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Building iOS Apps in Swift

Course notes for part 1

14th-16th September 2021

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Contents List

Day 1 - 14th September 2021

Day 2 - 15th September 2021

Day 3 - 16th September 2021

Session 1: Introduction to Swift

- Trainer and Delegate Introductions / Intro to course
- Foundations of Swift
- XCode Playgrounds
- Basics of the language: Types, Operators, Conditionals, Iterators, Strings, Arrays, Dictionaries
- Lab 1: Trying out the language basics

Welcome & Introductions

Chris Price

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Building iOS Apps in Swift

- 6 day course in two parts
- Based around excellent material provided by Apple
- Speeded up for professionals with experience
- Expanded on in complex areas not covered well by Apple's course

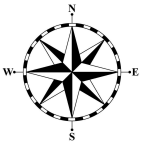
Introductions - me

- Course Instructor: Chris Price
  - Professor at Aberystwyth University, Wales
  - Teach courses in Software Engineering and in App Development in Swift
  - Been developing apps since 2009
  - Shipped apps to around 200,000 users in that time

Introductions - you

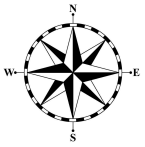
- Course attendees
  - You…
    - Name
    - Professional Position
    - Programming experience
    - Motivation and Expectations

Course Content



- Part 1: First three days
  - Basics of Swift language (briefly)
  - Extra features of Swift needed for app building
  - Enough about building iOS apps to build *most* self-contained apps
- Part 2: Second three days - more advanced apps
  - Persistence
  - Linking to internet systems, cloud services, libraries
  - Notifications
  - Reactive systems and concurrency
  - Automated testing

How will the course work



- We will cover basics of Swift very quickly, and try things out in Swift Playgrounds
- We will take more time over possibly unfamiliar features such as Optionals, Protocols and Closures
- We will build *many* small apps in Xcode, some together and some following instructions in Apple Books
- Support each other in building, and I will help where needed

Questions/comments?

?

Introduction to Swift and Playgrounds

Chris Price

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Swift - a modern language: Safe

- Strong typing
- Compile-time checking as much as possible
- Ensures that things are initialised
- Makes switch statements cover all possible cases
- Makes clear you know what is included in an if statement
- Takes nil pointers seriously

Swift - a modern language: Fast

- Language that helps compiler to optimise
- Encourages the user to make their intentions clear so that compiler can optimise the code

Swift - a modern language: Expressive

- Doesn't make people write stuff the compiler should know:
- Implied type declaration where possible
- Implicit type name when type known (e.g. for enums)

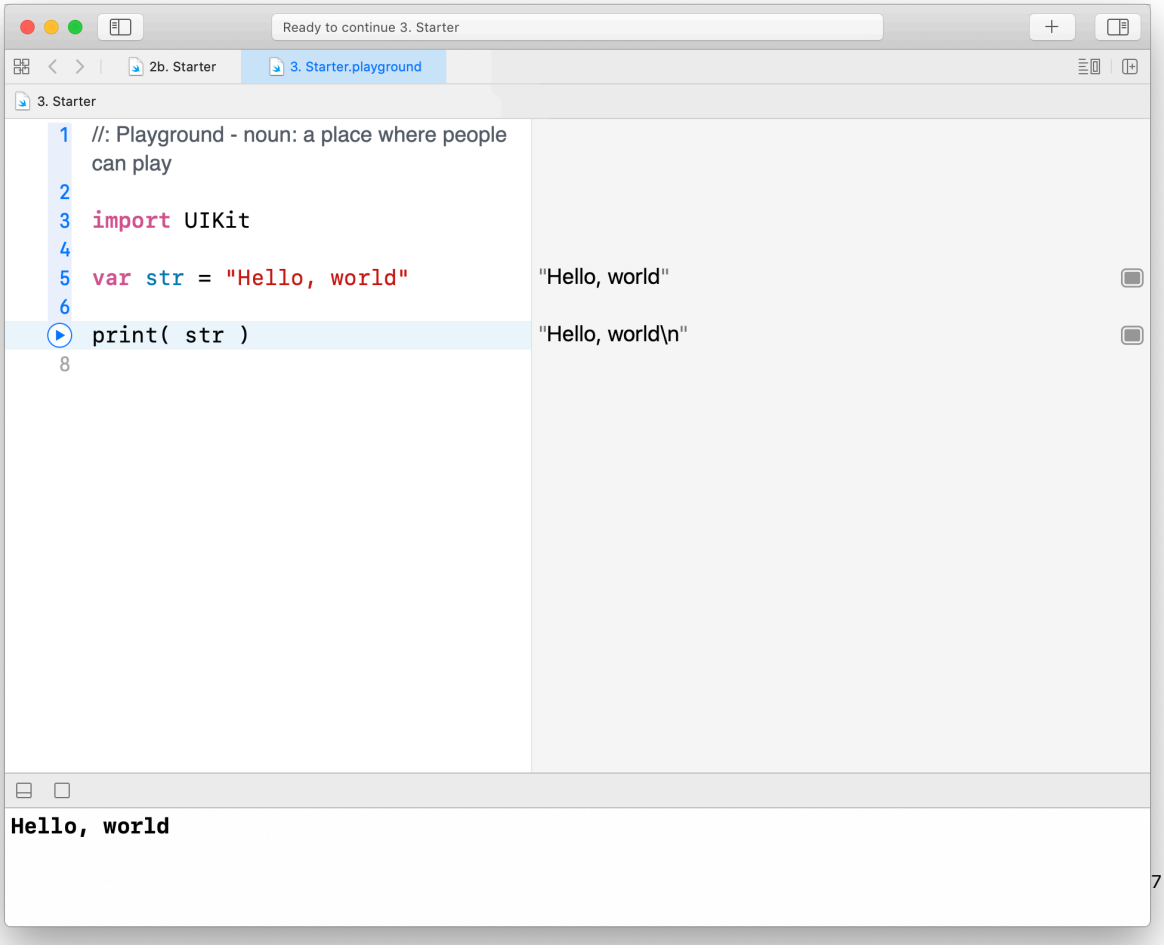
- Has the features you might expect in a modern language
- Powerful Collections
- Protocols
- Extensions
- Functional programming
- Ints, Doubles etc are first class items

Hello, world

```
print("Hello, world!")
```


Try making a playground

1. Open Xcode
2. Choose File > New > Playground
3. Select iOS, select the Blank template and click Next
4. Change str to "Hello, world!"
5. Hold cursor over line you want to compile to and a blue circle with triangle in it will show
6. Click on blue triangle to run all code up until there



Explore playgrounds and language basics

1. Try running "Starter Playground" included in Session 1 of the course
2. See how Playgrounds shows you the run values
3. There is a 4 page summary of the basics of the language included - try cutting and pasting language examples into a Playground, and see what they do.

More on material in this session

- We have very briefly covered the basics of the language
- They are covered much more slowly in Develop in Swift Fundamentals:
  - Lesson 1.1: Swift Intro and Playgrounds
  - Lesson 1.2: Constants, variables, types
  - Lesson 1.3: Operators
  - Lesson 1.4: Control flow
  - Lesson 2.1: Strings
  - Lesson 2.5: Collections
  - Lesson 2.6: Loops

We will look in more detail at:

- Lesson 2.2: Functions
- Lesson 2.3: Structures
- Lesson 2.4: Classes
- Unit 3: Optionals / Guard / Scopes

The Swift Language - Brief Overview (1)

Chris Price v1.4, Sept 2019

Simple Variable Types

Int, Double, Bool

Can be implicitly declared:
let x = 42 // Int constant
var y = 3.1 // Double variable

Explicit declaration:
let z: Int = 42 // Int constant
let a: Double = 3 // Double constant
let cold: Bool = true //Boolean constant

Common Operators

Arithmetic Operators

+	Add	// e.g. y = a+b
–	Subtract	
*	Multiply	
/	Divide	
%	Remainder	

Arithmetic shorthand

// e.g. y += 21 same as y = y+21

+=	Add and assign
–=	Subtract and assign
*=	Multiply and assign
/=	Divide and assign
%=	Remainder and assign

Unary operators

-	Minus	//e.g. y = -x Gives negative of a number

Boolean tests – return true or false

<	Less than
<=	Less than or equal
>	Greater than
>=	Greater than or equal
==	Equal
!=	Not equal
&&	Logical AND
||	Logical OR

Conditionals

```
if comparison1 {
  //called if comparison 1 is true
}
else if comparison2 {
   //called if comparison 2 is true
}
else {
   //called if nothing else is true
}
```

e.g.

```
let age = 27
if age >= 18 {
   print( "allowed to vote")
} else {
   print( "not old enough to vote")
}
```

Curly brackets are mandatory.
Round brackets around condition are optional.

Switch Statement

```
let age = 1
switch age {
case 0,1:
   print( "baby" )
case 2...4:
   print( "toddler" )
case 5..<18:
   print( "child" )
default:
   print( "adult" )
}
```

First applicable case is executed then exits. Must have a default unless all values are accounted for by other cases. Can switch on more than one value.

```
let num = 15
switch (num%3, num%5) {
   case (0, 0):
      print( "FizzBuzz" )
   case (0, _):
      print( "Fizz" )
   case (_, 0):
      print( "Buzz" )
   default:
      print( num )
}
```

The Swift Language - Brief Overview (2)

Chris Price v1.4, Sept 2019

Strings

Simple string expressions and printing out

```
let emptyString = ""
let greeting = "Hello"
let friendlyGreeting = greeting + ", friend"
print( friendlyGreeting ) // prints to console
```

String interpolation

```
let temp = "Boiling water is \(100*1.8 + 32)F"
```

String tests

```
if emptyString.isEmpty ...
if greeting.hasPrefix( "He" )...
if greeting.hasSuffix( "matey" )...
```

Equality tests whether made up of same characters in same order

```
if emptyString == ""     //this is true
if greeting == "hello"   // this is false as lower case
if "aardvark" < "apple"  // lexically less, so true
```

Useful string features

```
greeting.count // returns string length (5)
greeting.lowercased()  //returns "hello"
```

Manipulating characters in a string

```
let me = "Chris Price"
let space = me.firstIndex(of: " ") ?? me.endIndex
let name = me[..<space]
```

Arrays

```
//Declare empty array of strings
var myPets: [String]  =  [ ]
//Different way of doing same thing
var pets = [String]( )
myPets.count     // will be zero

myPets.append( "Chaz the Dog" )
myPets.append( "Dave the Goldfish" )
myPets.count    // will be two

//Declare constant array with one string in it
let yourPets = [ "Idris the Guinea Pig"]
// Combines the two string arrays into one string array
 var ourPets = myPets + yourPets
ourPets.count   // will be three

// Replace an element in a variable array
ourPets[0] = "Chaz the Bad Dog"
// Delete an element
let deadPet = ourPets.remove(at: 2)
ourPets.count    // now only two pets
// deadPet will contain the element removed

// can add extra element at specific position
ourPets.insert( "Bob the Capybara", at: 0)

// Initialise fixed size with default values
// Makes array with 200 values of 0.0
var readings = [Double]( repeating: 0.0, count: 200)
readings.removeLast()   // Can delete last element
readings.count              // will be 199
```

For Loops

for item in range { statements }

```
var sum = 0
for i in 1...5 { sum = sum + i }          // Gives the answer 15
sum = 0
for i in 1..<5 { sum = sum + i }          // Gives the answer 10
```

for item in collection { statements }

```
var listOfAttendees = [ "Bill", "Jane", "Jim", "Fred", "Ann" ]
for name in listOfAttendees{
   print( name )
}    // Will print each name in the list to console
```

Equivalent to 'for item in collection' using range

```
for i in 0..<listOfAttendees.count {
   print( listOfAttendees[i] )
}    // Will print each name in the list to console

// can get index and element by doing the following
for (index, name) in listOfAttendees.enumerated() {
   print( "\(index+1). \(name) " )
}
```

While Loops

while condition { statements }

e.g.

```
var i = 0
while (i < 100)
{
   print( "I told you so" )
   i++
}   // will print "I told you so 100 times
```

The Swift Language - Brief Overview (3)

Chris Price v1.4, Sept 2019

Functions

```
// function with no parameters or result
func printHello() {
  print( "Hello")
}
printHello()   // usage

// function with one parameter, no result
func printMessage(message: String) {
  print( message )
}
printMessage(message: "Well, hello")   // usage

// To not need to name parameter in usage,
// would need to define printMessage as follows
// func printMessage(_ message: String)

// function with two parameters, one result
func concat(s1: String, s2: String ) -> String {
   return s1 + " and " + s2
}
let billAndBen = concat(s1: "Bill", s2: "Ben")

// function with no params, tuple as result
func returnTuple() -> (String, Int) {
  return( "Page not found", 404 )
}
let result = returnTuple()
// String in result can be accessed as result.0
// Int in result can be accessed as result.1
```

Structures

```
struct Person{
  // properties
  let firstName: String
  let lastName: String

  // computed property
  var fullName: String {
    return firstName + " " + lastName
  }

  // Method - like function but on instance
   func printName(){
      print( fullName )
   }
}

//Create an instance of a Person
let newPerson = Person(firstName: "Jim",
                       lastName: "Jones")

//Call method for instance newPerson
newPerson.printName()

let oldPerson = newPerson
//When you assign a structure to a new variable,
//its value is COPIED (unlike classes).

// Structures have automatically generated
//initialisers, but you can also write your own.
```

Classes

```
//Class syntax would be identical for the Person
//class, but need to write an initialiser.
class Person{
  let firstName: String
  let lastName: String

   // Needs this initialiser
   init(fName: String, lName: String) {
      firstName = fName
      lastName = lName
   }

  var fullName: String {
      return firstName + " " + lastName
  }

   func printName(){
      print( fullName )
   }
}

let newPerson = Person(fName: "Jim",
                       lName: "Jones")

newPerson.printName()
let oldPerson = newPerson
//When you assign a class to a new variable,
//both variables point to the same structure
```

The Swift Language - Brief Overview (4)

Chris Price v1.4, Sept 2019

Class inheritance

```
// Can declared subclass of existing class
// Subclass inherits properties and methods
// Extra properties and methods can be declared,
// but extra properties must be initialised.
// Where methods are replaced by more specific
//versions, they need the qualifier 'overrides'

class Doctor: Person{
  let specialism: String
   // Needs this initialiser
   init(fName: String, lName: String, spec: String) {
      specialism = spec
      super.init(fName: fName,lName: lName)
   }

   override func printName(){
      print( "Dr " + fullName+" does "+specialism)
   }

   func seePatient( patientName: String ) {
      print( "Hullo, " + patientName
               + ", I'm Dr " + fullName )
   }
}
let doc = Doctor(fName: "Jane",
                 lName: "Jones", spec: "Pediatrics")
doc.printName()
doc.seePatient(patientName: "George")
```

Enumerations

```
enum TempType {
   case degF
   case degC
}
var tempType = TempType.degC
if tempType == .degF {
   print("In Fahrenheit")
} else {
   print("In centigrade")
}

// More complex example
enum DaysOfWeek {
   case monday, tuesday, wednesday,
          thursday, friday, saturday, sunday
}

var today = DaysOfWeek.monday
switch today{
case .saturday, .sunday:
   print( "Chill - it's the weekend" )
default:
   print( "Apply nose to grindstone" )
}
// Will print "Apply nose to grindstone"

today = .saturday
// We know type of today now,
// so don't need to say "DaysOfWeek"
```

Dictionaries

```
//Create a dictionary containing our pets
var pets = ["Dave": "Fish", "Chaz": "Dog"]
pets["Idris"] = "Pig"  //Adds Idris to pets
pets.isEmpty      // returns false
pets.count        // returns 3
pets["Idris"]     // returns " Pig"
pets["Dog"]       // returns nil

// Update value for Chaz
pets["Chaz"] = "Bad Dog"

// Loop over key/value pairs
for (name, animal) in pets {
    print( "\(name) is a \(animal)" )
}

//Delete Chaz from dictionary
pets["Chaz"] = nil // Deletes Chaz entry

// Loop over keys
for name in pets.keys {
   print( "\(name) is a pet" )
}

// Loop over values
for animal in pets.values {
   print( "We have a \(animal)" )
}
```

Session 2: Introduction to using Xcode

- Making first app / toolkit features
- MVC and linking code to Storyboards
- Using the documentation
- Introduction to UIKit
- *Lab 2: Building and running single screen apps on simulator and device*

- This will cover lessons 1.5 to 1.8 of Development in Swift Fundamentals

How do you make a multi-screen app?

Case Study: Crossflow Energy

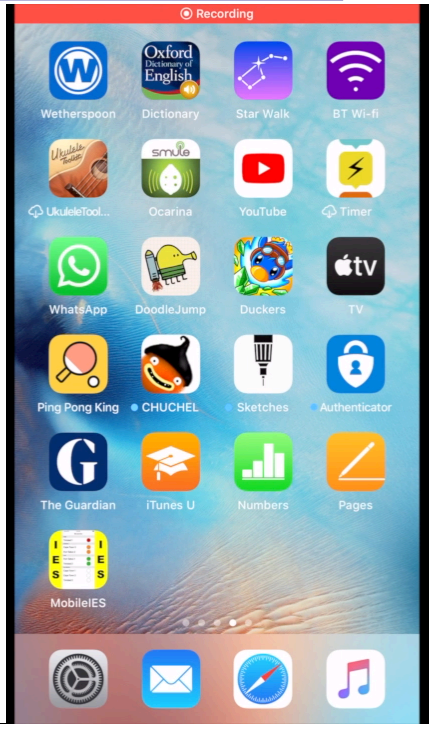
At the core of Crossflow's MODULAR MICROGENERATION SYTEMS are Crossflow's SMART Wind Turbines integrated with market leading solar and battery technologies.

Turbine
Crossflow SMART TURBINE

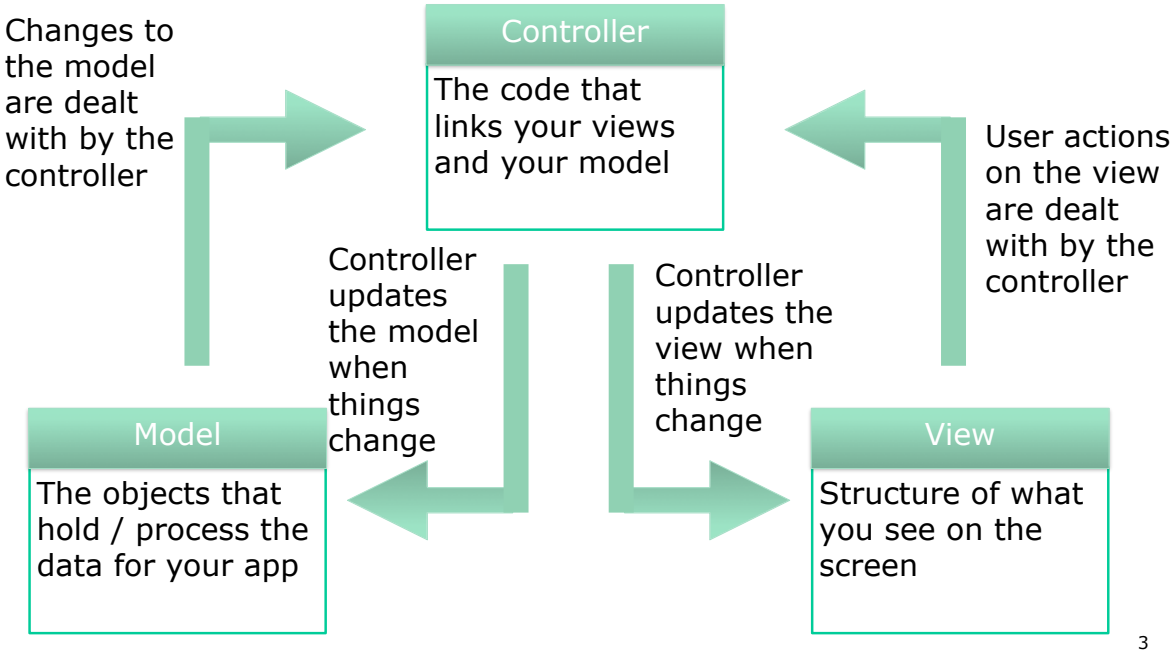
PV Array
Flexi or Fixed Solar pV with ground and tower mounting options

Battery
Latest rack mounted battery technology providing consistent power supply

Generation or Grid
Other Energy Generation inputs optional

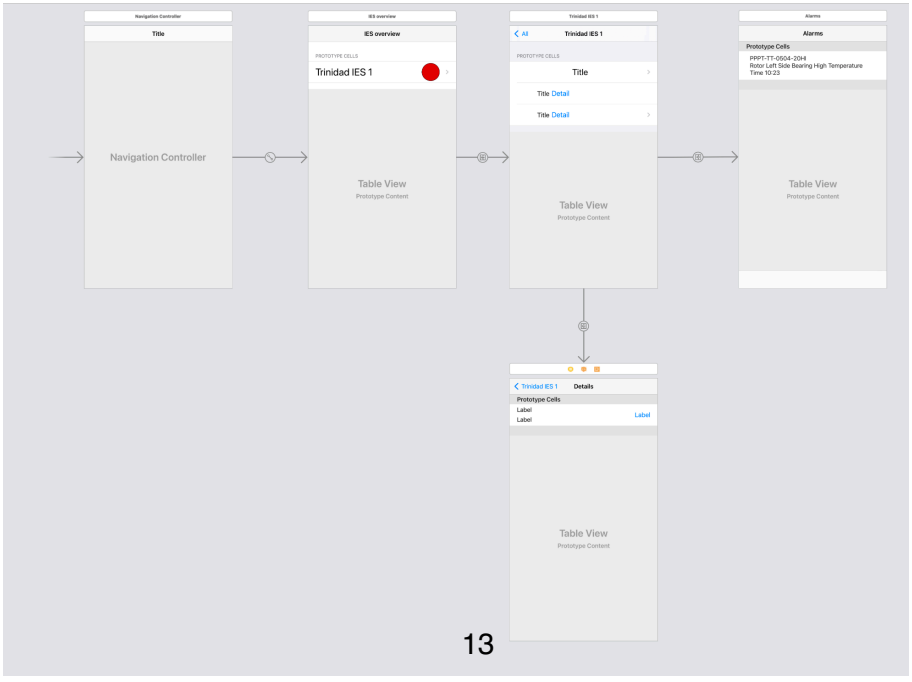


Model-View-Controller in Xcode

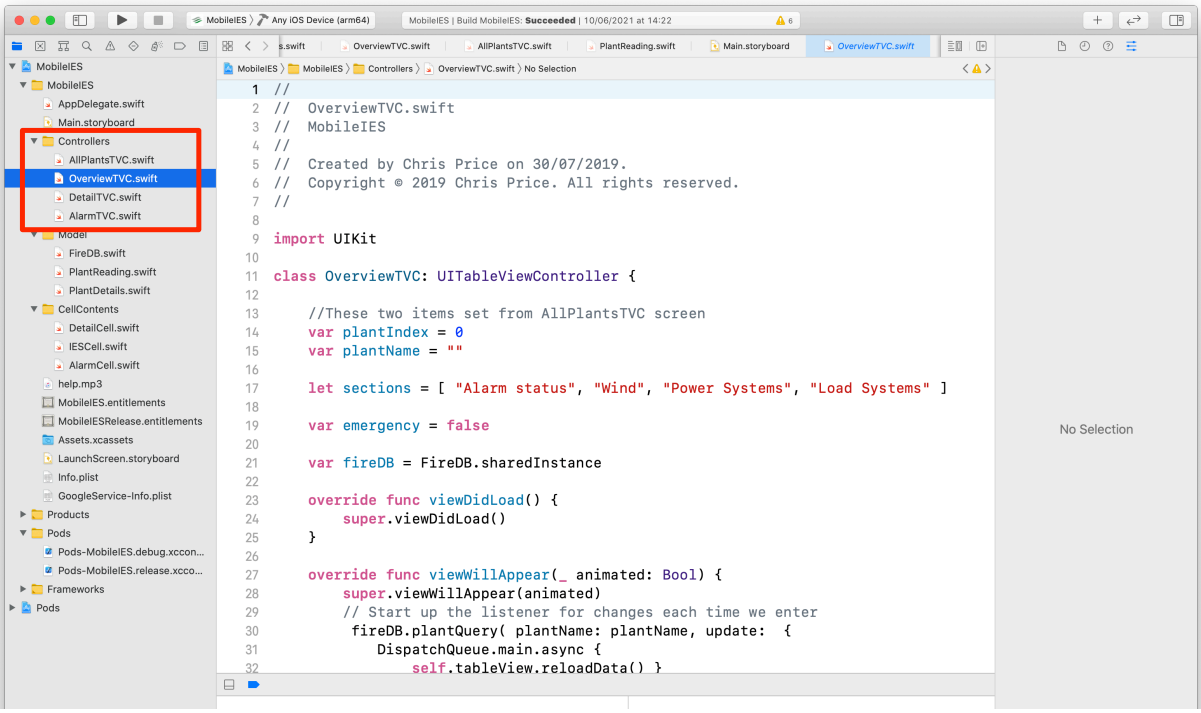


Views are made in Interface Builder

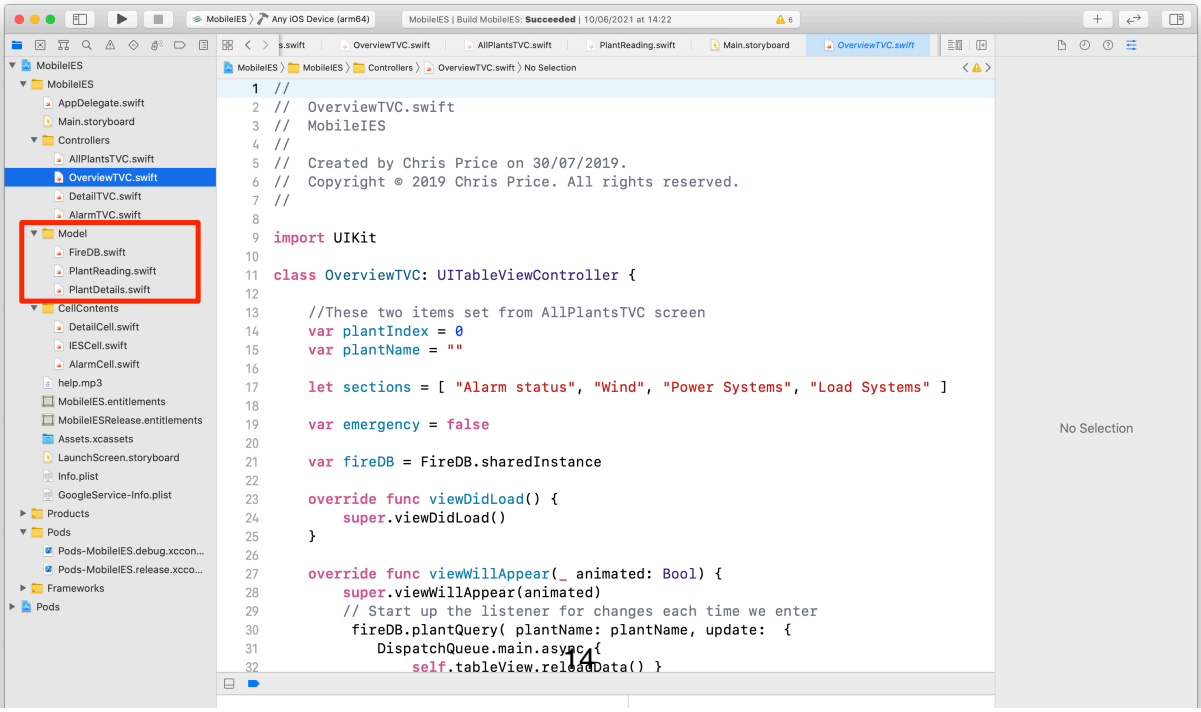
in simple case, one view for each screen



There will be view controller code for each of those screens



Model code will be a set of classes for holding and operating on data objects



Session 3: UIKit: Views and controls

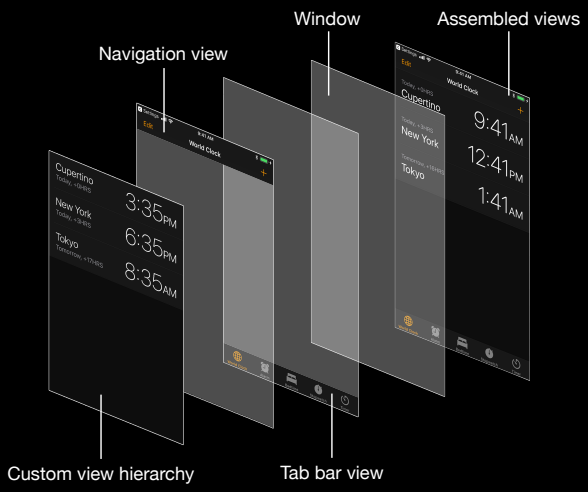
- Attributes of common views
- Adding controls to your app
- Adding more views
- *Lab 3: Building apps with more views and controls*

- This will cover lessons 2.7 to 2.9 of Development in Swift Fundamentals

1

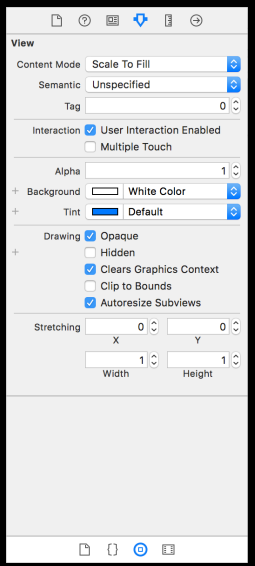
Unit 2—Lesson 7: Introduction to UIKit (p227 in book)

Common system views

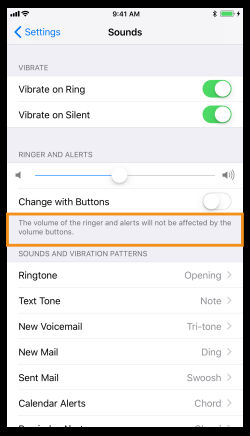


Common system views
Configuration

Property	Description
Size	Width and height of the view
Position	Position of the view onscreen
Alpha	Transparency of the view
Background Color	Background color that will be displayed
Tag	Integer that you can use to identify view objects



Label (UILabel)



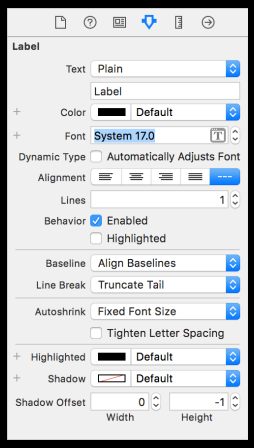
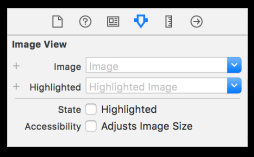
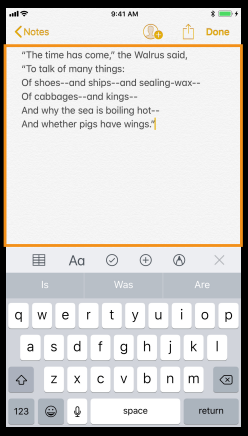
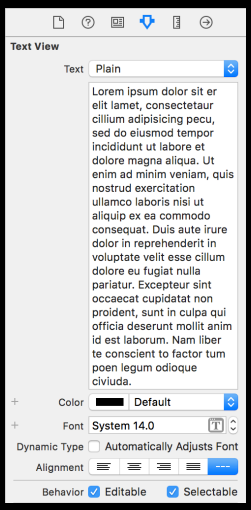


Image view (UIImageView)

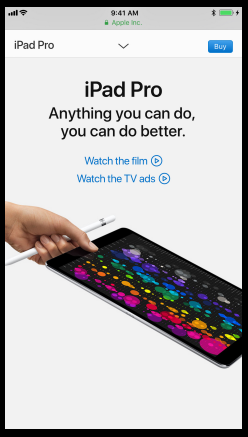


Text view (UITextView)





Scroll view (UIScrollView)



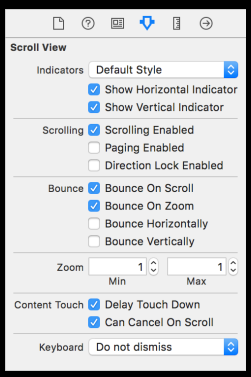
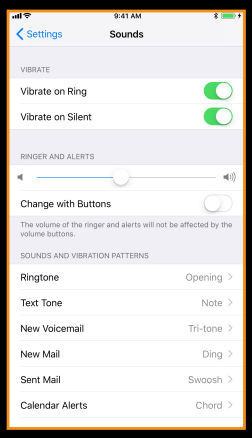
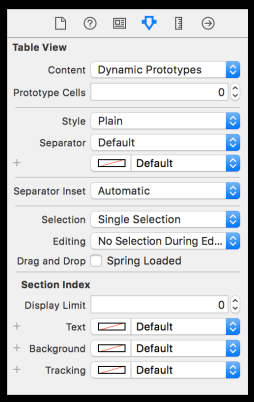
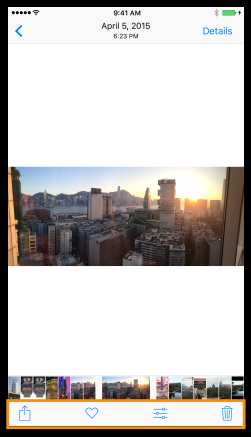


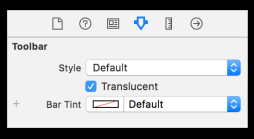
Table view (UITableView)



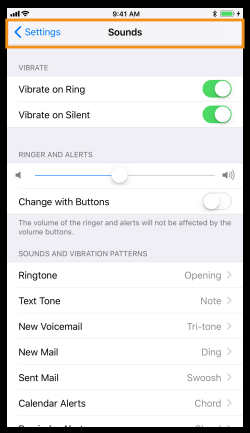


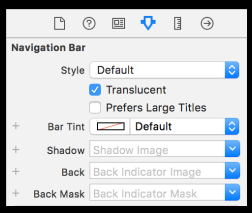
Toolbars (UIToolbar)



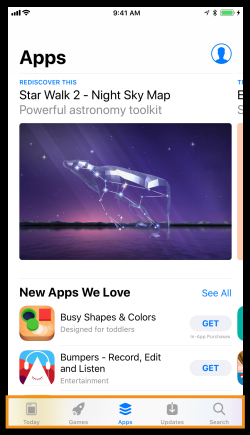


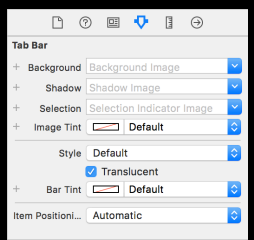
Navigation bars (UINavigationBar)





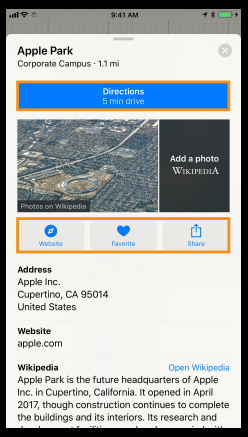
Tab bars (UITabBarController)

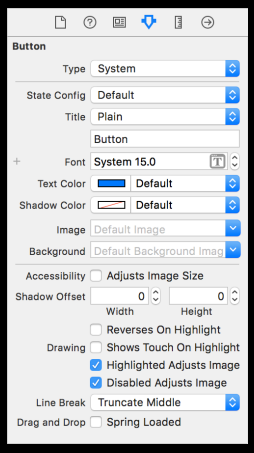




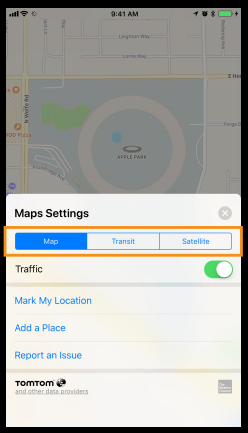
Controls

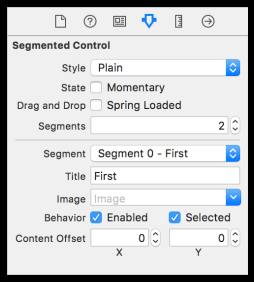
Buttons (UIButton)



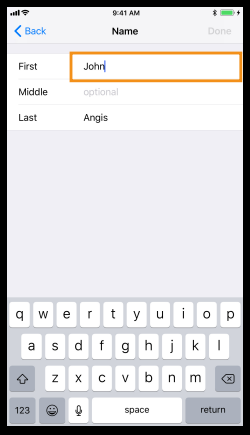


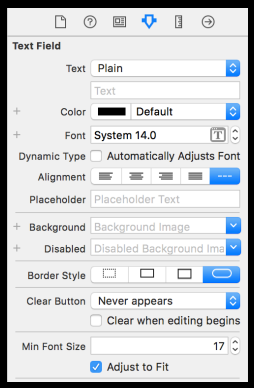
Segmented controls (UISegmentedControl)



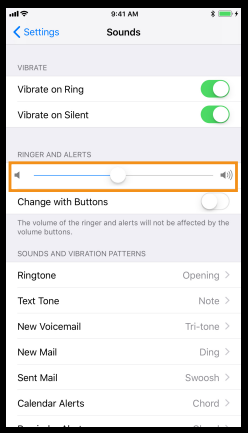


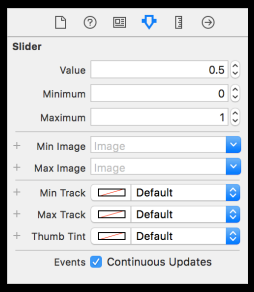
Text fields (UITextField)



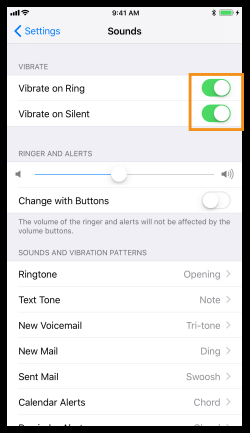


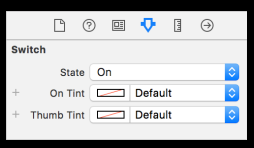
Sliders (UISlider)



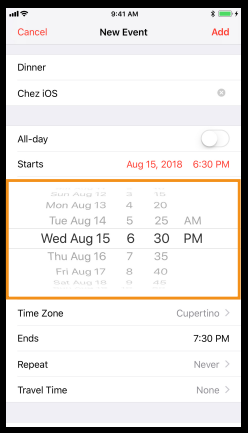


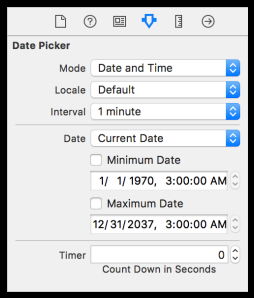
Switches (UISwitch)



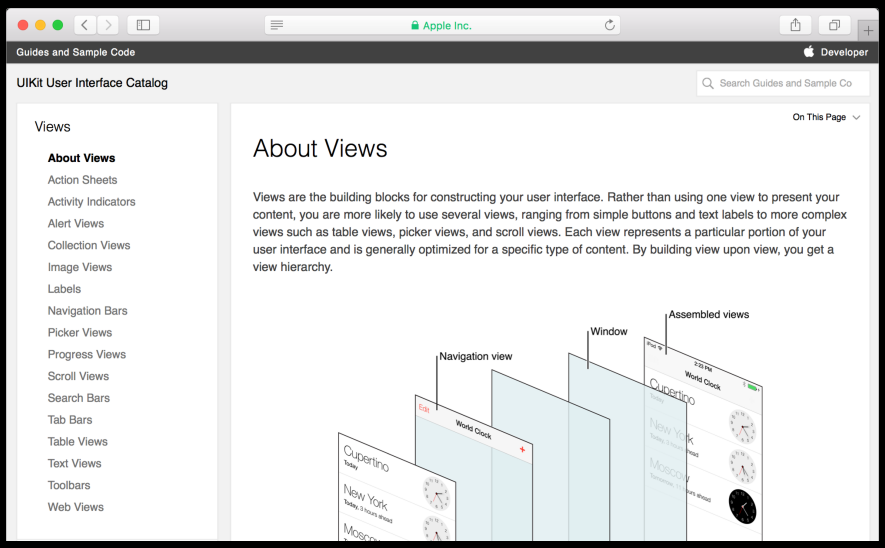


Date pickers (UIDatePicker)





UIKit User Interface Catalog



Practical

We will work through exercises in 2-08 Displaying Data (pp253-260)

Then do 2-09 Controls in Action (page 265 to top of page 283)

Session 4: Functions

- Attributes of common views
- Adding controls to your app
- Adding more views
- *Lab 3: Building apps with more views and controls*

- This covers lesson 2.2 of Development in Swift Fundamentals

1

Unit 2—Lesson 2: Functions

Functions

```
tieMyShoes()
```

```
makeBreakfast(food: "scrambled eggs", drink: "orange juice")
```

Functions
Defining a function

```
func functionName (parameters) -> ReturnType {
    // Body of the function
}
```

```
func displayPi() {
  print("3.1415926535")
}

displayPi()
```

```
3.1415926535
```

Parameters

```
func triple(value: Int) {
  let result = value * 3
  print("If you multiply \(value) by 3, you'll get \(result).")
}

triple(value: 10)
```

```
If you multiply 10 by 3, you'll get 30.
```

Parameters
Multiple parameters

```
func multiply(firstNumber: Int, secondNumber: Int) {
  let result = firstNumber * secondNumber
  print("The result is \(result).")
}

multiply(firstNumber: 10, secondNumber: 5)
```

```
The result is 50.
```

Return values

```
func multiply(firstNumber: Int, secondNumber: Int) -> Int {
  let result = firstNumber * secondNumber
  return result
}
```

Return values

```
func multiply(firstNumber: Int, secondNumber: Int) -> Int {
 return firstNumber * secondNumber
}
```

```
let myResult = multiply(firstNumber: 10, secondNumber: 5)
print("10 * 5 is \(myResult)")
```

```
print("10 * 5 is \(multiply(firstNumber: 10, secondNumber: 5))")
```

Argument labels

```
func sayHello(firstName: String) {
  print("Hello, \(firstName)!")
}

sayHello(firstName: "Amy")
```

Argument labels

```
func sayHello(to: String, and: String) {
  print("Hello \(to) and \(and)")
}

sayHello(to: "Luke", and: "Dave")
```