

Introduction (Apps and the Android platform)

CE881: Mobile and Social Application Programming

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1 / 38

- 1 About the Course
- 2 The Platform
- 3 First App
- 4 Developer Statistics

2 / 38

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

3 / 38

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

4 / 38

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 (though QuizUp not yet on Android)
- Social
 - Facebook, Twitter

5 / 38

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

6 / 38

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>

7 / 38

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

8 / 38

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

9 / 38

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

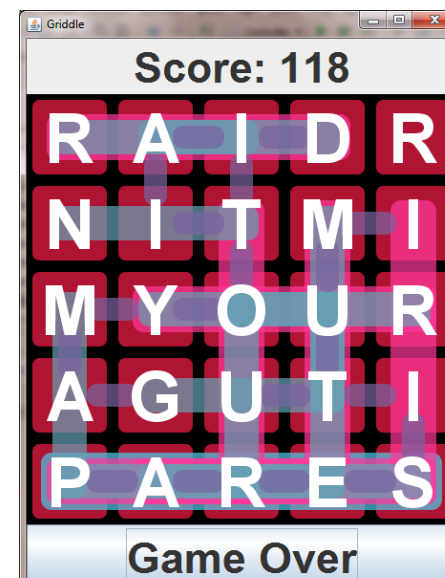
10 / 38

Example

- 5 x 5 grid
- Deck of letter cards shuffled before each game
- Place each letter in the grid to optimise total word score
- Once a letter is placed it cannot be moved
- Scores: 5 -> 10, 4 -> 7, 3 -> 3, 2 -> 1
- A longer word overrides sub-words
- The pack has 52 cards and a single joker (wildcard)
- More popular cards have more copies in the deck
 - E.g., 4 Es, 1 Q
- Let's PLAY!!!

11 / 38

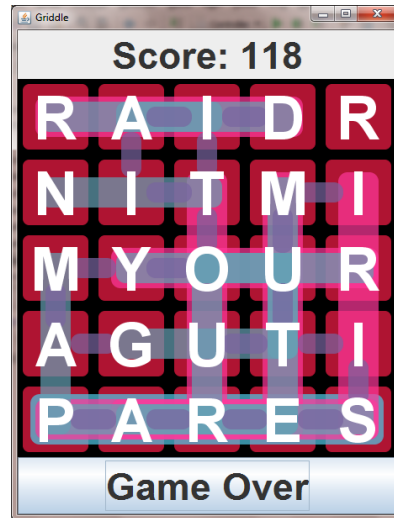
Play?



12 / 38

Sample App - Griddle

- Interesting case study
- Simple but enjoyable game
- Illustrates:
 - Reading asset files
 - Saving and loading state
 - Custom Views
 - Event Handling
 - Visualising information
 - Designing card decks for satisfying game experience



13 / 38

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

14 / 38

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?

15 / 38

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

16 / 38

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

17 / 38

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

18 / 38

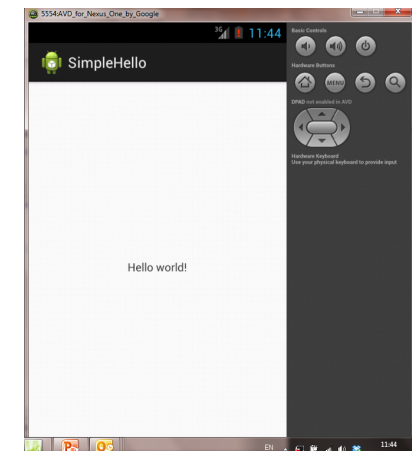
When things go wrong

- 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)

19 / 38

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)



20 / 38

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);
    }
}
```

21 / 38

Notes on Hello World

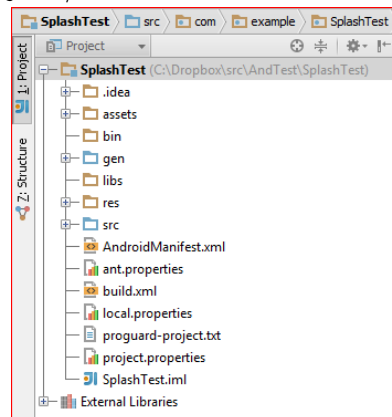
- Extends Activity: this is the most common class to sub-class when making an app
- onCreate is the method called when the app is first launched
- Bundle is the set of data passed to onCreate that allows an App to re-create the previous state where the user left off
- Well behaved Apps normally do something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

22 / 38

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



23 / 38

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)

24 / 38

Android Manifest File

```
<?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>
```

25 / 38

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">`

26 / 38

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

27 / 38

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

28 / 38

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

29 / 38

Can you fully explain this line?

- `setContentView(R.layout.activity_simple_hello);`

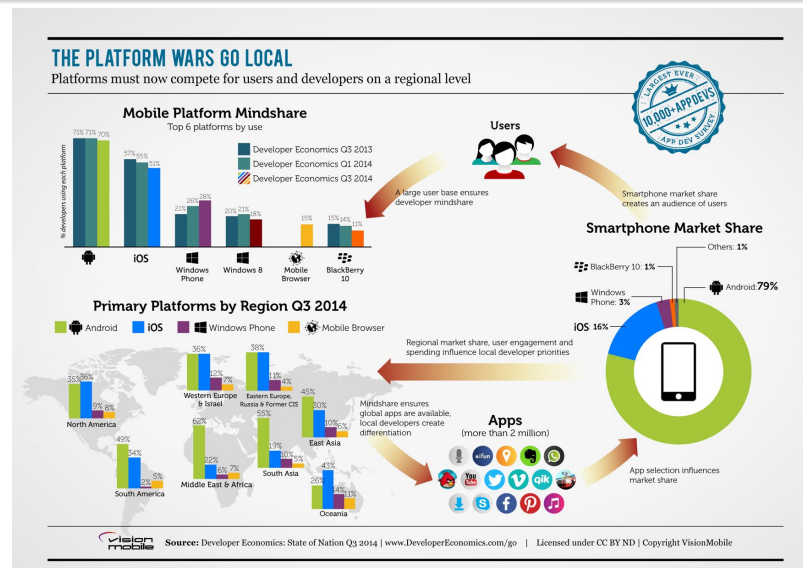
30 / 38

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

31 / 38

More Statistics

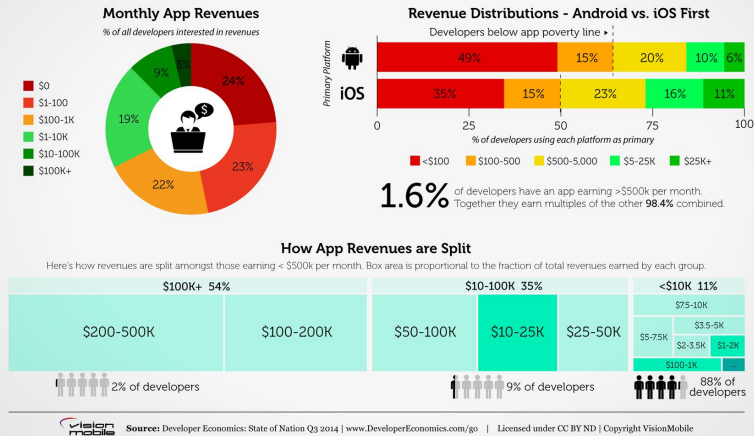


32 / 38

App Economy

THE APP ECONOMY IS A WINNER TAKES ALL GAME

How many app businesses are sustainable?

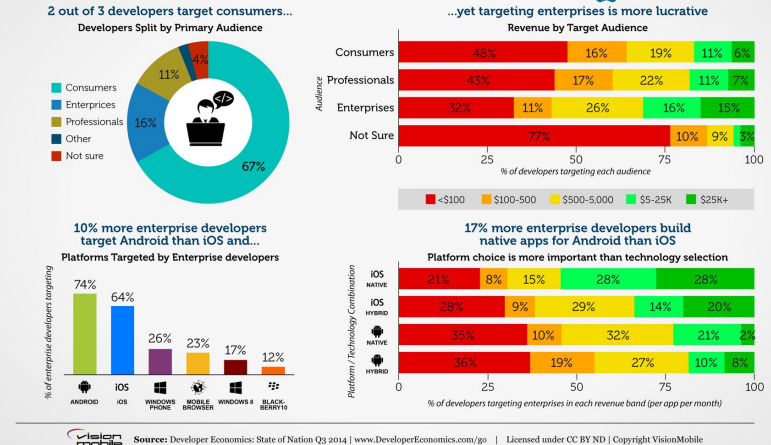


33 / 38

Enterprise Apps

THE UNTAPPED ENTERPRISE APP OPPORTUNITY

Businesses pay much more for software than consumers, disproportionately on iOS

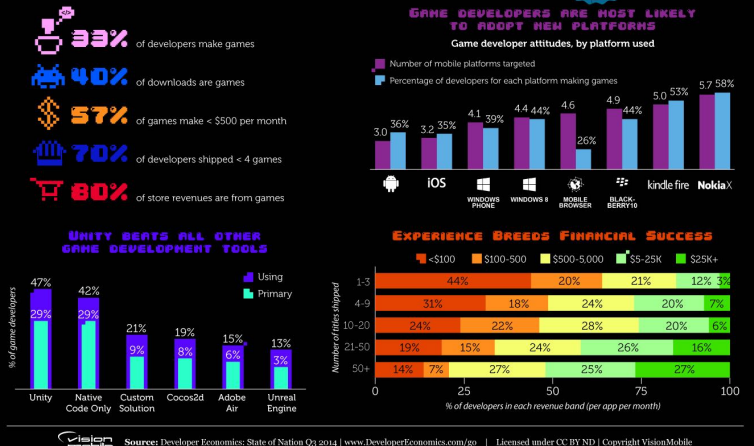


34 / 38

Games

THE STATE OF THE GAME DEVELOPERS NATION

In a multi-platform world, it takes experience and scale to succeed consistently

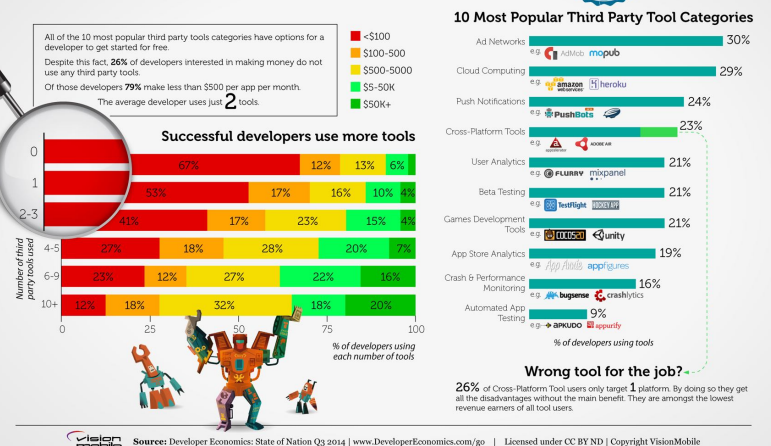


35 / 38

Tools

TOOLS OF THE APP DEVELOPER TRADE

Tools let you do more with less, use them or be left behind



36 / 38

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

- Note: much of the core material you need is freely available on-line
- But the book provides more insight and discussion in places
- Also many other books
- However: mostly it is best to learn by doing!

