

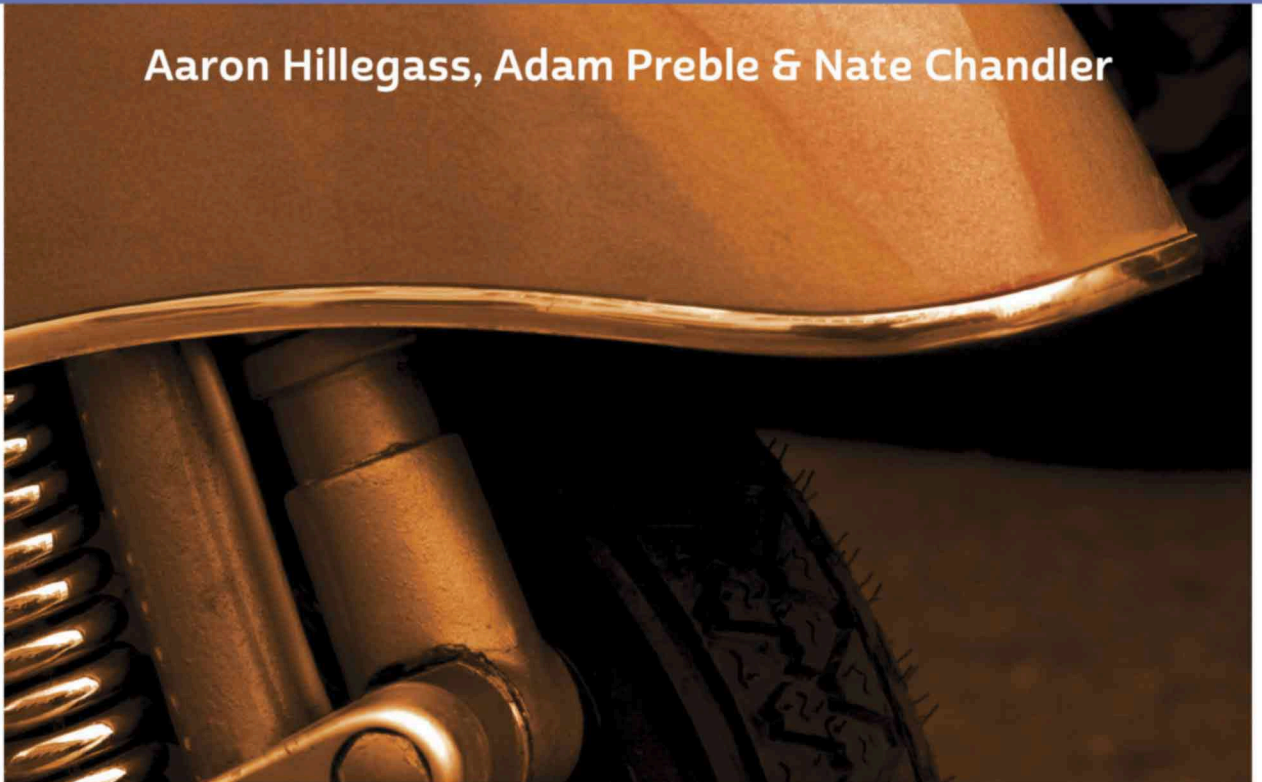


5TH EDITION

# Cocoa Programming for OS X

## THE BIG NERD RANCH GUIDE

Aaron Hillegass, Adam Preble & Nate Chandler



# **Cocoa Programming for OS X: The Big Nerd Ranch Guide**

by Aaron Hillegass, Adam Preble and Nate Chandler

Copyright © 2015 Big Nerd Ranch, LLC.

All rights reserved. Printed in the United States of America. This publication is protected by copyright, and permission must be obtained from the publisher prior to any prohibited reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying, recording, or likewise. For information regarding permissions, contact

Big Nerd Ranch, LLC.  
200 Arizona Ave NE  
Atlanta, GA 30307  
(770) 817-6373  
<http://www.bignerdranch.com/>  
[book-comments@bignerdranch.com](mailto:book-comments@bignerdranch.com)

The 10-gallon hat with propeller logo is a trademark of Big Nerd Ranch, LLC.

Exclusive worldwide distribution of the English edition of this book by

Pearson Technology Group  
800 East 96th Street  
Indianapolis, IN 46240 USA  
<http://www.informit.com>

The authors and publisher have taken care in writing and printing this book but make no expressed or implied warranty of any kind and assume no responsibility for errors or omissions. No liability is assumed for incidental or consequential damages in connection with or arising out of the use of the information or programs contained herein.

Many of the designations used by manufacturers and sellers to distinguish their products are claimed as trademarks. Where those designations appear in this book, and the publisher was aware of a trademark claim, the designations have been printed with initial capital letters or in all capitals.

ISBN-10 0134077113  
ISBN-13 978-0134077116

Fifth edition, first printing, April 2015  
Release D.5.1.1

# Cocoa Programming for OS X: The Big Nerd Ranch Guide

## Table of Contents

Cover

Copyright Page

Acknowledgments

Table of Contents

Introduction

- About This Book

  - Prerequisites

  - Typographical conventions

  - What's new in the fifth edition?

- The Story of Cocoa

  - NeXTSTEP and OpenStep

  - From NeXTSTEP to OS X to iOS

  - OSX, Unix, and Cocoa

- Introducing the Swift Language

- The Cocoa Frameworks

- Tools for Cocoa Programming

- Some Advice on Learning

1. Let's Get Started

- Creating an Xcode Project

  - Getting around in Xcode

- Application Design

  - Model-View-Controller

  - Creating the MainWindowController class

- Creating the User Interface in Interface Builder

  - Adding view objects

# Table of Contents

Configuring view objects

XIB files and NIB files

Showing the Window

Making Connections

Creating an outlet

Connecting an outlet

Defining an action method

Connecting actions

Creating the Model Layer

Connecting the Model Layer to the Controller

Improving Controller Design

## 2. Swift Types

Introducing Swift

Types in Swift

Using Standard Types

Inferring types

Specifying types

Literals and subscripting

Initializers

Properties

Instance methods

Optionals

Subscripting dictionaries

Loops and String Interpolation

Enumerations and the Switch Statement

Enumerations and raw values

Exploring Apple's Swift Documentation

## 3. Structures and Classes

Structures

Instance methods

Operator Overloading

# Table of Contents

## Classes

- Designated and convenience initializers

- Add an instance method

- Inheritance

## Computed Properties

## Reference and Value Types

- Implications of reference and value types

- Choosing between reference and value types

## Making Types Printable

## Swift and Objective-C

## Working with Foundation Types

- Basic bridging

- Bridging with collections

## Runtime Errors

## More Exploring of Apple's Swift Documentation

## Challenge: Safe Landing

## Challenge: Vector Angle

## 4. Memory Management

### Automatic Reference Counting

- Objects have reference counts

- Deallocating objects in a hierarchy

### Strong and Weak References

- Strong reference cycles

- Unowned references

### What is ARC?

## 5. Controls

### Setting up RGBWell

- Creating the MainWindowController class

- Creating an empty XIB file

- Creating an instance of MainWindowController

- Connecting a window controller and its window

# Table of Contents

## About Controls

## Working with Controls

- A word about NSCell
- Connecting the slider's target and action
- A continuous control
- Setting the slider's range values
- Adding two more sliders
- NSColorWell and NSColor
- Disabling a control

## Using the Documentation

- Changing the color of the color well

## Controls and Outlets

- Implicitly unwrapped optionals

## For the More Curious: More on NSColor

## For the More Curious: Setting the Target Programmatically

## Challenge: Busy Board

## Debugging Hints

## 6. Delegation

### Setting up SpeakLine

- Creating and using an Xcode snippet
- Creating the user interface

### Synthesizing Speech

### Updating Buttons

### Delegation

- Being a delegate
- Implementing another delegate
- Common errors in implementing a delegate
- Cocoa classes that have delegates
- Delegate protocols and notifications

### NSApplication and NSApplicationDelegate

- The main event loop

### For the More Curious: How Optional Delegate Methods Work

# Table of Contents

Challenge: Enforcing a Window's Aspect Ratio

## 7. Working with Table Views

### About Table Views

- Delegates and data sources

- The table view-data source conversation

- SpeakLine's table view and helper objects

### Getting Voice Data

- Retrieving friendly names

### Adding a Table View

- Table view and related objects

### Tables, Cells, and Views

- Table cell views

### The NSTableViewDataSource Protocol

- Conforming to the protocol

- Connecting the dataSource outlet

- Implementing data source methods

- Binding the text field to the table cell view

### The NSTableViewDelegate Protocol

- Making a connection with the assistant editor

- Implementing a delegate method

- Pre-selecting the default voice

### Challenge: Make a Data Source

## 8. KVC, KVO, and Bindings

### Bindings

- Setting up Thermostat

- Using bindings

- Key-value observing

- Making keys observable

- Binding other attributes

### KVC and Property Accessors

### KVC and nil

### Debugging Bindings

# **Table of Contents**

## Using the Debugger

- Using breakpoints

- Stepping through code

- The LLDB console

- Using the debugger to see bindings in action

For the More Curious: Key Paths

For the More Curious: More on Key-Value Observing

For the More Curious: Dependent Keys

Challenge: Convert RGBWell to Use Bindings

## 9. NSArrayController

- RaiseMan's Model Layer

- RaiseMan's View Layer

- Introducing NSArrayController

- Adding an Array Controller to the XIB

- Binding the Array Controller to the Model

- Binding the Table View's Content to the Array Controller

- Connecting the Add Employee Button

- Binding the Text Fields to the Table Cell Views

- Formatting the Raise Text Field

- Connecting the Remove Button

- Binding the Table View's Selection to the Array Controller

- Configuring RaiseMan's Remove Button

- Sorting in RaiseMan

- How Sorting Works in RaiseMan

- For the More Curious: The `caseInsensitiveCompare(_:)` Method

- For the More Curious: Sorting Without NSArrayController

- For the More Curious: Filtering

- For the More Curious: Using Interface Builder's View Hierarchy Popover

- Challenge: Sorting Names by Length

## 10. Formatters and Validation

# Table of Contents

## Formatters

- Formatters, programmatically

- Formatters and a control's objectValue

- Formatters and localization

## Validation with Key-Value Coding

- Adding Key-Value validation to RaiseMan

For the More Curious: NSValueTransformer

## 11. NSUndoManager

- Message Passing and NSInvocation

- How the NSUndoManager Works

- Using NSUndoManager

- Key-Value Coding and To-Many Relationships

- Adding Undo to RaiseMan

- Key-Value Observing

- Using the Context Pointer Defensively

- Undo for Edits

- Begin Editing on Insert

- For the More Curious: Windows and the Undo Manager

## 12. Archiving

- NSCoder and NSCoder

- Encoding

- Decoding

- The Document Architecture

- Info.plist and NSDocumentController

- NSDocument

- NSWindowController

- Saving and NSKeyedArchiver

- Loading and NSKeyedUnarchiver

- Setting the Extension and Icon for the File Type

- Application Data and URLs

- For the More Curious: Preventing Infinite Loops

# **Table of Contents**

For the More Curious: Creating a Protocol

For the More Curious: Automatic Document Saving

For the More Curious: Document-Based Applications Without Undo

For the More Curious: Universal Type Identifiers

## **13. Basic Core Data**

Defining the Object Model

Configure the Array Controller

Add the Views

Connections and Bindings

How Core Data Works

Fetching Objects from the NSManagedObjectContext

Persistent Store Types

Choosing a Cocoa Persistence Technology

Customizing Objects Created by NSArrayController

Challenge: Begin Editing on Add

Challenge: Implement RaiseMan Using Core Data

## **14. User Defaults**

NSUserDefaults

Adding User Defaults to SpeakLine

Create Names for the Defaults

Register Factory Defaults for the Preferences

Reading the Preferences

Reflecting the Preferences in the UI

Writing the Preferences to User Defaults

Storing the User Defaults

What Can Be Stored in NSUserDefaults?

Precedence of Types of Defaults

What is the User's Defaults Database?

For the More Curious: Reading/Writing Defaults from the Command  
Line

# **Table of Contents**

For the More Curious: NSUserDefaultsController

Challenge: Reset Preferences

## **15. Alerts and Closures**

NSAlert

Modals and Sheets

Completion Handlers and Closures

Closures and capturing

Make the User Confirm the Deletion

For the More Curious: Functional Methods and Minimizing Closure  
Syntax

Challenge: Don't Fire Them Quite Yet

Challenge: Different Messages for Different Situations

## **16. Using Notifications**

What Notifications Are

What Notifications Are Not

NSNotification

NSNotificationCenter

Starting the Chatter Application

Using Notifications in Chatter

For the More Curious: Delegates and Notifications

Challenge: Beep-beep!

Challenge: Add Usernames

Challenge: Colored Text

Challenge: Disabling the Send Button

## **17. NSView and Drawing**

Setting Up the Dice Application

Creating a view subclass

Views, Rectangles, and Coordinate Systems

frame

bounds

# Table of Contents

## Custom Drawing

- `drawRect(_:)`

- When is my view drawn?

- Graphics contexts and states

- Drawing a die face

## Saving and Restoring the Graphics State

## Cleaning up with Auto Layout

## Drawing Images

- Inspectable properties and designable views

- Drawing images with finer control

## Scroll Views

## Creating Views Programmatically

- For the More Curious: Core Graphics and Quartz

- For the More Curious: Dirty Rects

- For the More Curious: Flipped Views

- Challenge: Gradients

- Challenge: Stroke

- Challenge: Make DieView Configurable from Interface Builder

## 18. Mouse Events

- NSResponder

- NSEvent

- Getting Mouse Events

- Click to Roll

- Improving Hit Detection

- Gesture Recognizers

- Challenge: NSBezierPath-based Hit Testing

- Challenge: A Drawing App

## 19. Keyboard Events

- NSResponder

- NSEvent

# Table of Contents

## Adding Keyboard Input to DieView

- Accept first responder
- Receive keyboard events
- Putting the dice in Dice

## Focus Rings

## The Key View Loop

## For the More Curious: Rollovers

## 20. Drawing Text with Attributes

### NSFont

### NSAttributedString

### Drawing Strings and Attributed Strings

### Drawing Text Die Faces

#### Extensions

### Getting Your View to Generate PDF Data

### For the More Curious: NSFontManager

### Challenge: Color Text as SpeakLine Speaks It

## 21. Pasteboards and Nil-Targeted Actions

### NSPasteboard

### Add Cut, Copy, and Paste to Dice

### Nil-Targeted Actions

#### Looking at the XIB file

### Menu Item Validation

### For the More Curious: Which Object Sends the Action Message?

### For the More Curious: UTIs and the Pasteboard

#### Custom UTIs

### For the More Curious: Lazy Copying

### Challenge: Write Multiple Representations

### Challenge: Menu Item

## 22. Drag-and-Drop

### Make DieView a Drag Source

# Table of Contents

Starting a drag

After the drop

Make DieView a Drag Destination

registerForDraggedTypes(\_:)

Add highlighting

Implement the dragging destination methods

For the More Curious: Operation Mask

## 23. NSTimer

NSTimer-based Animation

How Timers Work

NSTimer and Strong/Weak References

For the More Curious: NSRunLoop

## 24. Sheets

Adding a Sheet

Create the Window Controller

Set Up the Menu Item

Lay Out the Interface

Configuring the Die Views

Present the Sheet

Modal Windows

Encapsulating Presentation APIs

Challenge: Encapsulate Sheet Presentation

Challenge: Add Menu Item Validation

## 25. Auto Layout

What is Auto Layout?

Adding Constraints to RaiseMan

Constraints from subview to superview

Constraints between siblings

Size constraints

Intrinsic Content Size

# Table of Contents

Creating Layout Constraints Programmatically

Visual Format Language

Does Not Compute, Part 1: Unsatisfiable Constraints

Does Not Compute, Part 2: Ambiguous Layout

For the More Curious: Autoresizing Masks

Challenge: Add Vertical Constraints

Challenge: Add Constraints Programmatically

## 26. Localization and Bundles

Different Mechanisms for Localization

Localizing a XIB File

Localizing String Literals

Demystifying NSLocalizedString and genstrings

Explicit Ordering of Tokens in Format Strings

NSBundle

NSBundle's role in localization

Loading code from bundles

For the More Curious: Localization and Plurality

Challenge: Localizing the Default Name for a Newly Added  
Employee

Challenge: Localizing the Undo Action Names

## 27. Printing

Dealing with Pagination

Adding Printing to RaiseMan

For the More Curious: Are You Drawing to the Screen?

Challenge: Add Page Numbers

Challenge: Persist Page Setup

## 28. Web Services

Web Services APIs

RanchForecast Project

NSURLSession and asynchronous API design

# Table of Contents

NSURLSession, HTTP status codes, and errors

Add JSON parsing to ScheduleFetcher

Lay out the interface

Opening URLs

Safely Working with Untyped Data Structures

For the More Curious: Parsing XML

Challenge: Improve Error Handling

Challenge: Add a Spinner

Challenge: Parse the XML Courses Feed

## 29. Unit Testing

Testing in Xcode

Your First Test

A Note on Literals in Testing

Creating a Consistent Testing Environment

Sharing Constants

Refactoring for Testing

For the More Curious: Access Modifiers

For the More Curious: Asynchronous Testing

Challenge: Make Course Implement Equatable

Challenge: Improve Test Coverage of Web Service Responses

Challenge: Test Invalid JSON Dictionary

## 30. View Controllers

NSViewController

Starting the ViewControl Application

Windows, Controllers, and Memory Management

Container View Controllers

Add a Tab View Controller

View Controllers vs. Window Controllers

Considerations for OS X 10.9 and Earlier

Challenge: SpeakLineViewController

# **Table of Contents**

Challenge: Programmatic View Controller

Challenge: Add a Window Controller

## **31. View Swapping and Custom Container View Controllers**

View Swapping

NerdTabViewController

Adding Tab Images

Challenge: Boxless NerdTabViewController

Challenge: NerdSplitViewController

Challenge: Draggable Divider

## **32. Storyboards**

A New UI for RanchForecast

Adding the course list

Adding the web view

Connecting the Course List Selection with the Web View

Creating the CourseListViewControllerDelegate

Creating the parent view controller

For the More Curious: How is the Storyboard Loaded?

## **33. Core Animation**

CALayer

Scattered

Implicit Animation and Actions

More on CALayer

Challenge: Show Filenames

Challenge: Reposition Image Layers

## **34. Concurrency**

Multithreading

A Deep Chasm Opens Before You

Improving Scattered: Time Profiling in Instruments

Introducing Instruments

Analyzing output from Instruments

# Table of Contents

NSOperationQueue

    Multithreaded Scattered

    Thread synchronization

For the More Curious: Faster Scattered

Challenge: An Even Better Scattered

## 35. NSTask

    ZIPspector

    Asynchronous Reads

    iPing

    Challenge: .tar and .tgz Files

## 36. Distributing Your App

    Build Configurations

    Preprocessor Directives: Using Build Configurations to Change Behavior

    Creating a Release Build

    A Few Words on Installers

    App Sandbox

        Entitlements

        Containers

        Mediated file access and Powerbox

    The Mac App Store

    Receipt Validation

        Local receipt verification

        Server-based verification

## 37. Afterword

Index