Sensors

Lecture 7

CIS 1951

Last time, in CIS 1951…

Custom Views & Event Handling

- GeometryReader, safe area
- SwiftUI shapes, .fill/.stroke, .clipShape, .contentShape
- Understanding event propagation and handling
- Keyboard handling and text input events
- Custom gesture recognition in SwiftUI
- **Questions? Comments? Feedback?**

CIS 1951 as a whole

Lectures 1-6: The Basics

Lectures 7-10: Technologies

Lectures 11-13: Beyond Development

The iPhone

Precision dual-frequency GPS (GPS, GLONASS, Galileo, QZSS, BeiDou, and NavIC)

Digital compass

Wi-Fi

Cellular

iBeacon microlocation

Face ID

LiDAR Scanner

Barometer

High dynamic range gyro

High-g accelerometer

Proximity sensor

Dual ambient light sensors

Volume up/down

Action button

Camera Control

Side button

USB-C connector

Built-in microphones

Built-in stereo speaker

Pro camera system

48MP Fusion: 24 mm, ƒ/1.78 aperture, second-generation sensor-shift optical image stabilization, 100% Focus Pixels, support for super-high-resolution photos (24MP and 48MP)

Also enables 12MP 2x Telephoto: 48 mm, ƒ/1.78 aperture, second generation sensor-shift optical image stabilization, 100% Focus Pixels

48MP Ultra Wide: 13 mm, ƒ/2.2 aperture and 120° field of view, Hybrid Focus Pixels, super-high-resolution photos (48MP)

12MP 5x Telephoto: 120 mm, ƒ/2.8 aperture and 20° field of view, 100% Focus Pixels, seven-element lens, 3D sensor-shift optical image stabilization and autofocus, tetraprism design

5x optical zoom in, 2x optical zoom out; 10x optical zoom range

Digital zoom up to 25x

Camera Control

Customizable default lens (Fusion)

Sapphire crystal lens cover

Adaptive True Tone flash

Photonic Engine

Deep Fusion

Smart HDR 5

Next-generation portraits with Focus and Depth Control

Portrait Lighting with six effects

Night mode

Night mode portraits enabled by LiDAR Scanner

Panorama (up to 63MP)

Latest-generation Photographic Styles

Spatial photos

48MP macro photography

Apple ProRAW

Wide color capture for photos and Live Photos

Lens correction (Ultra Wide)

Advanced red-eye correction

Auto image stabilization

Burst mode

Photo geotagging

Image formats captured: HEIF, JPEG, and DNG

12MP camera

ƒ/1.9 aperture

Autofocus with Focus Pixels

Retina Flash

Photonic Engine

Deep Fusion

Smart HDR 5

Next-generation portraits with Focus and Depth Control

Portrait Lighting with six effects

Animoji and Memoji

Night mode

Latest-generation Photographic Styles

Apple ProRAW

Wide color capture for photos and Live Photos

Lens correction

Auto image stabilization

Burst mode

4K Dolby Vision video recording at 24 fps, 25 fps, 30 fps, or 60 fps

1080p Dolby Vision video recording at 25 fps, 30 fps, or 60 fps

Cinematic mode up to 4K Dolby Vision at 30 fps

ProRes video recording up to 4K at 60 fps with external recording

Log video recording

Academy Color Encoding System

Slo-mo video support for 1080p at 120 fps

Time-lapse video with stabilization

Night mode Time-lapse

QuickTake video up to 4K at 60 fps in Dolby Vision

Cinematic video stabilization (4K, 1080p, and 720p)

Spatial Audio and stereo recording

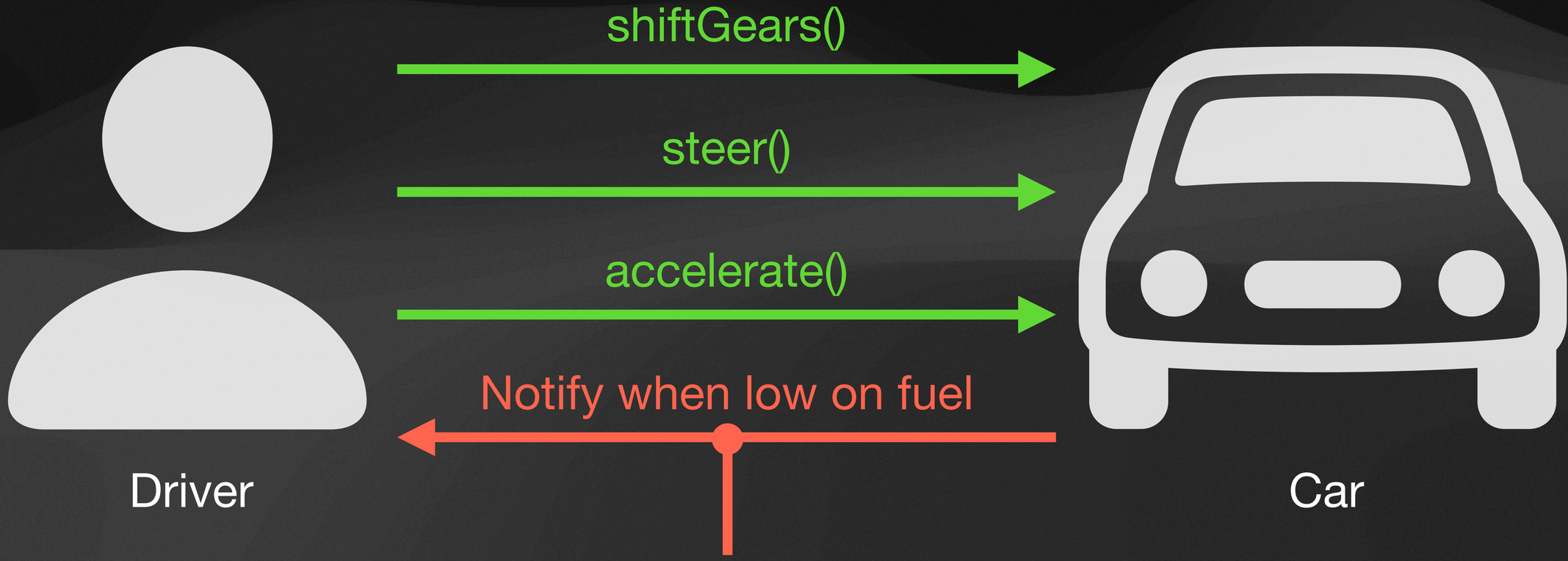
This week

Location

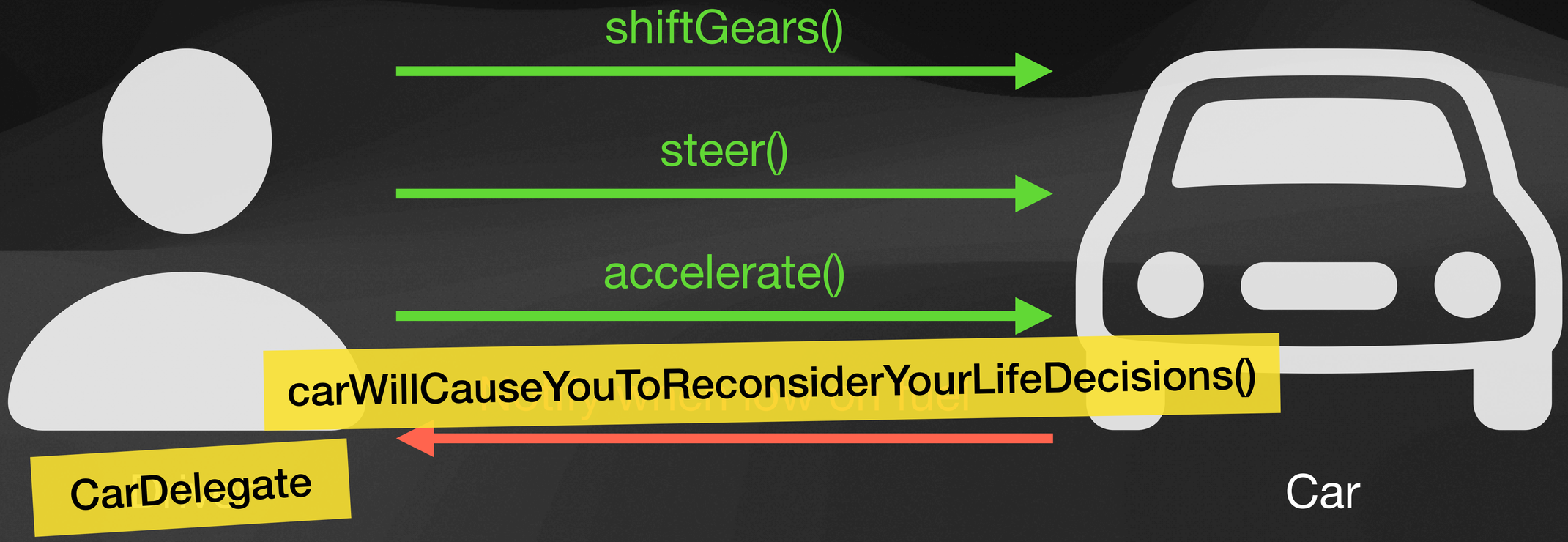
Motion

But first, some design patterns

Suppose we're designing a **Car** interface…



The Delegate Pattern



The Delegate Pattern

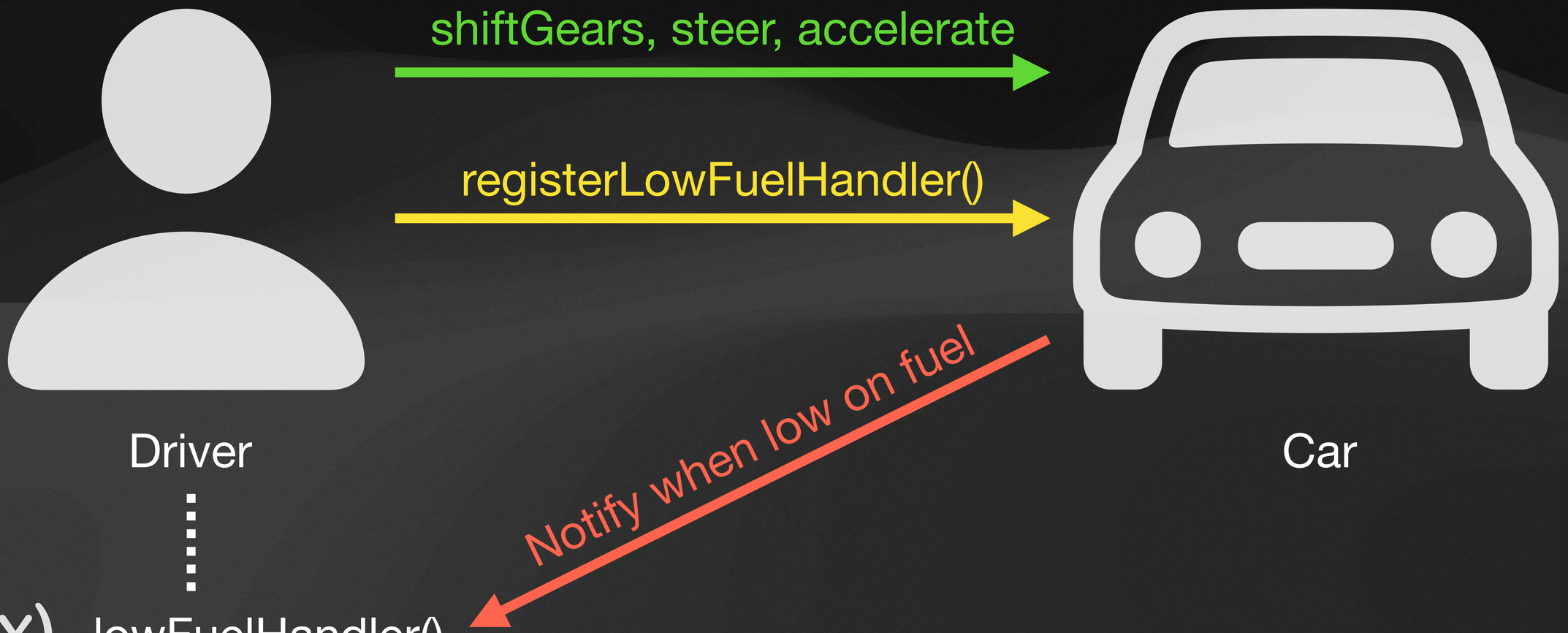
```
protocol CarDelegate: AnyObject {
    func carWillCauseYouToReconsiderYourLifeDecisions()
}

class Car {
    weak var delegate: CarDelegate?

    func shiftGears() {}
    func steer() {}
    func accelerate() {}
}

class Driver: CarDelegate {
    func carWillCauseYouToReconsiderYourLifeDecisions() {
        // Panic...
    }
}
```

The Observer Pattern

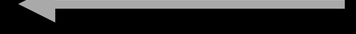


The Observer Pattern

```
class Car {
    func shiftGears() {}
    func steer() {}
    func accelerate() {}

    func registerLowFuelHandler(_ handler: @escaping () -> Void) {}
}

let car = Car()
car.registerLowFuelHandler {
    // Panic...
}
```



Similar to .onChange/.onAppear

The Observer Pattern

Another Example

```
class Driver {
    init() {
        let car = Car()
        car.registerLowFuelHandler { [weak self] in
            if let self = self {
                panic()
            }
        }
    }

    func panic() {}
}
```

`[weak self]`

`if let self = self`

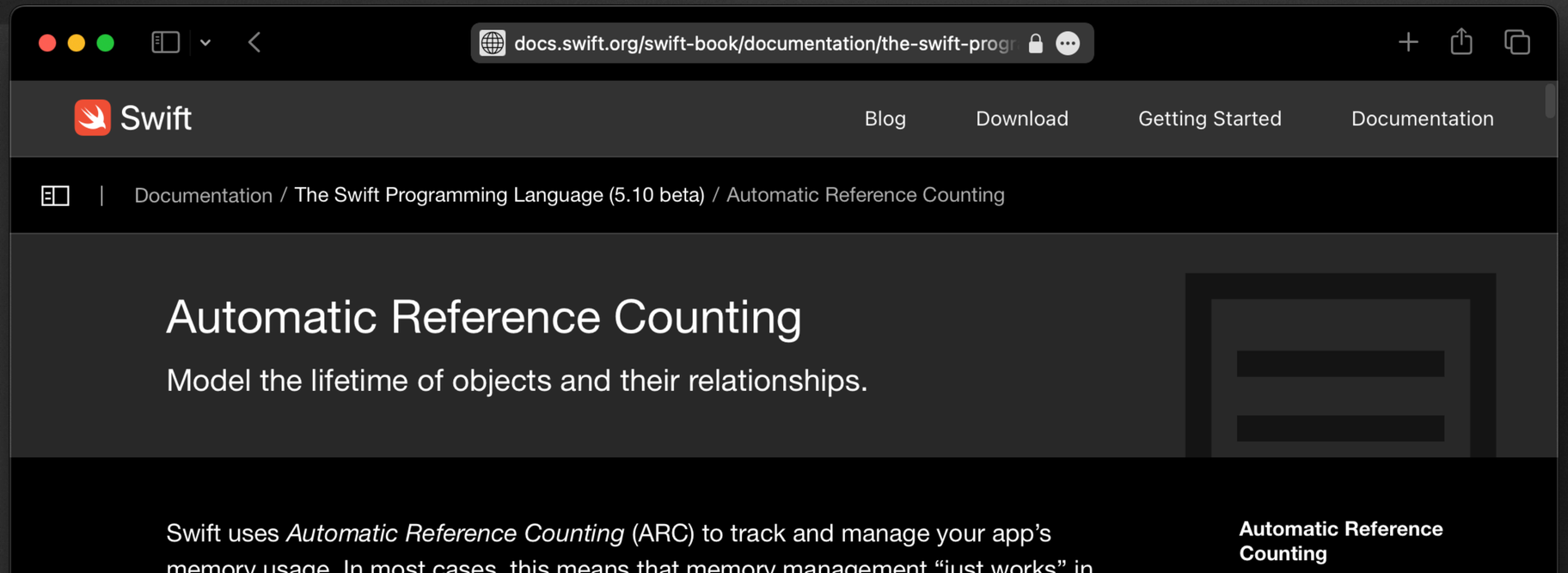
???

CIS 1905: Rust

[weak self]

if let self = self

???



Recap: Delegates vs. Observers

In the **delegate pattern**, we provide a **delegate-conforming class** which handles events that the host/manager undergoes.

Example: Core Location (we'll get to this in a bit)

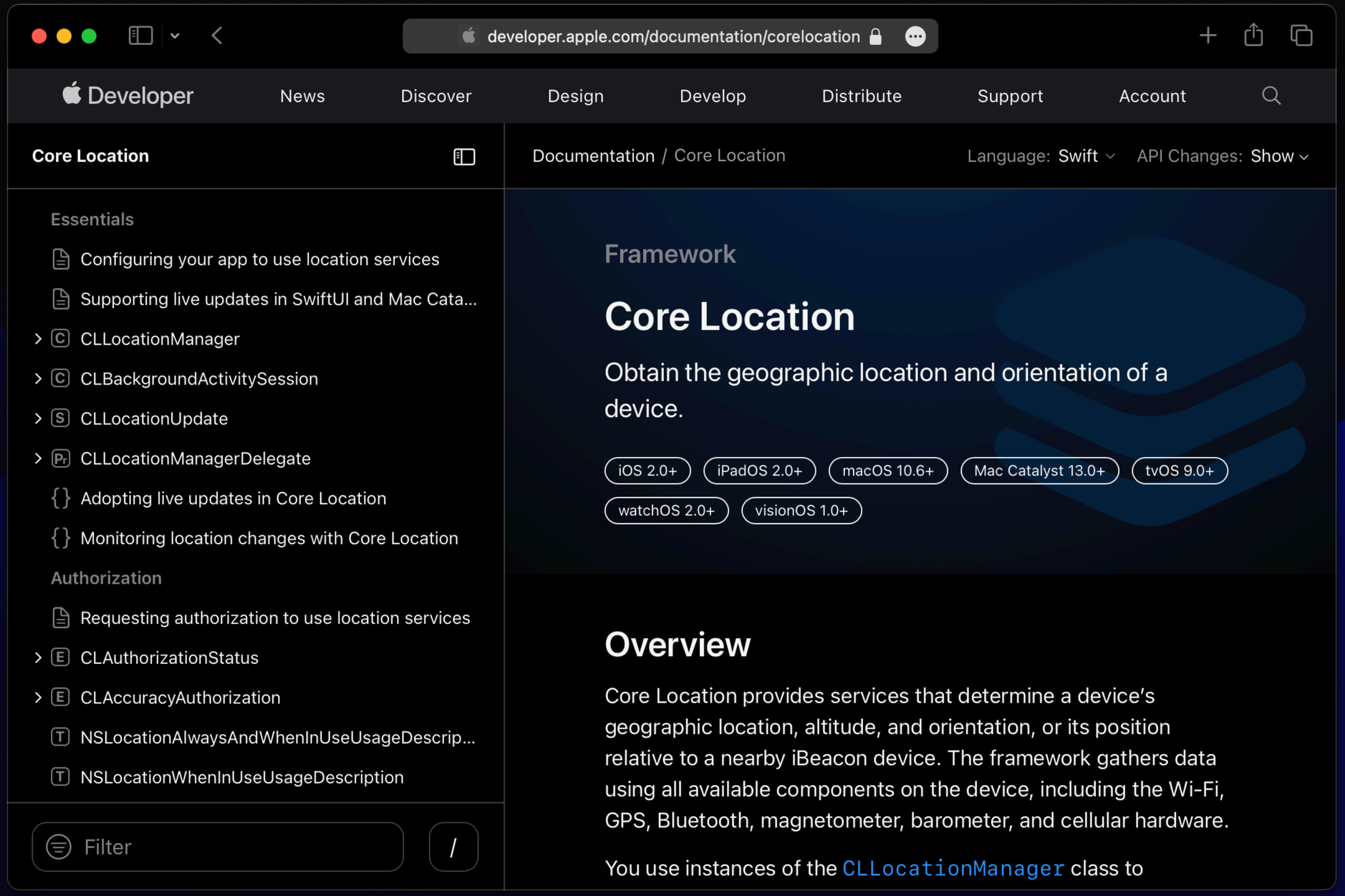
In the **observer pattern**, we provide **functions** to a host/manager. These functions will be called by the host whenever that event occurs.

Example: Core Motion (we'll get to this in a bit)

Recap: Delegates vs. Observers

The decision for which pattern to use depends on the specific framework. In other words, **this decision is often made for you**.

Location


developer.apple.com/documentation/corelocation
Developer
News
Discover
Design
Develop
Distribute
Support
Account
Core Location
Documentation / Core Location
Language: Swift
API Changes: Show
Essentials
Configuring your app to use location services
Supporting live updates in SwiftUI and Mac Cata...
CLLocationManager
CLBackgroundActivitySession
CLLocationUpdate
CLLocationManagerDelegate
Adopting live updates in Core Location
Monitoring location changes with Core Location
Authorization
Requesting authorization to use location services
CLAuthorizationStatus
CLAccuracyAuthorization
NSLocationAlwaysAndWhenInUseUsageDescrip...
NSLocationWhenInUseUsageDescription
Filter
/
Framework
Core Location
Obtain the geographic location and orientation of a device.
iOS 2.0+
iPadOS 2.0+
macOS 10.6+
Mac Catalyst 13.0+
tvOS 9.0+
watchOS 2.0+
visionOS 1.0+
Overview
Core Location provides services that determine a device's geographic location, altitude, and orientation, or its position relative to a nearby iBeacon device. The framework gathers data using all available components on the device, including the Wi-Fi, GPS, Bluetooth, magnetometer, barometer, and cellular hardware.
You use instances of the CLLocationManager class to

1 Set up a CLLocationManager

```
import CoreLocation
import SwiftUI

class GenericViewModel {
    let locationManager = CLLocationManager()
}
```

2 Set up a delegate

From the Objective-C days

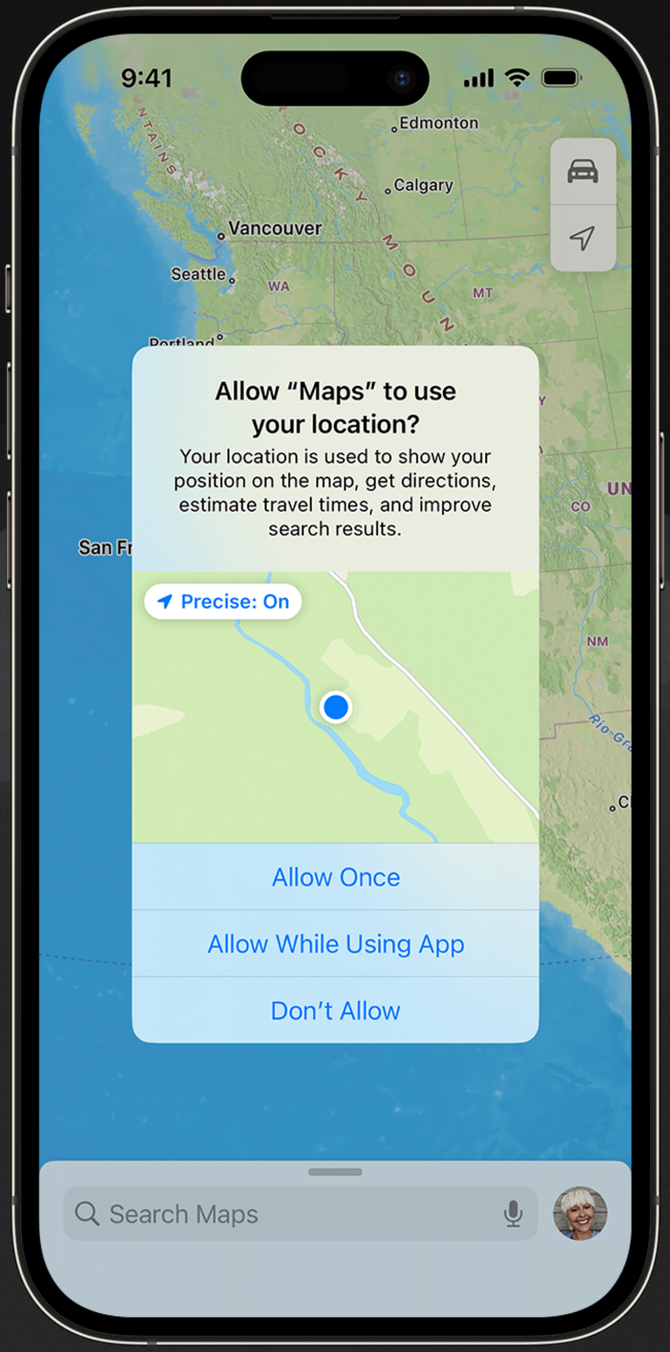
```
class GenericViewModel: NSObject, CLLocationManagerDelegate {
    let locationManager = CLLocationManager()

    override init() {
        super.init()
        locationManager.delegate = self
    }
}
```

3 Request access

```
locationManager.requestWhenInUseAuthorization()
```

Requires a “purpose string” *(more on that later)*



4 Respond to the user’s choice

```
class GenericViewModel: NSObject, CLLocationManagerDelegate {
    // ...

    func locationManagerDidChangeAuthorization(_ manager: CLLocationManager) {
        switch manager.authorizationStatus {
        case .authorizedWhenInUse, .authorizedAlways:
            doSomethingWithLocationAccess()
        case .denied, .restricted:
            showAlert("Enyabwe wocation access in settings pwease 🥺”)
        default:
            break
        }
    }
}
```

5 Request the user’s location

```
func doSomethingWithLocationAccess() {
    locationManager.requestLocation()
}
```

6 Receive the user's location

```
func locationManager(_ manager: CLLocationManager,
                     didUpdateLocations locations: [CLLocation]) {
    if let location = locations.last {
        send(location, to: sketchyServer)
    }
}
```

7 Handle errors

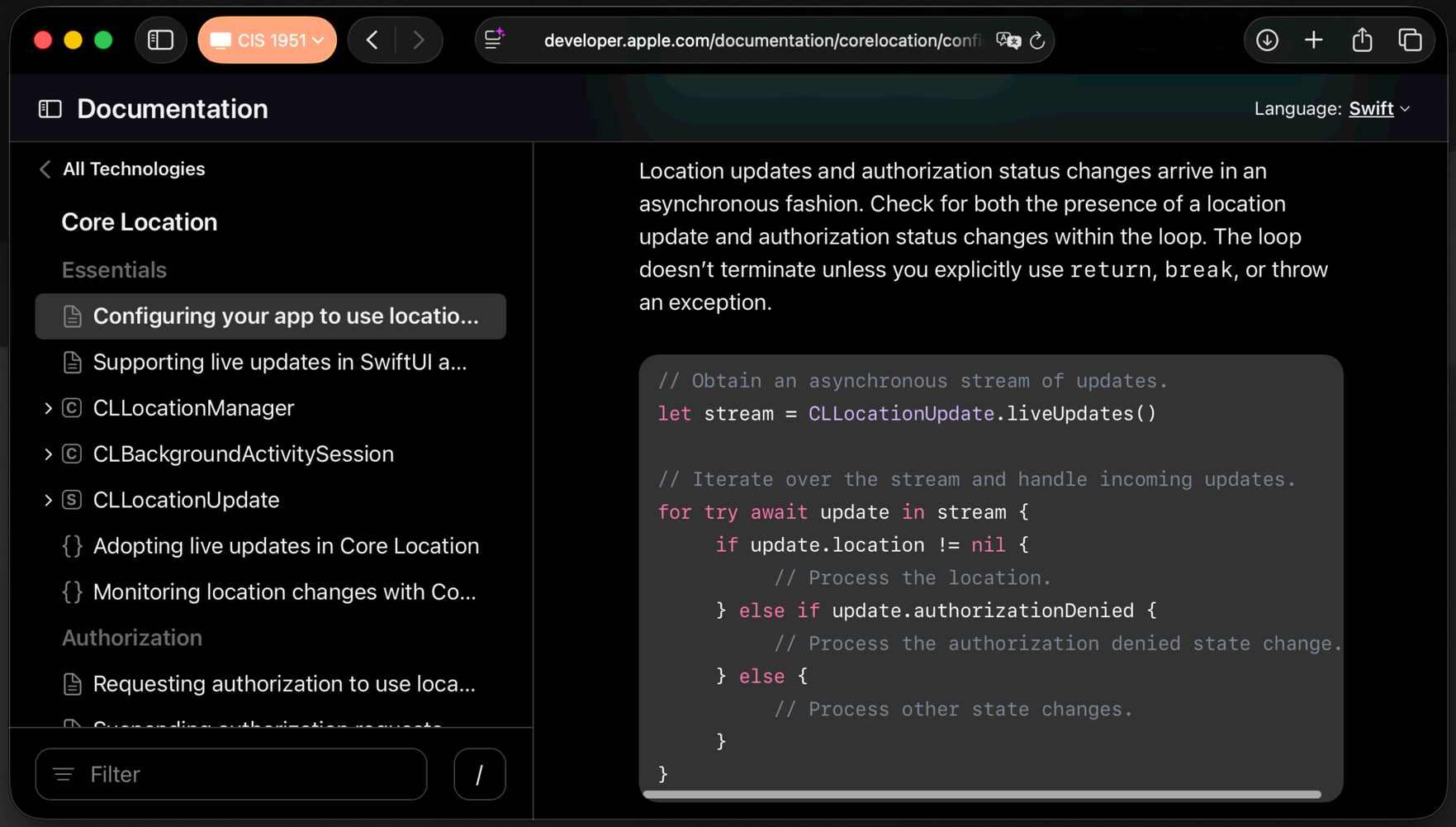
```
func locationManager(_ manager: CLLocationManager,
                     didFailWithError error: Error) {
    showAlert("Owoh noes, can't find yow wocation!")
}
```

App will crash if this is not present!

CLLocationUpdate.liveUpdates()

Using async/await instead of a delegate

NEW



Configuring your app to use location services

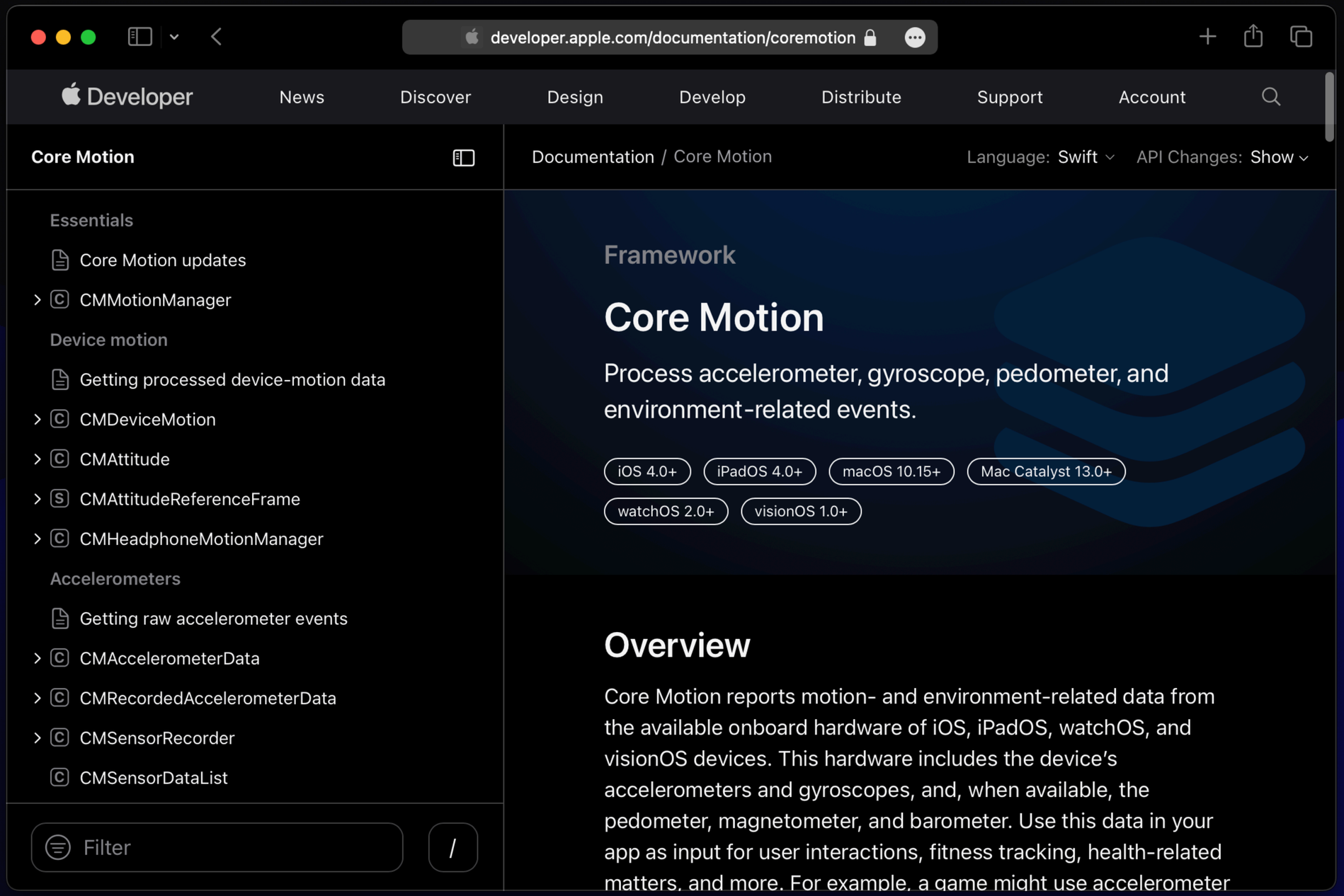
Core Location documentation

Other things you can do with CoreLocation

…that we won’t have time to cover

- Continuous location updates
- Visited place monitoring
- Significant location change notifications
- Geofencing
- Background access
- And much more — **check the docs!**

Motion


developer.apple.com/documentation/coremotion
Developer
News
Discover
Design
Develop
Distribute
Support
Account
Core Motion
Documentation / Core Motion
Language: Swift
API Changes: Show
Essentials
Core Motion updates
CMMotionManager
Device motion
Getting processed device-motion data
CMDeviceMotion
CMAttitude
CMAttitudeReferenceFrame
CMHeadphoneMotionManager
Accelerometers
Getting raw accelerometer events
CMAccelerometerData
CMRecordedAccelerometerData
CMSensorRecorder
CMSensorDataList
Filter
/
Framework
Core Motion
Process accelerometer, gyroscope, pedometer, and environment-related events.
iOS 4.0+
iPadOS 4.0+
macOS 10.15+
Mac Catalyst 13.0+
watchOS 2.0+
visionOS 1.0+
Overview
Core Motion reports motion- and environment-related data from the available onboard hardware of iOS, iPadOS, watchOS, and visionOS devices. This hardware includes the device's accelerometers and gyroscopes, and, when available, the pedometer, magnetometer, and barometer. Use this data in your app as input for user interactions, fitness tracking, health-related matters, and more. For example, a game might use accelerometer

1 Set up a CMMotionManager

```
import CoreMotion

let motionManager = CMMotionManager()
```

2 Check if motion data is available

```
if motionManager.isDeviceMotionAvailable {
    // TODO: Start requesting the device's motion
} else {
    showAlert("Looks wike device motion is not avaiwabwle >w<")
}
```

3 Subscribing to device motion data

```
motionManager.deviceMotionUpdateInterval = 1 / 60
motionManager.startDeviceMotionUpdates(to: .main) { motion, error in
    if let motion {
        send(motion, to: sketchyServer)
    } else if let error {
        showAlert("oopsie whoopsie, something’s wrong nya~")
    }
}
```

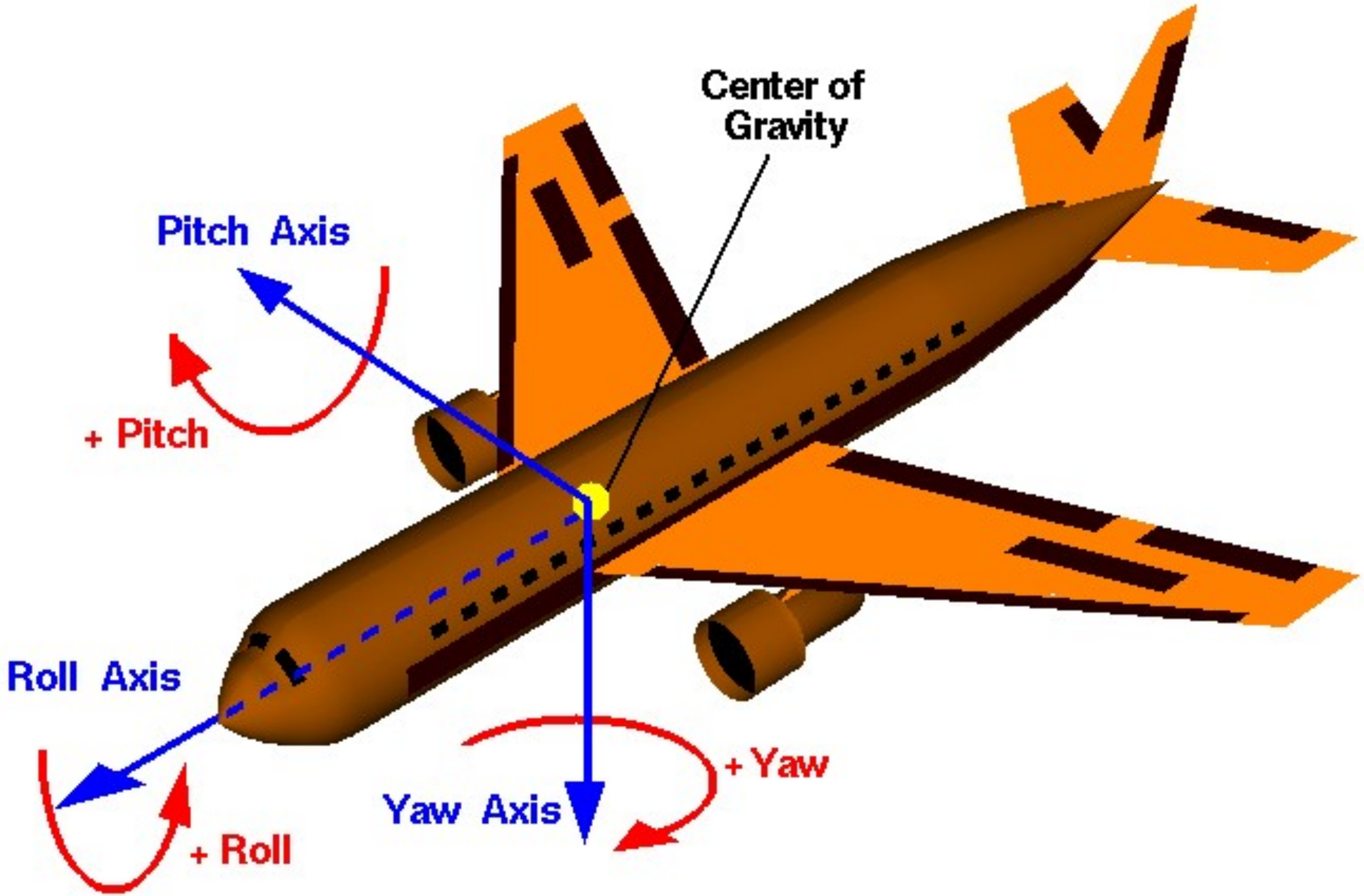
You can also do this without a handler function — check the docs

4 Clean up

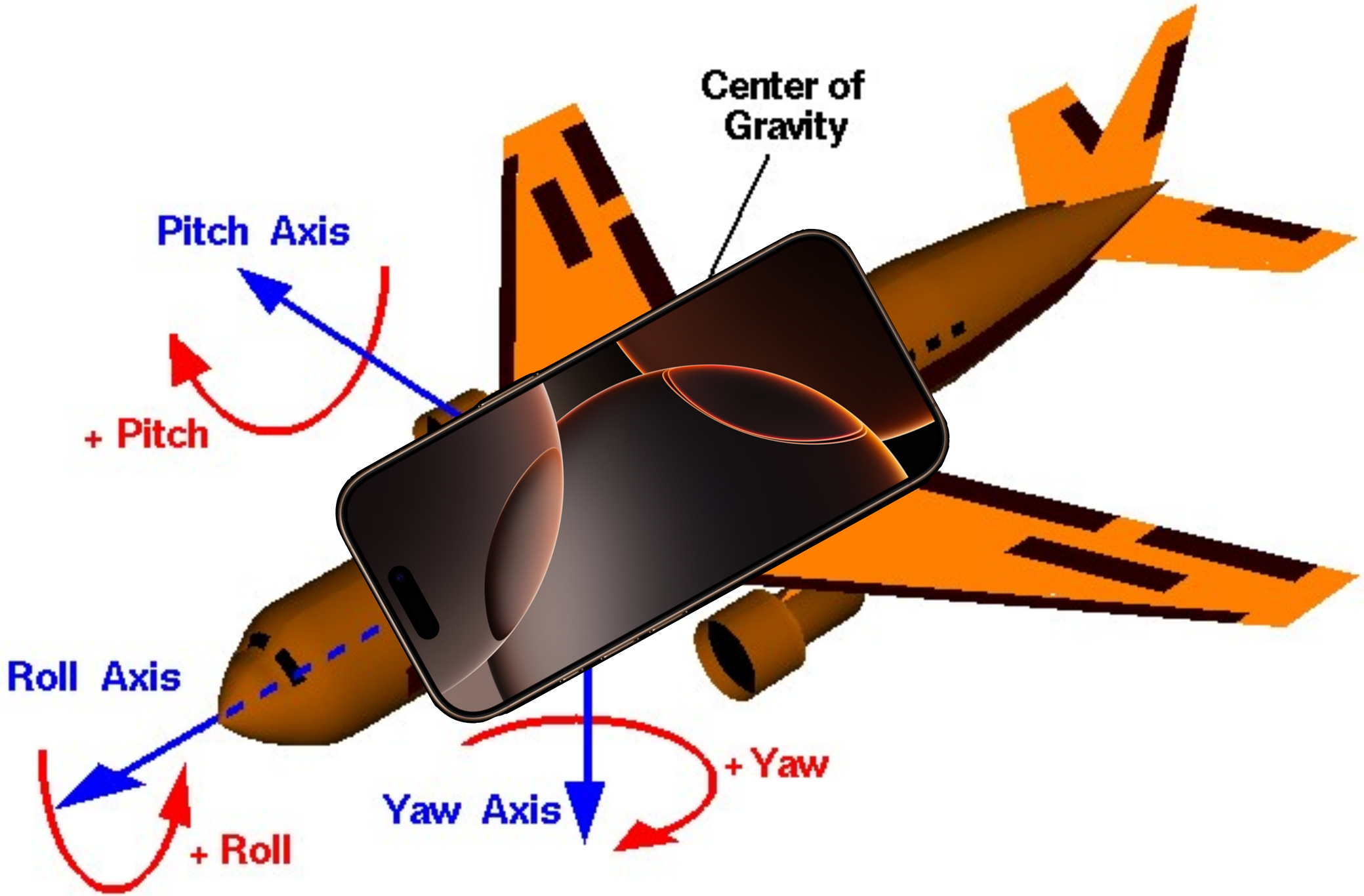
```
class GenericViewModel {
    // ...

    deinit {
        motionManager.stopDeviceMotionUpdates()
    }
}
```

Attitude


Center of
Gravity
Pitch Axis
+ Pitch
Roll Axis
+ Roll
Yaw Axis
+ Yaw

Attitude


Center of Gravity
Pitch Axis
+ Pitch
Roll Axis
+ Roll
Yaw Axis
+ Yaw

What data can you get?

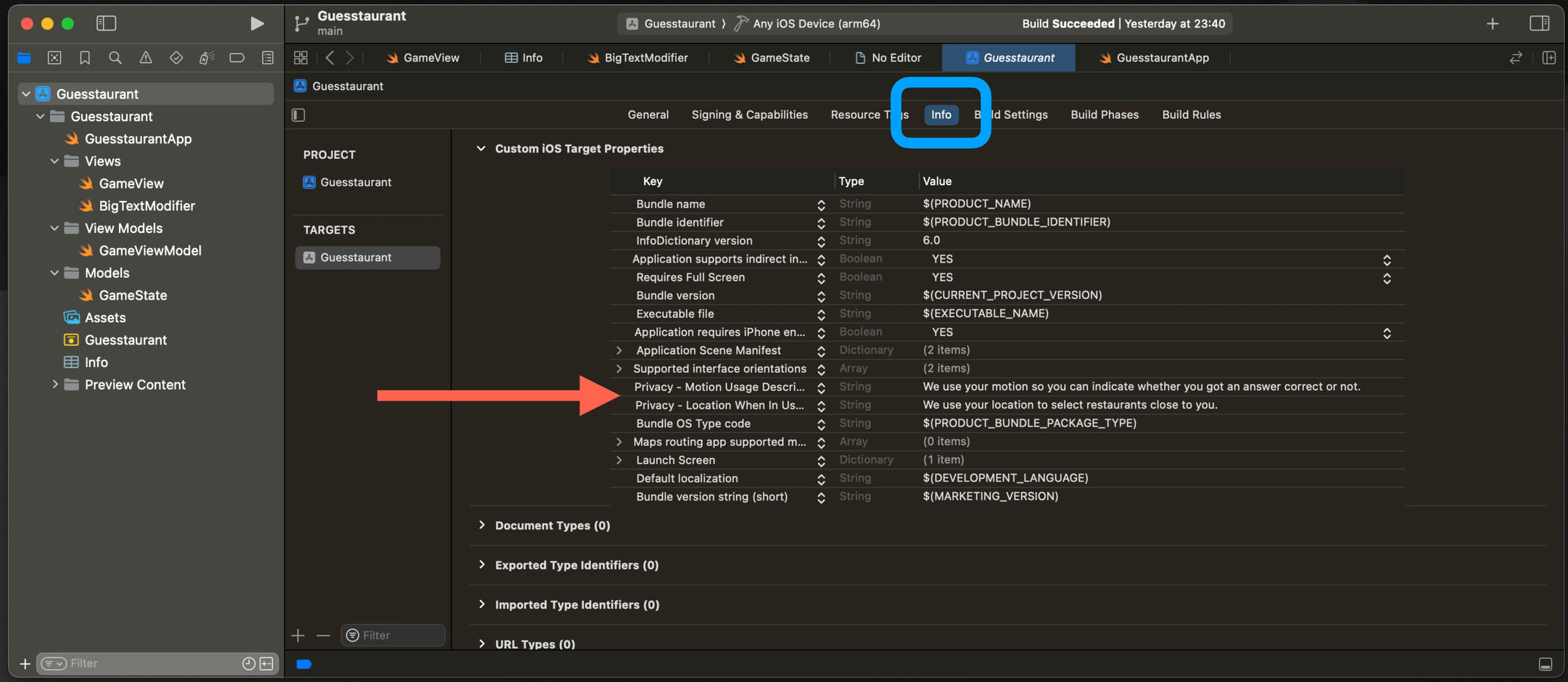
- Device rotation (“attitude”)
- Rotation rate
- Gravity
- Device acceleration
- Magnetic fields
- Compass heading
- Headphone motion
- Raw gyroscope and accelerometer data
- Altitude
- Step count
- Pressure and temperature
- Movement disorder symptom data (Apple Watch only)
- Water temperature and depth (Apple Watch Ultra only)
- Fall detection events (Apple Watch only)

Some of these require **other methods** in CoreMotion

Purpose Strings

Purpose Strings

Required for privacy-sensitive features to work

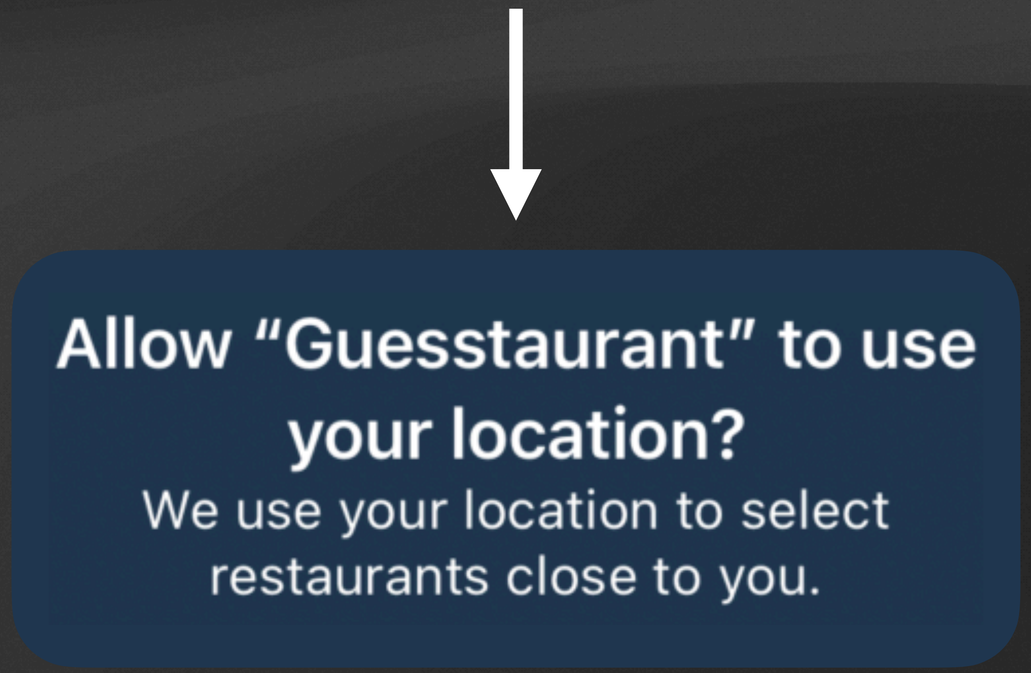


Purpose Strings

Required for privacy-sensitive features to work

Specify `NSMotionUsageDescription` and `NSLocationWhenInUseUsageDescription` in Info.plist

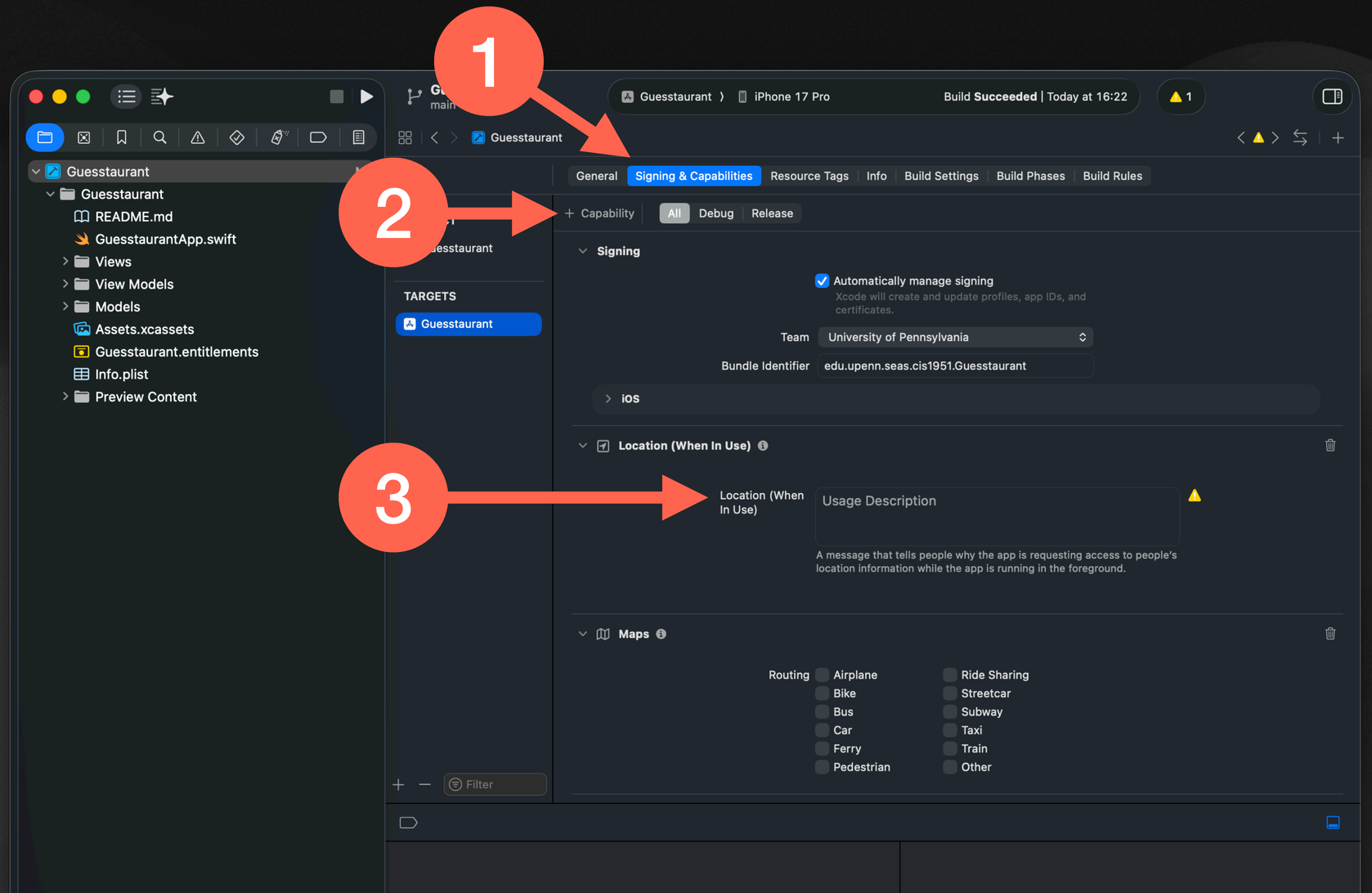
Privacy - Motion Usage Descri...	String	We use your motion so you can indicate whether you got an answer correct or not.
Privacy - Location When In Us...	String	We use your location to select restaurants close to you.



Purpose Strings

Required for privacy-sensitive features to work

NEW



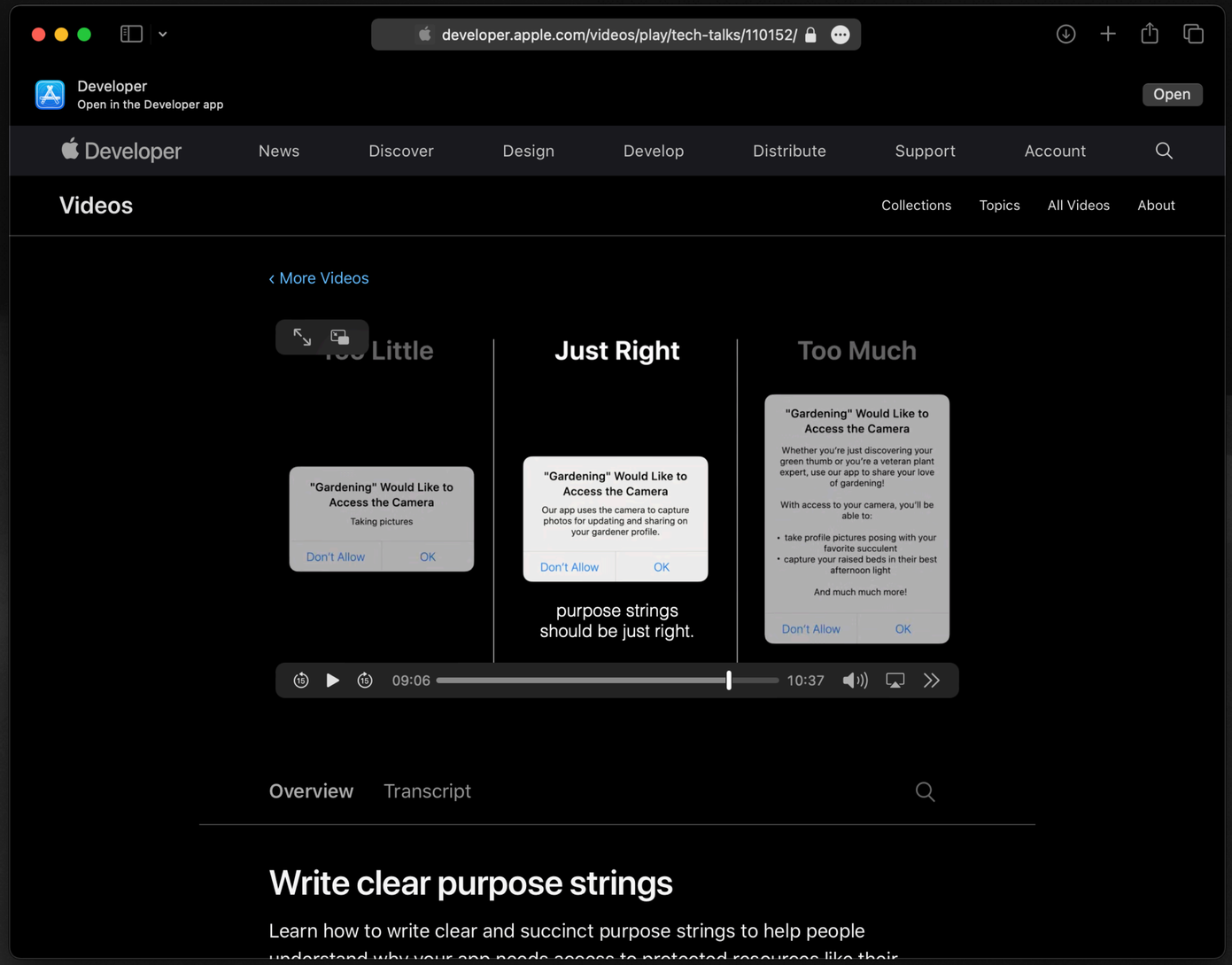
Purpose Strings

Must be clear

Adhere to the requirements for purpose strings

To give people useful, concise information about why you're requesting access to protected resources, make sure each purpose string you provide is valid by checking the following:

- The purpose string isn't blank and doesn't consist solely of whitespace characters.
- The purpose string is shorter than 4,000 bytes. Typical purpose strings are one complete sentence, but you can provide additional information to help a person make the right decision about sharing personal information.
- The purpose string has the proper type that the corresponding key requires, typically a string.
- The purpose string provides a description that's accurate, meaningful, and specific about why the app needs to access the protected resource.



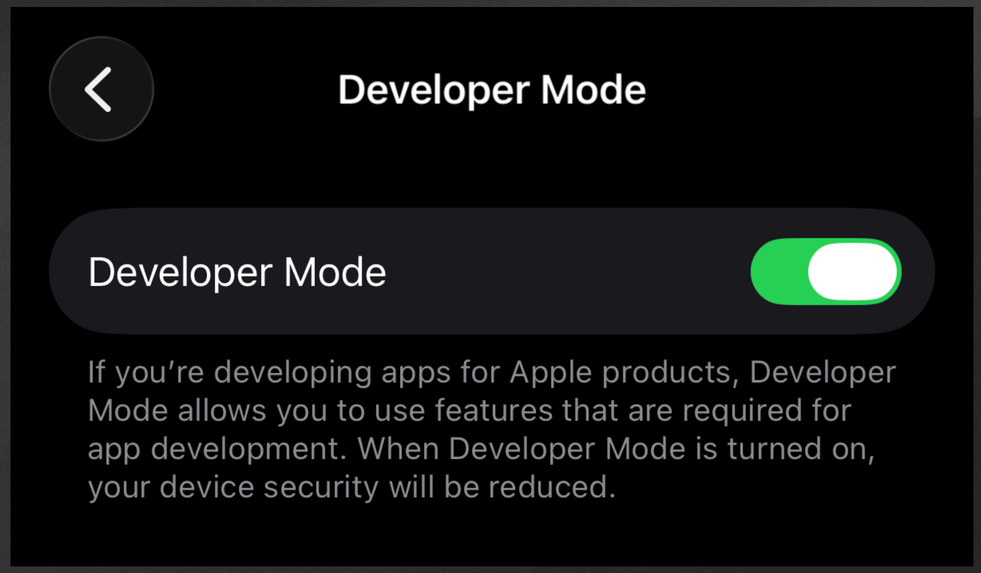
Unclear purpose strings are a **common App Store rejection**!

Running your app on-device

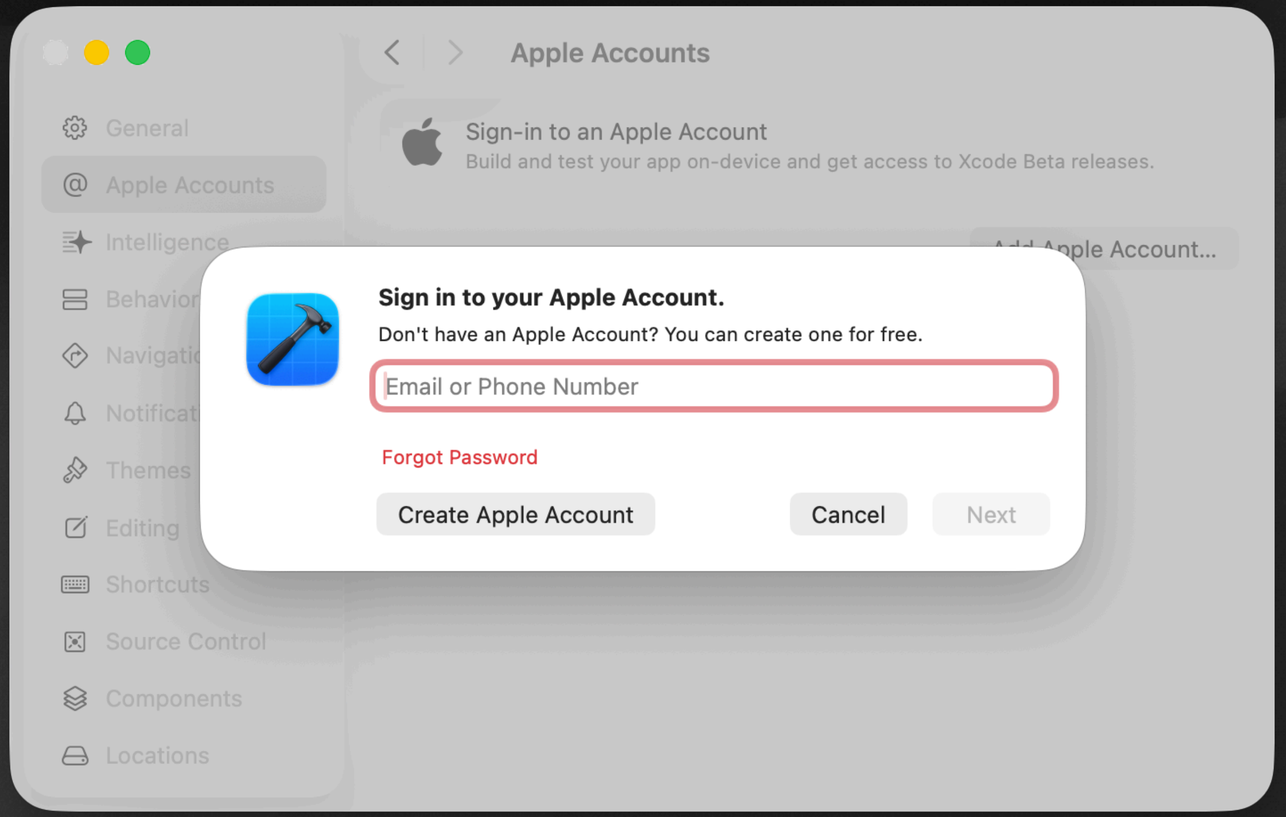
1 Plug your device into your computer

2 Enable Developer Mode on your device

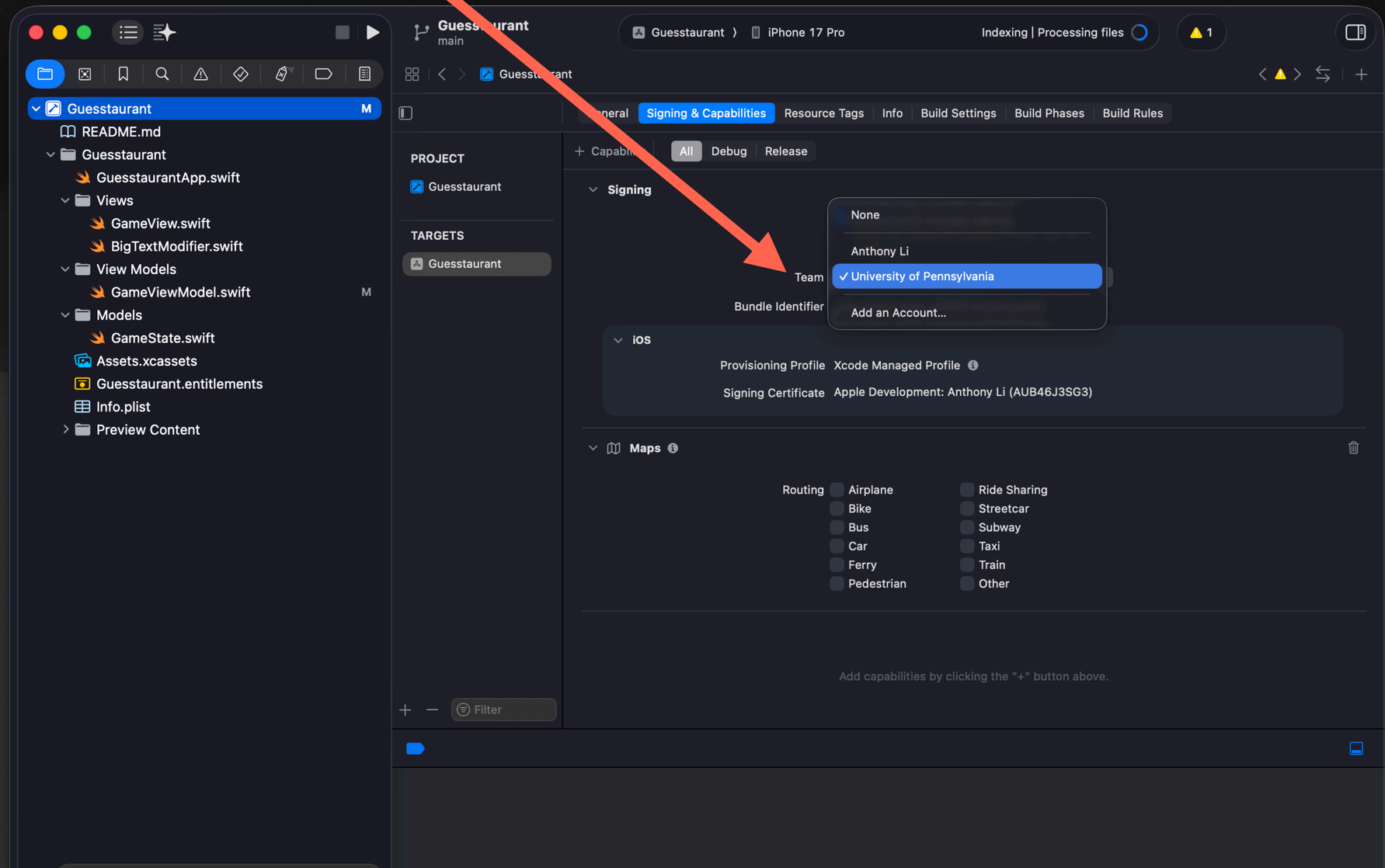
Settings › Privacy & Security



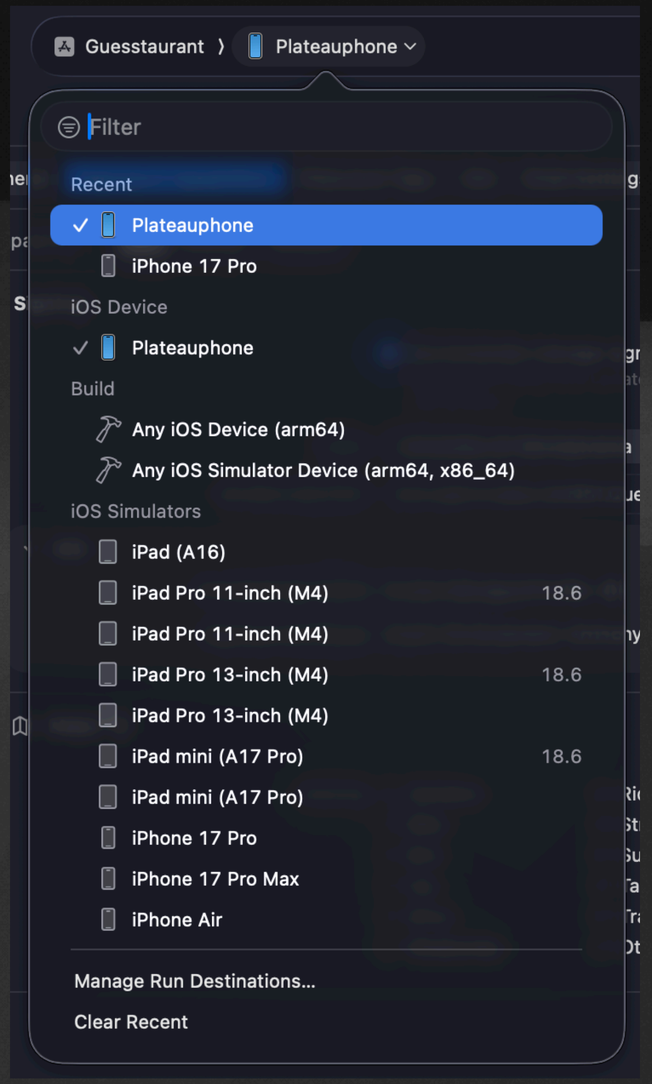
3 Sign into your Apple ID in Xcode Settings



4 Set your Team under Signing & Capabilities



5 Select your device



6 Build and run!

Coding time!

https://github.com/cis1951/lec7-code

HW3

Penn Dining Scavenger Hunt

- Will be released **today, 10/15**
- Due **Wednesday, 10/29**

- HW2 due **Wednesday, 10/16**