Chapter 23: Creating custom controls

Every `Xamarin.Forms` view has an accompanying renderer for each platform that creates an instance of a native control. When a View is rendered on the specific platform the `ViewRenderer` class is instantiated.

The process for doing this is as follows:

Create a Xamarin.Forms custom control.

Consume the custom control from Xamarin.Forms.

Create the custom renderer for the control on each platform.

Section 23.1: Label with bindable collection of Spans

I created custom label with wrapper around `FormattedText` property:

```
public class MultiComponentLabel : Label
{
    public IList<TextComponent> Components { get; set; }

    public MultiComponentLabel()
    {
        var components = new ObservableCollection<TextComponent>();
        components.CollectionChanged += OnComponentsChanged;
        Components = components;
    }

    private void OnComponentsChanged(object sender, NotifyCollectionChangedEventArgs e)
    {
        BuildText();
    }

    private void OnComponentPropertyChanged(object sender,
System.ComponentModel.PropertyChangedEventArgs e)
    {
        BuildText();
    }

    private void BuildText()
    {
        var formattedString = new FormattedString();
        foreach (var component in Components)
        {
            formattedString.Spans.Add(new Span { Text = component.Text });
            component.PropertyChanged -= OnComponentPropertyChanged;
            component.PropertyChanged += OnComponentPropertyChanged;
        }

        FormattedText = formattedString;
    }
}
```

I added collection of custom `TextComponents`:

```
public class TextComponent : BindableObject
{
    public static readonly BindableProperty TextProperty =
```

```
        BindableProperty.Create(nameof(Text),
                                typeof(string),
                                typeof(TextComponent),
                                default(string));

    public string Text
    {
        get { return (string)GetValue(TextProperty); }
        set { SetValue(TextProperty, value); }
    }
}
```

And when collection of text components changes or `Text` property of separate component changes I rebuild `FormattedText` property of base `Label`.

And how I used it in `XAML`:

```
<ContentPage x:Name="Page"
        xmlns="http://xamarin.com/schemas/2014/forms"
        xmlns:x="http://schemas.microsoft.com/winfx/2009/xaml"
        xmlns:controls="clr-namespace:SuperForms.Controls;assembly=SuperForms.Controls"
        x:Class="SuperForms.Samples.MultiComponentLabelPage">
<controls:MultiComponentLabel Margin="0,20,0,0">
    <controls:MultiComponentLabel.Components>
      <controls:TextComponent Text="Time"/>
      <controls:TextComponent Text=": "/>
      <controls:TextComponent Text="{Binding CurrentTime, Source={x:Reference Page}}"/>
    </controls:MultiComponentLabel.Components>
  </controls:MultiComponentLabel>
</ContentPage>
```

Codebehind of page:

```
public partial class MultiComponentLabelPage : ContentPage
{
    private string _currentTime;

    public string CurrentTime
    {
        get { return _currentTime; }
        set
        {
            _currentTime = value;
            OnPropertyChanged();
        }
    }

    public MultiComponentLabelPage()
    {
        InitializeComponent();
        BindingContext = this;
    }

    protected override void OnAppearing()
    {
        base.OnAppearing();

        Device.StartTimer(TimeSpan.FromSeconds(1), () =>
        {
            CurrentTime = DateTime.Now.ToString("hh : mm : ss");
```

```
            return true;
        });
    }
}
```

Section 23.2: Implementing a CheckBox Control

In this example we will implement a custom Checkbox for Android and iOS.

Creating the Custom Control

```
namespace CheckBoxCustomRendererExample
{
    public class Checkbox : View
    {
        public static readonly BindableProperty IsCheckedProperty =
BindableProperty.Create<Checkbox, bool>(p => p.IsChecked, true, propertyChanged: (s, o, n) => { (s
as Checkbox).OnChecked(new EventArgs()); });
        public static readonly BindableProperty ColorProperty = BindableProperty.Create<Checkbox,
Color>(p => p.Color, Color.Default);

        public bool IsChecked
        {
            get
            {
                return (bool)GetValue(IsCheckedProperty);
            }
            set
            {
                SetValue(IsCheckedProperty, value);
            }
        }

        public Color Color
        {
            get
            {
                return (Color)GetValue(ColorProperty);
            }
            set
            {
                SetValue(ColorProperty, value);
            }
        }

        public event EventHandler Checked;

        protected virtual void OnChecked(EventArgs e)
        {
            if (Checked != null)
                Checked(this, e);
        }
    }
}
```

We'll start off with the Android Custom Renderer by creating a new class (`CheckboxCustomRenderer`) in the `Android` portion of our solution.

A few important details to note:

- We need to mark the top of our class with the ExportRenderer attribute so that the renderer is registered

with `Xamarin.Forms`. This way, `Xamarin.Forms` will use this renderer when it's trying to create our `Checkbox` object on `Android`.

- We're doing most of our work in the `OnElementChanged` method, where we instantiate and set up our native control.

Consuming the Custom Control

```
<ContentPage xmlns="http://xamarin.com/schemas/2014/forms"
xmlns:x="http://schemas.microsoft.com/winfx/2009/xaml" xmlns:local="clr-
namespace:CheckBoxCustomRendererExample"
x:Class="CheckBoxCustomRendererExample.CheckBoxCustomRendererExamplePage">
    <StackLayout Padding="20">
        <local:Checkbox Color="Aqua" />
    </StackLayout>
</ContentPage>
```

Creating the Custom Renderer on each Platform

The process for creating the custom renderer class is as follows:

1. Create a subclass of the `ViewRenderer<T1,T2>` class that renders the custom control. The first type argument should be the custom control the renderer is for, in this case `CheckBox`. The second type argument should be the native control that will implement the custom control.
2. Override the `OnElementChanged` method that renders the custom control and write logic to customize it. This method is called when the corresponding `Xamarin.Forms` control is created.
3. Add an `ExportRenderer` attribute to the custom renderer class to specify that it will be used to render the `Xamarin.Forms` custom control. This attribute is used to register the custom renderer with `Xamarin.Forms`.

Creating the Custom Renderer for Android

```
[assembly: ExportRenderer(typeof(Checkbox), typeof(CheckBoxRenderer))]
namespace CheckBoxCustomRendererExample.Droid
{
    public class CheckBoxRenderer : ViewRenderer<Checkbox, CheckBox>
    {
        private CheckBox checkBox;

        protected override void OnElementChanged(ElementChangedEventArgs<Checkbox> e)
        {
            base.OnElementChanged(e);
            var model = e.NewElement;
            checkBox = new CheckBox(Context);
            checkBox.Tag = this;
            CheckboxPropertyChanged(model, null);
            checkBox.SetOnClickListener(new ClickListener(model));
            SetNativeControl(checkBox);
        }
        private void CheckboxPropertyChanged(Checkbox model, String propertyName)
        {
            if (propertyName == null || Checkbox.IsCheckedProperty.PropertyName == propertyName)
            {
                checkBox.Checked = model.IsChecked;
            }

            if (propertyName == null || Checkbox.ColorProperty.PropertyName == propertyName)
            {
                int[][] states = {
                    new int[] { Android.Resource.Attribute.StateEnabled}, // enabled
                    new int[] {Android.Resource.Attribute.StateEnabled}, // disabled
                    new int[] {Android.Resource.Attribute.StateChecked}, // unchecked
```

```
                    new int[] { Android.Resource.Attribute.StatePressed}  // pressed
                };
                var checkBoxColor = (int)model.Color.ToAndroid();
                int[] colors = {
                    checkBoxColor,
                    checkBoxColor,
                    checkBoxColor,
                    checkBoxColor
                };
                var myList = new Android.Content.Res.ColorStateList(states, colors);
                checkBox.ButtonTintList = myList;

            }
        }

        protected override void OnElementPropertyChanged(object sender, PropertyChangedEventArgs e)
        {
            if (checkBox != null)
            {
                base.OnElementPropertyChanged(sender, e);

                CheckboxPropertyChanged((Checkbox)sender, e.PropertyName);
            }
        }

        public class ClickListener : Java.Lang.Object, IOnClickListener
        {
            private Checkbox _myCheckbox;
            public ClickListener(Checkbox myCheckbox)
            {
                this._myCheckbox = myCheckbox;
            }
            public void OnClick(global::Android.Views.View v)
            {
                _myCheckbox.IsChecked = !_myCheckbox.IsChecked;
            }
        }
    }
}
```

Creating the Custom Renderer for iOS

Since in iOS the is no built in checkbox, we will create a `CheckBoxView` first a then create a renderer for our Xamarin.Forms checkbox.

The `CheckBoxView` is based in two images the checked_checkbox.png and the unchecked_checkbox.png so the property `Color` will be ignored.

The CheckBox view:

```
namespace CheckBoxCustomRendererExample.iOS
{
    [Register("CheckBoxView")]
    public class CheckBoxView : UIButton
    {
        public CheckBoxView()
        {
            Initialize();
        }
```

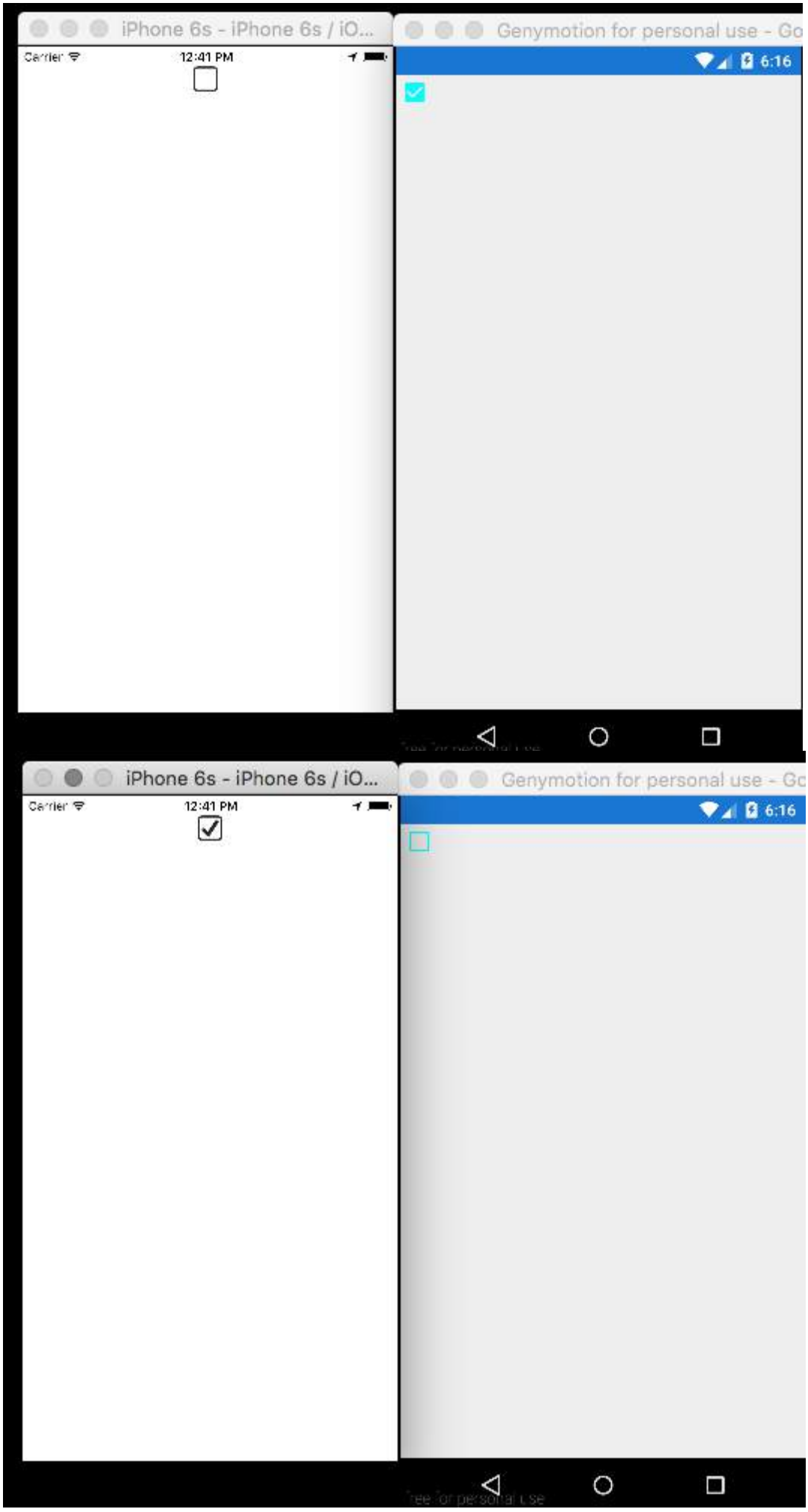
```
        public CheckBoxView(CGRect bounds)
            : base(bounds)
        {
            Initialize();
        }

        public string CheckedTitle
        {
            set
            {
                SetTitle(value, UIControlState.Selected);
            }
        }

        public string UncheckedTitle
        {
            set
            {
                SetTitle(value, UIControlState.Normal);
            }
        }

        public bool Checked
        {
            set { Selected = value; }
            get { return Selected; }
        }

        void Initialize()
        {
            ApplyStyle();

            TouchUpInside += (sender, args) => Selected = !Selected;
            // set default color, because type is not UIButtonType.System
            SetTitleColor(UIColor.DarkTextColor, UIControlState.Normal);
            SetTitleColor(UIColor.DarkTextColor, UIControlState.Selected);
        }

        void ApplyStyle()
        {
            SetImage(UIImage.FromBundle("Images/checked_checkbox.png"), UIControlState.Selected);
            SetImage(UIImage.FromBundle("Images/unchecked_checkbox.png"), UIControlState.Normal);
        }
    }
}
```

The CheckBox custom renderer:

```
[assembly: ExportRenderer(typeof(Checkbox), typeof(CheckBoxRenderer))]
namespace CheckBoxCustomRendererExample.iOS
{
    public class CheckBoxRenderer : ViewRenderer<Checkbox, CheckBoxView>
    {

        /// <summary>
        /// Handles the Element Changed event
        /// </summary>
        /// <param name="e">The e.</param>
        protected override void OnElementChanged(ElementChangedEventArgs<Checkbox> e)
        {
            base.OnElementChanged(e);
```

```
            if (Element == null)
                return;

            BackgroundColor = Element.BackgroundColor.ToUIColor();
            if (e.NewElement != null)
            {
                if (Control == null)
                {
                    var checkBox = new CheckBoxView(Bounds);
                    checkBox.TouchUpInside += (s, args) => Element.IsChecked = Control.Checked;
                    SetNativeControl(checkBox);
                }
                Control.Checked = e.NewElement.IsChecked;
            }

            Control.Frame = Frame;
            Control.Bounds = Bounds;

        }

        /// <summary>
        /// Handles the <see cref="E:ElementPropertyChanged" /> event.
        /// </summary>
        /// <param name="sender">The sender.</param>
        /// <param name="e">The <see cref="PropertyChangedEventArgs"/> instance containing the event
data.</param>
        protected override void OnElementPropertyChanged(object sender, PropertyChangedEventArgs e)
        {
            base.OnElementPropertyChanged(sender, e);

            if (e.PropertyName.Equals("Checked"))
            {
                Control.Checked = Element.IsChecked;
            }
        }
    }
}
```

Result:


iPhone 6s - iPhone 6s / iO...
Carrier
12:41 PM
Genymotion for personal use - Go
6:16
iPhone 6s - iPhone 6s / iO...
Carrier
12:41 PM
Genymotion for personal use - Go
6:16

Section 23.3: Create an Xamarin Forms custom input control (no native required)

Below is an example of a pure Xamarin Forms custom control. No custom rendering is being done for this but could easily be implemented, in fact, in my own code, I use this very same control along with a custom renderer for both the `Label` and `Entry`.

The custom control is a `ContentView` with a `Label`, `Entry`, and a `BoxView` within it, held in place using 2 `StackLayouts`. We also define multiple bindable properties as well as a `TextChanged` event.

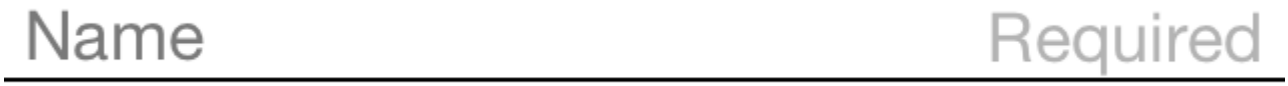
The custom bindable properties work by being defined as they are below and having the elements within the control (in this case a `Label` and an `Entry`) being bound to the custom bindable properties. A few on the bindable properties need to also implement a `BindingPropertyChangedDelegate` in order to make the bounded elements change their values.

```
public class InputFieldContentView : ContentView {

    #region Properties

    /// <summary>
    /// Attached to the <c>InputFieldContentView</c>'s <c>ExtendedEntryOnTextChanged()</c> event, but returns the <c>sender</c> as <c>InputFieldContentView</c>.
    /// </summary>
    public event System.EventHandler<TextChangedEventArgs> OnContentViewTextChangedEvent; //In OnContentViewTextChangedEvent() we return our custom InputFieldContentView control as the sender but we could have returned the Entry itself as the sender if we wanted to do that instead.

    public static readonly BindableProperty LabelTextProperty = BindableProperty.Create("LabelText", typeof(string), typeof(InputFieldContentView), string.Empty);

    public string LabelText {
        get { return (string)GetValue(LabelTextProperty); }
        set { SetValue(LabelTextProperty, value); }
    }

    public static readonly BindableProperty LabelColorProperty = BindableProperty.Create("LabelColor", typeof(Color), typeof(InputFieldContentView), Color.Default);

    public Color LabelColor {
        get { return (Color)GetValue(LabelColorProperty); }
        set { SetValue(LabelColorProperty, value); }
    }

    public static readonly BindableProperty EntryTextProperty = BindableProperty.Create("EntryText", typeof(string), typeof(InputFieldContentView), string.Empty, BindingMode.TwoWay, null, OnEntryTextChanged);

    public string EntryText {
        get { return (string)GetValue(EntryTextProperty); }
        set { SetValue(EntryTextProperty, value); }
    }

    public static readonly BindableProperty PlaceholderTextProperty = BindableProperty.Create("PlaceholderText", typeof(string), typeof(InputFieldContentView), string.Empty);

    public string PlaceholderText {
        get { return (string)GetValue(PlaceholderTextProperty); }
        set { SetValue(PlaceholderTextProperty, value); }
```

```
    }

    public static readonly BindableProperty UnderlineColorProperty =
BindableProperty.Create("UnderlineColor", typeof(Color), typeof(InputFieldContentView),
Color.Black, BindingMode.TwoWay, null, UnderlineColorChanged);

    public Color UnderlineColor {
        get { return (Color)GetValue(UnderlineColorProperty); }
        set { SetValue(UnderlineColorProperty, value); }
    }

    private BoxView _underline;

    #endregion

    public InputFieldContentView() {

        BackgroundColor   = Color.Transparent;
        HorizontalOptions = LayoutOptions.FillAndExpand;

        Label label = new Label {
            BindingContext    = this,
            HorizontalOptions = LayoutOptions.StartAndExpand,
            VerticalOptions   = LayoutOptions.Center,
            TextColor         = Color.Black
        };

        label.SetBinding(Label.TextProperty, (InputFieldContentView view) => view.LabelText,
BindingMode.TwoWay);
        label.SetBinding(Label.TextColorProperty, (InputFieldContentView view) => view.LabelColor,
BindingMode.TwoWay);

        Entry entry = new Entry {
            BindingContext          = this,
            HorizontalOptions       = LayoutOptions.End,
            TextColor               = Color.Black,
            HorizontalTextAlignment = TextAlignment.End
        };

        entry.SetBinding(Entry.PlaceholderProperty, (InputFieldContentView view) =>
view.PlaceholderText, BindingMode.TwoWay);
        entry.SetBinding(Entry.TextProperty, (InputFieldContentView view) => view.EntryText,
BindingMode.TwoWay);

        entry.TextChanged += OnTextChangedEvent;

        _underline = new BoxView {
            BackgroundColor   = Color.Black,
            HeightRequest     = 1,
            HorizontalOptions = LayoutOptions.FillAndExpand
        };

        Content = new StackLayout {
            Spacing           = 0,
            HorizontalOptions = LayoutOptions.FillAndExpand,
            Children          = {
                new StackLayout {
                    Padding           = new Thickness(5, 0),
                    Spacing           = 0,
                    HorizontalOptions = LayoutOptions.FillAndExpand,
                    Orientation       = StackOrientation.Horizontal,
                    Children          = { label, entry }
```

```
                }, _underline
            }
        };

        SizeChanged += (sender, args) => entry.WidthRequest = Width * 0.5 - 10;
    }

    private static void OnEntryTextChanged(BindableObject bindable, object oldValue, object
newValue) {
        InputFieldContentView contentView = (InputFieldContentView)bindable;
        contentView.EntryText             = (string)newValue;
    }

    private void OnTextChangedEvent(object sender, TextChangedEventArgs args) {
        if(OnContentViewTextChangedEvent != null) { OnContentViewTextChangedEvent(this, new
TextChangedEventArgs(args.OldTextValue, args.NewTextValue)); } //Here is where we pass in 'this'
(which is the InputFieldContentView) instead of 'sender' (which is the Entry control)
    }

    private static void UnderlineColorChanged(BindableObject bindable, object oldValue, object
newValue) {
        InputFieldContentView contentView      = (InputFieldContentView)bindable;
        contentView._underline.BackgroundColor = (Color)newValue;
    }
}
```

And here is a picture of the final product on iOS (the image shows what it looks like when using a custom renderer for the `Label` and `Entry` which is being used to remove the border on iOS and to specify a custom font for both



elements):

One issue I ran into was getting the `BoxView.BackgroundColor` to change when `UnderlineColor` changed. Even after binding the `BoxView`'s `BackgroundColor` property, it would not change until I added the `UnderlineColorChanged` delegate.

Section 23.4: Creating a custom Entry control with a MaxLength property

The Xamarin Forms `Entry` control does not have a `MaxLength` property. To achieve this you can extend `Entry` as below, by adding a Bindable `MaxLength` property. Then you just need to subscribe to the `TextChanged` event on `Entry` and validate the length of the `Text` when this is called:

```
class CustomEntry : Entry
{
    public CustomEntry()
    {
        base.TextChanged += Validate;
    }

    public static readonly BindableProperty MaxLengthProperty =
BindableProperty.Create(nameof(MaxLength), typeof(int), typeof(CustomEntry), 0);

    public int MaxLength
    {
        get { return (int)GetValue(MaxLengthProperty); }
        set { SetValue(MaxLengthProperty, value); }
    }
```

```
    public void Validate(object sender, TextChangedEventArgs args)
    {
        var e = sender as Entry;
        var val = e?.Text;

        if (string.IsNullOrEmpty(val))
            return;

        if (MaxLength > 0 && val.Length > MaxLength)
            val = val.Remove(val.Length - 1);

        e.Text = val;
    }
}
```

Usage in XAML:

```
   <ContentView xmlns="http://xamarin.com/schemas/2014/forms"
        xmlns:x="http://schemas.microsoft.com/winfx/2009/xaml"
        xmlns:customControls="clr-namespace:CustomControls;assembly=CustomControls"
        x:Class="Views.TestView">
<ContentView.Content>
    <customControls:CustomEntry MaxLength="10" />
</ContentView.Content>
```

Section 23.5: Creating custom Button

```
/// <summary>
/// Button with some additional options
/// </summary>
public class TurboButton : Button
{
    public static readonly BindableProperty StringDataProperty = BindableProperty.Create(
      propertyName: "StringData",
      returnType: typeof(string),
      declaringType: typeof(ButtonWithStorage),
      defaultValue: default(string));

    public static readonly BindableProperty IntDataProperty = BindableProperty.Create(
      propertyName: "IntData",
      returnType: typeof(int),
      declaringType: typeof(ButtonWithStorage),
      defaultValue: default(int));

    /// <summary>
    /// You can put here some string data
    /// </summary>
    public string StringData
    {
        get { return (string)GetValue(StringDataProperty); }
        set { SetValue(StringDataProperty, value); }
    }

    /// <summary>
    /// You can put here some int data
    /// </summary>
    public int IntData
    {
        get { return (int)GetValue(IntDataProperty); }
```

```
        set { SetValue(IntDataProperty, value); }
    }

    public TurboButton()
    {
        PropertyChanged += CheckIfPropertyLoaded;
    }

    /// <summary>
    /// Called when one of properties is changed
    /// </summary>
    private void CheckIfPropertyLoaded(object sender, PropertyChangedEventArgs e)
    {
        //example of using PropertyChanged
        if(e.PropertyName == "IntData")
        {
            //IntData is now changed, you can operate on updated value
        }
    }
}
```

Usage in XAML:

```
<?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="SomeApp.Pages.SomeFolder.Example"
   xmlns:customControls="clr-namespace:SomeApp.CustomControls;assembly=SomeApp">
    <StackLayout>
        <customControls:TurboButton x:Name="exampleControl" IntData="2" StringData="Test" />
    </StackLayout>
</ContentPage>
```

Now, you can use your properties in c#:

```
exampleControl.IntData
```

Note that you need to specify by yourself where your TurboButton class is placed in your project. I've done it in this line:

```
xmlns:customControls="clr-namespace:SomeApp.CustomControls;assembly=SomeApp"
```

You can freely change "customControls" to some other name. It's up to you how you will call it.