Introduction (Apps and the Android platform)

Spyros Samothrakis
Research Fellow, IADS
Univerisity of Essex

January 11, 2016

Course Structure

- 10 weeks
- Each week:
  - 2-hour lecture (including group discussion and software demos)
  - 2-hour lab: practice writing and debugging apps
- Assessment:
  - 2 assignments
    - App prototype (20%, wk 19)
    - Final app (70%, wk 25)
- 1 progress test (10%, wk 20)
  - Multi-choice test under exam conditions

Mobile and Social Application Programming

- Course focus: the software design and implementation of mobile applications
- Exciting platforms to develop on
- Many facilities:
  - Powerful processors, reasonable memory
  - Hi-Res touch-screen
  - Connected: Internet (3G, WiFi), Bluetooth, Telephony, SMS, Near Field?, 4G?
  - GPS, location services, maps
  - Access to multi media play and capture
  - Motion sensors

Wide Range of Apps (1)

- Games
  - Casual e.g., reaction games, card games, board games, Tetris, physics-based
  - Arcade e.g., Asteroids
  - 3D Console Style e.g. Grand Theft Auto
  - Social e.g. Quiz/ QuizUp
- Social
  - Facebook, Twitter

Wide Range of Apps (2)

- Sports
  - e.g. trackers like Endomondo, MapMyRide
- Productivity
  - Email, note taking, shopping
- Information (flights, weather, traffic,. . .)
- Transactional (e.g. Shopping: Amazon, eBay)
- Health, Education

Why Android?

- Open platform
- Large market share:
  - Diverse range of devices (some beautiful!)
  - Extensive monetization possibilities
  - Play store and other markets
- Powerful mobile operating system
  - Worth studying in its own right
- Good support tools and easy deployment
- Main language: Java
  - Well known, great IDEs (Intellij, Eclipse), easy to learn and use
- For more on Market Share see:
  - http://www.theguardian.com/technology/2014/jan/09/market-share-smartphones-iphone-android-windows

There are alternatives to Java!

- This course is java-centric
- Not always the case, android development is done in other platforms as well
- From Python (Kivy) to Unity, there are alternatives to Java
- Java is however considered the default android language

Android App Development

- Take an idea through to implementation and publication
  - Idea -> Draft Requirements
  - Requirements may change opportunistically
  - Underlying logic / model
  - File or Network I/O
  - Sensors
  - GUI Design and event handling
    - Glue logic: ensuring all components talk to each properly
  - Testing, Debugging, Redesign, Testing, Debugging, ...
  - Design of Launcher Icon

Note on Opportunistic Development

- For your assignment, and for App development in general I recommend taking an agile development approach
- Start with a rough spec, implement a prototype, then redesign as necessary
- Don't bother trying to get all the details fully specified before implementing anything

Commercial Vs Research

- Let's have a look at possible projects for the course
- Research Project?
  - Different style, different audience
- Commercial focus?
  - What makes a good up sell?

Use a Good IDE (e.g., IntelliJ or Eclipse)

- Auto-generate and check project structure
- Refactoring support
  - Change method names
  - Move methods between classes
  - Pull methods up from classes to interfaces
- Auto-check lots of tedious errors
- Navigate from usage to definition and vice versa
- Auto-generate UML Class Diagrams
  - Useful for high-level view
  - And inclusion in reports
- Drag and Drop GUI Designer

Mining the play store

- Discussion Question
  - As an app developer, what useful market research data is freely available from the Play Store PRIOR to publishing an app?
- And a follow-up:
  - What data is available after publishing?

From Java to Android

- Suppose you are a competent or even expert Java programmer
  - What more knowledge / skills do you need to become and Android Developer?
- App lifecycles
- Android API (e.g. the GUI classes are completely different)
  - Fortunately the many standard Java packages are all included
- XML Descriptor Files
  - Can design GUI using layout editor (which constructs XML), XML editor (text view), or write directly in Java

Good Android apps need to be well engineered

- Some standard ways of doing things
- And some important restrictions you need to learn
  - Seemingly innocent actions such as updating a view with the wrong thread can cause an app to stop
- Architecture such as Model View Controller (MVC)
  - Encapsulation of state (good practice anyway, but essential for easy restoration after a restart)
  - Attention to lifecycle
  - Bundling data
  - Activities, Intents, Fragments
  - Highly modular

Learning and Discovery

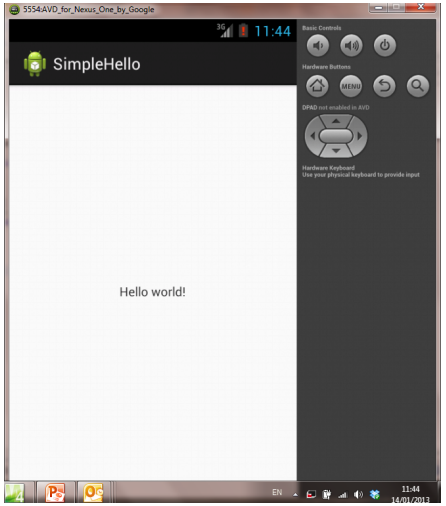
- This is a taught project-style course
- Lectures and labs will cover a good deal of useful material
- BUT: the Android platform is extensive, we won't cover it all
- You will need to discover / research many aspects for yourself
- Ask me and each other
- StackOverflow, developer.android.com and other resources
- Just Googling for a problem often finds the solution

When things go wrong

- Use IDE to find static edit / compile time errors
- For Runtime errors learn to use the Logcat
- All System.out is directed there
- Use Tags to filter most relevant messages
- Learn to use debugger
  - DDMS (Dalvik Debug Monitor Server)
  - Find problems with running code
  - (Dalvik is the name for the Android Java Virtual Machine)
- Google for solutions to other problems (e.g. deployment errors)

Hello World

- This is just one possible first app
- The one that gets auto-created by Intellij or Eclipse when selecting a Blank Activity
- (each IDE may have minor differences in the default HelloWorld app)



Hello World Code

```
package com.example.simplehello;

import android.os.Bundle;

public class SimpleHelloActivity extends Activity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_simple_hello);
    }
}
```

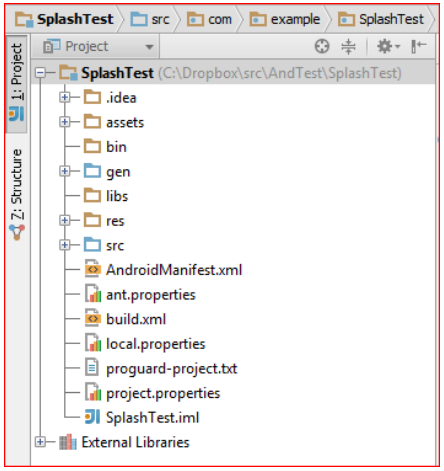

Notes on Hello World

- Extends Activity: this is the most common class to sub-class when making an app
- onCreate is the method called when the app is first launched
- Bundle is the set of data passed to onCreate that allows an App to re-create the previous state where the user left off
- Well behaved Apps normally do something to explicitly manage state
- Either using the Bundle, or by storing data in a file
- The file-based approach gives longer persistence

Anatomy of an Android App

http://developer.android.com/tools/projects/index.html

- assets: files you provide at compile-time for your app
- bin: the final .apk file for deployment on Google Play gets built here
- gen: auto-generated resources go here
  - generated from the XML files in the res folder



Anatomy Continued

- libs
  - Put library .jar files (e.g. we'll be using gson.jar to save and load data with minimal effort)
- res
  - XML files go here that specify GUI features of the project including the arrangement of component views
- src
  - Java files go here
- They should be properly package qualified
- e.g., for a developer account:
  - com.ssamotapps. . . . (important when publishing on Play)

Android Manifest File

SplashScreen.java | StartPage.html | AndroidManifest.xml | main.xml | FirstScreen.java | firstscreen.xml

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
          package="com.example.SplashTest"
          android:versionCode="1"
          android:versionName="1.0">
    <uses-sdk android:minSdkVersion="17"/>
    <application android:label="@string/app_name" android:icon="@drawable/ic_launcher">
        <activity android:name="SplashScreen"
                  android:label="@string/app_name">
            <intent-filter>
                <action android:name="android.intent.action.MAIN"/>
                <category android:name="android.intent.category.LAUNCHER"/>
            </intent-filter>
        </activity>
        <activity android:name="FirstScreen"
                  android:label="@string/app_name">
        </activity>
    </application>
</manifest>
```


Important Aspects of the Manifest File

- The manifest file is auto-created by the IDE but may involve you specifying some options
- You can also edit these by hand
  - `<uses-sdk android:minSdkVersion="17"/>`
- Choose one as low as you can that supports all the features you need
- The application attributes specify the app name and the app icon
- Note the use of the '@' to refer to resources declared elsewhere:
- `<application android:label="@string/app_name"`
  `android:icon="@drawable/ic_launcher">`

The Res Folder

- Four drawable folders containing different resolution versions of the same icon
- A layout folder with an XML file for each activity
- A values file containing a strings.xml file to define commonly used string values
- Note: res folders can contain more than this

An application contains at least one Activity

- The one identified by the MAIN intent is the one called when the App is launched (e.g. by clicking the icon on a device screen)
- The main activity may then launch other activities
- Only one main activity can be defined per application
- But Activities may respond to other Intents

Exploring Manifest Entries

- Tip!
- Use navigation within an IDE to find where things are defined
- E.g.

```
<activity android:name="FirstScreen"
          android:label="@string/first_label">
</activity>
```

- In Intellij using -b will with the cursor in “FirstScreen” will take you to the FirstScreen.java file where the class FirstScreen is defined
- This also works for Strings and other definitions

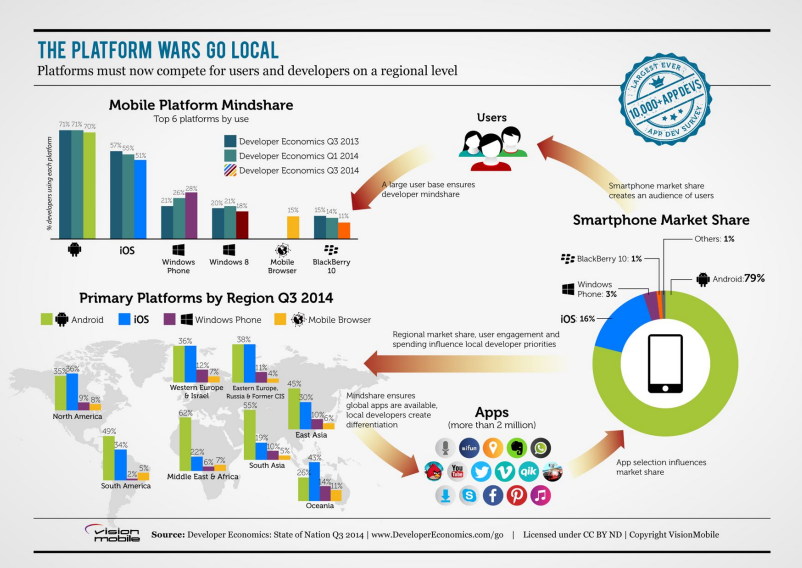
Can you fully explain this line?

- setContentView(R.layout.activity_simple_hello);

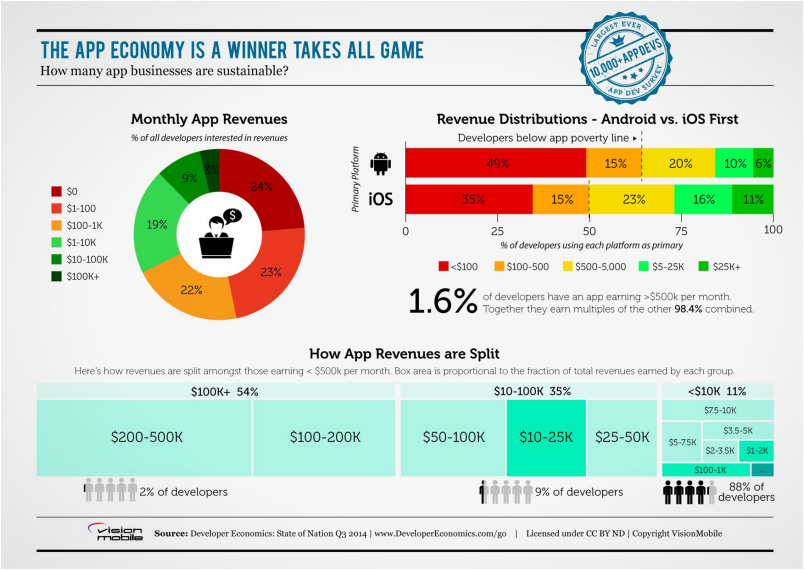
Statistics

- Let's assume you finish the course
- What are your chances of earning money in the wild west?
- Developer Economics, State of the Developer Nation Q3 2014 www.developereconomics.com/go
- Survey on 10K developers

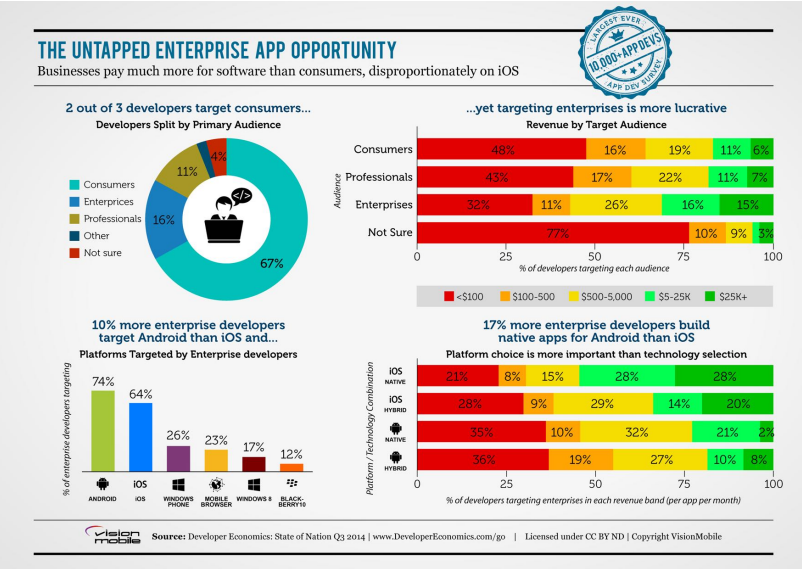
More Statistics



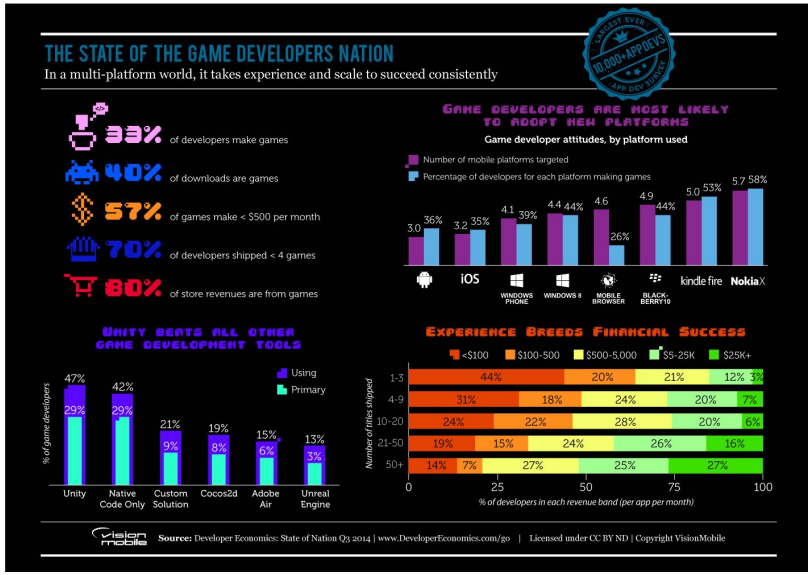
App Economy



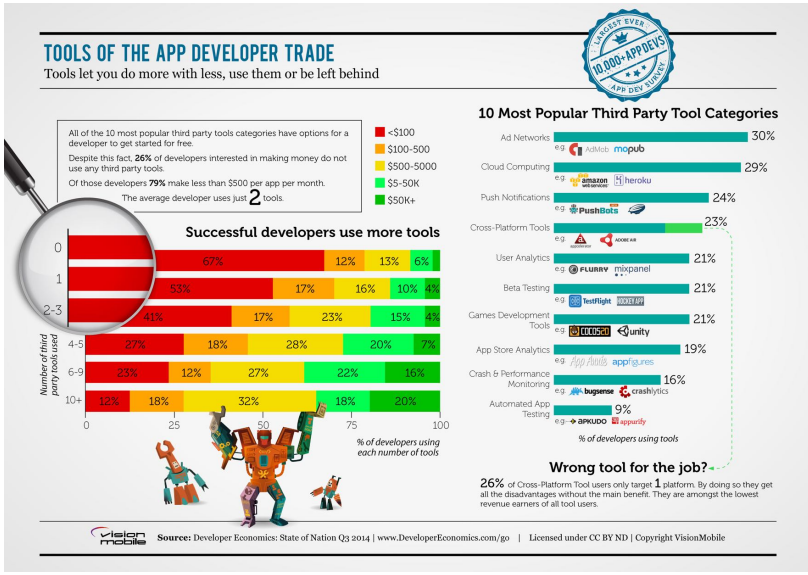
Enterprise Apps



Games



Tools



Summary

- Android is a rich and powerful platform, with many opportunities for developing and profiting from apps
- Give careful thought to the app you want to develop for this course
- IDEs such as Intellij and Eclipse take a lot of the tedium out of the development process
  - But Android is complex, and there is much to learn
- Massive audience, you still stand a chance to make it big

Recommended reading

Programming Android: Java Programming for the New Generation of Mobile Devices, By Zigurd Mednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura, Publisher: O'Reilly Media, July 2011
Android Programming: The Big Nerd Ranch Guide (2nd Edition), by Bill Phillips, Chris Stewart, Brian Hardy and Kristin Marsicano

Credits

- Course outline/structure was based on Simon's Lucas 2014 Course