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Sams Teach Yourself iOS® 6 Application Development in 24 Hours

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About the Author

John Ray is currently serving as the Interim Director of the Office of Research Information Systems for the Ohio State University. He has written numerous books for Macmillan/Sams/Que, including *Using TCP/IP: Special Edition*, *Teach Yourself Dreamweaver MX in 21 Days*, *Mac OS X Unleashed*, *My Mountain Lion MacBook*, and *Teach Yourself iOS 5 Development in 24 Hours*. As a Macintosh user since 1984, he strives to ensure that each project presents the Macintosh with the equality and depth it deserves. Even technical titles such as *Using TCP/IP* contain extensive information about the Macintosh and its applications and have garnered numerous positive reviews for their straightforward approach and accessibility to beginner and intermediate users.

You can visit his website at http://teachyourselfios.com or follow him on Twitter at @johnemeryray or #iOSIn24.

Dedication

This edition of iOS 6 is dedicated to the memory of iOS 5 and the upcoming birth of iOS 7.

Acknowledgments

Thank you to the group at Sams Publishing—Laura Norman, Keith Cline, Anne Groves—for slowly nudging me toward the finish line. As I read and re-read these chapters, I'm amazed at how you can see the intention behind the seemingly random words that I type. The team has performed pure magic in transforming the files I've submitted into clean, well-styled, content.

As always, thanks to everyone who puts up with me over the months of writing. I'm grateful for your support.

We Want to Hear from You!

As the reader of this book, *you* are our most important critic and commentator. We value your opinion and want to know what we're doing right, what we could do better, what areas you'd like to see us publish in, and any other words of wisdom you're willing to pass our way.

We welcome your comments. You can email or write to let us know what you did or didn't like about this book—as well as what we can do to make our books better.

Please note that we cannot help you with technical problems related to the topic of this book.

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Introduction

When you pick up an iOS device and use it, you feel connected. Whether it be an iPad, an iPhone, or an iPod, the interface acts as an extension to your fingers; it is smooth, comfortable, and invites exploration. Other competing devices offer similar features, and even sport gadgets such as styluses and trackpads, but they cannot match the user experience that is iOS.

When creating iOS and the Xcode tools used to develop for it, Apple considered everything from interface to application performance and battery life. There is always the expectation that, no matter what, the device will remain responsive and usable. As a developer, does this mean that there are rules to follow? Absolutely. But, by following these rules, you can create applications that are interactive works of art for your users to love—not software they will load and forget.

Through the App Store, Apple has created the ultimate digital distribution system for iOS applications. Programmers of any age or affiliation can submit their applications to the App Store for just the cost of a modest yearly Developer Membership fee. Games, utilities, and full-feature applications have been built for everything from pre-K education to retirement living. No matter what the content, with a user base as large as the iPhone, iPod Touch, and iPad, an audience exists.

Each year, Apple introduces new devices—bringing larger, faster, and higher-resolution capabilities to the iOS family. With each new hardware refresh come new development opportunities and new ways to explore the boundaries between software and art.

My hope is that this book brings iOS development to a new generation of developers. *Teach Yourself iOS 6 Development in 24 Hours* provides a clear and natural progression of skills development, from installing developer tools and registering your device with Apple, to submitting an application to the App Store. It's everything you need to get started in 24 one-hour lessons.

Who Can Become an iOS Developer?

If you have an interest in learning, time to invest in exploring and practicing with Apple's developer tools, and an Intel Macintosh computer running Mountain Lion, you have everything you need to begin creating software for iOS.

Developing an app won't happen overnight, but with dedication and practice, you can be writing your first applications in a matter of days. The more time you spend working with the Apple developer tools, the more opportunities you'll discover for creating new and exciting projects.

You should approach iOS application development as creating software that *you* want to use, not what you think others want. If you're solely interested in getting rich quick, you're likely to be disappointed. (The App Store is a crowded marketplace—albeit one with a lot of room—and competition for top sales is fierce.) However, if you focus on building useful and unique apps, you're much more likely to find an appreciative audience.

Who Should Use This Book?

This book targets individuals who are new to development for iOS and have experience using the Macintosh platform. No previous experience with Objective-C, Cocoa, or the Apple developer tools is required. Of course, if you do have development experience, some of the tools and techniques may be easier to master, but the author does not assume that you've coded before.

That said, some things are expected of you, the reader. Specifically, you must be willing to invest in the learning process. If you just read each hour's lesson without working through the tutorials, you will likely miss some fundamental concepts. In addition, you need to spend time reading the Apple developer documentation and researching the topics presented in this book. A vast amount of information on iOS development is available, but only limited space in this book. Therefore, this book covers what you need to forge your own path forward.

What Is (and Isn't) in This Book?

The material in this book specifically targets iOS release 6 and later on Xcode 4.5 and later. Much of what you'll learn is common to all the iOS releases, but this book also covers several important areas that have only come about in recent iOS releases, such as gesture recognizers, embedded video playback with AirPlay, Core Image, social networking, multitasking, universal (iPhone/iPad) applications, and more!

Unfortunately, this is not a complete reference for the iOS application programming interfaces (APIs); some topics just require much more space than this book allows. Thankfully, the Apple developer documentation is available directly within the free tools you install in Hour 1, "Preparing Your System and iDevice for Development." In many hours, you'll find a section titled "Further Exploration." This identifies additional related topics of interest. Again, a willingness to explore is an important quality in becoming a successful developer.

Each coding lesson is accompanied by project files that include everything you need to compile and test an example or, preferably, follow along and build the application yourself. Be sure to download the project files from this book's website at http://teachyourselfios.com. If you have issues with any projects, view the posts on this site to see whether a solution has been identified.

In addition to the support website, you can follow along on Twitter! Search for #iOSIn24 on Twitter to receive official updates and tweets from other readers. Use the hashtag #iOSIn24 in your tweets to join the conversation. To send me messages via Twitter, begin each tweet with @johnemeryray.

HOUR 16
Building Responsive User Interfaces

What You'll Learn in This Hour:

- ▶ How to make an application "responsive"
- ▶ Using Auto Layout to enable automatic resizing and rotation
- ▶ Creating UI elements programmatically for the ultimate control
- ▶ How to swap views for landscape and portrait viewing

You can use almost every iOS interface widget available, create multiple views and view controllers, add sounds and alerts, write files, and even manage application preferences, but until now, your applications have been missing a very important feature: responsive interfaces. The ability to create interfaces that display correctly regardless of your iDevice's screen size or orientation is one of the key features that users expect in an application—and the key goal of responsive interface design.

This hour's lesson explores the Xcode Auto Layout system and three different ways of adding rotatable and resizable interfaces to your apps. As you read this hour's lesson, an important fact to keep in mind is that there are *many* different ways to solve the problem of responsive interface design. What works best for you may be entirely different than what I describe here.

Responsive Interfaces

Years ago, when I had my first Windows Mobile smartphone, I longed for an easy way to look at web content in landscape mode. There was a method for triggering a landscape view, but it was glitchy and cumbersome to use. The iPhone introduced the first consumer phone with on-the-fly interface rotation that feels natural and doesn't get in the way of what you're trying to do.

The iPhone 5 shakes things up by introducing the first 4" iPhone screen with a different aspect ration and resolution than the traditional 3.5" models. Does this mean that you need to worry about iPhone 3.5" displays, 4" displays, iPad displays, and portrait and landscape orientations for each? Nope! The iOS Auto Layout system makes it easy to adapt to different resolution displays and change your interface layout as your device resolution changes.

TIP

Using Auto Layout to adapt between 3.5" and 4" screens is no different from adapting to a device that rotates between portrait and landscape. The resolution changes on-the-fly in the case of rotation, but you'll use the same tools to compensate. The only difference is that you can control whether or not your application handles different orientations—you can't control whether or not your users buy a 4" iPhone screen.

Although you should definitely plan to accommodate all sizes of the iPhone screen in your iPhone apps, the decision to handle rotation is entirely up to you. Consider how the user will be interfacing with the app. Does it make sense to force a portrait-only view? Should the view rotate to accommodate any of the possible orientations the phone may assume? The more flexibility you give users to adapt to their own preferred working style, the happier they'll be. Best of all, enabling rotation is a simple process.

TIP

Apple's user interface guidelines for the iPad strongly encourage the support of any orientation/rotation: portrait, left landscape, right landscape, and upside-down.

Enabling Interface Rotation

The projects that you've built to-date have had supported limited interface rotation because of a single line of code in a single method in your view controller. This is added by default when you use one of Apple's iOS templates.

When an iOS device wants to check to see whether it should rotate your interface, it sends the `supportedInterfaceOrientations` message to your view controller. The implementation of `supportedInterfaceOrientations` just returns a value that describes the supported orientation. To cover more than one orientation, you just return the list of constants you want to use, separated by the | character.

There are seven screen orientation support constants, as listed here.

Orientation	Orientation Support Constant
Portrait	`UIInterfaceOrientationMaskPortrait`
Portrait upside-down	`UIInterfaceOrientationMaskPortraitUpsideDown`
Landscape left	`UIInterfaceOrientationMaskLandscapeLeft`

Orientation	Orientation Support Constant
Landscape right	`UIInterfaceOrientationMaskLandscapeRight`
Any Landscape	`UIInterfaceOrientationMaskLandscape`
Anything but upside-down	`UIInterfaceOrientationMaskAllButUpsideDown`
Anything	`UIInterfaceOrientationMaskAll`

For example, to allow your interface to rotate to either the portrait or landscape left orientations, you implement `supportedInterfaceOrientations` in your view controller with the code in Listing 16.1.

LISTING 16.1 This Method Activates Interface Rotation

```
- (NSUInteger)supportedInterfaceOrientations {
    return UIInterfaceOrientationMaskPortrait |
                      UIInterfaceOrientationMaskLandscapeLeft;
}
```

The `return` statement handles everything. It returns the combination of the two constants that describe landscape left and portrait orientations.

NOTE

In addition to adding this method to your view controllers, you must also choose the orientations supported by your app by clicking the Supported Interface Orientation icons in the application summary. This is described in the section “Setting Supported Device Orientations” in Hour 2, “Introduction to Xcode and the iOS Simulator.”

At this point, take a few minutes and go back to some of the earlier hours and modify this method in your view controller code to allow for different orientations. Test the applications in the iOS simulator or on your device. For iPhone apps, try switching between 3.5" and 4" displays.

Some of the applications will probably look just fine, but you’ll notice that others, well, don’t quite “work” in the different screen orientations and sizes, as shown in Figure 16.1 (ImageHop, from Hour 8, “Handling Images, Animation, Sliders, and Steppers”).

Everything we’ve been building has defaulted to a portrait design and, for the iPhone, a 4" screen, so how can we create interfaces that look good regardless of the orientation and size of the screen? We obviously need to make some tweaks.

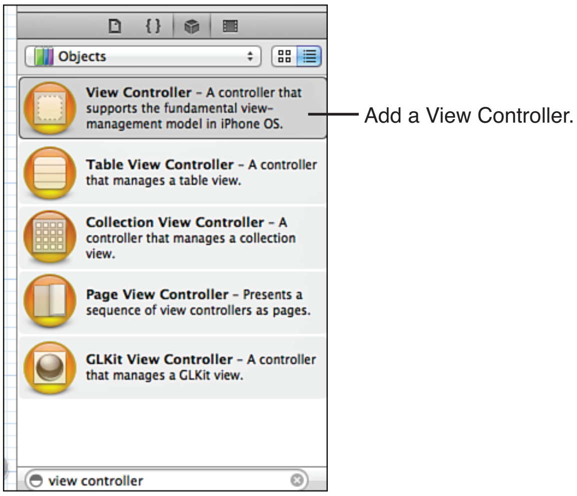

Objects
View Controller - A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller - A controller that manages a table view.
Collection View Controller - A controller that manages a collection view.
Page View Controller - Presents a sequence of view controllers as pages.
GLKit View Controller - A controller that manages a GLKit view.
view controller
Add a View Controller.

FIGURE 16.1
Enabling an orientation doesn't mean it will look good.

Designing Rotatable and Resizable Interfaces

In the remainder of this hour, we explore several different techniques for building interfaces that rotate and resize themselves appropriately depending on the device, or when the user changes the device's screen orientation. Before we get started, let's quickly review the different approaches and when you'd want to use them.

Auto Layout

The Xcode Interface Builder (IB) editor provides tools for describing how your interface should react when it is rotated or when the size of the screen can be variable. It is possible to define a single view in IB that positions and sizes itself appropriately—no matter what the situation—without writing a single line of code. This bit of Apple magic is called *Auto Layout*. It will be your best friend and worst enemy in creating responsive interfaces.

Using Auto Layout should be the starting point for all interfaces. If you can successfully define portrait and landscape modes in a single view in the IB editor, your work is done.

Unfortunately, Auto Layout doesn't work well when there are many irregularly positioned interface elements. A single row of buttons? No problem. Half a dozen fields, switches, and images all mixed together? Probably not going to work.

Programming Interfaces

As you've learned, each UI element is defined by a rectangular area on the screen: its `frame` property. If we programmatically define an application interface, we can make it into anything we want. Although this might sound challenging, it's actually very simple and very effective for creating interfaces that vary dramatically between different sizes and orientations.

For example, to detect when the interface rotates, we can implement the method `didRotate-FromInterfaceOrientation` in our view controller. The view controller property `interface Orientation` will tell us the current orientation of the interface, by containing one of these four constants:

Orientation	**Current Orientation Constant**
Portrait	`UIInterfaceOrientationPortrait`
Portrait upside-down	`UIInterfaceOrientationPortraitUpsideDown`
Landscape left	`UIInterfaceOrientationLandscapeLeft`
Landscape right	`UIInterfaceOrientationLandscapeRight`

The drawback to doing everything in code is that you are doing *everything* in code. It becomes very difficult to prototype interface changes and visualize what your final interface will look like. In addition, it is harder to adapt to changes in the future. It's best, in my opinion, to use a combination of Auto Layout with hand-coded interfaces to provide the best flexibility and speed of development.

Swapping Views

A more dramatic approach to changing your view to accommodate different screen orientations is to use entirely different views for landscape and portrait layouts. When the user rotates the device, the current view is replaced by another view that is laid out properly for the orientation.

This means that you can define two views in a single scene that look exactly the way you want, but it also means that you must keep track of separate `IBOutlets` for each view. Although it is certainly possible for elements in the views to invoke the same `IBActions`, they cannot share the same outlets, so you'll potentially need to keep track of twice as many UI widgets within a single view controller.

NOTE

To know when to change frames or swap views, you will be implementing the method `didRotate-FromInterfaceOrientation` in your view controller. This message is sent to a view controller when the interface has finished changing orientation. If you want to react *prior* to the orientation change taking place, you could implement the `willRotateToInterfaceOrientation:duration` method.

TIP

Apple has implemented a screen-locking function so that users can lock the screen orientation without it changing if the device rotates. (This can be useful for reading while lying on your side.) When the lock is enabled, your application will not receive notifications about a change in orientation. In other words, to support the orientation lock, you don't need to do a thing.

Using Auto Layout

As already mentioned, Auto Layout enables us to build responsive interfaces without writing a line of code. Because of that, our first tutorial is a series of examples that you can follow along with, rather than a project that we build. I've included several sample storyboard files in this hour's Projects folder, but you should definitely get yourself into IB and attempt the examples on your own.

NOTE

You'll be making changes to the Empty.storyboard file in this example. I recommend copying this file and making changes to your copies. This will save you the time of having to create a new storyboard file (or deleing the contents of the current file) each time you want to try something new.

In addition, the examples in this section all target the iPhone. Why? Because the iPhone screen is the perfect place for practice. It can change between both portrait and landscape orientations *and* resize from 3.5" to 4" displays.

The Language and Tools of Auto Layout

When I see something with *Auto* in the name, I expect that it is going to do things for me: automatically. Auto Layout lives up to this, but not without a reasonably long "getting to know you" phase. To use Auto Layout effectively, you must understand the terminology and know where to look for the tools. We spend the next few minutes getting into details, and then walk through a few examples that should get you started on the way to mastery. (Perhaps of archery or speed skating. Auto Layout if you're lucky.)

Constraint Basics

Auto Layout works by building a series of *constraints* for your onscreen objects. Constraints define placement of objects, distances between objects, and how flexible these relationships are. A vertical constraint for a button, for example, might be along the lines of "keep X many points of space between this object and the top of the screen" or "keep object Y vertically centered in the view." Unfortunately, the language used for positioning can be a bit confusing; you may not be familiar with these terms:

- **Leading:** The “front” or left side of an object.
- **Trailing:** The “back” or right side of an object.
- **Superview:** The view that contains an object. In our examples, this is the “view” that makes up the scene itself.

NOTE

Xcode *must* always have enough constraints defined for an object that it can determine its horizontal and vertical position at any point in time (regardless of the screen orientation/size). This means that if you don’t add constraints of your own (called user constraints and represented by a blue icon), Xcode will add system constraints automatically (represented by a purple icon).

For example, try adding a button to the window in the Empty.storyboard file; make sure is located toward the top-left side of the view and that you’ve resized the button slightly. Notice that parallel to the button in the document outline hierarchy a new Constraints entry shows up, as well as a Constraints item within the button object itself, as shown in Figure 16.2.

Navigating the Constraints Objects

Within the view’s Constraints object are two constraints: horizontal space and vertical space constraint. The horizontal constraint states that the left side of the button will be a certain number of points from the left edge of the view. This is known as the *leading space* (versus the space between the right side and the edge of the view, which is called the *trailing space*). The vertical constraint is the distance from the top of the view to the top of the button.

What constraints are added depend on where the object is in relation to its containing view. Xcode does its best to choose what constraints make the most sense. If you position a button near the bottom of the view, for example, it will add a constraint for the distance between the bottom of the button and the bottom of the view.

Constraints, however, are more than just entries that tie an object to the view it is within. They can be flexible, ensuring that an object maintains *at least* or *at most* a certain distance from another object, or even that two objects, when resized, maintain the same distance between one another.

TIP

Alignment of objects is also a constraint, and is managed using the alignment tools you’ve already learned about. In other words, when you set vertical or horizontal alignments, you’re actually configuring constraints that will be maintained regardless of the device’s screen size or orientation!

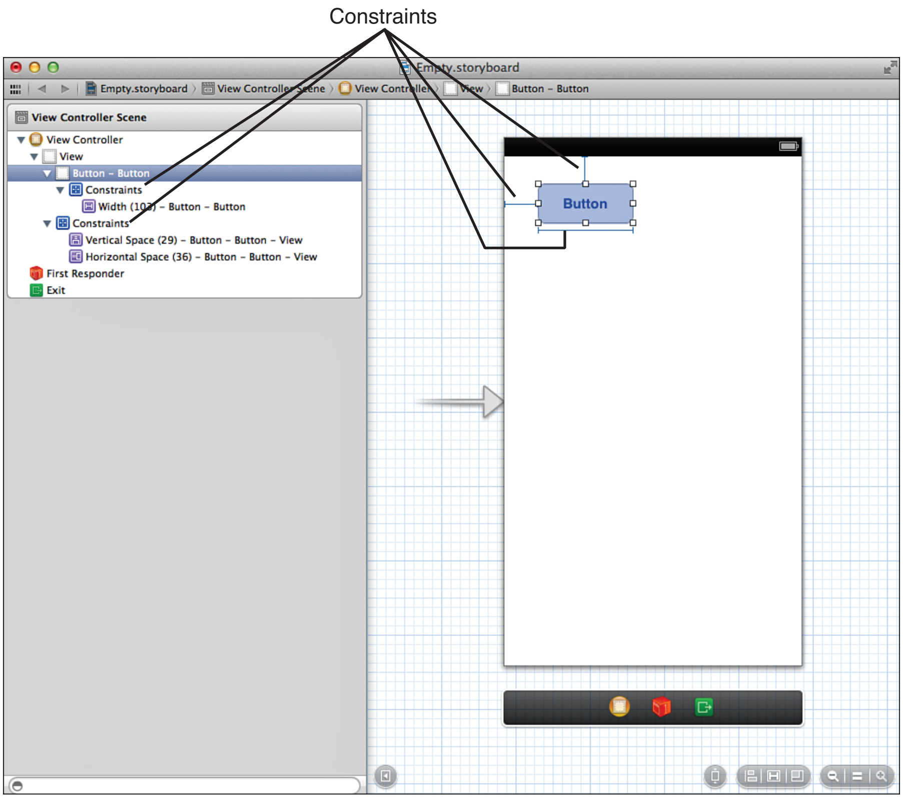


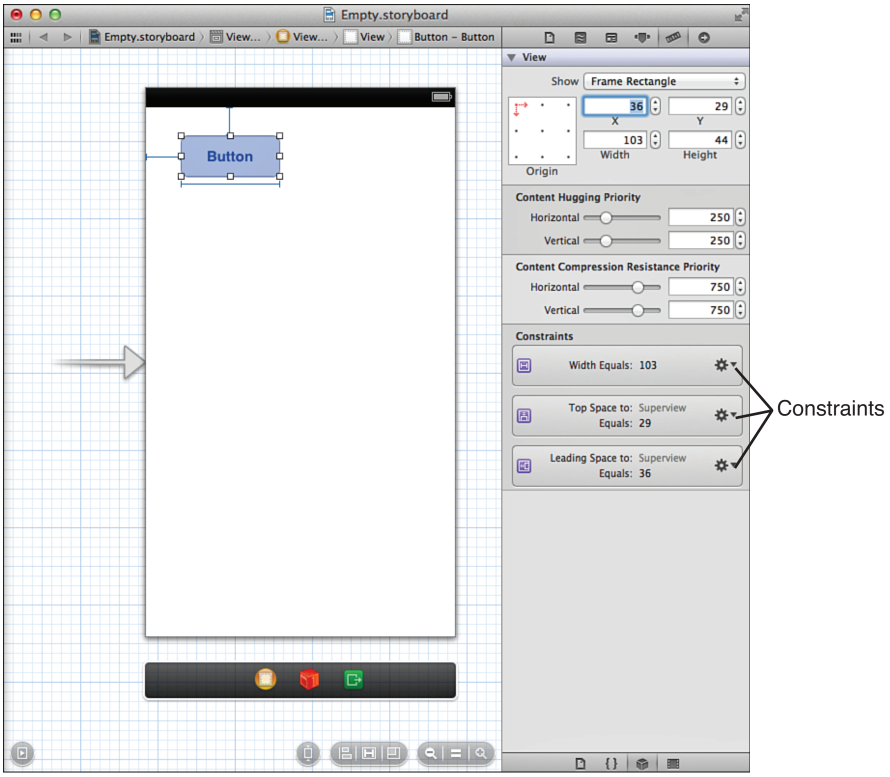
FIGURE 16.2
The Constraints object represents the positioning relationships within a view, or Constraints on the UI elements themselves.

Constraints that set a specific size or distance between objects are called *pinning*. The flexibility (or inflexibility of a constraint) is managed by configuring a *relationship*.

This brings us to the second constraint object in the document outline: constraints on the object itself, not on its positioning. When you resize a user interface (UI) element or set constraints on how the content *within* it is positioned, Xcode adds (or modifies) a constraint object *within* the UI element itself. These constraints determine the width or height of the element. Not surprisingly, when you've got dozens of components in your UI, you'll have *lots* of constraints in your document outline.

Viewing and Editing Constraints via the Size Inspector

While sorting through constraints in the document outline can be a pain, you can quickly view *all* the constraints applied to an element (whether located in the Constraints object on the view the element is in, or within the UI element itself) within the Size Inspector (Option-Command-5). For example, if you've added a resized button to the storyboard, opening the Size Inspector should look something like Figure 16.3. Here horizontal and vertical positioning for the button are represented as constraints, as well as the width of the button.


Empty.storyboard

Empty.storyboard 〉 View… 〉 View… 〉 View 〉 Button – Button

View

Show: Frame Rectangle

X: 36 Y: 29

Width: 103 Height: 44

Origin

Content Hugging Priority

Horizontal: 250

Vertical: 250

Content Compression Resistance Priority

Horizontal: 750

Vertical: 750

Constraints

Width Equals: 103

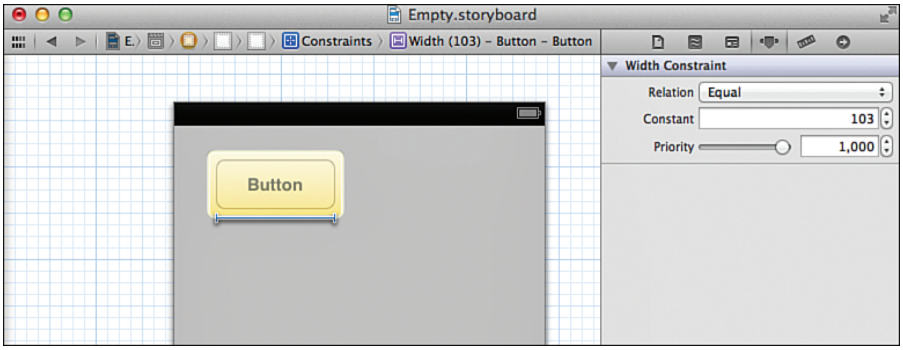
Top Space to: Superview Equals: 29

Leading Space to: Superview Equals: 36

FIGURE 16.3
Use the Size Inspector to view your constraints.

Using the gear menu to the right side of each constraint to do one of three things. First, you can select and edit a constraint. For example, if you pick a width constraint and choose Select and Edit, Xcode jumps you into the Attributes Inspector, where you can see and adjust the details of the constraint, as shown in Figure 16.4.

The Relation drop-down determines what the constraint is trying to do. Is it trying to keep a distance or size equal to a value? Greater than or equal to it? Less than or equal? You choose the relation that gives your interface the flexibility you need. With each relation, you can also set a constant. This is a measurement, in points, that the relationship will be maintaining.



Width Constraint
Relation Equal
Constant 103
Priority 1,000

FIGURE 16.4
Use the Attributes Inspector to edit constraints.

You'll also notice a Priority slider and a Standard check box (sometimes) appear in the editor. The Priority slider determines how "strong" the constraint relationship is. There may, for example, be instances when multiple constraints must be evaluated against one another. The priority setting determines the importance of any given constraint. A value of 1000 is a constraint that is required. If you move the Constraint slider, Xcode shows a description of what to expect at a given constraint priority.

The Standard check box lets Xcode use its internal database of spacing to set the recommended space between two objects. This, in many cases, is preferred because it ensures a consistent interface.

In a few minutes, we'll make use of the editor to configure a few relationships. Trust me, it makes more sense once you get started.

TIP

Constraints can also be edited by selecting them in the design view and opening the Attributes Inspector. If you're good at clicking on thin lines, you can do this without first going into the Size Inspector. I, personally, prefer starting by selecting the UI element, viewing the constraints in the Size Inspector, then jumping into editing from there.

The other options available in the gear menu in the Size Inspector are Promote to User Constraint and Delete. With Promote to User Constraint, you can select a constraint that you didn't add manually, turn it into a user constraint. The other option, Delete, removes the constraint from the Storyboard. Remember that there *must* be constraints to describe the object's position complete, so if you delete a constraint, don't be surprised to see Xcode add a new constraint back into the storyboard to fill in missing positioning details.

NOTE

You can edit system constraints *and* user constraints, so if the system constraints are serving your needs, there's no reason to turn it into a user constraint.

Content Hugging and Content Compression Resistance

When viewing an interface object with the Size Inspector, you probably noticed the settings Content Hugging Priority and Content Compression Resistance Priority. These features are related to Auto Layout, but what do they do?

When inspecting an object that is within an Auto Layout XIB, these settings control how closely the sides of an object "hug" the content in the object and how much the content can be compressed or clipped. Imagine a button that you want to expand horizontally, but not vertically. To allow horizontal expansion, you'd set horizontal hugging is a low priority. To keep it from growing vertically, you set vertical hugging to a high priority.

Similarly, the content (the button label) should not be compressed or clipped at all, so the content compression resistance settings for both horizontal and vertical compression should be very high priority.

You will not often need to adjust these settings beyond their defaults, which IB adds for you.

TIP

UI objects like buttons have *intrinsic* constraints that do not appear in the interface. These are the sizes that Xcode determines the object should have in order to display your content (such as a button label or button image). Xcode will automatically try to maintain these constraints unless you override them with your own user constraints and content compression/hugging settings. Other objects, such as switches, cannot resize at all, so there's no tweaking that will cause them to violate their intrinsic constraints. Text views, image views, and other "generic" content holders, however, will happily resize with no difficulty. You'll see this behavior in a few minutes.

I'm Beginning to See How This Works, But How Can You Create Complex Responsive Layouts with Just These Simple Tools?

There is no "one way" to build interfaces with Auto Layout, but there is a mindset that will be helpful as you build your own designs. Specifically, you should start by identifying the interface elements that you want to anchor somewhere on the screen, regardless of orientation or screen size. From there, begin looking for the relationships between those elements and the other objects that make up your interface. Building relationships between objects, rather than trying to tie each element to specific coordinates within a view, is a good tactic for successful UI design.

Example One: Centering Constraints

Let's look at a very simple example: a button that stays centered regardless of whether you use a 3.5" or 4" iPhone (or any iPad), or rotates between portrait and landscape orientations. To do this, begin by adding and positioning the button:

1. If you already have a push button added to a window in the Empty.storyboard file, you're in good shape. If not, open the file and add one now.
2. With the button highlighted, select Editor, Align, Vertical Center in Container.
3. Reselect the button, then choose Editor, Align, Horizontal Center in Container. The layout should now resemble Figure 16.5.

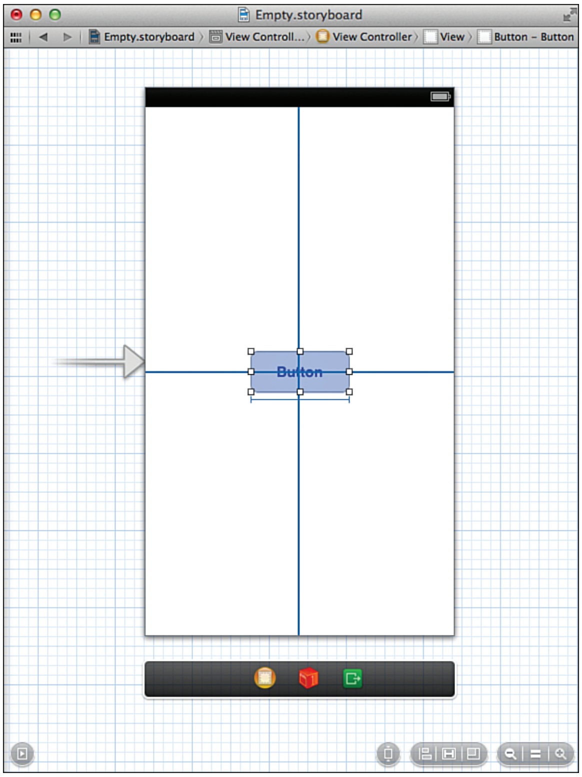


FIGURE 16.5
Align the button to the vertical and hortizontal centers.

The constraints that you've added show up as dark blue lines in the layout. Dark blue lines indicate user constraints; that is, *you* added the alignment constraints to the system.

TIP

If you don't add your own constraints Xcode will add some for you. In this example, had you dragged the button into the center of your view until both horizontal and vertical alignment guides appeared, Xcode would actually have created these same constraints for you! They would be system constraints, not user constraints, but they'd do the exact same thing.

Take a moment to view the constraints on the button via the Size Inspector. Select the button, then press Command-Option-5; the Size Inspector should show at least two constraints (more if you changed the size of the button), as shown in Figure 16.6.

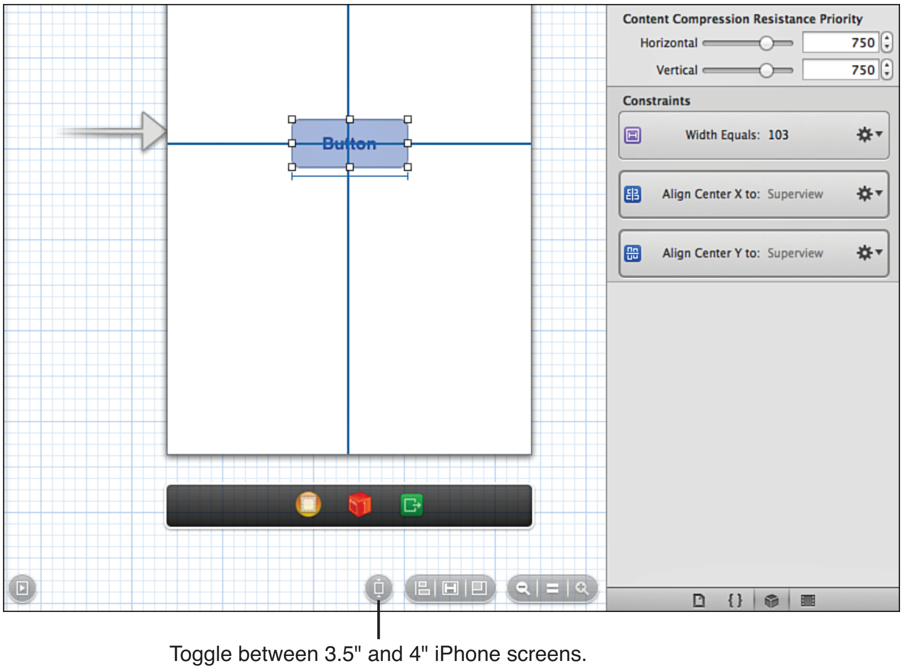

Content Compression Resistance Priority
Horizontal 750
Vertical 750
Constraints
Width Equals: 103
Align Center X to: Superview
Align Center Y to: Superview

FIGURE 16.6
Toggle the size of the screen.

Now try toggling the size of the screen between 3.5" and 4", using the toggle icon shown in Figure 16.6. The button should stay centered, regardless of the screen size. The final test is to try the interface in another orientation.

Make sure that the document outline is visible, select the view controller for the scene. Open the Attributes Inspector (Option-Command-4) and choose Landscape from the Orientation drop-down menu. IB updates to show the interface in landscape mode. Assuming your constraints are correct, the button should also properly center itself in the view, as demonstrated in Figure 16.7.

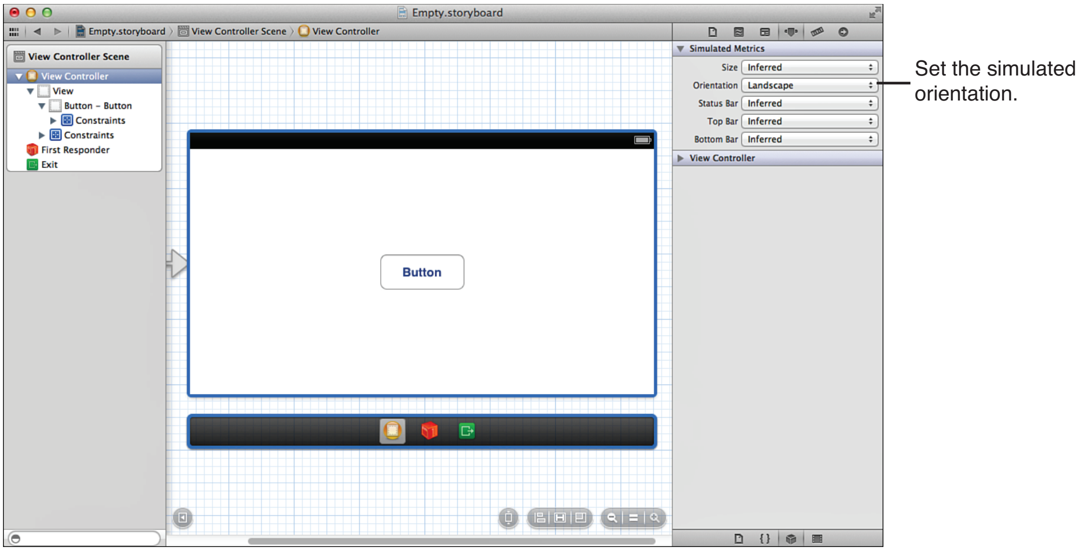


FIGURE 16.7
The button centers itself, regardless of orientation and screen size.

That was pretty simple, wasn't it? Of course, not all your applications will consist of just a single button (only the best ones). For that reason, we cover a few more examples, starting with resizing controls.

Example Two: Expanding Controls

A common design problem is where you have a series of controls on the screen and they need to expand to fill the size of the screen (or, in the case of a 3.5" iPhone display, properly shrink to fit on the screen). For example, let's create an interface with two text views at the top and a button at the bottom. The button should always remain anchored at the bottom, but should grow horizontally to fill the width of the display. The text views should grow or shrink vertically, and expand horizontally to fill the screen.

Creating the Interface

Starting from a fresh copy of Empty.storyboard, follow these steps:

1. Drag a button to the storyboard, positioning it using the guide at the bottom of the view.
2. Resize each side of the button by dragging toward the side of the view, and then release when you see the blue guide appear.

By using the guides in steps 1 and 2, you've created three constraints that anchor to the side and bottom margins of the view, as shown in Figure 16.8.

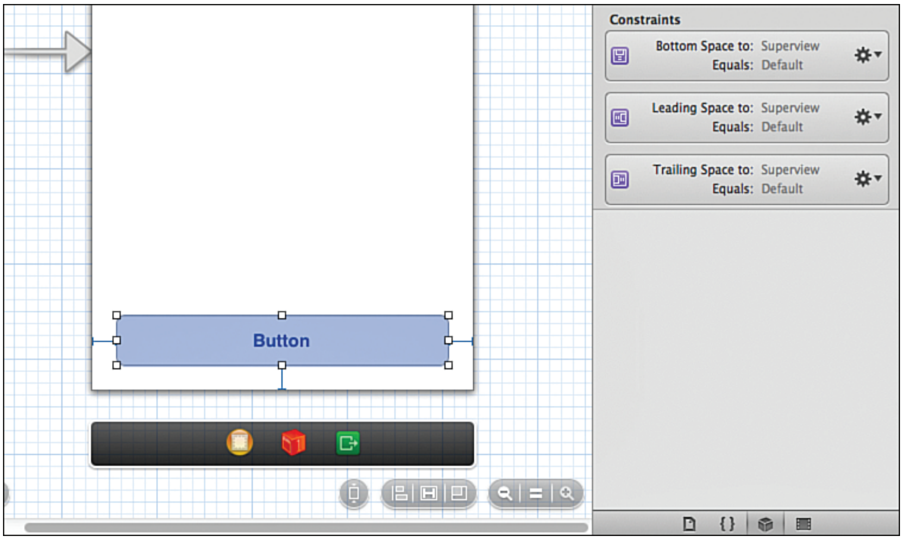

Constraints
Bottom Space to: Superview
Equals: Default
Leading Space to: Superview
Equals: Default
Trailing Space to: Superview
Equals: Default
Button

FIGURE 16.8
These three constraints make the button resize and stay anchored at the bottom, regardless of the screen size or orientation.

The constraints that have been automatically created are a good start for the button. These ensure that the sides of the button are always an equal distance from the sides of the view, regardless of the orientation. The same goes for the distance from the bottom of the view to the bottom of the button.

Next, add two text views to the scene:

1. Drag two text views to the scene, stacking one on top of the other.
2. Resize the text views to fill the scene horizontally, until the blue guides appear.
3. Size the text views vertically until the guides appear to keep the views from overlapping the button, one another, or the top margin of the scene.
4. Set the color of the text views to something other than white so that they are easier to see. Your finished view should look like Figure 16.9.

The top text view has constraints generated to attach it to the top of the view and the sides of the view. The bottom text view has constraints that keep it a set distance from the sides of the view and the button at the bottom. Between the two text views is a constraint that keeps them a set distance apart. Finally, one of the text views will have a height constraint applied.

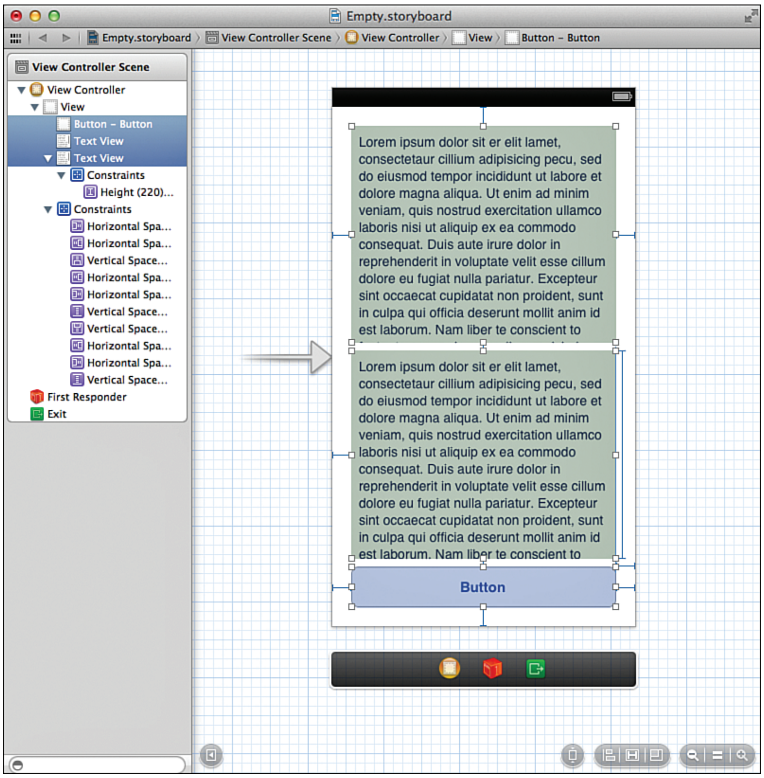


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FIGURE 16.9
You've added three UI elements and quite a few system constraints.

Setting the Constraints

Try resizing and rotating the display. What you'll notice is that resizing it vertically (switching between 3.5" and 4" screens) likely works okay. What definitely doesn't is rotating to landscape. In landscape mode, one of the text views will shrink so much that it isn't even visible. To make the scene work right, you need to set some additional constraints.

Specifically, you need to accomplish these things:

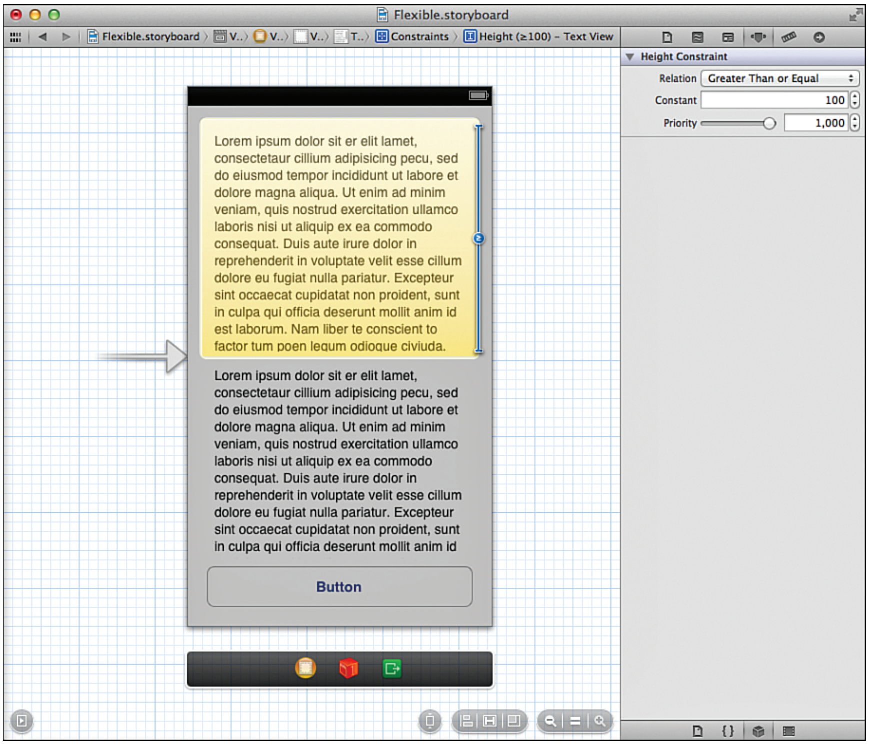
1. Pin the height of the button so that at no point in time is it resized.
2. Pick one of the text views to be the first to shrink when the size changes. We set this view so that its height is greater than or equal to the smallest size we want it to reach. I will use the top view for this purpose and set its minimum height to 100 points or greater.
3. Set a fixed width on the bottom text view (I'll use 210 points) so that it doesn't change size. *But*, we need to set its priority to less than 1000 (the default). This lets the text view change

sizes in an extreme situation. That “extreme situation” would otherwise occur in landscape mode where the top view would try to maintain a height of 100 points but the bottom view’s fixed height of 210 would force a condition where both can’t hold.

Begin by selecting the button and choosing, Editor, Pin, Height from the menu bar. Simple enough!

Next, choose the top text view and choose Editor, Pin, Height (again). You’ve just created a height constraint, but it needs to be adjusted so that it is flexible. Select the height constraint within the design view (or within the size inspector), and then open the Attributes inspector.

Using the Relation drop-down, choose Greater Than or Equal. Set the constant to 100 (the text view must be 100 points in height or greater) and leave the priority alone. Your configuration should look like Figure 16.10.


Flexible.storyboard
Flexible.storyboard › V.. › V.. › V.. › T.. › Constraints › Height (≥100) – Text View
Button

Height Constraint

Relation: Greater Than or Equal

Constant: 100

Priority: 1,000

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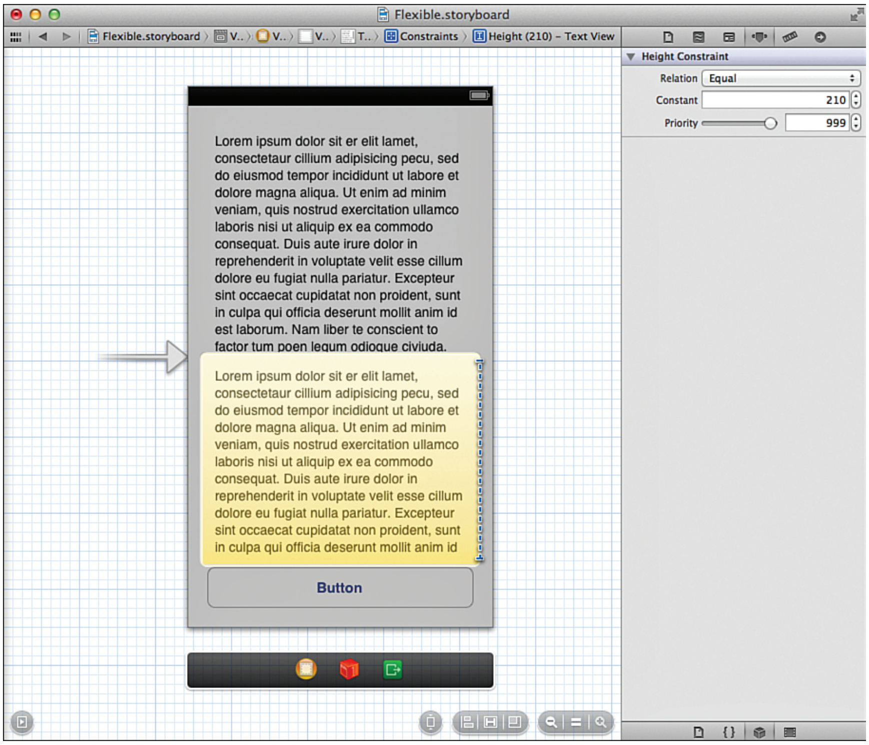
FIGURE 16.10
Set the relation for the height constraint.

Now the top text view will shrink when it needs to, but it can also grow; in fact, until a constraint is set on the bottom text view, it can grow *too large*, pushing the bottom text view until it is too small in any orientation.

Select the bottom text view and again add a height constraint (Editor, Pin, Height, yet again). Select the constraint and make sure that the relation is set to Equal with a constant around 210, as shown in Figure 16.11. This time, however, set the priority down to 999. This makes the constraint turn into a dotted line (visible in Figure 16.11) showing that the constaint will *try* to be maintained, but, if necessary, it can resize to avoid violating other constraints.


Flexible.storyboard
Flexible.storyboard 〉 V.. 〉 V.. 〉 V.. 〉 T.. 〉 Constraints 〉 Height (210) – Text View
Button

Height Constraint

Relation: Equal
Constant: 210
Priority: 999

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FIGURE 16.11
Set a height constraint with a priority lower than 1000 to enable the text view to change sizes if absolutely necessary.

Go ahead and try resizing the view between 3.5" and 4" iPhone screen sizes and rotating to landscape mode. Everything should work like a charm, with the top text view resizing when needed and the bottom text view resizing when it absolutely has to.

CAUTION

What If It Doesn't Work?

It's *really* easy to end up adding constraints you don't want by inadvertantly dragging things around in your view. If something doesn't appear to be working, it's likely because there are extra height constraints. Look for multiple height constraints (or any others that look out of place) and delete what you didn't intentionally add.

TIP

Combining multiple constraints with variable relationships, like this, is what you need to do to accommodate complex interfaces. Don't be shy about trying different relationships and priorities to see how they interact. There isn't a "recipe" for making effective Auto Layout designs. Spend a few hours playing with the tools—laying out interfaces in different ways. Hands-on is the only way you'll get the experience you need to be comfortable with Auto Layout.

Example Three: Variable and Matching Sizes (and Auto Layout Craziness!)

Okay, one more quick exercise to round things out. I promise this one is easier than the last. This time, we add three buttons in a horizontal line, and we add enough constraints to make the buttons all resize equally when we shift to a landscape mode.

CAUTION

They're *My* Constraints, Not Yours, Xcode!

When I say "Auto Layout craziness," I mean it. Even if you aren't building the example, be sure to read through this section to understand how Xcode can sometimes, without warning, start rewriting your Auto Layout constraints and wreaking havock on your work.

Let's make this happen! Create a new copy of the Empty.storyboard document, and then drag three buttons into the horizontal line on the screen. Label the buttons **Button A**, **Button B**, and **Button C**, as shown in Figure 16.12.

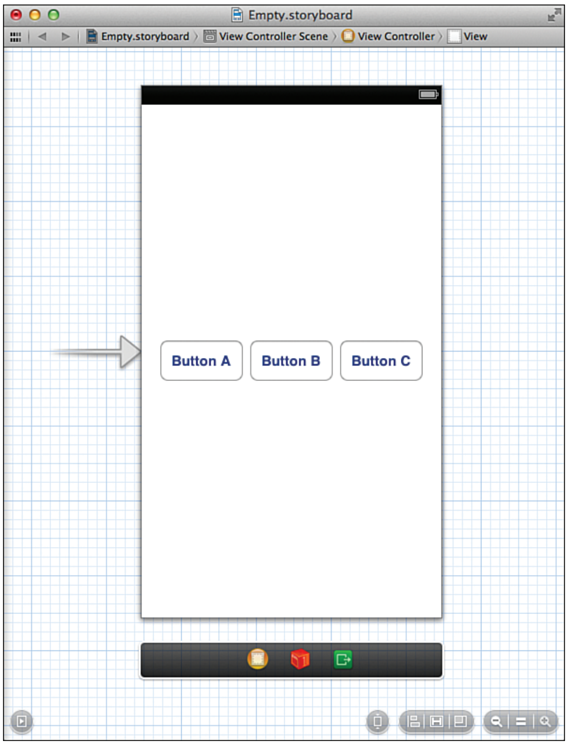


FIGURE 16.12
Add three buttons, nothing more.

You now know enough to make one of the buttons resize, but how could we constrain them so that *all* the buttons resize to fill in the screen in landscape mode? These are the constraints that I came up with:

1. Align all the buttons to the vertical center in the container. This keeps them centered vertically on the screen.
2. Pin the Leading Space of Button A to the superview (the edge of the view). This is unnecessary if you used a guide to align the left edge of the button and Xcode already added a constraint tying the edge of the button to the edge of the view.
3. Pin the Trailing Space of Button C to the superview. Like the first constraint, you don't technically need this one if you aligned the right side of the button to a guide and Xcode added a constraint for you.
4. Pin the Horizontal Spacing between Button A and Button B.

5. Pin the Horizontal Spacing between Button B and C. (If we stopped here, the center button (Button B) would stretch while the other buttons would stay the same size.)
6. Pin the buttons so that they all share the same width. (Select all the buttons, and then choose Editor, Pin, Widths Equally.)

Use the Editor menu to add these constraints to your project; you should know how to do it by now. There is no need to adjust the priority or relationships in this case. Your finished layout will hopefully be similar to Figure 16.13 (one of the = constraints may be on a different button. This is fine). *Save your work before continuing.*

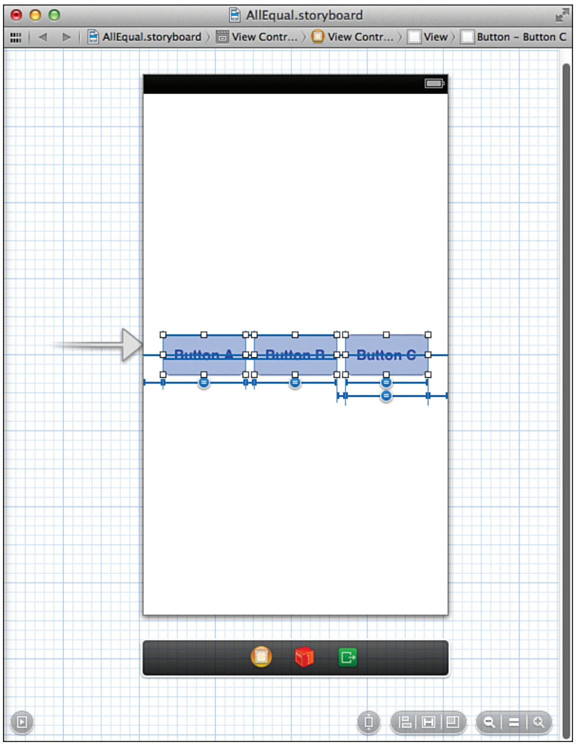
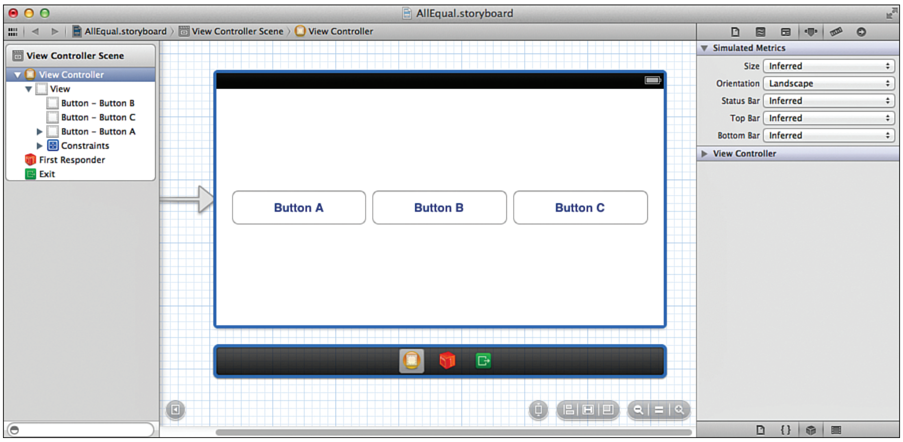


FIGURE 16.13
Add these constraints to your scene.

Now, here's where it gets interesting (wake up!). When you rotate the view to landscape, all the buttons should resize equally and fill in the space across the screen, as shown in Figure 16.14.



Size: Inferred
Orientation: Landscape
Status Bar: Inferred
Top Bar: Inferred
Bottom Bar: Inferred

FIGURE 16.14
The buttons' constraints force them to spread out across the screen and match sizes.

This is exactly what we want. *But*, what happens when you rotate back to a vertical position? Chances are that the buttons get all weird looking and overlap. Switch back and forth between horizontal and landscape orientations, and they may get even worse.

So, what's going on here? Xcode is being a pain, that's what. When you switch to landscape, it is rewriting the constraints as if you designed the view in landscape mode. You actually *lose* work and constraint logic depending on how the complex your interface is.

To deal with this bit of insanity, just use Command-Z to undo the switch to landscape orientation after validating that the interface looks okay. As long as it looks good in your original view and when it first switches to landscape, you're in good shape. The compiled view used in your actual application will work just fine (even if it switches back and forth between portrait and landscape orientations).

Wait, There's More

There is much more to the Auto Layout system than can be described in an hour. Be sure to explore the Pin menu to see the different types of constraints that you can put in place. Width/height constraints enforce a given width or height on an object. Equal width/height constraints ensure multiple objects maintain an equal width or height. The leading/trailing space pinnings tie the left side of an object to the left side of its parent view (leading), or the right side of an object to the right side of its parent view (trailing).

Review Apple's documentation, starting with *Cocoa Auto Layout Guide*, for more information.

Programmatically Defined Interfaces

In the previous example, you learned how the IB editor can help quickly create interface layouts that look as good horizontally as they do vertically and that can resize between the 3.5" and 4" iPhone displays. Unfortunately, in plenty of situations, IB can't quite accommodate. Irregularly spaced controls and tightly packed layouts rarely work out the way you expect. You may also find yourself wanting to tweak the interface to look completely different—positioning objects that were at the top of the view down by the bottom and so on.

In cases like this, consider implementing the UI (or portions of it) completely in code. But, what about the nice and neat drag-and-drop approach? Well, using code isn't as convenient as drawing your interface in IB, but it *isn't* difficult. We're going to move to a project that is the exact opposite of our last few examples—rather than building a responsive interface without code, we're going to *only* use code to create an interface.

Implementation Overview

In this tutorial, we create a very simple application with three UI elements: two buttons (Button A and Button B) and a label. The buttons trigger a method to set the label to the title of the button. Most important, however, is that the interface reacts properly to orientation and size changes.

In the portrait orientation, the buttons are drawn with the label sandwiched between them. In landscape, the buttons move closer to the bottom, and the label repositions above them. The final output will resemble Figure 16.15.

Take note that the positioning of the buttons and the label cannot be handled in Auto Layout (at least not through any straightforward approach). When you encounter issues that can't be solved in Auto Layout, there's no harm in coding your way out of the forest.

To handle the rotation and resizing of the objects, we use the `bounds` property of the scene's view. This gives us the width and height of the device corresponding to whatever orientation it is in. We then use these values to position the UI elements on the screen. By basing the positioning on the `bounds`, the size of the device screen and orientation are largely irrelevant, as you'll soon see.

Setting Up the Project

Unlike the previous example, we can't rely pointing and clicking for the interface, so there is a bit of code in the project. Once again, create a new single-view iOS application project and name it **AllInCode**.

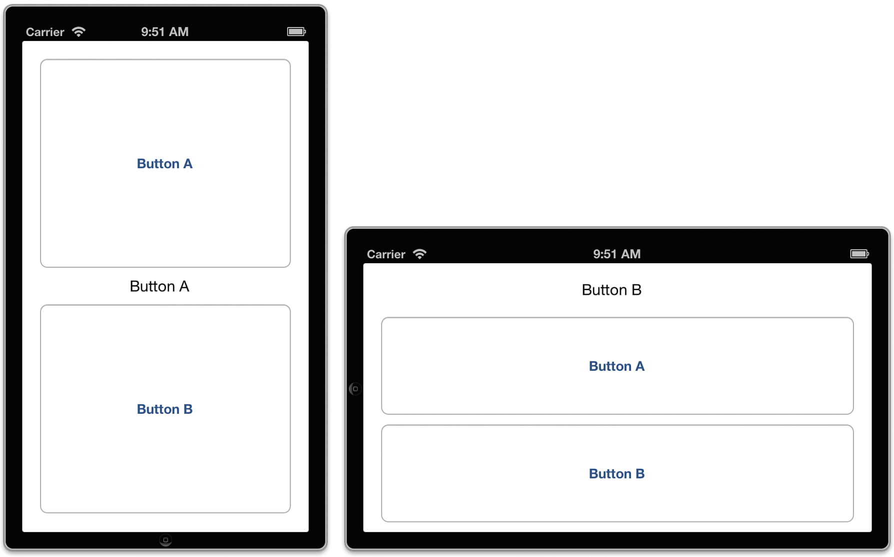


FIGURE 16.15
Buttons resize and reposition appropriately (all handled in code).

Planning the Properties and Connections

In this exercise, you manually resize and reposition three UI elements: two buttons (`UIButton`) and one label (`UILabel`). Although we aren't creating these with outlets, we define properties for them: `buttonA`, `buttonB`, and `theLabel` should suffice.

Why Aren't You Using Private Instance Variables?

Good question. You're welcome to do this, exactly as we have in some of our other projects. In this case, however, it might be useful for our view controller to expose these other elements so that they could be used by other classes. This also matches how IB itself handles UI elements. If you disagree with this approach, no worries; instance variables will work just fine.

We also implement a method: `handleButton`, which updates the onscreen label to show the title of a button that was tapped. Like the properties, this won't be declared using IB, but we'll be using it just like an `IBAction`. We also add two additional methods, `initInterface` and `updateInterface`, to handle setting up and updating the interface, respectively. These will be triggered by a change in orientation, so our next step is to set up the project to properly handle orientation changes.

Enabling Orientation Changes

For this project, enable support of all orientations. To do this, start by updating the project summary (click the blue project icon at the top of the project navigator) and select all the device orientations within the Supported Interface Orientations section. Next, add the `supportedInterfaceOrientations` method to `ViewController.m` and have it return the constant `UIInterfaceOrientationMaskAll`, as shown in Listing 16.2.

LISTING 16.2 Support All Interface Orientations

```
- (NSUInteger)supportedInterfaceOrientations {
    return UIInterfaceOrientationMaskAll;
}
```

Programming the Interface

We've now reached the point in the project where normally I'd say, "Let's design the interface." This time, however, there isn't going to be a visual design, just code. In fact, you've already seen the two screenshots that accompany this project, so if you're just skimming pictures, you'd better flip through a few more pages.

Defining Properties and Methods

We start by defining the properties and methods that the view controller will be using. Recall that we're adding three properties: `buttonA`, `buttonB`, and `theLabel`. We' also have three methods that we should prototype in ViewController.h: `initInterface`, `updateInterface`, and `handleButton`.

Edit ViewController.h, adding the properties and method prototypes, as shown in Listing 16.3.

LISTING 16.3 Add the Properties and Method Prototypes to ViewController.h

```
#import <UIKit/UIKit.h>

@interface ViewController : UIViewController

@property (weak,nonatomic) UIButton *buttonA;
@property (weak,nonatomic) UIButton *buttonB;
@property (strong,nonatomic) UILabel *theLabel;

- (void)initInterface;
- (void)updateInterface;
- (void)handleButton:(id)sender;

@end
```

Look closely and you'll notice that theLabel is set to use a strong property reference. Unfortunately, this is a result of overzealous memory cleanup by ARC. If we use weak instead, the label will actually be removed from memory before we can even get it onto the screen. Using strong ensures that the label sticks around as long as the ViewController object is active.

Everything else should look pretty straightforward. The initInterface and updateInterface methods don't take any arguments or return any values. The handleButton method is styled after a typical IBAction because it will behave exactly like a typical action; it's just being defined by hand rather than being built for us.

Initializing the Interface Properties

The next step is to add the initInterface method to ViewController.m. The purpose of this method is to configure all the interface elements (the two buttons and the label) so that they're ready to be added to the interface, but *not* display them just yet.

By keeping the display logic separated from the initialization logic, we can build a method that can be called at any time to update the interface. This method, aptly named updateInterface, is called at the end of the initInterface and anytime interface rotation is sensed.

Add the initInterface method from Listing 16.4 to ViewController.m.

LISTING 16.4 Prepare the Interface But Don't Display It Yet

```
- (void)initInterface {
    self.buttonA =[UIButton buttonWithType:UIButtonTypeRoundedRect];
    [self.buttonA addTarget:self action:@selector(handleButton:)
            forControlEvents:UIControlEventTouchUpInside];
    [self.buttonA setTitle:@"Button A" forState:UIControlStateNormal];

    self.buttonB =[UIButton buttonWithType:UIButtonTypeRoundedRect];
    [self.buttonB addTarget:self action:@selector(handleButton:)
            forControlEvents:UIControlEventTouchUpInside];
    [self.buttonB setTitle:@"Button B" forState:UIControlStateNormal];

    self.theLabel=[[UILabel alloc] init];
    self.theLabel.text=@"Welcome";
    [self updateInterface];
}
```

This might be the first time we've manually created a number of UI elements, but because you've been working with these objects and adjusting their properties for hours, this code shouldn't seem completely foreign.

Line 2 initializes the `buttonA` property as a button of type `UIButtonTypeRoundedRect`—the standard button we use in our views. Lines 3–4 use the button's `addTarget:action:forControlEvents` method to choose what will happen when the `Touch Up Inside` event occurs for the button. The `@selector` directive specifies which method will be called during the event—such as `handleButton`. This is exactly the same as connecting a button to an `IBAction` in IB.

Line 5 sets the title for the button to Button A.

Lines 7–10 repeat the same process for Button B (`buttonB`).

Lines 12–13 allocate and initialize a label (`theLabel`) with the default text Welcome.

Lastly, line 14 invokes the `updateInterface` method so that the newly defined user elements can be placed on the screen. So, what do we do now? Implement `updateInterface`.

Implementing the Interface Update Method

The `updateInterface` method does the heavy lifting for the application. It checks to see what the current orientation is, and then it draws content based on the view's `bounds` property. By basing the drawing on the height and width contained within `bounds`, you can scale to any screen size at all.

For example, consider this code snippet:

```
float screenWidth;
float screenHeight;
screenWidth=self.view.bounds.size.width;
screenHeight=self.view.bounds.size.height;
```

This grabs and stores the current screen width and height in the variables `screenWidth` and `screenHeight`. The dimensions and position of UI objects are determined by their `frame`, which is a property of type `CGRect`. To set the `frame` of a button property named `theButton` so that it filled the top half of the screen, I'd write the following:

```
self.theButton.frame=CGRectMake(0.0,0.0,screenWidth,screenHeight/2);
```

The first two values of `CGRectMake` (which create a `CGRect` data structure) set the origin point at 0,0. The second two parameters determine the width and height of the `CGRect`. Using `screenWidth` sets the button to the same width of the screen and `screenHeight/2` sets the height of the button to half the height of the screen. In an actual implementation, you want to include some margin around the edges. This is why you'll see +20 and other values tacked onto my coordinates. Speaking of which, go ahead and implement `updateInterface`, as shown in Listing 16.5. When you're done, we step through the code.

LISTING 16.5 The `updateInterface` Implementation

```
 1: - (void)updateInterface {
 2:     float screenWidth;
 3:     float screenHeight;
 4:     screenWidth=self.view.bounds.size.width;
 5:     screenHeight=self.view.bounds.size.height;
 6:
 7:     if (self.interfaceOrientation==UIInterfaceOrientationPortrait ||
 8:         self.interfaceOrientation==UIInterfaceOrientationPortraitUpsideDown) {
 9:         self.buttonA.frame=CGRectMake(20.0,20.0,screenWidth-40.0,
10:                                       screenHeight/2-40.0);
11:         self.buttonB.frame=CGRectMake(20.0,screenHeight/2+20,
12:                                       screenWidth-40.0,screenHeight/2-40.0);
13:         self.theLabel.frame=CGRectMake(screenWidth/2-40,
14:                                        screenHeight/2-10,200.0,20.0);
15:     } else {
16:         self.buttonA.frame=CGRectMake(20.0,60.0,screenWidth-40.0,
17:                                       screenHeight/2-40.0);
18:         self.buttonB.frame=CGRectMake(20.0,screenHeight/2+30,
19:                                       screenWidth-40.0,screenHeight/2-40.0);
20:         self.theLabel.frame=CGRectMake(screenWidth/2-40,20.0,200.0,20.0);
21:     }
22:
23:     [self.view addSubview:self.buttonA];
24:     [self.view addSubview:self.buttonB];
25:     [self.view addSubview:self.theLabel];
26: }
```

Lines 2–5 grab and store the current screen size in `screenWidth` and `screenHeight`.

Lines 7–8 checks the `interfaceOrientation` property of the view controller, and, if it is in one of the portrait orientations, lines 8–14 are executed. Otherwise, lines 16–20 are evaluated. These blocks both have the same purpose: defining the `frame` properties for each of the UI elements (`buttonA`, `buttonB`, and `theLabel`).

Lines 8–14 define positions for the buttons so that there are margins on the edges of the screen and a space in the middle for the label. Lines 16–20 position the buttons lower on the screen and put the label at the top. The margins and spacing I used is completely arbitrary. You can try changing these values around to see what effect they have.

Finally, lines 23–25 add the buttons and label to the view so that they are visible onscreen.

Everything is now in place for the interface, but we need to take care of three small tasks before the project is complete. First, we need to make sure that the interface is drawn when the application first loads. Second, the interface must update when an orientation change occurs. Third, we need to implement `handleButton` to update the label when the buttons are pressed.

Drawing the Interface When the Application Launches

When the application first launches, there isn't an orientation change to trigger the interface to be drawn. To make sure there is something on the screen, we need to call `initInterface` when the application loads. Add this to `viewDidLoad`, as shown in Listing 16.6.

LISTING 16.6 Initialize the Interface When the Application Loads

```
- (void)viewDidLoad
{
    [super viewDidLoad];
    [self initInterface];
}
```

We're getting closer. The application will now initialize and display the interface, but it still can't adapt to a change in orientation.

Updating the Interface When Orientation Changes

To handle orientation changes, the application needs to call `updateInterface` within an implementation of `didRotateFromInterfaceOrientation`. We also need to remove the existing buttons, otherwise the old version of the interface will still be visible; this is surprisingly easy to do.

Add `didRotateFromInterfaceOrientation` to ViewController.m, as shown in Listing 16.7.

LISTING 16.7 Handle Rotation in `didRotateFromInterfaceOrientation`

```
1: - (void)didRotateFromInterfaceOrientation:
2:         (UIInterfaceOrientation)fromInterfaceOrientation {
3:     [[self.view subviews]
4:                 makeObjectsPerformSelector:@selector(removeFromSuperview)];
5:     [self updateInterface];
6: }
```

Lines 3–4 use the very cool `makeObjectsPerformSelector` method on all the subviews in the scene's view (all of our UI elements) to send them the message `removeFromSuperview`. This, as expected, removes the buttons and label from the view.

Line 5 calls `updateInterface` and draws the appropriate version of the interface for whatever orientation we are currently in.

Handling the Button Touches

The last piece of the puzzle is implementing `handleButton` so that it updates the onscreen label with the label of the button being touched. This is just a single line, so add Listing 16.8 to the view controller, and you're done.

LISTING 16.8 Handle Button Touches

```
- (void)handleButton:(id)sender {
    self.theLabel.text=((UIButton *)sender).currentTitle;
}
```

The one line of the implementation uses the `sender` parameter (typecast as a `UIButton`) to grab the title of the button (`currentTitle`) that was pressed.

Building the Application

Build and run the application. It should rotate and resize with no problem. What's more, because all of the interface layout was based on the height and width of the view, this same code will work, without changes, in an iPad or iPhone project.

I hope this didn't scare you too much. The purpose of this exercise was to show that responsive and flexible interfaces can be accomplished in code without it being too much of a hassle. The biggest challenge is determining how the controls will be laid out and then coming up with the `CGRectMake` functions to define their locations.

Swapping Views on Rotation

Some applications display entirely different UIs depending on the device's orientation. The iPhone Music application, for example, displays a scrolling list of songs in portrait mode and a "flickable" Cover Flow view of albums when held in landscape. You, too, can create applications that dramatically alter their appearance by simply switching between views when the phone is rotated.

Our last tutorial in this hour is short and sweet and gives you the flexibility to manage your landscape and portrait views all within the comfort of the IB editor. What's more, you can still use Auto Layout within each of these views to position your interface objects to accommodate different screen sizes (like the 3.5" and 4" iPhone screens).

Implementation Overview

The previous examples used a single view and rearranged it (either through Auto Layout or code) to fit a different orientation. When the view is too different or complex for this to be feasible, however, you can use two individual views with a single view controller. This is precisely what we do in this application. We start by adding a second view to the traditional single-view application, and then we design both views and make sure we can easily access them through properties in our code.

Once that is complete, we write the code necessary to swap the views when the device rotates. There is a catch, which you'll learn about in a bit, but nothing that poses too much of a problem to coders as experienced as we are.

Setting Up the Project

Create a new project named **Swapper** using the Single View Application template. Although this includes a single view already (which we'll use for the default portrait display), we need to supplement it with a second landscape view.

Planning the Property and Connections

This application does not implement any real UI elements, but we need to access two `UIView` instances programmatically. One view is for portrait orientation (`portraitView`) and another for landscape orientation (`landscapeView`). We will implement a method to handle orientation changes, but it will not be triggered by any actions.

Adding a Degree to Radians Constant

Later in this exercise, we have to call a special Core Graphics method to define how to rotate views. The method requires a value to be passed in radians rather than degrees. In other words, instead of saying we want to rotate the view 90 degrees, we have to tell it we want to rotate 1.57 radians. To help us handle the conversion, we define a constant for the conversion factor. Multiplying degrees by the constant gets us the resulting value in radians.

To define the constant, add the following line after the `#import` line in ViewController.m:

```
#define kDeg2Rad (3.1415926/180.0)
```

Enabling Orientation Changes

As with the previous example, we need to ensure that the implementation of `supportedInter-faceOrientations` is behaving as we expect in our view controller. Unlike the previous implementation, however, this time we allow the device to rotate only between the two landscape modes and upright portrait.

Update ViewController.m to include the implementation in Listing 16.9.

LISTING 16.9 Disable the Upside-Down Orientation

```
- (NSUInteger)supportedInterfaceOrientations {
    return UIInterfaceOrientationMaskAllButUpsideDown;
}
```

Be sure to also go into the project summary and set the allowed orientations to everything but upside-down.

Designing the Interface

When you are swapping views, the sky is the limit for the design. You build them exactly as you would in any other application. The only difference is that if you have multiple views handled by a single view controller, you must define outlets that encompass all the interface elements.

This example demonstrates just how to swap views, so our work will be a piece of cake.

Creating the Views

Open the MainStoryboard.storyboard file and drag a new instance of the `UIView` object from the Object Library to the document outline, placing it at the same level in the hierarchy as the view controller, as shown in Figure 16.16. Don't put the `UIView` inside the existing view.

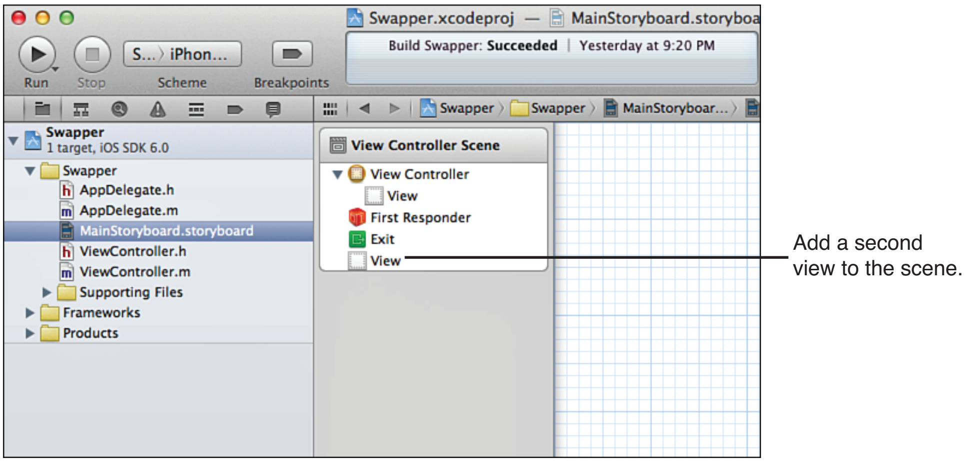


FIGURE 16.16
Add a second view to the scene.

TIP

It might seem counterintuitive, but there's no reason that a scene can't contain multiple views if they are going to be managed by the same view controller. Only the view nested within the view controller is displayed by default. Additional views have to be displayed manually.

Now, open the default view and add a label, such as **Portrait View**; make sure that it is selected. Use Editor, Align from the menu bar to set constraints so that it is aligned to the horizontal and vertical centers of the view. Now set a background color to differentiate the view. That finishes one view, but we still have another to do. Unfortunately, you can only edit a view that is assigned to a view controller in IB, so we have to be creative.

Drag the view you just created out of the view controller hierarchy in the document outline, placing it at the same level as the view controller. Drag the second view onto the view controller line in the document outline. You can now edit it by adding a unique background color and a label such as **Landscape View**. You may want to switch the view controller to simulate a landscape mode while making these edits. When the second view is done, rearrange the view hierarchy again, nesting the portrait view inside the view controller and the landscape view outside the view controller.

If you want to make this more interesting, you're welcome to add other controls and design the view as you see fit. Our finished landscape and portrait views are shown in Figure 16.17.

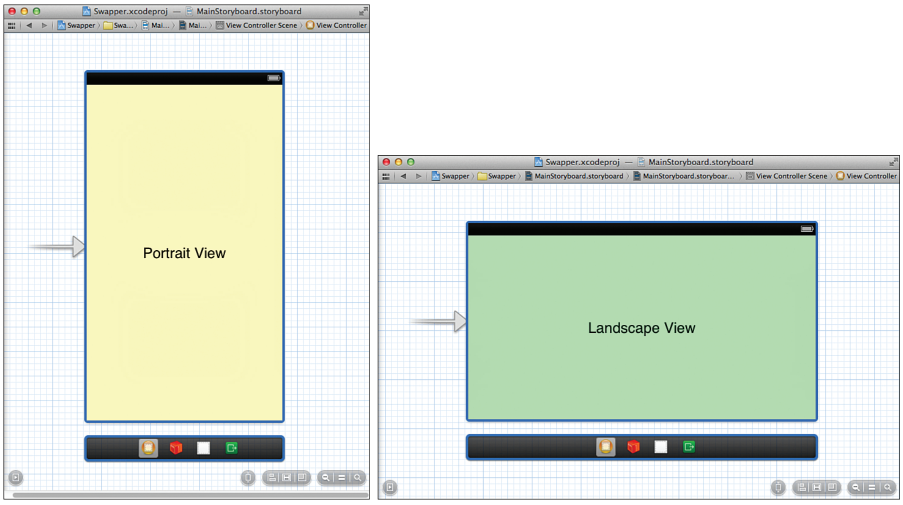

Swapper.xcodeproj — MainStoryboard.storyboard
Swapper › Swa... › Mai... › Mai... › View Controller Scene › View Controller
Portrait View
Swapper.xcodeproj — MainStoryboard.storyboard
Swapper › Swapper › MainStoryboard.storyboard › MainStoryboard.storyboar... › View Controller Scene › View Controller
Landscape View

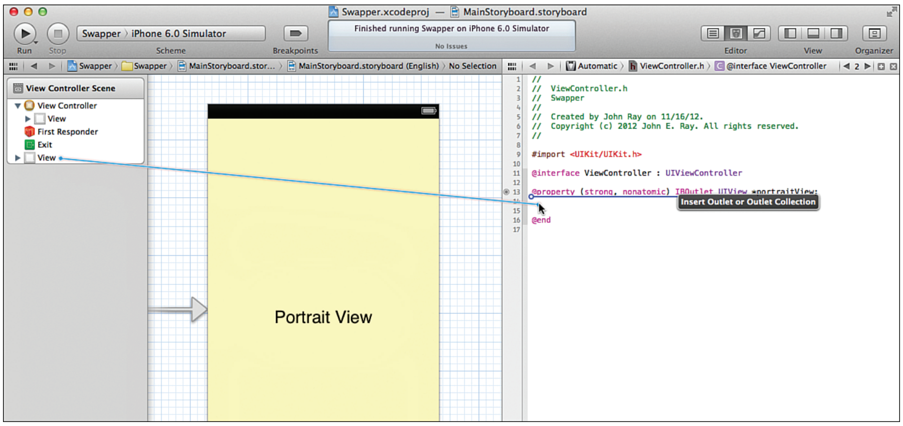
FIGURE 16.17
Edit the two views so that you can tell them apart.

Creating and Connecting the Outlets

To finish up our interface work, we need to connect the two views to two outlets. The default view (nested in the view controller) will be connected to `portraitView`. The second view will be connected to `landscapeView`. Switch to the assistant editor and make sure that the document outline is visible.

Because we're dealing with views rather than objects in our interface design, the easiest way to make these connections is to Control-drag from the respective lines in the document outline to the ViewController.h file. In addition, unlike with most of the projects in this book, we need to create outlets with the storage set to Strong; otherwise, ARC will conveniently get rid of the views when they aren't visible.

Control-drag from the default (nested) view to below the `@interface` line in ViewController.h. Create a new outlet for the view called `portraitView`, with the storage set as Strong. Repeat the process for the second view, naming the connection `landscapeView` as demonstrated in Figure 16.18.


Swapper.xcodeproj — MainStoryboard.storyboard
Run
Stop
Swapper › iPhone 6.0 Simulator
Scheme
Breakpoints
Finished running Swapper on iPhone 6.0 Simulator
No Issues
Editor
View
Organizer
Swapper › Swapper › MainStoryboard.stor... › MainStoryboard.storyboard (English) › No Selection
Automatic › ViewController.h › @interface ViewController
View Controller Scene
View Controller
View
First Responder
Exit
View
Portrait View
Insert Outlet or Outlet Collection

```
//
//  ViewController.h
//  Swapper
//
//  Created by John Ray on 11/16/12.
//  Copyright (c) 2012 John E. Ray. All rights reserved.
//

#import <UIKit/UIKit.h>

@interface ViewController : UIViewController

@property (strong, nonatomic) IBOutlet UIView *portraitView;


@end
```

FIGURE 16.18
Connect the views to corresponding outlets using a storage type of Strong.

Implementing the Application Logic

For the most part, swapping views is actually easier than the reframing logic we implemented in the last project—with one small exception. Even though we designed one of the views to be in landscape view, it doesn't "know" that it is supposed to be displayed in a landscape orientation.

Understanding the View-Rotation Logic

For a landscape view to be successfully swapped onto the screen, we need to rotate it and define how big it is. The reason for this is that there is no inherent logic built in to a view that says "hey, I'm supposed to be sideways." As far as it knows, it is intended to be displayed in portrait mode but has UI elements that are pushed off the sides of display.

Each time we change orientation, we go through three steps: swapping the view, rotating the view to the proper orientation through the `transform` property, and setting the view's origin and size via the `bounds` property.

For example, assume we're rotating to landscape right orientation:

1. First, we can grab the current view size (after rotation) by accessing and storing `self.view.bounds`. This can be used later to make sure that the new view is set to the proper size:

   ```
   currentBounds=self.view.bounds;
   ```

2. Second, we swap out the view by assigning `self.view`, which contains the current view of the view controller, to the `landscapeView` property. If we left things at that, the view would properly switch, but it wouldn't be rotated into the landscape orientation. A landscape view displayed in a portrait orientation isn't a pretty thing. For example:

   ```
   self.view=self.landscapeView;
   ```

3. Next, to deal with the rotation, we define the `transform` property of the view. This property determines how the view will be altered before it is displayed. To meet our needs, we have to rotate the view 90 degrees to the right (for landscape right), –90 degrees to the left (for landscape left), and 0 degrees for portrait. As luck would have it, the Core Graphics C function, `CGAffineTransformMakeRotation()`, accepts a rotation value in radians and provides an appropriate structure to the `transform` property to handle the rotation. For example:

   ```
   self.view.transform=CGAffineTransformMakeRotation(deg2rad*(90));
   ```

NOTE

Note that we multiply the rotation in degrees (90, –90, and 0) by the constant `kDeg2Rad` that we defined earlier so that `CGAffineTransformMakeRotation()` has the radian value it expects.

4. The final step is to set the `bounds` property of the view to the bounds that we stored in step 1. For example:

   ```
   self.view.bounds=currentBounds;
   ```

Now that you understand the steps, let's take a look at the actual implementation.

Adding the View-Rotation Logic

All the rotation magic happens within a single method: `supportedInterfaceOrientations.`

Open the ViewController.m file and implement the method, as shown in Listing 16.7.

LISTING 16.10 Rotate the View into the Proper Orientation

```
 1: - (void)didRotateFromInterfaceOrientation:
 2:     (UIInterfaceOrientation)fromInterfaceOrientation {
 3:
 4:     CGRect currentBounds=self.view.bounds;
 5:
 6:     if (self.interfaceOrientation == UIInterfaceOrientationLandscapeRight) {
 7:         self.view=self.landscapeView;
 8:         self.view.transform=CGAffineTransformMakeRotation(kDeg2Rad*(90));
 9:     } else if (self.interfaceOrientation == UIInterfaceOrientationLandscapeLeft) {
10:         self.view=self.landscapeView;
11:         self.view.transform=CGAffineTransformMakeRotation(kDeg2Rad*(-90));
12:     } else {
13:         self.view=self.portraitView;
14:         self.view.transform=CGAffineTransformMakeRotation(0);
15:     }
16:     self.view.bounds=currentBounds;
17: }
```

Line 4 grabs the current `bounds` of the scene's view after the rotation has occurred, and stores it in `currentBounds`.

Lines 6–8 handle rotation to the right (landscape right). Lines 9–11 deal with rotation to the left (landscape left). Finally, lines 13–14 configure the view for the default orientation, portrait.

In the very last step, line 16, the bounds of the view we swapped in are set to the `currentBounds` that we stored when the method started.

NOTE

Although we used an `if-then-else` statement in this example, you could easily use a `switch` structure instead. The `toInterfaceOrientation` parameter and orientation constants are integer values, which means they can be evaluated directly in a `switch` statement.

TIP

In this hour's exercises, we used `didRotateFromInterfaceOrientation` to detect and react to a change in orientation. If you'd prefer to being reacting immediately *prior* to iOS adjusting the orientation, you can use the method `willRotateToInterfaceOrientation:duration` instead.

Building the Application

Save the implementation file, and then run and test the application. As you rotate the device or the iOS simulator, your views should be swapped in and out appropriately. This approach gives you a good combination of flexibility while keeping the benefits of Auto Layout. Unfortunately, it also means that you have to manage twice as many objects in your code.

When designing your own applications, you need to strike a balance between interface flexibility and code complexity. In some cases, it's just easier to design a different scene and use a second view and view controller to handle other orientations.

Further Exploration

Although we covered several different ways of working with rotation in the iPhone interface, you may want to explore additional features outside of this hour's lesson. Using the Xcode documentation tool, review the `UIView` instance methods. You'll see that there are additional methods that you can implement, such as `willAnimateRotationToInterfaceOrientation:duration`, which is used to set up a single-step animated rotation sequence. What's more, you can combine these methods with segues—programmatically triggering a segue to a new scene when an orientation event occurs.

In short, there are a number of ways to create interfaces that do anything you want. It's a good idea to practice the techniques discussed here to learn what will work best for your projects.

Summary

iDevices are all about the user experience—a touchable display, intuitive controls, and now, rotatable and resizable interfaces. Using the techniques described in this hour, you can adapt to almost any type of rotation scenario. To handle interface size changes without a line of code, for example, you can take advantage of the Auto Layout. For more complex changes, however, you might want to programmatically define your onscreen elements, giving you complete control over their size and placement. Finally, for a good balance in flexibility, you can create multiple different views and swap them as the device rotates.

By implementing rotation and size-aware applications, you give your users the ability to use their devices in the way that feels most comfortable to them.

Q&A

Q. Why don't many iPhone applications implement the upside-down portrait mode?

A. Although there is no problem implementing the upside-down portrait orientation using the approaches described in this hour, it isn't recommended. When the iPhone is upside-down, the Home button and sensors are not in the "normal" location. If a call comes in or the user needs to interact with the phone's controls, the user will need to rotate the phone 180 degrees—a somewhat complicated action to perform with one hand.

Q. How do I get the controls in application XYZ to behave using Auto Layout?

A. This is a difficult question with no clear answer because there may be dozens of ways of implementing constraints that have the desired effect. I have implemented Auto Layout constraints for 3.5" and 4" iPhone displays in all my sample projects. You may want to take a look at those to get an idea of how I solved resizing problems (landscape, however, is up to you!).

Workshop

Quiz

1. The iDevice interface can rotate through three different orientations. True or false?

2. How does an application communicate which rotation orientations it supports?

3. What was the purpose of the `kDeg2Rad` constant that we defined in the final exercise?

Answers

1. False. There are four primary interface orientations: landscape right, landscape left, portrait, and upside-down portrait.

2. As long as the the `supportedInterfaceOrientations` method is implemented in the view controller, the application identifies which of the four orientations it will operate in.

3. We defined the `kDeg2Rad` constant to give us an easy way of converting degrees to radians for the Core Graphics C function `CGAffineTransformMakeRotation()`.

Activities

1. Edit the Swapper example so that each view presents and processes user input. Keep in mind that because both views are handled by a single view controller, you must add all the outlets and actions for both views to the view controller interface and implementation files.

2. Return to an earlier lesson and revise the interface to support multiple different orientations and iPhone screen sizes. Use any of the techniques described in this hour's exercises for the implementation.

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