Tools

#WWDC14

Swift Interoperability in Depth

Session 407

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Introduction

Swift is a new language for Cocoa

Seamless interoperability with Objective-C

Focus on language-level interoperability

Roadmap

Working with Cocoa

- How Objective-C APIs look and feel in Swift
- id and AnyObject

Bridging Core Cocoa Types

Subclassing Objective-C Classes

CF Interoperability

Working with Cocoa

Swift View of Objective-C APIs

Swift provides seamless access to Objective-C APIs

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Swift view of an Objective-C API is *different* from Objective-C

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Swift provides seamless access to Objective-C APIs

Swift view of an Objective-C API is *different* from Objective-C

Same Cocoa conventions and idioms

Our Example: UIDocument

```
typedef NS_ENUM(NSInteger, UIDocumentSaveOperation) {
    UIDocumentSaveForCreating,
    UIDocumentSaveForOverwriting
};

@interface UIDocument : NSObject

@property NSDate *fileModificationDate;

- (instancetype)initWithFileURL:(NSURL *)url;

- (NSString *)fileNameExtensionForType:(NSString *)typeName
                saveOperation:(UIDocumentSaveOperation)saveOperation;

@end
```

Properties

Objective-C

```
@property NSDate *fileModificationDate;
```

Properties

Objective-C

```
@property NSDate *fileModificationDate;
```

Swift

```
var fileModificationDate: NSDate!
```

Implicitly Unwrapped Optionals

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A value of class type in Swift is never `nil`

Implicitly Unwrapped Optionals

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var fileModificationDate: NSDate!
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A value of class type in Swift is never `nil`

Optional types generalize the notion of `nil`

Implicitly Unwrapped Optionals

```
var fileModificationDate: NSDate!
```

A value of class type in Swift is never `nil`

Optional types generalize the notion of `nil`

Objective-C does not have a notion of a “never-`nil`” pointer

Implicitly Unwrapped Optionals

```
var fileModificationDate: NSDate!
```

A value of class type in Swift is never `nil`

Optional types generalize the notion of `nil`

Objective-C does not have a notion of a “never-`nil`” pointer

‘!’ is an *implicitly unwrapped optional*

- Can be tested explicitly for `nil`
- Can directly access properties/methods of the underlying value
- Can be implicitly converted to its underlying value (e.g., `NSDate`)

- Intermediate Swift — Presidio — Wednesday 2:00PM

Mapping Objective-C Types to Swift

Objective-C

```
@property (readonly) NSString *fileType;
```

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Objective-C

```
@property (readonly) NSString *fileType;
```

Swift

```
var fileType: String! { get }
```

Objective-C Types in Swift

Objective-C Type	Swift Equivalent
`BOOL`	`Bool`
`NSInteger`	`Int`
`SEL`	`Selector`
`id`	`AnyObject!`
`Class`	`AnyClass!`
`NSString *`	`String!`
`NSArray *`	`AnyObject[]!`

Methods

Objective-C

```
- (NSString *)fileNameExtensionForType:(NSString *)typeName
                  saveOperation:(UIDocumentSaveOperation)saveOperation;
```

Methods

Objective-C

```
- (NSString *)fileNameExtensionForType:(NSString *)typeName
                  saveOperation:(UIDocumentSaveOperation)saveOperation;
```

Swift

```
func fileNameExtensionForType(typeName: String!,
          saveOperation: UIDocumentSaveOperation) -> String!
```

Methods

Argument labels

Objective-C

```
- (NSString *)fileNameExtensionForType:(NSString *)typeName
                  saveOperation:(UIDocumentSaveOperation)saveOperation;
```

Swift

```
func fileNameExtensionForType(typeName: String!,
         saveOperation: UIDocumentSaveOperation) -> String!
```

Methods

Argument labels in calls

Objective-C

```
- (NSString *)fileNameExtensionForType:(NSString *)typeName
                  saveOperation:(UIDocumentSaveOperation)saveOperation;
```

Swift

```
func fileNameExtensionForType(typeName: String!,
           saveOperation: UIDocumentSaveOperation) -> String!
```

Usage

```
let ext = document.fileNameExtensionForType("public.presentation",
                         saveOperation: UIDocumentSaveOperation.ForCreating)
```

Methods

Objective-C

```
- (void)saveToURL:(NSURL *)url
        forSaveOperation:(UIDocumentSaveOperation)saveOperation
        completionHandler:(void (^)(BOOL success))completionHandler;
```

Methods

Objective-C

```
- (void)saveToURL:(NSURL *)url
        forSaveOperation:(UIDocumentSaveOperation)saveOperation
        completionHandler:(void (^)(BOOL success))completionHandler;
```

Swift

```
func saveToURL(url: NSURL!,
               forSaveOperation saveOperation: UIDocumentSaveOperation,
               completionHandler: ((success: Bool) -> Void)!)
```

Methods

Argument labels and internal parameter names

Objective-C

```
- (void)saveToURL:(NSURL *)url
        forSaveOperation:(UIDocumentSaveOperation)saveOperation
        completionHandler:(void (^)(BOOL success))completionHandler;
```

Swift

```
func saveToURL(url: NSURL!,
               forSaveOperation saveOperation: UIDocumentSaveOperation,
               completionHandler: ((success: Bool) -> Void)!)
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Methods

Argument labels and internal parameter names

Objective-C

```
- (void)saveToURL:(NSURL *)url
        forSaveOperation:(UIDocumentSaveOperation)saveOperation
        completionHandler:(void (^)(BOOL success))completionHandler;
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Swift

```
func saveToURL(url: NSURL!,
               forSaveOperation saveOperation: UIDocumentSaveOperation,
               completionHandler: ((success: Bool) -> Void)!)
```

Methods

Blocks and closures

Objective-C

```
- (void)saveToURL:(NSURL *)url
        forSaveOperation:(UIDocumentSaveOperation)saveOperation
        completionHandler:(void (^)(BOOL success))completionHandler;
```

Swift

```
func saveToURL(url: NSURL!,
               forSaveOperation saveOperation: UIDocumentSaveOperation,
               completionHandler: ((success: Bool) -> Void)!)
```

Methods

Swift

```
func saveToURL(url: NSURL!,
               forSaveOperation saveOperation: UIDocumentSaveOperation,
               completionHandler: ((success: Bool) -> Void)!)
```

Methods

Trailing closure syntax

Swift

```
func saveToURL(url: NSURL!,
               forSaveOperation saveOperation: UIDocumentSaveOperation,
               completionHandler: ((success: Bool) -> Void)!)
```

Methods

Trailing closure syntax

Swift

```
func saveToURL(url: NSURL!,
               forSaveOperation saveOperation: UIDocumentSaveOperation,
               completionHandler: ((success: Bool) -> Void)!)
```

Usage

```
document.saveToURL(documentURL,
                   saveOperation: UIDocumentSaveOperation.ForCreating) {
    success in
        if success { … } else { … }
}
```

Initializers

Objective-C

```
- (instancetype)initWithFileURL:(NSURL *)url;
```

Initializers

Objective-C

```
- (instancetype)initWithFileURL:(NSURL *)url;
```

Swift

```
init(fileURL url: NSURL!)
```

Initializers

Objective-C

```
- (instancetype)initWithFileURL:(NSURL *)url;
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Swift

```
init(fileURL url: NSURL!)
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Objective-C

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- (instancetype)initWithFileURL:(NSURL *)url;
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Initializers

Objective-C

```
- (instancetype)initWithFileURL:(NSURL *)url;
```

Swift

```
init(fileURL url: NSURL!)
```

Creating Objects

Objective-C

```
- (instancetype)initWithFileURL:(NSURL *)url;

UIDocument *document = [[UIDocument alloc] initWithFileURL:documentURL];
```

Creating Objects

Objective-C

```
- (instancetype)initWithFileURL:(NSURL *)url;

UIDocument *document = [[UIDocument alloc] initWithFileURL:documentURL];
```

Swift

```
init(fileURL url: NSURL!)

let document = UIDocument(fileURL: documentURL)
```

Factory Methods

Objective-C

```
+ (UIColor *)colorWithRed:(CGFloat)red green:(CGFloat)green
                     blue:(CGFloat)blue alpha:(CGFloat)alpha;
```

Factory Methods

Objective-C

```
+ (UIColor *)colorWithRed:(CGFloat)red green:(CGFloat)green
                     blue:(CGFloat)blue alpha:(CGFloat)alpha;

UIColor *color = [UIColor colorWithRed:1 green:0.67 blue:0.04 alpha:0];
```

Factory Methods

Objective-C

```
+ (UIColor *)colorWithRed:(CGFloat)red green:(CGFloat)green
                     blue:(CGFloat)blue alpha:(CGFloat)alpha;

UIColor *color = [UIColor colorWithRed:1 green:0.67 blue:0.04 alpha:0];
```

Swift

```
class func colorWithRed(red: CGFloat, green: CGFloat, blue: CGFloat,
                        alpha: CGFloat) -> UIColor!
```

Factory Methods

Objective-C

```
+ (UIColor *)colorWithRed:(CGFloat)red green:(CGFloat)green
                     blue:(CGFloat)blue alpha:(CGFloat)alpha;

UIColor *color = [UIColor colorWithRed:1 green:0.67 blue:0.04 alpha:0];
```

Swift

```
class func colorWithRed(red: CGFloat, green: CGFloat, blue: CGFloat,
                        alpha: CGFloat) -> UIColor!

let color = UIColor.colorWithRed(1, green: 0.67, blue: 0.04, alpha: 0)
```

Factory Methods as Initializers

Objective-C

```
+ (UIColor *)colorWithRed:(CGFloat)red green:(CGFloat)green
                     blue:(CGFloat)blue alpha:(CGFloat)alpha;

UIColor *color = [UIColor colorWithRed:1 green:0.67 blue:0.04 alpha:0];
```

Swift

```
init(red: CGFloat, green: CGFloat, blue: CGFloat, alpha: CGFloat)
```

Factory Methods as Initializers

Objective-C

```
+ (UIColor *)colorWithRed:(CGFloat)red green:(CGFloat)green
                     blue:(CGFloat)blue alpha:(CGFloat)alpha;

UIColor *color = [UIColor colorWithRed:1 green:0.67 blue:0.04 alpha:0];
```

Swift

```
init(red: CGFloat, green: CGFloat, blue: CGFloat, alpha: CGFloat)

let color = UIColor(red: 1, green: 0.67, blue: 0.04, alpha: 0)
```

Enums

Objective-C

```
typedef NS_ENUM(NSInteger, UIDocumentSaveOperation) {
    UIDocumentSaveForCreating,
    UIDocumentSaveForOverwriting
};
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Enums

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```
typedef NS_ENUM(NSInteger, UIDocumentSaveOperation) {
    UIDocumentSaveForCreating,
    UIDocumentSaveForOverwriting
};
```

Swift

```
enum UIDocumentSaveOperation : Int {
    case ForCreating
    case ForOverwriting
}
```

Swift

```
enum UIDocumentSaveOperation : Int {
    case ForCreating
    case ForOverwriting
}
```

Usage

```
let ext = document.fileNameExtensionForType("public.presentation",
                saveOperation:
```

Using Enums

Swift

```
enum UIDocumentSaveOperation : Int {
    case ForCreating
    case ForOverwriting
}
```

Usage

```
let ext = document.fileNameExtensionForType("public.presentation",
                saveOperation: UIDocumentSaveOperation .ForCreating)
```

Using Enums

Swift

```
enum UIDocumentSaveOperation : Int {
    case ForCreating
    case ForOverwriting
}
```

Usage

```
let ext = document.fileNameExtensionForType("public.presentation",
                saveOperation: .ForCreating)
```

NSError

Objective-C

```
- (id)contentsForType:(NSString *)typeName error:(NSError **)outError;
```

NSError

Objective-C

```
- (id)contentsForType:(NSString *)typeName error:(NSError **)outError;
```

Swift

```
func contentsForType(typeName: String!, error: NSErrorPointer) -> AnyObject!
```

Swift

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func contentsForType(typeName: String!, error: NSErrorPointer) -> AnyObject!
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Using NSError

Swift

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func contentsForType(typeName: String!, error: NSErrorPointer) -> AnyObject!
```

Using NSError

Swift

```
func contentsForType(typeName: String!, error: NSErrorPointer) -> AnyObject!
```

Usage

```
var error: NSError?
if let contents = document.contentsForType("public.presentation",
                                           error: &error) {
    // use the contents
}
```

Using NSError

Swift

```
func contentsForType(typeName: String!, error: NSErrorPointer) -> AnyObject!
```

Usage

```
var error: NSError?
if let contents = document.contentsForType("public.presentation",
                                           error: &error) {
    // use the contents
} else if let actualError = error {
    // handle error
}
```

```
35 class UIDocument : NSObject, NSFilePresenter, NSObjectProtocol {
36
37     // The designated initializer. Passing an empty URL will cause this method to t
38     init(fileURL url: NSURL!)
39
40     // UIKit may call these methods on background threads, so subclasses that overr
41     // These values will be set by UIKit before the completion handlers to the open
42     // Clients that wish to access these properties outside of an open, save, or re
43
44     var fileURL: NSURL! { get }
45     var localizedName: String! { get } // The default implementation derives the na
46     var fileType: String! { get } // The file's UTI. Derived from the fileURL by de
47     var fileModificationDate: NSDate! // The last known modification date of the do
48
49     var documentState: UIDocumentState { get }
50
51     // Subclassing this method without calling super should be avoided. Subclassers
52     // Open the document located by the fileURL.  This will call readFromURL:error:
53     func openWithCompletionHandler(completionHandler: ((Bool) -> Void)!)
54
55     // Close the document. The default implementation calls [self autosaveWithCompl
56     func closeWithCompletionHandler(completionHandler: ((Bool) -> Void)!)
```

Modernizing Your Objective-C

These rules apply to all Objective-C APIs imported into Swift

Swift benefits greatly from "modern" Objective-C:

- Properties
- instancetype
- NS_ENUM/NS_OPTIONS
- NS_DESIGNATED_INITIALIZER

Modernizing Your Objective-C

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Swift benefits greatly from "modern" Objective-C:

- Properties
- `instancetype`
- `NS_ENUM/NS_OPTIONS`
- `NS_DESIGNATED_INITIALIZER`

- What's New in LLVM — Marina — Wednesday 9:00AM

id and AnyObject

id in Objective-C

Upcasts

```
id object = [[NSURL alloc] initWithString:@"http://developer.apple.com"];
object = view.superview;
```

id in Objective-C

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Message sends

```
[object removeFromSuperview];
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id in Objective-C

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Message sends

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Subscripting

```
id date = object[@"date"];
```

AnyObject: An Object of Any Type

Upcasts

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object = view.superview;
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Message sends

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Subscripting

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id date = object[@"date"];
```

AnyObject: An Object of Any Type

Upcasts

```
var object: AnyObject = NSURL(string: "http://developer.apple.com")
object = view.superview
```

Message sends

```
[object removeFromSuperview];
```

Subscripting

```
id date = object[@"date"];
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AnyObject: An Object of Any Type

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object = view.superview
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Message sends

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object.removeFromSuperview()
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AnyObject: An Object of Any Type

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var object: AnyObject = NSURL(string: "http://developer.apple.com")
object = view.superview
```

Message sends

```
object.removeFromSuperview()
```

Subscripting

```
let date = object["date"]
```

respondsToSelector Idiom

Messaging `id` or `AnyObject` can result in “unrecognized selector” failures

```
[object removeFromSuperview];
```

respondsToSelector Idiom

Messaging `id` or `AnyObject` can result in "unrecognized selector" failures

```
[object removeFromSuperview];
```

`respondsToSelector` idiom to test the presence of a method

```
if ([object respondsToSelector:@selector(removeFromSuperview)]) {
    [object removeFromSuperview];
}
```

Checking the Presence of a Method

A method of `AnyObject` is "optional"

```
object.removeFromSuperview()
```

Checking the Presence of a Method

A method of `AnyObject` is "optional"

```
object.removeFromSuperview?()
```

Chaining ? folds the `respondsToSelector` check into the call

Downcasting AnyObject

`AnyObject` does not implicitly downcast

```
let view: UIView = object
```

Downcasting AnyObject

`AnyObject` does not implicitly downcast

```
let view: UIView = object // error: ‘AnyObject’ cannot be implicitly downcast
```

Downcasting AnyObject

`AnyObject` does not implicitly downcast

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```

"`as`" operator forces the downcast

```
let view = object as UIView
```

Downcasting AnyObject

`AnyObject` does not implicitly downcast

```
let view: UIView = object // error: 'AnyObject' cannot be implicitly downcast
```

"`as`" operator forces the downcast

```
let view = object as UIView
```

"`as?`" operator performs a conditional downcast

```
if let view = object as? UIView {
    // view is a UIView
}
```

Protocols

Objective-C

```
@protocol UITableViewDataSource<NSObject>
@optional
- (NSInteger)numberOfSectionsInTableView:(UITableView *)tableView;
@required
- (NSInteger)tableView:(UITableView *)tableView
             numberOfRowsInSection:(NSInteger)section;
@end
```

Protocols

Objective-C

```
@protocol UITableViewDataSource<NSObject>
@optional
- (NSInteger)numberOfSectionsInTableView:(UITableView *)tableView;
@required
- (NSInteger)tableView:(UITableView *)tableView
             numberOfRowsInSection:(NSInteger)section;
@end
```

Swift

```
@objc protocol UITableViewDataSource : NSObjectProtocol {
  func tableView(tableView: UITableView, numberOfRowsInSection: Int) -> Int
  @optional func numberOfSectionsInTableView(tableView: UITableView) -> Int
}
```

Protocols

Objective-C

```
@protocol UITableViewDataSource<NSObject>
@optional
- (NSInteger)numberOfSectionsInTableView:(UITableView *)tableView;
@required
- (NSInteger)tableView:(UITableView *)tableView
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@objc protocol UITableViewDataSource : NSObjectProtocol {
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@objc protocol UITableViewDataSource : NSObjectProtocol {
  func tableView(tableView: UITableView, numberOfRowsInSection: Int) -> Int
  @optional func numberOfSectionsInTableView(tableView: UITableView) -> Int
}
```

Protocol Types

Objective-C

```
@property id <UITableViewDataSource> dataSource;
```

Protocol Types

Objective-C

```
@property id <UITableViewDataSource> dataSource;
```

Swift

```
var dataSource: UITableViewDataSource!
```

Testing Protocol Conformance

Downcast via “as?” to protocol type

```
if let dataSource = object as? UITableViewDataSource {
  let rowsInFirstSection = dataSource.tableView(tableView,
                                                numberOfRowsInSection: 0)
}
```

Protocol Types

Objective-C

```
@property id <UITableViewDataSource> dataSource;
@property id <UINavigationControllerDelegate,
              UIImagePickerControllerDelegate> delegate;
```

Swift

```
var dataSource: UITableViewDataSource!
var delegate: protocol<UINavigationControllerDelegate,
                       UIImagePickerControllerDelegate>
```

Number of Rows in the Last Section

```
if let dataSource = object as? UITableViewDataSource {
  var lastSection = 0
  let numSections = dataSource.numberOfSectionsInTableView(tableView)
  lastSection = numSections - 1

  let rowsInLastSection = dataSource.tableView(tableView,
                                               numberOfRowsInSection: lastSection)
}
```

Optional Methods in Protocols

```
if let dataSource = object as? UITableViewDataSource {
  var lastSection = 0
  let numSections = dataSource.numberOfSectionsInTableView(tableView)
  lastSection = numSections - 1

  let rowsInLastSection = dataSource.tableView(tableView,
                                               numberOfRowsInSection: lastSection)
}
```

Optional Methods in Protocols

```
if let dataSource = object as? UITableViewDataSource {
  var lastSection = 0
  let numSections = dataSource.numberOfSectionsInTableView(tableView)
  lastSection = numSections - 1    // error: method is optional

  let rowsInLastSection = dataSource.tableView(tableView,
                                               numberOfRowsInSection: lastSection)
}
```

Optional Methods in Protocols

Use the chaining ? operator

```
if let dataSource = object as? UITableViewDataSource {
  var lastSection = 0
  let numSections = dataSource.numberOfSectionsInTableView(tableView)
  lastSection = numSections - 1

  let rowsInLastSection = dataSource.tableView(tableView,
                                               numberOfRowsInSection: lastSection)
}
```

Optional Methods in Protocols

Use the chaining ? operator

```
if let dataSource = object as? UITableViewDataSource {
  var lastSection = 0
  if let numSections = dataSource.numberOfSectionsInTableView?(tableView){
      lastSection = numSections - 1
  }
  let rowsInLastSection = dataSource.tableView(tableView,
                                               numberOfRowsInSection: lastSection)
}
```

Optional Methods in Protocols

Use the chaining ? operator

```
if let dataSource = object as? UITableViewDataSource {
  var lastSection = 0
  if let numSections = dataSource.numberOfSectionsInTableView?(tableView){
      lastSection = numSections - 1
  }
  let rowsInLastSection = dataSource.tableView(tableView,
                                               numberOfRowsInSection: lastSection)
}
```

Optionals and Safety

Optionals and Safety

`AnyObject` is Swift's equivalent to `id`

- Similar functionality, more safe by default
- `AnyClass` is Swift's equivalent to `Class`

Optionals and Safety

`AnyObject` is Swift's equivalent to `id`

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Optionals used throughout the language to represent dynamic checks

- `as?` for safe downcasting, protocol conformance checking
- Optionals when referring to methods that may not be available
- `if let` and chaining `?` make optionals easy to use

Bridging Core Cocoa Types

Native Strings, Arrays, Dictionaries

One set of general-purpose native value types

- Safe by default
- Predictable performance
- Typed collections support items of any type

Bridged to Cocoa `NSString`, `NSArray`, `NSDictionary`

Native String Type

`String` is an efficient, Unicode-compliant string type

Flexible, efficient, high-level APIs for string manipulation

Value semantics

Native String Type

`String` is an efficient, Unicode-compliant string type

Flexible, efficient, high-level APIs for string manipulation

Value semantics

```
var s1 = "Hello"
var s2 = s1
s1 += " Swift”
println(s1)
Hello Swift
println(s2)
Hello
```

Characters

Iteration over a string produces characters

```
let dog = "Dog!🐶"
for c in dog {     // c is inferred as Character
    println(c)
}
```

Characters

Iteration over a string produces characters

```
let dog = "Dog!🐶"
for c in dog {     // c is inferred as Character
    println(c)
}
```

```
D
o
g
!
🐶
```

Characters and Code Points

Unicode characters cannot be efficiently encoded as fixed-width entities

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- Correct use of UTF-8 or UTF-16 requires deep knowledge of Unicode

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- Low-level operations (`length`, `characterAtIndex`) are not provided by `String`

Characters and Code Points

Unicode characters cannot be efficiently encoded as fixed-width entities

- Correct use of UTF-8 or UTF-16 requires deep knowledge of Unicode
- Low-level operations (`length`, `characterAtIndex`) are not provided by `String`

`countElements` can be used to count the number of characters

```
let dog = "Dog!🐶"
println("There are \(countElements(dog)) characters in `\(dog)’")
```

Characters and Code Points

Unicode characters cannot be efficiently encoded as fixed-width entities

- Correct use of UTF-8 or UTF-16 requires deep knowledge of Unicode
- Low-level operations (`length`, `characterAtIndex`) are not provided by `String`

`countElements` can be used to count the number of characters

```
let dog = "Dog!🐶"
println("There are \(countElements(dog)) characters in `\(dog)’")

// There are 5 characters in `Dog!🐶’
```

Code Points

UTF-16 is available via a property

```
for codePoint in dog.utf16 { // codePoint is inferred as UInt16
  // …
}

print("There are \(countElements(dog.utf16)) UTF-16 code points in `\(dog)'")
```

Code Points

UTF-16 is available via a property

```
for codePoint in dog.utf16 { // codePoint is inferred as UInt16
  // …
}

print("There are \(countElements(dog.utf16)) UTF-16 code points in `\(dog)’")
// There are 6 UTF-16 code points in `Dog!🐶’
```

String and NSString

Foundation `NSString` APIs are available on `String`

```
let fruits = "apple;banana;cherry".componentsSeparatedByString(";")
```

String and NSString

Foundation `NSString` APIs are available on `String`

```
let fruits = "apple;banana;cherry".componentsSeparatedByString(";")
                                                    // inferred as String[]
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let fruits = "apple;banana;cherry".componentsSeparatedByString(";")
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Cast to `NSString` to access properties and methods on `NSString` categories

```
("Welcome to WWDC 2014" as NSString).myNSStringMethod()
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String and NSString

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```
let fruits = "apple;banana;cherry".componentsSeparatedByString(";")
                                                    // inferred as String[]
```

Cast to `NSString` to access properties and methods on `NSString` categories

```
("Welcome to WWDC 2014" as NSString).myNSStringMethod()
```

Extend `String` with your method

```
extension String {
  func myStringMethod() -> String { … }
}
```

NSArray Bridges to Array of AnyObject

Objective-C

```
@property NSArray *toolbarItems;
```

NSArray Bridges to Array of AnyObject

Objective-C

```
@property NSArray *toolbarItems;
```

Swift

```
var toolbarItems: AnyObject[]!
```

Upcasting Arrays

An array `T[]` can be assigned to an `AnyObject[]`

```
let myToolbarItems: UIBarButtonItem[] = [item1, item2, item3]
controller.toolbarItems = myToolbarItems
```

Downcasting Arrays

Iteration over an `AnyObject[]` produces `AnyObject` values

```
for object: AnyObject in viewController.toolbarItems {
    let item = object as UIBarButtonItem
    // …
}
```

Downcasting Arrays

Iteration over an `AnyObject[]` produces `AnyObject` values

```
for object: AnyObject in viewController.toolbarItems {
    let item = object as UIBarButtonItem
    // …
}
```

Can downcast `AnyObject[]` to an array of a specific type

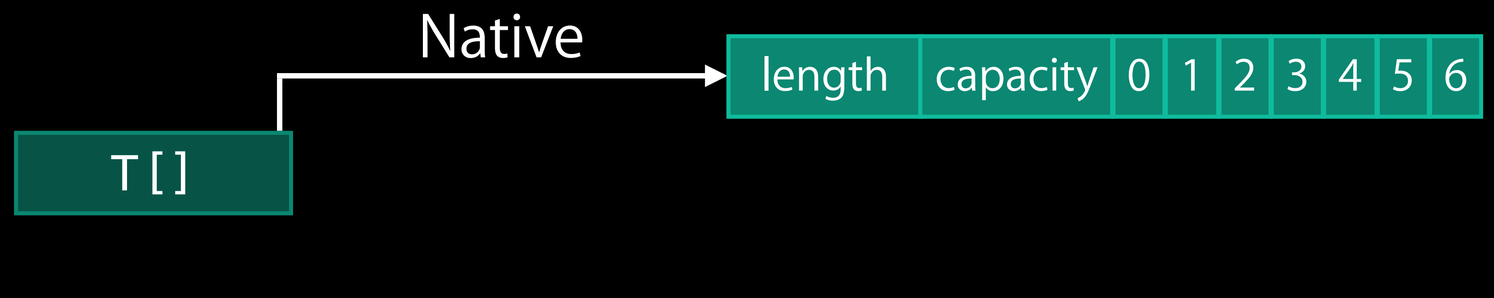
```
for item in viewController.toolbarItems as UIBarButtonItem[] {
    // …
}
```

Array Bridging—Under the Hood

Swift array has two representations

Array Bridging—Under the Hood

Swift array has two representations



Array Bridging—Under the Hood

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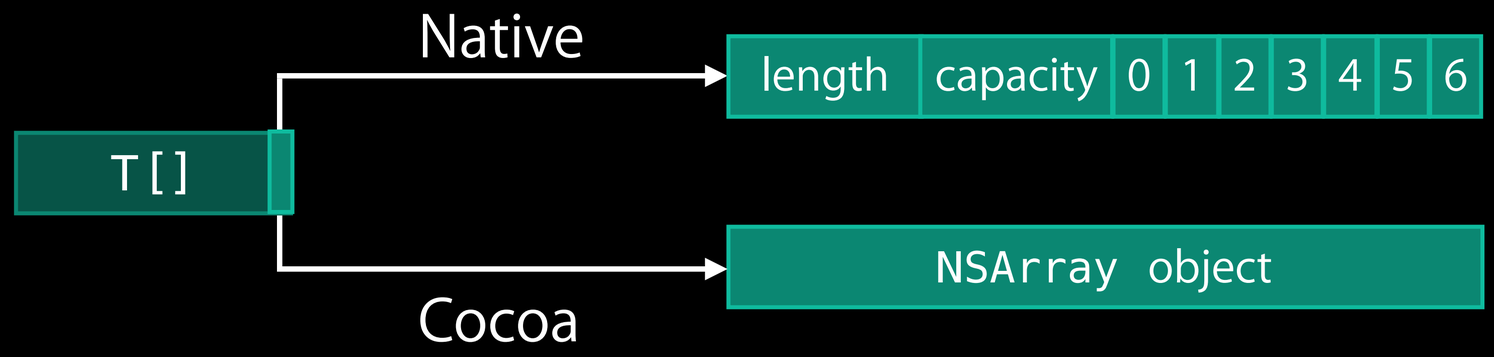

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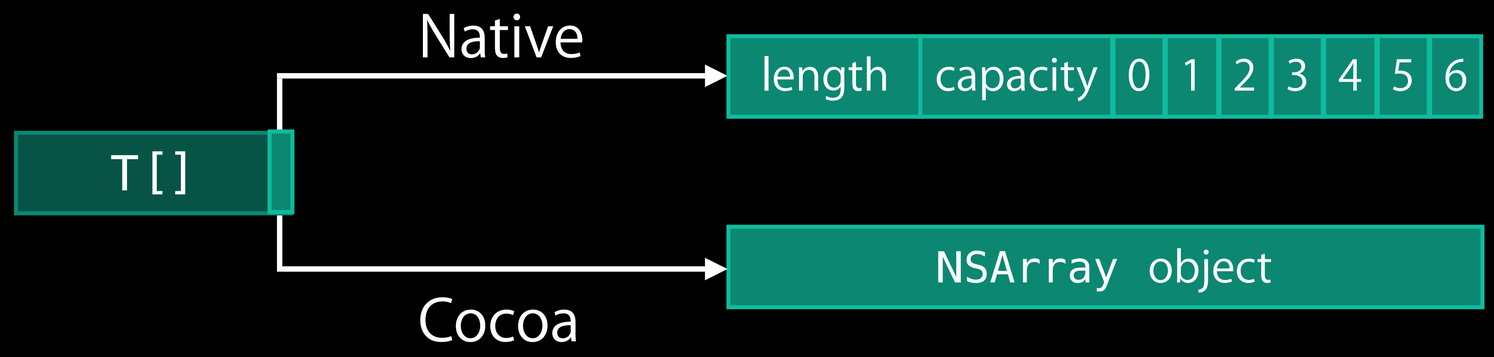
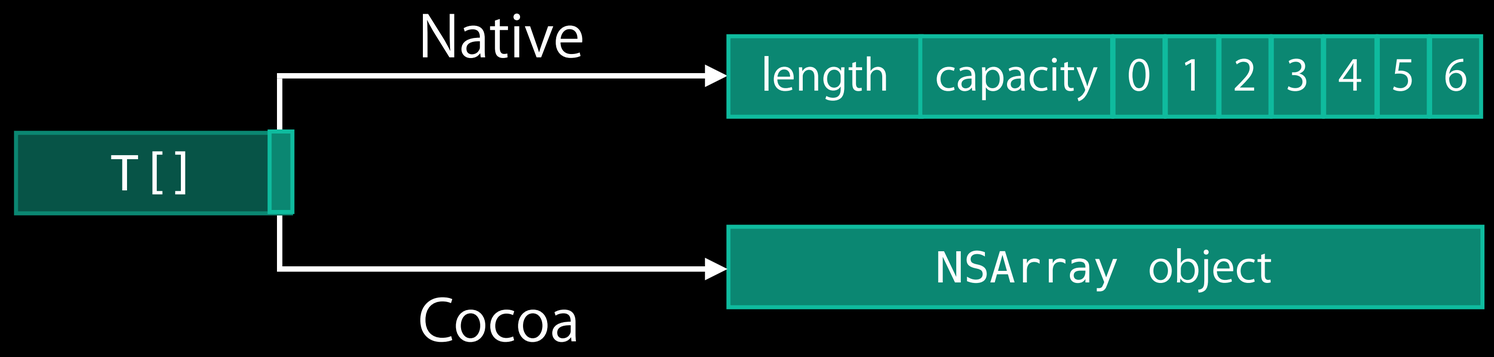


Array methods manage the representation internally

Array Bridging—Under the Hood

Swift array has two representations



Array methods manage the representation internally

Bridging converts between `NSArray` and a Swift array

NSArray → Swift Array Bridging

Returning an `NSArray*` from an Objective-C method to Swift

```
let items: AnyObject[] = viewController.toolbarItems
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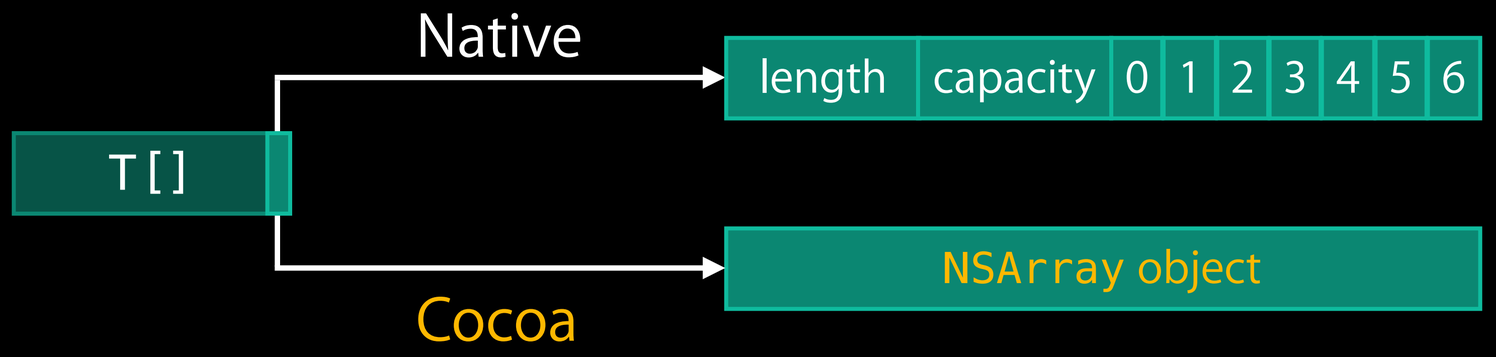

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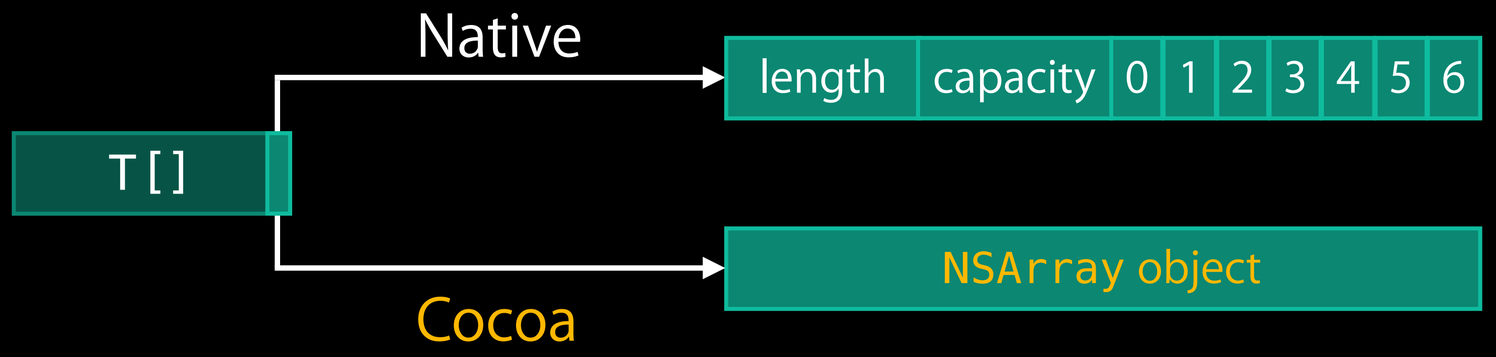

Calls `copy()` to ensure the array won't change underneath us

NSArray → Swift Array Bridging

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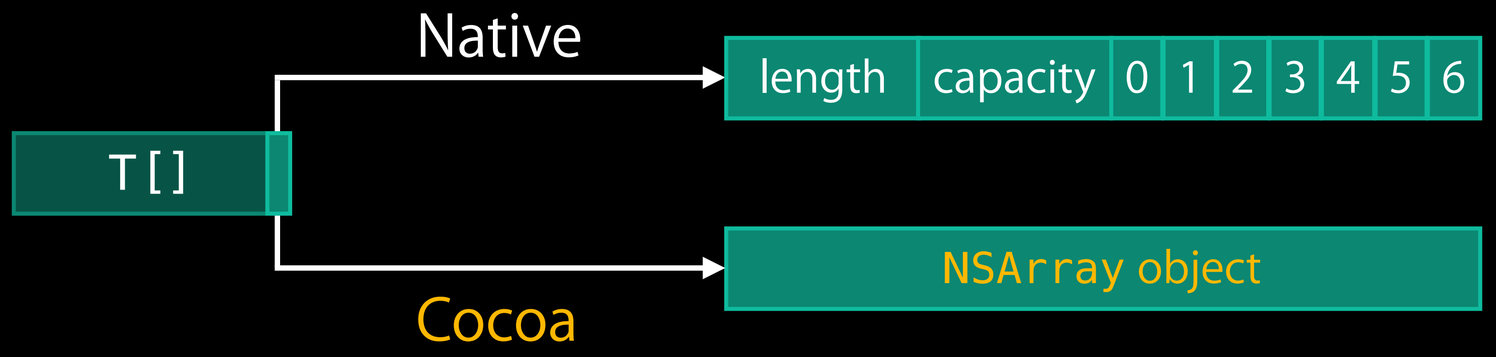


Calls `copy()` to ensure the array won't change underneath us

- For immutable `NSArrays`, this operation is trivial

T[] → NSArray Bridging

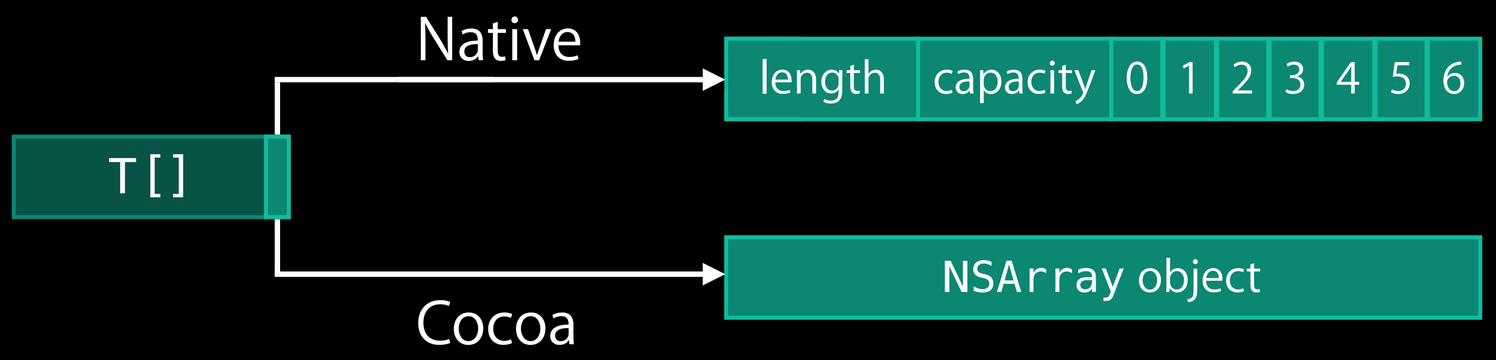
Passing a Swift array to an Objective-C method expecting an `NSArray*`

```
viewController.toolbarItems = myToolbarItems
```

T[] → NSArray Bridging

Passing a `T[]` to an Objective-C method expecting an `NSArray*`

```
viewController.toolbarItems = myToolbarItems
```



T[] → NSArray Bridging

Passing a `T[]` to an Objective-C method expecting an `NSArray*`

```
viewController.toolbarItems = myToolbarItems
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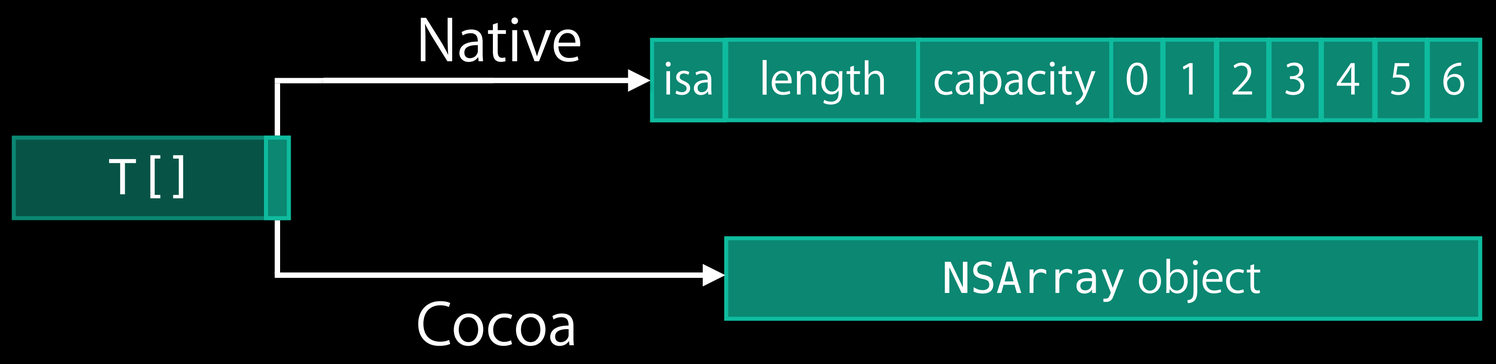

Native array representation “isa” NSArray, optimized

Subclassing Objective-C Classes

Swift Objects Are Objective-C Objects

All Swift classes are “id compatible”

- Same layout as an Objective-C class
- Same basic infrastructure (retain/release/class/etc.)

Swift Objects Are Objective-C Objects

All Swift classes are "id compatible"

- Same layout as an Objective-C class
- Same basic infrastructure (retain/release/class/etc.)

Inherit from an Objective-C class to make your class directly visible in Objective-C

```
class MyDocument : UIDocument {
    var items: String[] = []
}
```

Overriding Methods

"override" keyword required when overriding a method

```
override func handleError(error: NSError!, userInteractionPermitted: Bool) {
    // customized behavior
    super.handleError(error,
                      userInteractionPermitted: userInteractionPermitted)
}
```

Overriding Properties

Override the property itself, not the getter or setter

```
override var description: String {
    return "MyDocument containing \(items)"
}
```

Overriding and NSError**

NSErrorPointer is Swift's version of NSError**

```
override func contentsForType(typeName: String!, error: NSErrorPointer)
                -> AnyObject! {
    if cannotProduceContentsForType(typeName) {
        if error {
            error.memory = NSError(domain: domain, code: code, userInfo: [:])
        }
        return nil
    }
    // …
}
```

Your Swift Class…

Swift

```
class MyDocument : UIDocument {
    var items: String[] = []

    override func handleError(error: NSError, userInteractionPermitted: Bool)

    override var description: String

    override func contentsForType(typeName: String!, error: NSErrorPointer)
                    -> AnyObject!
}
```

Your Swift Class…in Objective-C

Objective-C

```
SWIFT_CLASS("_TtC5MyApp10MyDocument")
@interface MyDocument : UIDocument

@property (nonatomic) NSArray *items;

- (void)handleError:(NSError *)error
       userInteractionPermitted:(BOOL)userInteractionPermitted;

@property (nonatomic, readonly) NSString *description;

- (id)contentsForType:(NSString *)typeName error:(NSError **)outError;
@end
```

Your Swift Class…in Objective-C

Objective-C

```
SWIFT_CLASS("_TtC5MyApp10MyDocument")
@interface MyDocument : UIDocument

@property (nonatomic) NSArray *items;

- (void)handleError:(NSError *)error
       userInteractionPermitted:(BOOL)userInteractionPermitted;

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- (id)contentsForType:(NSString *)typeName error:(NSError **)outError;
@end
```

Your Swift Class…in Objective-C

Objective-C

```
SWIFT_CLASS("_TtC5MyApp10MyDocument")
@interface MyDocument : UIDocument

@property (nonatomic) NSArray *items;    // Swift: var items: String[] = []

- (void)handleError:(NSError *)error
       userInteractionPermitted:(BOOL)userInteractionPermitted;

@property (nonatomic, readonly) NSString *description;

- (id)contentsForType:(NSString *)typeName error:(NSError **)outError;
@end
```

Your Swift Class…in Objective-C

Objective-C

```
SWIFT_CLASS("_TtC5MyApp10MyDocument")
@interface MyDocument : UIDocument

@property (nonatomic) NSArray *items;

- (void)handleError:(NSError *)error
       userInteractionPermitted:(BOOL)userInteractionPermitted;

@property (nonatomic, readonly) NSString *description;

- (id)contentsForType:(NSString *)typeName error:(NSError **)outError;
@end
```

Your Swift Class…in Objective-C

Objective-C

```
SWIFT_CLASS("_TtC5MyApp10MyDocument")      // usually written MyApp.MyDocument
@interface MyDocument : UIDocument

@property (nonatomic) NSArray *items;

- (void)handleError:(NSError *)error
       userInteractionPermitted:(BOOL)userInteractionPermitted;

@property (nonatomic, readonly) NSString *description;

- (id)contentsForType:(NSString *)typeName error:(NSError **)outError;
@end
```

Limitations of Objective-C

Swift has advanced features that aren't expressible in Objective-C

- Tuples
- Generics
- Enums and structs

```
func myGenericMethod<T>(x: T) -> (String, String) { … }
```

Limitations of Objective-C

Swift has advanced features that aren't expressible in Objective-C

- Tuples
- Generics
- Enums and structs

```
@objc func myGenericMethod<T>(x: T) -> (String, String) { … }
                                    // error: not expressible in Objective-C
```

"objc" attribute verifies that the declaration can be used in Objective-C

Controlling Objective-C Names

"objc" attribute can be used to change the name of an Objective-C method

```
var enabled: Bool {
    get { … }
    set { … }
}
```

Controlling Objective-C Names

"objc" attribute can be used to change the name of an Objective-C method

```
var enabled: Bool {                                  // property is named "enabled"
    get { … }                                        // getter is named "enabled"
    set { … }                                        // setter is named "setEnabled:"
}
```

Controlling Objective-C Names

"objc" attribute can be used to change the name of an Objective-C method

```
var enabled: Bool {                                  // property is named "enabled"
    @objc(isEnabled) get { … }                       // getter is named "isEnabled"
    set { … }                                        // setter is named "setEnabled:"
}
```

Controlling Objective-C Names

"objc" attribute can be used to change the name of an Objective-C method

```
var enabled: Bool {                                  // property is named "enabled"
    @objc(isEnabled) get { … }                       // getter is named "isEnabled"
    set { … }                                        // setter is named "setEnabled:"
}
```

Or the name of a class

```
@objc(ABCMyDocument) class MyDocument : UIDocument {
    // …
}
```

CF Interoperability

CF in Objective-C

```
void drawGradientRect(CGContextRef context, CGColorRef startColor,
                      CGColorRef endColor, CGFloat width, CGFloat height) {









}
```

CF in Objective-C

```
void drawGradientRect(CGContextRef context, CGColorRef startColor,
                      CGColorRef endColor, CGFloat width, CGFloat height) {
    CGColorSpaceRef colorSpace = CGColorSpaceCreateDeviceRGB();
    NSArray *colors = @[(__bridge id)startColor, (__bridge id)endColor];
    CGFloat locations[2] = {0.0, 1.0};
    CGGradientRef gradient = CGGradientCreateWithColors(colorSpace,
                                (CFArrayRef)colors, locations);




}
```

CF in Objective-C

Bridge casts

```
void drawGradientRect(CGContextRef context, CGColorRef startColor,
                      CGColorRef endColor, CGFloat width, CGFloat height) {
    CGColorSpaceRef colorSpace = CGColorSpaceCreateDeviceRGB();
    NSArray *colors = @[(__bridge id)startColor, (__bridge id)endColor];
    CGFloat locations[2] = {0.0, 1.0};
    CGGradientRef gradient = CGGradientCreateWithColors(colorSpace,
                                (CFArrayRef)colors, locations);




}
```

CF in Objective-C

Three kinds of arrays

```
void drawGradientRect(CGContextRef context, CGColorRef startColor,
                      CGColorRef endColor, CGFloat width, CGFloat height) {
    CGColorSpaceRef colorSpace = CGColorSpaceCreateDeviceRGB();
    NSArray *colors = @[(__bridge id)startColor, (__bridge id)endColor];
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}
```

CF in Objective-C

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    CGGradientRef gradient = CGGradientCreateWithColors(colorSpace,
                             (CFArrayRef)colors, locations);

    CGPoint startPoint = CGPointMake(width / 2, 0);
    CGPoint endPoint = CGPointMake(width / 2, height);
    CGContextDrawLinearGradient(context, gradient, startPoint, endPoint, 0);


}
```

CF in Objective-C

Manual memory management

```
void drawGradientRect(CGContextRef context, CGColorRef startColor,
                      CGColorRef endColor, CGFloat width, CGFloat height) {
    CGColorSpaceRef colorSpace = CGColorSpaceCreateDeviceRGB();
    NSArray *colors = @[(__bridge id)startColor, (__bridge id)endColor];
    CGFloat locations[2] = {0.0, 1.0};
    CGGradientRef gradient = CGGradientCreateWithColors(colorSpace,
                             (CFArrayRef)colors, locations);

    CGPoint startPoint = CGPointMake(width / 2, 0);
    CGPoint endPoint = CGPointMake(width / 2, height);
    CGContextDrawLinearGradient(context, gradient, startPoint, endPoint, 0);

    CGColorSpaceRelease(colorSpace);
    CGGradientRelease(gradient);
}
```

CF in Swift

```
func drawGradientRect(context: CGContext, startColor: CGColor,
                      endColor: CGColor, width: CGFloat, height: CGFloat) {









}
```

Managed CF Objects

```
func drawGradientRect(context: CGContext, startColor: CGColor,
                      endColor: CGColor, width: CGFloat, height: CGFloat) {
    let colorSpace = CGColorSpaceCreateDeviceRGB()




}
```

Managed CF Objects

```
func drawGradientRect(context: CGContext, startColor: CGColor,
                      endColor: CGColor, width: CGFloat, height: CGFloat) {
    let colorSpace = CGColorSpaceCreateDeviceRGB() // inferred as CGColorSpace




}
```

Managed CF Objects

```
func drawGradientRect(context: CGContext, startColor: CGColor,
                      endColor: CGColor, width: CGFloat, height: CGFloat) {
    let colorSpace = CGColorSpaceCreateDeviceRGB() // inferred as CGColorSpace



    // colorSpace automatically released
}
```

Toll-Free Bridging Conversions

```
func drawGradientRect(context: CGContext, startColor: CGColor,
                      endColor: CGColor, width: CGFloat, height: CGFloat) {
    let colorSpace = CGColorSpaceCreateDeviceRGB()
    let gradient = CGGradientCreateWithColors(colorSpace,
                                              [startColor, endColor],
                                              [0.0, 1.0])



}
```

C Interoperability

```
func drawGradientRect(context: CGContext, startColor: CGColor,
                      endColor: CGColor, width: CGFloat, height: CGFloat) {
    let colorSpace = CGColorSpaceCreateDeviceRGB()
    let gradient = CGGradientCreateWithColors(colorSpace,
                                              [startColor, endColor],
                                              [0.0, 1.0])


}
```

Construction of C Structs

```
func drawGradientRect(context: CGContext, startColor: CGColor,
                      endColor: CGColor, width: CGFloat, height: CGFloat) {
    let colorSpace = CGColorSpaceCreateDeviceRGB()
    let gradient = CGGradientCreateWithColors(colorSpace,
                                              [startColor, endColor],
                                              [0.0, 1.0])

    let startPoint = CGPoint(x: width / 2, y: 0)
    let endPoint = CGPoint(x: width / 2, y: height)
    CGContextDrawLinearGradient(context, gradient, startPoint, endPoint, 0)
}
```

Explicitly Bridged APIs

Some CF APIs have not been audited for implicit bridging

```
CGColorRef CGColorGetRandomColor(void);
```

Explicitly Bridged APIs

Some CF APIs have not been audited for implicit bridging

```
CGColorRef CGColorGetRandomColor(void);
```

Swift uses Unmanaged<T> when the ownership convention is unknown

```
func CGColorGetRandomColor() -> Unmanaged<CGColor>
```

Working with Unmanaged Objects

Unmanaged<T> enables manual memory management

```
struct Unmanaged<T: AnyObject> {
    func takeUnretainedValue() -> T   // for +0 returns
    func takeRetainedValue() -> T     // for +1 returns


}
```

Working with Unmanaged Objects

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```

Use it to work with unaudited CF APIs

```
let color = CGColorGetRandomColor().takeUnretainedValue()
```

Working with Unmanaged Objects

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struct Unmanaged<T: AnyObject> {
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```
let color = CGColorGetRandomColor().takeUnretainedValue()
                                                // inferred as CGColor
```

- Advanced Swift — Presidio — Thursday 11:30AM

Working with Unmanaged Objects

Unmanaged<T> enables manual memory management

```
struct Unmanaged<T: AnyObject> {
    func takeUnretainedValue() -> T   // for +0 returns
    func takeRetainedValue() -> T     // for +1 returns


    func retain() -> Unmanaged<T>
    func release()
    func autorelease() -> Unmanaged<T>
}
```

Use it to work with unaudited CF APIs

```
let color = CGColorGetRandomColor().takeUnretainedValue()
                                                  // inferred as CGColor
```

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Implicit Bridging

Audit CF APIs to ensure that conform to CF memory conventions

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CGColorRef CGColorGetRandomColor(void);
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Swift uses Unmanaged<T> when the ownership convention is unknown

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Implicit Bridging

Audit CF APIs to ensure that conform to CF memory conventions

```
CF_IMPLICIT_BRIDGING_ENABLED
CGColorRef CGColorGetRandomColor(void);
CF_IMPLICIT_BRIDGING_DISABLED
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CGColorRef CGColorGetRandomColor(void);
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```

Implicit bridging eliminates Unmanaged<T>

```
func CGColorGetRandomColor() -> CGColor
```

Summary

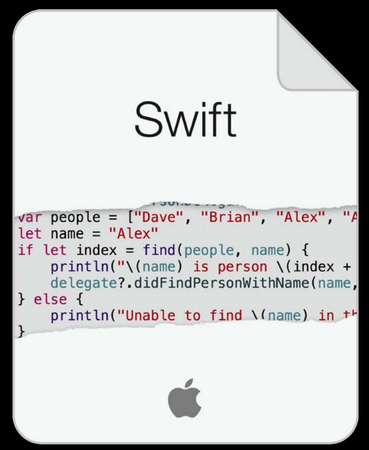
Seamless interoperability between Swift and Objective-C

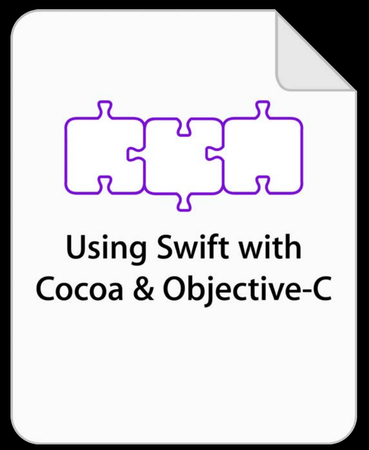
- Let the tools help you understand the relationship

Bridging of Core Cocoa types

- Prefer native strings, arrays, dictionaries

Automated CF memory management





More Information

Dave DeLong
Developer Tools Evangelist
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Documentation
Using Swift with Cocoa and Objective-C
http://apple.com

Apple Developer Forums
http://devforums.apple.com

Related Sessions

• Integrating Swift with Objective-C	Presidio	Wednesday 9:00AM
• Intermediate Swift	Presidio	Wednesday 2:00PM
• Advanced Swift	Presidio	Thursday 11:30AM

Labs

• Swift	Tools Lab A	Thursday 9:00AM
• Swift	Tools Lab A	Thursday 2:00PM
• Swift	Tools Lab A	Friday 9:00AM
• Swift	Tools Lab A	Friday 2:00PM

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