

Mobile App Development

Let's Start Android Development!



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Objectives

- Get familiar with the history of Android
- Get familiar with the Android environment
 - Android SDK
 - Android AVD
 - Android Studio
 - adb
- Understand Android file system
- Write and run your first Android app
- Know how to get help on Android development

Devices

PercentMobile

Android OS - The First 100 Devices



Acer E110 320x480, 3 mega pixels, 118g; **Acer E500** 320x480, 3 mega pixels, 125g; **Acer S100** 480x800, 3 mega pixels, 135g; **Alcatel OT-680** 340x320, 2 mega pixels, 155g; **Apad P7901a** 800x480, Non-phone, 388g; **Archos 5 Tablet** 800x480, 182g; **Archos 7 Tablet** 800x480, Non-phone, 388g; **Barnes&Noble Nook** 600x800, Non-phone, 353g; **Cinemat** Bell Blaze 320x480, 5 mega pixels, 113g; **Cyde M7** 480x800, 480g

Dell Aero 360x540, 5 mega pixels, 105g; **Dell Mini** 5 480x854, Non-phone, 225g; **Eken M001** 800x480, Non-phone, 350g; **Eken M003** 800x800, 560g; **Garmin A19** 320x480, 5 mega pixels, 120g; **Garmin A90** 320x480, 3 mega pixels, 104g; **General Mobile DST-L1** 240x400, 5 mega pixels, 135g; **Helpad M701** 800x480, 350g; **HTC Aria** 320x480, 5 mega pixels, 115g; **HTC Desire** 480x800, 5 mega pixels, 130g

HTC Desire HD 480x800, 8 mega pixels, 154g; **HTC Droid Eris** 320x480, 5 mega pixels, 120g; **HTC Espresso** 320x480, 5 mega pixels, 167g; **HTC EVO 4G** 480x800, 8 mega pixels, 170g; **HTC G1** 320x480, 3 mega pixels, 159g; **HTC G2** 320x480, 3 mega pixels, 118g; **HTC G2 Touch** 320x480, 5 mega pixels, 135g; **HTC Incredible** 480x800, 8 mega pixels, 130g; **HTC Legend** 320x480, 5 mega pixels, 125g; **HTC Liberty** 320x480, 5 mega pixels, 113g

HTC Nexus One 480x800, 5 mega pixels, 130g; **HTC Tattoo** 320x480, 3 mega pixels, 113g; **HTC Wildfire** 240x320, 5 mega pixels, 130g; **Huawei U7510** 240x320, 2 mega pixels, 105g; **Huawei U8100** 320x320, 3 mega pixels, 104g; **Huawei U8110** 240x320, 3 mega pixels, 110g; **Huawei U8200** 320x480, 3 mega pixels, 130g; **Huawei U8230** 320x480, 3 mega pixels, 130g; **Huawei V845** 240x320, 3 mega pixels, 115g; **i-mobile 6010** 240x400, 3 mega pixels, 106g

i-mobile 858 480x800, 3 mega pixels, 104g; **Kyocera M6000** 480x800, 3 mega pixels, 109g; **Kyocera Zio** 480x800, 3 mega pixels, 105g; **LG Ally** 480x800, 3 mega pixels, 159g; **LG QT540** 240x400, 3 mega pixels, 115g; **LG QW620** 320x480, 5 mega pixels, 139g; **LG KH200** 320x480, 2 mega pixels, 130g; **LG LU2000** 480x800, 5 mega pixels, 128g; **LG SU990** 480x800, 5 mega pixels, 130g; **Motola CLIO XT** 320x480, 5 mega pixels, 131g

Motola Devo 320x480, 3 mega pixels, 180g; **Motola Droid** 480x854, 5 mega pixels, 169g; **Motola Droid X** 480x854, 8 mega pixels, 140g; **Motola Droid2** 480x854, 5 mega pixels, 169g; **Motola 11** 320x480, 5 mega pixels, 131g; **Motola MB200** 320x480, 5 mega pixels, 155g; **Motola MB300** 320x480, 5 mega pixels, 160g; **Motola MB502** 320x480, 3 mega pixels, 110g; **Motola MB811** 320x240, 3 mega pixels, 120g; **Motola XT502** 320x480, 5 mega pixels, 113g

Motola XT701 480x854, 5 mega pixels, 140g; **Motola XT720** 480x854, 6 mega pixels, 140g; **Motola XT800** 480x854, 5 mega pixels, 120g; **Motola XT806** 480x854, 5 mega pixels, 165g; **Nexian A890** 5 mega pixels, 104g; **Orange Boston** 320x480, 5 mega pixels, 118g; **Pantech 630** 480x800, 5 mega pixels, 128g; **Pantech IM-A600** 480x800, 5 mega pixels, 128g; **Pantech IM-A6500** 480x800, 5 mega pixels, 114g; **Samsung Behold Z** 320x480, 5 mega pixels, 115g

Samsung Galaxy S 480x800, 5 mega pixels, 120g; **Samsung Galaxy Tab** 1024x600, Non-phone, 3 mega pixels, 388g; **Samsung Galaxy Y** 480x800, 5 mega pixels, 131g; **Samsung GT-S5800** 240x320, 2 mega pixels, 102g; **Samsung GT-S5830** 240x480, 2 mega pixels, 102g; **Samsung GT-S7000** 320x480, 3 mega pixels, 120g; **Samsung GT-S9800** 240x400, 3 mega pixels, 110g; **Samsung GT-S9820** 480x800, 8 mega pixels, 155g; **Samsung T700** 320x480, 5 mega pixels, 114g; **Samsung M1000** 480x800, 5 mega pixels, 129g

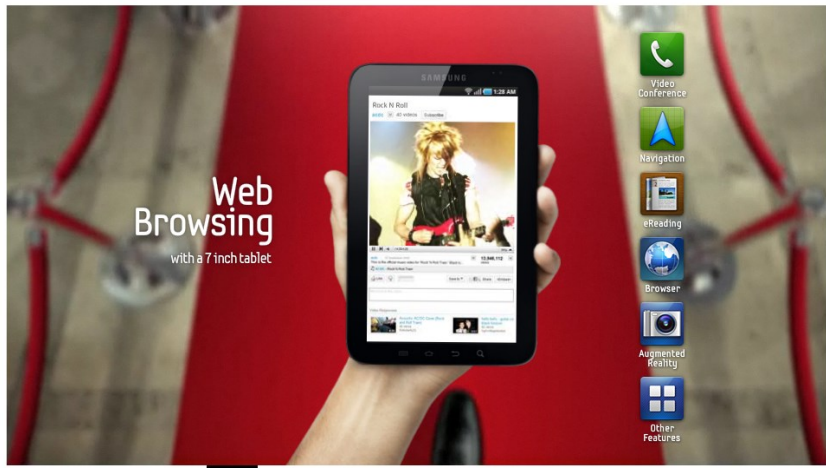
Samsung R800 320x480, 5 mega pixels, 140g; **Samsung SCH-R990** 480x800, 5 mega pixels, 128g; **Samsung SPH-M110S** 480x800, 5 mega pixels, 121g; **Samsung SPH-P700** 480x320, 3 mega pixels, 150g; **Samsung SPH-P8000** 480x854, 5 mega pixels, 169g; **Samsung SPH-M910** 240x400, 3 mega pixels, 138g; **Sharp 9501** 960x480, 5 mega pixels, 230g; **SMIT MID-S60** 800x480, Non-phone, 388g; **SonyEricsson X10** 480x854, 6 mega pixels, 105g

SonyEricsson X10 mini 240x320, 5 mega pixels, 120g; **SonyEricsson X10 mini pro** 240x320, 5 mega pixels, 120g; **SonyEricsson X8** 320x480, 3 mega pixels, 104g; **Spice M300** 320x480, 5 mega pixels, 104g; **Vibo A888** 320x480, 5 mega pixels, 104g; **Videcon V7000** 320x480, 5 mega pixels, 114g; **Welcom A900** 480x800, Non-phone, 3 mega pixels, 104g; **Wellcom A88** 320x480, 5 mega pixels, 114g; **Winfast A8-E** 320x480, Non-phone, 388g; **YTE X800** 240x320, 3 mega pixels, 100g

Source: <http://percentmobile.com>

Samsung GALAXY Tab

SAMSUNG mobile



Web Browsing
with a 7 inch tablet

ON THE GO DESIGN VIDEO DOWNLOAD SPECIFICATION ACCESSORIES PRESS

facebook YouTube

<http://galaxytab.samsungmobile.com/>
First Android Tablet
launched in Sept. 2010

First Android phone
launched in Nov. 2009



Devices



*Google Glass launched in
April 2013*



*First Android Wear watch
launched in July 2014*

Android Platform

- Complete, open and free mobile platform
 - Open source <https://source.android.com>
 - Open standards
 - No fee for developers (except to publish in the Google Play Store)
- Open Handset Alliance
 - Google and handset manufacturers formed the Open Handset Alliance in 2007 to develop the next generation of wireless platforms
 - Lower development costs and increase profits
 - Design of a platform with unprecedented features

Google Android OS Code Names

- Android 1.1, February 2008
- Android 1.5 CupCake, April 2009
- Android 1.6 Donut, September 2009
- Android 2.0 / 2.1 Éclair, October 2009 / December 2009
- Android 2.2 Froyo, May 2010
- Android 2.3 Gingerbread, December 2010 /
-
-
-

& More available at:

<https://source.android.com/setup/start/build-numbers>

LATEST VERSION : Android Pie 9.0 => Q



**Developing for
Android is not easy!**

Target Devices

<https://developer.android.com/about/dashboards>

What do developers need?

- Android Studio
 - <https://developer.android.com/sdk/installing/studio.html>
 - *Android SDKs*
 - <https://developer.android.com/studio/intro/update>
- Documentation
 - <http://developer.android.com>
 - <https://developer.android.com/design>
 - <https://developer.android.com/distribute>
 - <http://stackoverflow.com>
- Google Play
 - <http://play.google.com>
- Latest news on Android
 - <http://www.androidpolice.com>

Android Application Components

- **Activities**

- Core component of the Android platform
- Each activity is a task of the application
- Often corresponds to an application screen

- **Content providers**

- A content provider manages a shared set of application data (sharing of data between apps)

- **Intents**

- System messages notifying applications of events that start activities
- Examples of predefined intents: hardware events (e.g., SD card inserted), data events (e.g., new SMS message)

Android Application Components

- **Services**

- Long-live applications designed to run in the background (e.g., checking a RSS feed or play music)
- Not associated with a screen

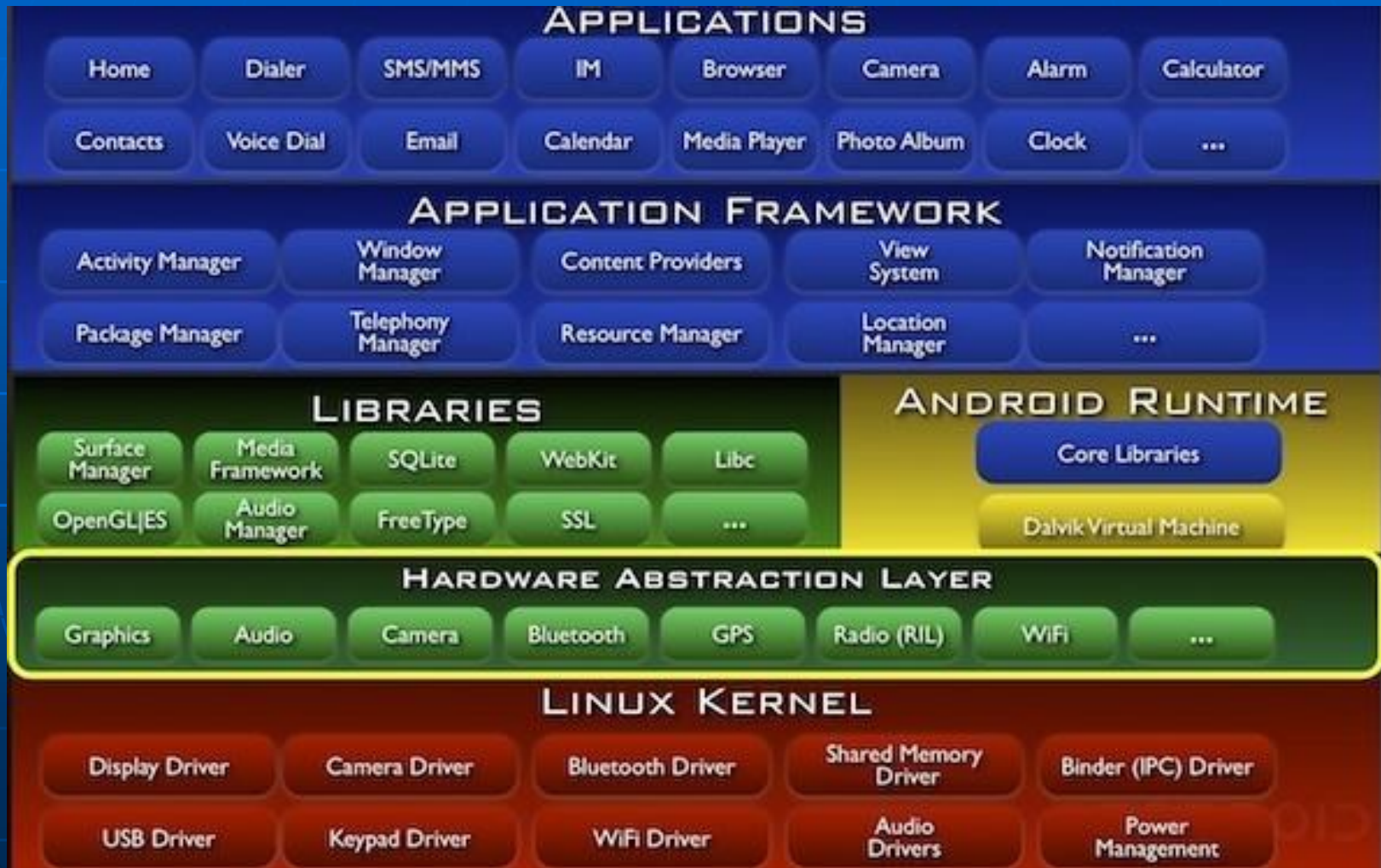
- **Broadcast receivers**

- Component that listens for relevant broadcast events to trigger an event
- Examples of pre-defined broadcasted events: low battery and new application installed
- Examples of user generated broadcasted events: finished calculation and started thread

- **Fragments** (introduced in Android 3.0)

- Represents a behavior or part of the user interface in an activity

Architecture

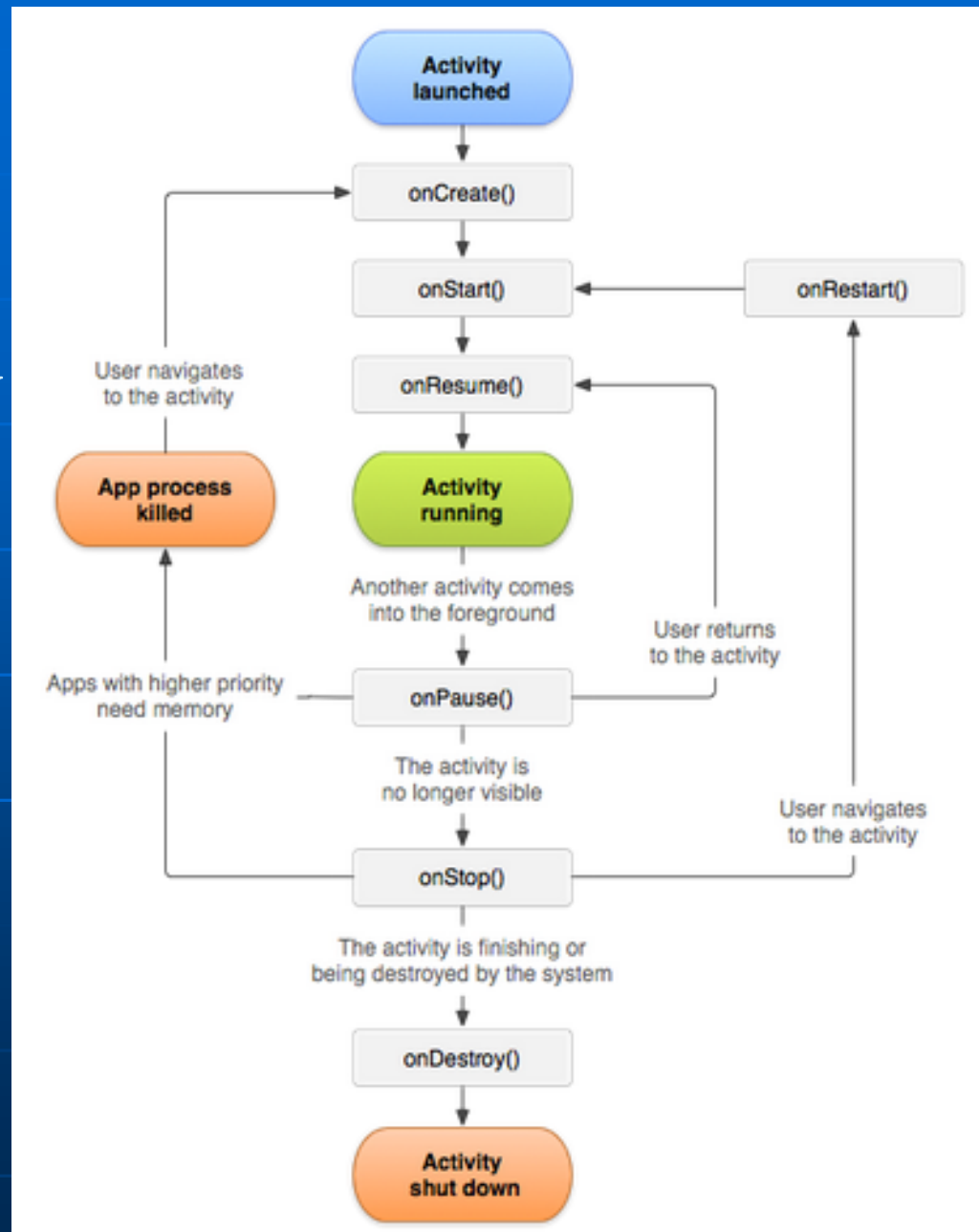


Unknown Source

Activity Lifecycle

- An Activity is like a screen
- Check out the Activity class
- Methods:
 - onCreate
 - onStart
 - onResume
 - onPause
 - onDestroy
 - onRestart

<http://developer.android.com/reference/android/app/Activity.html>



Android Studio

<https://developer.android.com/studio/index.html>

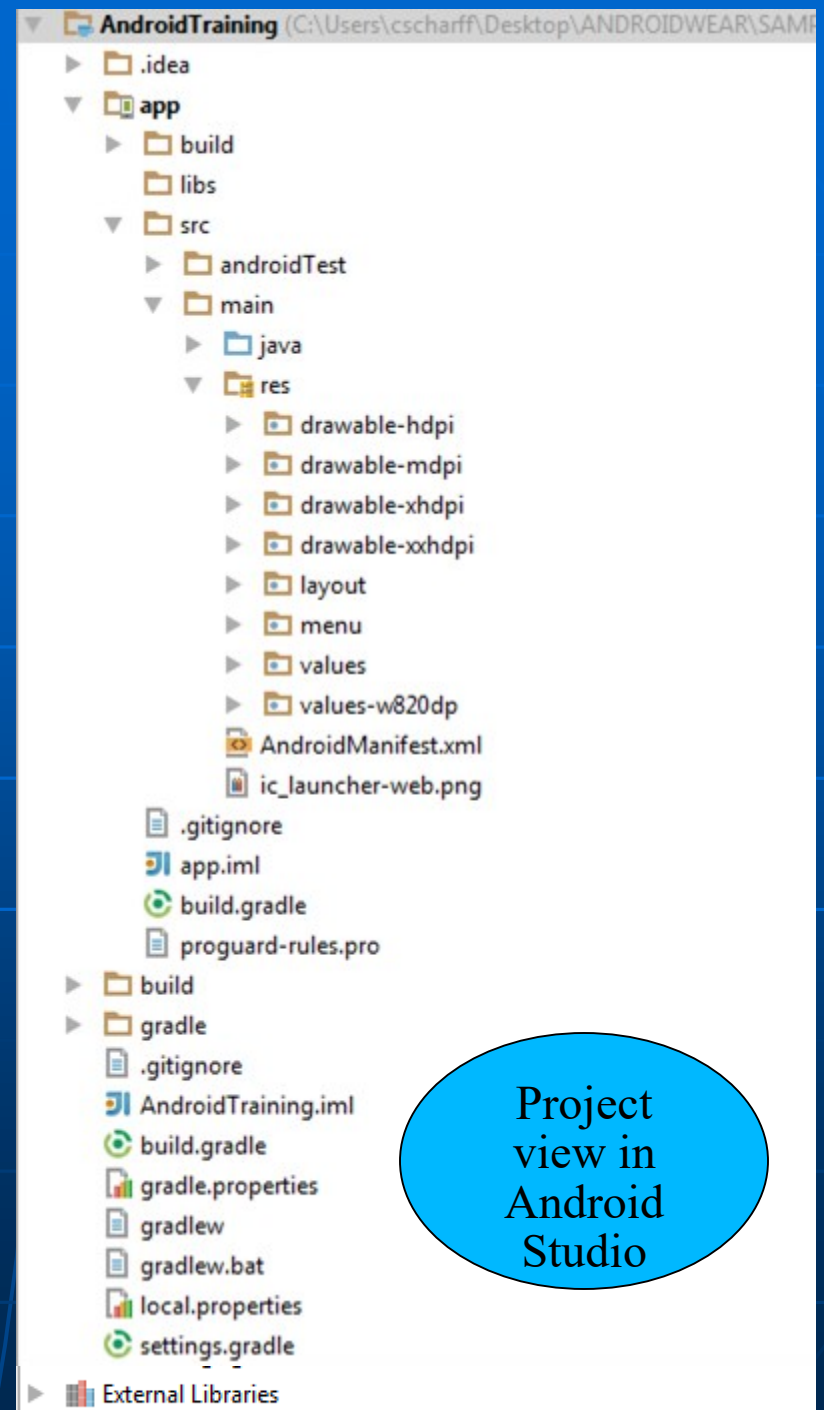
What is the current version?

Lab – Android Studio

- Install Android Studio and be sure that you have the latest version available (reinstall or/and update if necessary)
- <http://developer.android.com/tools/studio/index.html>

Project Structure


- Model View Controller (MVC) design pattern
- Source code (src)
- Resources (res)
 - images (drawables)
 - layouts
 - values
 - menus etc.
- AndroidManifest.xml
- Gradle is the build system used in Android Studio



Project
view in
Android
Studio

Project Structure

- Support for Mobiles and Wearables (even Glass and TV)

 Target Android Devices

Select the form factors your app will run on
Different platforms require separate SDKs

☒ Phone and Tablet

Minimum SDK

Lower API levels target more devices, but have fewer features available. By targeting API 10 and later, your app will run on approximately 99.5% of the devices that are active on the Google Play Store. [Help me choose..](#)

☐ TV

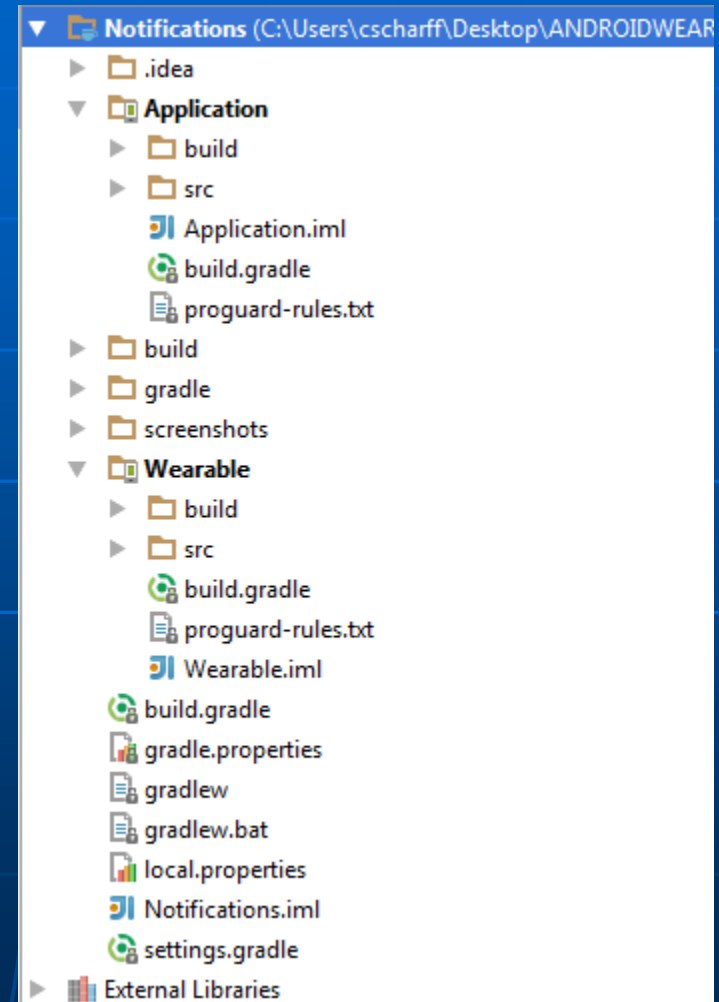
Minimum SDK

☐ Wear

Minimum SDK

☐ Glass

Minimum SDK



Android Manifest

- **AndroidManifest.xml** – XML configuration file describing the application and its components (e.g., activities and services)
 - Defines the default activity to be launched by the application
 - Defines the package name and application version
 - Defines the application (e.g., name, icon, activities, functionalities and services provided)
 - Defines the permissions (e.g., `android.permission.READ_CONTACTS` for the application to be able access the contacts)

Example of Manifest

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.cscharff.myapplication">

    <uses-permission android:name="android.permission.ACCESS_FINE_LOCATION"></uses-permission>

    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:label="My Application"
        android:supportsRtl="true"
        android:theme="@style/AppTheme">
        <activity android:name=".MainActivity">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
    </application>
</manifest>
```

Gradle (build.gradle)

```
apply plugin: 'com.android.application'

android {
    compileSdkVersion 23
    buildToolsVersion "23.0.3"

    defaultConfig {
        applicationId "com.example.cscharff.myapplication"
        minSdkVersion 23
        targetSdkVersion 23
        versionCode 1
        versionName "1.0"
    }

    buildTypes {
        release {
            minifyEnabled false
            proguardFiles getDefaultProguardFile('proguard-android.txt'), 'proguard-rules.pro'
        }
    }
}

dependencies {
    compile fileTree(dir: 'libs', include: ['*.jar'])
    testCompile 'junit:junit:4.12'
    compile 'com.android.support:appcompat-v7:23.4.0'
```

MinSdk is the minimum version you want to support (Android Studio suggests it when you create the project)

TargetSdk is the version you want to target

Resources

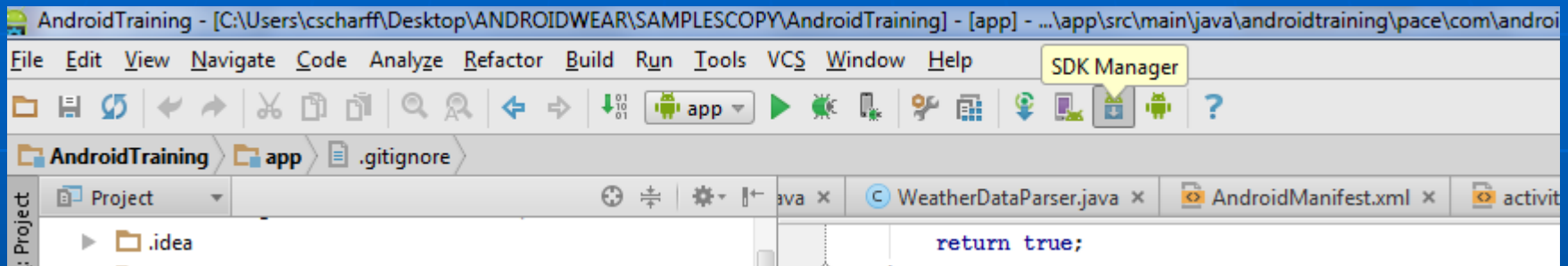
- Each resource has a unique id
- **res** – Directory that contains resources such as icons, GUI layouts, music...
 - res/drawable – Icon graphic resources in different screen densities and resolutions (hdpi, mdpi, ldpi, xhdpi, xxhdpi)
 - res/layout – User interface layout files
 - res/values – Organization of the various types of resources
 - strings.xml – String resources
 - Can be used for translating apps
 - res/menu – Menus of the application

Questions to Answer

- In what directory is Android Studio installed?
- What are the directories under that directory?
- What are the directories inside the sdk directory?

Lab – Android SDK Manager

- Install ALL the Android SDK (after version 4)



Default Settings

Appearance & Behavior > System Settings > Android SDK

Manager for the Android SDK and Tools used by Android Studio

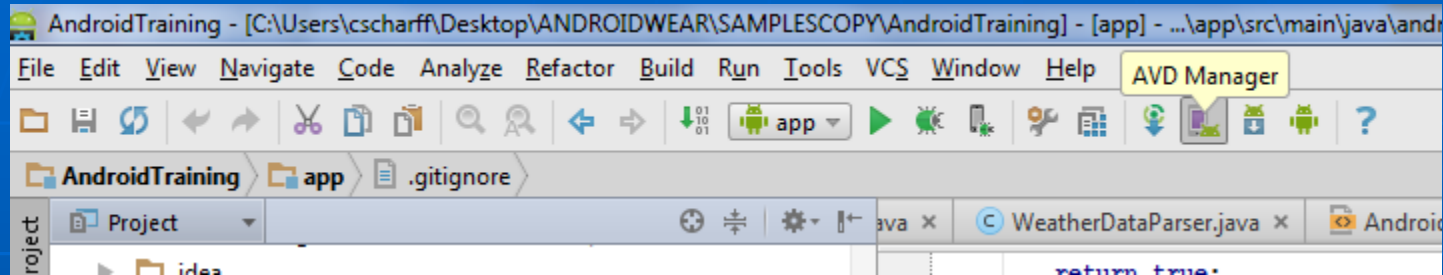
Android SDK Location: [Edit](#)

SDK Platforms | SDK Tools | SDK Update Sites

Each Android SDK Platform package includes the Android platform and sources pertaining to an API level by default. Once installed, Android Studio will automatically check for updates. Check "show package details" to display individual SDK components.

	Name	API Level	Revision	Status
<input type="checkbox"/>	Android N Preview	N	3	Not installed
<input checked="" type="checkbox"/>	Android 6.0 (Marshmallow)	23	3	Installed
<input checked="" type="checkbox"/>	Android 5.1 (Lollipop)	22	2	Installed
<input checked="" type="checkbox"/>	Android 5.0 (Lollipop)	21	2	Installed
<input checked="" type="checkbox"/>	Android 4.4 (KitKat Wear)	20	2	Installed
<input checked="" type="checkbox"/>	Android 4.4 (KitKat)	19	4	Installed
<input checked="" type="checkbox"/>	Android 4.3 (Jelly Bean)	18	3	Installed
<input checked="" type="checkbox"/>	Android 4.2 (Jelly Bean)	17	3	Installed
<input checked="" type="checkbox"/>	Android 4.1 (Jelly Bean)	16	5	Installed
<input checked="" type="checkbox"/>	Android 4.0.3 (IceCreamSandwich)	15	5	Installed
<input type="checkbox"/>	Android 4.0 (IceCreamSandwich)	14	4	Partially installed
<input checked="" type="checkbox"/>	Android 3.2 (Honeycomb)	13	1	Installed
<input checked="" type="checkbox"/>	Android 3.1 (Honeycomb)	12	3	Installed
<input checked="" type="checkbox"/>	Android 3.0 (Honeycomb)	11	2	Installed
<input checked="" type="checkbox"/>	Android 2.3.3 (Gingerbread)	10	2	Installed
<input type="checkbox"/>	Android 2.3 (Gingerbread)	9	2	Not installed
<input type="checkbox"/>	Android 2.2 (Froyo)	8	3	Not installed
<input type="checkbox"/>	Android 2.1 (Eclair)	7	3	Not installed

Lab – Create AVD (Android Virtual Devices)



Android Virtual Device Manager

Your Virtual Devices
Android Studio

Type	Name	Resolution	API	Target	CPU/ABI	Size on Disk	Actions
	android2.3.2	768 × 1280: xhdpi	10	Android 2.3.3	arm	122 MB	
	android3.2	768 × 1280: xhdpi	13	Android 3.2	arm	104 MB	
	android32	768 × 1280: xhdpi	13	Android 3.2	arm	2 MB	
	API 13.2	480 × 800: mdpi	13	Android 3.2	arm	250 MB	
	nexus4 4.3	768 × 1280: xhdpi	18	Android 4.3	arm	172 MB	
	nexus4	768 × 1280: xhdpi	18	Android 4.3	arm	53 MB	
	nexus5	1080 × 1920: xxhdpi	19	Android 4.4	arm	466 MB	
	Nexus SX API 23 x86 64	Unknown Resolution	23	Android 6.0	arm	550 MB	Failed to load

+ Create Virtual Device...

Emulators are slow and it's normal!

Lab – Using your Own Device (instead of AVD)



- Connect your Android device to your computer!
- What Android phone do you have? What OS is it using?
- Your device must have Developer Options enabled
- Unknown Sources must be checked in Settings > Security
- On Windows you may need to install drivers
 - <http://developer.android.com/sdk/win-usb.html>

Java

- You should be comfortable with Java to develop native applications for Android!
- Java is an objet-oriented language
 - Inheritance
 - Encapsulation
 - Polymorphism
- Be sure that you know what are:
 - package, extends, implements, super, this, public, private, protected, new, @override

Lab – Your First Android App

- Create and run your first Android app in Android Studio

<https://developer.android.com/training/basics/firstapp/creating-project>

DEMO

Question

- In what directory is your project?

Questions

- Where is the apk file located?
 - Apk files are the files you install on your phones to run the Android app

Go to Android Studio projects files:

Select the project name

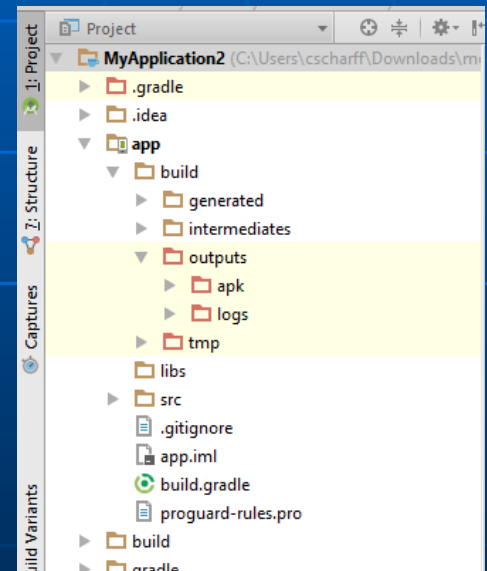
Select app

Select build

Select Outputs

The apk file is located in that directory


There are different view for your project you should use Project to see these files



- What is the default name of the apk file?

Getting help!

- Android Developer web site
 - <http://developer.android.com/index.html>

 Developers ^	Design	Develop	Distribute
About Wear TV Auto	Get Started Devices Style Patterns Building Blocks Downloads Videos	Training API Guides Reference Tools Google Services Samples	Google Play Essentials Get Users Engage & Retain Monetize Tools & Reference Developer Stories

- Android reference packages
 - <http://developer.android.com/reference/packages.html>

- Stackoverflow



- <http://stackoverflow.com/questions/tagged/android>
- <http://stackoverflow.com/questions/tagged/android-wear>
- <http://stackoverflow.com/questions/tagged/google-glass>

Questions

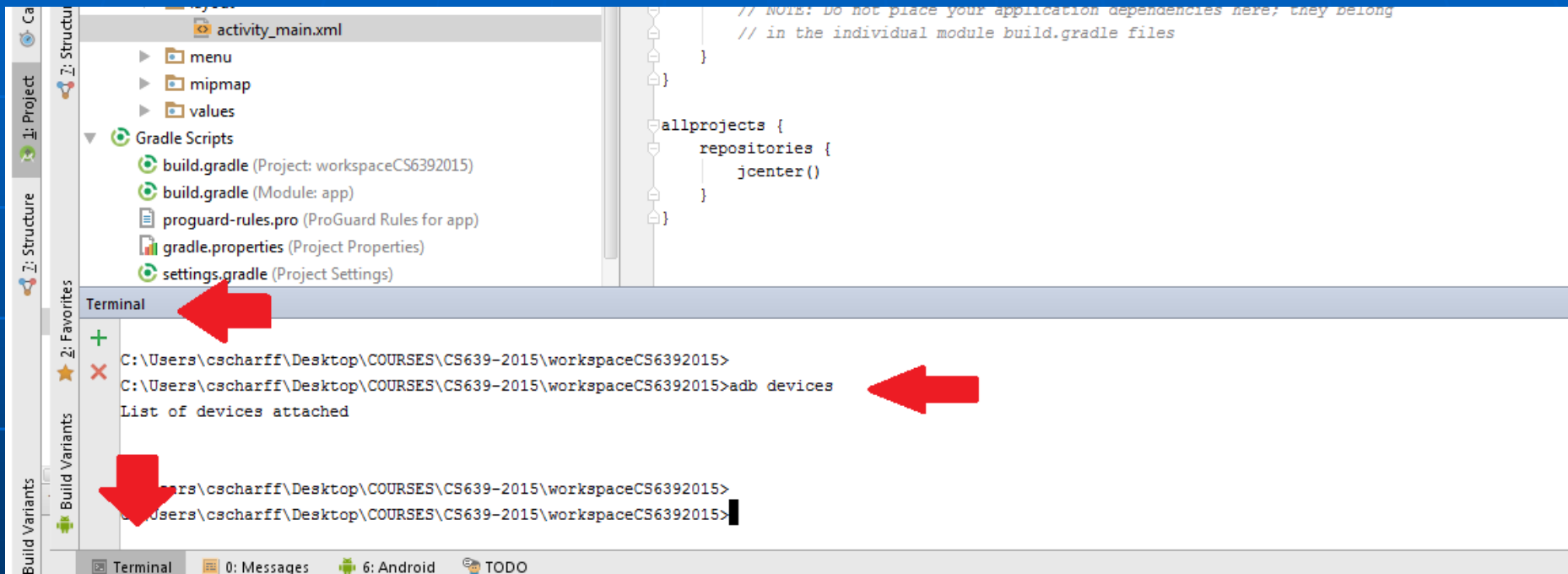
- Cite 5 methods of the Activity class
 - <http://developer.android.com/reference/android/app/Activity.html>
- What methods relate to the menu in the Activity class?
- How do the classes *Activity* and *AppCompatActivity* relate to each others?
 - <https://developer.android.com/reference/android/support/v7/app/AppCompatActivity>
- What is a fragment?
 - <https://developer.android.com/reference/android/app/Fragment>

Adb: Android Debug Bridge

- Adb is a tool to interact with a device, install, uninstall ... apps from the **command line (Terminal in Android Studio)**
- adb is used to interact with an AVD or devices
- Command line
- adb devices
- adb uninstall
 - `adb -s emulator-5554 uninstall cs639.pace.com.cs639sampleproject`
- adb install
 - `adb -s emulator-5554 install cs639.pace.com.cs639sampleproject`
- `adb -s emulator-5554 shell stop`
- `adb -s emulator-5554 shell start`
- `adb -s emulator-5554 shell logcat`

<http://developer.android.com/tools/help/adb.html>

Example



Lab

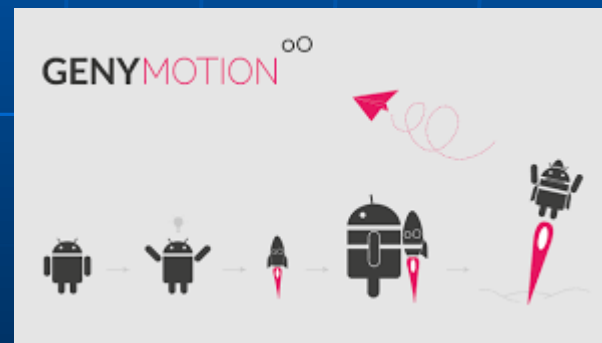
- Run an Android app on an emulator or on a device
- Execute: `adb devices` in the command line

Going Further

- As default emulators are slow, it may be adapted to install and run third-party emulators
 - Intel Hardware Accelerated Execution Manager
 - GENYMOTION
- These emulators can however be limited as they may not have access to Google APIs



<https://software.intel.com/en-us/android/articles/intel-hardware-accelerated-execution-manager>



<https://www.genymotion.com>

Dr. Scharff's Recommendations

- Use the latest version of Android Studio
- Use a real device – rather than an emulator (You may want to buy a cheap tablet or phone)
- If you use emulators be sure they have the Google APIs if you want to use maps, Google App Engines etc.
- Android evolves quickly! Some of the slides may be outdated but in general they have the relevant information
- Be persistent! There are lots of things that can go wrong!