children.Add(label);
   ...
   this.Content = stackLayout;
}
```

Disabling XAMLC

- Attribute also lets you disable XAMLC for a specific class

```
using Xamarin.Forms.Xaml;

[XamlCompilationAttribute(XamlCompilationOptions.Skip)]
public partial class DetailsPage : ContentPage {
```

Specify Skip to turn off compiler for this specific page; goes back to using `LoadFromXaml`

Individual Exercise

Cleanup the XAML code and tailor the UI to the platform

Thank You!

Microsoft