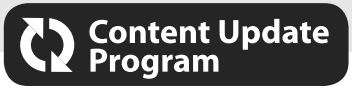
Erica Sadun

The Swift™ Developer's Cookbook

FREE SAMPLE CHAPTER

SHARE WITH OTHERS

The Swift™ Developer's Cookbook



This book is part of Addison-Wesley and InformIT's exciting new Content Update Program, which provides automatic content updates for major technology improvements!

- As Apple makes significant updates to the Swift 2 language, sections of this book may be updated or new sections added.
- Updates are delivered via a free Web Edition of this book, which can be accessed with any Internet connection.
- This means your purchase is protected from immediately outdated information!

For more information on InformIT's Content Update program, see the inside back cover or go to ***informit.com/CUP***.

If you have additional questions, please email our Customer Service department at informit@custhelp.com.

The Swift™ Developer's Cookbook

This page intentionally left blank

The Swift™ Developer's Cookbook

Erica Sadun

Addison-Wesley

Boston • Columbus • Indianapolis • New York • San Francisco • Amsterdam • Cape Town
Dubai • London • Madrid • Milan • Munich • Paris • Montreal • Toronto • Delhi • Mexico City
Sao Paulo • Sidney • Hong Kong • Seoul • Singapore • Taipei • Tokyo

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.

The Swift Developer's Cookbook is an independent publication and has not been authorized, sponsored, or otherwise approved by Apple Inc.

Apple, the Apple logo, Apple TV, Apple Watch, Cocoa, Cocoa Touch, eMac, FaceTime, Finder, iBook, iBooks, iCal, Instruments, iPad, iPad Air, iPad mini, iPhone, iPhoto, iTunes, the iTunes logo, iWork, Keychain, Launchpad, Lightning, LocalTalk, Mac, the Mac logo, MacApp, MacBook, MacBook Air, MacBook Pro, MacDNS, Macintosh, Mac OS, Mac Pro, MacTCP, the Made for iPad logo, the Made for iPhone logo, the Made for iPod logo, Metal, the Metal logo, the Monaco computer font, Multi-Touch, the New York computer font, Objective-C, OpenCL, OS X, Passbook, Pixlet, PowerBook, Power Mac, Quartz, QuickDraw, QuickTime, the QuickTime logo, Retina, Safari, the Sand computer font, Shake, Siri, the Skia computer font, Swift, the Swift Logo, the Textile computer font, Touch ID, TrueType, WebObjects, WebScript, and Xcode are trademarks of Apple, Inc., registered in the United States and other countries. OpenGL and the logo are registered trademarks of Silicon Graphics, Inc. The YouTube logo is a trademark of Google, Inc. Intel, Intel Core, and Xeon are trademarks of Intel Corp. in the United States and other countries.

The author and publisher have taken care in the preparation of 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.

For information about buying this title in bulk quantities, or for special sales opportunities (which may include electronic versions; custom cover designs; and content particular to your business, training goals, marketing focus, or branding interests), please contact our corporate sales department at corpsales@pearsoned.com or (800) 382-3419.

For government sales inquiries, please contact governmentsales@pearsoned.com.

For questions about sales outside the U.S., please contact international@pearsoned.com.

Visit us on the Web: informit.com/aw

Library of Congress Control Number: 2015953712

Copyright © 2016 Pearson Education, Inc.

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, request forms, and the appropriate contacts within the Pearson Education Global Rights & Permissions Department, please visit www.pearsoned.com/permissions/.

ISBN-13: 978-0-13-439526-5

ISBN-10: 0-13-439526-3

Text printed in the United States on recycled paper at RR Donnelley in Crawfordsville, Indiana.

First printing: December 2015

Cover image is the Phú Mỹ bridge, Ho Chi Minh City, Vietnam.

Editor-in-Chief
Mark Taub

Senior Acquisitions Editor
Trina MacDonald

Senior Development Editor
Chris Zahn

Managing Editor
Kristy Hart

Senior Project Editor
Betsy Gratner

Copy Editor
Kitty Wilson

Indexer
Tim Wright

Proofreader
Sarah Kearns

Technical Reviewers
Kevin Ballard
Sebastian Celis
Alexander Kempgen

Editorial Assistant
Olivia Basegio

Cover Designer
Chuti Prasertsith

Compositor
Nonie Ratcliff

Contents

Preface

More than a year after its introduction, the Swift programming language is still growing and evolving. While it seems a bit ridiculous writing a book about a language that's not fixed, final, and polished, that's exactly what *The Swift Developer's Cookbook* does. Swift is not so raw and young that even in its ever-changing state, it doesn't know what it's trying to achieve for its audience of Apple developers. A modern type-safe language, Swift already has locked down its fundamentals, even as its specific implementation details resolve over time.

Swift is simply a joy to program in. Its constructs and libraries present you with new ways to craft code, handle data, and perform the endless daily tasks that make up a programmer's life. From protocol-oriented and functional programming to first-class closures and algebraic data types, Swift offers a fresh and exciting take on programming. The more time you spend developing in Swift, the harder it becomes to return to older languages that don't offer these powerful features.

This book is not a traditional tutorial. It's written for programmers both experienced and new who are looking to push existing aptitudes into a new arena. Each concept-focused chapter covers a practical skill set. These chapters guide you to mastery over those essential Swift development tasks. You needn't read this cookbook from cover to cover (although you are more than welcome to do so). Instead, dive into whatever topic you want to learn about and uncover key insights to bring away with you from each discussion.

The Swift Developer's Cookbook has been an amazing project to work on. I hope you enjoy reading this book half as much as I've enjoyed working on it.

How This Book Is Organized

This book offers a practical survey of key Swift development topics. Here's a rundown of what you'll find in this book's chapters:

- **Chapter 1, "Welcome to Modern Swift"**—This chapter explores the kinds of applications you can build using this new modern type-safe programming language. Working in a new and changing language isn't always smooth sailing. Since Apple introduced Swift, the language has remained in constant flux. From beta to beta, dot release to dot release, new features and updated syntax mean source code that compiles in one release might not in the next. In this chapter, learn what it means to work in an evolving language and how to migrate your code as the language updates.
- **Chapter 2, "Printing and Mirroring"**—Although programming focuses on crafting artifacts through code, it's important to remember that code serves the developer as well as the end user. Code doesn't just need to compile: It should communicate clearly, coherently, and effectively as well. The features discussed in this chapter cover the gamut of output scenarios that range from user-facing write operations to developer-facing debugging support. This chapter surveys these technologies and explores how to precisely build feedback, documentation, and output to fit your development and debugging needs.

- **Chapter 3, "Optionals?!"**—Unlike in many other languages, in Swift a nil is not a pointer. Using it is a safe and expressive way to represent the potential for both valid and invalid values within a single construct. Learning how to recognize and use optionals is an essential step in mastering the Swift language. This chapter introduces optionals and surveys the supporting constructs you need in order to create, test, and successfully use optionals in your code.
- **Chapter 4, "Closures and Functions"**—Lexical closures provide the basis for methods, functions, and "block" parameters, all of which power the Swift applications you develop. By encapsulating state and functionality, they promote behavior to first-class constructs. This chapter explores closures, showing how they work in Swift and how to best incorporate them into your applications.
- **Chapter 5, "Generics and Protocols"**—Generics help you build robust code to expand functionality beyond single types. A generic implementation services an entire group of types instead of just one specific version. A combination of generic types and protocols (behavior contracts) establishes a powerful and flexible programming synergy. This chapter introduces these concepts and explores how you can navigate this often-confusing development arena.
- **Chapter 6, "Errors"**—In Swift, as in any other programming language, things fail. In daily development tasks, you encounter both logical errors—that is, things that compile but don't work the way you expect them to—and runtime errors that arise from real-world conditions such as missing resources or inaccessible services. Swift's response mechanisms range from assertions that fail fatally to error types that support recovery, enabling you to track what went wrong, and offer runtime workarounds. This chapter introduces errors and helps you understand how to handle many kinds of failure.
- **Chapter 7, "Types"**—When it comes to types, Swift offers three distinct families. Its type system includes classes, which provide reference types, and enumerations and structures, which are both algebraic value types. Each provides unique strengths and features to support your development. This chapter surveys some of the key concepts used in the Swift language and explores how its types work in your applications.
- **Chapter 8, "Miscellany"**—Swift is a vibrant and evolving language with many features that don't always fit tidily under a single umbrella. This chapter introduces an assortment of topics that could not find proper homes elsewhere in this book but that still deserve your attention.

About the Sample Code

You'll find the source code for this book at https://github.com/erica/SwiftCookbook on the open-source GitHub hosting site. There, you'll find a chapter-by-chapter collection of source code that provides examples of the material covered in this book.

Retrieve sample code either by using git tools to clone the repository or by clicking GitHub's Download button. It was at the right center of the page when I wrote this book. It enables you to retrieve the entire repository as a ZIP archive or tarball.

Contribute!

Sample code is never a fixed target. It continues to evolve as Apple updates its Swift language. Get involved. Pitch in by suggesting bug fixes and corrections and by expanding the code that's on offer. GitHub allows you to fork repositories and grow them with your own tweaks and features and then share them back to the main repository. If you come up with a new idea or approach, let me know.

Getting GitHub

GitHub (http://github.com) is the largest git-hosting site, with more than 150,000 public repositories. It provides both free hosting for public projects and paid options for private projects. With a custom Web interface that includes wiki hosting, issue tracking, and an emphasis on social networking of project developers, it's a great place to find new code or collaborate on existing libraries. Sign up for a free account at the GitHub website, which then allows you to copy and modify this repository or create your own open-source iOS projects to share with others.

Contacting the Author

If you have any comments or questions about this book, please drop me an email message at erica@ericasadun.com or stop by the GitHub repository and contact me there.

Acknowledgments

My sincere thanks go out to Trina MacDonald, Chris Zahn, and Olivia Basegio, along with the entire Addison-Wesley/Pearson production team, specifically Betsy Gratner, Kitty Wilson, and Nonie Ratcliff, and my amazing team of technical editors, Kevin Ballard, Alex Kempgen, and Sebastian Celis.

My gratitude extends to everyone who helped read through drafts and provided feedback. Specific thanks go out to Ken Ferry, Jeremy Dowell, Remy Demarest, August Joki, Mike Shields, Phil Holland, Mike Ash, Nate Cook, Josh Weinberg, Davide De Franceschi, Matthias Neeracher, Tom Davie, Steve Hayman, Nate Heagy, Chris Lattner, Jack Lawrence, Jordan Rose, Joe Groff, Stephen Celis, Cassie Murray, Kelly Gerber, Norio Nomura, “Eiam,” Wess Cope, and everyone else who contributed to this effort. If I have omitted your name here, please accept my apologies.

Special thanks also go to my husband and kids. You guys are the best.

About the Author

Erica Sadun is a bestselling author, coauthor, and contributor to several dozen books on programming and other digital topics. She has blogged at TUAW.com, O'Reilly's Mac Devcenter, Lifehacker, and Ars Technica. In addition to being the author of dozens of iOS-native applications, Erica holds a Ph.D. in computer science from Georgia Tech's Graphics, Visualization and Usability Center. A geek, a programmer, and an author, she's never met a gadget she didn't love. When not writing, she and her geek husband have parented three geeks-in-training, who regard their parents with restrained bemusement, when they're not busy rewiring the house or plotting global domination.

Editor's Note: 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.

You can email or write me directly 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 stronger.

Please note that I cannot help you with technical problems related to the topic of this book, and that due to the high volume of mail we receive, we might not be able to reply to every message.

When you write, please be sure to include this book's title and author as well as your name and phone or email address. I will carefully review your comments and share them with the author and editors who worked on the book.

Email: trina.macdonald@pearson.com

Mail: Trina MacDonald
Senior Acquisitions Editor
Addison-Wesley/Pearson Education
75 Arlington St., Ste. 300
Boston, MA 02116

Reader Services

Register your copy of *The Swift Developer's Cookbook* at informit.com for convenient access to downloads, updates, and corrections as they become available. To start the registration process, go to informit.com/register and log in or create an account*. Enter the product ISBN, 9780134395265, and click Submit. Once the process is complete, you will find any available bonus content under Registered Products.

*Be sure to check the box that you would like to hear from us in order to receive exclusive discounts on future editions of this product.

This page intentionally left blank

3

Optionals?!

`nil` happens. When dictionary lookups fail, when instance properties are case dependent, when asynchronous operations have not completed, when failable initializers cannot create instances, and in dozens of other situations where values may or may not have been set, Swift may return `nil` instead of some other more concrete content. Swift provides `nil` as a powerful tool for expressing situations in which values are unavailable for use.

Swift differentiates these "no content" scenarios from error handling. In error handling, control flow changes to offer failure mitigation and reporting. With `nil`, a *value-of-no-value* represents an absence of data. It offers a testable placeholder to be used when no data is otherwise available.

Unlike in many other languages, in Swift, `nil` is not a pointer. It is a safe and expressive way to represent the potential for both a valid and invalid value within a single construct. In Swift, the `Optional` type encapsulates this concept and enables you to differentiate between successful value assignments and `nil` cases.

Learning how to recognize and use optionals is an essential step in mastering the Swift language. This chapter introduces optionals and surveys the supporting constructs you need to create, test, and successfully use optionals in your code.

Optionals 101

Question marks and exclamation points are the hallmark of Swift optionals. Any variable marked with `?` may—or may not—contain a valid value. To get a sense of this language feature, consider the following example:

```
var soundDictionary = ["cow": "moo", "dog": "bark", "pig": "squeal"]
print(soundDictionary["cow"] == "moo") // prints true
print(soundDictionary["fox"]) // What does the fox say?
```

What does the fox say? In Swift, the answer is `nil`. In Swift, `nil` indicates "no value." Unlike in Objective-C, in Swift, `nil` is not a pointer. Swift `nil` indicates a semantic missing

non-existence, a count of Monte Cristo, a cup of "not tea," an honest politician. A `nil` item means "nothing to see here, move along, move along, move along."

In this `soundDictionary` example, the variable stores a string dictionary. With strings for both keys and values, its type is `Swift.Dictionary<Swift.String, Swift.String>`. You can also represent this type as `[String: String]`, using square brackets and a colon. Swift infers this type from the concrete data provided on the right-hand side of the `soundDictionary` assignment. Alternatively, you can use explicit type annotation in your code by adding a colon and a type in the variable declaration:

```
var soundDictionary: [String: String] =
    ["cow": "moo", "dog": "bark", "pig": "squeal"]
```

Although the dictionary uses `String` keys and values, when you look up any item in this dictionary, the value returned is not a `String`. It's typed `String?`. That question mark is critical to understanding dictionaries because it indicates an `Optional` type. Dictionary lookups may succeed or fail. Optional return types encapsulate both possibilities.

Contrast this behavior with arrays, where it's the programmer's job to check whether an index exists before accessing it. Both types could easily be implemented with the other convention, of course, but the Swift people chose the more likely use case for each type. Arrays are highly bounded with a small domain of legal lookup indexes. Dictionaries are often sparse compared against their possible key domain. Optionals enables dictionaries to better represent their "may or may not map to a value" results.

Confirm the return type with Quick Help. Enter the dictionary and the following assignment in Xcode. Then Option-click the sound symbol (as in Figure 3-1) or select the symbol and open View > Utilities > Show Quick Help Inspector. The declaration line in the Quick Help presentation confirms that the type assigned to `sound` is `String?`:

```
var sound = soundDictionary["cow"] // sound is typed String?
```

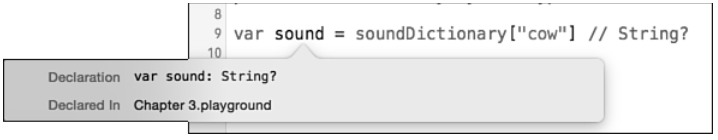


Figure 3-1 Xcode's Quick Help reveals symbol typing.

While it might appear that the dictionary returns `"moo"` on success or `nil` for failed lookups, this is actually misleading. Print the output to the Xcode console, with `print(sound)`. A successful result looks like `Optional("moo")`, with its value embedded in an optional wrapper. In this case, the `Optional` type uses a `.Some` enumeration, and its associated value is the `"moo"` string.

You cannot use this optional directly as a string. The following example fails because you must unwrap `Optional` types before using their values:

```
let statement = "The cow says " + sound
```

The + operator in this case works on two string values, not on a string and an optional. Unwrapping gives you access to the string stored within the optional wrapper, enabling you to perform tasks like appending values.

Unwrapping Optionals

`Optional` types always return either a wrapped value or `nil`. Wrapping means that any actual content is stored within a logical outer structure. You cannot get to that value (in this case, `"moo"`) without unwrapping it. In the Swift world, it is always Christmas, and there are always presents—or at least variables—to unwrap.

Swift offers a variety of mechanisms for unwrapping optionals and recovering the underlying data type stored within them. There are more ways to get at a wrapped optional value than you might expect. The expressive possibilities expanded in Apple's Swift 2 update to provide greater developer flexibility.

Forced Unwrapping

The simplest way to extract an optional value is to append an exclamation point:

```
print("The sound is \(sound!)") // may or may not crash
```

This is also the most dangerous approach, and you want to generally avoid it in production code.

If the value is wrapped (that "optional" result you just read about), the exclamation point returns the value stored within the wrapped element. If the value is `nil`, you experience a fatal runtime error—which is not nearly as fun or gratifying for your workday.

The `nil` value is the Swift equivalent of your aunt's home-crocheted vest with a large friendly moose decoration on it. It's pretty important to check whether an item is `nil` before unwrapping it. You can more safely unwrap with an exclamation point within an `if` statement because this `sound` is nominally guaranteed to be non-`nil` in non-extreme (that is, nonthreaded) situations:

```
if sound != nil {
    print("The sound is \(sound!)") // doesn't crash
}
```

Safety is a relative thing. While this forced unwrap is pretty safe at compile time and runtime in its current use, it's dangerous while editing. If you accidentally move that `print` line out of the `if` block, the compiler cannot warn you about it, and you will ship broken code.

In this example, the `sound` variable is also not `weak`. It won't deallocate between the `nil` test and unwrapping. Never use forced unwraps with `weak` variables because they may do just that.

As a rule, avoiding forced unwraps, even within `if` clauses, helps you avoid potential disasters.

Conditional Binding

Conditional binding provides a better and safer approach that avoids forced unwrapping. In conditional binding, you optionally bind (that is, assign) a value to a new constant or variable using an `if-let` or `if-var` statement. When the optional is not `nil`, Swift unwraps the value, assigns it, and executes a block of code. When `nil`, you either enter an `else` clause or continue to the next statement:

```
if let sound = soundDictionary[animal] {
    print("The \(animal) says \(sound)")
} else {
    print("Any sound the \(animal) says is unknown to modern science")
}
```

It's conventional in Swift to use identical identifiers in conditional bindings for both wrapped and unwrapped versions. In the following snippet, a `mySound` constant is unwrapped within the `if-let` (or `if-var`) scope but wrapped outside it:

```
let mySound = soundDictionary[animal] // mySound is wrapped
if let mySound = mySound {
    print(mySound) // mySound is unwrapped
}
```

Using the same identifier makes it clear that you're working with the same semantics in different states of undress. Conditional binding clauses tend to be short. This enables you to verify your overloaded symbol intent with a glance.

The right-hand value in an `if-let` assignment must be an optional. You cannot use this construct with an already-unwrapped item. The following statement leads to an error, complaining that a conditional binding initializer must have `Optional` type:

```
if let sound = soundDictionary["cow"]! { // error!
    print("The cow says \(sound)")
}
```

Conditional Binding and Type Casts

Type casting enables you to re-interpret an instance's type at runtime. Swift offers two distinct type-casting operators (`is` and `as`) with four variations: `is`, `as`, `as?`, and `as!`. These operators enable you to check value types and cast values to other types. The `is` operator checks whether you can convert an instance's type to another, typically more specialized, type:

```
let value = 3
value is Any // true
value is Int // true
value is String // false
```

The `as` operator casts to other types and can test whether an item conforms to a protocol. These are its three forms:

- The `as` operator applies direct casts. The compiler must determine at compile time that the cast will succeed.
- The `as?` variant contains a question mark. It performs a conditional cast that always returns an optional value. If the cast succeeds, it's wrapped in an optional instance. If not, it returns `nil`. This is the cast I use most often in day-to-day coding. The compiler issues warnings when it detects that a cast will always succeed (for example, `String` to `NSString`) or always fail (`String` to `NSArray`).
- The forced variant `as!` includes an exclamation point. It either returns an unwrapped item or raises a runtime error. This is the most dangerous cast type. Use it when you know a cast will always succeed or when you want your application to prematurely crash.

Conditional binding and conditional casting work hand-in-hand. Figure 3-2 demonstrates why. In this screenshot, Swift code creates a string-indexed dictionary that stores arbitrary `Any` instance types. Even when a lookup returns a valid integer for the `"Three"` key, a forced unwrap still reports `Any` type. To use this value as a number, you must downcast from `Any` to `Int`.

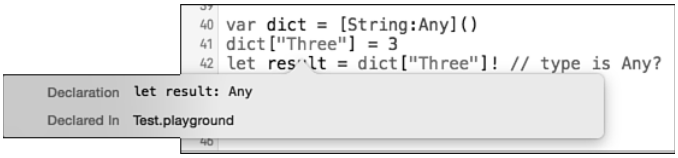


Figure 3-2 Lookups from a `[String:Any]` dictionary return `Optional<Any>` values. The type remains `Any` even after forced unwrapping.

The `as?` type operator produces optionals even when used with non-optional values:

```
let value = 3 // Int
let optionalValue = value as? Int // Int?
```

Conditional binding enables you to apply a cast, test the resulting optional, and then bind unwrapped values to a local variable. In the following example, `result` is bound as an `Int` constant within the `if` clause code block:

```
if let result = dict["Three"] as? Int {
    print("\(result + 3) = 6") // 6 = 6
}
```

This conditional pattern of `fetch`, `cast`, and `bind` commonly appears when working with structured data from web services and databases. Swift enables you to use type safety while navigating through key paths down to data leaves.

Recipe 3-1 searches a `UIView` hierarchy, using conditional casting to match subviews against a supplied type, returning the first subview that matches that type. The `as?` type operator returns an optional, which is conditionally bound to a local `view` variable. If the binding succeeds and a type match is found, the function returns. Otherwise, it recurses down the tree in a depth-first search.

Recipe 3-1 **Using Conditional Binding to Test Types**

```
public func fetchViewWithType<T>(
    type t: T.Type, contentView: UIView) -> T? {
    for eachView in contentView.subviews {
        if let view = eachView as? T {return view}
        if let subview = fetchViewWithType(
            type: t.self, contentView:eachView) {
            return subview
        }
    }
    return nil
}
```

Binding Cascades

Although useful for accessing values, `if-let` bindings build into code structures colloquially known as *pyramids of doom*. Each successive test indents your code further and further to the right, creating a triangle of empty space to the left of the `if` statements and then the closing brackets:

```
if let cowSound = soundDictionary["cow"] {
    if let dogSound = soundDictionary["dog"] {
        if let pigSound = soundDictionary["pig"] {
            // use sounds here
        }
    }
}
```

It's the sort of code you don't want to bring home to your project manager—or your mummy.

Using multiple optional bindings within a single test enables you to avoid this structural mess. First introduced in Swift 1.2, cascading permits any number of conditional bindings tests within a unified conditional:

```
if let
    cowSound = soundDictionary["cow"],
    dogSound = soundDictionary["dog"],
    pigSound = soundDictionary["pig"] {
        // use sounds here
}
```

If any assignment fails, evaluation stops, and control moves past the `if` statement. This approach is particularly useful when working with web-sourced data, such as JSON, where each step may depend on the results of the previous conditional binding. The following example is from a script that checks prices on the iTunes App Store:

```
if let
    json = json as? NSDictionary,
    resultsList = json["results"] as? NSArray,
    results = resultsList.firstObject as? NSDictionary,
    name = results["trackName"] as? String,
    price = results["price"] as? NSNumber {
    // Process results
}
```

This code pulls data from the App Store and deserializes it with `NSJSONSerialization.JSONObjectWithData`. The results list is extracted from the JSON data, and the app results from that list, and so forth.

While this approach avoids pyramid indentation, it introduces a bad tendency toward code constipation. Increased blockiness makes `if-let` cascades hard to mentally process. Copious commenting and spacing can mitigate this. As shown here, the results are faster for the brain to parse, make it easier to spot errors, and are better for adding, removing, and reordering intermediate steps:

```
if let
    // Access JSON as dictionary
    json = json as? NSDictionary,

    // Retrieve results array
    resultsList = json["results"] as? NSArray,

    // Extract first item
    results = resultsList.firstObject as? NSDictionary,

    // Extract name and price
    name = results["trackName"] as? String,
    price = results["price"] as? NSNumber {

        // Process results
}
```

`guard` Statements

The `guard` statement was first introduced in Swift 2. It offers another way to unwrap and use optionals. Although `guard` is not limited to use with optionals—you can use it with general Boolean conditions as well—it provides a major development advantage that's specific to optional handling. In particular, `guard` statements move code out of indented scopes by offering early-return error handling.

Early-return inverts the handling of success and failure paths. Errors are handled first, enabling success code to be written at the highest possible scope. Compare this to `if-let`, where you cannot put the failure path first and your success conditions must be handled in a child scope. Without `guard` statements, all conditionally bound values must be used with the `if` statement code block that binds them. For example, the following snippet conditionally binds a `cowSound` constant using `if-let`, and the `cowSound` constant is undefined outside that scope:

```
if let cowSound = soundDictionary["cow"] {
    // cowSound is unwrapped within this scope
}
// cowSound is undefined outside the scope
```

Like `if-let`, a `guard` statement conditionally unwraps and binds optional variables. When that binding fails, it executes a mandatory `else` clause, which *must* exit the current scope, using `throw`, `break`, `continue`, or `return` statements. Otherwise, the `guard` statement unwraps the optional value and binds it to a variable you can use throughout the remaining lifetime of the current scope:

```
guard let cowSound = soundDictionary["cow"] else {throw Error.MissingValue}
// cowSound now defined and unwrapped
```

Think of a `guard` statement as a soldier that will not permit the flow of execution to continue forward unless its condition or conditions are met. Unlike `if-let`, `guard` does not establish new scopes. Instead, it guides traffic through the existing scope.

Like `if-let`, a single `guard` statement can express multiple conditions, separated by comma delineators. For example, you might perform multiple constant assignments:

```
guard let
    cowSound = soundDictionary["cow"],
    dogSound = soundDictionary["dog"]
    else {throw Error.MissingValue}
```

Or you might include a more general test along with assignments:

```
guard
    soundDictionary.count > 2,
    let cowSound = soundDictionary["cow"],
    let dogSound = soundDictionary["dog"]
    else {throw Error.MissingValue}
```

Implicitly Unwrapped Optionals

Swift provides a feature called implicitly unwrapped optionals, which you declare by appending an exclamation point to the end of the type. Unlike normal optionals, these versions unwrap themselves, much like a jack-in-the-box or the hired entertainment at a bachelor party. Use implicitly unwrapped optionals cautiously. They're a fairly dangerous feature as they introduce fatal runtime errors if you attempt to access values stored inside a `nil` case optional.

Here's an example of first an assignment to a normally typed constant and then to an implicitly unwrapped one. The difference is what happens when you access the wrapped value. That's where the name comes from because during access, the value is implicitly unwrapped:

```
var animal = "cow" // 1
let wrappedSound = soundDictionary[animal] // Optional("moo")
let unwrappedSound: String! = soundDictionary[animal] // "moo"

// prints: The unwrapped sound is "moo"
let soundString = "\"" + unwrappedSound + "\"" // 2
print("The unwrapped sound is \(soundString)")
```

In this example, when you use `unwrappedSound` in the string assignment, its value is not `Optional("moo")`. Its value is accessed as `moo`, and it behaves like a simple string. Implicit unwrapping extracts the value from an optional item and uses the data type you'd expect from a successful dictionary lookup. Once unwrapped, you can use the variable directly. You don't have to add that "unwrap this variable" exclamation point or use conditional binding.

A real danger arises from unwrapping `nil` values. If you replace the assignment to `animal` in the line marked `1` with `"fox"` instead of `"cow"`, this code raises a fatal error in the line marked `2`. The runtime complains that it `unexpectedly found nil while unwrapping an Optional value`. With great unwrapping comes great responsibility. Take care that you properly guard these items to ensure that you don't attempt to unwrap `nil`.

Limit implicit unwrapping to when you know in advance that a variable will always have a value after some logical point. For example, if you're responding to button taps or menu clicks, you probably don't have to wonder "does this button or menu item exist?" It does. If it didn't, you would never have reached your callback.

Don't use implicit unwrapping for more general cases like dictionary lookups. That's just asking for trouble. You can, however, print unwrapped items and test them against `nil`:

```
print(unwrappedSound) // prints nil
if unwrappedSound != nil {
    print("Valid:", unwrappedSound)
}
```

An error won't be raised until you perform an operation that attempts to access the value inside.

As a rule, it is legal to assign a value, an optional value, or `nil` to an implicitly unwrapped variable. The following code is legal and will compile without error:

```
var myImplicitlyUnwrappedOptional: String!
myImplicitlyUnwrappedOptional = Optional("Value")
myImplicitlyUnwrappedOptional == "Value" // true
myImplicitlyUnwrappedOptional = nil // do not test except against nil
myImplicitlyUnwrappedOptional == nil // true
myImplicitlyUnwrappedOptional = "Value"
myImplicitlyUnwrappedOptional == "Value" // true
```

Assignments to both optional and non-optional values end with non-optional results, which you see by comparing against the non-optional string literal `"Value"`. The danger lies in the `nil` assignment. A non-`nil` comparison tries to access the value and ends in a runtime error. The win is that you can perform an assignment to either optional or non-optional values with a single assignment.

An implicitly unwrapped scenario is common when working with Interface Builder. A view *binding* is optional; it may or may not be properly instantiated in the interface file. The view *use* is normally non-optional; presumably you set up the binding correctly. Implicit unwrapping simplifies code access to views at the cost of potential crashes during development and testing.

Swift 2's one-line `guard` statement more or less offers a shorthand summary for the following initialization pattern:

```
let cowSound: String! = soundDictionary["cow"]
if cowSound == nil {throw Error.missingValue} // Handle nil case
// cowSound's value is now usable without explicit unwrapping
```

This assignment uses implicit unwrapping and then tests against `nil`. This is a safe check because the code makes no attempt to access an associated value. If the optional is `nil`, the `if` statement's conditional block executes, transferring control away from this scope. Otherwise, execution continues, and the unwrapped `cowSound` constant is now available for use.

An implicitly unwrapped approach is both wordier and less safe than `guard`. It uses multiple statements compared with `guard`'s one, and it makes no conditions about leaving the current scope. If the `throw` request were replaced with a `print` statement, the `nil` case would continue forward. In doing so, it might encounter a use of `cowSound`'s nonexistent value and a nasty runtime crash.

Use implicit unwrapping cautiously and prefer `guard` where possible.

Guarding Failable Initializers

When an initializer returns an optional instance, it's called a *failable* initializer. The initializer may succeed in establishing a new instance, or it may fail and return `nil`. For example, the following structure can be initialized only with even numbers:

```
struct EvenInt {
    let number: Int
    init?(_ number: Int) {
        if number % 2 == 0 {self.number = number} else {return nil}
    }
}
```

Mark failable initializers by appending a question mark or an exclamation point to the `init` keyword (`init?` or `init!`). The punctuation choice depends on whether the initializer returns a normal optional instance or an implicitly unwrapped one. The implicitly unwrapped variation is almost never used in real life. According to my technical editor Kevin Ballard, you might theoretically encounter one when working with legacy code ported from Core Foundation or from any unaudited Objective-C API.

Use `guard` to test assignments from failable initialization. Here's an example built around the `EvenInt` struct. When created with an odd number, an `EvenInt` initializer returns `nil`. The `guard` statement throws an error and exits the scope:

```
do {
    guard let even2 = EvenInt(2) else {throw Error.Odd}
    print(even2) // prints EvenInt(number: 2)
    guard let even3 = EvenInt(3) else {throw Error.Odd} // fails
    print(even3) // never gets here
} catch {print(error)}
```

Although you can use any approach for testing and unwrapping optionals, `guard` statements offer a natural synchronicity with failable initializers. Guarding initializers once again enables you to test for failed initialization at the point where you declare variables and constants and ensures that these bindings remain valid for the remaining scope.

Optionals and Sentinel Values

It is tempting to use optionals to signal when an operation has failed. The following snippet represents Swift prior to version 2 and is common to Apple's traditional Cocoa patterns:

```
func doSomething() -> String? {
    let success = (arc4random_uniform(2) == 1) // flip a coin
    if success {return "success"} // succeed
    return nil // fail
}

if let result = doSomething() {
    // use result here
}
```

An unsuccessful operation returns `nil`, and a successful one returns a value.

Starting in Swift 2, reserve `nil` failures for initialization (although you can also use `throws` in initializers as well as in normal code) and prefer `guard` over `if-let`. Instead of using optionals as sentinels—that is, to signal success and fail conditions—use Swift's new error-handling system. Error handling enables you to redirect the flow of control to mitigate errors and provide recovery support:

```
func betterDoSomething() throws -> String {
    let success = (arc4random_uniform(2) == 1) // flip a coin
    if success {return "success"} // succeed
    throw Error.failure // fail
}

do {
    let result = try betterDoSomething()
} catch {print(error)}
```

This refactoring skips optionals; the `nil` case is never of interest to the client code. Swift 2 error handling means you never have to unwrap.

When a thrown error is not of interest to its consumer, the `try?` operator can discard errors and convert results to optionals. This lets you integrate new-style errors with old-style optional handling. A `try?` expression returns a wrapped value for successful calls and `nil` for thrown errors:

```
guard let foo = try? somethingThatMayThrow else {
    // ...handle error condition and leave scope
}
if let foo = try? somethingThatMayThrow {}
```

The new error-handling system profoundly affects Cocoa-sourced APIs. Calls that used `NSError` pointers pre-Swift 2 change their return type from optional to non-optional, add the `throws` keyword, and eliminate error pointers from API calls. The new system sends `NSError` through `do-try-catch`. Compare the old approach with the new one:

```
// Old
func dataFromRange(range: NSRange,
    documentAttributes dict: [NSObject: AnyObject],
    error: NSErrorPointer) -> NSData?

// New
func dataFromRange(range: NSRange,
    documentAttributes dict: [String: AnyObject]) throws -> NSData
```

By introducing error handling, optionals can eliminate overloaded "failed call" semantics. It's always better to use `throws` with well-defined errors than to use optional sentinel values. When you really have no information to pass back to the caller other than "I failed," Swift 2's updated error system simplifies creating an error enumeration to explain why that failure occurred. It is ridiculously easy to add informative errors that don't require complicated `NSError` initializers:

```
enum Error: ErrorType {case BadData, MemoryGlitch, ItIsFriday}
```

Although many current APIs, especially asynchronous handlers and calls based on Core Foundation, have yet to transition to the new system, I encourage you to update your code to avoid using optionals as sentinel values. Return your optionals to the "contains a value or does not contain a value" semantics they were designed to handle.

Coalescing

Swift's `nil`-coalescing operator `??` unwraps optionals and provides fallback values for the `nil` case. This next example checks uses `nil`-coalescing to assign a value to the `sound` constant:

```
let sound = soundDictionary["fox"] ?? "unknown"
```

If the lookup succeeds and the dictionary returns a wrapped value, the operator unwraps it and assigns it to `sound`. If not, it assigns the fallback value, which is `"unknown"`. In either case, the assignment is not optional. `sound` uses a `String` type, not `String?`.

Use `nil` coalescing when you can supply fallback values that won't interrupt a normal operational flow. When you cannot, choose `guard` instead and handle `nil` as an error case in the `else` clause.

> **Note**
>
> If the optional is non-`nil`, the right-hand side of the operator is never evaluated. The operation short-circuits, as with the Boolean operators `&&` and `||`.

Optional Assignment

In `nil` coalescing, you must supply a valid unwrapped fallback value. In cases where a fallback does not exist, consider optional assignment instead. This approach shortcuts any case where an optional value is unavailable. Normally, you embed assignments into an `if-let` scope. If the conditional binding succeeds, you assign the unwrapped value.

Alternatively, you might consider creating a custom operator that conditionally assigns values to a target, as in the following example:

```
// Thanks, Mike Ash
infix operator =? {}
public func =?<T>(inout target: T, newValue: T?) {
    if let unwrapped = newValue {
        target = unwrapped
    }
}
```

This snippet builds an `=?` operator that supports simple assignment by wrapping and hiding its underlying `if-let` approach with a basic `infix` call.

The following assignments show this operator in action. The `s` string variable updates only for non-`nil` assignments:

```
var s: String = "initial value"
s =? "value 1" // value 1
s =? nil // value 1
```

Hiding `if-let` overhead makes the resulting conditional assignments cleaner and potentially more intuitively obvious to read through.

Optional Patterns

A Swift *pattern* matches a value's structure rather than just the value itself. Patterns decompose and express a data structure, including component elements. They enable you to refer to an item's subconstructs when testing instead of dealing with instances as a monolithic whole. Using patterns is a powerful and nuanced way to represent an instance, and it's extremely handy for working with optionals.

The optional enumeration consists of two cases, `.None` and `.Some`. The `.Some` case contains an associated value of an arbitrary type:

```
enum Optional<T> {
    case None
    case Some(T)
}
```

With optionals, pattern matching enables you to limit statements to work only with the `.Some` case. You can reach into that case and bind the internal value using a single declaration. Follow the `case` keyword with a specific enumeration (the `.Some` case) and then bind the value nestled within it using `let` or `var`:

```
switch soundDictionary[animal] {
    case .Some(let sound):
        print("Using case, the unwrapped sound is \(sound)")
    default: break
}
```

The result is an unwrapped value, ready for access.

The `case .Some(let constant)` expression provides a one-to-one pattern match with the underlying optional. Optionals with the `None` case don't match this pattern, so the `case` code need not consider `nil` scenarios.

There's no denying that the `case` (`case .Some(let constant)`) is awkward to process visually. It lacks grace. Responding to the complexity of this optional pattern-matching code, Swift 2 introduces shorthand using a postfixed question mark:

```
switch soundDictionary[animal] {
    case let sound?:
        print("Using case, the unwrapped sound is \(sound) [2]")
    default: break
}
```

This postfixed question mark is nothing more than syntactic sugar for the `.Some` case. The results are simpler and more readable because this `case` matches and unwraps its optionals.

The preceding example shortchanges Swift because there's still no major advantage in using this one-`case switch` statement over, say, `if-let`. When you introduce a simple `where` clause, you begin to see where pattern-matching optionals adds power and concision.

The following snippet uses a `switch` statement to differentiate unwrapped optionals whose string values are longer than five characters from those that are shorter:

```
switch soundDictionary[animal] {
case let sound? where sound.characters.count > 5:
    print("The \(sound) is long")
case let sound?:
    print("The \(sound) sound is under 5 characters")
default: break
}
```

Swift's `switch` cases may experience significant logical overlap where small details select which case to execute.

Using pattern matching with `if` statements enables you to drop `switch` statement overhead and simplify one-`case` code even further. You lose the default statement and the surrounding `switch`, and you reduce the check to just a simple pattern comparison with `where` clause support. This `if` statement uses both pattern matching and a `where` clause for precise testing:

```
if case let sound? = soundDictionary[animal] where sound.hasPrefix("m") {
    print("Sound \(sound) starts with m")
}
```

The `where` clause isn't limited to `if-case`. You can construct a similar statement using `if-let`:

```
if let sound = soundDictionary[animal] where sound.hasPrefix("m") {
    print("Sound \(sound) starts with m")
}
```

Pattern matching also enables you to iterate through an array and perform actions on unwrapped non-`nil` values. The `for-case-let` approach simplifies working with optional collections, as you see in the following snippet:

```
// Collect sound optionals into array
let soundOptionals = ["cow", "rhino", "dog", "goose", "hippo",
    "pig"].map({soundDictionary[$0]})
```

```
print(soundOptionals) // [Optional("moo"), nil, Optional("bark"),
                      // nil, nil, Optional("squeal")]

for case let sound? in soundOptionals {
    print("The sound \"\(sound)\" appears in the dictionary")
}
```

You can also use pattern matching with `guard` statements:

```
guard case let .Some(sound) = soundDictionary["cow"] else {fatalError()}
print(sound)
```

This example from Apple sample code uses a GameplayKit enumeration. It performs an enumeration pattern match and binds the `targetAgent` associated value:

```
guard case let .HuntAgent(targetAgent) = mandate else {return}
```

Optional Chaining

In Swift, you *chain* methods and properties by appending period-delimited selectors. Each function in the chain returns an intermediate value. This allows calls to be joined into a single statement without requiring variables that store intermediate results:

```
soundDictionary.description.characters.count
```

This approach creates a *fluent interface*, which is ideally a parsimonious and more readable expression of a set of operations you want to consider as a single unit. A danger, of course, lies in over-chaining. If you're producing enormous lines of code that are difficult to debug and hard to read and that cannot be easily commented or differentiated on updates, you're probably doing this wrong. Ask yourself, "Would I ever need to put a breakpoint in this statement or step through it?" If the answer is yes, you are over-chaining.

Swift introduces a powerful feature called *optional chaining*. Swift method calls may return optionals, and you must take this into account when forming chains. Swift provides a way that an entire chain can fail gracefully on encountering `nil`.

Optional chaining involves adding question marks after optional values. For example, you might look up an animal in the sound dictionary and use optional chaining to return a capitalized version of the sound:

```
soundDictionary[animal]?.capitalizedString // Moo or nil
```

Even though `capitalizedString` normally returns a non-optional, this chain returns `String?`. It may succeed or fail, depending on the lookup.

Add question marks to any chain participants that return optionals:

```
soundDictionary[animal]?.characters.first?.hashValue // returns Int?
```

You can add forced unwrapping to any chain item by replacing the question mark with an exclamation point. This usage comes with the same forced unwrapping dangers discussed earlier in this chapter:

```
soundDictionary[animal]!.capitalizedString // Moo or Runtime Error
```

Here's a real-world example of where you might use optional chaining to simplify an `if-let` pattern. This code extends `Array` to return the index of a possible maximum element. Swift's standard library `maxElement()` function returns an optional based on whether a sequence has values to compare (Apple writes in the standard library, "Returns the maximum element in `` `self` `` or `` `nil` `` if the sequence is empty."):

```
extension Array where Element:Comparable {
    var maxIndex: Int? {
        if let e =
            self.enumerate().maxElement({$1.element > $0.element}) {
            return e.index
        }
        return nil
    }
}
```

Introducing optional chaining greatly simplifies this code, enabling you to shortcut the `index` lookup and returning `nil` if the `maxElement` call fails. Recipe 3-2 returns the index of an array's maximum value.

Recipe 3-2 **Using Optional Chaining to Shortcut Evaluations**

```
extension Array where Element:Comparable {
    var maxIndex: Int? {
        return self.enumerate().maxElement(
            {$1.element > $0.element})?.index
    }
}
```

Extend Recipe 3-2's functionality to all collection types with the following snippet:

```
extension CollectionType where Generator.Element: Comparable {
    var maxIndex: Index? {
        return self.indices.maxElement({self[$1] > self[$0]})
    }
}
```

Selector Testing and Optional Chaining

Optional chaining isn't just about transforming your code into bite-sized lines. It also acts as shorthand to test whether an item responds to a method or property selector. Optional

chaining offers a rough equivalent to Objective-C's `respondsToSelector:` method, enabling you to determine whether it's safe to execute calls on particular instances.

Commonly, you work with subclasses that are directly related to each other but that implement distinct method sets. For example, you might retrieve a collection of SpriteKit nodes from a scene and then adjust the line widths of the shape nodes. This snippet uses a failable cast followed by an optionally chained property assignment:

```
for node in nodes {(node as? SKShapeNode)?.lineWidth = 4.0}
```

This selector-testing approach also works in pure Swift, as in the following example:

```
// Root class put two subclasses
class Root {func rootFunc() {}}
class Sub1: Root {func sub1Func() {print("sub1")}}
class Sub2: Root {func sub2Func() {print("sub2")}}

// Create heterogeneous array of items
var items: [Root] = [Sub1(), Sub2()]

// Conditionally test and run selectors
(items[0] as? Sub1)?.sub1Func() // runs
(items[0] as? Sub2)?.sub2Func() // no-op, nil
```

This snippet constructs a heterogeneous array of `Root` subclasses. It then performs conditional casts and uses selector tests before calling class-specific methods.

Selector testing enables you to test whether a method exists before constructing a new instance. Adding the question mark ensures that the `NSString` call won't fail with a runtime "unrecognized selector" exception:

```
let colorClass: AnyClass = UIColor.self
let noncolorClass: AnyClass = NSString.self
colorClass.blueColor?() // returns a blue color instance
noncolorClass.blueColor?() // returns nil
```

This is a special behavior of `AnyClass` and `AnyObject` that works only with Objective-C methods, for compatibility with `Class` and `id`. These are special cases because these types return functions as implicitly unwrapped optionals. Other types don't do that.

Subscripts

Contrary to expectations, optional chaining with subscripts *doesn't* introduce safe lookups. This is an important factor that you should internalize as soon as possible and recognize in your code. In the following example, if you try to access index 8 (aka the ninth element of this six-element array), your code dies with a fatal `Array index out of range` error:

```
let array: Array? = [0, 1, 2, 3, 4, 5]
array?[0] // 0
// array?[8] // still fails
```

In this example, the question mark does not qualify the lookup for safety. It is required for subscripting after `array`, which is optional. With subscripts, you add chain annotations in-line after the optional value and before the subscript brackets.

Optional chaining is meant solely to set and retrieve values for subscripts used with optional values. It does not and cannot short-circuit failed subscripts unless you build a failable subscripting extension, as in the following example:

```
extension Array {
    subscript (safe index: UInt) -> Element? {
        return Int(index) < count ? self[Int(index)] : nil
    }
}
```

Once you add a simple array `safe`-index extension, you can optionally chain the safe version of the subscript. In the following calls, the `Element?` results of the `safe:` subscript are now optional and can be chained:

```
print(array?[safe: 0]?.dynamicType) // nil
print(array?[safe: 8]?.dynamicType) // Optional(Swift.Int)
```

Optional Mapping

Swift's `map` and `flatMap` functions enable you to conditionally apply functions to optional values. Their calls are similar, as you see in the following declarations, and both are incredibly useful tools:

```
/// If `self == nil`, returns `nil`. Otherwise, returns `f(self!)`.
func map<U>(f: @noescape (T) -> U) -> U?
/// Returns `f(self)!` iff `self` and `f(self)` are not nil.
func flatMap<U>(f: @noescape (T) -> U?) -> U?
```

The `map` closures return type `U`, which may or may not be an optional, while `flatMap` closures specifically return type `U?`, which is always an optional. This practical limitation simply means you can use `map` with closures that return non-optionals, but you cannot do the same with `flatMap`:

```
// flatMap must return optional
print(word.map({string->String in string})) // compiles
// print(word.flatMap({string->String in string})) // errors
```

Maps and Chaining

When working with optionals, `map` and `flatMap` both act like chaining, but you supply an arbitrary closure instead of a chained method name or property:

```
var word: String? = "hello"
var cap = word?.capitalizedString // Optional("Hello")
cap = word.map({$0.capitalizedString}) // Optional("Hello")
```

When you just want to unwrap-and-apply, use `map`. This mapping:

```
UIImage(named:"ImageName").map({print($0.size)})
```

is equivalent to this `if-let`:

```
if let image = UIImage(named:" ImageName ") {
    print(image.size)
}
```

Both the mapping and `if-let` include about the same level of code complexity for this particular example. Both unwrap the optional returned by `UIImage(named:)` and then print the size. You can argue which approach is better. Both bind the unwrapped result to a local constant whether that constant does or does not have an explicit name.

Filtering `nil` Values with `flatMap`

The `flatMap` function offers great utility both in the realm of optionals and outside it. With optionals, you can use `flatMap` to filter away `nil` values and easily convert an array of optionals to an array of unwrapped values:

```
let optionalNumbers: [Int?] = [1, 3, 5, nil, 7, nil, 9, nil]
let nonOptionals = optionalNumbers.flatMap({$0})
print(nonOptionals) // [1, 3, 5, 7, 9]
```

Recipe 3-3 uses a single `flatMap` call to eliminate `nil` instances and extract values from their optional wrappers.

Recipe 3-3 **Extracting Members from an Optionals Array**

```
func flatMembers<T>(array: [T?]) -> [T] {
    return array.flatMap({$0})
}
```

Unmanaged Wrappers

In rare cases (which are growing rarer by the day), a Core Foundation function may return a C pointer or an object reference embedded in an `Unmanaged` wrapper. You encounter these in the older, dustier, and stranger parts of Cocoa, where grues still lurk in shadows. Keychain Services is a notorious offender in this regard. You must transfer `Unmanaged` references into the normal memory management system before working with them.

An `Unmanaged` wrapper, like an `Optional` wrapper, provides a layer of safety between your code and a potentially nasty crash. The `Unmanaged<T>` type stores a pointer whose memory is not controlled by the Swift runtime system. Before using this data, you take responsibility for how this memory should stay alive.

In Cocoa, this works very much like bridging in Objective-C. Unwrap any object with an existing +1 retain count using `takeRetainedValue()`. This applies to any item built with `Create` or `Copy` in its name. Use `takeUnretainedValue()` for +0 returns.

If you have an Objective-C framework or are developing one that you would like people to use in their Swift application—and if there are methods or functions in your Objective-C framework that return Core Foundation objects—decorate your methods or function names with `CF_RETURNS_RETAINED` or `CF_RETURNS_NOT_RETAINED`. If you don't decorate your methods or functions, Core Foundation objects are returned as unmanaged.

In Swift 2, `CF-IMPLICIT-BRIDGING-ENABLED` and `CF-IMPLICIT-BRIDGING-DISABLED` automatically bridge based on Core Foundation naming conventions. So if you audit your APIs and ensure that they follow `get`/`copy`/`create` conventions, you can avoid specific method decoration.

For example, `UTTypeCopyPreferredTagWithClass` returns a +1 `CFString` instance. Assign this result with `takeRetainedValue()`, making sure to test for failed calls. Unwrapping `nil` causes nasty crashes that even blessed potions of restore life will not fix. Recipe 3-4 demonstrates how to use unmanaged wrappers by returning a preferred file extension for a given universal type indicator.

Recipe 3-4 **Conditional Binding from Unmanaged Wrappers**

```
import MobileCoreServices
Import Foundation

enum Error: ErrorType {case NoMatchingExtension}

public func preferredFileExtensionForUTI(uti: String) throws -> String {
    if let result = UTTypeCopyPreferredTagWithClass(
        uti, kUTTagClassFilenameExtension) {
        return result.takeRetainedValue() as String
    }
    throw Error.NoMatchingExtension
}
```

This recipe uses conditional binding. The `UTTypeCopyPreferredTagWithClass()` function returns `Unmanaged<CFString>?`, which is an optional instance. If the call fails and returns `nil`, the function throws an error. Test the recipe by passing it a few common UTIs, such as public.jpeg and public.aiff-audio:

```
let shouldBeJPEG = try PreferredFileExtensionForUTI("public.jpeg")
let shouldBeAIFF = try PreferredFileExtensionForUTI("public.aiff-audio")
```

Use `takeUnretainedValue()` to unwrap any object built by a Core Foundation function with `Get` in its name (for example, `CFAllocatorGetDefault()`) and constants passed as unmanaged objects (for example, `kLSSharedFileListSessionLoginItems`). These items are not automatically retained for you. Unlike with `takeRetainedValue()`, calling `takeUnretainedValue()` won't consume a retain upon unwrapping.

These functions follow the patterns established in Apple's *Memory Management Programming Guide for Core Foundation*, where you can read more about the "create rule," the "get rule," and other details about memory ownership policies. Search the web for the latest update of this document.

Wrap-up

Optionals are an invaluable component of Swift development. With their "possible value" semantics, they enable you to store and represent the results of lookup operations whose data may or may not exist. Optionals are a powerful workhorse construct that you regularly use in day-to-day operations.

Swift's new early-return `guard` statement is a gift that eliminates awkwardness from your code. Now you can assign, unwrap, and use values with a clear path for missing values. Between `guard` and `nil` coalescing, Swift 2 can elegantly express both fail-on-`nil` and fallback-on-`nil` scenarios with a minimum of overhead and indenting.

Swift 2's revised error handling has also started to eliminate the role of optionals as sentinel values. This usage continues to be common as it's simple to use optionals to represent fail and success states for method calls. Ideally, optional sentinels will shrivel and die as the language matures and Apple's APIs catch up with current language features. Until then, know that it's always better to use `throws` with well-defined errors than to use optional-style sentinels in the code you control.

`nil` happens. Be prepared.

This page intentionally left blank

Index

Symbols

A

B

C

D

E

F

G

H-I

J-K

L

M

N

O

P

Q

R

S

T

U

V

W

X-Y-Z