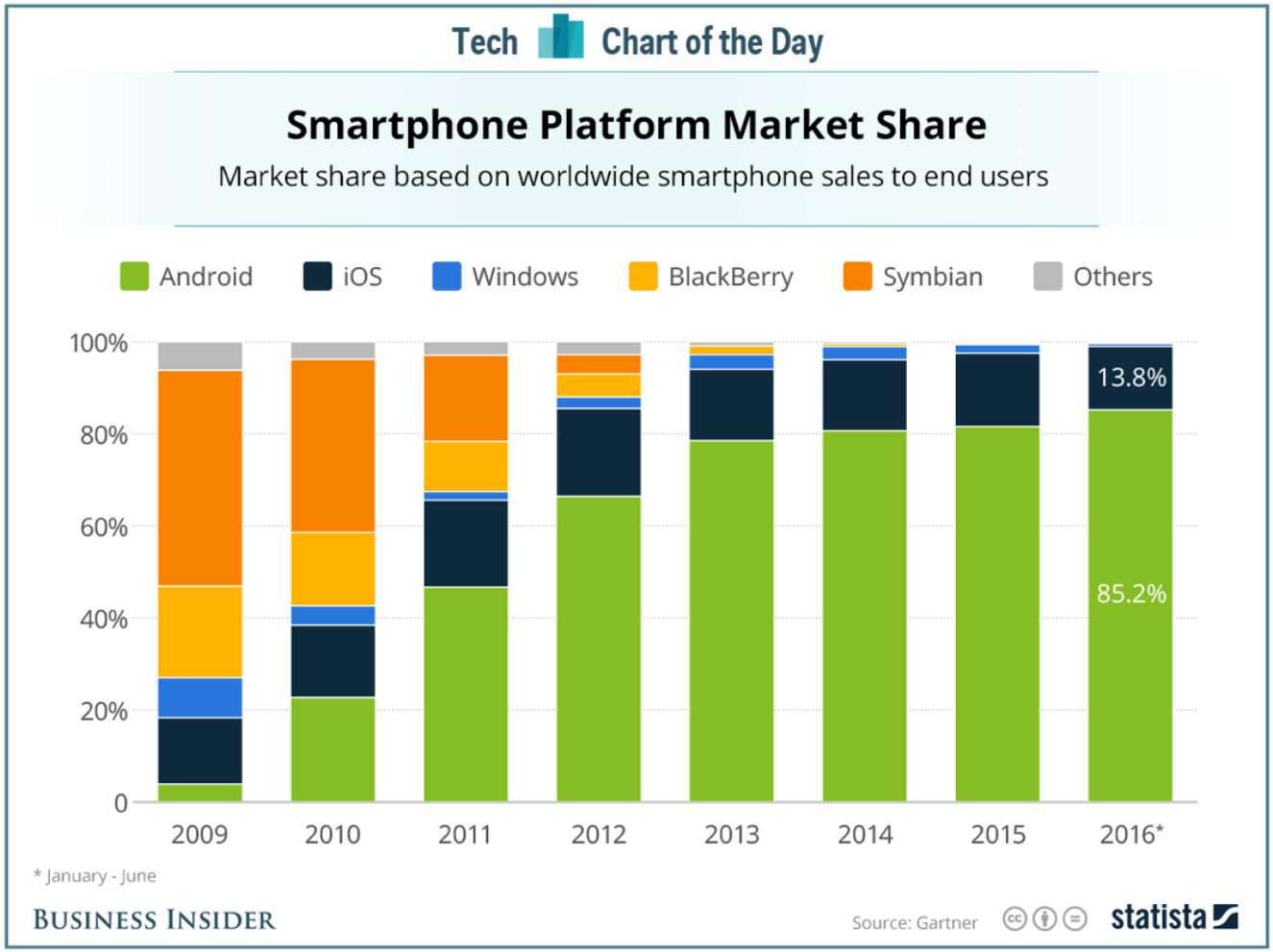
G53MDP
Mobile Device Programming

Lecture 20 – iOS, Cross-platform

Smartphone Platform Market Share



https://appsamurai.com/7-major-differences-between-ios-and-android-development/

Main Differences- Android vs. IOS

	Android	IOS
Market Share	82.8%	13.9%
Programming Language	Java Kotlin	Objective-C Swift (2014)
IDE	Eclipse (previously) Android Studio	XCode (now in version 7)
Operating Systems	Windows/Mac/Linux	Only on Mac!
Distribution Process	Release an App in hours	Release an App in weeks
Fees	$25 one-off	$100 per year

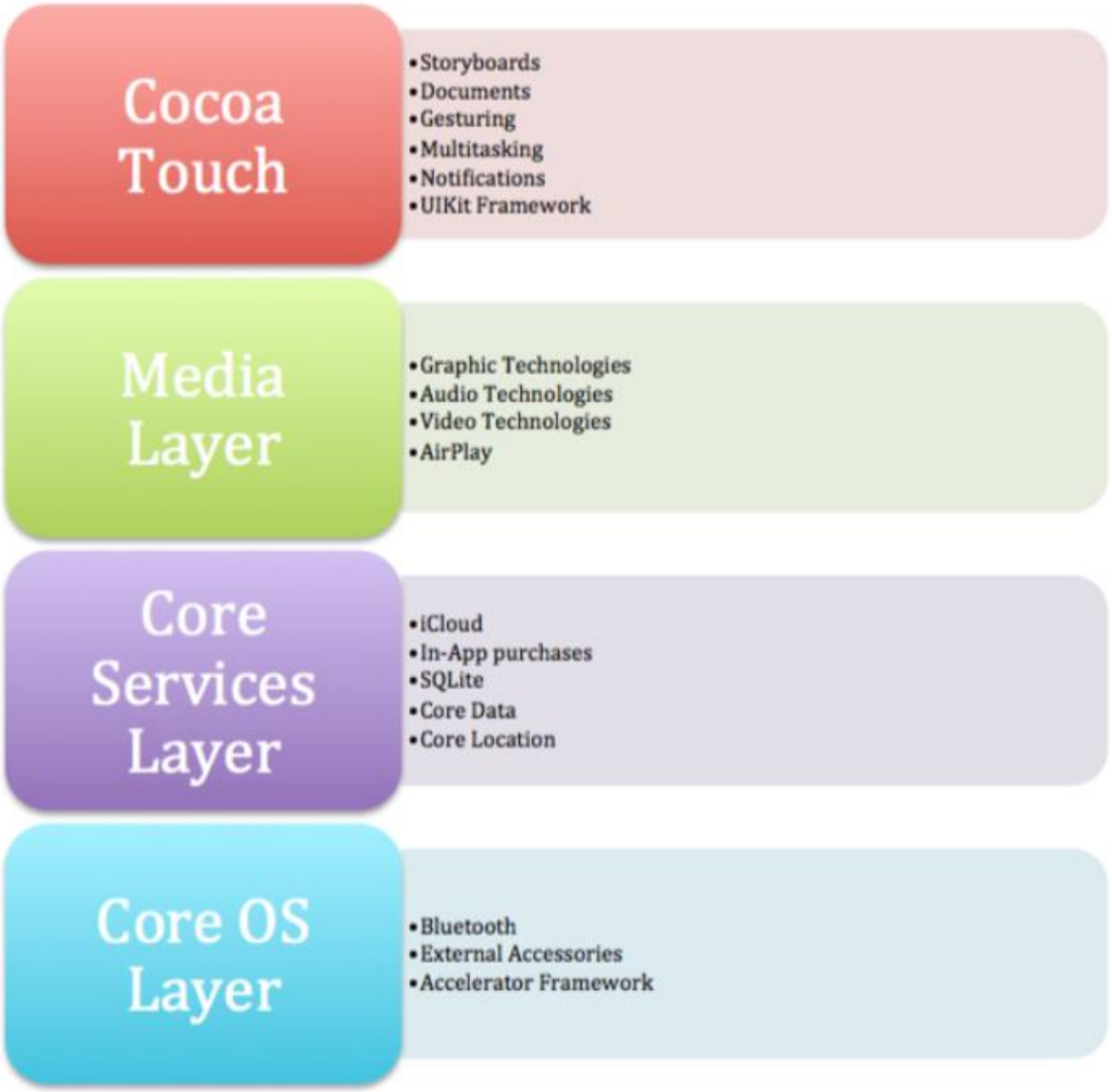
iOS

- OS of the iPhone/iPad/iPod Touch
  - Originally called iPhoneOS
  - Based (heavily) on MacOS X
- Closed Source
  - Tools, deployment, app ecosystem controlled by Apple
- Apps can only be installed from an App Store
  - Cryptographically signed
  - Apple runs iTunes App Store
  - Approves all apps available from it

iOS Apps

- Written in Objective-C (ObjC) / Swift
  - Extension of C to add support for OO
  - Using the Cocoa Touch UI framework
  - Can also use C/C++ libraries
  - Compiles to native code via LLVM (not interpreted/JIT as on Android)
  - Swift is getting popular

iOS Frameworks



App appearance, user interactions, high level

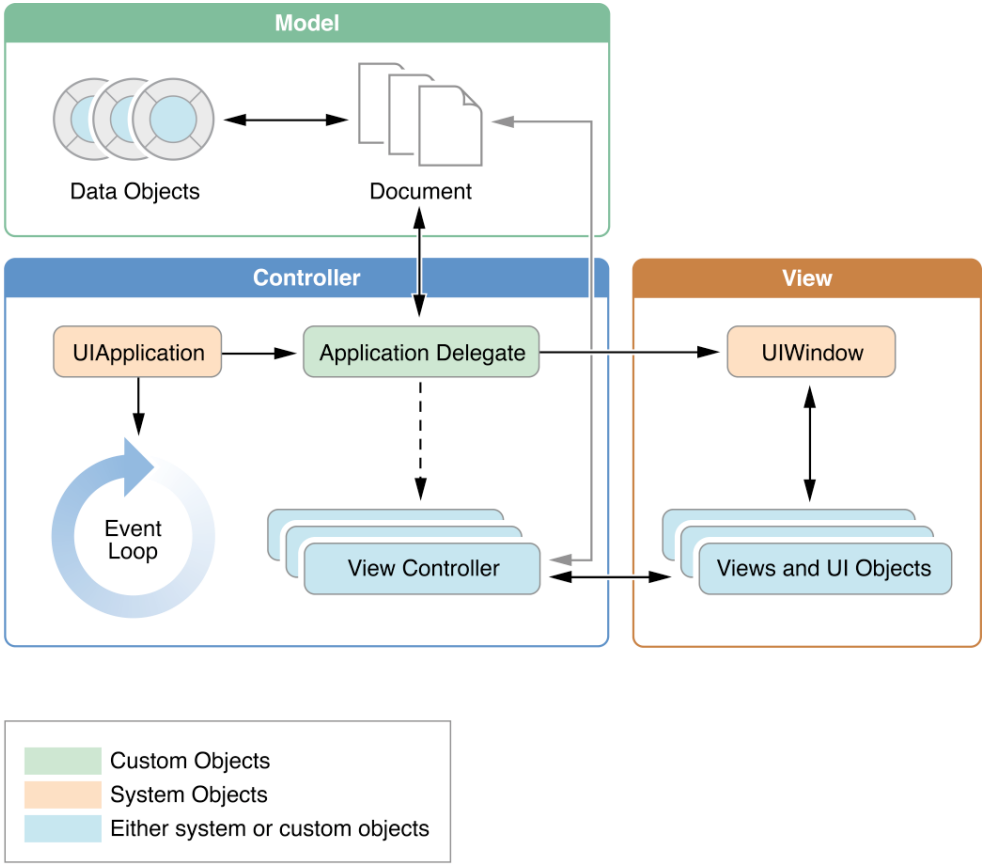
Media pipeline to handle audio/video codec, 3D graphics

Fundamental operating system services

Low-level services related to hardware & networks

Structure of an App
Model View Controller Design Pattern

- **UIApplication Object:** manages event loop & high-level app behaviour
- **Delegate:** handle app initialisation, state transition
- **Data Objects:** store data for the App (e.g. images, database)
- **Document:** manage data objects
- **View Controller:** manages the presentation of app on the screen, load view, show view, rotate view, etc.
- **UIWindow:** coordinates the presentation of one or more views on a screen (& external screen)
- **Views & UI objects:** draw content, buttons, text fields etc.



iOS Lifecycle

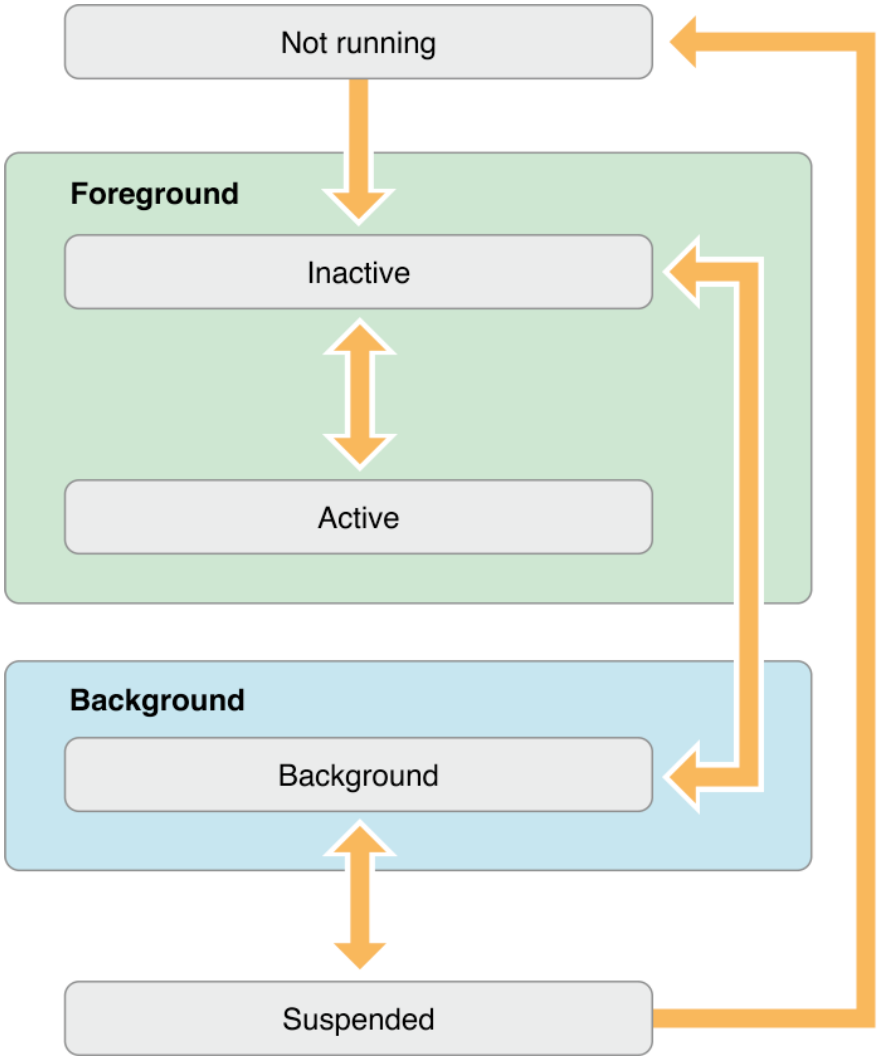
- Analogous to Android lifecycle
  - Apps are sandboxed, inter-app communication to pass data
  - Only one application in the foreground / visible at any one time
- A main loop processes events for the application
  - Xcode creates the main function
- An app can be a number of significant states
  - Active :foreground
  - Inactive: foreground but interrupted by a phone call, notification etc.
  - Background: can remain in this state to perform long running tasks (analogous to Services in Android)
  - Suspended: main loop no longer running, remained in memory but potentially killed by the operating system
- iOS 3.2 and earlier
  - No support for suspended / background states (no long running tasks)

State Transition

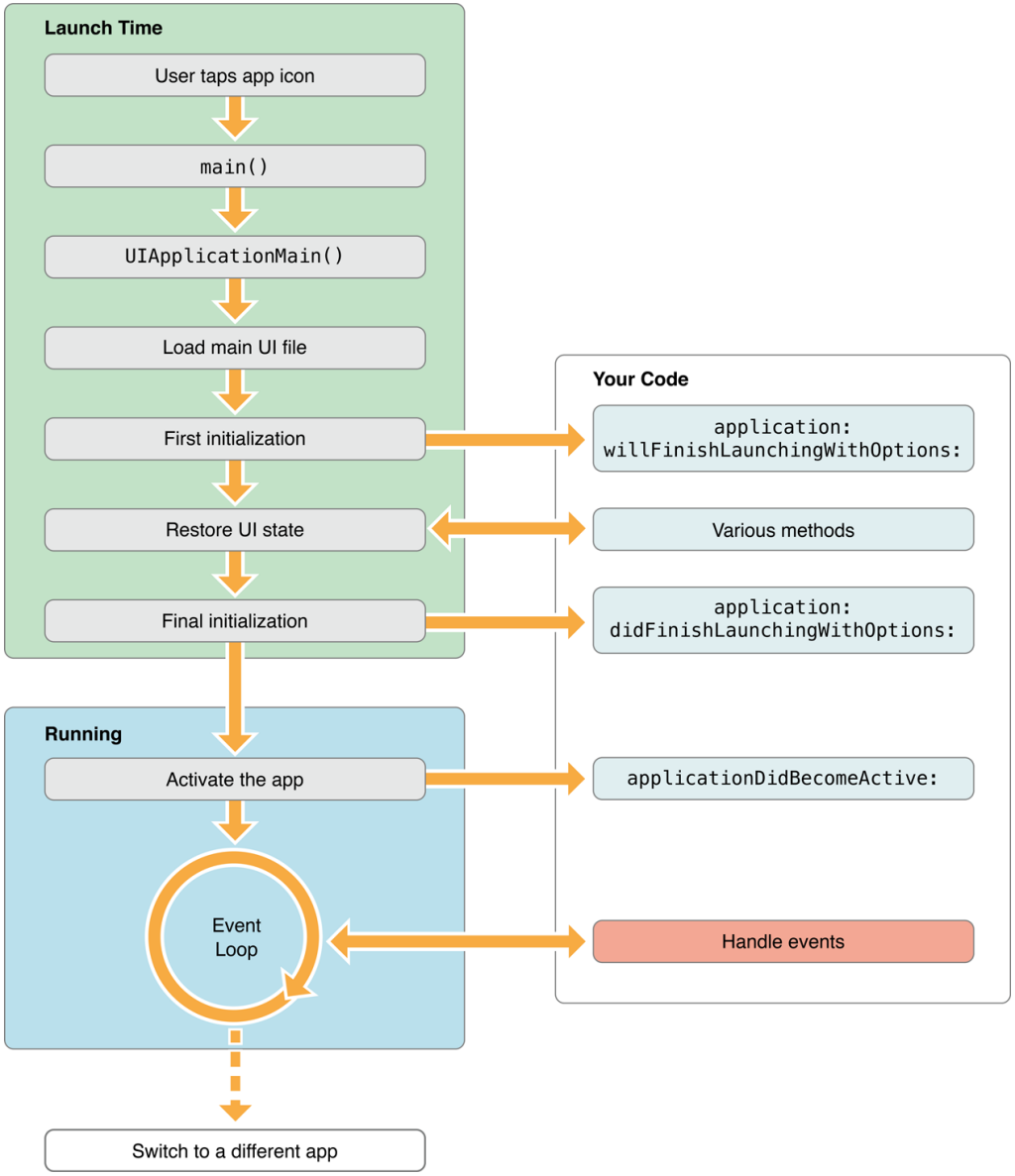
State transition handled by Delegate object

Not running: the app has not been launched
Inactive: running in the foreground but currently not receiving events.
Active: running in the foreground and is receiving events.
Background: app is in the background and executing code.
Suspended: app is in the background but is not executing code (remains in memory)

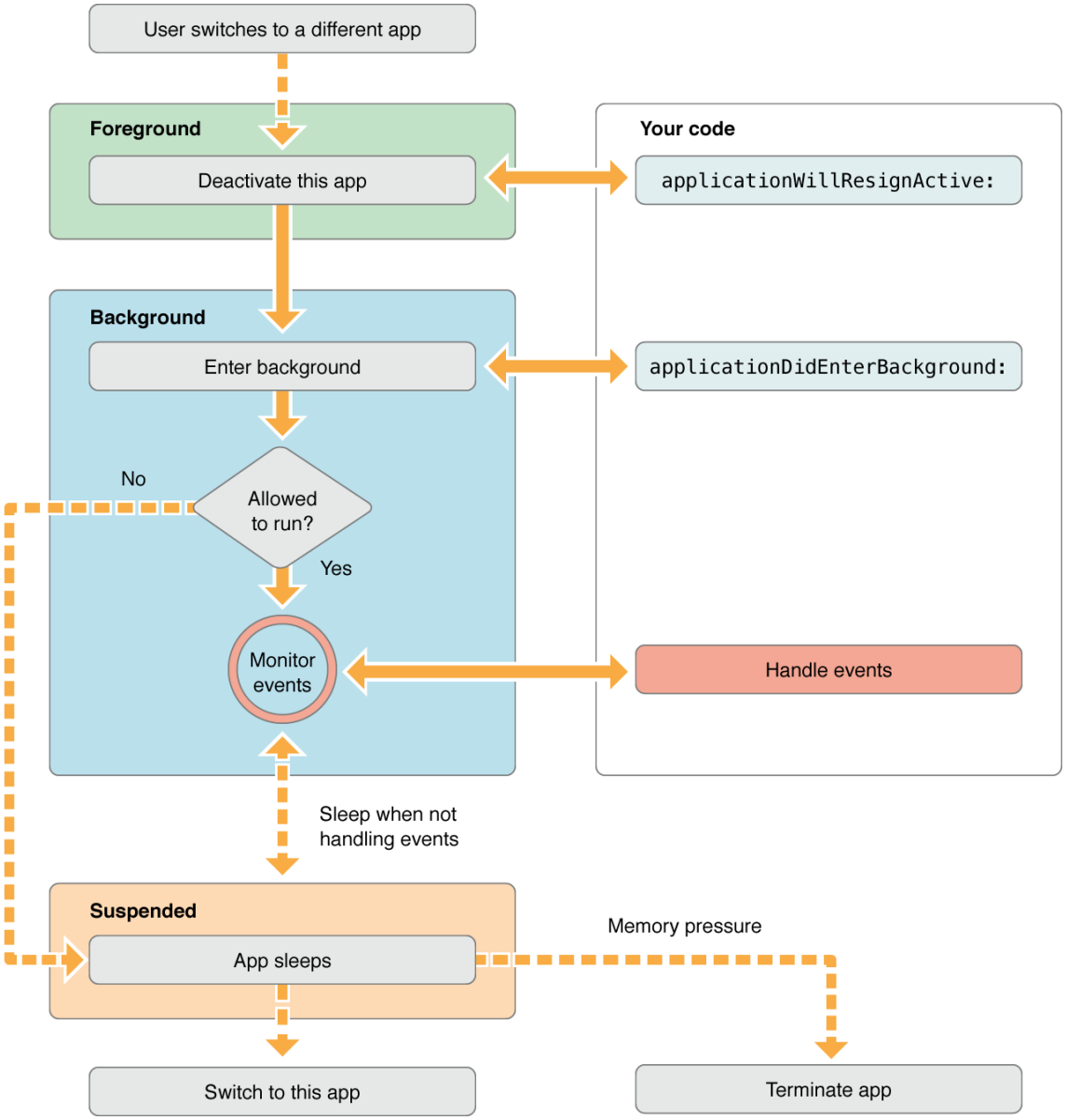
Threads & Concurrency:
Use Grand Central Dispatch
Main thread for UI
Other lengthy tasks are in background



App Launch Cycle



Handling State Transitions



Save data, stop initiate new tasks, pause the process, etc.

App Store

- “We will reject Apps for any content or behavior that we believe is over the line. What line, you ask? Well, as a Supreme Court Justice once said, "I'll know it when I see it". And we think that you will also know it when you cross it.”
- Pre-moderation
  - Apple checks all applications in advance manually
  - Vs Android – publish then revoke
- A long list of guidelines as to what is appropriate
  - Correct use of interface components
  - Substantial content

App Store Restrictions

- **2.5** Apps that use non-public APIs will be rejected
- **2.8** Apps that install or launch other executable code will be rejected
- **2.10** iPhone Apps must also run on iPad without modification, at iPhone resolution, and at 2X iPhone 3GS resolution
- **2.16** Multitasking Apps may only use background services for their intended purposes: VoIP, audio playback, location, task completion, local notifications, etc.
- **2.17** Apps that browse the web must use the iOS WebKit framework and WebKit Javascript
- **13.2** Apps that rapidly drain the device's battery or generate excessive heat will be rejected

Cross Platform?

- Apps developed for one system won't work on another
- Would need to port it over
  - This can actually be desirable
    - Can tailor our app to the look and feel of the target device
    - Apple encourage the use of iOS "metaphors"
      - Sliding on/off switches, spinning picker wheels
  - Significant coding effort
- However, there are times when it is desirable to target multiple platforms
  - In-house apps
  - Games (Platform chrome usually irrelevant)
- What are the issues behind cross-platform support?

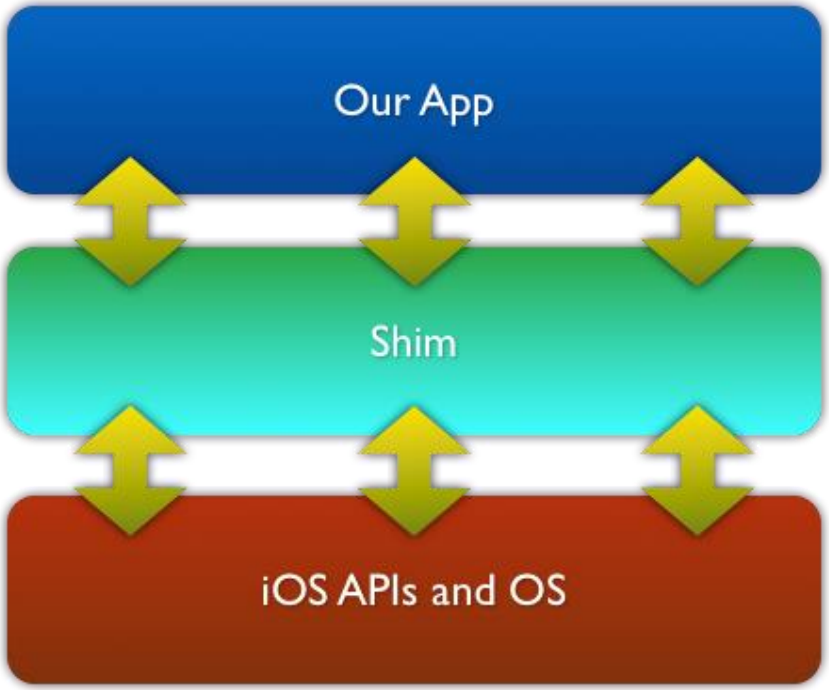
Language

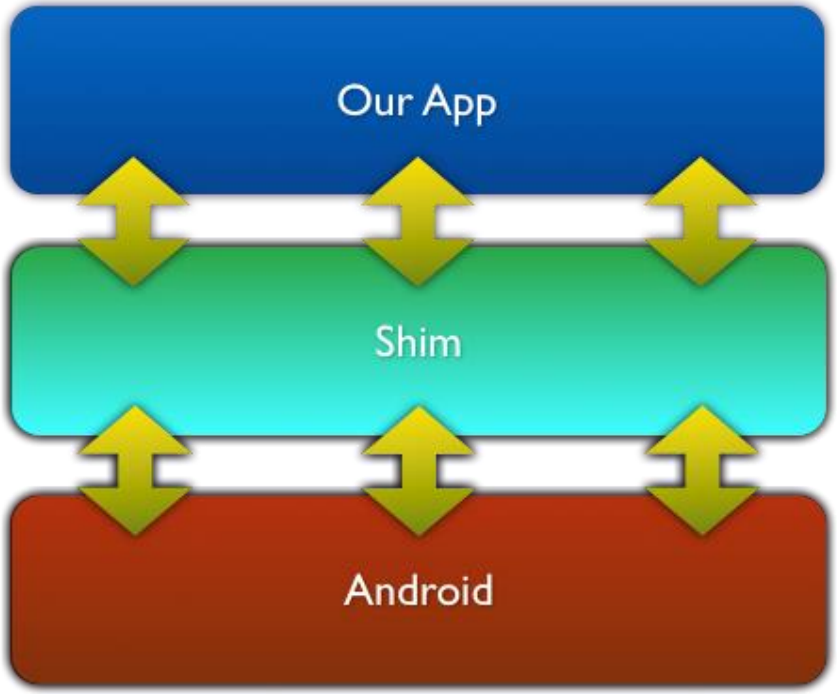
- Compile code for multiple platforms?
  - Can compile Java into native code (gcj)
    - Android supports native code libraries
  - C++ can be compiled to common language runtime (CLR)
- This would work at a technical level
- The code would execute
  - But the app wouldn't run
  - Each platform has different APIs…
    - Android — Activities, Intents, Services…
    - iOS — Views, ViewControllers,
- Could port the app logic relatively easily
  - But would still need to rewrite the UI
  - This maybe enough for games
    - OpenGL ES supported across several platforms
  - End up rewriting boilerplate UI setup stuff

Truly Cross Platform

- Assuming that we can compile code for each device
- To be completely cross platform we can insert a **shim** between our code and the APIs
  - Effectively abstracting our code from the original APIs
  - Our code calls our abstraction
- To port to another device, change the shim and recompile with the appropriate tool-chain
  - New shim provides the same interface to our app
  - But implements it using the native APIs of the new platform


Our App
iOS APIs and OS


Our App
Shim
iOS APIs and OS


Our App
Shim
Android

Current Solutions

- PhoneGap: https://phonegap.com/
  - Code is significantly reused
  - Doesn't look native
- Mono Wrapper: http://www.mono-project.com/; https://www.xamarin.com/
  - Written in C#
  - Access to almost all platform APIs
  - UI still written for each platform

References

- http://phonegap.com/
- http://unity3d.com/
- https://www.xamarin.com/
- https://developer.apple.com/library/content/documentation/iPhone/Conceptual/iPhoneOSProgrammingGuide/Introduction/Introduction.html#//apple_ref/doc/uid/TP40007072-CH1-SW1