Chapter 6

Button clicks

The components of a graphical user interface can be divided roughly into views that are used for presentation, which display information *to* the user, and interaction, which obtain input *from* the user. While the `Label` is the most basic presentation view, the `Button` is probably the archetypal interactive view. The `Button` signals a command. It's the user's way of telling the program to initiate some action—to do something.

A Xamarin.Forms button displays text, with or without an accompanying image. (Only text buttons are described in this chapter; adding an image to a button is covered in Chapter 13, "Bitmaps.") When the user's finger presses on a button, the button changes its appearance somewhat to provide feedback to the user. When the finger is released, the button fires a `Clicked` event. The two arguments of the `Clicked` handler are typical of Xamarin.Forms event handlers:

- The first argument is the object firing the event. For the `Clicked` handler, this is the particular `Button` object that's been tapped.
- The second argument sometimes provides more information about the event. For the `Clicked` event, the second argument is simply an `EventArgs` object that provides no additional information.

Once an application begins implementing user interaction, some special needs arise: The application should make an effort to save the results of that interaction if the program happens to be terminated before the user has finished working with it. For that reason, this chapter also discusses how an application can save transient data, particularly in the context of application lifecycle events. These are described in the section "Saving transient data."

Processing the click

Here's a program named **ButtonLogger** with a `Button` that shares a `StackLayout` with a `ScrollView` containing another `StackLayout`. Every time the `Button` is clicked, the program adds a new `Label` to the scrollable `StackLayout`, in effect logging all the button clicks:

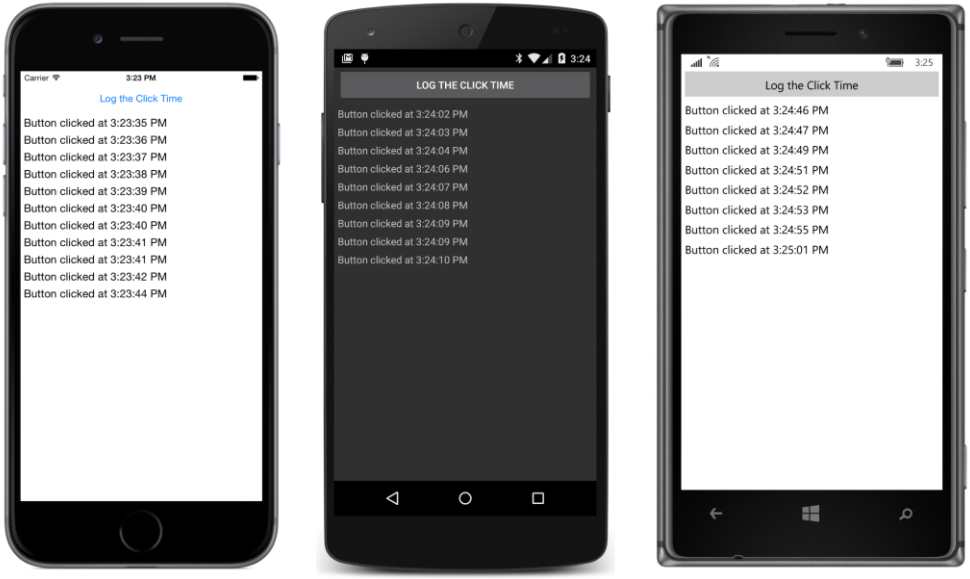
```
public class ButtonLoggerPage : ContentPage
{
    StackLayout loggerLayout = new StackLayout();

    public ButtonLoggerPage()
    {
        // Create the Button and attach Clicked handler.
        Button button = new Button
```

```
        {
            Text = "Log the Click Time"
        };
        button.Clicked += OnButtonClicked;

        this.Padding = new Thickness(5, Device.OnPlatform(20, 0, 0), 5, 0);

        // Assemble the page.
        this.Content = new StackLayout
        {
            Children =
            {
                button,
                new ScrollView
                {
                    VerticalOptions = LayoutOptions.FillAndExpand,
                    Content = loggerLayout
                }
            }
        };
    }

    void OnButtonClicked(object sender, EventArgs args)
    {
        // Add Label to scrollable StackLayout.
        loggerLayout.Children.Add(new Label
        {
            Text = "Button clicked at " + DateTime.Now.ToString("T")
        });
    }
}
```

In the programs in this book, event handlers are given names beginning with the word `On`, followed by some kind of identification of the view firing the event (sometimes just the view type), followed by the event name. The resultant name in this case is `OnButtonClicked`.

The constructor attaches the `Clicked` handler to the `Button` right after the `Button` is created. The page is then assembled with a `StackLayout` containing the `Button` and a `ScrollView` with another `StackLayout`, named `loggerLayout`. Notice that the `ScrollView` has its `VerticalOptions` set to `FillAndExpand` so that it can share the `StackLayout` with the `Button` and still be visible and scrollable.

Here's the display after several `Button` clicks:



As you can see, the `Button` looks a little different on the three screens. That's because the button is rendered natively on the individual platforms: on the iPhone it's a `UIButton`, on Android it's an Android `Button`, and on Windows 10 Mobile it's a Windows Runtime `Button`. By default the button always fills the area available for it and centers the text inside.

`Button` defines several properties that let you customize its appearance:

- `FontFamily` of type `string`
- `FontSize` of type `double`
- `FontAttributes` of type `FontAttributes`
- `TextColor` of type `Color` (default is `Color.Default`)
- `BorderColor` of type `Color` (default is `Color.Default`)
- `BorderWidth` of type `double` (default is 0)
- `BorderRadius` of type `double` (default is 5)
- `Image` (to be discussed in Chapter 13)

`Button` also inherits the `BackgroundColor` property (and a bunch of other properties) from `VisualElement` and inherits `HorizontalOptions` and `VerticalOptions` from `View`.

Some `Button` properties might work a little differently on the various platforms. As you can see, none of the buttons in the screenshots has a border. (However, the Windows Phone 8.1 button has a visible white border by default.) If you set the `BorderWidth` property to a nonzero value, the border

becomes visible only on the iPhone, and it's black. If you set the `BorderColor` property to something other than `Color.Default`, the border is visible only on the Windows 10 Mobile device. If you want a visible border on both iOS and Windows 10 mobile devices, set both `BorderWidth` and `BorderColor`. But the border still won't show up on Android devices unless you also set the `BackgroundColor` property. Customizing a button border is a good opportunity for using `Device.OnPlatform` (as you'll see in Chapter 10, "XAML markup extensions").

The `BorderRadius` property is intended to round off the sharp corners of the border, and it works on iOS and Android if the border is displayed, but it doesn't work on Windows 10 and Windows 10 Mobile. The `BorderRadius` works on Windows 8.1 and Windows Phone 8.1, but if you use it with `BackgroundColor`, the background is not enclosed within the border.

Suppose you wrote a program similar to **ButtonLogger** but did not save the `loggerLayout` object as a field. Could you get access to that `StackLayout` object in the `Clicked` event handler?

Yes! It's possible to obtain parent and child visual elements by a technique called *walking the visual tree*. The `sender` argument to the `OnButtonClicked` handler is the object firing the event, in this case the `Button`, so you can begin the `Clicked` handler by casting that argument:

```
Button button = (Button)sender;
```

You know that the `Button` is a child of a `StackLayout`, so that object is accessible from the `Parent` property. Again, some casting is required:

```
StackLayout outerLayout = (StackLayout)button.Parent;
```

The second child of this `StackLayout` is the `ScrollView`, so the `Children` property can be indexed to obtain that:

```
ScrollView scrollView = (ScrollView)outerLayout.Children[1];
```

The `Content` property of this `ScrollView` is exactly the `StackLayout` you were looking for:

```
StackLayout loggerLayout = (StackLayout)scrollView.Content;
```

Of course, the danger in doing something like this is that you might change the layout someday and forget to change your tree-walking code similarly. But the technique comes in handy if the code that assembles your page is separate from the code handling events from views on that page.

Sharing button clicks

If a program contains multiple `Button` views, each `Button` can have its own `Clicked` handler. But in some cases it might be more convenient for multiple `Button` views to share a common `Clicked` handler.

Consider a calculator program. Each of the buttons labeled 0 through 9 basically does the same

thing, and having 10 separate `Clicked` handlers for these 10 buttons—even if they share some common code—simply wouldn't make much sense.

You've seen how the first argument to the `Clicked` handler can be cast to an object of type `Button`. But how do you know which `Button` it is?

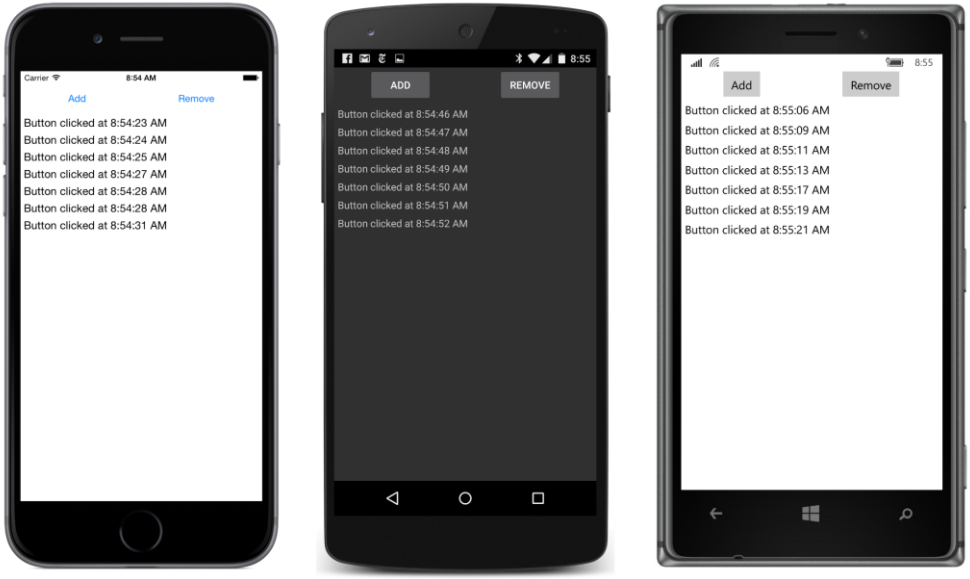
One approach is to store all the `Button` objects as fields and then compare the `Button` object firing the event with these fields.

The **TwoButtons** program demonstrates this technique. This program is similar to the previous program but with two buttons—one to add `Label` objects to the `StackLayout`, and the other to remove them. The two `Button` objects are stored as fields so that the `Clicked` handler can determine which one fired the event:

```
public class TwoButtonsPage : ContentPage
{
    Button addButton, removeButton;
    StackLayout loggerLayout = new StackLayout();

    public TwoButtonsPage()
    {
        // Create the Button views and attach Clicked handlers.
        addButton = new Button
        {
            Text = "Add",
            HorizontalOptions = LayoutOptions.CenterAndExpand
        };
        addButton.Clicked += OnButtonClicked;

        removeButton = new Button
        {
            Text = "Remove",
            HorizontalOptions = LayoutOptions.CenterAndExpand,
            IsEnabled = false
        };
        removeButton.Clicked += OnButtonClicked;

        this.Padding = new Thickness(5, Device.OnPlatform(20, 0, 0), 5, 0);

        // Assemble the page.
        this.Content = new StackLayout
        {
            Children =
            {
                new StackLayout
                {
                    Orientation = StackOrientation.Horizontal,
                    Children =
                    {
                        addButton,
                        removeButton
                    }
```

```
                },

                new ScrollView
                {
                    VerticalOptions = LayoutOptions.FillAndExpand,
                    Content = loggerLayout
                }
            }
        };
    }

    void OnButtonClicked(object sender, EventArgs args)
    {
        Button button = (Button)sender;

        if (button == addButton)
        {
            // Add Label to scrollable StackLayout.
            loggerLayout.Children.Add(new Label
            {
                Text = "Button clicked at " + DateTime.Now.ToString("T")
            });
        }
        else
        {
            // Remove topmost Label from StackLayout.
            loggerLayout.Children.RemoveAt(0);
        }

        // Enable "Remove" button only if children are present.
        removeButton.IsEnabled = loggerLayout.Children.Count > 0;
    }
}
```

Both buttons are given a `HorizontalOptions` value of `CenterAndExpand` so that they can be displayed side by side at the top of the screen by using a horizontal `StackLayout`:



Notice that when the `Clicked` handler detects `removeButton`, it simply calls the `RemoveAt` method on the `Children` property:

```
loggerLayout.Children.RemoveAt(0);
```

But what happens if there are no children? Won't `RemoveAt` raise an exception?

It can't happen! When the **TwoButtons** program begins, the `IsEnabled` property of the `removeButton` is initialized to `false`. When a button is disabled in this way, a dim appearance signals to the user that it's nonfunctional. It does not provide feedback to the user and it does not fire `Clicked` events. Toward the end of the `Clicked` handler, the `IsEnabled` property on `removeButton` is set to `true` only if the `loggerLayout` has at least one child.

This illustrates a good general rule: if your code needs to determine whether a button `Clicked` event is valid, it's probably better to prevent invalid button clicks by disabling the button.

Anonymous event handlers

As with any event handler, you can define a `Clicked` handler as an anonymous lambda function. Here's a program named **ButtonLambdas** that has a `Label` displaying a number and two buttons. One button doubles the number, and the other halves the number. Normally, the number and `Label` variables would be saved as fields. But because the anonymous event handlers are defined right in the constructor after these variables are defined, the event handlers have access to these local variables:

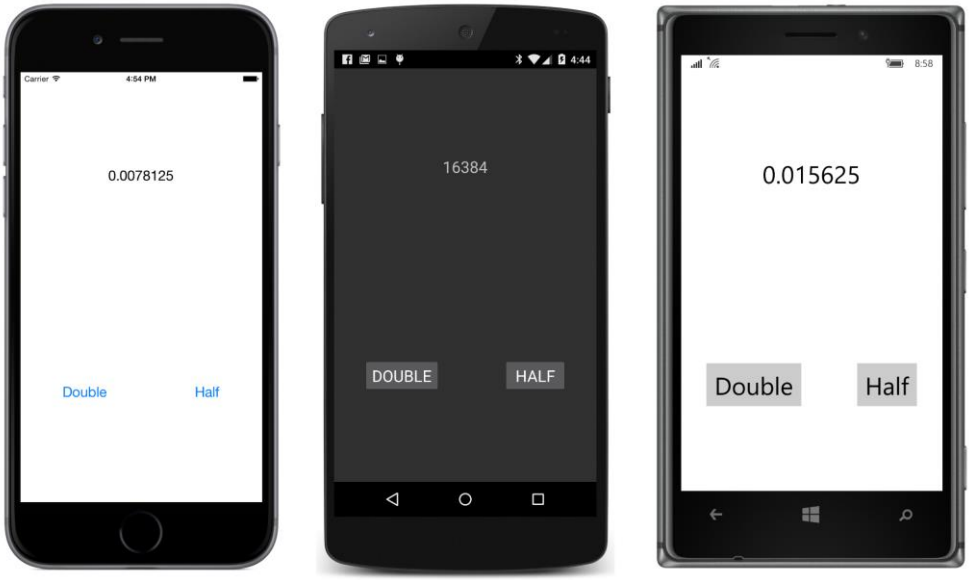
```
public class ButtonLambdasPage : ContentPage
{
```

```
public ButtonLambdasPage()
{
    // Number to manipulate.
    double number = 1;

    // Create the Label for display.
    Label label = new Label
    {
        Text = number.ToString(),
        FontSize = Device.GetNamedSize(NamedSize.Large, typeof(Label)),
        HorizontalOptions = LayoutOptions.Center,
        VerticalOptions = LayoutOptions.CenterAndExpand
    };

    // Create the first Button and attach Clicked handler.
    Button timesButton = new Button
    {
        Text = "Double",
        FontSize = Device.GetNamedSize(NamedSize.Large, typeof(Button)),
        HorizontalOptions = LayoutOptions.CenterAndExpand
    };
    timesButton.Clicked += (sender, args) =>
    {
        number *= 2;
        label.Text = number.ToString();
    };

    // Create the second Button and attach Clicked handler.
    Button divideButton = new Button
    {
        Text = "Half",
        FontSize = Device.GetNamedSize(NamedSize.Large, typeof(Button)),
        HorizontalOptions = LayoutOptions.CenterAndExpand
    };
    divideButton.Clicked += (sender, args) =>
    {
        number /= 2;
        label.Text = number.ToString();
    };

    // Assemble the page.
    this.Content = new StackLayout
    {
        Children =
        {
            label,
            new StackLayout
            {
                Orientation = StackOrientation.Horizontal,
                VerticalOptions = LayoutOptions.CenterAndExpand,
                Children =
                {
                    timesButton,
                    divideButton
```

```
                    }
                }
            }
        };
    }
}
```

Notice the use of `Device.GetNamedSize` to get large text for both the `Label` and the `Button`. When used with `Label`, the second argument of `GetNamedSize` should indicate a `Label`, and when used with the `Button` it should indicate a `Button`. The sizes for the two elements might be different.

Like the previous program, the two buttons share a horizontal `StackLayout`:



The disadvantage of defining event handlers as anonymous lambda functions is that they can't be shared among multiple views. (Actually they can, but some messy reflection code is involved.)

Distinguishing views with IDs

In the **TwoButtons** program, you saw a technique for sharing an event handler that distinguishes views by comparing objects. This works fine when there aren't very many views to distinguish, but it would be a terrible approach for a calculator program.

The `Element` class defines a `StyleId` property of type `string` specifically for the purpose of identifying views. It's not used for anything internal to Xamarin.Forms, so you can set it to whatever is convenient for the application. You can test the values by using `if` and `else` statements or in a `switch`

and `case` block, or you can use a `Parse` method to convert the strings into numbers or enumeration members.

The following program isn't a calculator, but it is a numeric keypad, which is certainly part of a calculator. The program is called **SimplestKeypad** and uses a `StackLayout` for organizing the rows and columns of keys. (One of the intents of this program is to demonstrate that `StackLayout` is not quite the right tool for this job!)

The program creates a total of five `StackLayout` instances. The `mainStack` is vertically oriented, and four horizontal `StackLayout` objects arrange the 10 digit buttons. To keep things simple, the keypad is arranged with telephone ordering rather than calculator ordering:

```
public class SimplestKeypadPage : ContentPage
{
    Label displayLabel;
    Button backspaceButton;

    public SimplestKeypadPage()
    {
        // Create a vertical stack for the entire keypad.
        StackLayout mainStack = new StackLayout
        {
            VerticalOptions = LayoutOptions.Center,
            HorizontalOptions = LayoutOptions.Center
        };

        // First row is the Label.
        displayLabel = new Label
        {
            FontSize = Device.GetNamedSize(NamedSize.Large, typeof(Label)),
            VerticalOptions = LayoutOptions.Center,
            HorizontalTextAlignment = TextAlignment.End
        };
        mainStack.Children.Add(displayLabel);

        // Second row is the backspace Button.
        backspaceButton = new Button
        {
            Text = "\u21E6",
            FontSize = Device.GetNamedSize(NamedSize.Large, typeof(Button)),
            IsEnabled = false
        };
        backspaceButton.Clicked += OnBackspaceButtonClicked;
        mainStack.Children.Add(backspaceButton);

        // Now do the 10 number keys.
        StackLayout rowStack = null;

        for (int num = 1; num <= 10; num++)
        {
            if ((num - 1) % 3 == 0)
            {
```

```
                rowStack = new StackLayout
                {
                    Orientation = StackOrientation.Horizontal
                };
                mainStack.Children.Add(rowStack);
            }

            Button digitButton = new Button
            {
                Text = (num % 10).ToString(),
                FontSize = Device.GetNamedSize(NamedSize.Large, typeof(Button)),
                StyleId = (num % 10).ToString()
            };
            digitButton.Clicked += OnDigitButtonClicked;

            // For the zero button, expand to fill horizontally.
            if (num == 10)
            {
                digitButton.HorizontalOptions = LayoutOptions.FillAndExpand;
            }
            rowStack.Children.Add(digitButton);
        }

        this.Content = mainStack;
    }

    void OnDigitButtonClicked(object sender, EventArgs args)
    {
        Button button = (Button)sender;
        displayLabel.Text += (string)button.StyleId;
        backspaceButton.IsEnabled = true;
    }

    void OnBackspaceButtonClicked(object sender, EventArgs args)
    {
        string text = displayLabel.Text;
        displayLabel.Text = text.Substring(0, text.Length - 1);
        backspaceButton.IsEnabled = displayLabel.Text.Length > 0;
    }
}
```

The 10 number keys share a single `Clicked` handler. The `StyleId` property indicates the number associated with the key, so the program can simply append that number to the string displayed by the `Label`. The `StyleId` happens to be identical to the `Text` property of the `Button`, and the `Text` property could be used instead, but in the general case, things aren't always quite that convenient.

The backspace `Button` is sufficiently different in function to warrant its own `Clicked` handler, although it would surely be possible to combine the two methods into one to take advantage of any code they might have in common.

To give the keypad a slightly larger size, all the text is given a `FontSize` using `NamedSize.Large`. Here are the three renderings of the **SimplestKeypad** program:

Of course, you'll want to press the keys repeatedly until you see how the program responds to a really large string of digits, and you'll discover that it doesn't adequately anticipate such a thing. When the `Label` gets too wide, it begins to govern the overall width of the vertical `StackLayout`, and the buttons start shifting as well.

Moreover, if the buttons contain letters or symbols rather than numbers, the buttons will be misaligned because each button width is based on its content.

Can you fix this problem with the `Expands` flag on the `HorizontalOptions` property? No. The `Expands` flag causes extra space to be distributed equally among the views in the `StackLayout`. Each view will increase additively by the same amount, but the buttons start out with different widths, and they will always have different widths. For example, take a look at the two buttons in the **TwoButtons** or **ButtonLambdas** program. Those buttons have their `HorizontalOptions` properties set to `Fill-AndExpand`, but they are different widths because the width of the button content is different.

A better solution for these programs is the layout known as the `Grid`, coming up in Chapter 17.

Saving transient data

Suppose you're entering an important number in the **SimplestKeypad** program and you're interrupted—perhaps with a phone call. Later on, you shut off the phone, effectively terminating the program.

What should happen the next time you run **SimplestKeypad**? Should the long string of numbers you entered earlier be discarded? Or should it seem as though the program resumed from the state

you last left it? Of course, it doesn't matter for a simple demo program like **SimplestKeypad**, but in the general case, users expect mobile applications to remember exactly what they were doing the last time they interacted with the program.

For this reason, the `Application` class supports two facilities that help the program save and restore data:

- The `Properties` property of `Application` is a dictionary with `string` keys and `object` items. The contents of this dictionary are automatically saved prior to the application being terminated, and the saved contents become available the next time the application runs.
- The `Application` class defines three protected virtual methods, named `OnStart`, `OnSleep`, and `OnResume`, and the `App` class generated by the Xamarin.Forms template overrides these methods. These methods help an application deal with what are known as *application lifecycle* events.

To use these facilities, you need to identify what information your application needs to save so that it can restore its state after being terminated and restarted. In general, this is a combination of *application settings*—such as colors and font sizes that the user might be given an opportunity to set—and *transient data*, such as half-entered entry fields. Application settings usually apply to the entire application, while transient data is unique to each page in the application. If each item of this data is an entry in the `Properties` dictionary, each item needs a dictionary key. However, if a program needs to save a large file such as a word-processing document, it shouldn't use the `Properties` dictionary, but instead should access the platform's file system directly. (That's a job for Chapter 20, "Async and file I/O.")

Also, you should restrict the data types used with `Properties` to the basic data types supported by .NET and C#, such as `string`, `int`, and `double`.

The **SimplestKeypad** program needs to save only a single item of transient data, and the dictionary key "displayLabelText" seems reasonable.

Sometimes a program can use the `Properties` dictionary to save and retrieve data without getting involved with application lifecycle events. For example, the **SimplestKeypad** program knows exactly when the `Text` property of `displayLabel` changes. It happens only in the two `Clicked` event handlers for the number keys and the delete key. Those two event handlers could simply store the new value in the `Properties` dictionary.

But wait: `Properties` is a property of the `Application` class. Do we need to save the instance of the `App` class so that code in the `SimplestKeypadPage` can get access to the dictionary? No, it's not necessary. `Application` defines a static property named `Current` that returns the current application's instance of the `Application` class.

To store the `Text` property of the `Label` in the dictionary, simply add the following line at the bottom of the two `Clicked` event handlers in **SimplestKeypad**:

```
Application.Current.Properties["displayLabelText"] = displayLabel.Text;
```

Don't worry if the `displayLabelText` key does not yet exist in the dictionary: The `Properties` dictionary implements the generic `IDictionary` interface, which explicitly defines the indexer to replace the previous item if the key already exists or to add a new item to the dictionary if the key does not exist. That behavior is exactly what you want here.

The `SimplestKeypadPage` constructor can then conclude by initializing the `Text` property of the `Label` with the following code, which retrieves the item from the dictionary:

```
IDictionary<string, object> properties = Application.Current.Properties;

if (properties.ContainsKey("displayLabelText"))
{
    displayLabel.Text = properties["displayLabelText"] as string;
    backspaceButton.IsEnabled = displayLabel.Text.Length > 0;
}
```

This is all your application needs to do: just save information in the `Properties` dictionary and retrieve it. Xamarin.Forms itself is responsible for the job of saving and loading the contents of the dictionary in platform-specific application storage.

In general, however, it's better for an application to interact with the `Properties` dictionary in a more structured manner, and here's where the application lifecycle events come into play. These are the three methods that appear in the `App` class generated by the Xamarin.Forms template:

```
public class App : Application
{
    public App()
    {
        …
    }

    protected override void OnStart()
    {
        // Handle when your app starts
    }

    protected override void OnSleep()
    {
        // Handle when your app sleeps
    }

    protected override void OnResume()
    {
        // Handle when your app resumes
    }
}
```

The most important is the `OnSleep` call. In general, an application goes into sleep mode when it no longer commands the screen and has become inactive (apart from some background jobs it might

have initiated). From this sleep mode, an application can be resumed (signaled by an `OnResume` call) or terminated. But this is important: After the `OnSleep` call, there is no further notification that an application is being terminated. The `OnSleep` call is as close as you get to a termination notification, and it always precedes a termination. For example, if your application is running and the user turns off the phone, the application gets an `OnSleep` call as the phone is shutting down.

Actually, there are some exceptions to the rule that a call to `OnSleep` always precedes program termination: a program that crashes does not get an `OnSleep` call first, but you probably expect that. But here's a case that you might not anticipate: When you are debugging a Xamarin.Forms application, and use Visual Studio or Xamarin Studio to stop debugging, the program is terminated without a preceding `OnSleep` call. This means that when you are debugging code that uses these application lifecycle events, you should get into the habit of using the phone itself to put your program to sleep, to resume the program, and to terminate it.

When your Xamarin.Forms application is running, the easiest way to trigger an `OnSleep` call on a phone or simulator is by pressing the phone's **Home** button. You can then bring the program back to the foreground and trigger an `OnResume` call by selecting the application from the home menu (on iOS devices or Android devices) or by pressing the **Back** button (on Android and Windows Phone devices).

If your Xamarin.Forms program is running and you invoke the phone's application switcher—by pressing the **Home** button twice on iOS devices, by pressing the **Multitask** button on Android devices (or by holding down the **Home** button on older Android devices), or by holding down the **Back** button on a Windows Phone—the application gets an `OnSleep` call. If you then select that program, the application gets an `OnResume` call as it resumes execution. If you instead terminate the application—by swiping the application's image upward on iOS devices or by tapping the X on the upper-right corner of the application's image on Android and Windows Phone devices—the program stops executing with no further notification.

So here's the basic rule: Whenever your application gets a call to `OnSleep`, you should ensure that the `Properties` dictionary contains all the information about the application you want to save.

If you're using lifecycle events solely for saving and restoring program data, you don't need to handle the `OnResume` method. When your program gets an `OnResume` call, the operating system has already automatically restored the program contents and state. If you want to, you can use `OnResume` as an opportunity to clear out the `Properties` dictionary because you are assured of getting another `OnSleep` call before your program terminates. However, if your program has established a connection with a web service—or is in the process of establishing such a connection—you might want to use `OnResume` to restore that connection. Perhaps the connection has timed out in the interval that the program was inactive. Or perhaps some fresh data is available.

You have some flexibility when you restore the data from the `Properties` dictionary to your application as your program starts running. When a Xamarin.Forms program starts up, the first opportunity you have to execute some code in the Portable Class Library is the constructor of the `App` class. At that

time, the `Properties` dictionary has already been filled with the saved data from platform-specific storage. The next code that executes is generally the constructor of the first page in your application instantiated from the `App` constructor. The `OnStart` call in `Application` (and `App`) follows that, and then an overridable method called `OnAppearing` is called in the page class. You can retrieve the data at any time during this startup process.

The data that an application needs to save is usually in a page class, but the `OnSleep` override is in the `App` class. So somehow the page class and the `App` class must communicate. One approach is to define an `OnSleep` method in the page class that saves the data to the `Properties` dictionary and then call the page's `OnSleep` method from the `OnSleep` method in `App`. This approach works fine for a single-page application—indeed, the `Application` class has a static property named `MainPage` that is set in the `App` constructor and which the `OnSleep` method can use to get access to that page—but it doesn't work nearly as well for multipage applications.

Here's a somewhat different approach: You first define all the data you need to save as public properties in the `App` class, for example:

```
public class App : Application
{
    public App()
    {
        …
    }

    public string DisplayLabelText { set; get; }
    …

}
```

The page class (or classes) can then set and retrieve those properties when convenient. The `App` class can restore any such properties from the `Properties` dictionary in its constructor prior to instantiating the page and can store the properties in the `Properties` dictionary in its `OnSleep` override.

That's the approach taken by the **PersistentKeypad** project. This program is identical to **SimplestKeypad** except that it includes code to save and restore the contents of the keypad. Here's the `App` class that maintains a public `DisplayLabelText` property that is saved in the `OnSleep` override and loaded in the `App` constructor:

```
namespace PersistentKeypad
{
    public class App : Application
    {
        const string displayLabelText = "displayLabelText";

        public App()
        {
            if (Properties.ContainsKey(displayLabelText))
            {
                DisplayLabelText = (string)Properties[displayLabelText];
            }
```

```
            MainPage = new PersistentKeypadPage();
        }

        public string DisplayLabelText { set; get; }

        protected override void OnStart()
        {
            // Handle when your app starts
        }

        protected override void OnSleep()
        {
            // Handle when your app sleeps
            Properties[displayLabelText] = DisplayLabelText;
        }

        protected override void OnResume()
        {
            // Handle when your app resumes
        }
    }
}
```

To avoid spelling errors, the `App` class defines the string dictionary key as a constant. It's the same as the property name except that it begins with a lowercase letter. Notice that the `DisplayLabelText` property is set prior to instantiating `PersistentKeypadPage` so that it's available in the `PersistentKeypadPage` constructor.

An application with many more items might want to consolidate them in a class named `AppSettings` (for example), serialize that class to an XML or a JSON string, and then save the string in the dictionary.

The `PersistentKeypadPage` class accesses that `DisplayLabelText` property in its constructor and sets the property in its two event handlers:

```
public class PersistentKeypadPage : ContentPage
{
    Label displayLabel;
    Button backspaceButton;

    public PersistentKeypadPage()
    {

        …

        // New code for loading previous keypad text.
        App app = Application.Current as App;
        displayLabel.Text = app.DisplayLabelText;
        backspaceButton.IsEnabled = displayLabel.Text != null &&
                                    displayLabel.Text.Length > 0;

    }
```

```
    void OnDigitButtonClicked(object sender, EventArgs args)
    {
        Button button = (Button)sender;
        displayLabel.Text += (string)button.StyleId;
        backspaceButton.IsEnabled = true;

        // Save keypad text.
        App app = Application.Current as App;
        app.DisplayLabelText = displayLabel.Text;
    }

    void OnBackspaceButtonClicked(object sender, EventArgs args)
    {
        string text = displayLabel.Text;
        displayLabel.Text = text.Substring(0, text.Length - 1);
        backspaceButton.IsEnabled = displayLabel.Text.Length > 0;

        // Save keypad text.
        App app = Application.Current as App;
        app.DisplayLabelText = displayLabel.Text;
    }
}
```

When testing programs that use the `Properties` dictionary and application lifecycle events, you'll want to occasionally uninstall the program from the phone or simulator. Uninstalling a program from a device also deletes any stored data, so the next time the program is deployed from Visual Studio or Xamarin Studio, the program encounters an empty dictionary, as though it were being run for the very first time.