



XAM270

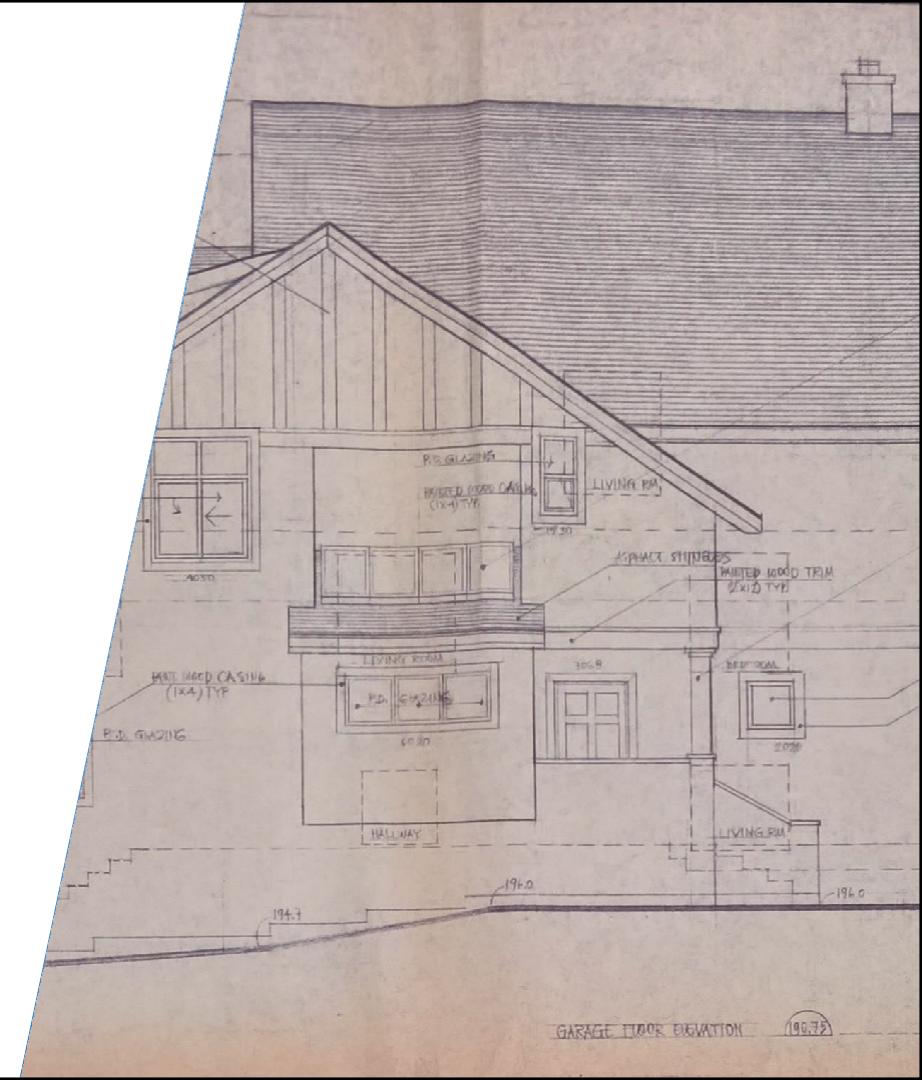
Data Binding in Xamarin.Forms



Xamarin University

Objectives

1. Use data binding to decouple code-behind from UI
2. Use value converters to bind incompatible types





Use data binding to decouple code-behind from UI

Tasks

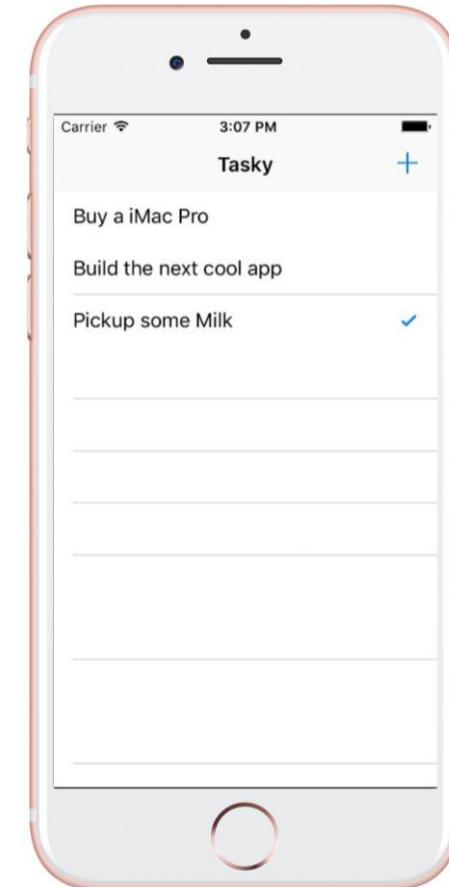
1. Map data to visuals
2. Create bindings in code
3. Create bindings in XAML
4. Work with binding context
5. Change binding modes
6. Implement property change notifications



Apps are driven by data

- ❖ Most applications display and manipulate data in some form
 - internally generated
 - read from an external source

- ❖ Classes created to represent data are often referred to as Models
 - can also refer to "entity" objects



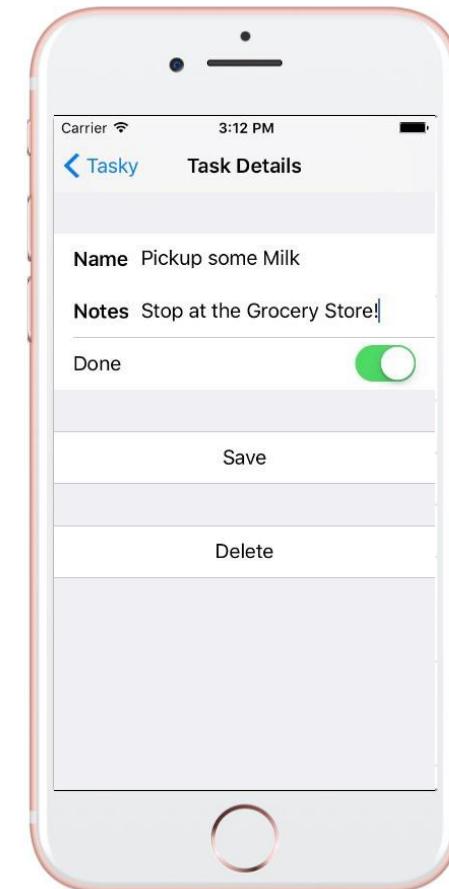
Data > Views

- ❖ We use code to display internal data in our pages

```
Name.Text = task.Title;  
Notes.Text = task.Notes;  
IsDone.IsToggled = task.Completed;  
...
```

- ❖ ... and events to provide interactivity / behavior

```
Name.TextChanged += (sender, e) =>  
    task.Title = Name.Text;  
IsDone.Toggled += (sender, e) =>  
    task.Completed = IsDone.IsToggled;
```



Data > Views in code

- ❖ This approach works, and for small-ish applications is perfectly adequate but it has disadvantages as the application grows in complexity



Updates to data are not centralized



Relationships in data or UI behavior is harder to manage



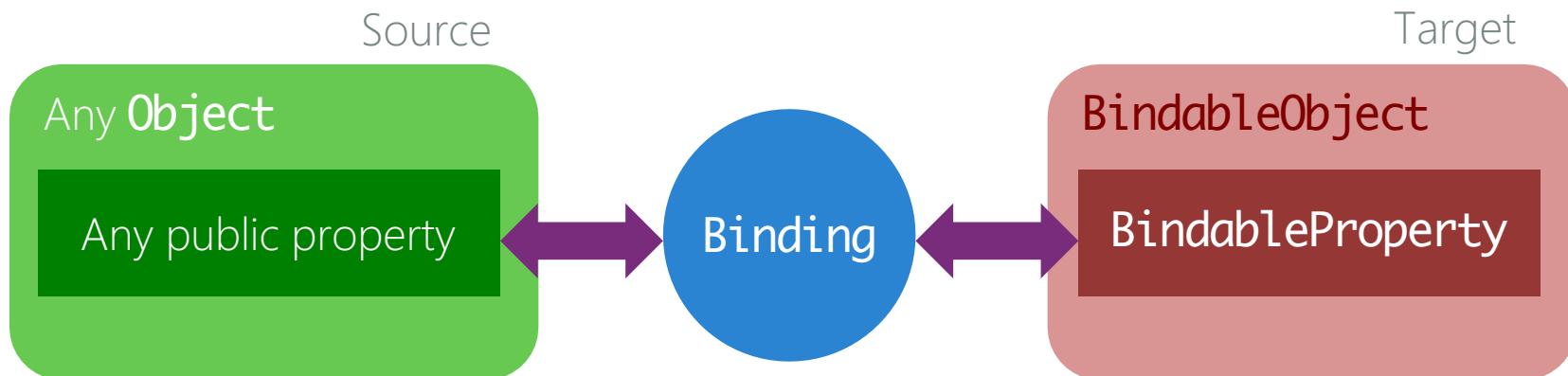
Hard to unit test



UI is tightly coupled to the code behind logic, changes ripple through code

Introducing: Data Binding

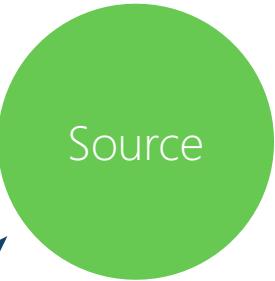
- ❖ Data Binding involves creating a loose relationship between a source property and a target property so that the source and target are unaware of each other



Binding acts as an *intermediary* – moving the data between the source and target

Creating Bindings in Xamarin.Forms

- ❖ Bindings require three pieces of information



Source

Can be any
accessible object



Path

Public property
defined on the
source object



Target

Must be a
BindableProperty

Creating bindings [Source]

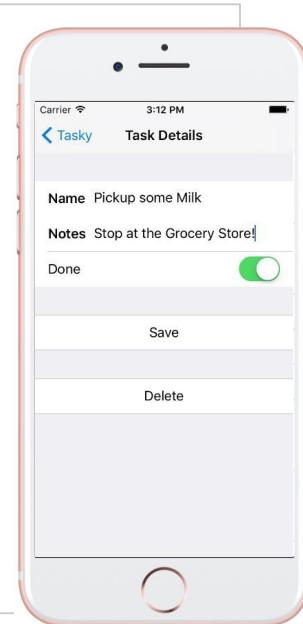
```
Todo task = new Todo() { Title = "Pickup some Milk", ... };
```

```
Entry Name = new Entry();
```

1 `Binding nameBinding = new Binding();
nameBinding.Source = task;`

...

Binding identifies the source of the binding data – this is where the data comes from, in this case it's a single Todo object defined in our application



Creating bindings [Path]

```
Todo task = new ToDo() { Title = "Pickup some Milk", ... };
```

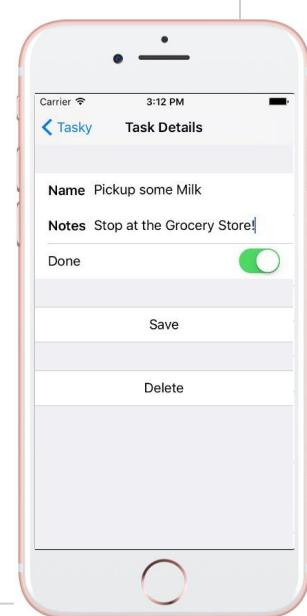
```
Entry Name = new Entry();
```

```
Binding nameBinding = new Binding();  
nameBinding.Source = task;
```

2 nameBinding.Path = "Title";

...

Binding identifies the *property path* which identifies a property on the source to get the data from, in this case we want to get the value from the **Todo.Title** property



Creating bindings [Path]

```
Todo task = new Todo { Title = "Pickup some Milk", ... };
```

```
Entry Name = n
```

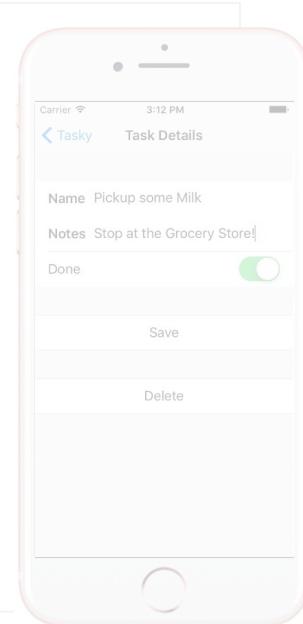
```
Binding nameBind  
nameBinding.S
```

```
nameBinding.Pa
```

```
...
```

More Path Examples

```
new Binding("Property")  
new Binding("Property.Child")  
new Binding("Property[Key]")  
new Binding("Property[1]")  
new Binding("[Key]")  
new Binding(".")
```



Creating bindings [Target]

```
Todo task = new ToDo() { Title = "Pickup some Milk", ... };
```

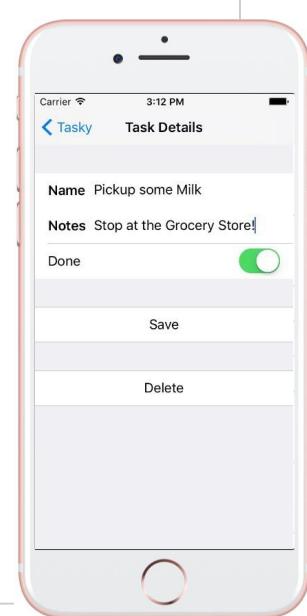
```
Entry Name = new Entry();
```

```
Binding nameBinding = new Binding();  
nameBinding.Source = task;  
nameBinding.Path = "Title";
```

3

```
Name.SetBinding(Entry.TextProperty, nameBinding);
```

Binding is associated to the target property using the
BindableObject.SetBinding method



Creating bindings [Target]

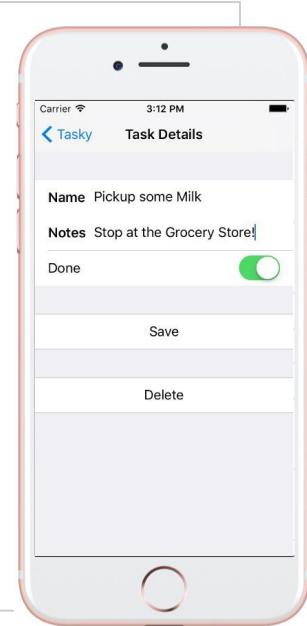
```
Todo task = new ToDo() { Title = "Pickup some Milk", ... };
```

```
Entry Name = new Entry();
```

```
Binding nameBinding = new Binding();  
nameBinding.Source = task;  
nameBinding.Path = "Title";
```

3 Name.SetBinding(Entry.TextProperty, nameBinding);

This is passed the specific target property the binding will work with – this must be a **BindableProperty**



Creating bindings [Target]

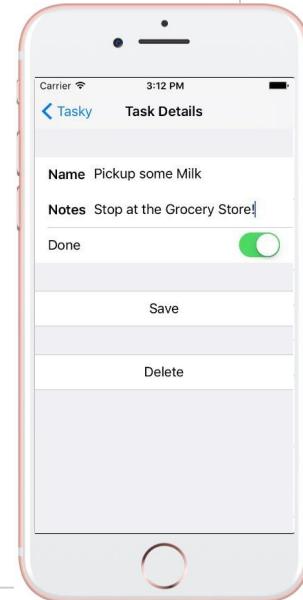
```
Todo task = new ToDo() { Title = "Pickup some Milk", ... };
```

```
Entry Name = new Entry();
```

```
Binding nameBinding = new Binding();  
nameBinding.Source = task;  
nameBinding.Path = "Title";
```

3 Name.SetBinding(Entry.TextProperty, nameBinding);

... and the binding which identifies the source and the property on the source to apply



Creating bindings [XAML]

- ❖ Create bindings in XAML with **{Binding}** markup extension

```
<StackLayout Padding="20" Spacing="20">
    <StackLayout.Resources>
        <ResourceDictionary>
            <Todo x:Key="getMilk" Title="Pickup some Milk" />
        </ResourceDictionary>
    </StackLayout.Resources>
    <Entry Text="{Binding Title,
        Source={StaticResource getMilk}}" />
    ...
</StackLayout>
```

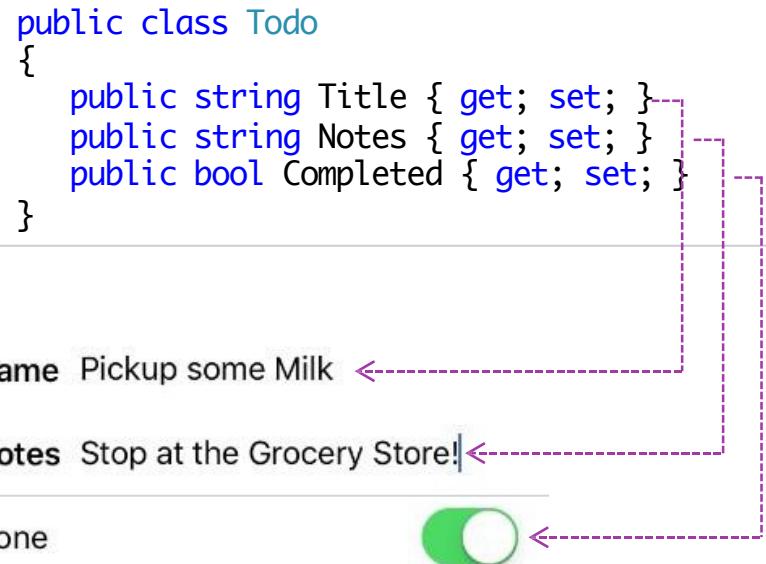
Assigned to Target property

{Binding} takes the Path as the first unnamed argument

Source supplied through resource

Data binding source

- ❖ Pages often display properties from a small number of data objects
- ❖ Can set the binding source on each binding separately, or use the **BindingContext** as the *default* binding source



Multiple Bindings

- ❖ **BindingContext** supplies the source for any binding associated with a view when the **Binding.Source** property is not set

```
Todo task = new Todo() { Title = "Buy a Surface Studio", ... };  
...  
Name.BindingContext = task;  
Name.SetBinding<Todo>(Entry.TextProperty,  
                      data => data.Title, BindingMode.TwoWay);
```

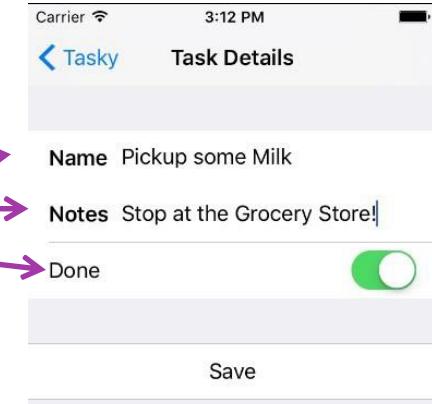


Useful to use a generic form of **SetBinding** to create bindings with typed properties when establishing bindings in code, notice we are *not* setting a source property on the binding – instead, it will use **BindingContext**

BindingContext inheritance

- ❖ **BindingContext** is automatically *inherited* from parent to child – can set it once on the root view and it will be used for all children

```
public partial class TaskyDetailsPage : ContentPage  
{  
    public TaskyDetailsPage (Todo task)  
    {  
        BindingContext = task;  
        InitializeComponent ();  
    }  
}
```



BindingContext inheritance

- ❖ BindingContext is automatically *inherited* from parent to child – can set it once on the root view and it will be used for all children

```
BindingContext = new Todo() { Title = "Buy a Surface Studio" };
```

```
<StackLayout Padding="20" Spacing="20">
    <Entry Text="{Binding Title}" />
    <Entry Text="{Binding Notes}" />
    <Switch IsToggled="{Binding Completed}" />
</StackLayout>
```



By setting the binding context to the **Todo**, no explicit source is necessary in XAML



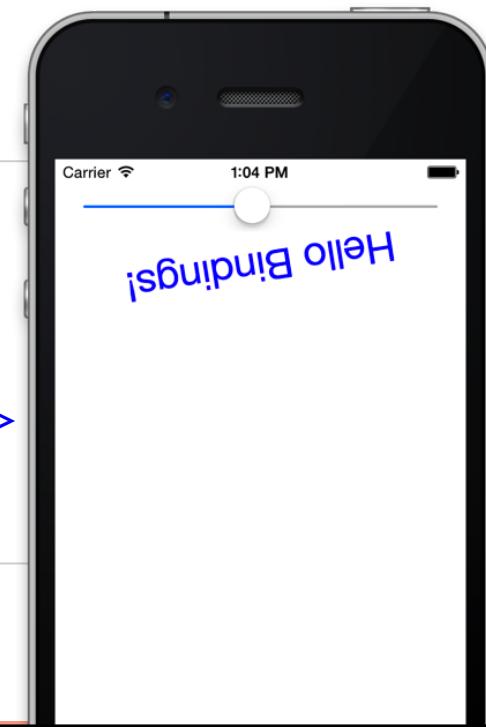
Group Exercise

Using Data Binding in a Xamarin.Forms Application

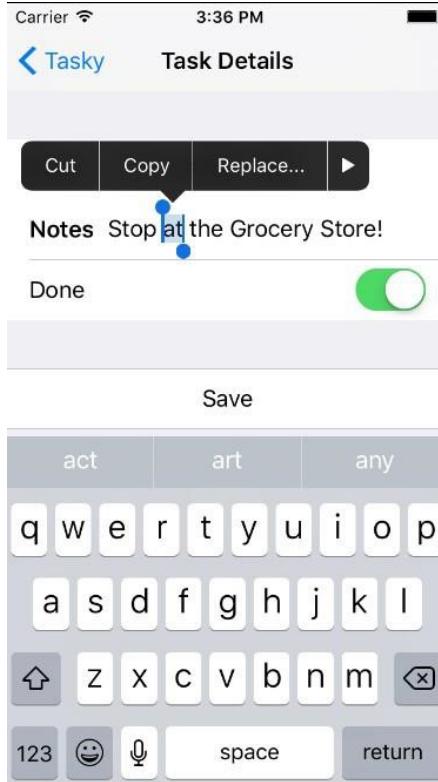
View-to-View Bindings

- ❖ `{x:Reference}` identifies named elements in the same XAML page – can use this to provide a source to a **Binding**

```
<StackLayout Padding="20" Spacing="20">
    <Label Text="Hello, Bindings" TextColor="Blue" ...
        Rotation="{Binding Source={x:Reference slider},
            Path=Value}" />
    ...
    <Slider x:Name="slider" Minimum="0" Maximum="360" />
</StackLayout>
```



Creating two-way bindings



- ❖ Typically want data to be bi-directional
 - source > target (always happens)
 - target > source (optional)

```
Notes.TextChanged += (sender, e)  
=> task.Notes = Notes.Text;
```

Binding Mode

- ❖ Binding Mode controls the direction of the data transfer, can set to "TwoWay" to enable bi-directional bindings

```
Notes.SetBinding(Entry.TextProperty,  
    new Binding("Notes") {  
        Mode = BindingMode.TwoWay  
    });
```

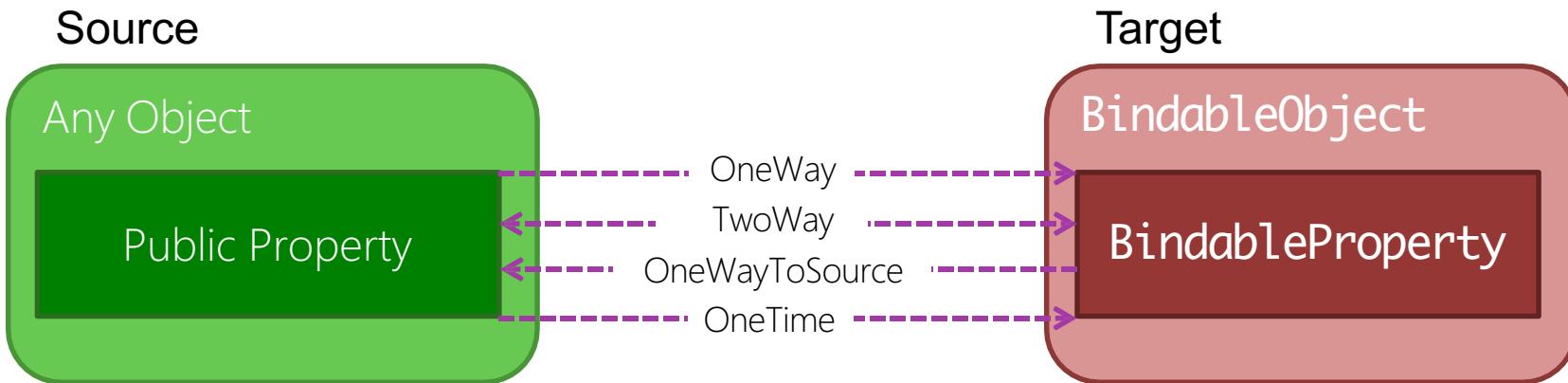
Manually controlled through the
Binding.Mode property

```
<Entry  
    Text="{Binding Notes, Mode=TwoWay}" />
```

Source Property must
have **public setter**



Available Binding Modes



BindingMode.Default is the default value and it decides the mode based on the target property preference – either **OneWay** or **TwoWay**

Default Binding Mode

- ❖ Default binding mode is *property-specific*, most are one-way by default with a few exceptions that default to two-way

`DatePicker.Date`

`Entry.Text`

`ListView.SelectedItem`

`MultiPage<T>.SelectedItem`

`Picker.SelectedIndex`

`SearchBar.Text`

`Stepper.Value`

`Switch.IsToggled`

`TimePicker.Time`



XAML platforms handle binding modes differently, best practice to get in the habit of explicitly setting the mode if it's not one-way – even if it defaults to what you want

Pushing changes to the UI

- ❖ One-Way and Two-Way bindings always update the UI when the source property is changed

```
task.Notes = "Buy Groceries";
```

```
public class Todo
{
    public string Title { get; set; }
    public string Notes { get; set; }
    public DateTime By { get; set; }
    public bool Completed { get; set; }
}
```

Q:

How could
Xamarin.Forms know
Notes has changed?



INotifyPropertyChanged

- ❖ **INotifyPropertyChanged** provides change notification contract, should be implemented by any modifiable model object you bind to

```
namespace System.ComponentModel
{
    public interface INotifyPropertyChanged
    {
        event PropertyChangedEventHandler PropertyChanged;
    }
}
```

Implementing INotifyPropertyChanged

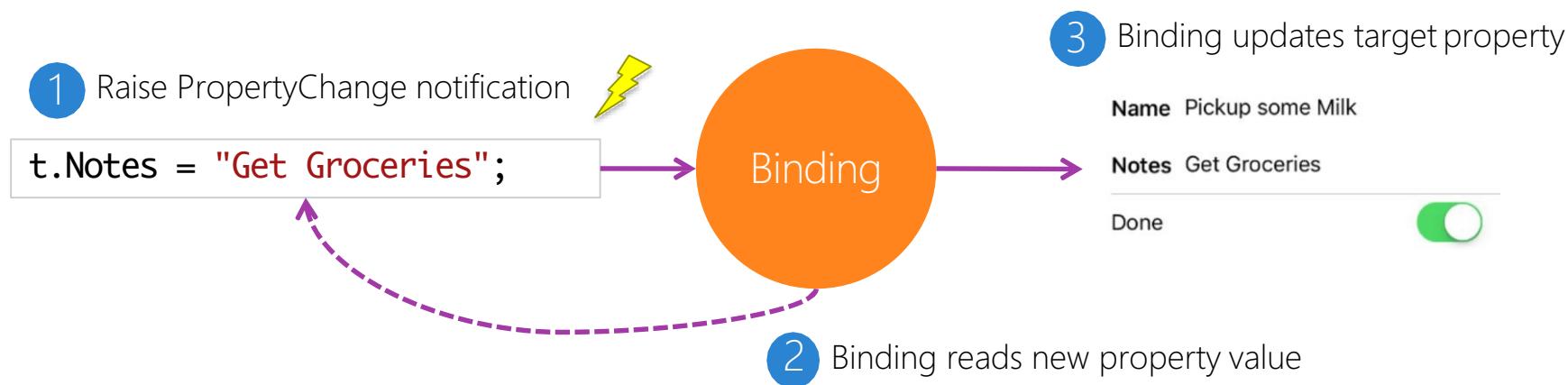
```
public class Todo : INotifyPropertyChanged
{
    public event PropertyChangedEventHandler PropertyChanged;

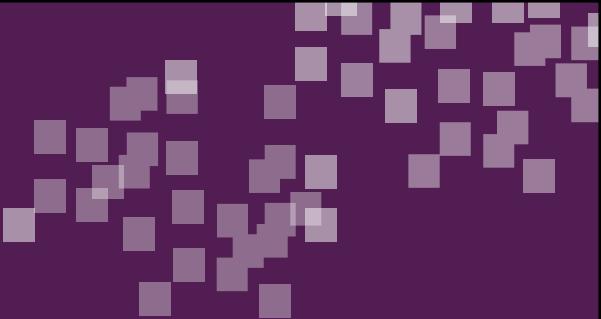
    string notes;
    public string Notes {
        get { return notes; }
        set {
            if (notes != value) {
                notes = value;
                PropertyChanged?.Invoke(
                    this, new PropertyChangedEventArgs(nameof(Notes)));
            }
        }
    }
}
```

Must raise the **PropertyChanged** event when any property is changed
– otherwise the UI will not update

INPC + Bindings

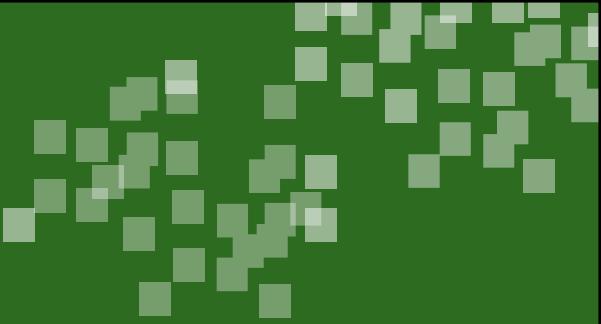
- ❖ Binding will subscribe to the **PropertyChanged** event and update the target property when it sees the source property notification





Individual Exercise

Keeping the UI and data in sync using Bindings



Flash Quiz

Flash Quiz

- ① The source data is supplied through _____ (Select all that apply).
- a) DataContext property
 - b) Binding.Source property
 - c) BindingContext property
 - d) None of the above

Flash Quiz

- ① The source data is supplied through _____ (Select all that apply).
- a) DataContext property
 - b) Binding.Source property
 - c) BindingContext property
 - d) None of the above

Flash Quiz

- ② The source can be any object
 - a) True
 - b) False

Flash Quiz

- ② The source can be any object
 - a) True
 - b) False

Flash Quiz

- ③ The target can be any object
 - a) True
 - b) False

Flash Quiz

- ③ The target can be any object
 - a) True
 - b) False

Flash Quiz

- ④ Model objects should perform the following steps when a property setter is called (pick the best answer):
- a) Change the property and raise the PropertyChanged event
 - b) Check if the property is different, change the property and raise the PropertyChanged event
 - c) Check if the property is different, raise the PropertyChanged event and then change the property
 - d) None of these are correct

Flash Quiz

- ④ Model objects should perform the following steps when a property setter is called (pick the best answer):
- a) Change the property and raise the PropertyChanged event
 - b) Check if the property is different, change the property and raise the PropertyChanged event
 - c) Check if the property is different, raise the PropertyChanged event and then change the property
 - d) None of these are correct

Summary

1. Map data to visuals
2. Create bindings in code
3. Create bindings in XAML
4. Work with binding context
5. Change binding modes
6. Implement property change notifications





Use value converters to bind incompatible types

Tasks

1. Perform textual conversions in XAML
2. Create a value converter
3. Apply a value converter in XAML



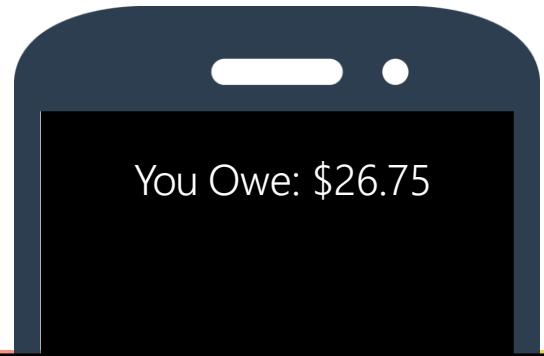
Simple Textual Conversions

- ❖ Binding can do simple, text formatting when going from Source > Target

```
public double BillAmount { get; set; }
```

```
<Label Text="{Binding BillAmount,  
           StringFormat='You Owe: {0:C}'}"/>
```

Binding calls a **String.Format** passing the specified format string and the source value before assigning it to the target



Going beyond textual formatting

- ❖ Bindings attempt to automatically coerce data when C# would allow it, but sometimes the data available isn't quite what the UI needs to display

Enter Password



Invalid

Enter Password



Excellent

Want the text color to change based on the password strength

```
<Label Text="{Binding PasswordStrength}"  
      TextColor="{Binding PasswordStrength}"  
      FontSize="24" />
```

Value Converters

- ❖ Value Converters enable type coercion and formatting
- ❖ Assigned to **Converter** property of Binding
- ❖ Supports optional parameter (**Binding.ConverterParameter**)

```
public interface IValueConverter
{
    object Convert(object value,
                  Type targetType,
                  object parameter,
                  CultureInfo culture);

    object ConvertBack(object value,
                      Type targetType,
                      object parameter,
                      CultureInfo culture);
}
```

Convert used for source ➔ target

ConvertBack used for target ➔ source

Creating a Value Converter

```
public class PWStrengthConverter : IValueConverter
{
    public object Convert(object value, Type targetType, object parameter, CultureInfo culture)
    {
        PasswordStrength pwdstr = (PasswordStrength) value;
        ...
        return Color.Red;
    }

    public object ConvertBack(object value, Type targetType, object parameter, CultureInfo culture)
    {
        throw new NotSupportedException();
    }
}
```

Converter performs whatever translation is necessary to provide target with data – this can be simple conversions or even completely different objects!

Creating a Value Converter

```
public class PWStrengthConverter
{
    public object Convert(object value, Type targetType, object parameter, CultureInfo culture)
    {
        PasswordStrength pwdstr =
        ...
        return Color.Red;
    }

    public object ConvertBack(object value, Type targetType, object parameter, CultureInfo culture)
    {
        throw new NotSupportedException();
    }
}
```

Provides backwards conversion for two-way binding, or can throw exception if this not supported – this will cause a runtime failure

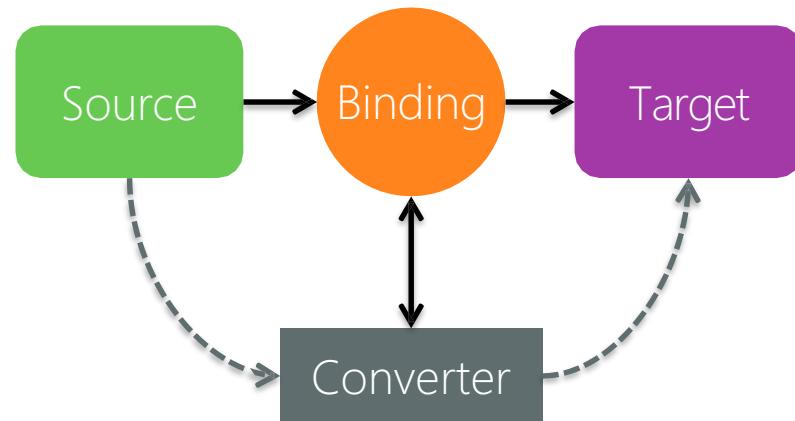
Using a Value Converter

- ❖ Value Converter is assigned to the binding **Converter** property

```
var binding = new Binding("PasswordStrength"){  
    Converter = new PWStrengthConverter()  
};
```

```
<ContentPage.Resources>  
    <ResourceDictionary>  
        <c:PWStrengthConverter x:Key="pwsCvt"/>  
    </ResourceDictionary>  
</ContentPage.Resources>
```

```
<Label TextColor="{Binding PasswordStrength,  
    Converter={StaticResource pwsCvt}} " />
```



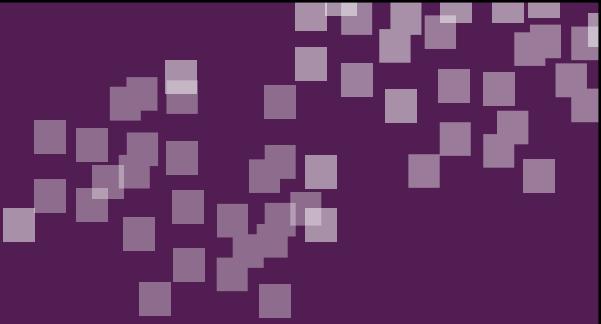
Binding passes values through converter

Debugging Bindings

- ❖ Can use dummy converter to debug data bindings – gets called during the data transfer and provides for a convenient breakpoint location

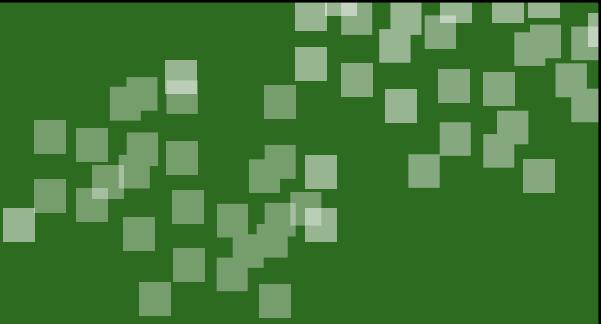
```
10 public class DummyConverter : IValueConverter
11 {
12     public object Convert(object value, Type targetType,
13     object parameter, CultureInfo culture) {
14         return value;
15     }
16
17     public object ConvertBack(object value, Type targetType,
18     object parameter, CultureInfo culture) {
19         return value;
20     }
21 }
```

 Check out <https://github.com/xamarinhq/xamu-infrastructure> for several great reusable value converters – including this one



Individual Exercise

Using Value Converters



Flash Quiz

Flash Quiz

- ① **IValueConverter.Convert** is called when going from _____ to _____
- a) Source > Target
 - b) Target > Source

Flash Quiz

- ① **IValueConverter.Convert** is called when going from _____ to _____
- a) Source > Target
 - b) Target > Source

Flash Quiz

- ② To pass a binding-specific parameter to a value converter, you can set the _____ property.
- a. Parameter
 - b. ConversionParameter
 - c. ConverterParameter
 - d. BindingParameter

Flash Quiz

- ② To pass a binding-specific parameter to a value converter, you can set the _____ property.
- a. Parameter
 - b. ConversionParameter
 - c. ConverterParameter
 - d. BindingParameter

Flash Quiz

- ③ **Binding.StringFormat** can be used to convert an integer type to a double type
 - a. True
 - b. False

Flash Quiz

- ③ **Binding.StringFormat** can be used to convert an integer type to a double type
 - a. True
 - b. False

Summary

1. Perform textual conversions in XAML
2. Create a value converter
3. Apply a value converter in XAML



Thank You!