SWIFT PROGRAMMING

MPCS 51043
AUTUMN 2017
SESSION 3

THE UNIVERSITY OF CHICAGO

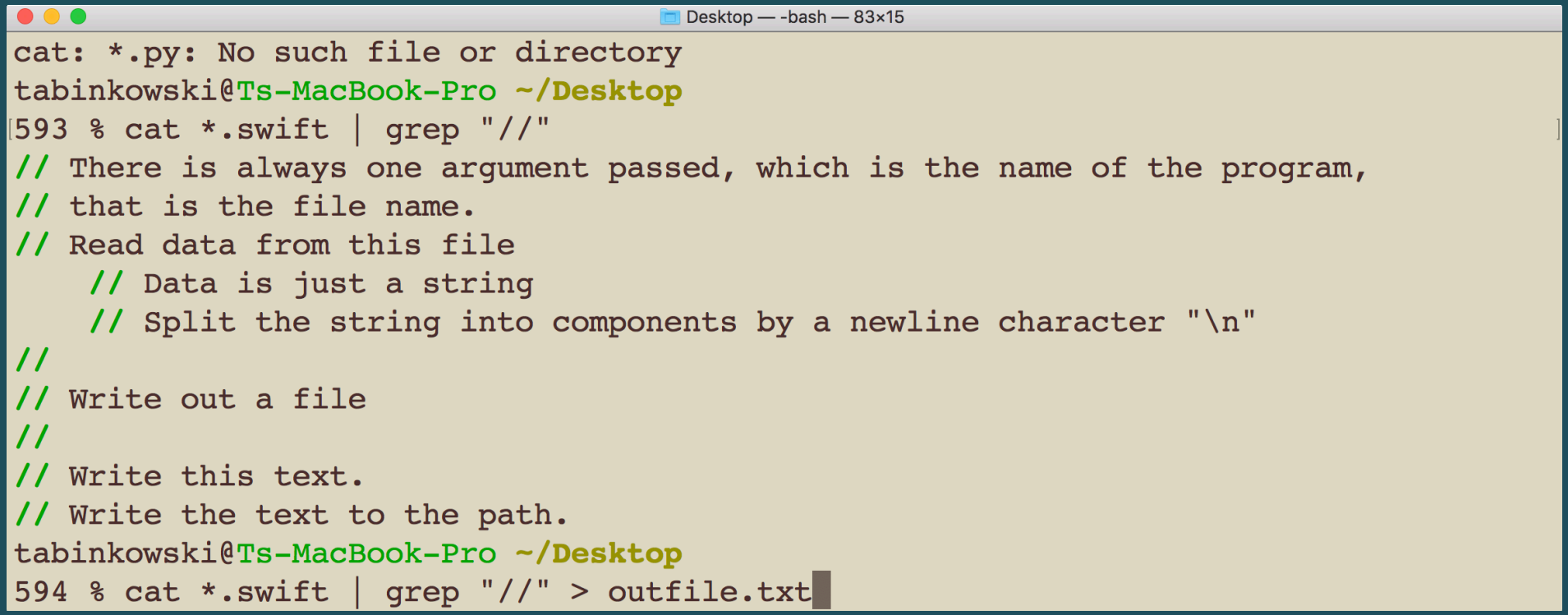
NEWS

CLASS NEWS

- Unix challenge
- Split the difference on homework regrading

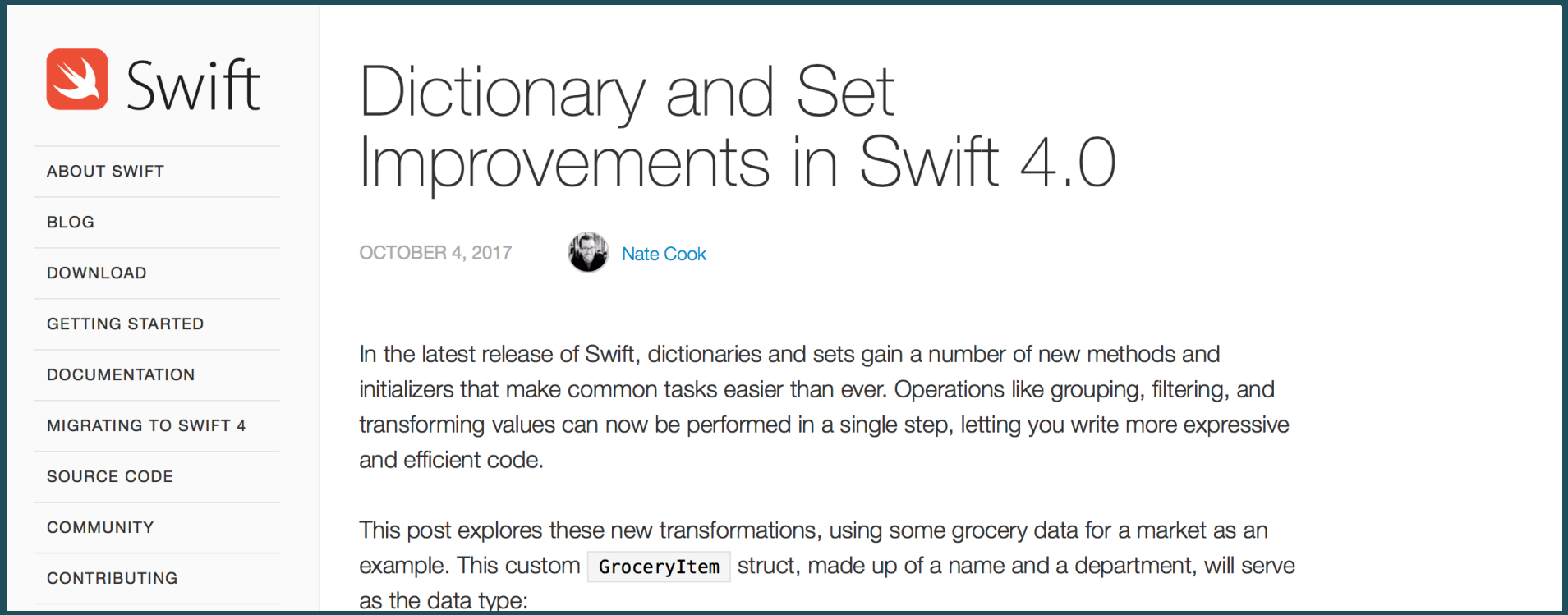
```
cat: *.py: No such file or directory
tabinkowski@Ts-MacBook-Pro ~/Desktop
593 % cat *.swift | grep "//"
// There is always one argument passed,
// that is the file name.
// Read data from this file
    // Data is just a string
    // Split the string into components
//
// Write out a file
//
// Write this text.
// Write the text to the path.
tabinkowski@Ts-MacBook-Pro ~/Desktop
594 % cat *.swift | grep "//" > outfile
```

CLASS NEWS



- Unix challenge: cat, grep, >

CLASS NEWS



Swift

ABOUT SWIFT
BLOG
DOWNLOAD
GETTING STARTED
DOCUMENTATION
MIGRATING TO SWIFT 4
SOURCE CODE
COMMUNITY
CONTRIBUTING

Dictionary and Set Improvements in Swift 4.0

OCTOBER 4, 2017 Nate Cook

In the latest release of Swift, dictionaries and sets gain a number of new methods and initializers that make common tasks easier than ever. Operations like grouping, filtering, and transforming values can now be performed in a single step, letting you write more expressive and efficient code.

This post explores these new transformations, using some grocery data for a market as an example. This custom `GroceryItem` struct, made up of a name and a department, will serve as the data type:

- https://swift.org/blog/dictionary-and-set-improvements/

OPTIONALS?!

OPTIONALS

- Optionals are special type in Swift that enforces safety by being explicit about nothing
- They help prevent you from trying to work with a variable that has no value

```
print("What is your name?")
var name = readLine()
print("Hi, \(name)")


# What is your name? Andrew
# Hi,  Optional(Andrew)
```

OPTIONALS

- Optionals can represent a value or no value (nil)
- Clarity about what nothing is

```
let x: String?
let y: Int?
let z: Double?
```

```
let x: String?
x = "Hello"
print(x) // Optional("Hello")
```

OPTIONALS

- When you are using optionals, you are asking a series of question:
  - Is the value `nil`?
  - If yes, then do something
  - If no, then unwrap it and copy the value to a new constant

```
//

if let unwrappedPhone
  print("The unwrappe
}

// Unwrap multiple va
if let
  unwrappedPhone = ph
  unwrappedPad = pad
  print("The unwrappe

}

// You can also assig
// (which may be conf
if let phone = phone
```

OPTIONALS

```
//:
//: # Optional Binding
//:

if let unwrappedPhone = phone {
  print("The unwrapped value of phone is: \(unwrappedPhone)")
}
```

- Optional binding uses `if-let` syntax to unwrap an optional if it is not nil
- Value is assigned to the constant after the `let`

OPTIONALS

```
// Unwrap multiple values at the same time
if let
  unwrappedPhone = phone,
  unwrappedPad = pad {
  print("The unwrapped value of phone is: \(unwrappedPhone)")

}
```

- Unwrap multiple values
- Will return `nil` if any are `nil`

OPTIONALS

```
//: ## Forced unwrapping
//: If you already know that a particular optional contains a value, then
    you can use what is known as forced unwrapping. This means you don't
    need the if statement to check if the optional contains a value.

var optionalString: String? = "Hello World!"
print("Force unwrapped! \(optionalString!.uppercased())")

//: This is convienent, but elimates the safety design of Swift
//: ## Implicit unwrapping
var optionalString2: String! = "Hello World!"
print("Implicit unwrapped! \(optionalString2.uppercased())")
```

- Forced unwrap

OPTIONALS

```
//:
//: ## Optional Chaining
//: Optional chaining is a concise way to work with optionals quickly
    without using if/let and a conditional block each time.

var maybeString: String? = "The eagle has landed"

// If `maybeString` is not `nil` then `.uppercaseString` will be evaluated.
    If it is `nil`, it will return `nil`

if let uppercase = maybeString?.uppercaseString
```

- Optional chaining

OPTIONALS

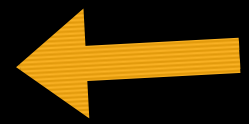
```
//:
//: # Nil-coalescing Operator
//:

var myOptionalVariable: Int?
var number: Int = 7
var number2: Int = myOptionalVariable ?? 0

var result: Int = number + number2
print(result) // prints: 7
```

- Provide a default value if variable is nil

OPTIONALS

- readLine() returns an optional type
- We need to unwrap it to get the value

```
print("What is your name?")
var input = readLine()
var name = input!

print("Hi, \(input)")
```



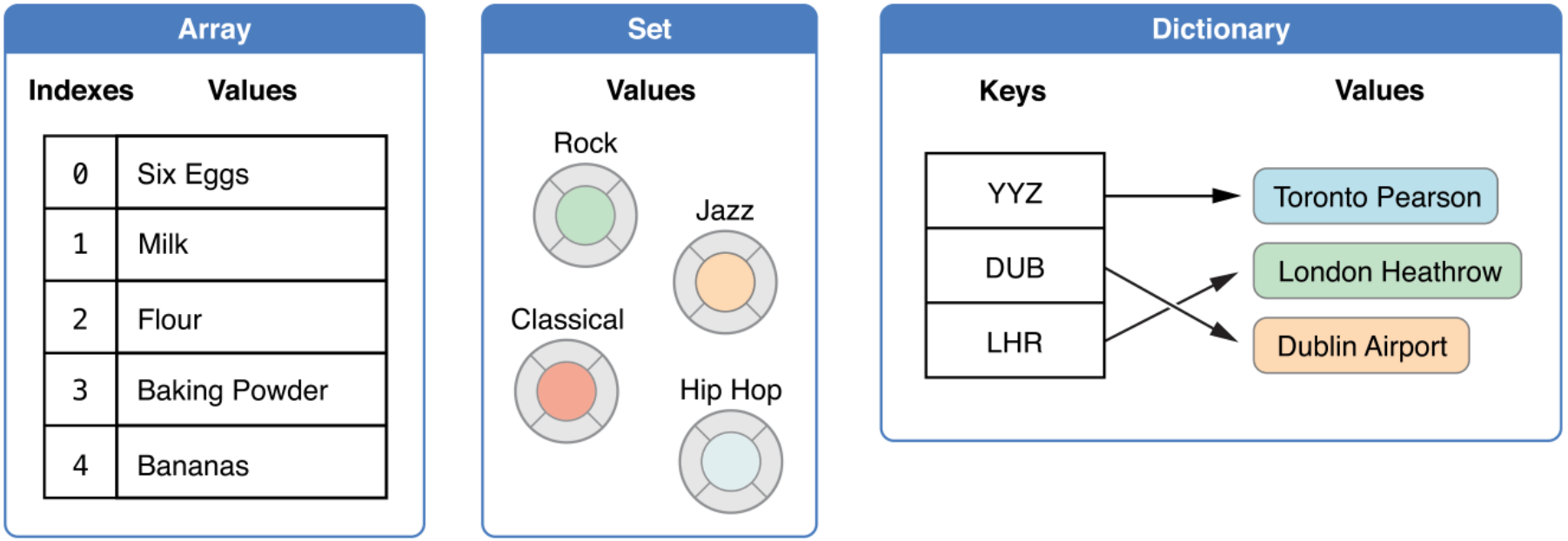
```
func readLine(strippingNewline: Bool = default) -> String?
```

DATA STRUCTURES

DATA STRUCTURES

- Data structures allow the storage of data in a consistent manner
- Built-in collection types:
  - Arrays, dictionaries, tuples, sets
- Custom types:
  - Define your custom data types specific to your programs specification
  - Structs, classes, enums

DATA STRUCTURES



DATA STRUCTURES

- Mutability is determined by the declaration

```
let array = [String]()
var mutableArray  = [String]()

let set = Set<String>()
var mutableSet = Set<String>()
```

DATA STRUCTURES

- Best practice
  - Immutable collections where collection does not need to change
  - Easier for you to reason about your code
  - Compiler optimization

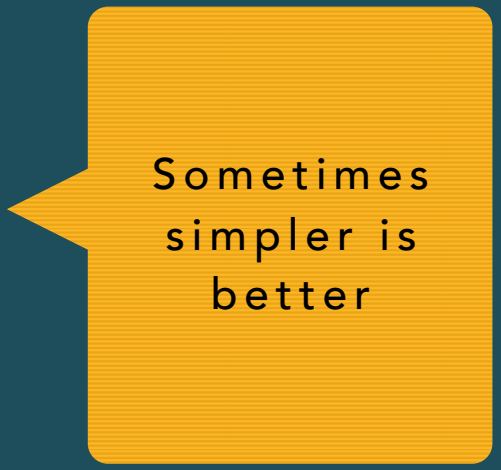
```
let array = [Int]()
var mutableArray  = [Int]()
```

DATA STRUCTURES

```
// Built-in collection array
let array  = [5, 4, 3, 2, 1]


// Custom data structure
struct Person {
let name: String
let age: Int
}

let charlie = Person(name: "Charlie", age: 8)
```

DATA STRUCTURES

- What is the best type of data structure to use?
- It depends
  - Task
  - Complexity
  - Development time



ARRAYS

BASIC COLLECTIONS

- Collections hold groups of data types
- Most basic (and used) data structures
  - In some cases, all you will ever need

```
var shoppingList = ["catfish", "water",
                    "tulips", "blue
                     paint"]

shoppingList[1] = "bottle of water"
```

BASIC COLLECTIONS

- Swift standard library has different collections
  - Array
  - Dictionary
  - Set
  - Tuples

```
var shoppingList = ["catfish", "water",
                    "tulips", "blue
                     paint"]

shoppingList[1] = "bottle of water"
```

WE WILL GO OVER THEM ALL NEXT WEEK IN DETAIL

BASIC COLLECTIONS

- Swift has different collections
  - Array
  - Dictionary
  - Set
  - Tuples

```
var arrayOfInts: [Int] = [1, 2, 3]
var arrayOfStrings: [String] =
["A","B"]

let arrayOfInts: [Int] = [1, 2, 3]
let arrayOfStrings: [String] =
["A","B"]

var emptyArray: [Int] = []
Var emptyArray = [Int]()
```

BASIC COLLECTIONS

- Access items by index

```
var listOfNumbers = [1, 2, 3, 10, 100]


listOfNumbers[0] // 1
listOfNumbers[1] // 2
listOfNumbers[2] // 3
listOfNumbers[3] // 10
listOfNumbers[4] // 100
//listOfNumbers[5]// error


let listSize = listOfNumbers.count
```

BASIC COLLECTIONS

- Add items with `append`

```
var numbers: [Int] = []

numbers.append(1)
numbers.append(2)
numbers.append(3)
numbers.append(4)
numbers.append(5)

print(numbers)
// [1, 2, 3, 4, 5]
```

BASIC COLLECTIONS

- Use `insert` to add a update at a specific index

```
var numbers: [Int] = [1, 2, 3]


numbers.insert(0, at: 0)
// numbers will be [0, 1, 2, 3]

numbers.insert(9, at: 1)
// numbers will be [0, 9, 1, 2, 3]
```

BASIC COLLECTIONS

- Append using += operator

```
var numbers: [Int] = [1, 2, 3]

numbers += [4, 5, 6]
//[1, 2, 3, 4, 5, 6]


numbers += [7]
// [1, 2, 3, 4, 5, 6, 7]
```

BASIC COLLECTIONS

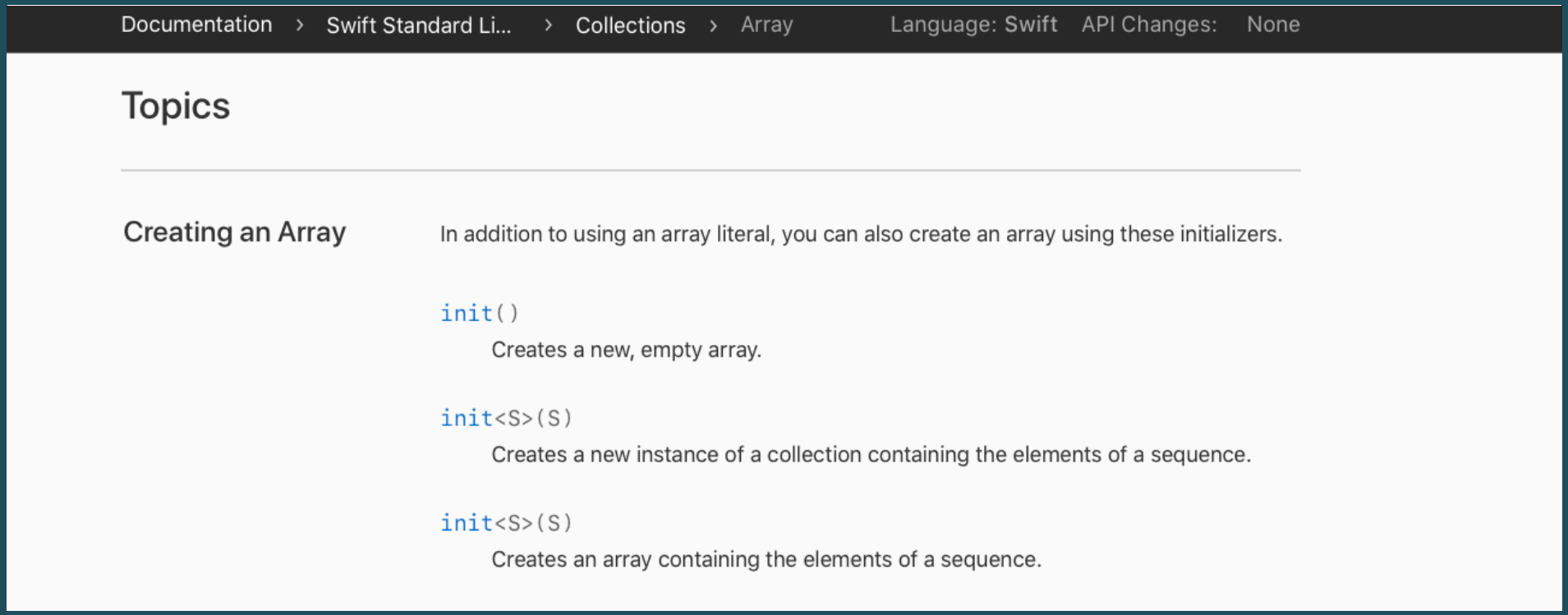
- Remove items

```
var numbers: [Int] = [1, 2, 3]

numbers.remove(at: 0)
// numbers will be [2, 3]
```

BASIC COLLECTIONS

- Change values

```
var numbers: [Int] = [1, 2, 3]

numbers[0] = 7
// numbers will be [7, 2, 3]

numbers[1] = 5
// numbers will be [7, 5, 3]

numbers[2] = 4
// numbers will be [7, 5, 4]
```

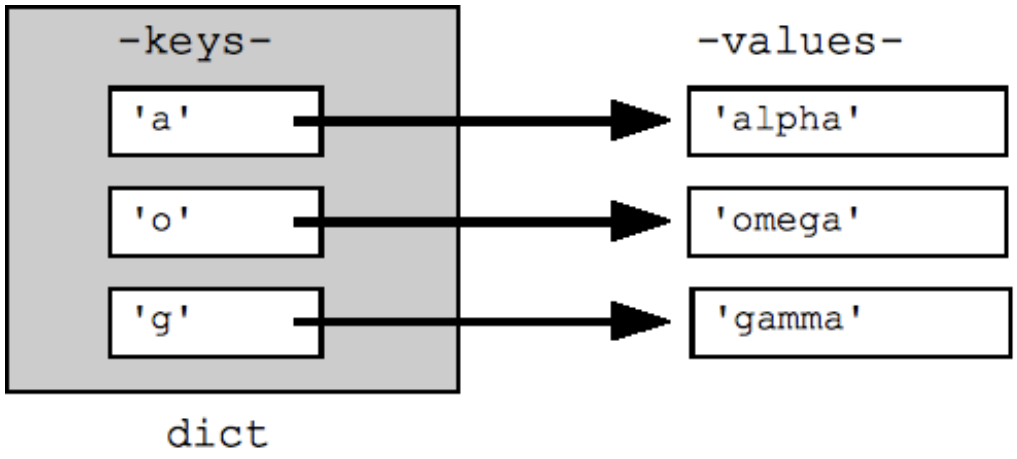


- https://developer.apple.com/documentation/swift/array

DICTIONARIES

DICTIONARIES

- Dictionaries store values that are associated with a key (key-value pair)
  - Perform "lookup" operations
- Dictionaries have different names in different languages
  - Associative Arrays - Perl / PHP
  - Properties or Map or HashMap - Java
  - Property Bag - C# / .Net



DICTIONARIES

- Dictionaries use `keys` instead of numbers to look up values
- The keys must conform to Hashable protocol 🤷‍♀️

```
// Dictionary type declaration (rarely used)
// var hero = Dictionary<String, String>()A


// Shorthand syntax (use this)
var hero = [String: String]()
hero["firstName"] = "Bruce"
hero["lastName"] = "Wayne"
hero["nickname"] = "Batman"
```

DICTIONARIES

- The keys must conform to Hashable protocol 🤷‍♀️

```
// Keys must conform to Hashable
// protocol (eg String, Integer, Bool)
var hero2 = [Int: String]()
hero2[1] = "Bruce"
hero2[2] = "Wayne"
hero2[3] = "Batman"
```

```
// Using a Bool as a key is limited
var hero3 = [Bool: String]()
hero3[true] = "Bruce"
hero3[false] = "Wayne"
```

DICTIONARIES

- Swift dictionaries are strict

```
var hero = [String: String]()
hero["firstName"] = "Bruce"
hero["lastName"] = "Wayne"
hero["nickname"] = "Batman"


// These are not allowed because
// they don't conform to the
// defined type

// hero["age"] = 40
// hero["enemies"] = ["Joker",
                      "Penguin",
                      "Poison Ivy"]
```

DICTIONARIES

```
//: ## Working with Dictionaries ##
var airportCodes: [String: String] = ["YYZ": "Toronto",
                                      "DUB": "Dublin",
                                      "MDW":"Midway"]

print(airportCodes.count)    // 3
print(airportCodes.isEmpty)  // false
```

DICTIONARIES

Rarely Used

```
// Update the values for a key
airportCodes["MDW"] = "O'Hare"
airportCodes.updateValue("Midway", forKey: "MDW")
```

- Update values for key

DICTIONARIES

Returns an

```
//: ## Accessing and Modifying Values
print(airportCodes["MDW"])

if let airportName = airports["MDW"] {
  print("The name of the airport is \(airportName).")
} else {
  print("That airport is not in the airports dictionary.")
}
```

```
"Optional("Midway")\n"


"That airport is not in the airports dictionary.\n"
```

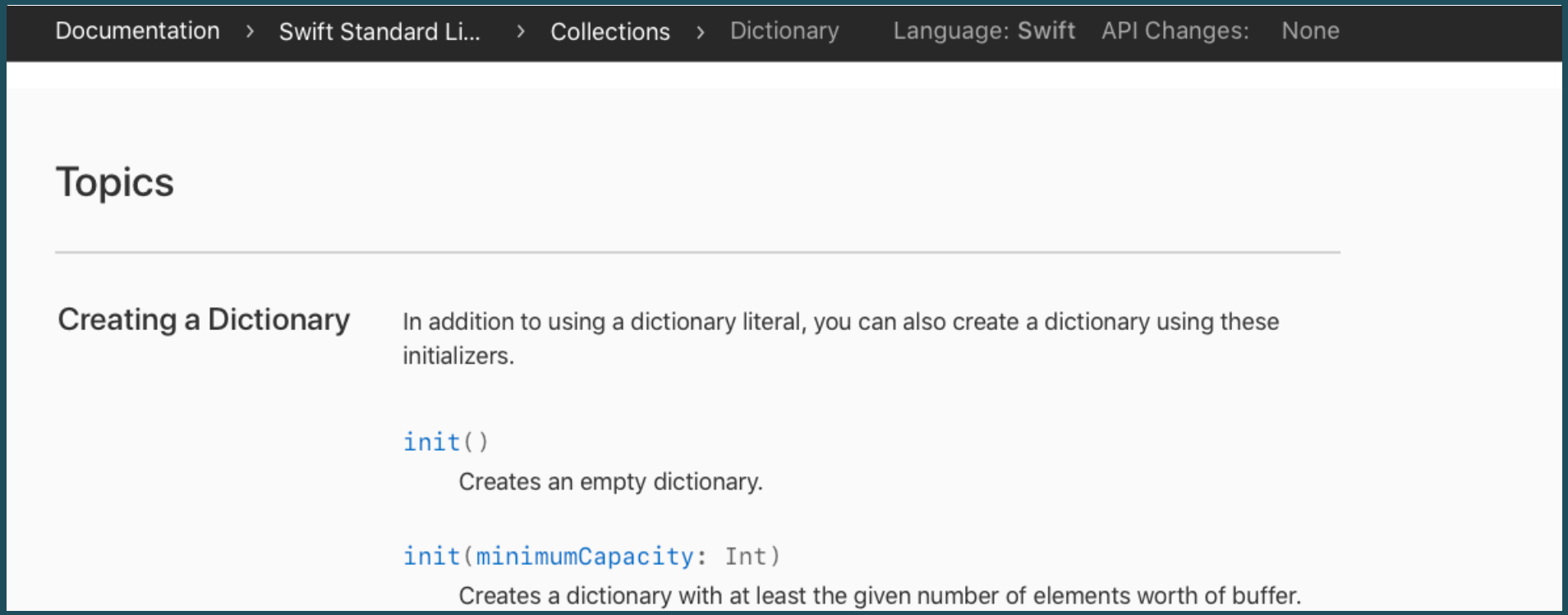
- Access a value by key return an optional
  - Don't know if there is a value for a key
- Unwrap the value to use it

DICTIONARIES

- Iteration returns tuple of key and values
- Order is not guaranteed

```
// Iterate through a dictionary
for ac in airportCodes {
  print("\(ac)")
}

for (airportCode, airportName) in airportCodes {
  print("\(airportCode): \(airportName)")
}
```

DICTIONARIES

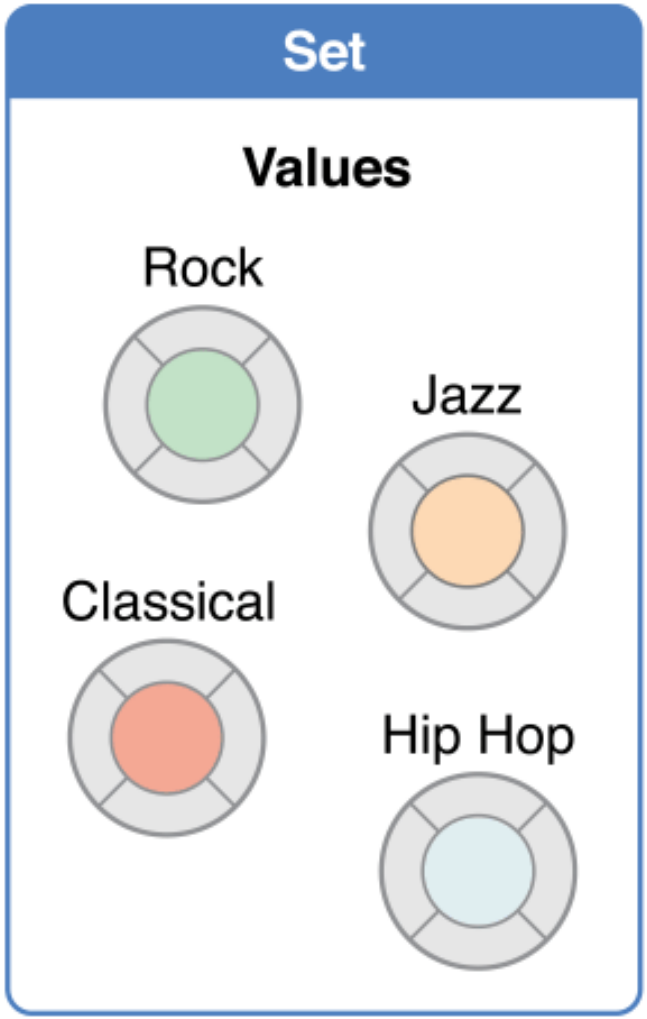


- https://developer.apple.com/documentation/swift/dictionary

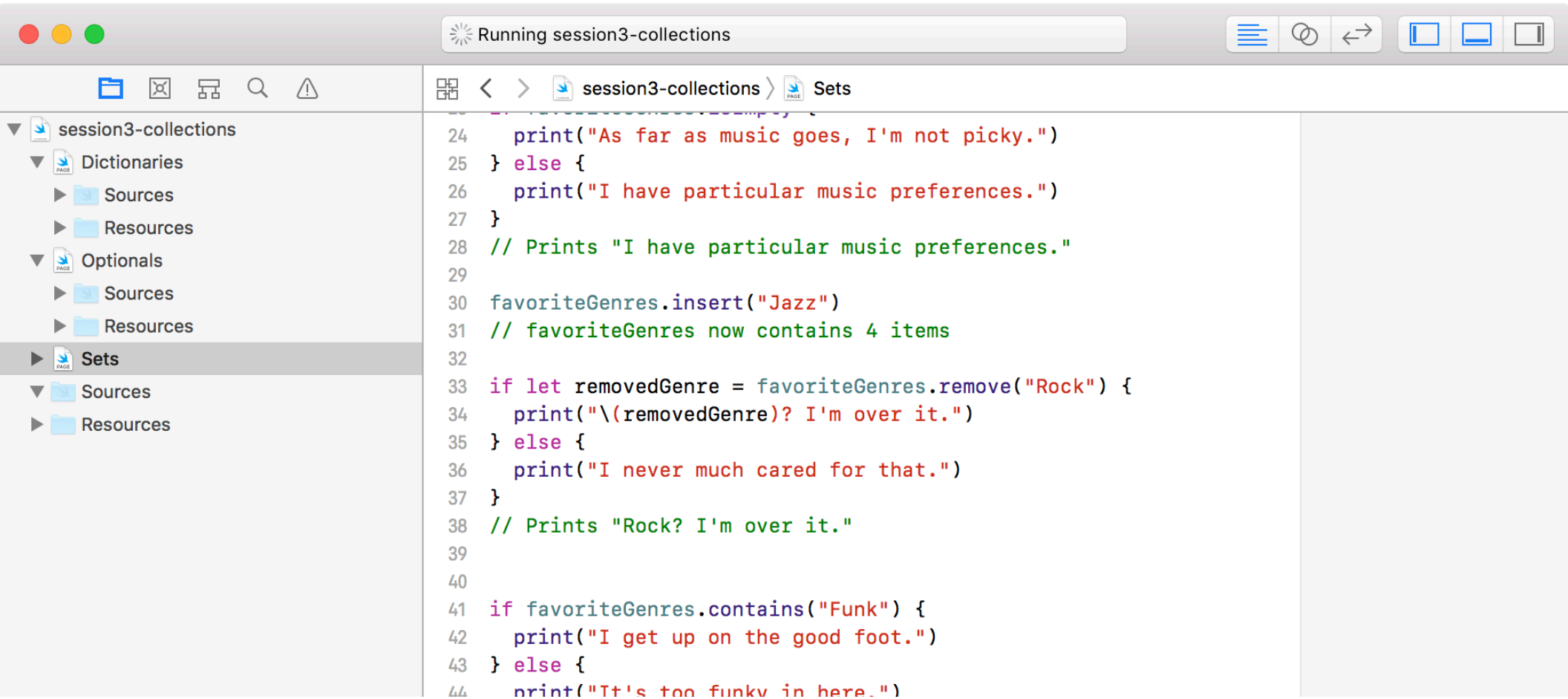
SETS

SETS

- Sets store distinct values with no order
- Use a Set instead of an array when order doesn't matter



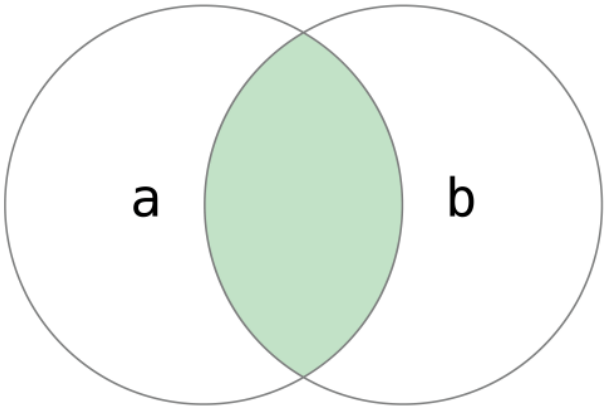
SETS


Running session3-collections
session3-collections
Sets
session3-collections
Dictionaries
Sources
Resources
Optionals
Sources
Resources
Sets
Sources
Resources
print("As far as music goes, I'm not picky.")
} else {
print("I have particular music preferences.")
}
// Prints "I have particular music preferences."
favoriteGenres.insert("Jazz")
// favoriteGenres now contains 4 items
if let removedGenre = favoriteGenres.remove("Rock") {
print("\(removedGenre)? I'm over it.")
} else {
print("I never much cared for that.")
}
// Prints "Rock? I'm over it."
if favoriteGenres.contains("Funk") {
print("I get up on the good foot.")
} else {

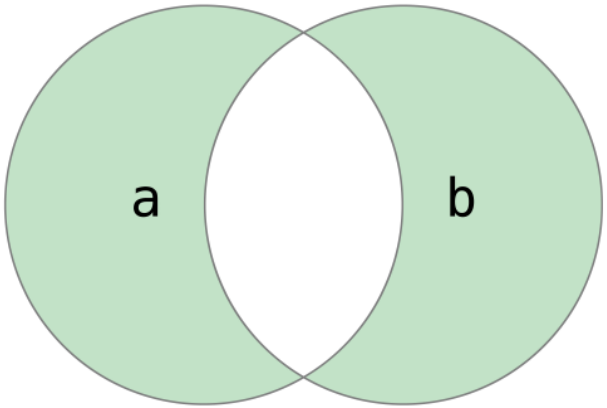
SETS

- Set have operations to evaluate members of sets

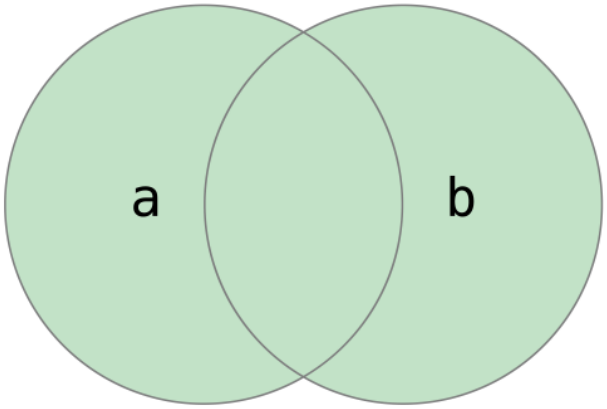
a.intersection(b)



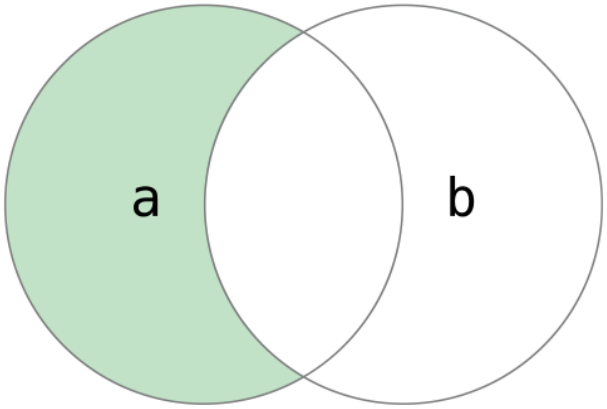
a.symmetricDifference(b)



a.union(b)

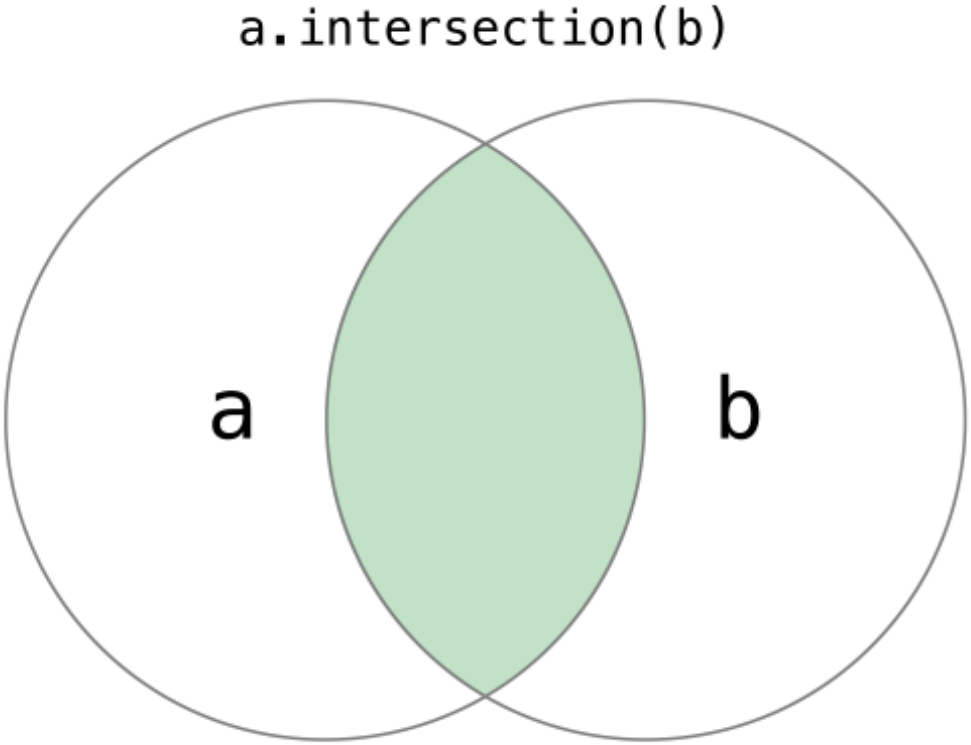


a.subtracting(b)



SETS

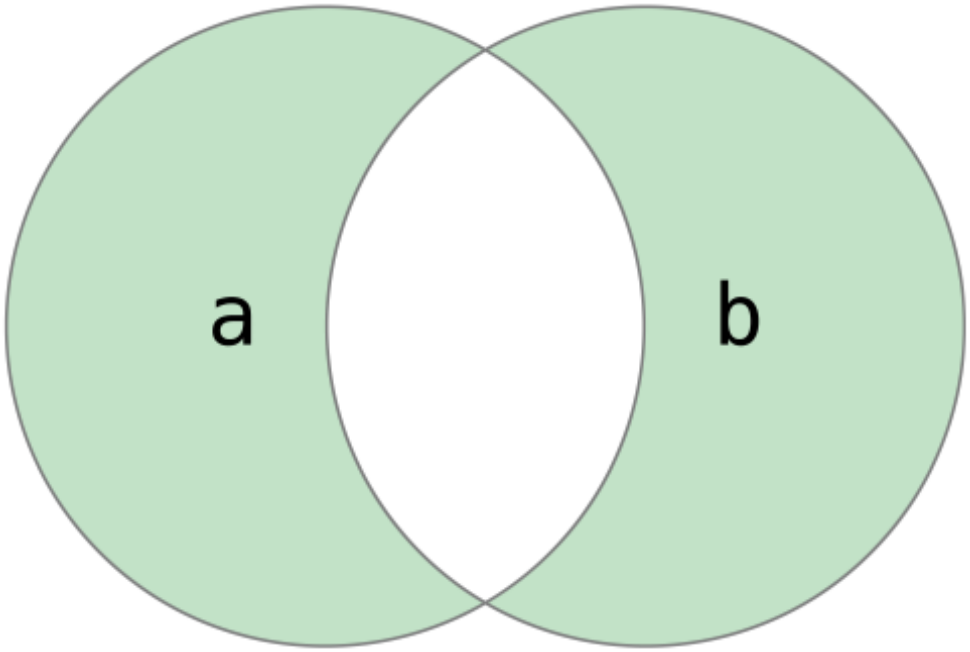
- the intersection(_:) method to create a new set with only the values common to both sets



SETS

- the symmetricDifference(_:) method to create a new set with values in either set, but not both

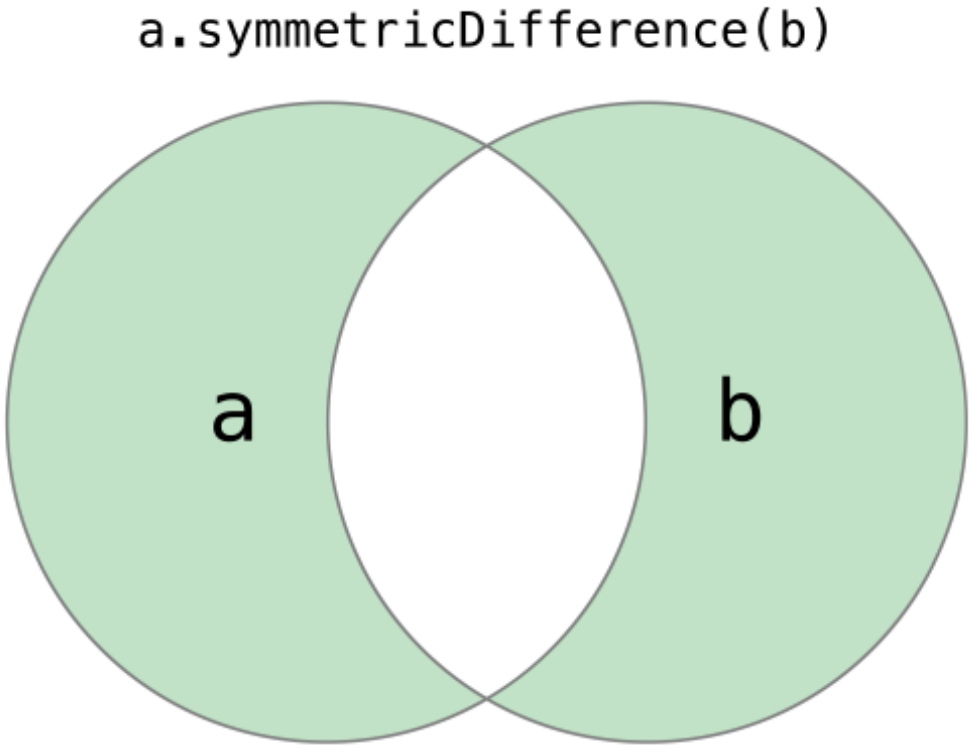
a.symmetricDifference(b)



a.subtracting(b)

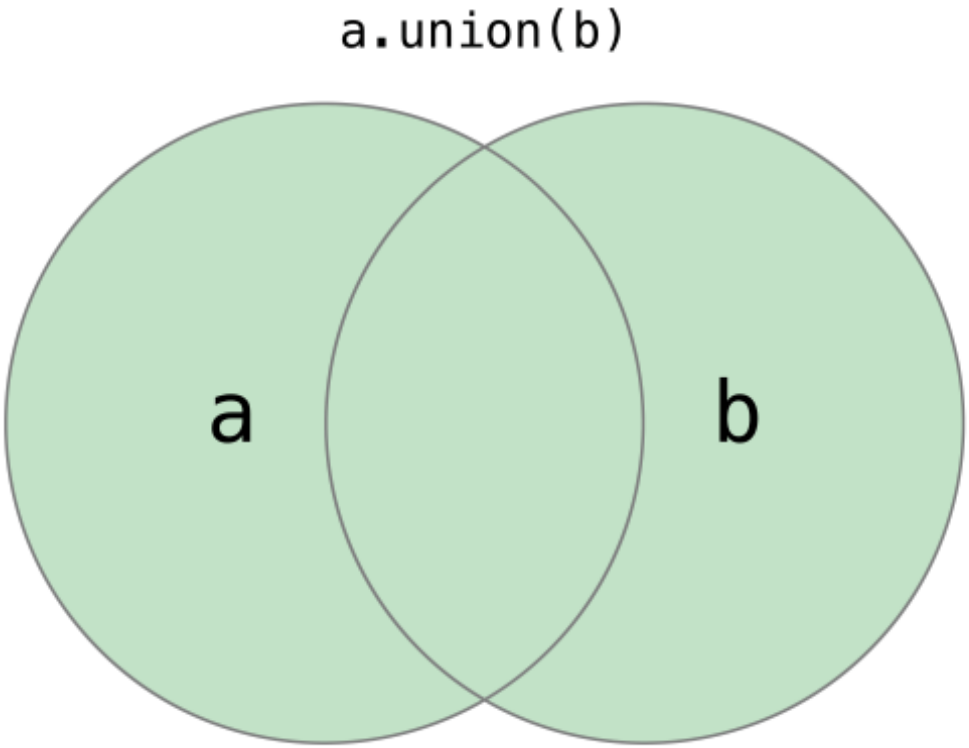
SETS

- the symmetricDifference(_:) method to create a new set with values in either set, but not both



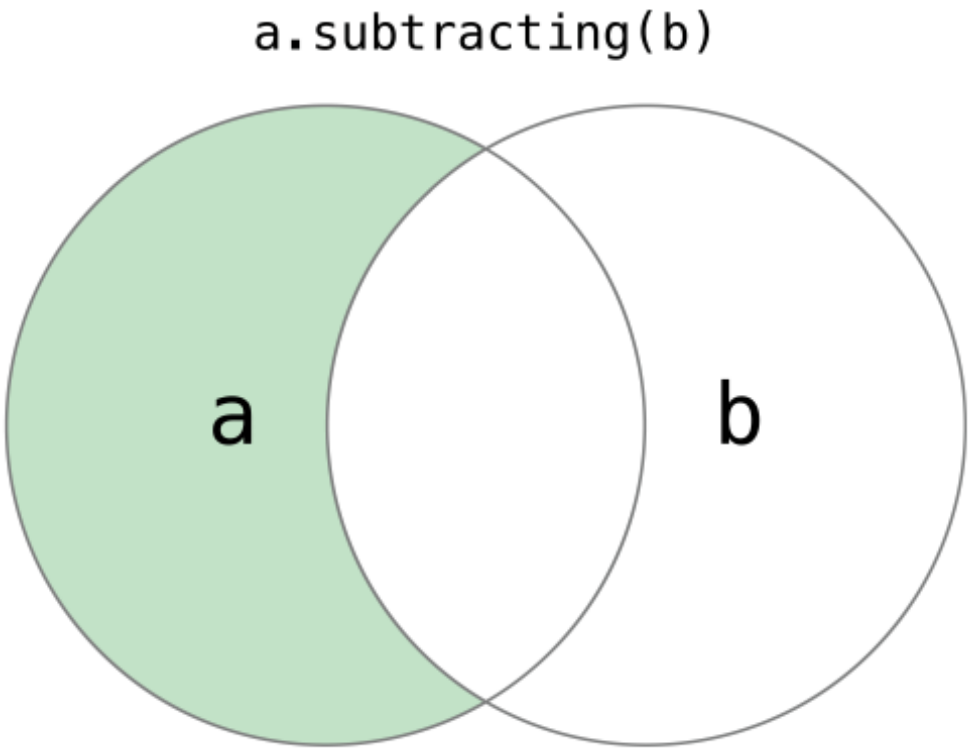
SETS

- The union(_:) method to create a new set with all of the values in both sets



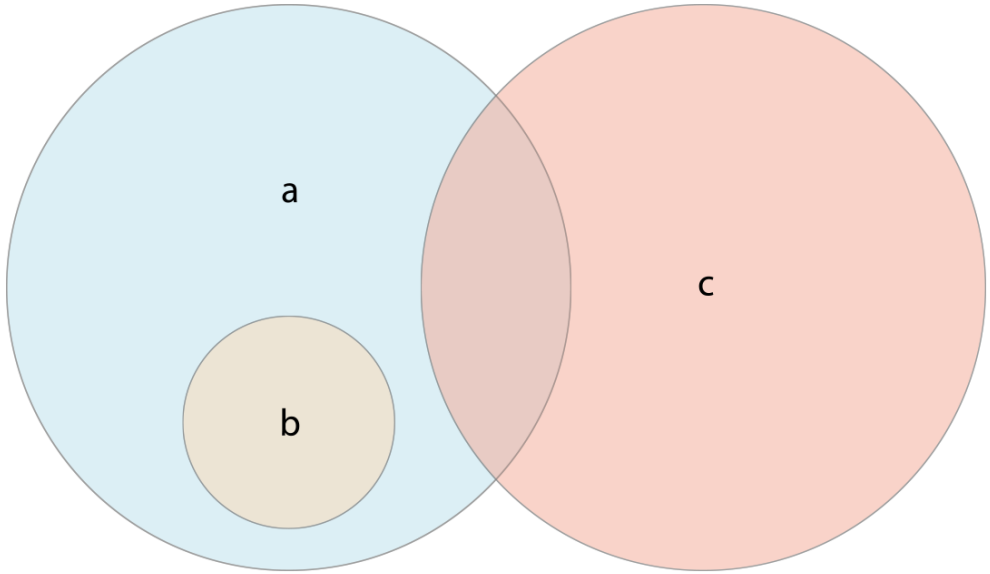
SETS

- The subtracting(_:) method to create a new set with values not in the specified set



SETS

- Set `a` is a superset of set `b`
  - `a` contains all elements in b
- `b` is a subset of set a
  - All elements in b are in `a`
- Set `b `and set `c` are disjoint
  - They share no elements in common



SETS

```
let houseAnimals: Set = ["🐶", "🐱"]
let farmAnimals: Set = ["🐮", "🐔", "🐑", "🐶", "🐱"]
let cityAnimals: Set = ["🐳", "🐭"]

houseAnimals == farmAnimals                    // false
houseAnimals.isSubset(of: farmAnimals)         // true
farmAnimals.isSuperset(of: houseAnimals)       // true
farmAnimals.isDisjoint(with: cityAnimals)      // true
```

SETS

```
init<S>(S)
```
Creates a new set from a finite sequence of items.

Inspecting a Set

```
var isEmpty: Bool
```
A Boolean value that indicates whether the set has no elements.

```
var isEmpty: Bool
```
A Boolean value that indicates whether the set is empty.

```
var isEmpty: Bool
```
A Boolean value indicating whether the collection is empty.

```
var count: Int
```

- https://developer.apple.com/documentation/swift/set

TUPLES

TUPLES

```
let myTuple = (1,"b",3)
type(of: myTuple)
```

```
(.0 1, .1 "b", .2 3)
(Int, String, Int).Type
```

- Tuples are another kind of sequence that functions much like a list
- A tuple is a fixed size grouping of elements
  - Elements which are indexed starting at 0

TUPLES

```
let things = (1,2,"Blue","Dog","🤔",["a","b","c"])

things.0
things.1
things.2
things.3
things.4
type(of:things.5)
```

```
(.0 1, .1 2, .2 "Blue", .3 "Dog", .4...

1
2
"Blue"
"Dog"
"🤔"
Array<String>.Type
```

- Tuples can have multiple types

TUPLES

- Tuples are comparable
- If the first item is equal, go on to next element, and so on, until it finds elements that differ

```
>>> (0, 1, 2) < (5, 1, 2)
True

>>> (0, 1, 2000000) < (0, 3, 4)
True

>>> ( 'Jones', 'Sally' ) < ('Jones',
'Sam')
True

>>> ( 'Jones', 'Sally') > ('Adams',
'Sam')
True
```

TUPLES

```
var things = (1,2,"Blue","Dog","🤔",["a","b","c"])

things.0
things.1
things.2
things.3
things.4
type(of:things.5)

// You can change the value as long as the
// type is the same as the initial value
things.0 = 4

things
```

```
(.0 1, .1 2, .2 "Blue", .3 "Dog", .4 "🤔", ["a", "b", "c"])

1
2
"Blue"
"Dog"
"🤔"
Array<String>.Type



4

(.0 4, .1 2, .2 "Blue", .3 "Dog", .4 "🤔", ["a", "b", "c"])
```

- Tuples are mutable (if declared) if the types match at the original index

TUPLES

- Tuples do not share all the functions as list

```
>>> x = (3, 2, 1)

>>> x.sort()
Traceback:
AttributeError: 'tuple' object has no
attribute 'sort'

>>> x.append(5)
Traceback:
AttributeError: 'tuple' object has no
attribute 'append'

>>> x.reverse()
Traceback:
AttributeError: 'tuple' object has no
attribute 'reverse'
```

TUPLES

- Why then?
  - Simpler and more efficient in terms of memory use and performance than lists
  - Useful for “temporary variables”
  - Matches data definition
    - (x, y, z) for a coordinate
    - (long, lat) for GPS position

TUPLES

```
func firstAndLast(numbers: [Int]) -> (Int,Int) {
  let first = numbers.first!
  let last = numbers.last!
  return (first, last)
}

let numbers = [1,2,3,4,5,6,7,8,9]
firstAndLast(numbers: numbers)
```

Convenient for returning multiple values

- Tuples are convenient

BREAK TIME

ENUMS

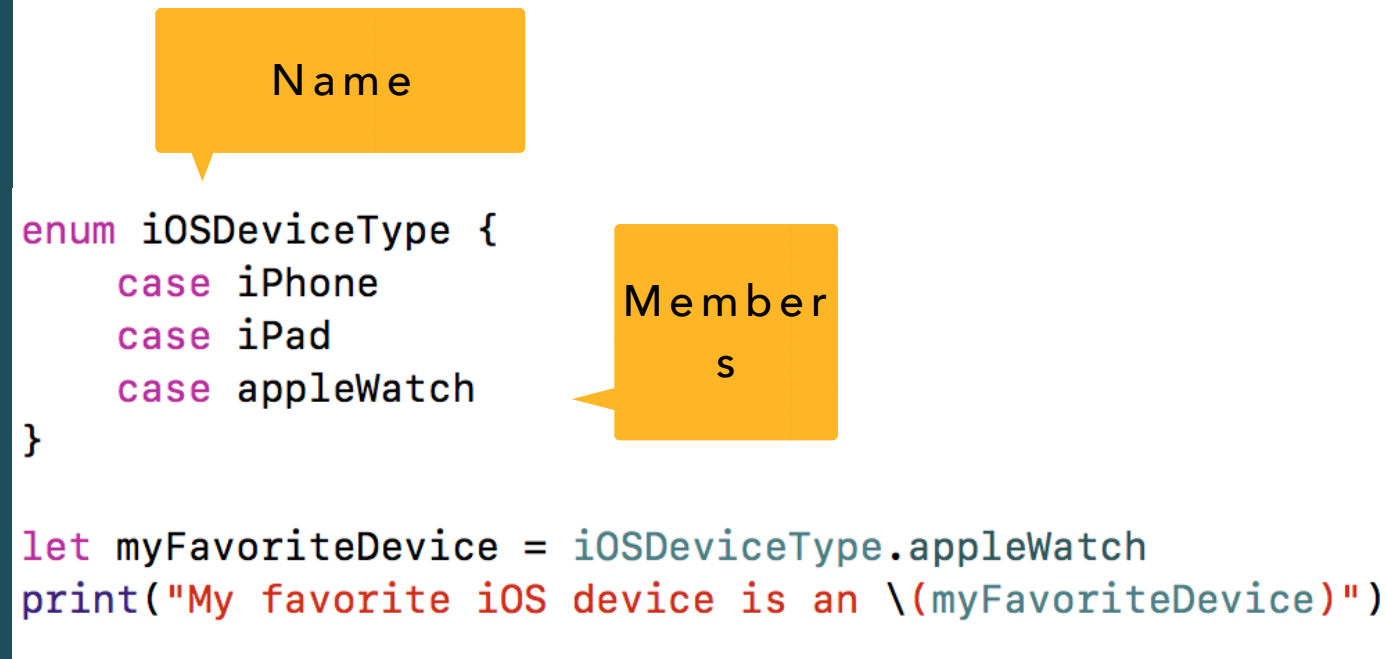
DEFINING AN ENUMERATION

- An enumeration defines a common type for a group of related values
- Work with those values in a type-safe way within your code

```
enum iOSDeviceType {
    case iPhone
    case iPad
    case appleWatch
}

let myFavoriteDevice = iOSDeviceType.appleWatch
print("My favorite iOS device is an \(myFavoriteDevice)")
```

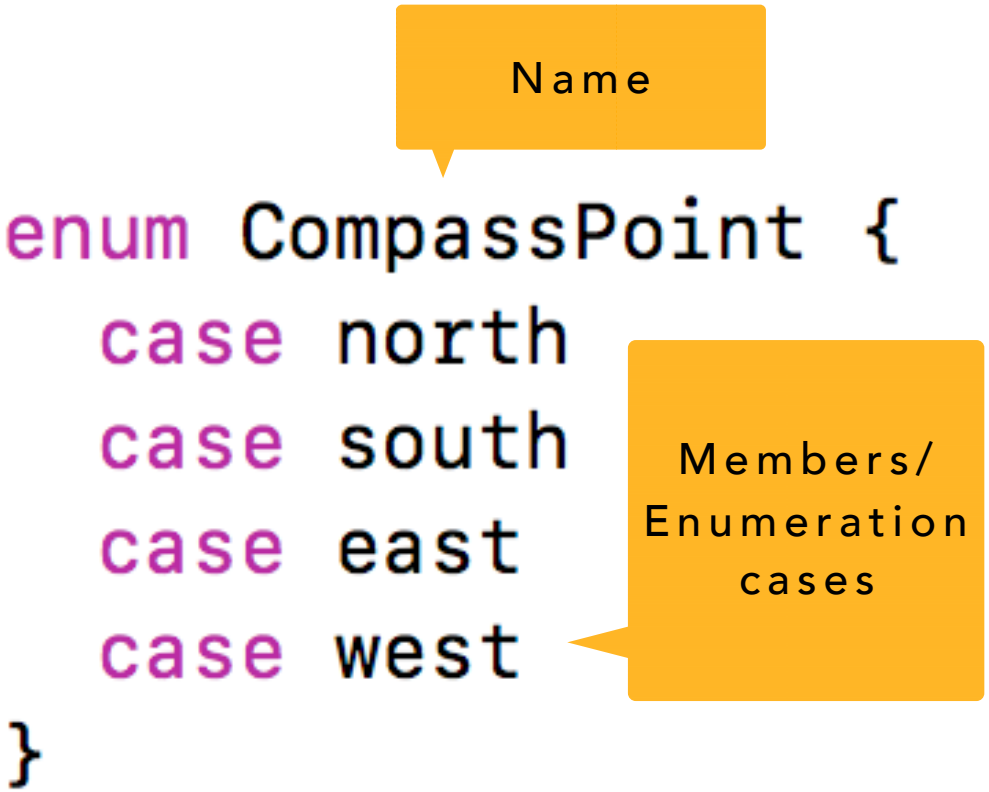
DEFINING AN ENUMERATION

- Define a new enumeration using the `**enum**` keyword followed by it's name
- The member values are introduced using the `**case**` keyword



DEFINING AN ENUMERATION

- Best practice to use capital first letter for enum and lowercase for the members
- Enum is a custom type; all types start with capital in Swift standard lib



DEFINING AN ENUMERATION

```
enum Planet {
  case mercury, venus, earth, mars, jupiter, saturn, uranus, neptune
}
```

- For the lazy, delcare multiple cases on a single line

DEFINING AN ENUMERATION

- If the type of an enumeration is known or can be inferred then you can use the dot syntax for members
- Some UIKit Enums are really, really, really, really long

```
import Foundation

enum iOSDeviceType {
    case iPhone
    case iPad
    case appleWatch
}

let myFavoriteDevice = iOSDeviceType.appleWatch

// Inferred enum can use dot syntax
let myLeastFavoriteDevice: iOSDeviceType = .iPad
```

It already knows its an iOSDEvicetype from Declaraion

DEFINING AN ENUMERATION

- Use switch statement to match enumerated values

```
//:
//: # Using Enumerations
//:

var directionToHead: CompassPoint = .south

switch directionToHead {
case .north:
  print("Lots of planets have a north")
case .south:
  print("Watch out for penguins")
case .east:
  print("Where the sun rises")
case .west:
  print("Where the skies are blue")
}
```

DEFINING AN ENUMERATION

- Switch statements must be exhaustive
- Error here for no `east` case

```
enum CompassPoint {
  case north
  case south
  case east
  case west
}

// Let's go on a trip
var directionToHead: CompassPoint = .south

switch directionToHead {
case .north:
  print("Lots of planets have a north")
case .south:
  print("Watch out for penguins")
case .west:
  print("Where the skies are blue")
}
```

DEFINING AN ENUMERATION

- Switch statements must be exhaustive
- Error here for no `east` case

```
enum CompassPoint {
  case north
  case south
  case east
  case west
}

// Let's go on a trip
var directionToHead: CompassPoint = .south

switch directionToHead {
case .north:
  print("Lots of planets have a north")
case .south:
  print("Watch out for penguins")
case .west:
  print("Where the skies are blue")
}
```

DEFINING AN ENUMERATION

- Use `default` case to match everything

```
// Let's go on a trip
var directionToHead: CompassPoint = .south

switch directionToHead {
case .north:
  print("Lots of planets have a north")
default:
  print("Use Google maps")
}
```

ASSOCIATED VALUES

- Enums can store associated values
  - The value type can be different for each member
  - Can be String, Int, Float, Char

Associated

```
enum WebService: String {
    case Post = "http://something/upload"
    case Request = "http://something/request"
}

var postUrl: WebService = .Post

// Use the rawValue property to access the raw
// value of an enumeration member
print("Post URL: \(postUrl.rawValue)")

// If the type is inferrable, you can access the
//value using dot syntax.
postUrl = .Request
print("Request URL: \(postUrl.rawValue)")
```

ASSOCIATED VALUES

- `raw value` will be the same type for members
- Values for each member must be unique

Raw value

```
enum WebService: String {
    case Post = "http://something/upload"
    case Request = "http://something/request"
}

var postUrl: WebService = .Post

// Use the rawValue property to access the raw
// value of an enumeration member
print("Post URL: \(postUrl.rawValue)")

// If the type is inferrable, you can access the
//value using dot syntax.
postUrl = .Request
print("Request URL: \(postUrl.rawValue)")
```

Access the associated value with `.rawvalue`

ASSOCIATED VALUES

- When integers are use they auto increment when not defined for a member

Doesn't have to

```
enum CompassPoint: Int {
    case north = 1
    case south
    case east
    case west
}
```

Autoincrement

ASSOCIATED VALUES

- `rawValues` can be anything in any order as long as they are the same type

```
enum CompassPoint: Int {
   case north = 1
   case south = 100
   case east = 3
   case west =4
}
```

ASSOCIATED VALUES

```
enum WebService: String {
  case Post = "http://something/upload"
  case Request = "http://something/request"
}

// Set an enum value using rawValue
let requestURL = WebService(rawValue: "http://something/request")
print(requestURL!)
```

Webservice.Request

- Set an Enum using `rawValue`

ASSOCIATED VALUES

Discriminated Union...oF course

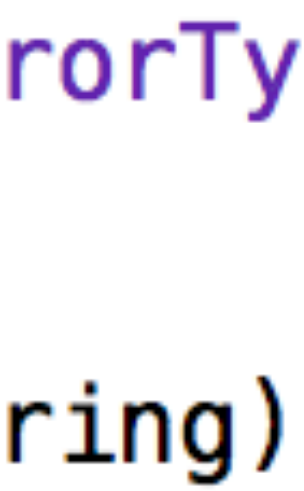
```
enum SchoolSupplies {
  case book(String)
  case money(Double)
  case lunchOrder(Int)
}

let supplies: SchoolSupplies = .money(100)
let book: SchoolSupplies = .book("War and Peace")
let lunch: SchoolSupplies = .lunchOrder(5)
```

- The 20% you'll never use; better ways of doing this with other data structures

ERROR TYPE

ERROR TYPE

- In Swift, errors are represented by values of types that conform to the ErrorType protocol
- This empty protocol indicates that a type can be used for error handling



ERROR TYPE

```
///
func validateUser(username: String, password: String)
  //
  guard password.characters.count > 0 else {
    throw UserValidationError.Empty
  }

  //
  guard password.characters.count >= 6 else {
    throw UserValidationError.MinimumLength
  }

  //
  guard password == "password" else {
    throw UserValidationError.Incorrect(message: "Wrong password")
  }

  // Lookup userId based on name and password
```

```
//
// Custom ErrorType
//
enum UserValidationError: ErrorType {
  case Empty
  case MinimumLength
  case Incorrect(message: String)
}
```

ERROR TYPE

```
= try self.validateUser("user@email.com", password: "123456")
owAlert("Successful")

n UserValidationError.Empty {
owAlert("Form Empty")
turn

n UserValidationError.MinimumLength {
owAlert("Password too short")
turn

n UserValidationError.Incorrect(let message)  {
owAlert(message)
turn

n {
 Swift wants error handling to
 account an undefined error
```

```
//
// Custom ErrorType
//
enum UserValidationError: ErrorType {
  case Empty
  case MinimumLength
  case Incorrect(message: String)
}
```

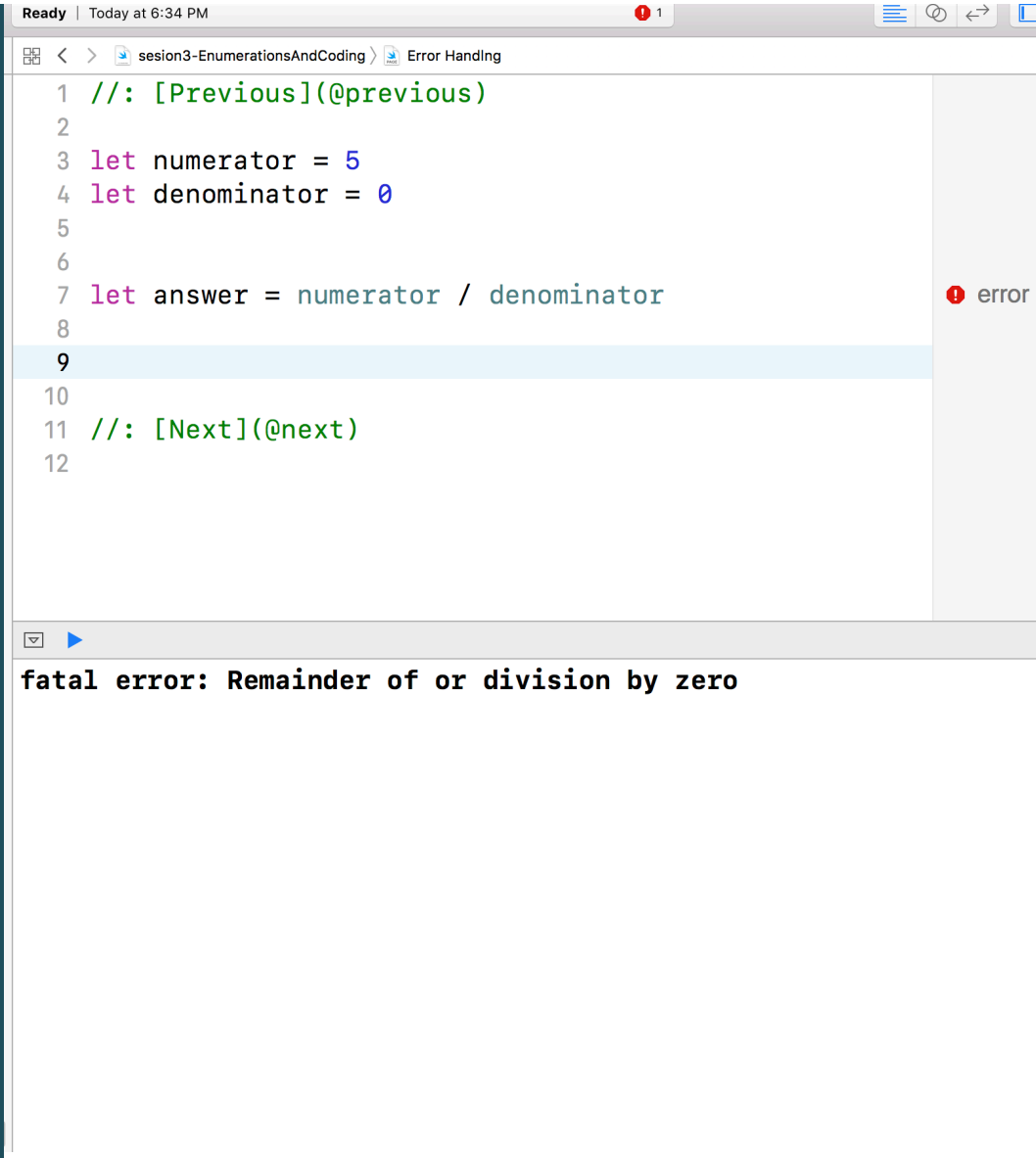


```
//
guard password == "password" else {
  throw UserValidationError.Incorrect(message: "Wrong password")
}
```

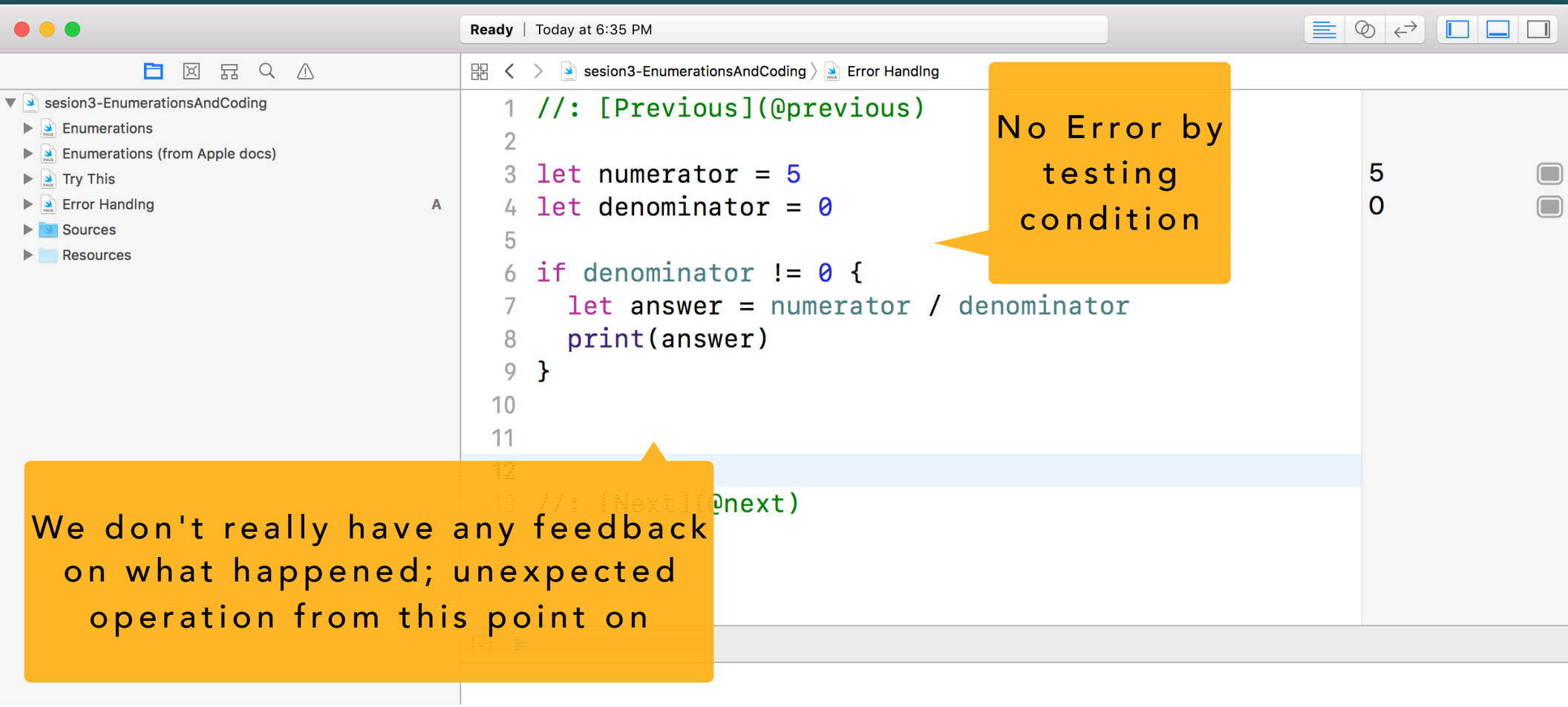
ERROR HANDLING

ERROR HANDLING

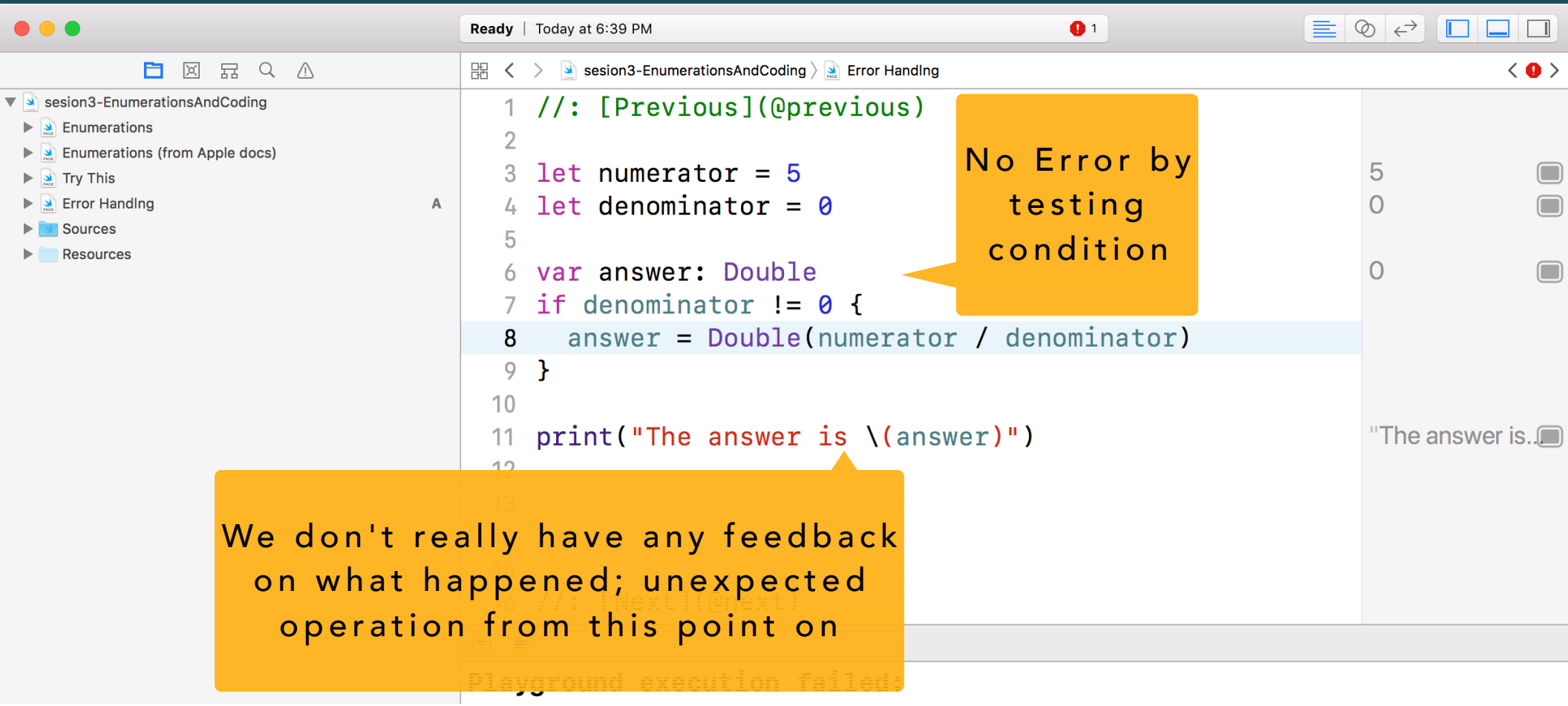
- Error handling is the process of responding to and recovering from error conditions in your program
- Allow your program to run when it would normally crashed



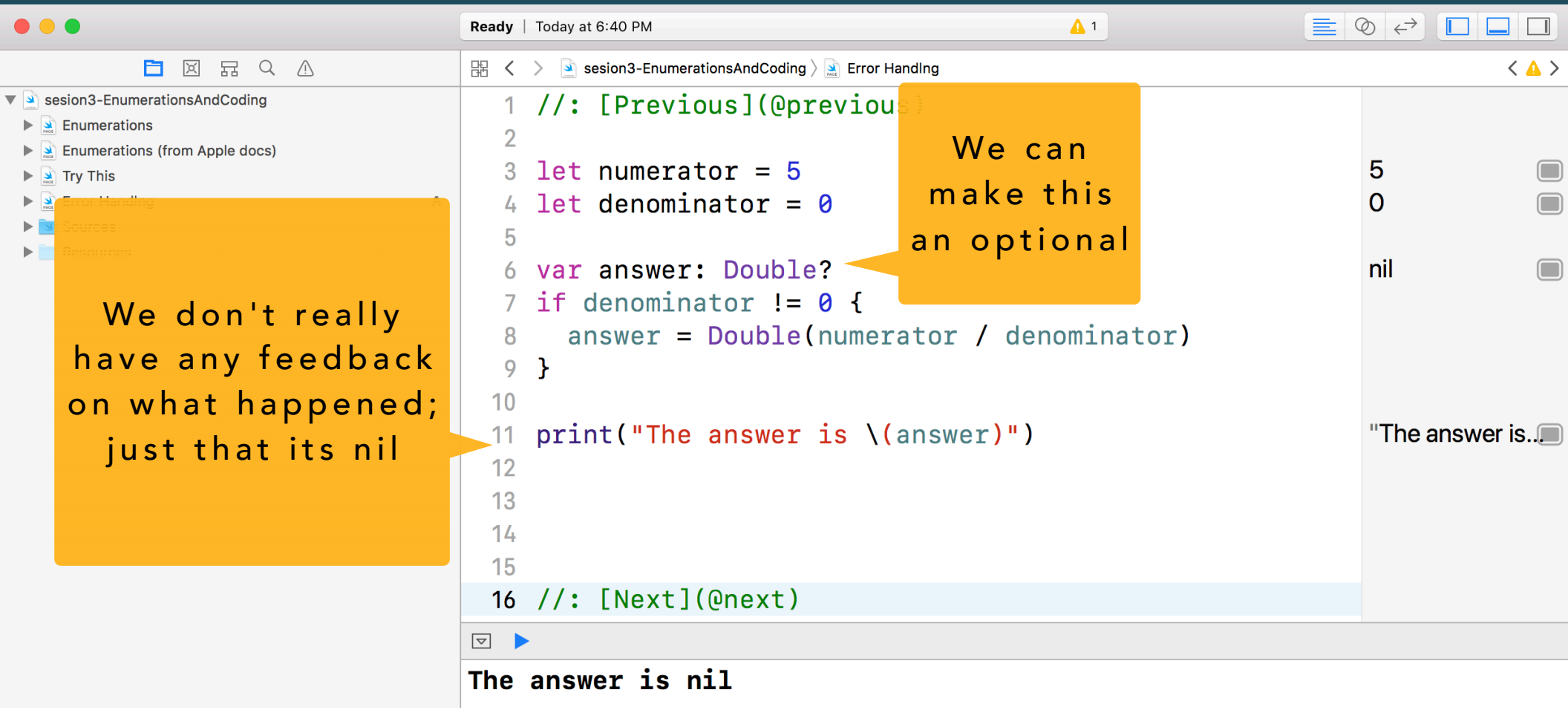
ERROR HANDLING



ERROR HANDLING

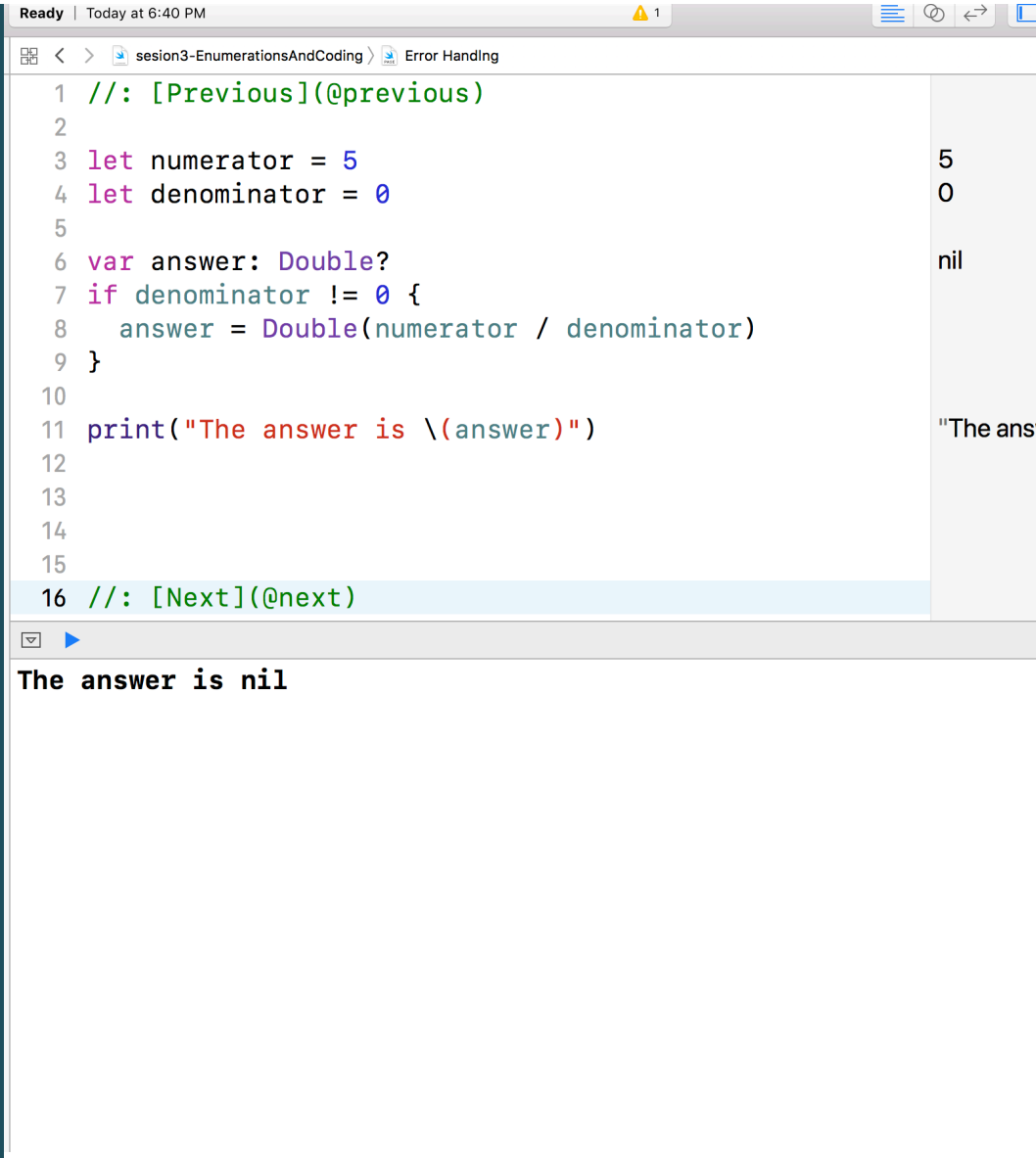


ERROR HANDLING



ERROR HANDLING

- Swift provides first-class language support for throwing, catching, propagating, and manipulating recoverable errors at runtime
- Provides a systematic and informative way to handle errors



ERROR TYPES

ERRORTYPE ENUM

- Swift errors are represented by special enums values types of `Error`
- Conform to `Error` protocol

Error type

```
enum DivisionError: Error {
  case divideByZero
  case nonNumeric
}
```

ERRORTYPE ENUM

- iOS APIs are full of custom error enums
- You can write your own

outError

AVAudioPlayer

Inherits from: NSObject
Conforms to: NSObject
Framework: AVFoundation in iOS 2.2 and later. More related items...

`- initWithContentsOfURL:error:`

Initializes and returns an audio player for playing a designated sound file.

Declaration

SWIFT

```
init(contentsOfURL url: NSURL) throws
```

OBJECTIVE-C

```
- (instancetype)initWithContentsOfURL:(NSURL *)url
                                 error:(NSError * _Nullable *)out
```

Parameters

url	A URL identifying the sound file to play. The audio data must be in For a list of supported formats, see Using Audio in *Multimedia Pro*
outError	If an error occurs, upon return the `NSError` object describes the e

Return value

On success, an initialized `AVAudioPlayer` object. If `nil`, the *outError* parameter describing the problem.

ERRORTYPE ENUM

- Throwing an error lets you indicate that something unexpected happened and the normal flow of execution can't continue

```
/// "
enum DivisionError: Error {
  case divideByZero
  case conversion
}

throw DivisionError.divideByZero
```

throw an error

ERRORTYPE ENUM

- `throw` keyword passes an error to the statement that called the function
- `try` keyword used with throws

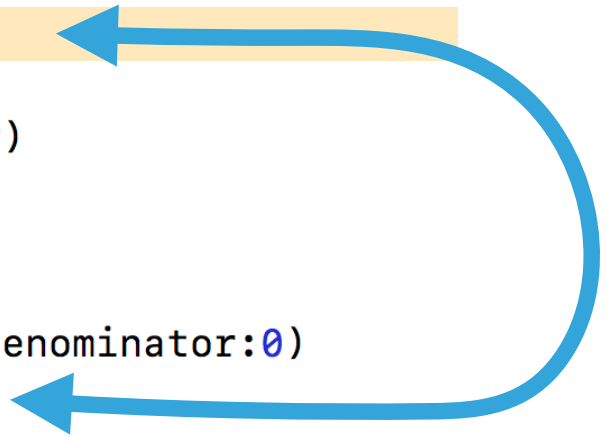
```
func canThrowErrors() throws -> String
try canThrowError()

func cannotThrowErrors() -> String
```

ERRORTYPE ENUM

```
enum DivisionError: Error {
  case divideByZero
}

func safeDivision(numerator: Int, denominator: Int) throws -> Double? {

  // Check all conditions that would result in an error
  if denominator != 0 {
    throw DivisionError.divideByZero
  }
 return Double(numerator / denominator)
}

do {
  _ = try safeDivision(numerator:10, denominator:0)
} catch DivisionError.divideByZero {
  print("Error: Division by 0")
}
```

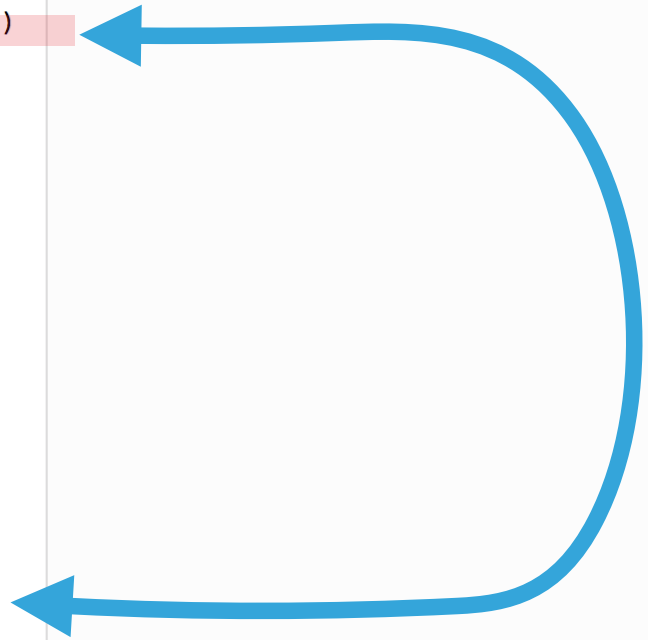
ERRORTYPE ENUM

```
enum DivisionError: Error {
  case divideByZero
}

func safeDivision(numerator: Int, denominator: Int) throws -> Double? {

  // Check all conditions that would result in an error
  if denominator != 0 {
    throw DivisionError.divideByZero
  }
 return Double(numerator / denominator)
}

do {
  _ = try safeDivision(numerator:10, denominator:0)
} catch DivisionError.divideByZero {
  print("Error: Division by 0")
}
```



ERRORTYPE ENUM

```
  do {
    let userId = try self.validateUser("user@email.com", password: "123456")
    print("Login was successfull: \(userId)")
  }
  catch UserValidationError.Empty {
    //
  }
  catch UserValidationError.MinimumLength {
    //
  }
  catch UserValidationError.Incorrect {
    //
  }
  catch {
    // Swift wants error handling to be exhaustive, so you must take into
    // account an undefined error
  }
}


func validateUser(username: String, password: String) throws -> String {
  //
  throw UserValidationError.Empty

  //
  throw UserValidationError.MinimumLength

  //
  throw UserValidationError.Incorrect

  // If you made it here, you can return:
  // let userId = //do something here
```



ERRORTYPE ENUM

- Alternative ways of handling errors
  - ! Ignore
  - ? Convert to optional

```
// Stop propogatio    errors.
let userId = try! self.validateUser("user@email.com", password: "123456")
print("\(userId) should be safe to use")

// Handle all error in the same way
if let userId = try? self.validateUser("user@email.com", password: "123456")
  print("\(userId) should be safe to use")
}
```

ERRORTYPE ENUM

- If an error is thrown while evaluating the try? expression, the value of the expression is `nil`

```
func someThrowingFunction() throws -> Int {
    // ...
}

let x = try? someThrowingFunction()

let y: Int?
do {
    y = try someThrowingFunction()
} catch {
    y = nil
}
```

ERRORTYPE ENUM

```
let photo = try! loadImage(atPath: "./Resources/John Appleseed.jpg")
```

- Use try! to disable throwing an error
- This does not mean that the results is safe

ERRORTYPE ENUM

Resources

```
enum UserValidationError: Error {
    case empty
    case minimumLength
    case incorrect(message: String)
}
```

Login Handling

```
/// Conduct basic validation on the username and password
/// - Returns:  A `String` of the userId
/// - Throws: A `UserValidationError`
///
func validateUser(_ username: String, password: String) throws -> String {

    guard password.characters.count > 0 else {
        throw UserValidationError.empty
    }

    guard password.characters.count >= 6 else {
        throw UserValidationError.minimumLength
    }
```

FILES AND PARSING

FILES AND PARSING

- Applications need to persist data between sessions
- Reading and writing data to disk

```
<Books>
    <Book ISBN="0553212419">
        <title>Sherlock Holmes: Complete Novels...
        <author>Sir Arthur Conan Doyle</author>
    </Book>
    <Book ISBN="0743273567">
        <title>The Great Gatsby</title>
        <author>F. Scott Fitzgerald</author>
    </Book>
    <Book ISBN="0684826976">
        <title>Undaunted Courage</title>
        <author>Stephen E. Ambrose</author>
    </Book>
    <Book ISBN="0743203178">
        <title>Nothing Like It In the World</title
        <author>Stephen E. Ambrose</author>
    </Book>
</Books>
```

FILES AND PARSING

- Files contain different types of data
  - Structured format (csv, XML, JSON, HTML)
  - Text (.txt)
  - Binary (.docx, .sql)
- An application can use any of these file types to save data

```
<Books>
    <Book ISBN="0553212419">
        <title>Sherlock Holmes: Complete Novels...
        <author>Sir Arthur Conan Doyle</author>
    </Book>
    <Book ISBN="0743273567">
        <title>The Great Gatsby</title>
        <author>F. Scott Fitzgerald</author>
    </Book>
    <Book ISBN="0684826976">
        <title>Undaunted Courage</title>
        <author>Stephen E. Ambrose</author>
    </Book>
    <Book ISBN="0743203178">
        <title>Nothing Like It In the World</title
        <author>Stephen E. Ambrose</author>
    </Book>
</Books>
```

FILES AND PARSING

- Different formats have different properties
  - Size
  - Privacy
  - Human readable

JSON

```
{
"siblings": [
{"firstName":"Anna","lastName":"Clayton"},
{"lastName":"Alex","lastName":"Clayton"}
]
}
```

XML

```
<siblings>
<sibling>
<firstName>Anna</firstName>
<lastName>Clayton</lastName>
</sibling>
<sibling>
<firstName>Alex</firstName>
<lastName>Clayton</lastName>
</sibling>
</siblings>
```

FILES AND PARSING

- Swift has built-in functions to help read text-based files
- Reading some file types may require special libraries

```
import Foundation

// Read data from this file
let path = "./data.txt"

do {
    let data = try String(contentsOfFile: path,encoding: String.Encoding.utf8)
    // Data is just a string
    print(data)

    // Split the string into components by a newline character "\n"
    for line in data.components(separatedBy: CharacterSet.newlines) {
        print("> Line: \(line)")
    }
} catch {
    print("Error:\(error)")
}
```

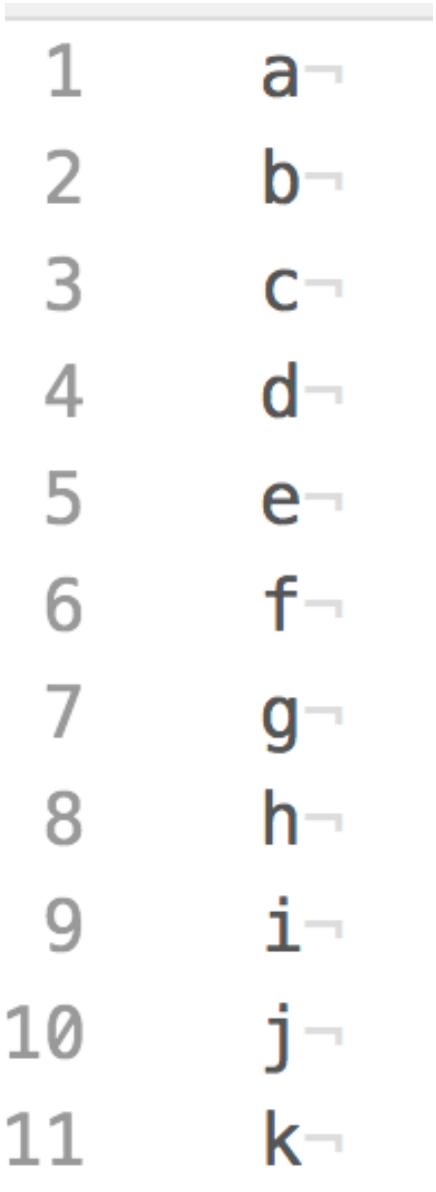
FILES AND PARSING

- One approach of many, but the most straightforward

```
// Read data from this file
let path = "./data.txt"

do {
    let data = try String(contentsOfFile: path,
                          encoding: String.Encoding.utf8)
    // Data is just a string
    print(data)

    // Split the string into components by a newline character "\n"
    for line in data.components(separatedBy: CharacterSet.newlines) {
      print("> Line: \(line)")
    }
  } catch {
    print("Error:\(error)")
  }
```

FILES AND PARSING

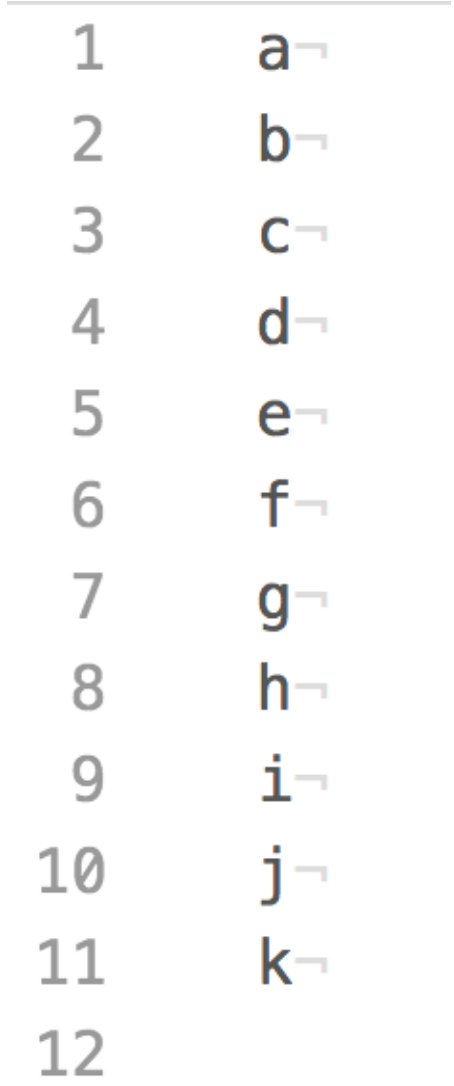
- Files have special (invisible) characters used in formatting
  - `\n` - "newline" to indicate when a line ends
  - `\t` - tab
- Use them to determined line breaks



FILES AND PARSING

- Pay attention to newline characters when printing
- You are reading them in from the file

End of file line



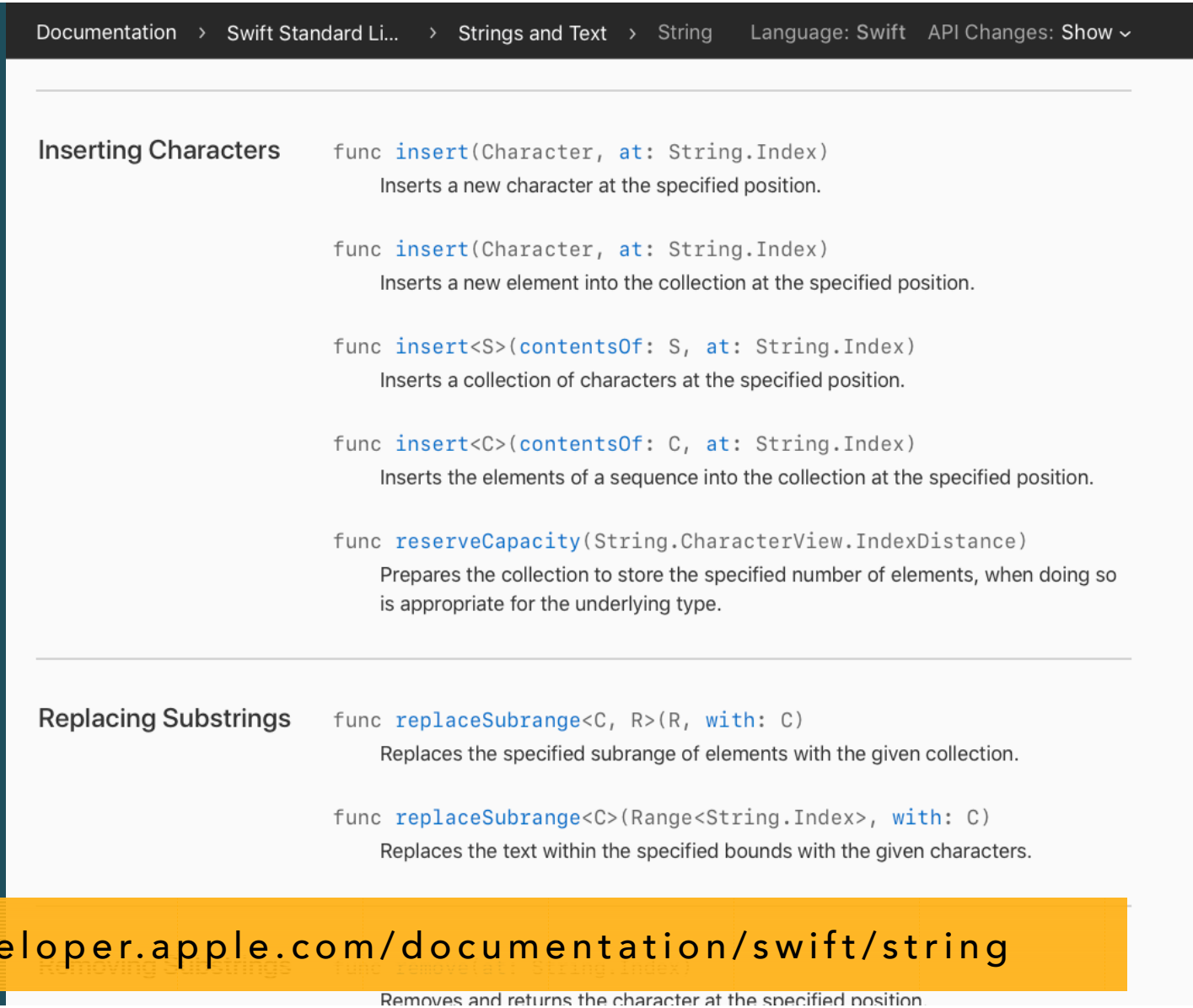
FILES AND PARSING

- We can read the whole file into a single string
  - \n are read in as well

```
let data = try String(contentsOfFile: path,
                      encoding: String.Encoding.utf8)
// Data is just a string
print(data)

// Split the string into components by a newline character "\n"
for line in data.components(separatedBy: CharacterSet.newlines) {
  print("> Line: \(line)")
}
```

FILES AND PARSING

- Clean up your data using string functions
- 'Whitespace' means characters you can not see
  - \t,\n,\ ,etc.



https://developer.apple.com/documentation/swift/string

FILES AND PARSING

- Cleaning up data is a fundamental problem in computer science
- There are many tools and workflows to accomplish a task
  - Sometimes it is easier to clean up your data before inputing it into a program
  - Sometimes you will write two programs (one to clean, one to process)

ASSIGNMENT

ASSIGNMENT

MPCS 51043

Assignment

Assignment 1 is due October 7, 2017 at 8:59am.

- Sign up for a GitHub account (if you don't have one).
- Sign up for Slack and join our workspace.
- Post a introductory comment to the `#general` channel on Slack. Tell everyone a little about yourself and your background (e.g. full/part time student, undergraduate degree, etc.). Please upload a picture of yourself so we know you who are. Hilarious pictures are encouraged.
- Setup your development environment by downloading Xcode and Atom. Use the latest version on Xcode that is on the Mac App Store.
- Review the Swift Guided Tour Playground Apple. Stop reading after `Functions and Closures` chapter.
- There are many resources for learning Swift listed above. Please

http://uchicago.codes

THE END

MPCS 51043
AUTUMN 2017
SESSION 3

THE UNIVERSITY OF CHICAGO

UNIT TESTING

GENERICS


LISTS

LISTS

- List constants are surrounded by square brackets
- The elements in the list are separated by commas

```
# List of strings
friends = [ 'Nick', 'Jane', 'Rachel']

# List of integers
favorite_numbers = [ 1, 2, 3, 4, 5]

# List iteration
dogs = [ 'spot', 'underdog', 'snooopy']
for dog in dogs:
    print dog,

>>> spot, underdog, snooopy
```

LISTS

- A list element can be any Python object
- Even another list

```
# List of strings
cats = [ 'garfield', 'lola', 'scaredy']
dogs = [ 'spot', 'underdog', 'snooopy']

# List of lists
pets = [ cats, dogs ]

>>> pets
[['garfield', 'lola', 'scaredy'],
['spot', 'underdog', 'snooopy']]
```

LISTS

- Iterating a list of lists

```
cats = [ 'garfield', 'lola', 'scaredy']
dogs = [ 'spot', 'underdog', 'snooopy']
pets = [ cats, dogs ]


# Loop through the list of lists
for pet in pets:

 # The iteration variable is a list
 for animal in pet:
    print animal,


>>> [['garfield', 'lola', 'scaredy'],
     ['spot', 'underdog', 'snooopy']]
```

LISTS

```
for pet in pets:
    print type(pet)

    if isinstance(pet, list):
        for animal in pet:
            print animal,
```

Remember a list can contain different types

```
<type 'list'>
['garfield', 'lola', 'scaredy']
<type 'list'>
['spot', 'underdog', 'snooopy']
```

LISTS

- Access the elements of list by their index

```
cats = [ 'garfield', 'lola', 'scaredy']
dogs = [ 'spot', 'underdog', 'snooopy']
pets = [cats, dogs]

print pets[0]     # cats list
print pets[0][0]  # garfield
print pets[0][1]  # lola

print pets[1]     # dogs list
print pets[1][1]  # underdog
```

LISTS

- If an index has a negative value, it counts backward from the end

```
cats = [ 'garfield', 'lola', 'scaredy']

print cats[-1] # scaredy

print cats[-2] # lola

print cats[-3] # garfield
```

LISTS

- Any integer expression can be used as an index
- IndexError if you try to read or write an element that does not exist

```
cats = [ 'garfield', 'lola', 'scaredy']
index = 4

print cats[index]
```

```
Traceback (most recent call last):
  File "workspace.py", line 4, in
<module>
    cats[4]
IndexError: list index out of range
```

LISTS

- The `range()` function returns a list of numbers that range from zero to one less than the parameter
- Take 1 or 2 parameters

```
for i in range(len(cats)):
    print "#", i,"->",cats[i]
# 0 -> garfield
# 1 -> lola
# 2 -> scaredy

for i in range(0,len(cats)):
    print "#", i,"->",cats[i]
# 0 -> garfield
# 1 -> lola
# 2 -> scaredy

for i in range(1,len(cats)):
    print "#", i,"->",cats[i]
# 0 -> garfield
# 1 -> lola
```

LISTS

- List are mutable

```
cats = [ 'garfield', 'lola', 'scaredy']
print cats
# >>> ['garfield', 'lola', 'scaredy']


# Mutate the value of the value at
# index 1
cats[1] = 'tom'

print cats
# >>> ['garfield', 'tom', 'scaredy']
```

LISTS

- Strings are not mutable

```
name = 'Ada'
print name[0] # A

name[0] = "B"


Traceback (most recent call last):
  File "workspace.py", line 11, in
<module>
    name[0] = "B"
TypeError: 'str' object does not
support item assignment
```

LISTS

- A list can be empty

```
drinks = []

print drinks  # []
```

LISTS

- Lists can be concatenated using the `+` operator

```
cats = [ 'garfield', 'lola', 'scaredy']
famous_cats = [ 'whiskers', 'grumpy
                cat']

# Use the + operator to concatenate
# lists
all_cats = cats + famous_cats

print all_cats

# >>> ['garfield', 'lola', 'scaredy',
'whiskers', 'grumpy cat']
```

LISTS

- Combined concatenation and value reassignment

```
cats = [ 'garfield', 'lola', 'scaredy']
famous_cats = [ 'whiskers', 'grumpy
cat']

# Use the += operator to concatenate
# and reassign to original list
# cats = cats + famous_cats
cats += famous_cats

print cats
# >>> ['garfield', 'lola', 'scaredy',
'whiskers', 'grumpy cat']
```

LISTS

- Lists can be sliced
  - list[start:stop]

```
cats = [ 'garfield', 'lola', 'scaredy']
famous_cats = [ 'whiskers', 'grumpy
                  cat']

# Use the + operator to concatenate
# lists
all_cats = cats + famous_cats

print all_cats

# >>> ['garfield', 'lola', 'scaredy',
'whiskers', 'grumpy cat']

print all_cats[2:5]
# >>> ['scaredy', 'whiskers', 'grumpy
cat']
```

LISTS

- A list can be empty

```
drinks = []

print drinks  # []
```

LISTS

- List have built-in functions
  - append(item)

```
drinks = []
print drinks  # []

drinks.append("Soda")
print drinks # ['Soda']

drinks.append("Wine")
print drinks # ['Soda', 'Wine']

drinks.append("Beer")
print drinks # ['Soda', 'Wine', 'Beer']
```

LISTS

- List have built-in functions
  - extend(list)

```
drinks = []
print drinks  # []


drinks.append("Soda")
print drinks # ['Soda']


more_drinks = ["Wine", "Beer"]
drinks.extend(more_drinks)
print drinks # ['Soda', 'Wine', 'Beer']
```

LISTS

- List have built-in functions
  - sort()

```
print drinks # ['Soda', 'Wine', 'Beer']

drinks.sort()

print drinks # ['Beer', 'Soda', 'Wine']
```

LISTS

- List have built-in functions
  - sorted(list) vs list.sort()
- Pay attention to returned values of functions

```
list = [6,4,2,3]
print list
# >>> [6, 4, 2, 3]

# sorted() returns a new list the
# original list remains the same
print sorted(list)
# >>> [2, 3, 4, 6]

print list
# >>> [6, 4, 2, 3]

print list.sort()
# None

print list
# >>> [2, 3, 4, 6]
```

LISTS

```
drinks = []
print drinks  # []

drinks.append("Soda")
print drinks # ['Soda']

more_drinks = ["Wine", "Beer"]
drinks += more_drinks
print drinks
# ['Soda', 'Wine', 'Beer']

drinks.insert(0,'Lemonade')
print drinks
# ['Lemonade', 'Soda', 'Wine', 'Beer']
```

insert(index,value)

LISTS

```
drinks = ["Soda", "Wine", "Beer", "Lemonade"]
print drinks
# ['Soda', 'Wine', 'Beer', 'Lemonade']

del drinks[0]
print drinks
# ['Wine', 'Beer', 'Lemonade']

del drinks [0:2]
print drinks
# ['Lemonade']
```

DEL LIST[INDEX] REMOVES THE ITEM AND DOES

LISTS

```
drinks = ["Soda", "Wine", "Beer", "Lemonade"]
del drinks[0]

print drinks
# ['Wine', 'Beer', 'Lemonade']

removed_item = drinks.pop()
print removed_item
# Lemonade

print drinks
# ['Wine', 'Beer']
```

pop returns the element removed

LISTS

```
drinks = ["Soda", "Wine", "Beer", "Lemonade"]
print drinks
# ['Lemonade', 'Soda', 'Wine', 'Beer']

drinks.remove('Wine')
drinks.remove('Beer')
print drinks
# ['Lemonade', 'Soda']
```

Remove(element) removes the element

LISTS

- dir()
  - attempt to return a list of valid attributes for that object

```
>>> x = list()
>>> type(x)

<type 'list'>
>>> y = []

>>> type(y)
<type 'list'>

>>> dir(y)
['append', 'count', 'extend', 'index',
'insert', 'pop', 'remove', 'reverse',
'sort']
```

LISTS

```
>>> x = list()
>>> type(x)

<type 'list'>
>>> y = []

>>> type(y)
<type 'list'>

>>> dir(y)
['append', 'count', 'extend', 'index', 'insert', 'pop',
'remove', 'reverse', 'sort']
```

LISTS

__X__ are special functions used internally by python

```
>>> dir(x)
['__add__', '__class__', '__contains__', '__delattr__',
'__delitem__', '__delslice__', '__doc__', '__eq__',
'__format__', '__ge__', '__getattribute__', '__getitem__',
'__getslice__', '__gt__', '__hash__', '__iadd__',
'__imul__', '__init__', '__iter__', '__le__', '__len__',
'__lt__', '__mul__', '__ne__', '__new__', '__reduce__',
'__reduce_ex__', '__repr__', '__reversed__', '__rmul__',
'__setattr__', '__setitem__', '__setslice__', '__sizeof__',
'__str__', '__subclasshook__', 'append', 'count', 'extend',
'index', 'insert', 'pop', 'remove', 'reverse', 'sort']
```

LISTS

- Built-in function `dir()`
  - Attempt to return a list of valid attributes for that object

```
>>> s = 'hi'
>>> type(s)
<type 'str'>
>>> dir(s)
['capitalize', 'center', 'count',
'decode', 'encode', 'endswith',
'expandtabs', 'find', 'format',
'index', 'isalnum', 'isalpha',
'isdigit', 'islower', 'isspace',
'istitle', 'isupper', 'join', 'ljust',
'lower', 'lstrip', 'partition',
'replace', 'rfind', 'rindex', 'rjust',
'rpartition', 'rsplit', 'rstrip',
'split', 'splitlines', 'startswith',
'strip', 'swapcase', 'title',
'translate', 'upper', 'zfill']
```

LISTS

- Lists can be function arguments

```
def add_them_up(numbers):
    # Take a list of numbers, sum
    # them and return the total
    total = 0
    for number in numbers:
        total = total + number
    return total


scores = [3, 41, 12, 9, 74, 15]
print add_them_up(scores)
```

LISTS

- Functions can return a list

```
def first_and_last(numbers):
    # Return the first and last
    # item of a list
    first = numbers[0]
    last = numbers[-1]
    first_last = [first, last]
    return first_last


scores = [3, 41, 12, 9, 74, 15]
print first_and_last(scores)
# >>> [3, 15]
```

LISTS

- Lists can be function arguments

```
def add_them_up(numbers):
    # Take a list of numbers, sum
    # them and return the total
    total = 0
    for number in numbers:
        total = total + number
    return total


scores = [3, 41, 12, 9, 74, 15]
print add_them_up(scores)
```

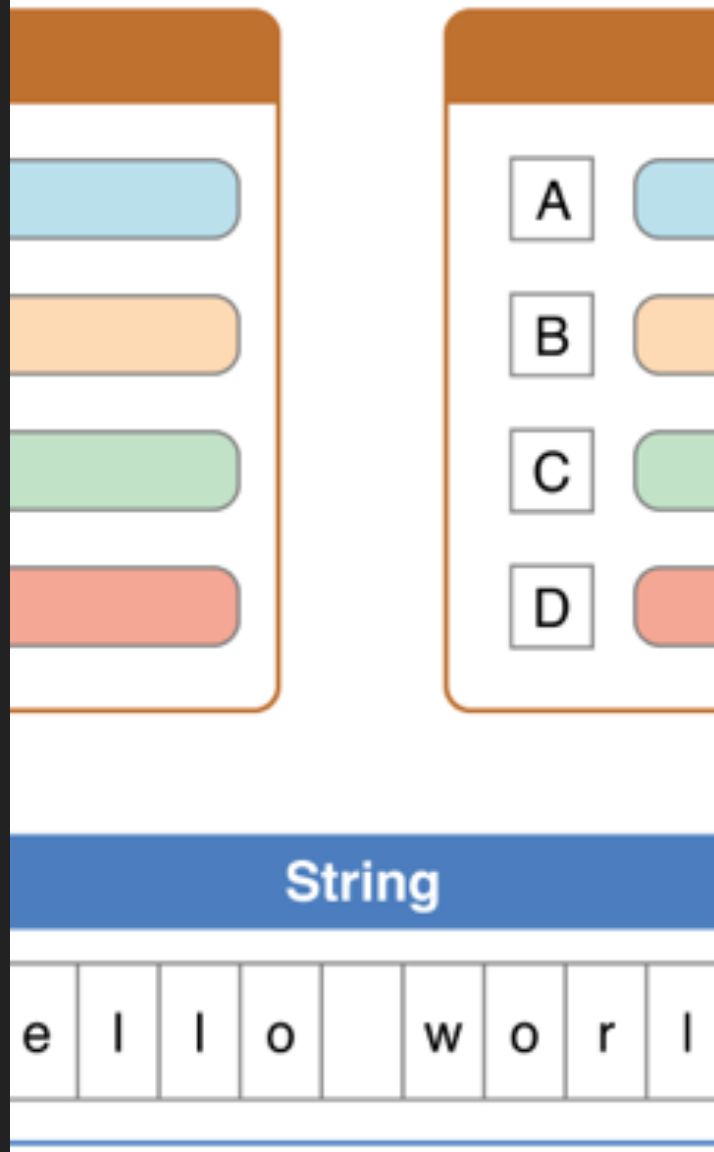
LISTS

- There are a number of functions built into Python that take lists as parameters

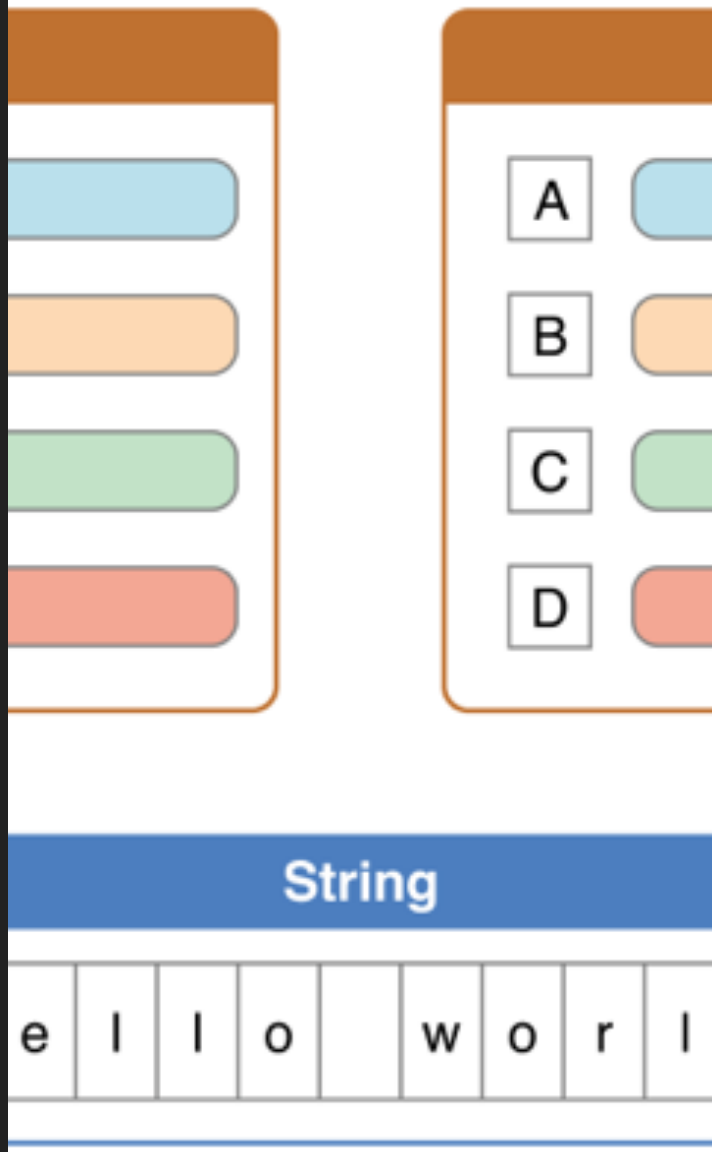
```
nums = [3, 41, 12, 9, 74, 15]

print len(nums)              # 6
print max(nums)              # 74
print min(nums)              # 3
print sum(nums)              # 154
print sum(nums)/len(nums)    # 25
```

FOUNDATION FRAMEWORK

- Defines a base layer of functionality required for almost all applications
- Primitive classes (eg. int, float, char)
- Value classes representing basic data types (e.g. strings, numbers, collections)
- Provide a small set of basic utility classes
- Make software development easier by introducing consistent conventions



- Introduces several paradigms that define functionality not provided by either the Objective-C runtime and language or Swift standard library and language
- Support internationalization and localization, to make software accessible to users around the world
- Provide a level of OS independence, to enhance portability



- Make software development easier by introducing consistent conventions for things such as deallocation.
- Support Unicode strings, object persistence, and object distribution.
- Provide a level of OS independence, to enhance portability.

The Foundation framework includes the root object class, classes representing basic data types such as strings and byte arrays, collection classes for storing other objects, classes representing system information such as dates, and classes representing communication ports. See Cocoa Objective-C Hierarchy for Foundation for a list of those classes that make up the Foundation framework.

The Foundation framework introduces several paradigms to avoid confusion in common situations, and to introduce a level of consistency across class hierarchies. This consistency is done with some standard policies, such as that for object ownership (that is, who is responsible for disposing of objects), and with abstract classes like `NSEnumerator`. These new paradigms reduce the number of special and exceptional cases in an API and allow you to code more efficiently by reusing the same mechanisms with various kinds of objects.

Foundation Framework Classes

The Foundation class hierarchy is rooted in the Foundation framework's `NSObject` class. The remainder of the Foundation framework consists of several related groups of classes as well as a few individual classes. Many of the groups form what are called class clusters—abstract classes that work as umbrella interfaces to a versatile set of private subclasses. `NSString` and `NSMutableString`, for example, act as brokers for instances of various private subclasses optimized for different kinds of storage needs. Depending on the method you use to create a string, an instance of the appropriate optimized class will be returned to you.

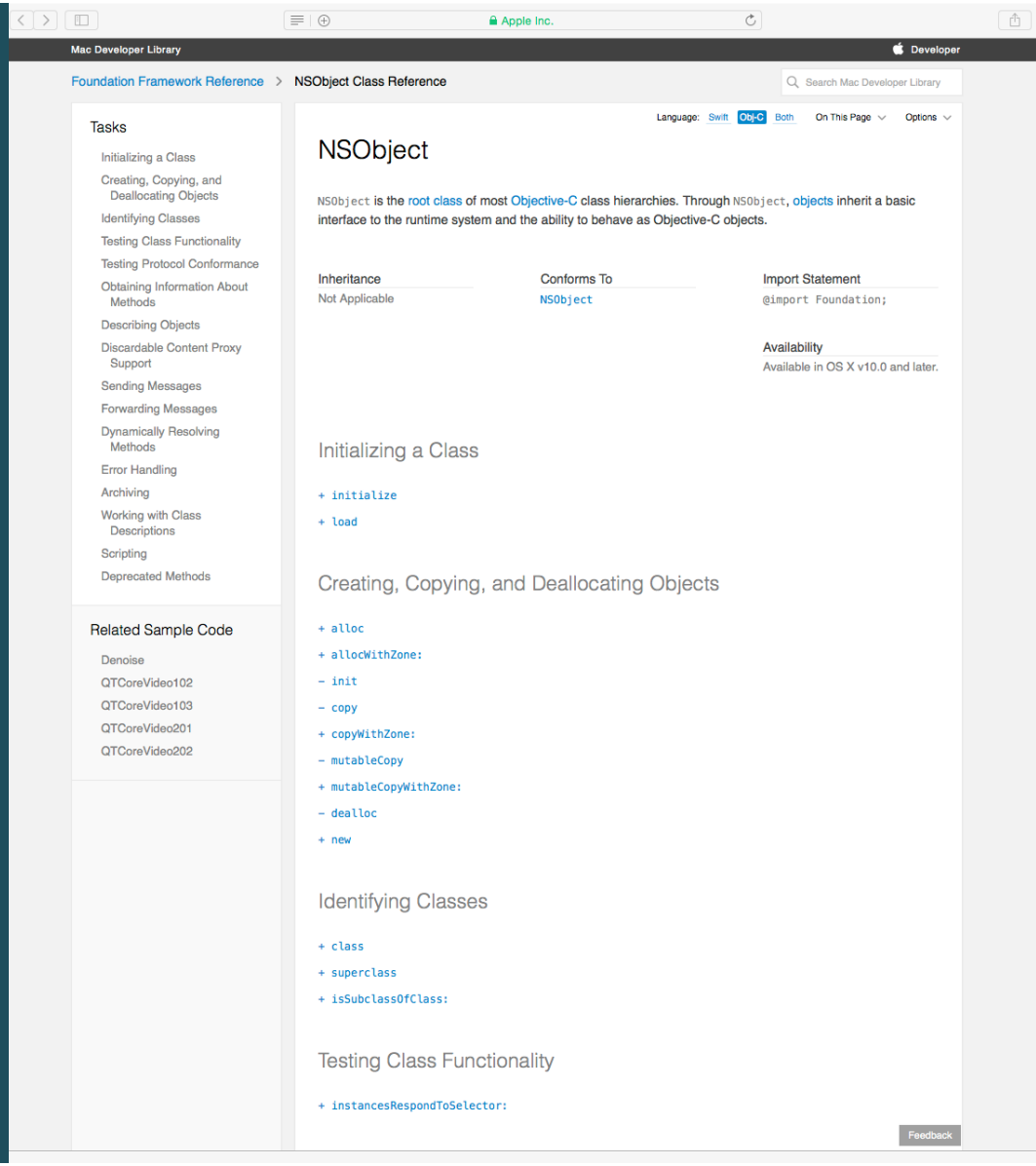
Many of these classes have closely related functionality:

- Data storage. `NSData` and `NSString` provide object-oriented storage for arrays of bytes. NSValue and NSNumber provide object-oriented storage for arrays of simple C data values. `NSArray`, `NSDictionary`, and `NSSet` provide storage for Objective-C objects of any class.
- Text and strings. `NSCharacterSet` represents various groupings of characters that are used by the `NSString` and `NSScanner` classes. The `NSString` classes represent text strings and provide methods for searching, combining, and comparing strings. An `NSScanner` object is used to scan numbers and words from an `NSString` object.

```
ponents instance
_Components(string: "https://swift.org")!

g useful about the URL
ost!)")

.org"
```

NSOBJECT

- Root class of all objects
- Implements basic functionality
  - Memory management
  - Introspection
  - Object equality



VALUE OBJECTS

- An object that encapsulates a primitive value (of a C data type)
- Provides services related to that value
- Some examples of value objects in the Foundation framework are:
  - NSString and NSMutableString
  - NSData and NSMutableData
  - NSDate
  - NSNumber
  - NSValue

VALUE OBJECTS

Related Documentation

- Number and Value Programming Topics
- Property List Programming Guide

Related Sample Code

- Advanced UISearchBar
- AdvancedURLConnections
- Core Image Filters with Photos and Video for iOS
- CryptoExercise
- TheElements

Inheritance

- NSObject
  - NSValue
    - NSNumber
      - NSDecimalNumber

Conforms To

NSCopying
NSObject
NSSecureCoding

Import Statement

```
@import Foundation;
```

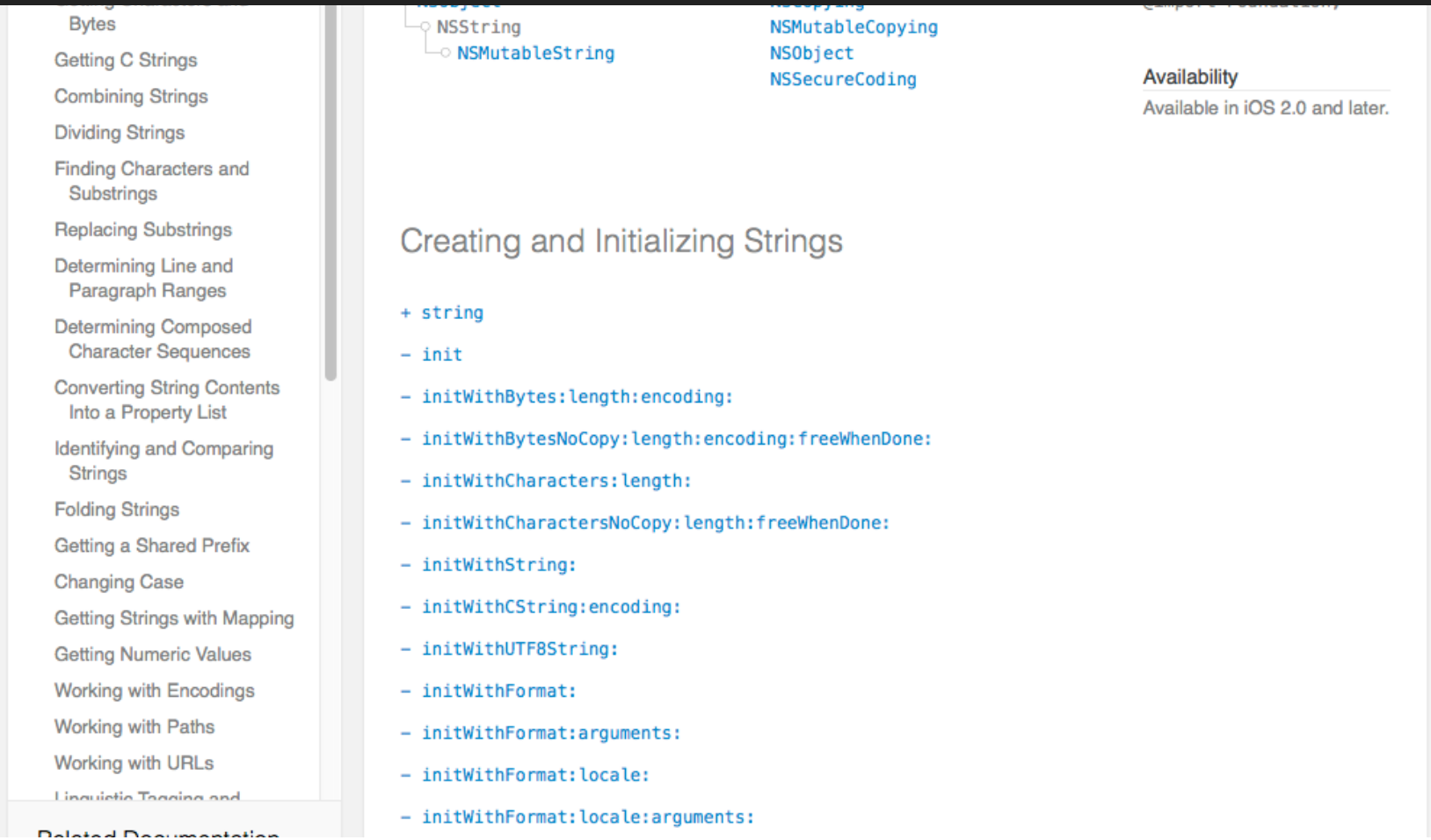
Availability

Available in iOS 2.0 and later.

Creating an NSNumber Object

```
+ numberWithBool:
+ numberWithChar:
+ numberWithDouble:
+ numberWithFloat:
+ numberWithInt:
+ numberWithInteger:
+ numberWithLong:
+ numberWithLongLong:
+ numberWithShort:
+ numberWithUnsignedChar:
+ numberWithUnsignedInt:
+ numberWithUnsignedInteger:
```

VALUE OBJECTS



VALUE OBJECTS

NSArray
NSMutableArray

NSFastEnumeration
NSMutableCopying
NSObject
NSSecureCoding

Availability

Available in OS X v10.0 and later.

Creating an Array

```
+ array
+ arrayWithArray:
+ arrayWithContentsOfFile:
+ arrayWithContentsOfURL:
+ arrayWithObject:
+ arrayWithObjects:
+ arrayWithObjects:count:
```

Initializing an Array

```
- init
- initWithArray:
- initWithArray:copyItems:
```

VALUE OBJECTS

Related Documentation

- Collections Programming Topics
- Key-Value Coding Programming Guide

Related Sample Code

- AVCompositionDebugViewer
- iSpend
- SimpleScriptingPlugin
- Sketch+Accessibility
- TableViewPlayground

NSObject
NSArray
NSMutableArray
SBElementArray

NSCopying
NSFastEnumeration
NSMutableCopying
NSObject
NSSecureCoding

```
@import Foundation;
```

Availability

Available in OS X v10.0 and later.

Creating and Initializing a Mutable Array

```
+ arrayWithCapacity:
+ arrayWithContentsOfFile:
+ arrayWithContentsOfURL:
- init
- initWithCapacity:
- initWithContentsOfFile:
- initWithContentsOfURL:
```

Adding Objects

```
- addObject:
- addObjectsFromArray:
- insertObject:atIndex:
```

VALUE OBJECTS

Inheritance

NSObject
NSDictionary
NSMutableDictionary

Conforms To

NSCopying
NSFastEnumeration
NSMutableCopying
NSObject
NSSecureCoding

Import Statement

```
@import Foundation;
```

Availability

Available in iOS 2.0 and later.

Creating a Dictionary

```
+ dictionary
+ dictionaryWithContentsOfFile:
+ dictionaryWithContentsOfURL:
+ dictionaryWithDictionary:
+ dictionaryWithObject:forKey:
+ dictionaryWithObjects:forKeys:
+ dictionaryWithObjects:forKeys:count:
+ dictionaryWithObjectsAndKeys:
```

Initializing an NSDictionary Instance

```
- initWithContentsOfFile:
```

VALUE OBJECTS

Collections Programming Topics

Related Sample Code

AdvancedURLConnections

Core Image Filters with Photos and Video for iOS

CryptoExercise

GenericKeychain

Quartz Composer IMStatus

Inheritance

NSObject
NSDictionary
NSMutableDictionary

Conforms To

NSCopying
NSFastEnumeration
NSMutableCopying
NSObject
NSSecureCoding

Import Statement

```
@import Foundation;
```

Availability

Available in iOS 2.0 and later.

Creating and Initializing a Mutable Dictionary

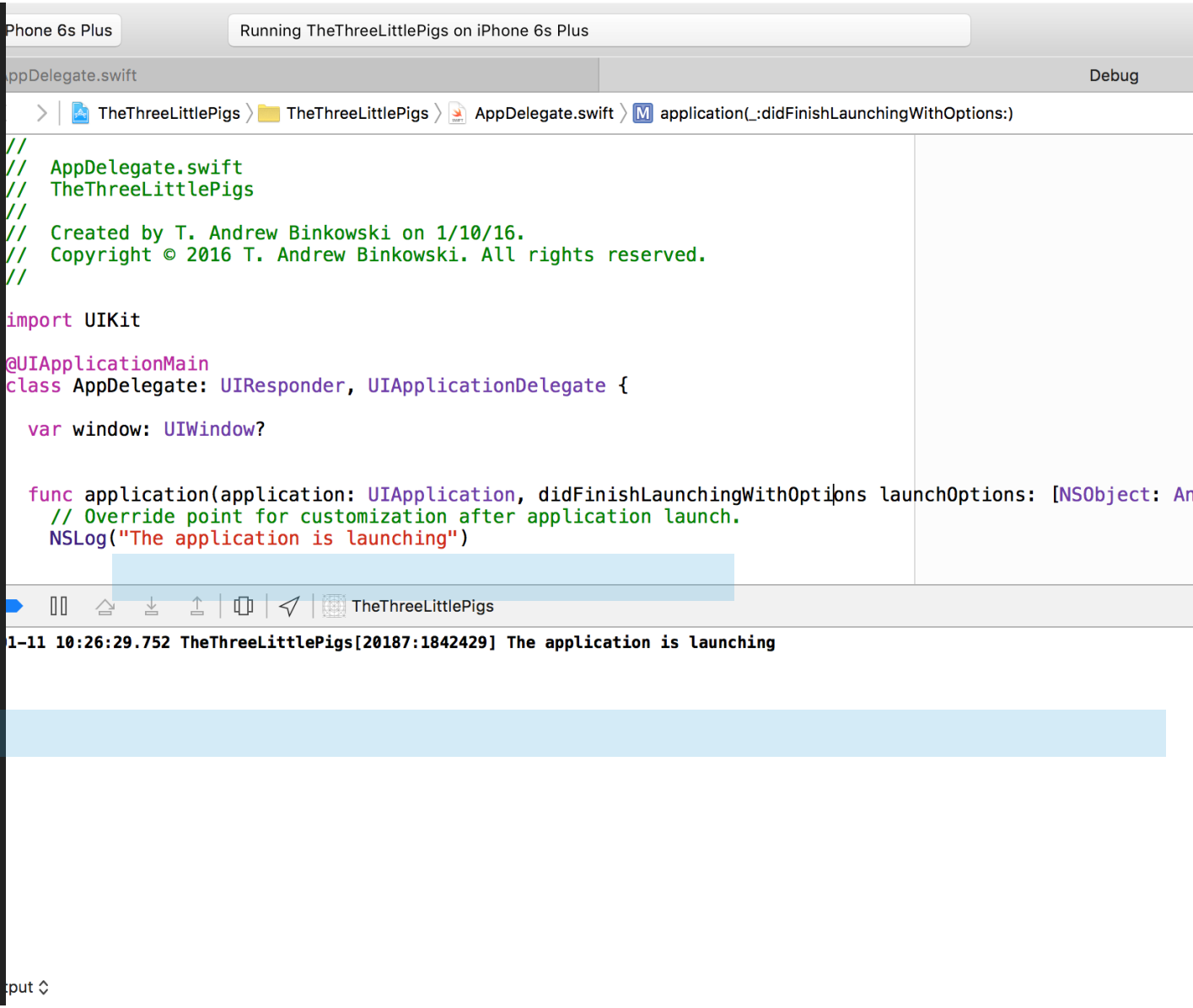
```
+ dictionaryWithCapacity:
- initWithCapacity:
- init
+ dictionaryWithSharedKeySet:
```

Adding Entries to a Mutable Dictionary

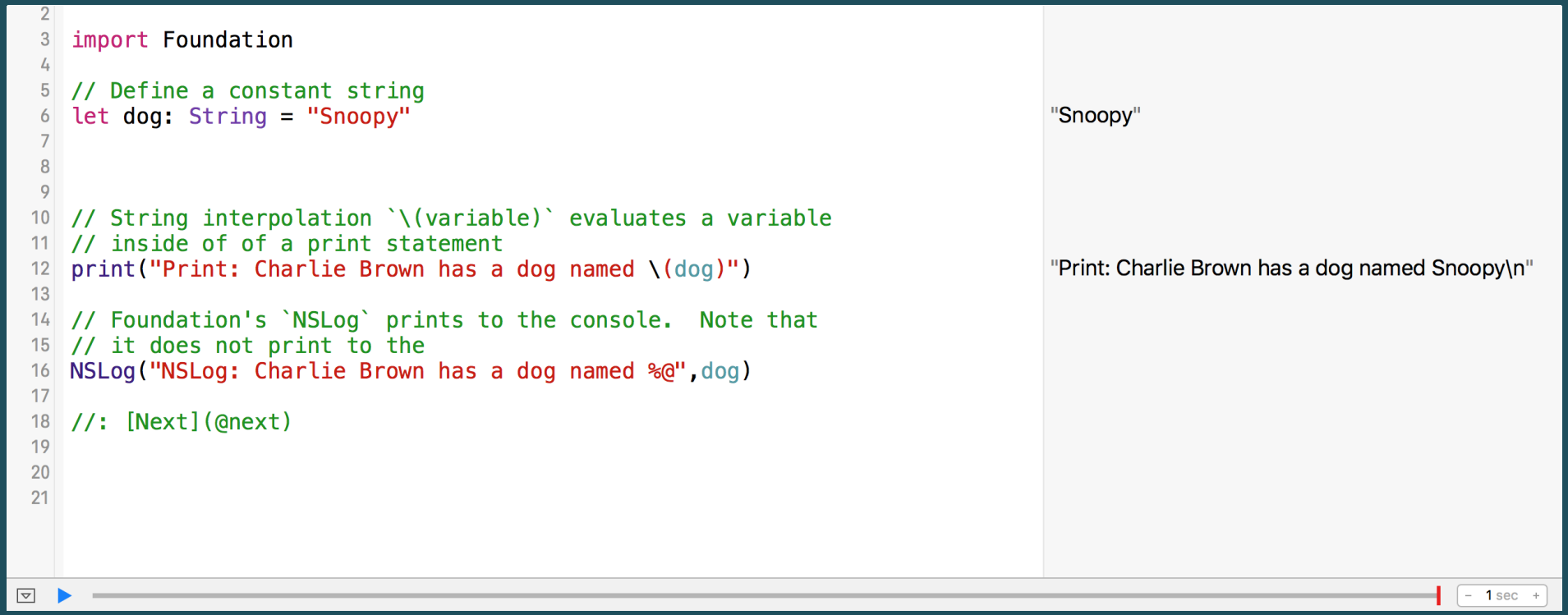
```
- setObject:forKey:
- setObject:forKeyedSubscript:
- setValue:forKey:
- addEntriesFromDictionary:
- setDictionary:
```

NSLOG

- Logs output to the Xcode console
- C-style type formatting for arguments
- calls `description` on an object



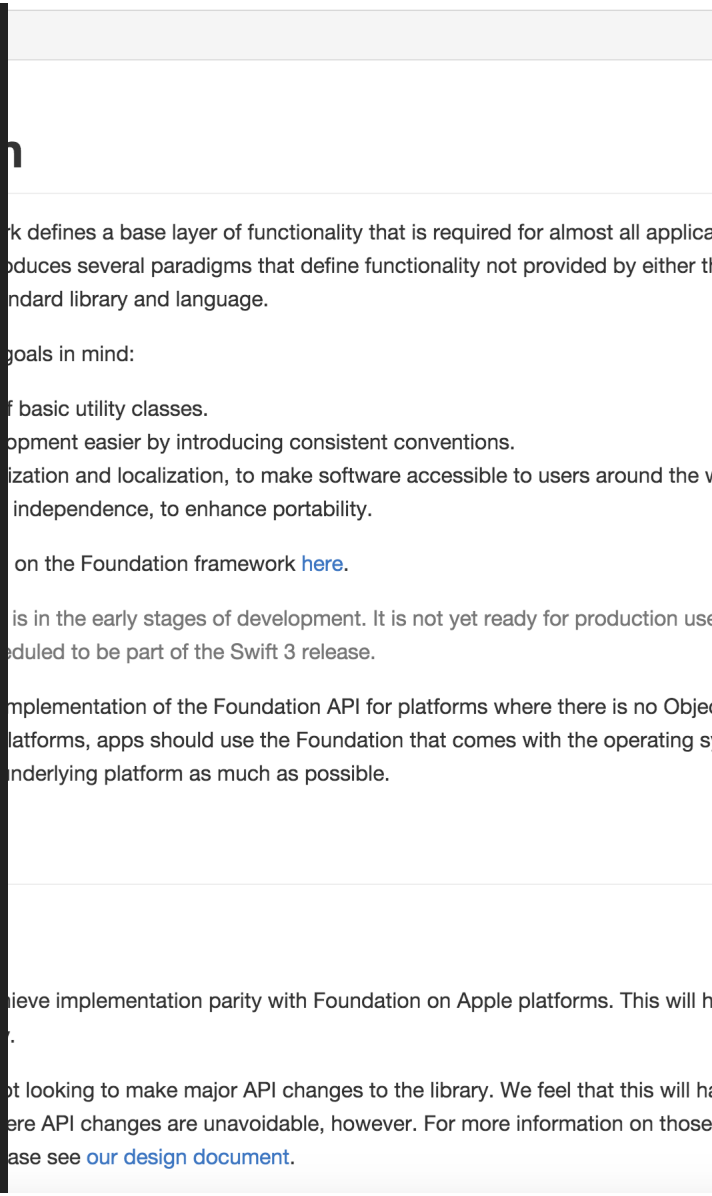
NSLOG



- Print vs. NSLog

WHAT ABOUT SWIFT TYPES

- Swift has native types
  - Compatible with Foundation counterparts
  - Some have same/more/less functionality



WHAT ABOUT SWIFT TYPES

Foundation.xcplaygroundpage

Session2-SwiftBasics 〉 Foundation

```
let dog: String = "Snoopy"                                                  "Snoopy"

// String interpolation `\(variable)` evaluates a variable
// inside of of a print statement
print("Print: Charlie Brown has a dog named \(dog)")                        "Print: Charlie Brown has a dog na..."

// Foundation's `NSLog` prints to the console.  Note that
// it does not print to the
NSLog("NSLog: Charlie Brown has a dog named %@",dog)


//: Swift vs. Foundation
//: --------------------
var greeting = "Hello from Swift"                                           "Hello from Swift"

// Make it more exciting using an exclusive Swift `String` API
greeting.appendContentsOf("!")                                              "Hello from Swift!"

// Make it more exciting for 2016 using a Foundation NSString API
greeting.stringByReplacingOccurrencesOfString("!", withString: "😀")        "Hello from Swift😀"

// Make it more exciting for the snapchat generation
let image = UIImage(named:"swift.jpg")                                      w 620 h 506


//: > Swift 3 will bring feature parity
```

WHAT ABOUT SWIFT TYPES

- Swift 3
  - Rewrite Foundation for portability
  - Simplify naming (no more NS)
  - Feature parity