Introduction to Android

Mobile and Ubiquitous Computing

MEIC/MERC 2016/17

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1. SOME CONTEXT

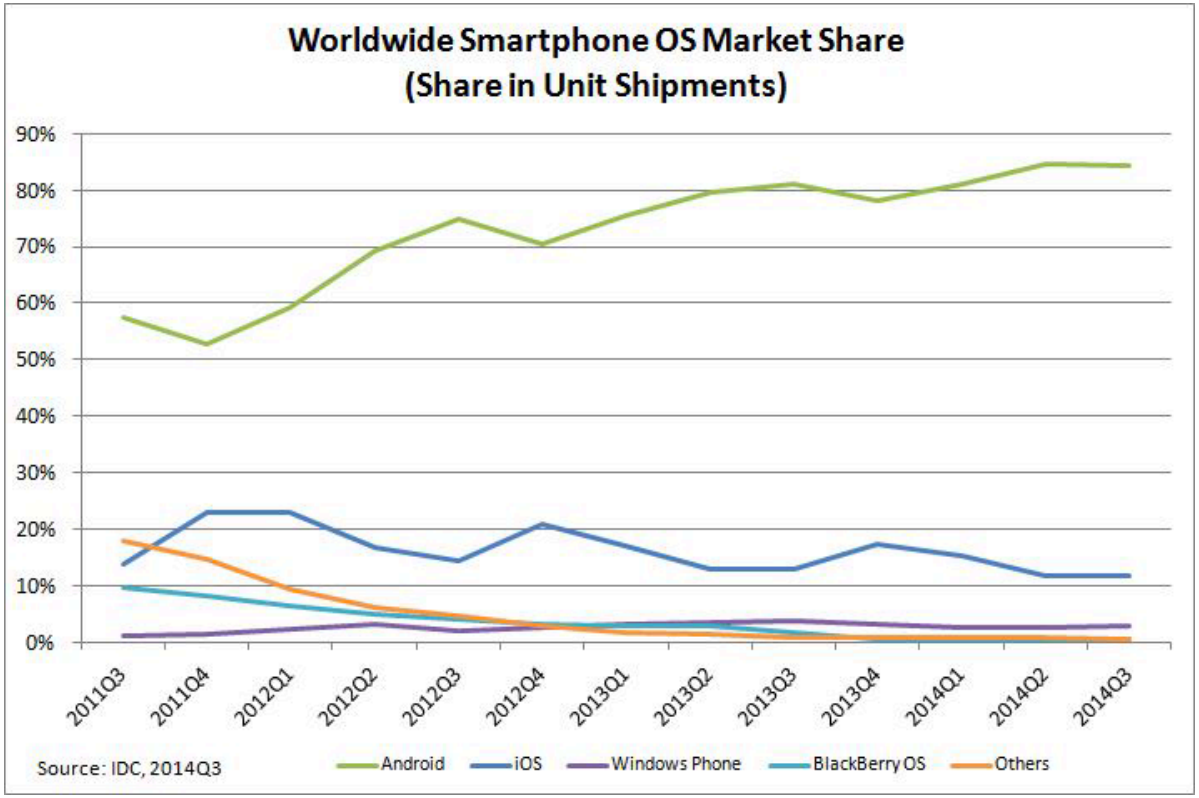
What Is Android?

"Android delivers a complete set of software for mobile devices: an operating system, middleware and key mobile applications."

-- http://android.com/about/

Why Look Into Android?

- Android is the world's most popular mobile platform



Source: http://www.idc.com/prodserv/smartphone-os-market-share.jsp

The History of Android

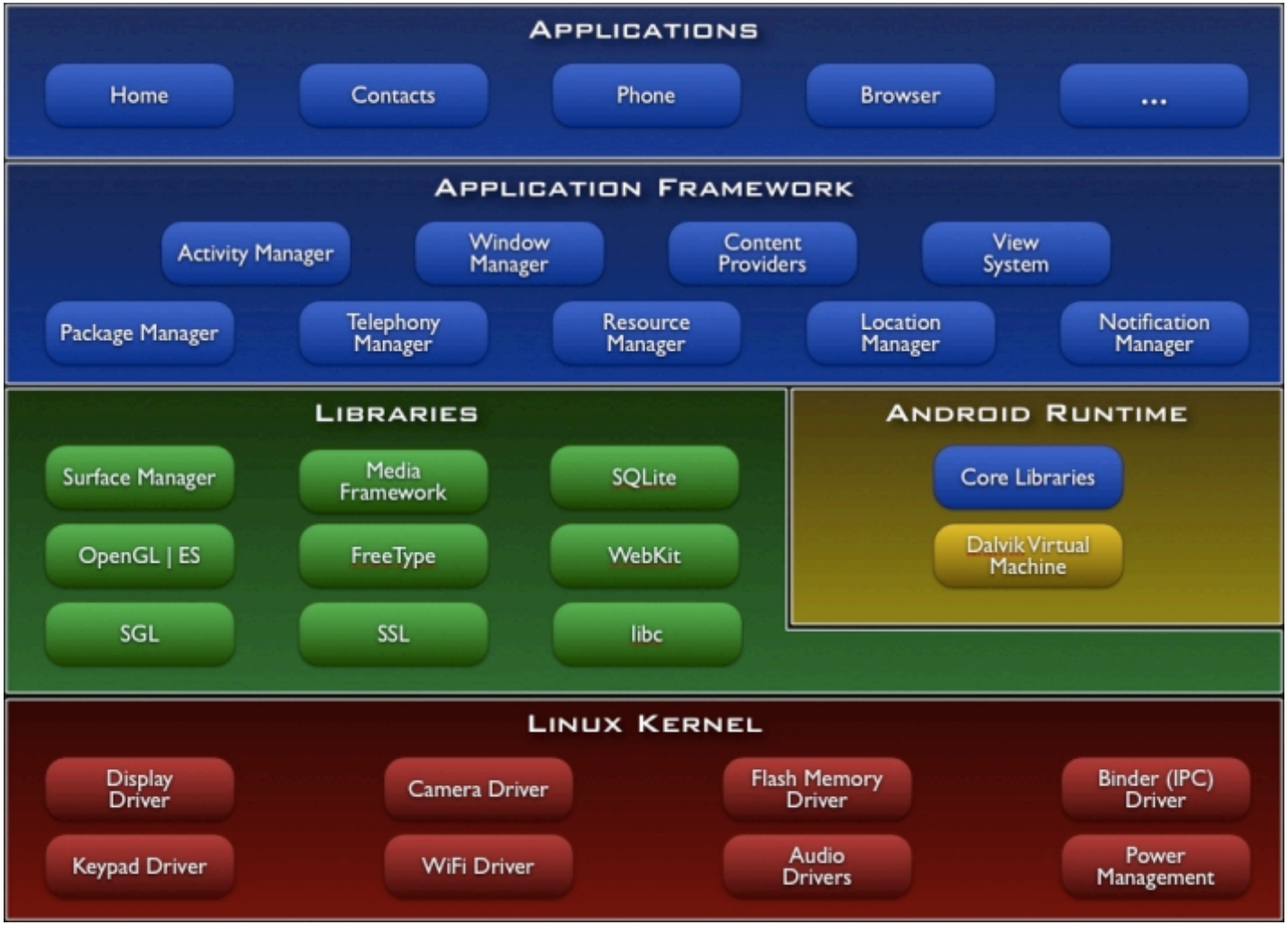
- **2003** - Android Inc. founded by Andy Rubin
  - Build ”…smarter mobile devices, more aware of its owner's location and preferences"
- **2005** - Google acquired Android Inc.
- **2007** – Creation of the Open Handset Alliance
  - A consortium of companies whose goal is to develop open standards for mobile devices
  - Members include Texas Instruments, Broadcom Corporation, Google, HTC, Intel…
- **2008** – Android 1.0 is released
- **2008** – 14 new members joined
- **2015** – Android 6.0 is released (Marshmallow)

Android Releases

- 1.0 - Released September, 2008
- 1.1 - Released February, 2009
- 1.5 (Cupcake) - Released April, 2009
- 1.6 (Donut) - Released September, 2009
- 2.0 / 2.1 (Eclair) - Released October, 2009 (2.0) and January, 2010 (2.1)
- 2.2 (Froyo) - Released May, 2010
- 2.3 (Gingerbread) - Released December, 2010
- 3.0 (Honeycomb) - Released February, 2011
- 4.0 (Ice Cream Sandwich) – Released October, 2011
- 4.1 (Jelly Bean) – Released June, 2012
- …
- 6.0 (Marshmallow) – Released October, 2015
- 7.0 (Nougat) – Released August, 2016

2. ANDROID OVERVIEW

Architecture



Noteworthy Features

- Java-based object-oriented application framework
  - Apps on top of Java core libraries running on a Dalvik virtual machine
- Highly-optimized Java implementation
  - Very memory- and performance-efficient
  - Highly tuned to limitations of small hardware
- Based upon a modified version of the Linux kernel
- Rich development environment
  - Device emulator, tools for debugging, profiling, rich IDE integration

Security and Permissions

- Each app deployed with unique user and group ID
  - Each application file is private
  - Sharing must be done explicitly
- Applications sandboxed in separate VMs
- Principle of least privilege
  - Applications must declare the permissions they need
  - The system prompts the user for consent at install time

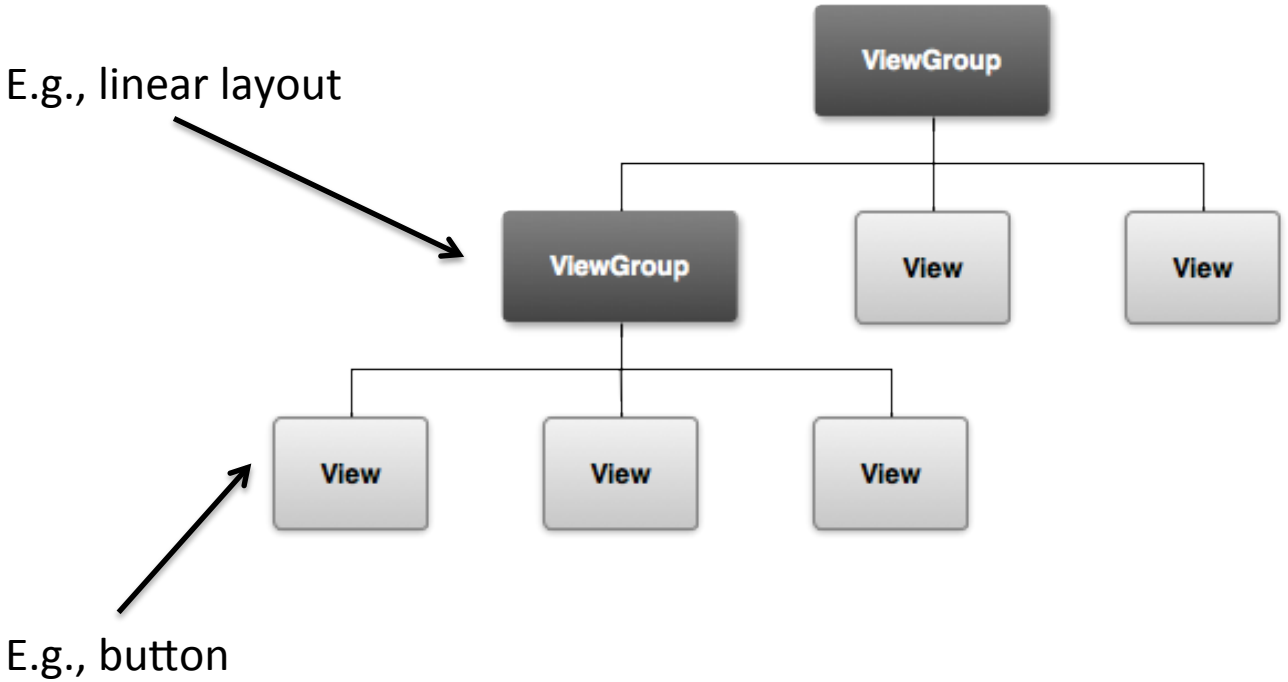
3. ANATOMY OF ANDROID APPS

Component Example

- **Activities**: are like the pages in a website
  - Provide an interface for users to interact with the app and take an action

Views

- **Views**: UI elements, hierarchically organized
  - Two types: *layouts*, and *widgets*



Components

- There are four different types of application components
  - Each type has different purpose and a distinct lifecycle

E.g., show list of emails

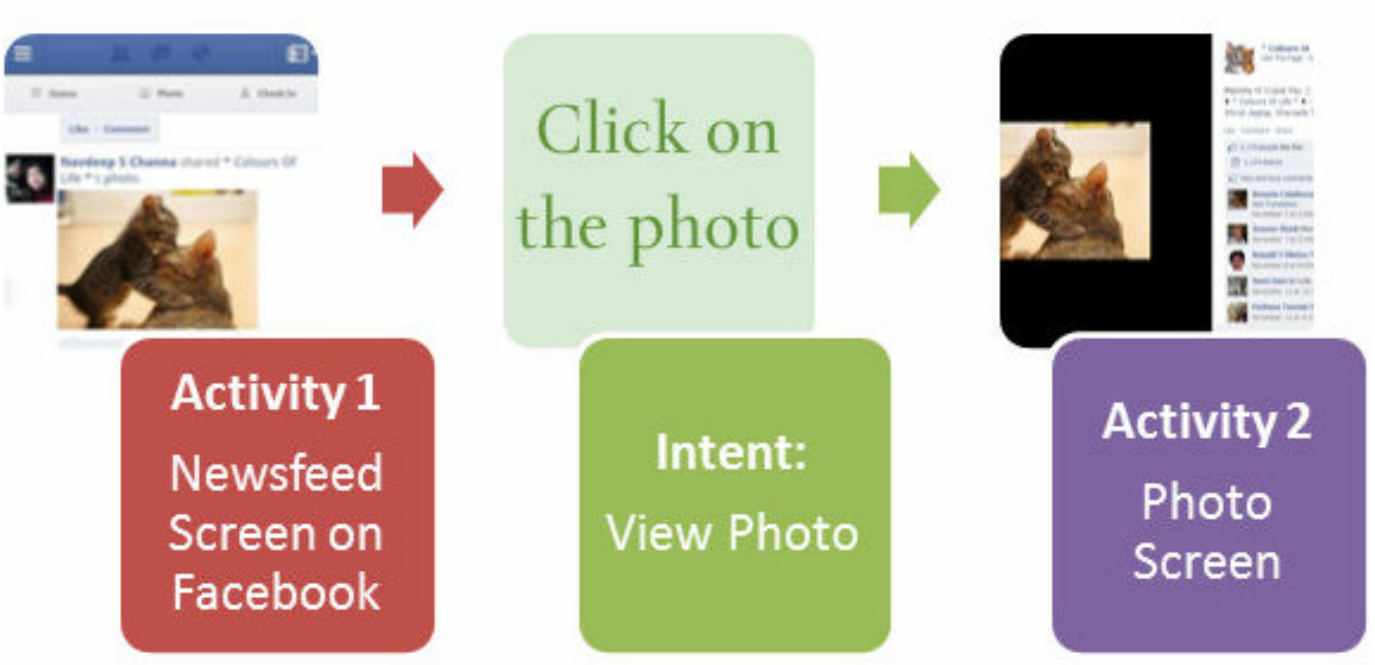
E.g., play music in background

E.g., take action if battery low

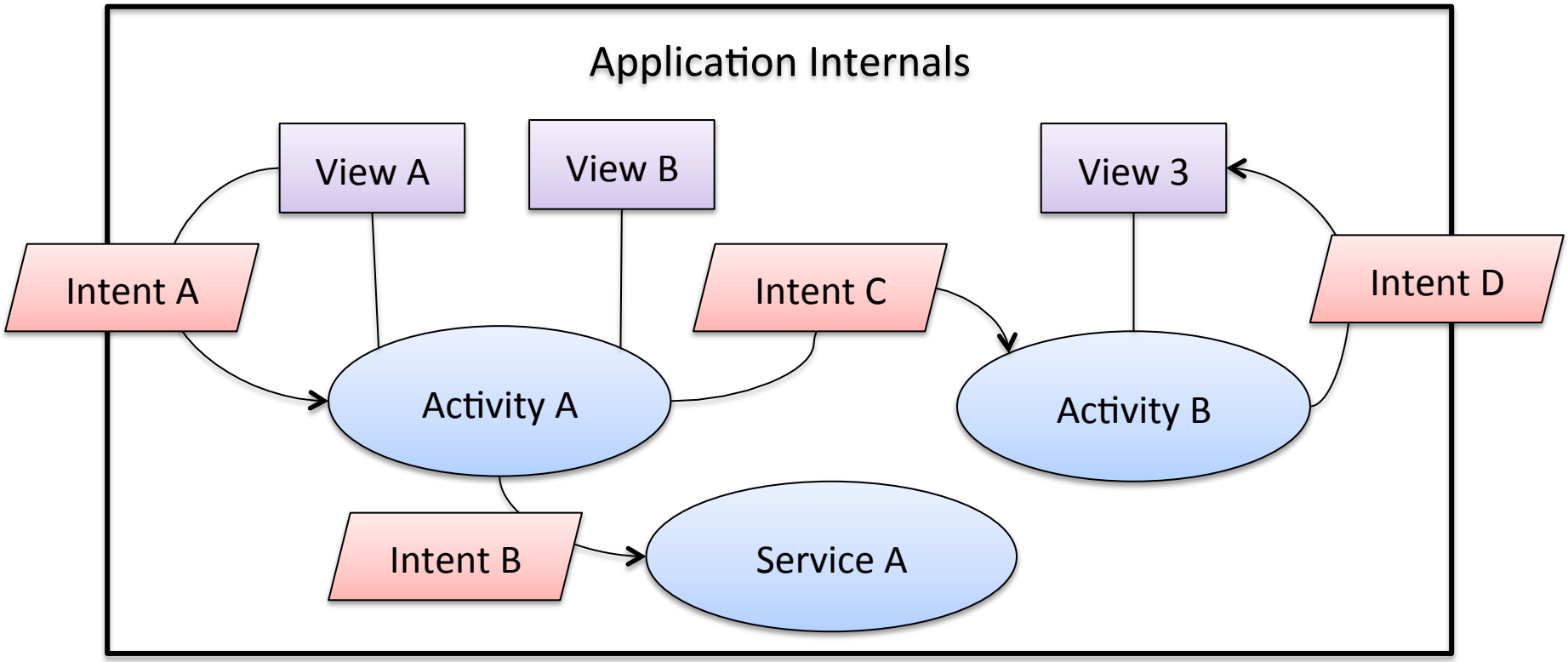
E.g., manage user's contact information

Intents

- Messages that enable communication across components



Android Application



Components
Modules

Views
UI elements (e.g., button)

Intents
Messages

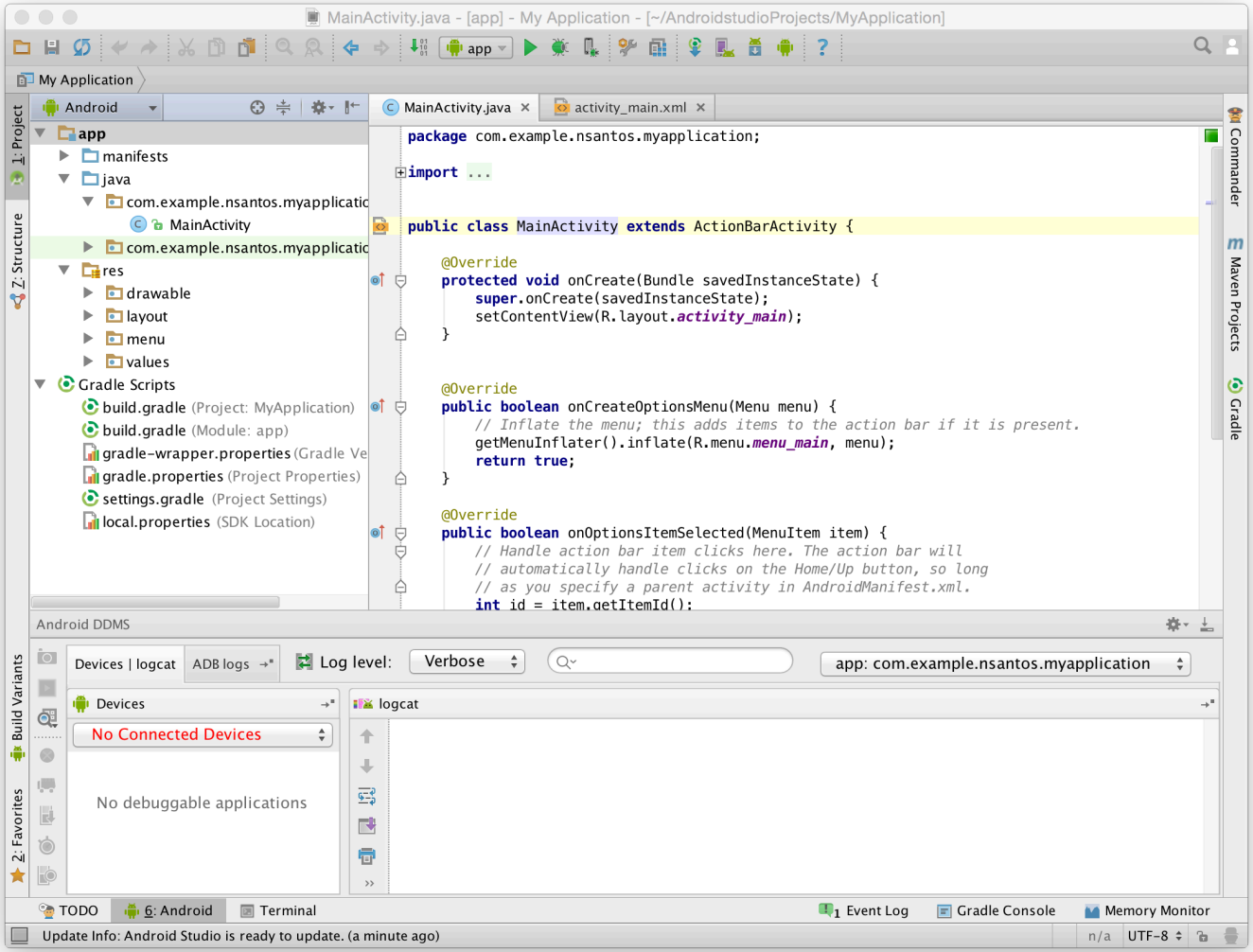
4. APPLICATION DEVELOPMENT

Development Tools

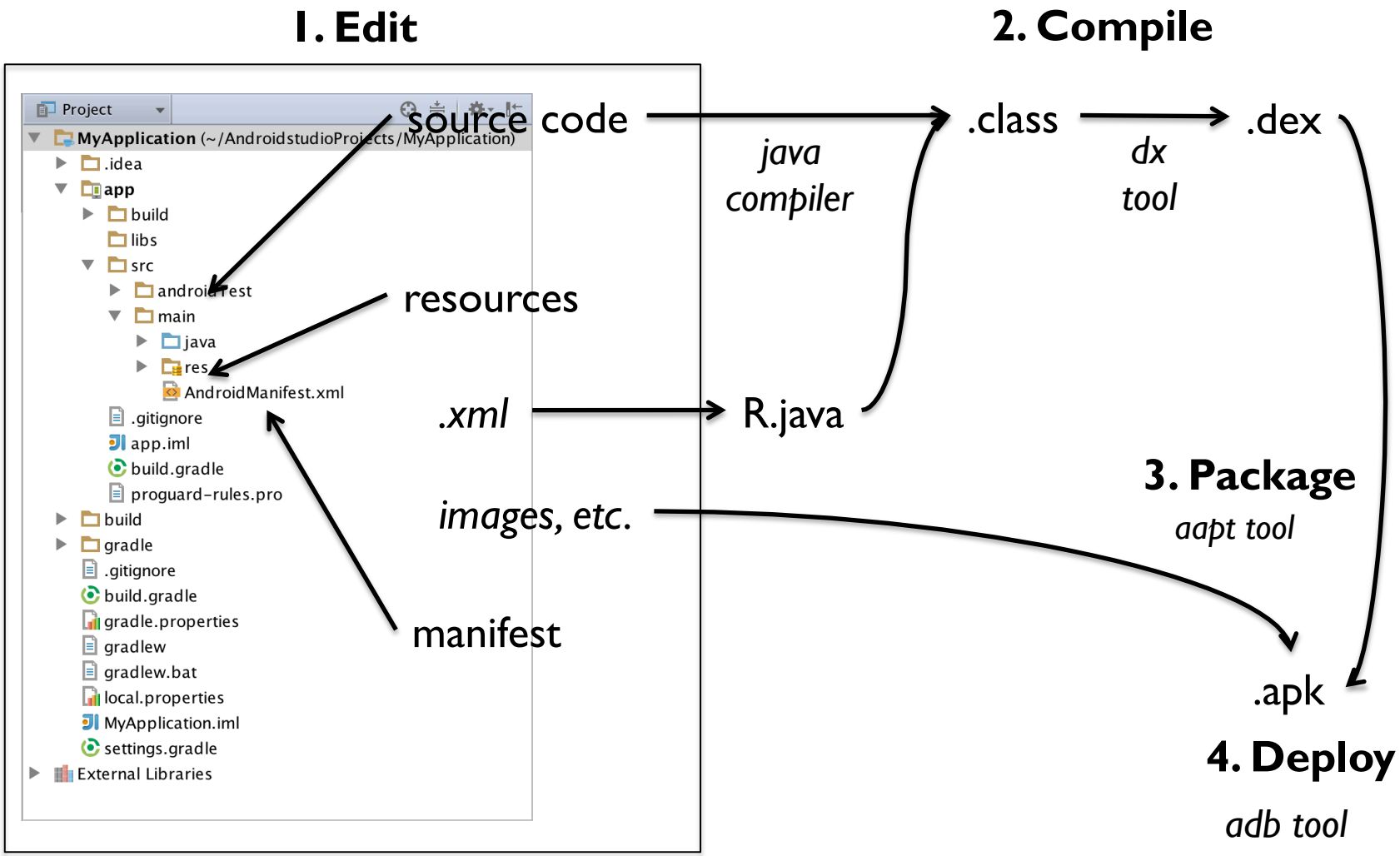
- Android Software Development Kit (SDK)
  - Tools to create, compile, and package apps
  - Device emulator
  - Tools to create Android Virtual Devices (AVDs)
  - Android Debug Bridge (ADB) tool

- Android Studio
  - Full blown IDE based on IntelliJ
  - Create, compile, debug and deploy Android applications
  - Create and start AVDs
  - Specialized edition of resource files

Android Studio



Development Process



Manifest

- *AndroidManifest.xml* defines the skeleton of an application

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.myfirstapp"
    android:versionCode="1"
    android:versionName="1.0" >
    <application
        android:allowBackup="true"
        android:icon="@drawable/ic_launcher"
        android:label="@string/app_name"
        android:theme="@style/AppTheme" >
        <activity
            android:name="com.example.myfirstapp.MainActivity"
            android:label="@string/app_name" >
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
    </application>
</manifest>
```

Resources

- Include images and certain XML configuration files
  - e.g., *res/layout/activity_main.xml*

```
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:orientation="horizontal" >

    <EditText android:id="@+id/edit_message"
              android:layout_height="wrap_content"
              android:layout_width="0dp"
              android:layout_weight="1"
              android:hint="@string/edit_message" />

    <Button
              android:layout_width="wrap_content"
              android:layout_height="wrap_content"
              android:text="@string/button_send"
              android:onClick="sendMessage" />

</LinearLayout>
```

- A reference to a new resource is automatically created in *R.java*

Source Code

- Source code implements the app components
  - E.g., *src/com/example/myfirstapp/MainActivity.java*

```
package com.example.myfirstapp;

import android.app.Activity;

public class MainActivity extends Activity {

    public final static String EXTRA_MESSAGE = "com.example.myfirstapp.MESSAGE";

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

    @Override
    public boolean onCreateOptionsMenu(Menu menu) {
        // Inflate the menu; this adds items to the action bar if it is present.
        getMenuInflater().inflate(R.menu.main, menu);
        return true;
    }
}
```

Useful Links

- Android developers: http://developer.android.com
  - Training:
    http://developer.android.com/training/index.html
  - API Guides:
    http://developer.android.com/guide/components/index.html
  - Reference
    http://developer.android.com/reference/packages.html
- Remember, Google is your friend ☺