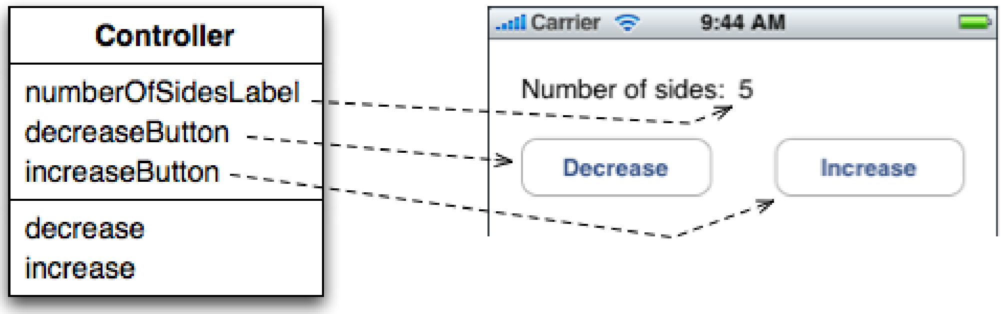
# CS193P: HelloPoly Walkthrough

## Overview

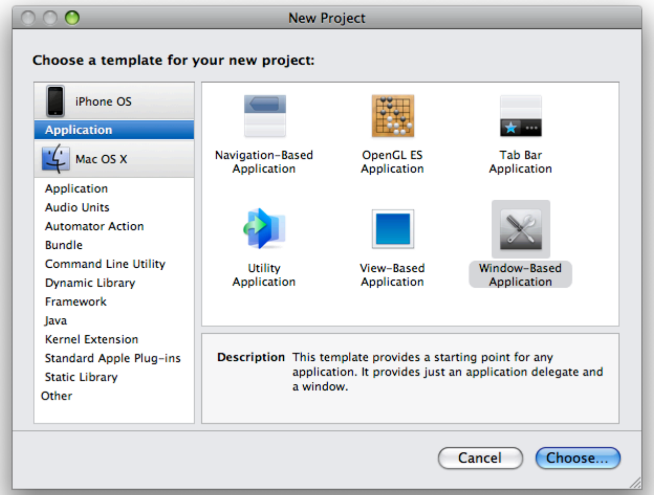
The goal of this 'walkthrough' is to give you a fairly step by step path through building a simple Cocoa Touch application. You are encouraged to follow the walkthrough, as it should help you successfully complete the assignment, help you quickly become familiar with the tools and basic iPhone development workflow.

Also keep in mind, that although you will be navigating a series of steps in tools, what you are building is the connected group of objects diagrammed below. You will define a controller object with instance variables (***outlets***) that refer to the user interface elements.



The controller object implements behavior, ***action methods***, that adjusts the number of sides of a polygon. You will connect each control so that the target of the control is the controller, and the action that will be sent is one of 'increase' or 'decrease'.

**Create a new Cocoa Touch project:**
1. Select menu **File** > **New Project…**
2. Select **iPhone OS Application**, then choose the **Window-Based Application** template
3. Name the project 'HelloPoly'



Description This template provides a starting point for any application. It provides just an application delegate and a window.

**Setting the Active SDK**
For simplicity, we'll use the iPhone Simulator in this walkthrough. When building iPhone applications you need to tell Xcode which platform to build against. To change the Active SDK use the Project > Set Active SDK menu item. Set this to 'Simulator - iPhone OS 2.0'. There is also a handy toolbar popup labeled 'Overview' which allows for setting both the Active SDK and the Build Configuration (typically debug or release) in one convenient location. If you choose View > Customize Toolbar... you can add this popup to the toolbar. Many people find this the easiest way to switch SDKs while developing iPhone apps.

**Checkpoint: Build and Test**
The project is already set up with the skeleton of a Cocoa Touch application. Convince yourself and double check by clicking the "Build and Go" button in the toolbar. This will build the application and then run it in the simulator.

Note that the template we are using is nothing more than a blank view. This is the most basic starting point template where you have to build everything yourself. Other templates provide different starting points, depending on the intended design of your application. We will use other templates in future assignments and examples.

**Troubleshooting:** If you reach this point and your application does not work as expected, please let us know. It's possible you selected a different project template or there may be an issue with the installation of the iPhone SDK.

**Working in Interface Builder**
The empty white view that you saw when you built and ran the bare-bones iPhone application are defined in the MainWindow.xib file. A xib file (sometimes called an "interface file" or "nib file") contains archived objects that you configure and connect in Interface Builder. Typically the Xcode project template will be configured to load the file named "MainWindow.xib" at launch time. This interface file contains the main window of the application and potentially other user interface element. At design time when a xib file is saved, objects archive their state and store it in the file. When a xib is loaded at runtime, all the objects within it are unarchived into live object instances and their state is restored.

Open the file MainWindow.xib by double clicking. This will launch Interface Builder. (Interface Builder is located in `/Developer/Applications`).

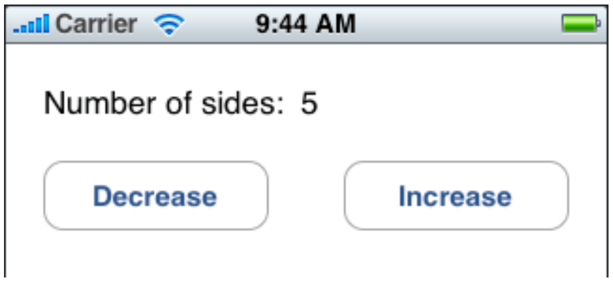
**Tip**: You can select Hide Others from the Interface Builder menu to focus on just Interface Builder.

In Interface Builder we will be doing four main tasks:

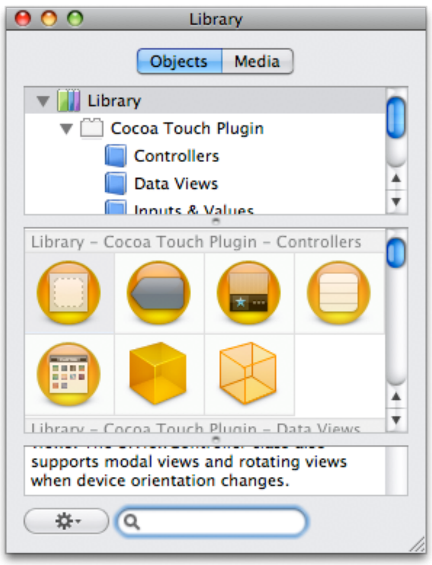
1. Layout and configure the user interface
2. Define a controller class and create an instance of that class
3. Connect the user interface and controller
4. Generate source files for the new controller class

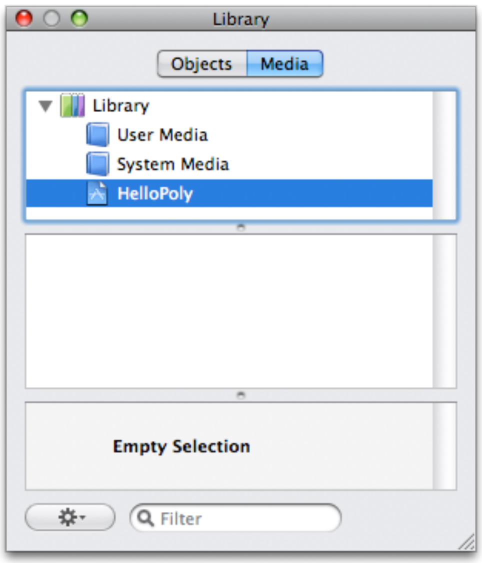
## Layout and configure the user interface

Following the steps below should give you a user interface that looks similar to:



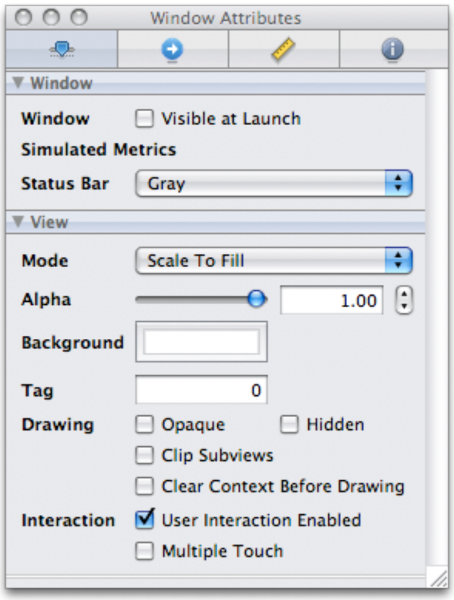
The Library window contains a variety of objects you can drag to the window. It also provides access to media resources (images, sounds, etc) that you may want to use in your user interface


Library
Objects
Media
Library
Cocoa Touch Plugin
Controllers
Data Views
Inputs & Values
Library - Cocoa Touch Plugin - Controllers
Library - Cocoa Touch Plugin - Data Views
supports modal views and rotating views when device orientation changes.



1. In the Objects tab select the Inputs & Values item under Cocoa Touch Plugin
2. Drag two push buttons from the Library to your application's window
3. Now drag two text labels into the app's window. One will be for the label on the left ("Number of sides") and the other will be for displaying the value.

**The Attributes Inspector**
Show the Attributes Inspector by selecting Tools > Attributes Inspector. You use the inspector to view and edit properties of the selected item.



Window Attributes

▼ Window

Window ☐ Visible at Launch

Simulated Metrics

Status Bar: Gray

▼ View

Mode: Scale To Fill

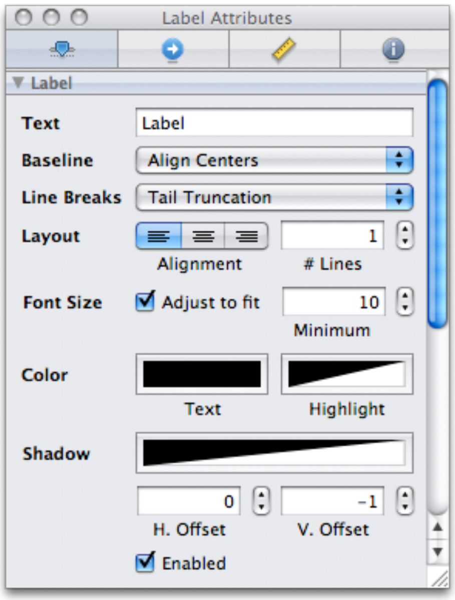
Alpha: 1.00

Background

Tag: 0

Drawing: ☐ Opaque ☐ Hidden ☐ Clip Subviews ☐ Clear Context Before Drawing

Interaction: ☑ User Interaction Enabled ☐ Multiple Touch



Label Attributes

▼ Label

Text: Label

Baseline: Align Centers

Line Breaks: Tail Truncation

Layout: Alignment; # Lines: 1

Font Size: ☑ Adjust to fit; Minimum: 10

Color: Text; Highlight

Shadow

H. Offset: 0; V. Offset: -1

☑ Enabled

You can edit the title of the labels by editing the Text field in the Attributes Inspector, or by double clicking directly on the label.

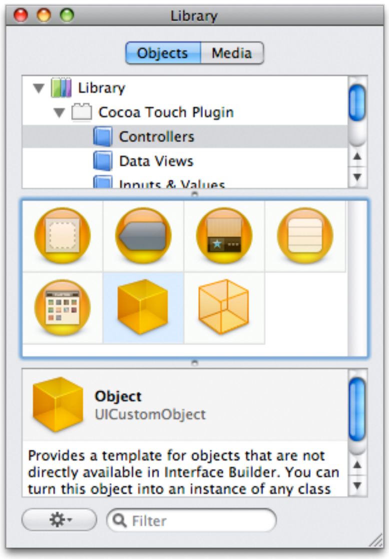
1. From the menu select Tools > Attributes Inspector if it is not already showing.
2. Select one of the text labels
3. Use the Text field in the inspector to set the text of the label to "Number of sides:"
4. Set the text of the other text label to "5" (the default number of sides we'll use)
5. Double click on one of the buttons to begin editing its title
6. Set the title to "Decrease"
7. Set the title of the other button to "Increase"

The user interface elements of your application are now in place. Lay them out in the window in a pleasing manner. Save your changes. You can build and run the project in Xcode again to verify that your interface file is being loaded correctly.

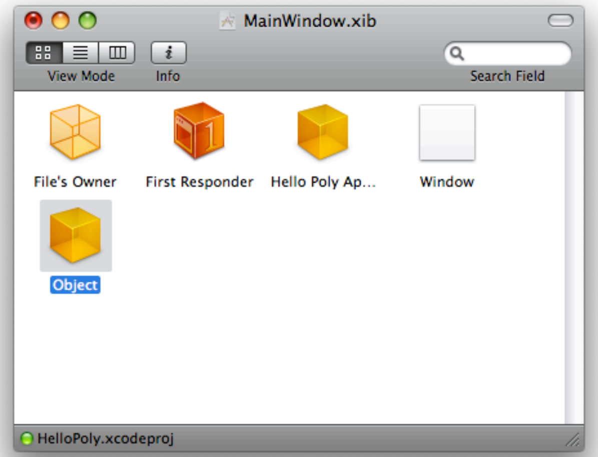
## Defining and instantiating a class in Interface Builder

We are now going to define a custom class named Controller. It will have instance variables that reference the two buttons and the value text label. Each reference is known as an *outlet*. The class will also define two methods that will be called by the buttons known as an *action*.

1. In the Library, select the Controllers group (under Cocoa Touch Plugin)
2. Select the **Object** item. This icon represents a custom object which you define.
3. Drag the Object icon to your interface document window
4. Select the Object item in the document window
5. Use the **Tools > Identity Inspector** menu item to show the inspector window
6. In the Class field, type **Controller**. Note that the name in the document window is updated



Provides a template for objects that are not directly available in Interface Builder. You can turn this object into an instance of any class



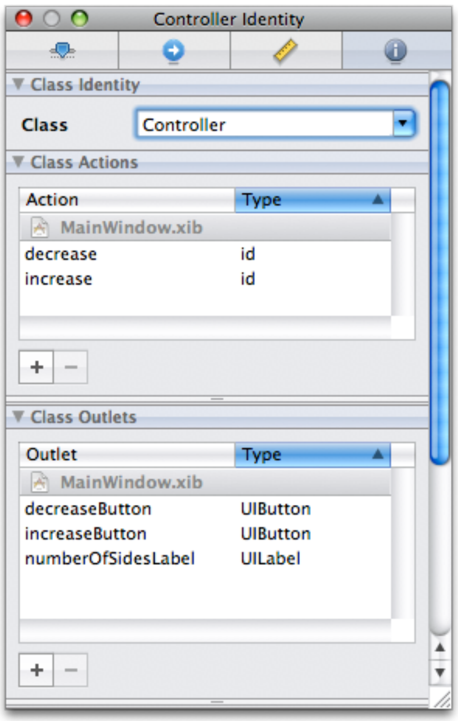
The Identity Inspector is also where you add outlets and actions to classes. To add outlets to our custom class:

1. Keep the 'Controller' object selected
2. In the **Class Outlets** section, add outlets with the following values for the outlet and types:

| **Outlet** | **Type** |
|---|---|
| numberOfSidesLabel | UILabel |
| decreaseButton | UIButton |
| increaseButton | UIButton |

3. In the **Class Actions** section, add two actions. Set the first action to '`increase`' and set the second action to '`decrease`'.

Your inspector should look like the following:



Class: Controller

| Action | Type |
|---|---|
| decrease | id |
| increase | id |

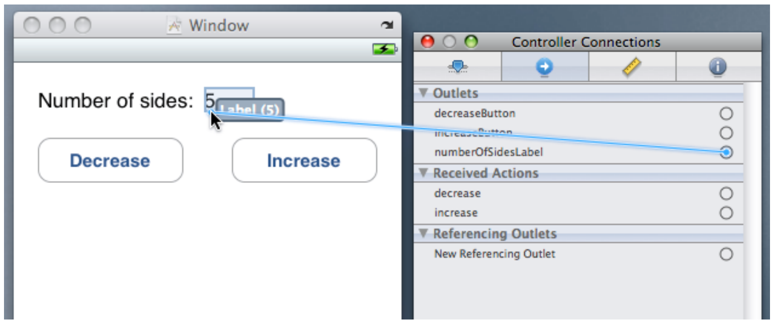
| Outlet | Type |
|---|---|
| decreaseButton | UIButton |
| increaseButton | UIButton |
| numberOfSidesLabel | UILabel |

## Connect the Controller to the UI

The Controller class is now defined and we have an instance created in our interface file, now we need to establish connections between the controller object and the user interface controls.

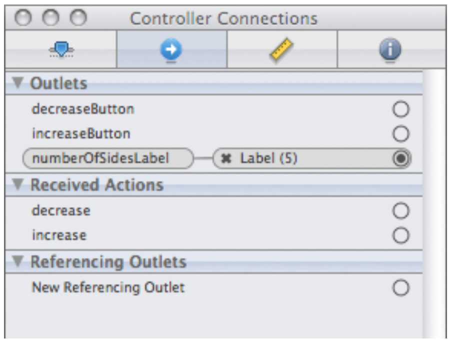
**Connecting the Outlets**
First, we'll connect the outlets. An outlet is a reference from one object to another. Establish a connection from the controller to the text label by:

1. Select the Controller object in the document window.
2. Use the **Tools > Connections Inspector** to show the appropriate inspector. The connections inspector shows all of the available outlets and actions for the selected object.
3. Next to each outlet and action is a "connection circle". Drag from the connection circle next to the 'numberOfSidesLabel' outlet to the text label you will use for showing the number of sides. You may note that IB will only allow connections to objects of the type that we had specified for the outlet above (UILabel in this case).



4. When the destination of the drag is highlighted, release the mouse.

5. The inspector will update to reflect that the connection for the outlet is now established, as shown below.



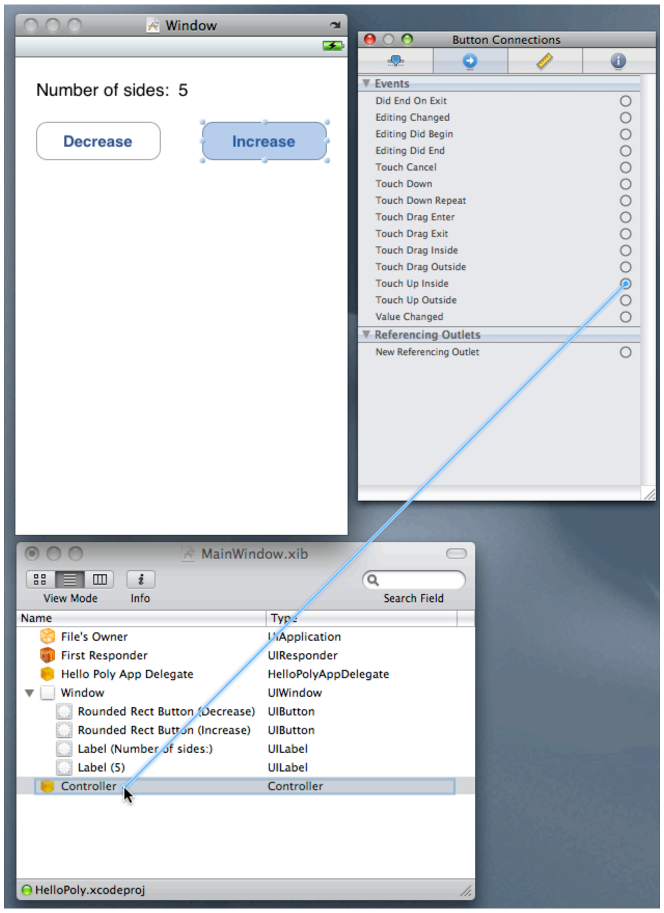
Repeat for the remaining outlets, dragging from the controller to the appropriate user interface element. Note that IB won't let you connect an outlet to an object of the wrong type. For example, when connecting the decreaseButton outlet, try connecting it to the text label. Because you specified the type of the decreaseButton as UIButton in the Identity Inspector it will only allow you to connect the outlet to buttons.

At runtime, the controller object will have references to these controls, and will be able to send messages to them, in our case, to set the value of the text label or to enable/disable the buttons.

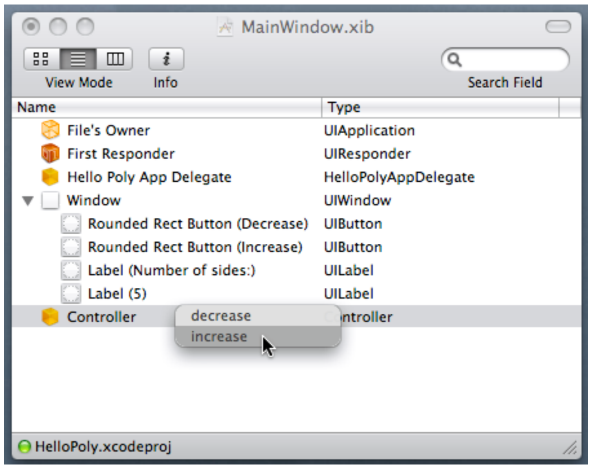
Save your changes.

**Connecting the buttons to a target and action**
Each control is able to store references to objects, known as the control's *targets*, and a method to be called on the target, known as the *action*. When specific events occur while the application is running, the control will invoke the action upon its target(s). In our application we want to connect the buttons to our Controller object and have them invoke the `increase` and `decrease` methods when the corresponding button is clicked. Connections for controls are set in a similar fashion to how outlets are specified. To set connect the sliders to our controller object, do the following:

1. Select the Increase button.
2. Use the **Tools > Connections Inspector** if the connections inspector is already visible.
3. In the inspector you will see a list of events that the control supports. Next to each event is a connection circle which you can drag. The event we are interested in is the "Touch Up Inside" event. Drag a connection from the Touch Up Inside event to our Controller object. With the Controller object highlighted, release the mouse. You have now specified the first part of the connection – **the target**
4. Upon releasing the mouse, a popup menu will appear showing the available **action** methods that can be invoked on the target object. In this case we have two actions methods. Choose the `increase` method. You have now specified the second part of the connection – **the action**.
5. Set the target and action of the Decrease button in the same way.



| Name | Type |
|---|---|
| File's Owner | UIApplication |
| First Responder | UIResponder |
| Hello Poly App Delegate | HelloPolyAppDelegate |
| Window | UIWindow |
| Rounded Rect Button (Decrease) | UIButton |
| Rounded Rect Button (Increase) | UIButton |
| Label (Number of sides:) | UILabel |
| Label (5) | UILabel |
| Controller | Controller |



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| Rounded Rect Button (Increase) | UIButton |
| Label (Number of sides:) | UILabel |
| Label (5) | UILabel |
| Controller | ntroller |

Save your changes.

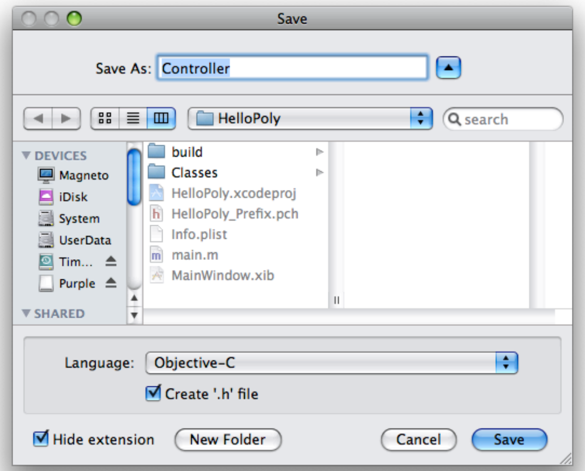
## Generate source files for the new class

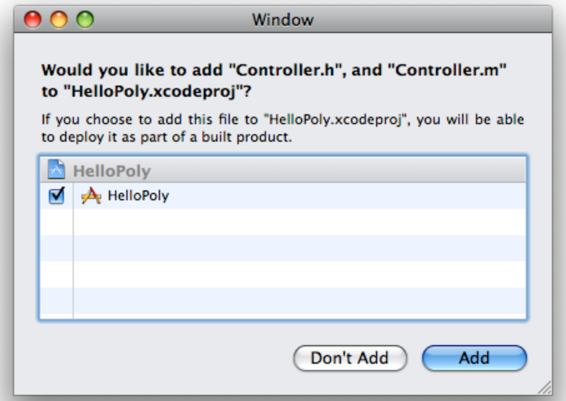
The Controller class is defined in Interface Builder, but since it is a class we just created, there is currently no Objective-C source code that defines the class. At the moment we are in a state such that when the nib file is loaded, there will be a runtime error because an object of type Controller will want to be created, yet there is no compiled code that defines the class.

If you're curious to see what happens and what the failure mode is, try it. Build and run in Xcode. You should see the application drop into the debugger and in the console you'll see a log saying, "`Unknown class Controller in Interface Builder file.`"

To generate the source files for our Controller class:

1. Select the Controller object in the document window.
2. Select the menu item **File > Write Class Files...**
3. A Save panel will appear. Notice the Save panel will create a header file and an Objective-C implementation file for the class. Click Save to accept the default settings.
4. Another dialog will appear asking if you would like to add the newly created files to your project. The dialog will list all the targets defined in the project. Our project only has a single target defined, our HelloPoly application. Click the checkbox next to the HelloPoly target and then click the Add button





Would you like to add "Controller.h", and "Controller.m" to "HelloPoly.xcodeproj"?

If you choose to add this file to "HelloPoly.xcodeproj", you will be able to deploy it as part of a built product.

In a moment, you will switch over to Xcode to view and edit the newly created file.

Save any changes to the nib file. We are now finished defining our interface.

## Inspecting our Controller class

Switch back to Xcode.

You will notice the Controller.h and Controller.m classes are now in your project. First take a look at the header file. Double-click Controller.h to open it in another window, or click the Editor button in the toolbar, a single click then will show the selected file in the editor in the main project window.

**Header file**
The Controller.h file should look something like:

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

@interface Controller : /* Specify a superclass (eg: NSObject or NSView) */
{
    IBOutlet UIButton *decreaseButton;
    IBOutlet UIButton *increaseButton;
    IBOutlet UILabel *numberOfSidesLabel;
}
- (IBAction)decrease;
- (IBAction)increase;
@end
```

Objective-C can look quite foreign to someone viewing it for the first time, even if familiar with C, C++, or Java. From our previous assignment you should be able to recognize this as a custom class. Because we created this custom class in Interface Builder, we never specified what class it inherited from. The template header file contains a comment where the superclass name should appear. If we tried to compile this header file the compilation would fail with a syntax error because no superclass has been specified. Replace the comment with the word `NSObject`. NSObject is the base class of the Cocoa Touch class hierarchy. All objects inherit from NSObject. Your class declaration should look like this:

```
@interface Controller : NSObject {
```

Within the curly braces you see the outlets you defined in Interface Builder, these are instance variables – and each is literally a pointer to an object (note the `UIButton *`). At runtime, when the nib is loaded all of these instance variables will have their values set according to the connections you made in Interface Builder, so you can message these objects. But what is the meaning of the `IBOutlet` keyword? IBOutlet is simply a hint to Interface Builder that the instance variable is something that should appear in the Connections Inspector in IB. It has no meaning at compile time (it's literally #defined as nothing so it just disappears).

You also see the declaration of the `increase` and `decrease` methods. Similar to IBOutlet, you'll note the `IBAction` keyword. This is again a hint to IB that the method is one that should appear as an action method for an object when making target-action connections in IB. It is synonymous with `void`. To see for yourself you can command-double-click on IBOutlet or IBAction (or any other keyword or method name) and Xcode will jump to the declaration of the thing you double clicked on.

So, every outlet and action defined in Interface Builder is represented here in code.

**Implementation File**
Next, open the Controller.m file.

**Tip**: You can jump between the header and implementation file using the Go To Counterparts button in the directly above the text. You can change the behavior of this to switch between the two in the same editor by adjusting **Xcode > Preferences… > General > Open counterparts in same editor.**

```
#import "Controller.h"

@implementation Controller
- (IBAction)decrease {

}

- (IBAction)increase {

}
@end
```

The .m file contains stubs for the implementation of the `increase` and `decrease` action methods. In Interface Builder the buttons were set to have the controller object as its target and these methods as their actions. Whenever one of the buttons is clicked, it will invoke the corresponding method message on the controller object.

**Checkpoint: Log, Build, and Test**
Before you write the guts of the `increase` and `decrease` methods, you may want to put in a simple logging statement in each, then build and test your application. If you've hooked up all the actions correctly, clicking the buttons should display the log message in the console.

A simple log statement in Cocoa:

```
NSLog(@“I’m in the increase method”);
```

To view the console in Xcode, select the **Run > Console** menu item.

**Troubleshooting:** If your log does not appear when clicking the buttons double check the connections for the button in IB. This is the most common mistake when using Interface Builder to specify target/actions for controls. If you still don't get the expected logs and the connections look correct, please let us know and we'll help sort out what's wrong.

## Putting the M in MVC

Up to this point we've been working on the V and C in MVC. The V is the user interface that we constructed in InterfaceBuilder. The C is the Controller object that we defined in the nib file. The controller was connected with the view using outlets and target-action. But where does the polygon come into play? Well, that's going to be our model, or the M.

It's fortunate that our last assignment involved creating a polygon class. We'll make use of that class here. The first step is to add that class to your Xcode project. Do the following:

1. In Xcode, select **Project > Add to Project...**
2. In the Open panel, navigate to your PolygonShape.h and .m files from the WhatATool project. Shift select both files and click Add.
3. In the next panel that appears be sure to check the "Copy items into destination group's folder (if needed)" so that the files are copied into your project directory. Failing to do so will cause the files to not be included with your HelloPoly project submission and will fail to build when we do grading.

Now that your PolygonShape class is part of your Xcode project we can begin using it. Because the polygon object is our model, it holds the actual state for our polygon, namely the number of sides that the polygon has. Our controller object needs access to this information in order to update the user interface and to update when the user clicks the increase and decrease buttons. We need to connect the Controller to the model object. This will be our next task.

## Connect the Controller to the Model

In order to access the PolygonShape instance you will need to establish a connection between the Controller object in the nib and the newly added PolygonShape object. At this point you've got all the know-how to accomplish this task so we'll just give a brief overview of what needs to be done:

1. Add a new instance variable outlet of type PolygonShape to your Controller class (note, you will have to #import PolygonShape.h into your Controller.h file). Similar to the other instance variables in your Controller class, you should specify the polygon as an IBOutlet so that it appears in the connections inspector in IB. **Note:** be sure to save the Controller.h file so that IB takes note of the newly added outlet
2. In IB, drag a new custom object into the document window. Set the class to PolygonShape (hint**:** this is the same as how we had initially created the Controller class). Note how Interface Builder is already aware of the PolygonShape class as you start typing the class name.
3. Using the connections inspector in IB, establish a connection from the Controller instance to the PolygonShape instance (hint: if the polygon outlet doesn't appear in the connections inspector double check that you saved Controller.h).
4. Save your nib file.

**Checkpoint: Build and Run**
You've done a lot of stuff so this would be a good time to do a quick build and make sure all the pieces are in the right place. Build your application and make sure it still runs as expected at this point.

We're almost done! We have all the pieces in place and now need to implement our Controller's behavior. There are two things we need to do: setup our initial state and implement our increase and decrease methods.

## Setting up initial state

In order to set up our initial state we need to configure our polygon with its minimum, maximum and starting number of sides. The question is when is the right time to do this initialization. Because both the Controller and the PolygonShape instances are created in the nib we need to have a point where we can execute some code where both objects have been instantiated and the outlet from the controller to the polygon has been established. Cocoa Touch defines such a hook for us to leverage, called `awakeFromNib`.

After all the objects in a nib have been unarchived and all connections have been established, each object will receive an awakeFromNib method call. If you choose to implement this method in your custom classes you can perform any setup that needs to be done. In our case we want to configure our polygon object's minimum, maximum and current number of sides. Your awakeFromNib method should be declared as follows:

```
- (void)awakeFromNib {
     // configure your polygon here
}
```

Set the minimum and maximum number of sides to 3 and 12, respectively.

In order to set the numberOfSides of the polygon, we can use the value that is in text label from the UI. Because we're in awakeFromNib, all of the user interface elements have been loaded and our outlets established. You can get the value of the numberOfSidesLabel field by doing:

```
numberOfSidesLabel.text.integerValue
```

**Checkpoint: Build and Run**
To make sure that you have all the connections set up correctly you should put a log at the end of your awakeFromNib method and log the description of your polygon. Something like:

```
NSLog (@"My polygon:  %@", polygon);
```

Verify that your polygon is configured with the correct number of sides.

## Implementing action methods

The last step is to implement our increase and decrease methods. In each case your action methods should do the following:

1. Retrieve the current number of sides from the polygon
2. Increment or decrement the number
3. Set the new number of sides on the polygon
4. Update the user interface to reflect the new state

Updating the user interface is common behavior which you will need to do in both the increase or decrease cases. This will involve doing three things:

1. Enable or disable the decrease button depending whether the current number of sides is greater than the minimum number of sides the polygon allows.
2. Enable or disable the increase button depending whether the current number of sides is less than the maximum number of sides the polygon allows.
3. Set the text of text label to indicate the current number of sides

Because this code needs to be invoked from multiple methods you should factor this code out to a common method which both the increase and decrease methods call. Implement a method such as:

```
- (void)updateInterface {
     // set interface state here
}
```

**Hints for updating the interface**

- You can set the enabled property of a UIButton by setting the "enabled" property. For example,
  ```
  someButton.enabled = NO;
  ```
  would disable the button.
- You can set the text of a UILabel by setting the "text" property. For example,
  ```
  someLabel.text = [NSString stringWithFormat:@"%d", someNumber];
  ```
  would set the text of the label to a string which displays a number.
- You may want to use the same method for updating the interface when you set up the initial state, for example from awakeFromNib.

**Build and Test**

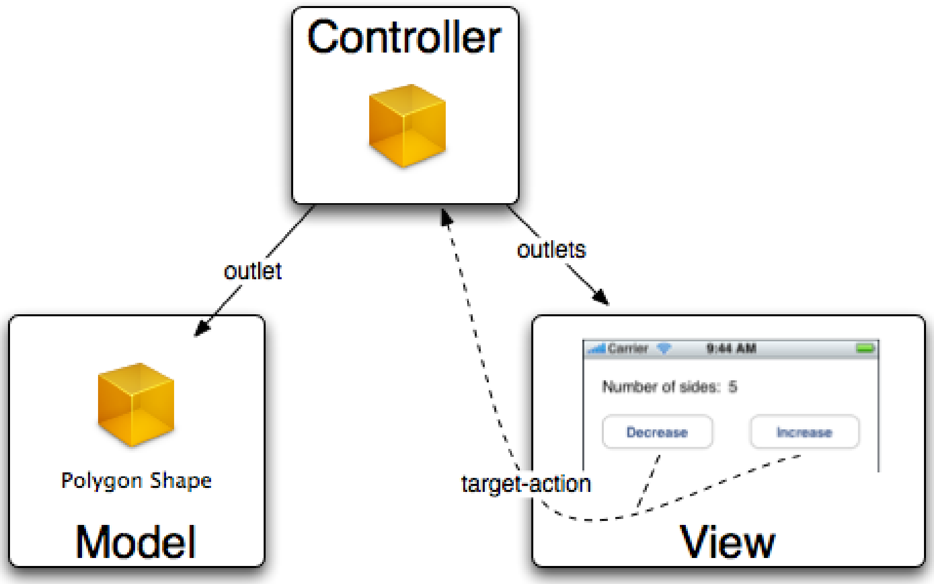
Once you have implemented the `increase` and `decrease` methods, build in Xcode, and run the application. Verify that you can tap the increase and decrease buttons and that the text label updates correctly. Also verify that you cannot decrease the number of sides below 3 nor above 12.

**Building for an iPhone or iPod touch**

Now that we have successfully built our application in the iPhone Simulator, we can try building it on a real iPhone or iPod touch. If you have a device that is set up for development you should be able to simply set the Active SDK to **Device - iPhone OS 2.0** and then build and run. Xcode will build the application for the device, install it and launch it. If this does not work for you, please let us know and we will help work out any technical issues.

## Reviewing Our Design

Congratulations on completing your first "real" iPhone application! Furthermore, you've completed a cleanly designed Model-View-Controller application. To give an overview of the "architecture" of our application and how the vocabulary we've seen so far fits into the picture, we could use a diagram like this:


Controller
outlet
outlets
target-action
Polygon Shape
Model
Carrier
9:44 AM
Number of sides: 5
Decrease
Increase
View