IN4MATX 133: User Interface Software

Lecture:
Hybrid and Native Architectures

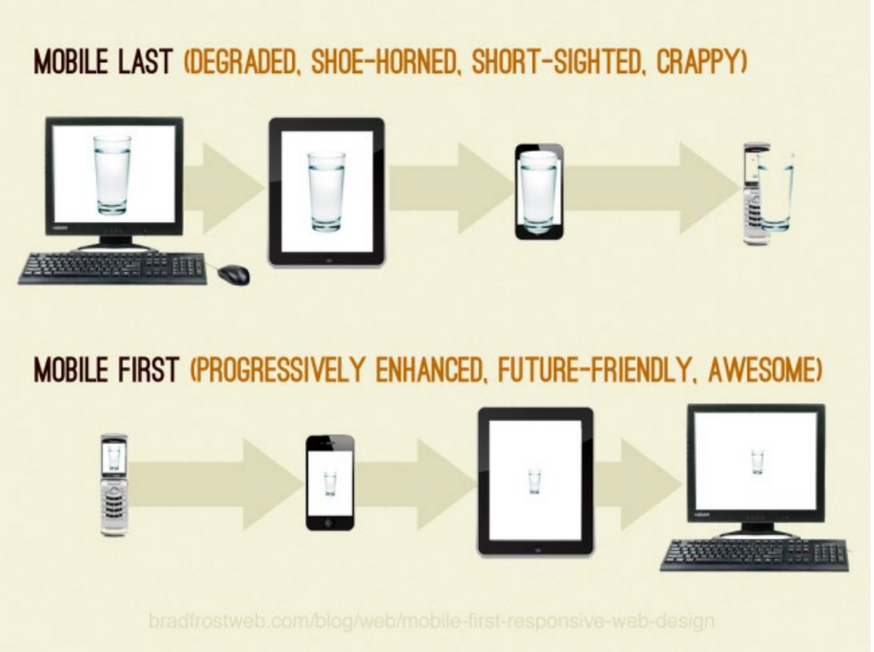
Today’s goals

By the end of today, you should be able to…

- Differentiate approaches to developing mobile interfaces
- Describe advantages and disadvantages of developing native, hybrid, and web applications
- Explain which approach Ionic takes to app development

Mobile-first design

- Plan your design for mobile
- Then make your app *better* with more real estate
  - Add more features
  - Make existing features easier to navigate
- A lot of businesses make mobile-friendly websites before making dedicated apps



Question: why might a business want a mobile app over a mobile website?

There are a variety of ways to build mobile apps

Mobile development methods

- Native
- WebView
- Hybrid
- Responsive

Native apps

- An app designed to work on a specific piece of hardware
- Usually built with tools created by the hardware or platform manufacturer
  - Android Studio for Android, in Java
  - Xcode for iOS, in Swift or Objective-C

Native apps

- As we think of them today, native apps started with the first iPhone
- Released a development platform alongside the hardware

Native apps

- iOS development languages:
  - Objective-C
  - Cocoa Touch
  - Swift
- These languages were either developed by or pretty much only used by Apple
  - Developer lock-in is a… Disadvantage? Advantage? Both?

Native apps

- iOS development tools:
  - Xcode
  - iOS Source Development Kit (SDK)
  - SDK provides access to phone's storage, camera, sensors, etc.

Native apps

- Android development languages:
  - Primarily Java
  - C and C++ via Android Native Development Kit (NDK)
- Align more closely with languages used in other contexts
  - Is this an advantage? A disadvantage?

Native apps

- Android development tools:
  - Android Studio
  - Android Source Development Kit (SDK)
  - Various IDEs like Eclipse or NetBeans

Native apps

- Platform-specific codebases
  - Android is in Java,
    iOS is in Objective-C or Swift
  - Both use different libraries
    to communicate with the hardware
- Usually require starting to code
  from scratch

What if we already made a website for our app? Or have some other existing codebase?

What if we want to share code across phone platforms?

Solution: hybrid apps

Hybrid apps

- “Use a common code base to deploy native-like apps on a wide range of platforms”
- Two primary approaches:
  - WebView app
  - Compiled hybrid app

WebView app

- Run a webpage written in HTML/CSS/JavaScript, on the phone's internal browser
- Load that browser in a lightweight native app
- Ideally, expose some native APIs to the browser

WebView app

- Essentially, the app is just a website
- Allows the same or similar code to be used across an app and a website

WebView app frameworks

- Ionic
- jQuery mobile
- NativeScript
- These frameworks use web technologies (HTML, CSS, TypeScript, JavaScript) rather than platform-specific technologies

WebView app frameworks

- WebView apps are just websites
- What do these frameworks provide?
  - Common mobile interface elements like sliders and buttons (more on that next week)
  - The native app for running the website
  - Some APIs for communicating with platform SDKs

Compiled hybrid apps

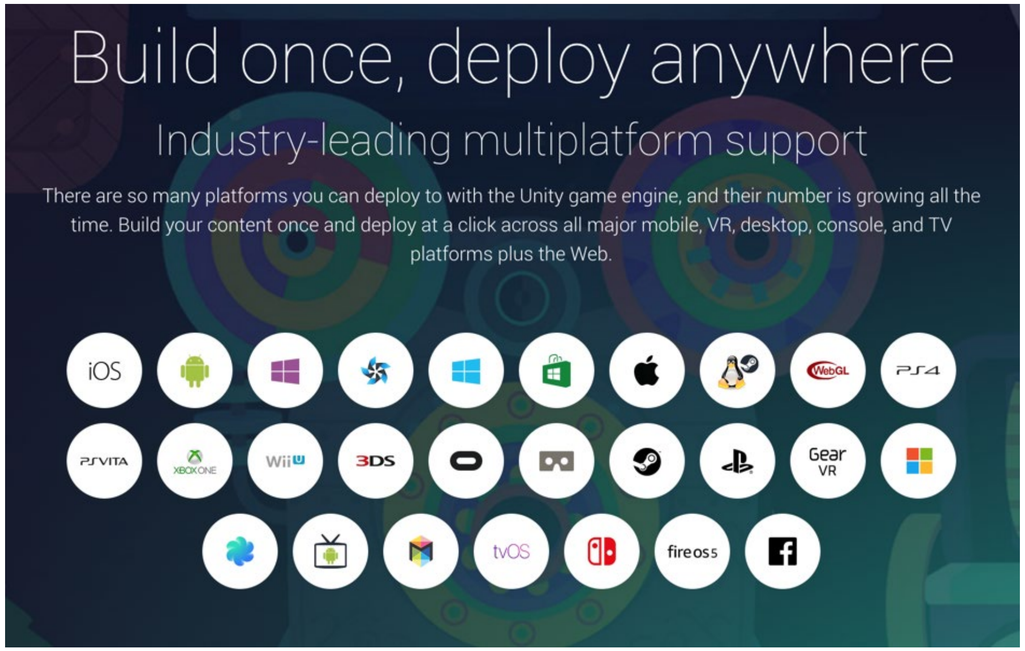
- “Write code in one language, such as C# or JavaScript, and compile it to native code supported by each platform”
- Result: a native app for each platform
- Challenge: less freedom in development

Compiled hybrid app frameworks

- Xamarin
  - C#
- Unity
  - C# of JavaScript
- React Native
  - JavaScript

Unity

- Leading game development platform
  - Supports consoles, web, and mobile
  - Will need to import
    or use platform-specific SDKs



React Native

- Uses React, a web framework similar to Angular
- Compiles a webpage to a native app

Performance is just one factor.

How do we choose a development approach?

Business considerations

- Development time
- Development cost
- Maintenance concerns
- Available infrastructure

UX and design considerations

- Consistency with platform
- Device capabilities
- Interaction models supported
- Performance and usability

Technical considerations

- Programming languages
- Integration with device
- Performance
- Upkeep and maintenance
- Flexibility
- Compatibility

Pros and cons of each option

Strengths of hybrid apps

- Can share a codebase between web and mobile
- Can save time and effort (sometimes)
- Easily design for various form factors
- Access to some device capabilities

Weaknesses of hybrid apps

- Performance issues
- Inconsistency with platform
- Limited access to device capabilities

Strengths of native apps

- Consistent experience with platform
- Leverages full device capabilities
- Uses native UI elements

Weaknesses of native apps

- Need to support separate development for each platform
- Cost of app development and maintenance
- Need to learn/manage multiple programming languages
- Need to manage multiple sets of tools

Hybrid apps vs. native apps

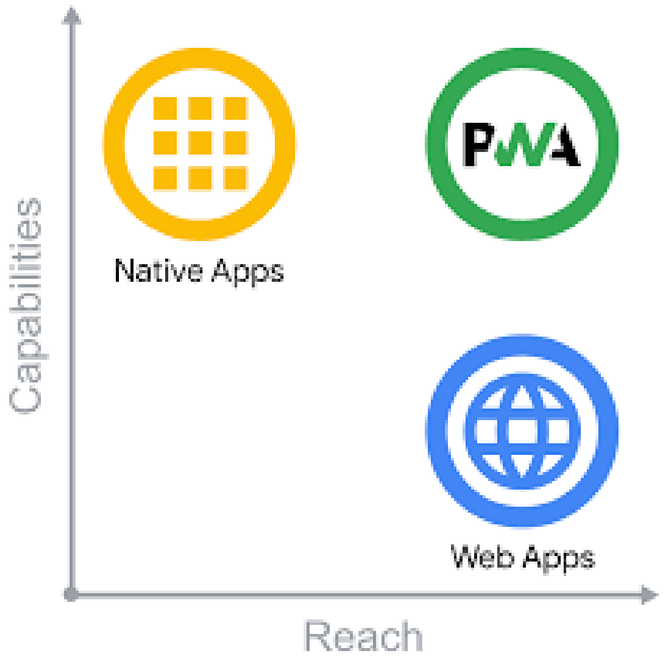
- Hybrid apps are great when time or money is a concern and you need to deploy on multiple platforms
- Native apps are great when performance and consistency with the platform are major concerns

Hybrid apps vs. native apps

- Hybrid apps
  - News sites
  - Informational apps
  - Product showcase
  - Seasonal/one-off
- Native apps
  - Games
  - Content-heavy apps
  - Uses a lot of device resources
  - Needs specific OS capabilities

Progressive Web Apps (PWAs)

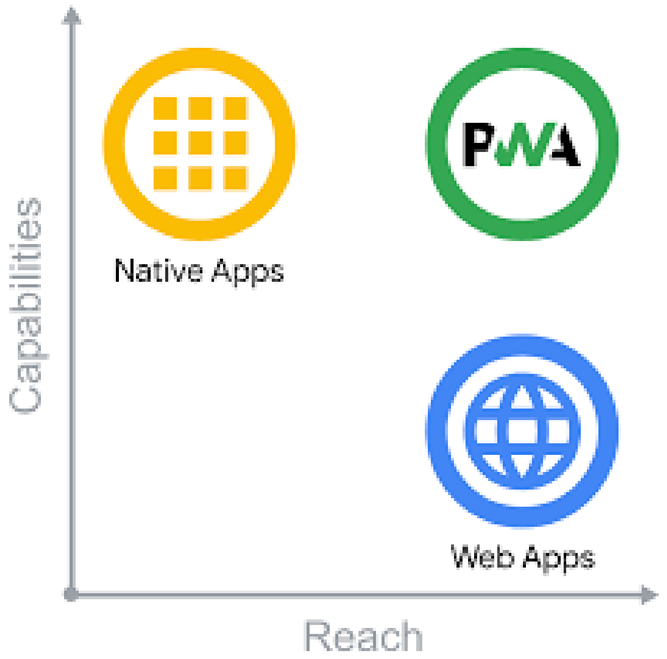
- Intended to “fill the gap” between native apps and web apps
- Really just a website that you can “install” on a phone
- Supported by major browsers & phones
- No associated framework, just a few files to add



https://en.wikipedia.org/wiki/Progressive_web_application

Progressive Web Apps (PWAs)

- Add some information to an app manifest (manifest.json)
  - Desired device orientation, URL to open, links to icons
- Relies on everything your browser relies on for other features
  - Web Storage for saving values
  - https://en.wikipedia.org/wiki/Web_storage



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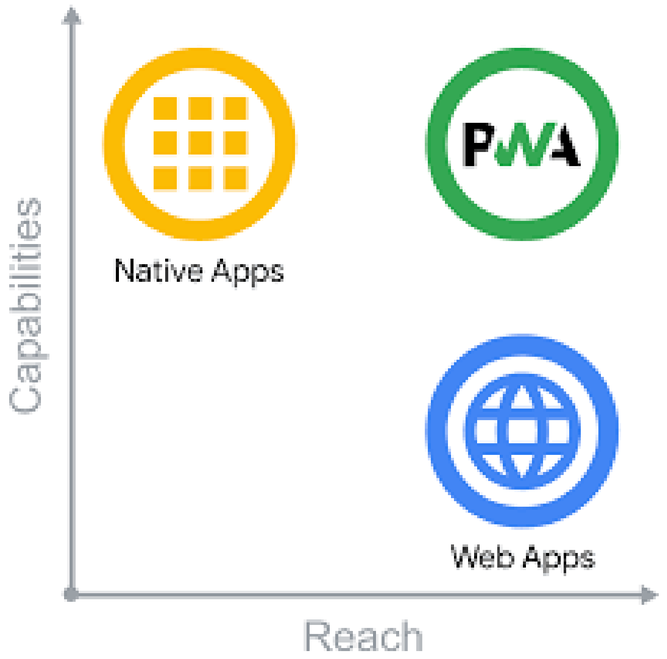
Progressive Web Apps (PWAs)

- A good PWA should:
  - Start fast, stay fast
  - Work in any browser
  - Be responsive to any screen size
  - Provide a custom offline page
  - Be installable



https://web.dev/pwa-checklist/

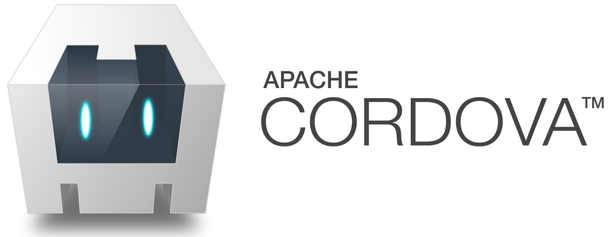
Progressive Web Apps (PWAs)

- Main advantages
  - They require almost no new code or libraries, making them ideal for having a shared codebase with your website and implementing progressive enhancement
  - Most apps don’t need native features
- Main disadvantage
  - They don’t show up in managed app stores like Apple’s App Store or Google Play, so not discoverable through traditional means
- To learn more visit (great resource for getting started):
  - https://developer.mozilla.org/en-US/docs/Web/Progressive_web_apps

One Hybrid (WebView) framework: Ionic

Ionic

- WebView app framework
- Launched in 2013
- Interface implemented in Angular
  - Recently added support for React and Vue
- Capacitor is the recommended hybrid app runtime for ionic, replacing Cordova
- Apache Cordova is still supported, but not recommended for new projects



https://ionicframework.com/resources/articles/capacitor-vs-cordova-modern-hybrid-app-development

Capacitor

- It provides the native app which opens the WebView
- Supports PWAs
- Also provides plugins for connecting to device resources
- Hundreds of plugins
  - Official
  - Community

https://github.com/capacitor-community/

https://capacitorjs.com/docs/apis

Ionic Native

- Ionic Native is a wrapper to bring plugins to ionic
  - Ionic Native plugins are imported as services
  - Can wrap Cordova plugins as well
- Capacitor has retro-compatibility with most Cordova plugins

https://ionicframework.com/docs/native/

Ionic Native

Some example plugins

- Geolocation
- Bluetooth
- Camera
- Health
- Gyroscope
- Pedometer

https://ionicframework.com/docs/native/

Ionic Native

Some example plugins

- Facebook
- LinkedIn
- WeChat
- Apple Pay
- Google Maps
- Youtube

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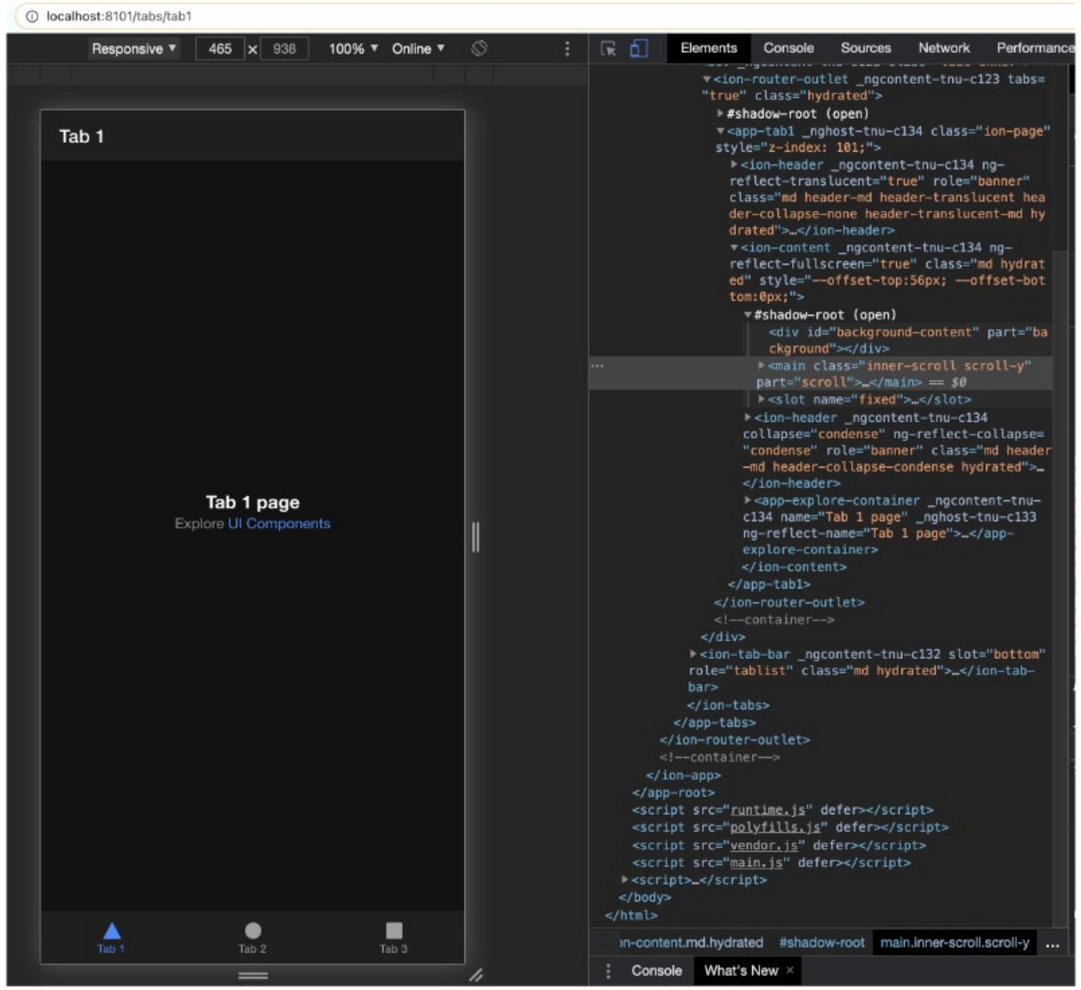
Ionic Dev

- Provides a WebView to open up Ionic apps
  - Lets you test your Ionic app in abrowser



https://ionicframework.com/docs/cli/commands/serve

Deploying Ionic apps

- Involves packaging up an app and “signing” it as a developer
  - For Android, this requires installing Android Studio
  - For iOS, this requires installing Xcode and getting a developer account
- Can then “deploy” the app to the app store
  - The iOS app store includes features for “beta” deployment with a small group of developers
- This process is often a pain

https://ionicframework.com/docs/building/ios or https://ionicframework.com/docs/building/android

Ionic iOS and Android Deployment

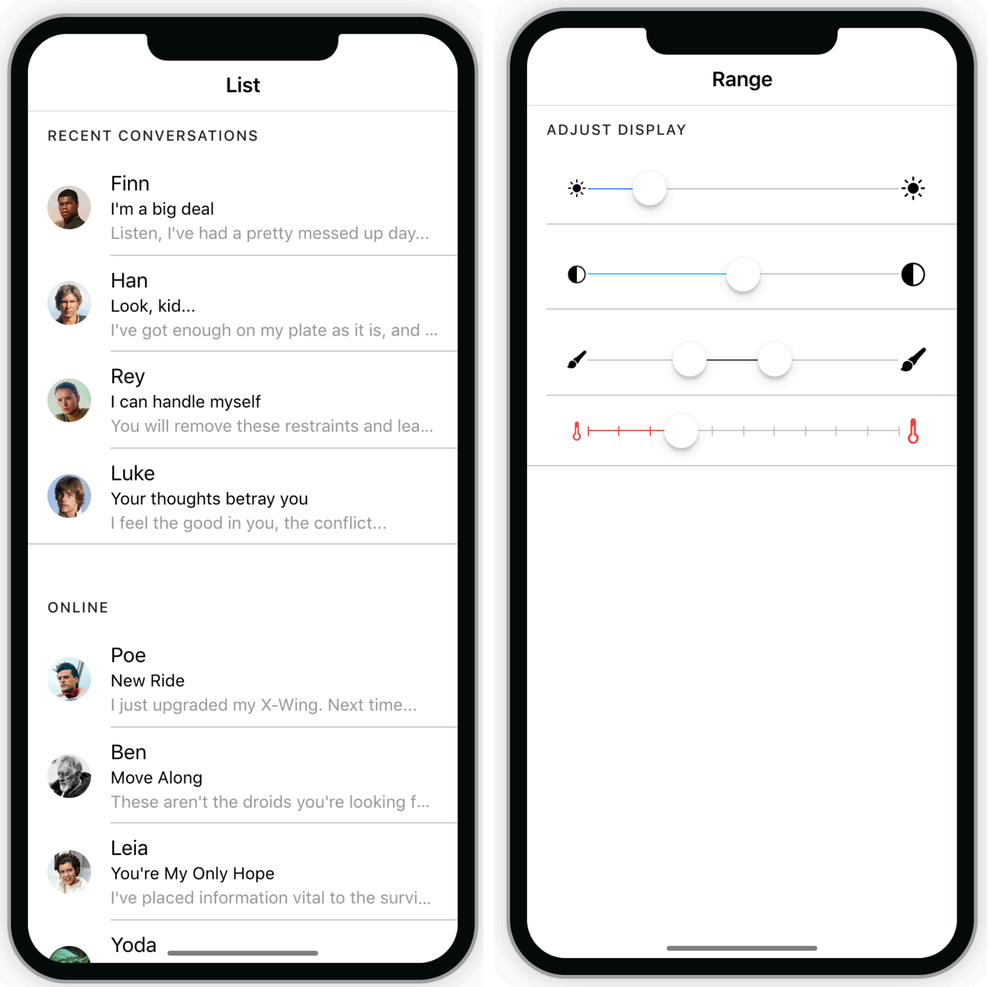
- “The key mantra of Capacitor is that developers should embrace native tools like Android Studio and Xcode”
- Pre-builds projects to be used in Xcode and Android Studio
  - Lets you test your Ionic app on an actual device or emulators
  - Emulators have limited use of plugins

https://ionicframework.com/docs/developing/starting

What does Ionic add over Angular?

Ionic components

- Ionic provides Angular-style components for a lot of interface elements common in mobile interfaces
  - Lists, buttons, sliders, tabs, modal dialogs, search bars, much more
  - These are the focus of next lecture



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