Bootstrapping iOS Application Development

Day 1

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Welcome to the 5-Day Bootstrapping iOS Application Development class. Over the course of these next 5 days, we’re going to be reviewing Objective C, UIKit, Core Animation, Core Data, and a host of other technologies you may only know by name.

Email me two pictures of you - one serious and one silly - to chris - at - fastestforward.com

1 Lab 1

Create a new Single View based application in XCode called Lab1

File › New › Project

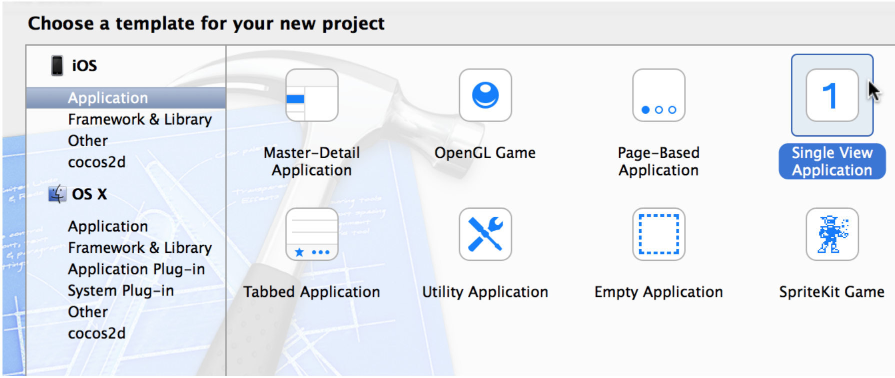


Figure : New Projects

Open Main.storyboard in Interface Builder

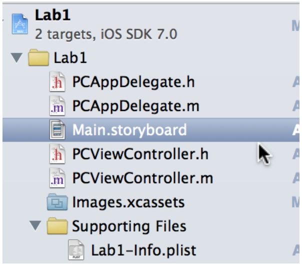
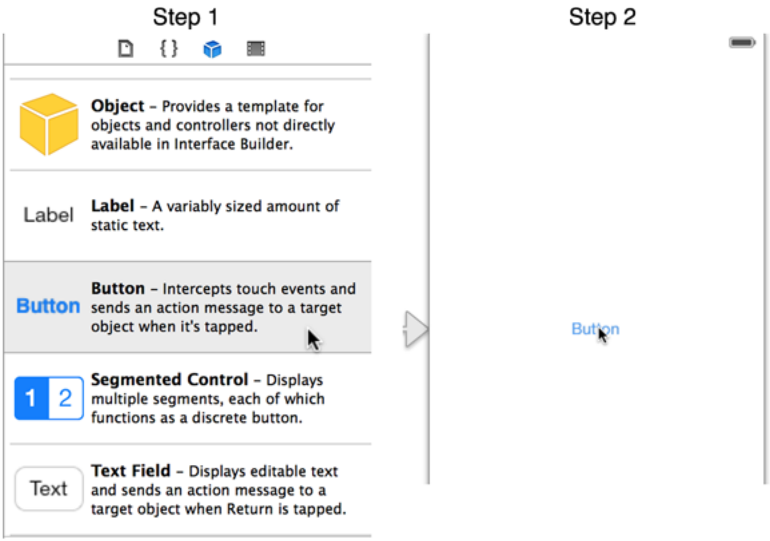


Figure : Main Storyboard

Add a button with the text "Hello iPhone"



Object – Provides a template for objects and controllers not directly available in Interface Builder.

Label – A variably sized amount of static text.

Button – Intercepts touch events and sends an action message to a target object when it's tapped.

Segmented Control – Displays multiple segments, each of which functions as a discrete button.

Text Field – Displays editable text and sends an action message to a target object when Return is tapped.

Figure : Drag Button to Storyboard

Add an IBAction selector to the view controller

```
// In the ViewController.h file
-(IBAction) helloWorldTapped:(id)sender;
```

Make it open an alert view

```
// In the ViewController.m file
-(IBAction) helloWorldTapped:(id)sender {
    [[[UIAlertView alloc] initWithTitle:@"Hello World"
                                message:@"Yay it worked"
                               delegate:nil
                      cancelButtonTitle:@"Dismiss"
                      otherButtonTitles: nil] show];
}
```

Connect the `IBAction` to the Button's `Touch Up Inside` action.

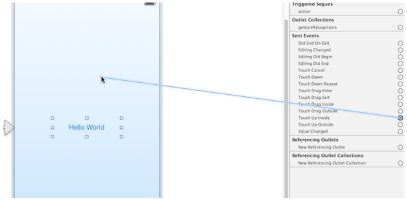


Figure : Connect Touch Up Inside event to IBAction

Run the simulator with ⌘ + R, the Product › Run menu, or the Play button

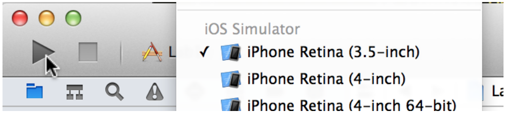
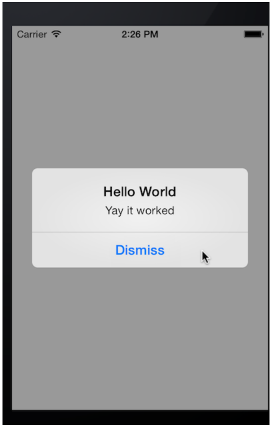


Figure : Launch Simulator


Carrier
2:26 PM

Hello World

Yay it worked

Figure : It Worked!

1 Objective C

Objective C is a superset of C. It tacks on to C a message-passing object model similar to Smalltalk’s (see Ruby), with support for reflection and limited runtime dynamic programming.

Objective C allows you to use weak and dynamicly typed language features along with the static typing of C; it also allows you to take advantage of runtime method resolution, so that your object's implementation of certain messages may be determined at call-time rather than at compile-time.

The language is still physically identical to C in many ways, in that the bulk of your development will be alternating between header files (.h files) and implementation files (.m files). You will also be doing a lot of memory management, which may fill you with either fear or joy, depending on your experience with garbage collected languages.

You will also be dealing a lot with many other C-family familiars, such as enumerated integer constants (enums), structs, pass-by-reference v. pass-by-value semantics and pointers. You don't need to have a very strong grasp on these things immediately, but the more iPhone programming and Objective C programming you do, the more your skills will benefit from a firm grasp of C.

Variable declaration in C follows the form `TYPE_DESCRIPTION NAME`, eg:

```c
int i = -1; // just an integer
unsigned int k = 0; // an unsigned integer
const unsigned int j = 0; // a constant unsigned integer, no reassignment
const char c = 'c'; // a constant char
const char * s = "a constant string"; // a pointer to a read-only char array
```

These are items you'll commonly encouter while doing iPhone programming whose roots belong in the C family:

```
typedef enum {
  NONE = 0,
  SOME,
  ALL
} HowMany;

HowMany i = SOME; // Use of enumerated constant
```

Note the `typedef` in this example, which is creating a type alias to be used later.

```
// Declaring a point in space type
typedef struct {
  float x;
  float y;
} APointInSpace;

APointInSpace point;
point.x = 20.0;
point.y = 410.0;

// C99 style struct instantiation
APointInSpace point2 = { .x= 21.0, .y=32.0 };
```

```c
// a constant byte array
char * constantCharArray = "Or in other words, a string";

// C99 style array instantiation
int aListOfNumbers[5] = { 1, 2, 3, 4, 5 };
int aListOfNumbers[] = { 1, 2, 3, 4, 5};

// C99 Variable length array declaration
float aListOfFloats[someQualifier];

// pointer declaration to NULL
int * someIntegerPtr = NULL;
int someInteger = 5;

// address dereference
someIntegerPtr = &someInteger;
```

```c
float aSimpleAdditionMethod(float a, float b){
  return a + b;
}

float aSimpleSubtractionMethod(float a, float b){
  return a - b;
}

int aFloatAdditionThatReturnsAnInt(float a, float b){
  return (int) (a + b);
}

float (*anFnPtr)(float, float) = aSimpleAdditionMethod;
anFnPtr(1, 1); // returns 2
anFnPtr = aSimpleSubtractionMethod;
anFnPtr(1, 1); // returns 0
```

```c
#include <stdio.h>
#define FOO 1
#define IS_ZERO(n) (n == 0)

int main(){
  printf("FOO is %i", FOO);
  if(IS_ZERO(0)) {
    printf("This code is very useful.")
  }
}
```

If you never learned C or it’s been a long time, a fantastic book for you is “The C Programming Language”. It doesn’t cover many of the newer items in C99, but it is a thorough reference to the language fundamentals.
If you’d like to read more about the new features introduced by C99, read more at C99Changes.

```objc
NSString * anExampleString = @"This is a pointer to an NSString object";
int strLen = [anExampleString length];

NSString * aSecondString = [anExampleString
  stringByAppendingString:@" that had a second string appended to it"];

if([anExampleString
     compare:@"this is a pointer to an nsstring object"
     options:NSCaseInsensitiveCompare] == NSOrderedSame){
  NSLog(@"The string %@ was case insensitive equal", anExampleString);
}
```

Given some Objective C object, like:

```
NSString * anObject = @"TheObject";
```

you can invoke functionality on that object via the form:

```
[anObject theMethodName];
```

Method names in Objective C follow the form `initialMethodNameAndArgument:theSecondArgument:theThirdArgument:`
.

Messages vs. Methods

When you see references to ”calling a method” or ”calling a function” on an object in Objective C, it’s best to consider these synonymous with ”dispatching a message”. Objective C objects respond to **messages**, and as you work more with Objective C, it will be more beneficial for you to perceive this as such.

An object in Objective C may be nil; nil is a “special” object which may have any message at all sent to it, to which it will respond with a nil object.

```
NSString * anObject = nil;
if([anObject whoaThisProbablyDoesntExist] == nil){
  NSLog(@"Ah well");
}
```

nil is the appropriate null object when dealing with pointers to Objective C classes; NULL, on the other hand, is the appropriate null value to use when dealing with pointers to all other types.

Tony Orlando & Dawn/Greatest Hits
Tie A Yellow Ribbon 'Round The Ole Oak Tree
Say, Has Anybody Seen My Sweet Gypsy Rose
You're A Lady
Who's In The Strawberry Patch With Sally
You Say The Sweetest Things
Steppin' Out, I'm Gonna Boogie Tonight
Candida
Knock Three Times
What Are You Doing Sunday
Summer Sand
Look In My Eyes Pretty Woman

Figure : Memory Management circa 1973

C based languages have traditionally used `malloc` and `free` as the means by which memory was allocated on demand. This code looked something like:

```
#include <stdio.h>
#include <stdlib.h>

int main(){
  int * anInteger = malloc(sizeof(int));
  *anInteger = 10;
  printf("Integer value is %i", *anInteger);
  free(anInteger);
  return 0;
}
```

`malloc` and `free` allocated memory on the heap; it was the programmer's responsibility to indicate when a particular item was ready to be released back to the operating system.

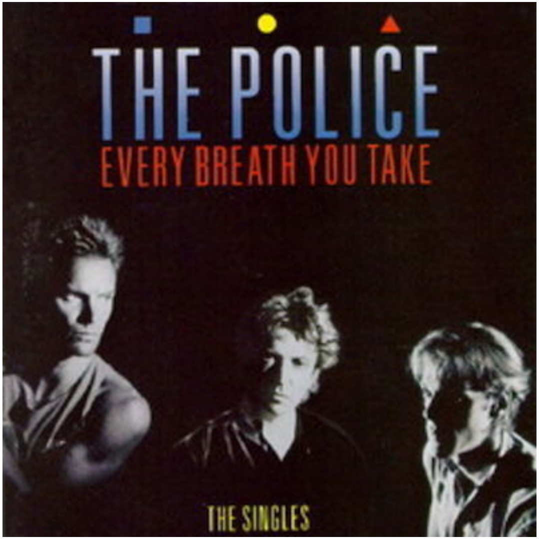


Figure : Memory Management circa 1983

Objective C used an “easier” means of managing the memory for its objects: reference counting.
Reference counting allowed Objective C programmers to write code that looked like this:

```
NSString * c = [[NSString alloc] initWithString:@"This is a string allocated
NSLog(@"String is %@", c);
[someOtherObject setString:c];
[c release];
```

Each object would respond to two methods: `retain` and `release`. Retain would increment an object's retain count, and release would decrement. When an object's retain count reached 0, it was considered "deallocated", and its memory on the heap would be available for use by other objects.

Objects could also be flagged as `autorelease`, which would send a release to an object at some point in the future. Typically this meant after one main NSRunLoop cycle (one UI loop).

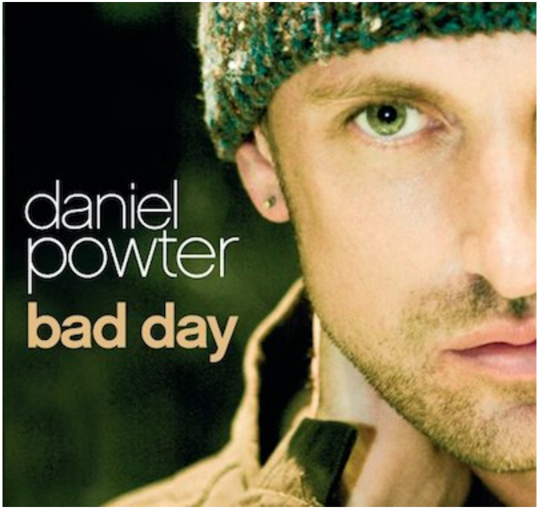


Figure : Memory Management circa 2006 - Apple adds Garbage Collection to Objective C

Figure : Memory Management circa 2008 - The iOS SDK 2.0 and App Store launch. The iPhone does not support Garbage Collection due to performance concerns.

Figure : Memory Management circa 2011 - ARC

Apple introduces a new tool called ARC (*Automatic Reference Counting*). Improvements in static code analysis allow Apple to detect and automatically insert retain/release calls for most code.
In other words, *most of the basic memory management is now done for you*.

What ARC *will do* for you:

- Let you avoid calling `retain` or `release` on Objective C objects

What ARC **will not do** for you:

- Prevent cyclic memory ownership
- Allow you to ignore `malloc` or `free` when using C-based apis
- Allow you to ignore memory management

```objc
NSString * s = [[NSString alloc] initWithString:@"Some string"];
NSLog(@"My string is %@", s);
// That's it.
```

```objc
NSString * s = [[NSString alloc] initWithString:@"Some string"];
[someOtherObject setString:s];

// and in the someOtherObject's implementation

@interface SomeOtherObject

@property(strong,nonatomic) NSString * string;

@end
```

You can indicate you don’t want to manage the release of an object by indicating an object should be autoreleased objects. Autoreleased objects are managed by an object called an NSAutoreleasePool, and are intermittently checked to see how many references have been claimed on them. The pool will release the object “at some unknown point in the future”* once all retains on the object have been released.

```objc
// Indicate that the foo object should be managed by
// the current NSAutoreleasePool
NSString * foo = [[[NSString alloc]
                             initWithString:@"Foo"]
                               autorelease];
NSLog(@"Foo will be good for now %@", foo);

[foo retain];
[foo release];
NSLog(@"Foo is still good, %@", foo);
// You may retain and release on an autoreleased object as normal

[foo release];
// Calling an 'unbalanced release' like this will cause a crash
// at some unknown point in the future
```

Different classes in Cocoa / Objective C have different rules about how they retain objects. The documentation is instructive in telling you what memory management semantics you should expect from given functionality.

Mac Programmers Have All The Luck

Should you be programming Mac OS applications as opposed to iOS applications, you can take advantage of garbage collection memory management which has been available since Mac OS Leopard (10.5); iOS programmers still have to manage their memory themselves, however.

Much of the interaction with Objective C objects equates to the usual getter/setter functionality commonly associated with Object Oriented Programming. To make it easier for programmers to declare this functionality, properties were introduced as a way to eschew all the boilerplate code and provide a common framework upon which to enhance Objective C objects.

```objc
@interface MyObject : NSObject {
  NSString * instanceVariable;
  float numericVariable;
}
@property(readwrite, retain) NSString * instanceVariable;
@property(readonly, assign) float numericVariable;
@end

@implementation MyObject

@synthesize instanceVariable;
@synthesize numericVariable;

-(void) dealloc {
  [instanceVariable release];
  [super dealloc];
}

@end
```

```objc
MyObject * mo = [[MyObject alloc] init];
[mo setInstanceVariable:@"Test"];
[mo setNumericVariable:20.0f];
NSLog(@"The values I set were %@ and %f",
        [mo instanceVariable],
        [mo numericVariable]);
```

You can specify the memory management semantics (retain, assign, copy) in the property declaration. You can also specify the atomicity (locking behavior) of the property, and more.

More to it..

Properties do not merely provide getter/setter functionality. The use of properties also implicitly adds Key-Value-Observing functionality to your class, letting you automatically monitor classes for change events and performing specific code in such cases. Read more at `http://developer.apple.com/mac/library/documentation/cocoa/conceptual/objectivec/articles/ocProperties.html`.

Selectors in Objective C are a way to provide a special type to indicate a message. They allow you to dynamically send a message to an object, as well as to query an object to see if it responds to a given message.

```objc
SEL aSelector = @selector(length);
NSString * foo = @"Foo";
if([foo respondsToSelector:aSelector]){
  NSLog(@"The length of foo is %i",  [foo performSelector:aSelector]);
}
```

Selectors can be built from strings, and can refer to any Objective C message that is forwarded to an object.

```
NSString * aUserSuppliedString = MagicallyGetStringFromUserInput();
SEL aSelector = NSSelectorFromString(aUserSuppliedString);
if([someObject respondsToSelector:aSelector]){
  // NOTE: Surely nothing bad will happen
  [someObject performSelector:aSelector];
}
```

Objective C provides only single-inheritance for its objects; to allow for situations where a class may provide functionality outside of its inheritance chain, the language provides Protocols, which are roughly analogous to interfaces in Java and C#. There are informal protocols (only referred to in documentation) and formal protocols, which are compiler checked. The majority of protocol usage in iOS programming is formal protocols.

```objc
@protocol TestProtocol

-(void) definitelyHasThisMethod;

@optional

-(void) mayHaveThisMethod;

@end

@interface SomeObject : NSObject<TestProtocol> {

}

@end
```

```
SomeObject<TestProtocol> * oo = [[SomeObject alloc] init];

// We assume this because the object conforms to TestProtocol
[oo definitelyHasThisMethod];

if([oo respondsToSelector:@selector(mayHaveThisMethod)]){
  [oo mayHaveThisMethod];
}
```

Categories allow you to mix in new code to existing classes without having to change the original source code for those classes. Examples of categories include automatically adding special serialization rules to NSObject, or special data structure Queue behavior to Cocoa collection classes.

Except for..

You can't add instance variables to a class with categories; they are purely for adding new methods to a class, but cannot change the memory layout of a class after the fact.

```
@interface NSString(FunkyStrings)

-(NSString *) getFunky;

@end

@implementation NSString(FunkyStrings)

-(NSString *) getFunky {
  return [self stringByAppendingString:@"...YEAH! ALL RIGHT! FEELS GOOD!"];
}

@end
```

```
objectivec #import "NSString+FunkyStrings.h" void main(){
NSLog(@"The funkiest string by far is %@", [@"James Brown"
getFunky]); }
```

There are a host of useful classes in the Cocoa Touch framework that provide special functionality to you. Some of the more common objects you'll use in your programming are NSArray, NSDictionary, NSNumber and NSString. Each of these objects have mutable versions that allow you to modify them after instantiation.

NSString is an enhanced, unicode aware string class that goes far beyond the simple byte-array behavior of C's byte-array strings.

```
NSString * s = [[NSString alloc] initWithCString:"this is an ascii string"
                                 encoding:NSASCIIStringEncoding];
NSMutableString * so = [[NSMutableString alloc]
                                initWithString:@"A mutable string with..."];

[so appendString:s];

NSLog(@"The mutable string is %@", so);

[so release];
[s release];
```

NSNumber is a simple abstract wrapper around numeric values which allows you to automatically convert its held value to the appropriate form, as well as having an object-like representations of a numeric value.

```
NSNumber * n = [[NSNumber alloc] initWithFloat:20.0f];
double d = [n doubleValue];
int i = [n intValue];
[n release];
```

NSDictionary is a generic dictionary object that you can use to hold key/value associations. A key can be any NSObject that responds to isEqual: and NSCopying; in most cases, your keys will be either NSString or NSNumber objects.

```objc
NSDictionary * a = [[NSDictionary alloc] initWithObjectsAndKeys:
                                     @"The foo string", @"Foo",
                                     @"The bar string", @"Bar",
                                     nil];

NSMutableDictionary * b = [[NSMutableDictionary alloc] init];
[b setObject:@"Another string" forKey:[NSNumber numberWithInt:20]];

NSLog(@"a's alue for Foo is %@, and b's value for 20 is %@",
                          [a objectForKey:@"Foo"],
                          [b objectForKey:[NSNumber numberWithInt:20]]);

for(id key in a){
  NSLog(@"The value for %@ is %@", key, [a objectForKey:key]);
}

[b release];
[a release];
```

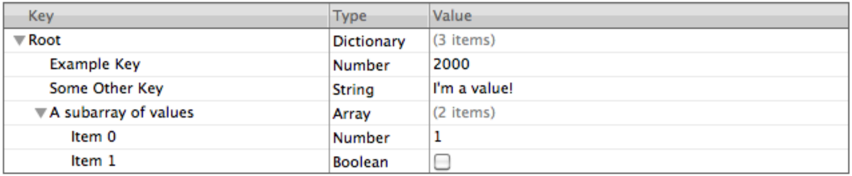
NSArray is a simple way to collect NSObject inheriting classes into a sequential list. NSArray automatically retains each object added to it, and releases each object it holds once its own retain count has reached 0.

```
NSArray * a = [[NSArray alloc] initWithObjects:@"Foo", @"bar", @"baz", nil];
NSMutableArray * b = [[NSMutableArray alloc] init];
[b addObject:@"Not foo"];
NSLog(@"The contents of a are %@ and b are %@", a, b);

for(NSString * obj in a){
  NSLog(@"The array contains %@", obj);
}

[a release];
[b release];
```

NSArray, NSDictionary, NSString and NSNumber may all be represented by the contents of a property list file (Plist). You can easily rebuild an NSArray or NSDictionary full of the property list contents by using the initialization method `initWithContentsOfFile:`



Key	Type	Value
▼ Root	Dictionary	(3 items)
Example Key	Number	2000
Some Other Key	String	I'm a value!
▼ A subarray of values	Array	(2 items)
Item 0	Number	1
Item 1	Boolean	☐

Figure : Sample Property List

```
NSDictionary * example = [[NSDictionary alloc]
                            initWithContentsOfFile:@"/path/to/sample.plist"]
NSLog(@"The subarray contents are %@",
           [example objectForKey:"A subarray of values"]);
[example release];
```

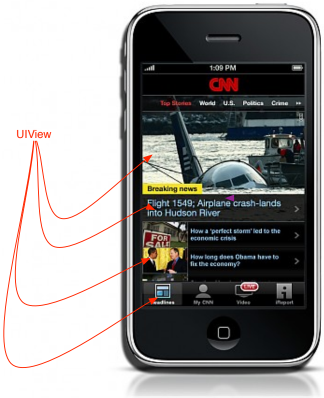
Objective C is a rich, deep language. There are lots of resources on the web and your computer where you can learn more. The best is easily the XCode documentation, but there are blogs out there that can provide invaluable help: Mike Ash's NSBlog, Cocoa With Love , and the Apple Developer Forums can all provide invaluable help in learning new techniques and advanced usage for your apps.

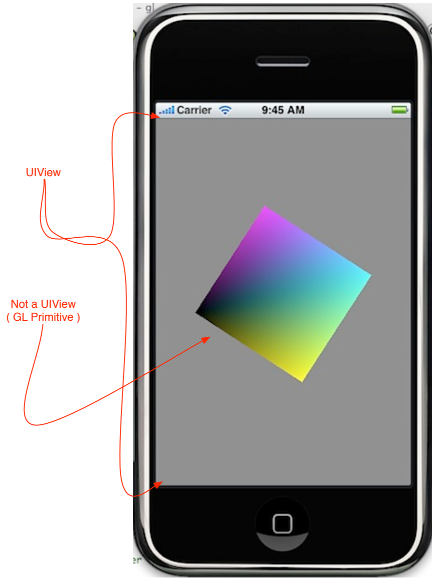
1 iPhone App Layout Conventions

Apple strongly encourages you to adhere to Model View Controller pattern

On iOS, a UIApplication (your app) typically has one UIWindow, which is the primary UIView upon which everything else displays. A UIView is just a rectangle upon which you draw things.

Almost everything visual is a UIView (except the things that aren’t).

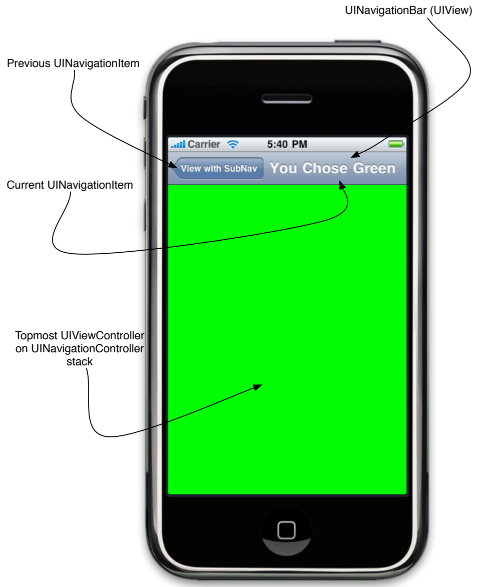

UIView
1:09 PM
CNN
Top Stories
World
U.S.
Politics
Crime
Breaking news
Flight 1549: Airplane crash-lands into Hudson River
How a 'perfect storm' led to the economic crisis
How long does Obama have to fix the economy?
Headlines
My CNN
Video
iReport


UIView
Not a UIView
(GL Primitive)
Carrier
9:45 AM

UIViewControllers are objects that manage what the views on screen are currently doing; typically where you write event handling code and user interaction code.

You provide the model

UINavigationController is a stack based manager of view controllers that the user can navigate through


UINavigationBar (UIView)
Previous UINavigationItem
Current UINavigationItem
Topmost UIViewController on UINavigationController stack
Carrier
5:40 PM
View with SubNav
You Chose Green

Every UIViewController managed by a UINavigationController has a reference to that UINavigationController

```
MyViewController * controller = [[MyViewController alloc] initWithNibName:nil
                                                              bundle:nil];
[[self navigationController] pushViewController:controller animated:YES];
[controller release];
```

Create a new View based project

Add a UINavigationController to MainWindow.xib

Create a new view controller

Add a button to the first view controller and create an action to open the second view controller

UITabBarController swaps in UIViewControllers assigned to it when users click on the associated button

Each UIViewController has a tabBarItem property that UITabBarController uses to populate its UITabBar

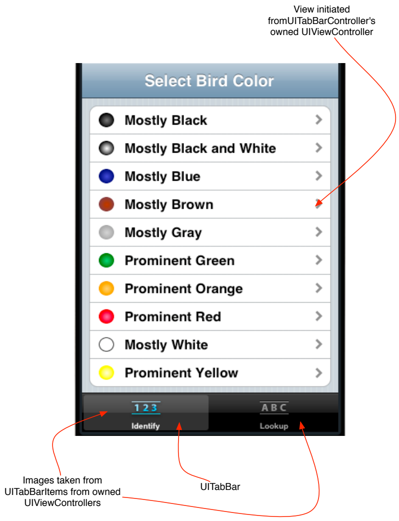


Figure : UITabBarController example

UITableViewController instructs a UITableView about the number of rows it contains, what to do when clicked, the number of sections, and other information

UITableViewController is just a convenience class that saves you from manually conforming an object to the UITableViewDataSource and UITableViewDelegate protocols

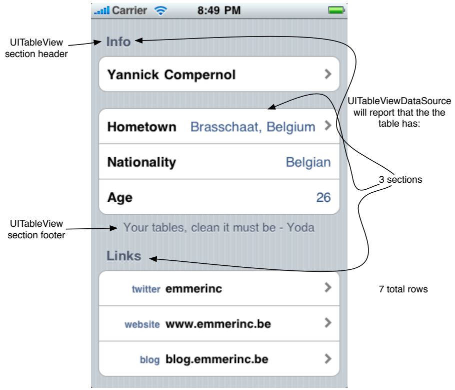


Figure : UITableView example

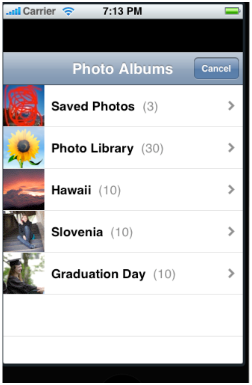
Add a UITableViewController to the project

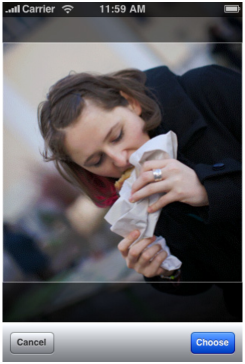
Add an NSArray containing names from the class to the controller

Change the Interface builder reference to the UITableViewController

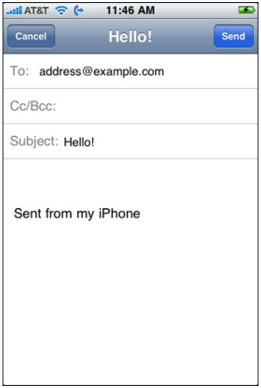
Not all view controllers fit within the “display in UINavigationController” or “display in UITabBarController” model.

UIImagePickerController





MFMailComposeViewController



To: address@example.com

Cc/Bcc:

Subject: Hello!

Sent from my iPhone

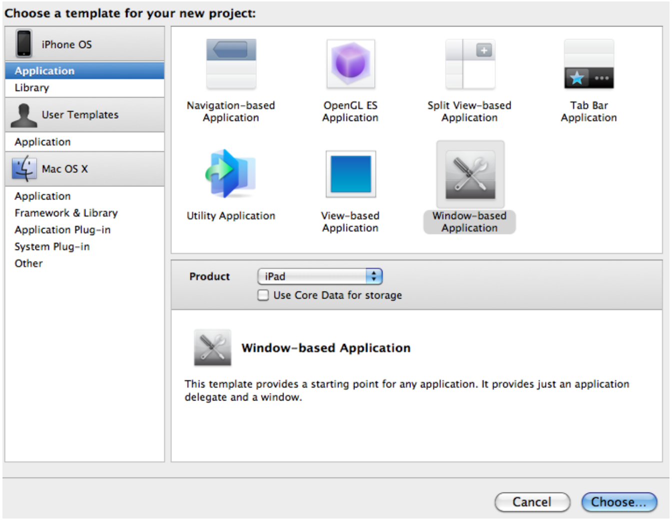
You can present a view controller modally by using the `presentModalViewController:animated:` message

```
-(IBAction) buttonClicked:(id) sender {
  MyViewController * mvc = [[MyViewController alloc]
                              initWithNibName:@"TheNib"
                              bundle:nil];
  [self presentModalViewController:mvc animated:YES];
  [mvc release];
}
```

You can specify the transition style with which the view controller appears via the UIViewController message `setModalTransitionStyle:(UIModalTransitionStyle)style`

XCode and Interface Builder combined provide a development, debugging and interface development tool for you to develop your iPhone apps. It can integrate with SVN, CVS or Perforce (and soon, Git!), it can run automated tests on your code, provide inline documentation assist, code completion and a lot more. It also provides a developer level interface to all the devices you will be debugging your code on; you can manage devices and device profiles through XCode as necessary.

XCode provides a number of application templates for starting an app. Most basic types of applications can get a fast start by using one of these app templates.


Choose a template for your new project:

Product: iPad

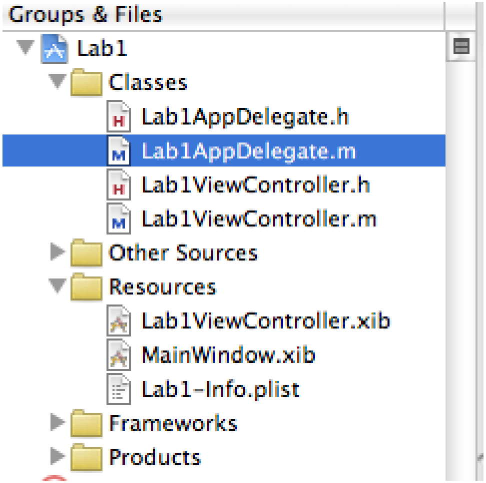
Use Core Data for storage

Window-based Application

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

Figure : XCode New Project window

Once you've selected the type of app you want to create, your project will be created with an application delegate and usually at least one view controller that will manage what goes on the screen. It will also have a .xib file for your application, and for each view controller in the app, that is used by Interface Builder to layout the screen contents.



Double clicking on a .xib file will open it in Interface Builder, where you can drag components from the Interface Builder toolbox into the view. You can easily change the orientation of objects.

Help - Developer Documentation is an invaluable resource for researching Cocoa internals.

Learn hotkeys! (CMD+SHIFT+D and CMD+0 will buy you hours)

Make XCode fit you (Single window interface, XCode themes, application templates)

XCode plugins (Code Pilot
`http://mac.brothersoft.com/code-pilot-for-xcode.html`,
Accessorizer
`http://www.kevincallahan.org/software/accessorizer.html`)