Android Application Development Tutorial

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What is Android?

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

  - Open
  - All application and Created equal
  - Breaking down application boundaries
  - Fast & easy application development

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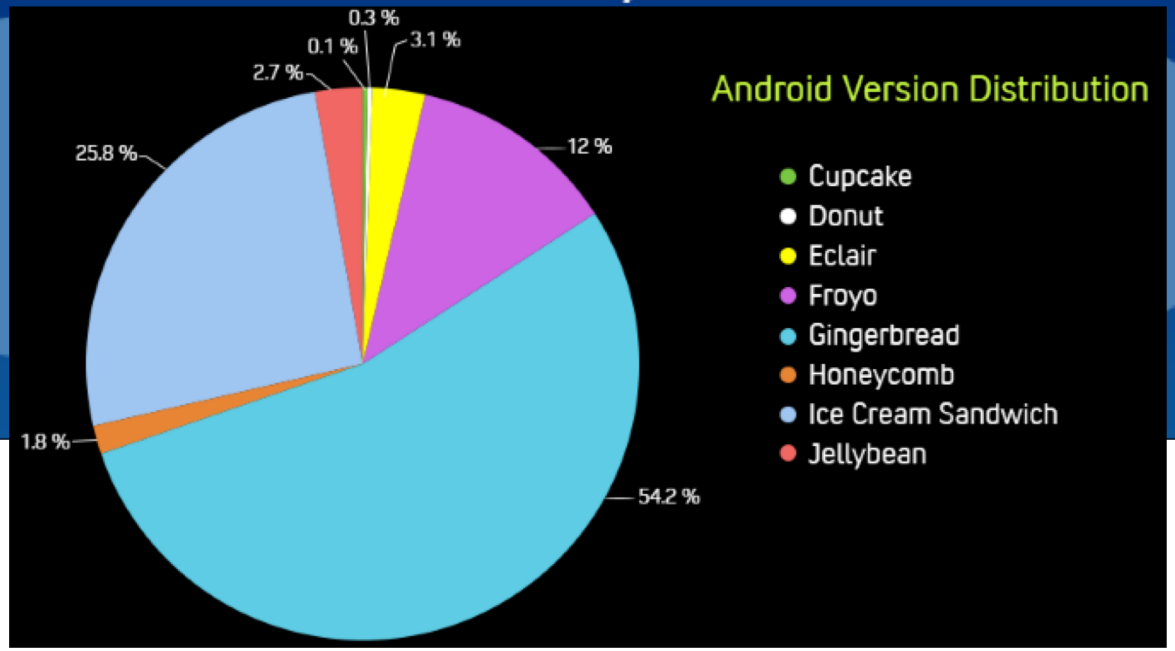
ANDROID

History of Android

The first Android device, the HTC Dream (G1), featuring Android 1.0.	23 September, 2008
Based on Linux kernel 2.6.27, the official 1.5 (Cupcake) update for Android was released.	30 April 2009
Based on Linux kernel 2.6.29, the 1.6 (Donut) SDK was released.	15 September 2009
Based on Linux kernel 2.6.29, the 2.0 (Eclair) SDK was released.	26 October 2009
Based on Linux kernel 2.6.32, the 2.2 (Froyo) SDK was released.	20 May 2010
The 2.3 (Gingerbread) SDK was released.	6 December 2010
The 3.1 SDK was released.	10 May 2011

Android 4.0 (Ice Cream Sandwich)

Android 4.1 (Jelly Bean) was released on 9 July 2012



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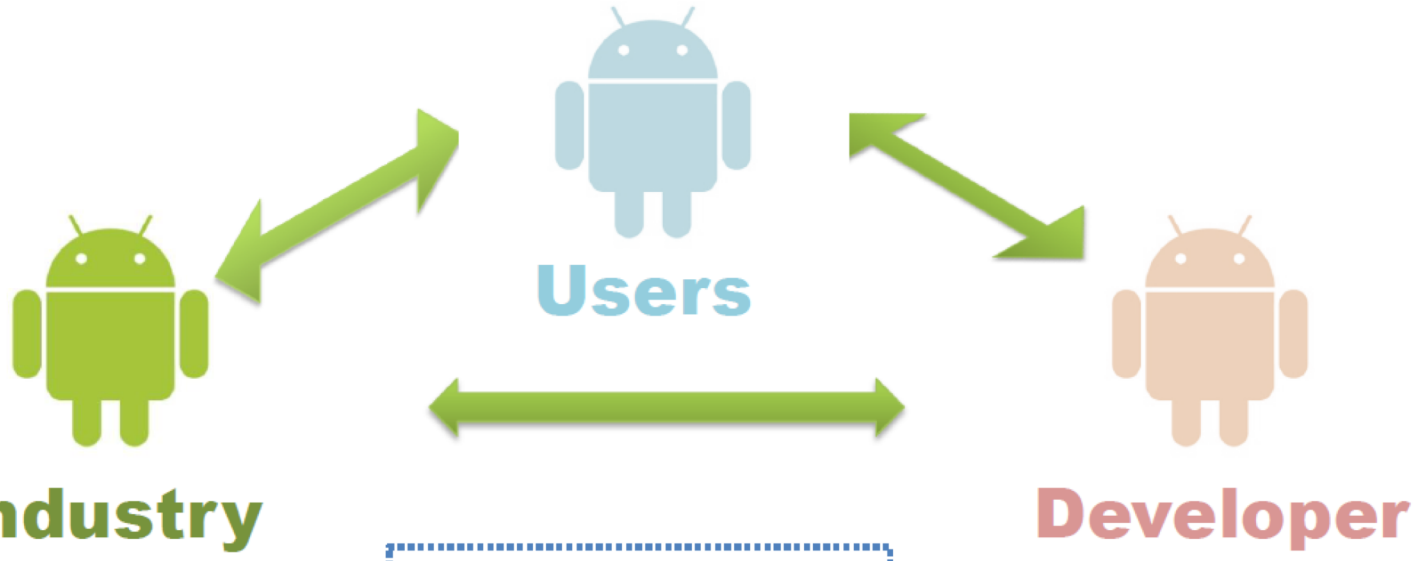
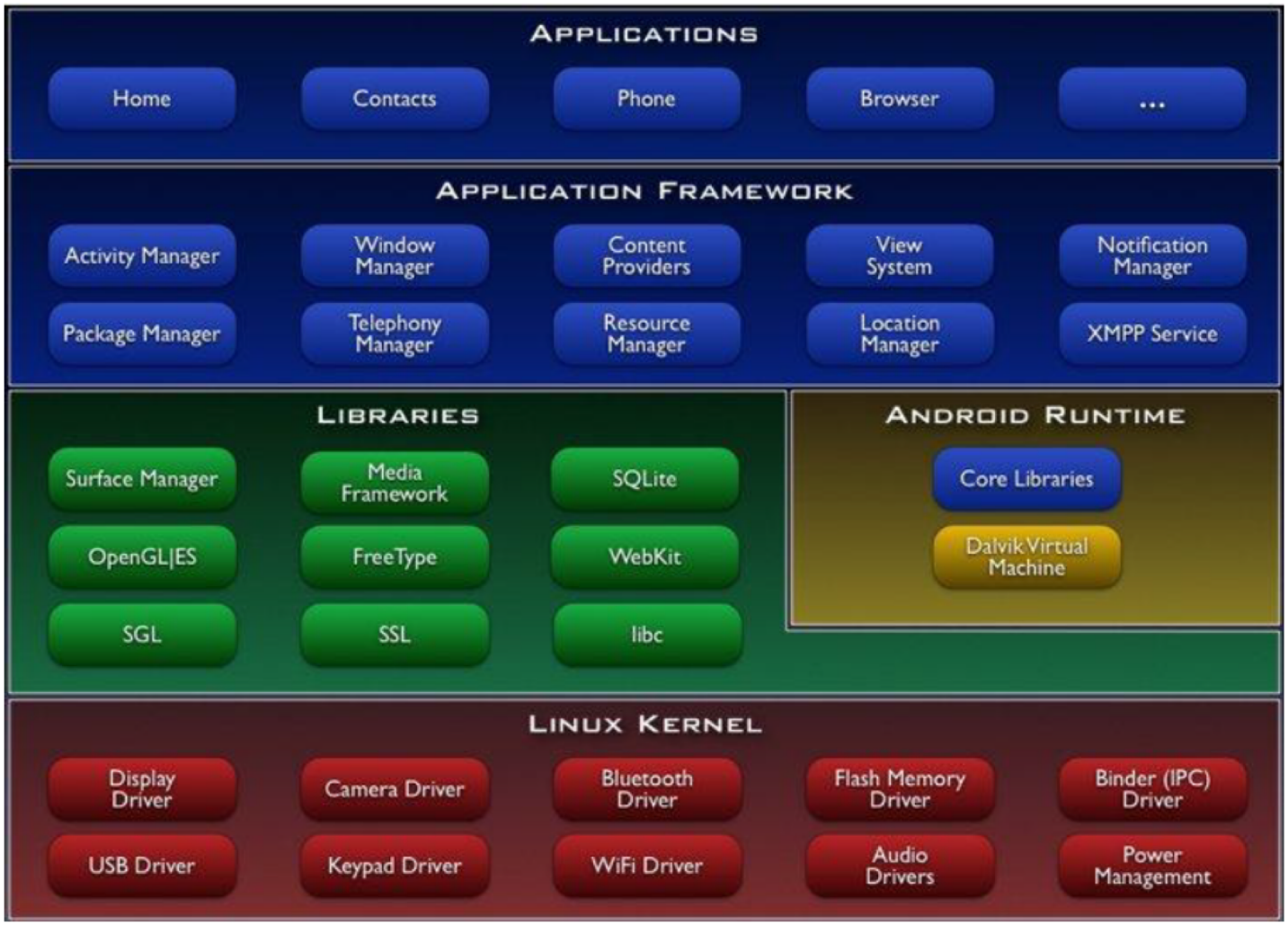


Industry
- Software stack open-sourced under Apache 2.0 license
- Source available after first handsets ship
- Anyone will be able to build a system image

Users
- Users have control of their experience
- They control what gets installed
- They choose the defaults

Developer
- Don not need permission to ship an application
- No hidden or privileged framework APIs
- Can **integrate**, **extend** and **replace** existing components

Andriod Architecture



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Details of Architecture

- Linux Version 2.6.x for core system services
- Android uses only "Kernel" portion in Linux

- Core Libraries
  - Provides the functionality of the JAVA Programming Language
  - Android Application runs in its own process, with its own instance of the Dalvik virtual machine
  - Dalvik VM: Java based license free VM
    - Register based VM, optimization for low memory requirements
    - Executes files in the Dalvik Executable (.dex) format
    - DX tool converts classes to .dex format

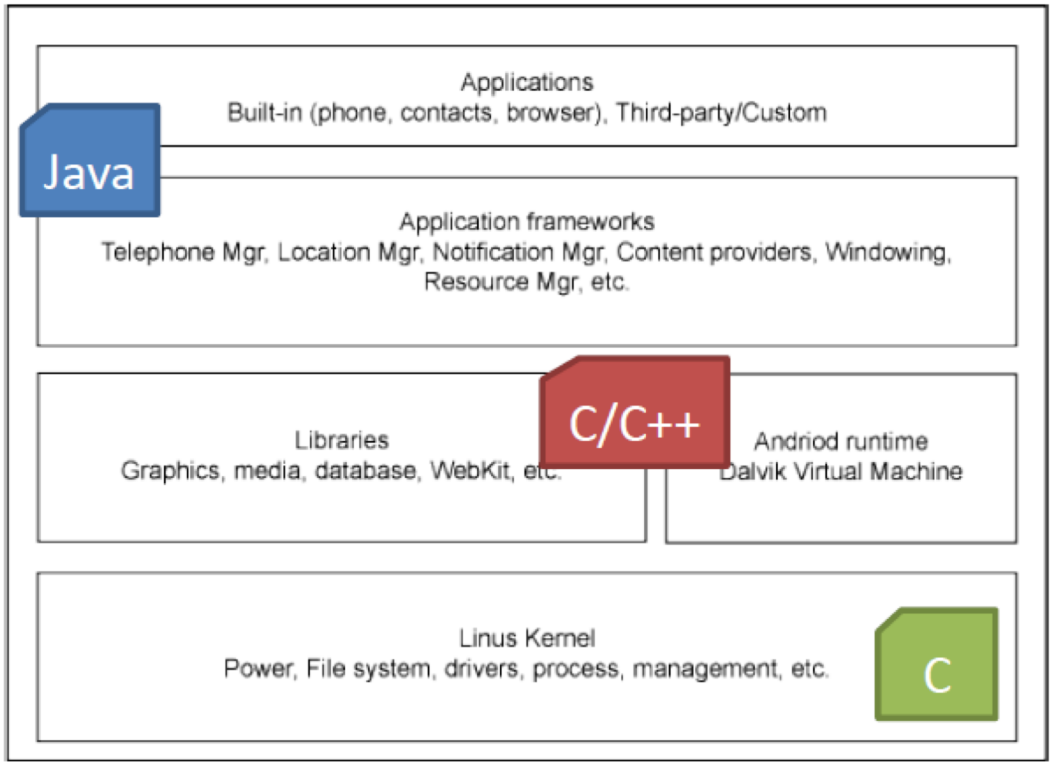
Details of Architecture

- **Libc:** c standard lib.
- **SSL:** Secure Socket Layer
- **SGL:** 2D image engine
- **OpenGL|ES:** 3D image engine
- **Media Framework:** Core part of Android multi-media
- **SQLite:** Embedded database
- **WebKit:** Kernel of web browser
- **FreeType:** Bitmap and Vector
- **Sufrace Manager:** Manage difference windows for different applications

Details of Architecture

- No limited application
- Equality of each apps.
- Easy to embedded web browser
- Parallel running

Details of Architecture



- The Design goal of Android: Openness
  - Be as flexible as possible
  - How it handles access to data: Mash up on the internet and everything else
  - Rapid development(XML, Java)
- Develop Language
  - App: Java
  - Framework: Java
  - Libraries: C/C++
  - OS & Driver: C

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How to develop on Android

Install Eclipse

◆Need download and install JDK (include Java Runtime Environment)

Menu Bar

Tool Bar

Package Exploer
(Projects, files)

Console pane
(Realtime info of program)

Editor Area
(Coding here)

Outline View
(Class, method, arguments)

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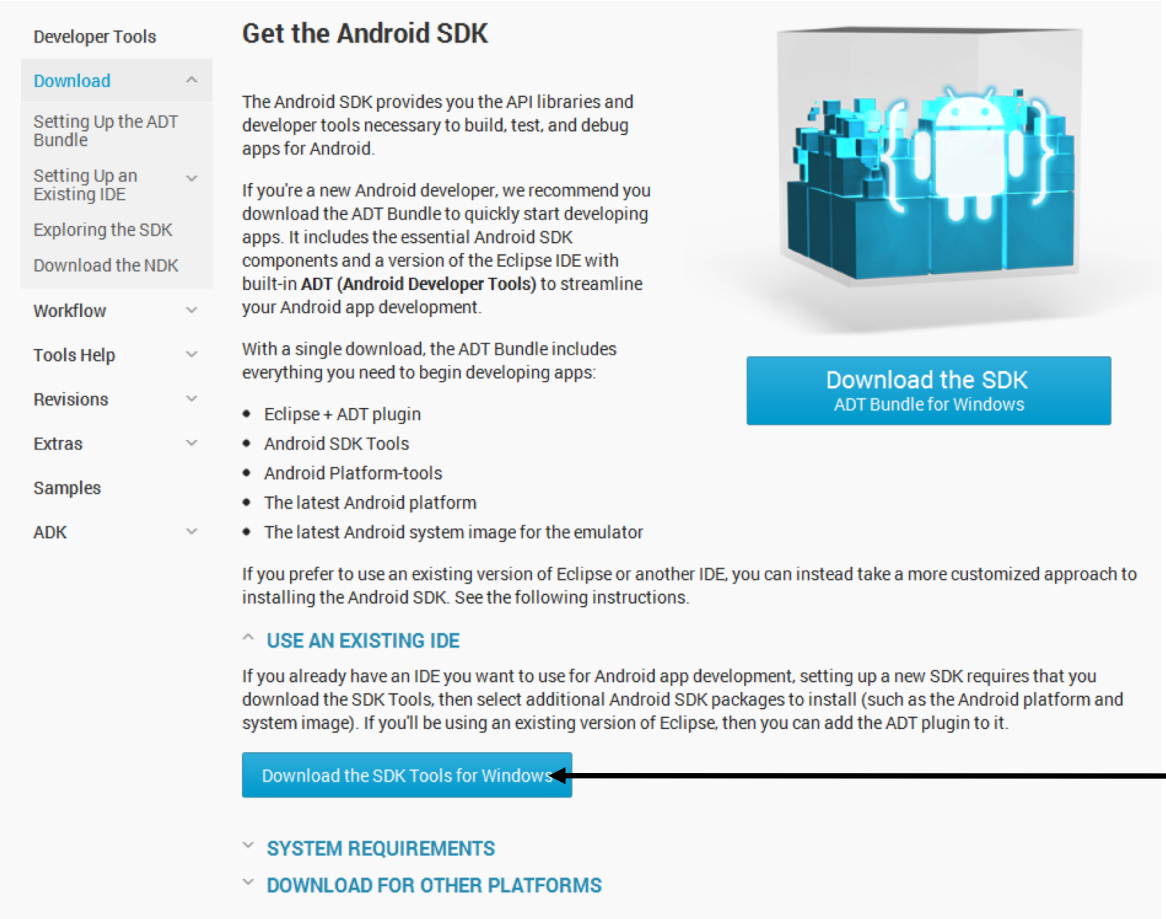
Install Android SDK and Emulator (AVDs)

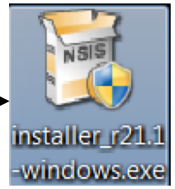
1. Download the Android Software Development Kit

Go **http://developer.android.com/sdk/index.html** to download the Android SDK that will let you develop Android application on your local computer



Click here

*** Double-click the executable (.exe file) to start the install.**



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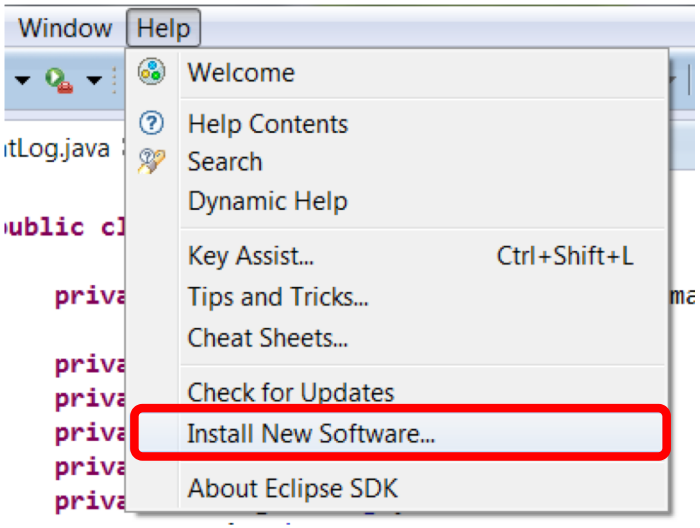
Install Android SDK and Emulator (AVDs)

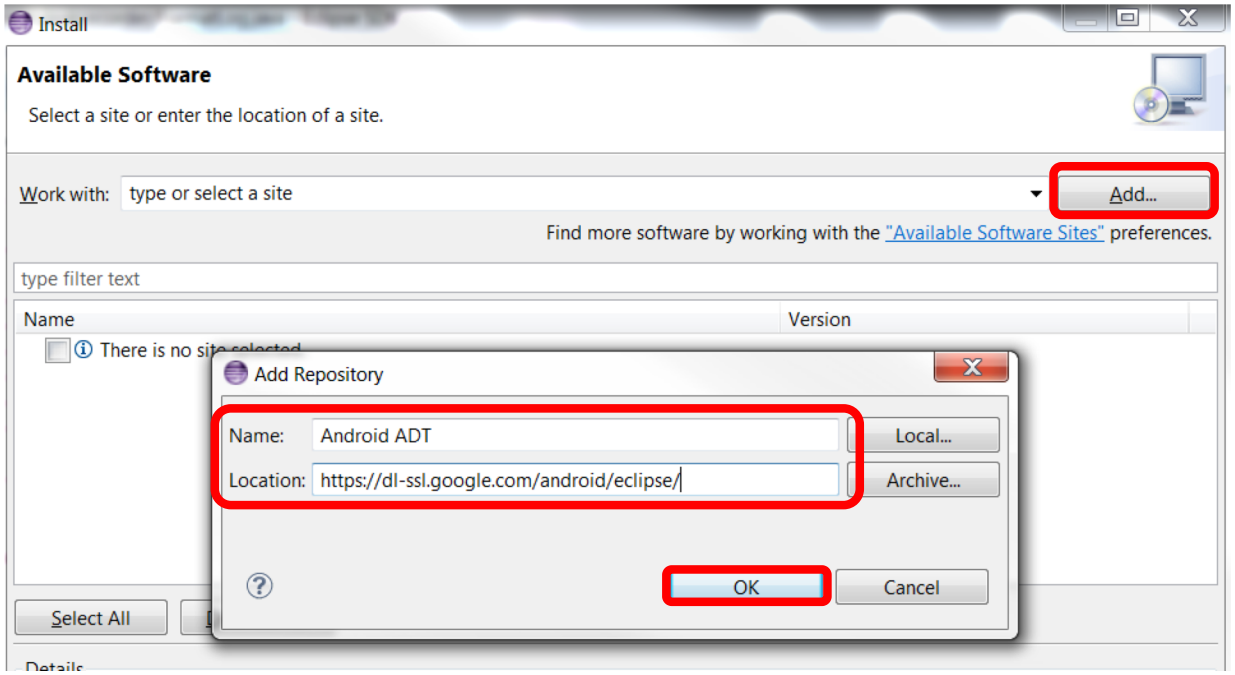
2. Use Eclipse to install the Android Development Tools



- Run Eclipse.
- Choose “Help” > “Install New Software….”
- Click the “Add…” button and create a new entry:

  Name: “Android ADT” (this space is for your own personal use, so name it whatever you want)

  Location: “**https://dl-ssl.google.com/android/eclipse/**” (try just http:// if the https:// does not work for you)



- Click the "OK"

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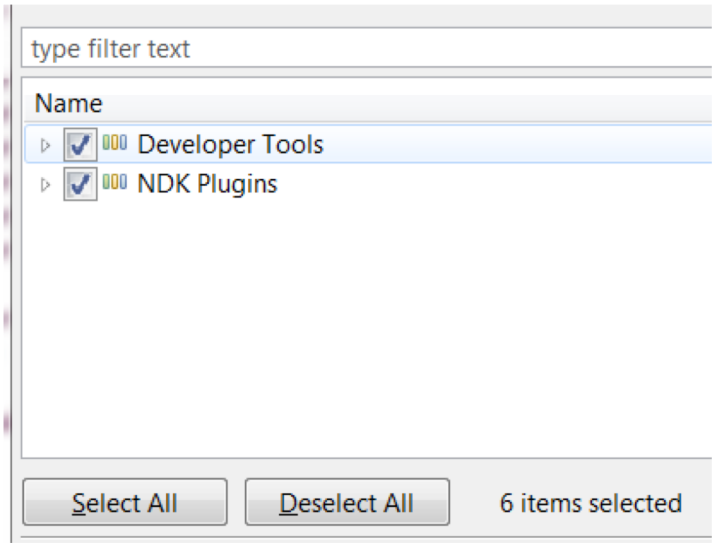
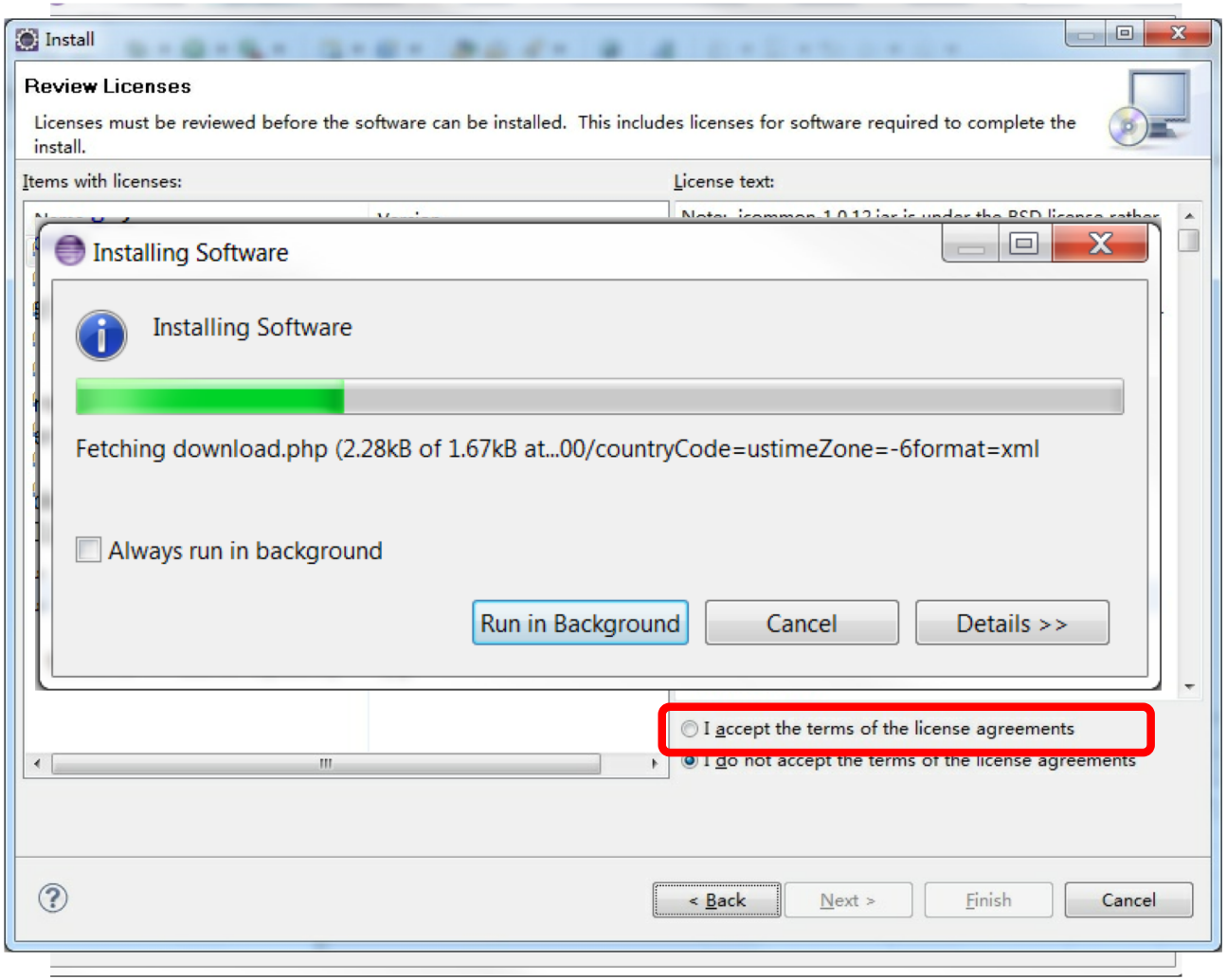
Install Android SDK and Emulator (AVDs)

2. Use Eclipse to install the Android Development Tools



- Check all the boxes to install all the tools
- Just keep clicking “I agree”, “Next”, “Yes”, etc. until it asks you to restart



- Restart Eclipse after all steps

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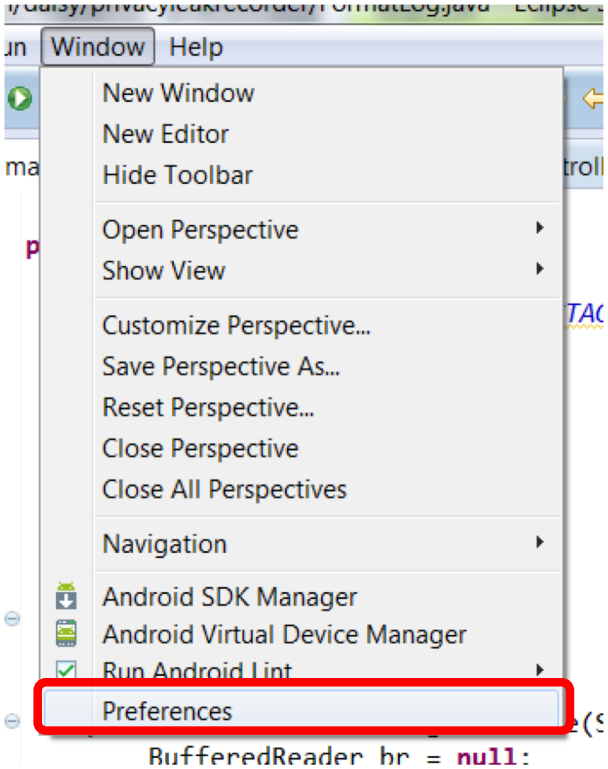
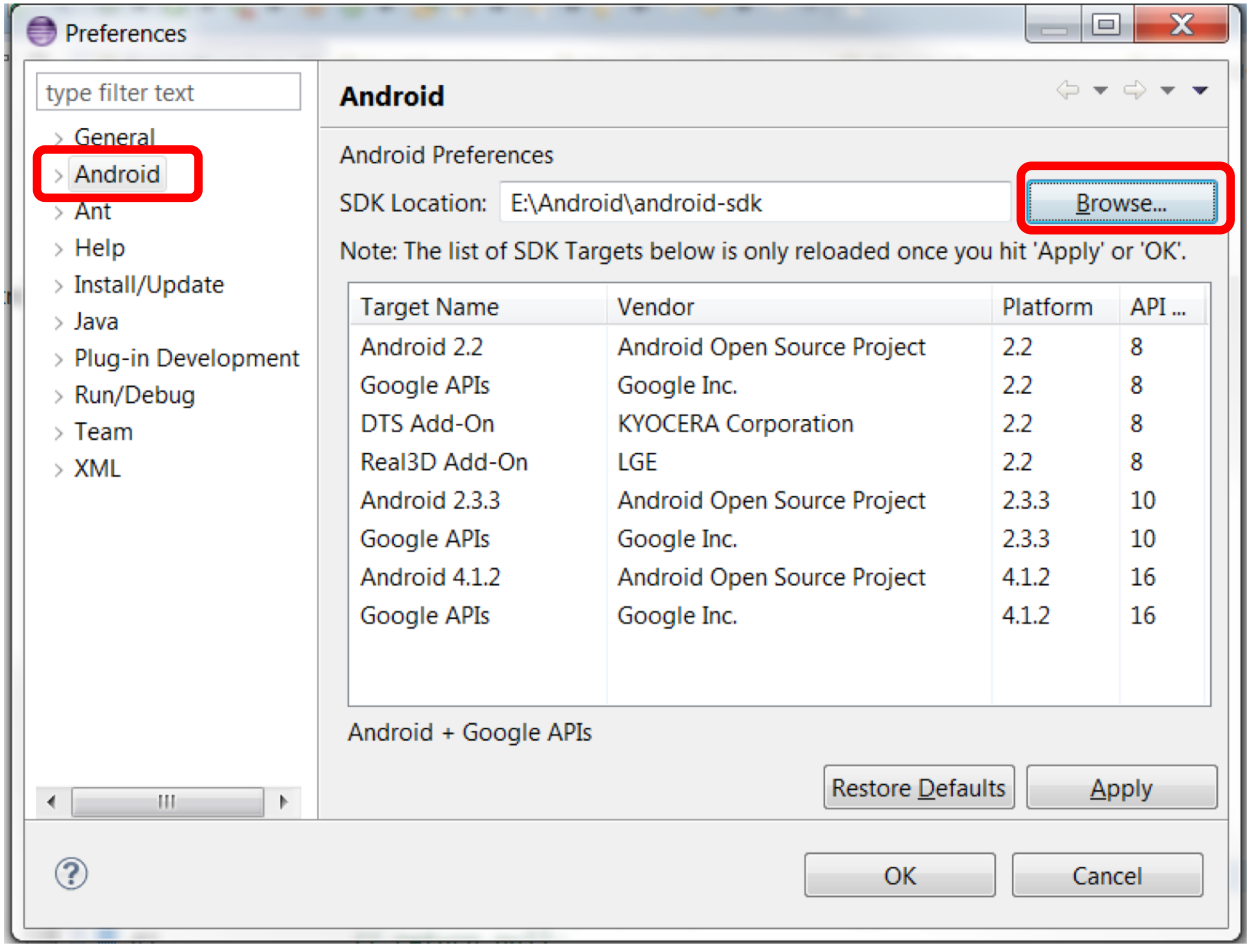
Install Android SDK and Emulator (AVDs)

3. Connect Android SDK with Eclipse IDE



- Click "Window"and choose “Preferences”
- Click on “Android” heading in the menu-tree to open our Android Eclipse preferences
- Click the “Browse…” button to find location of your SDK directory



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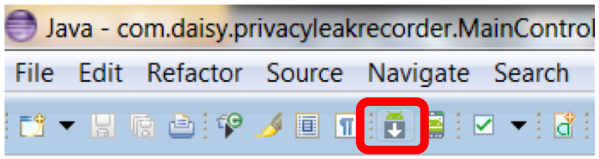
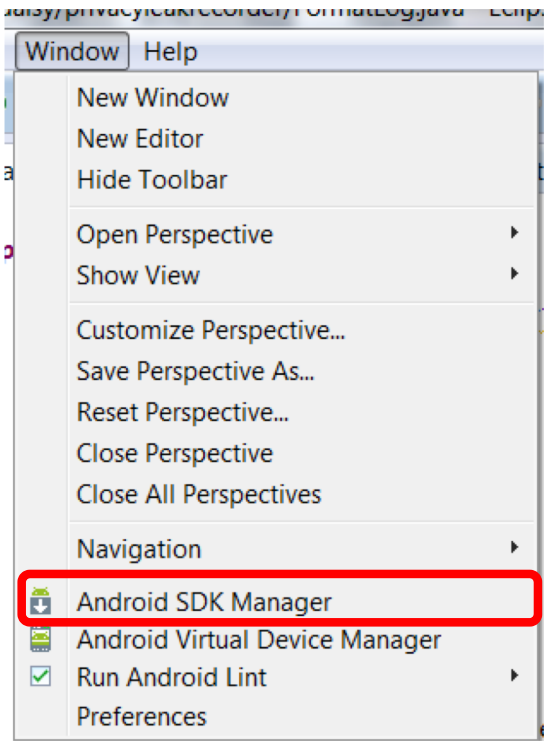
Install Android SDK and Emulator (AVDs)

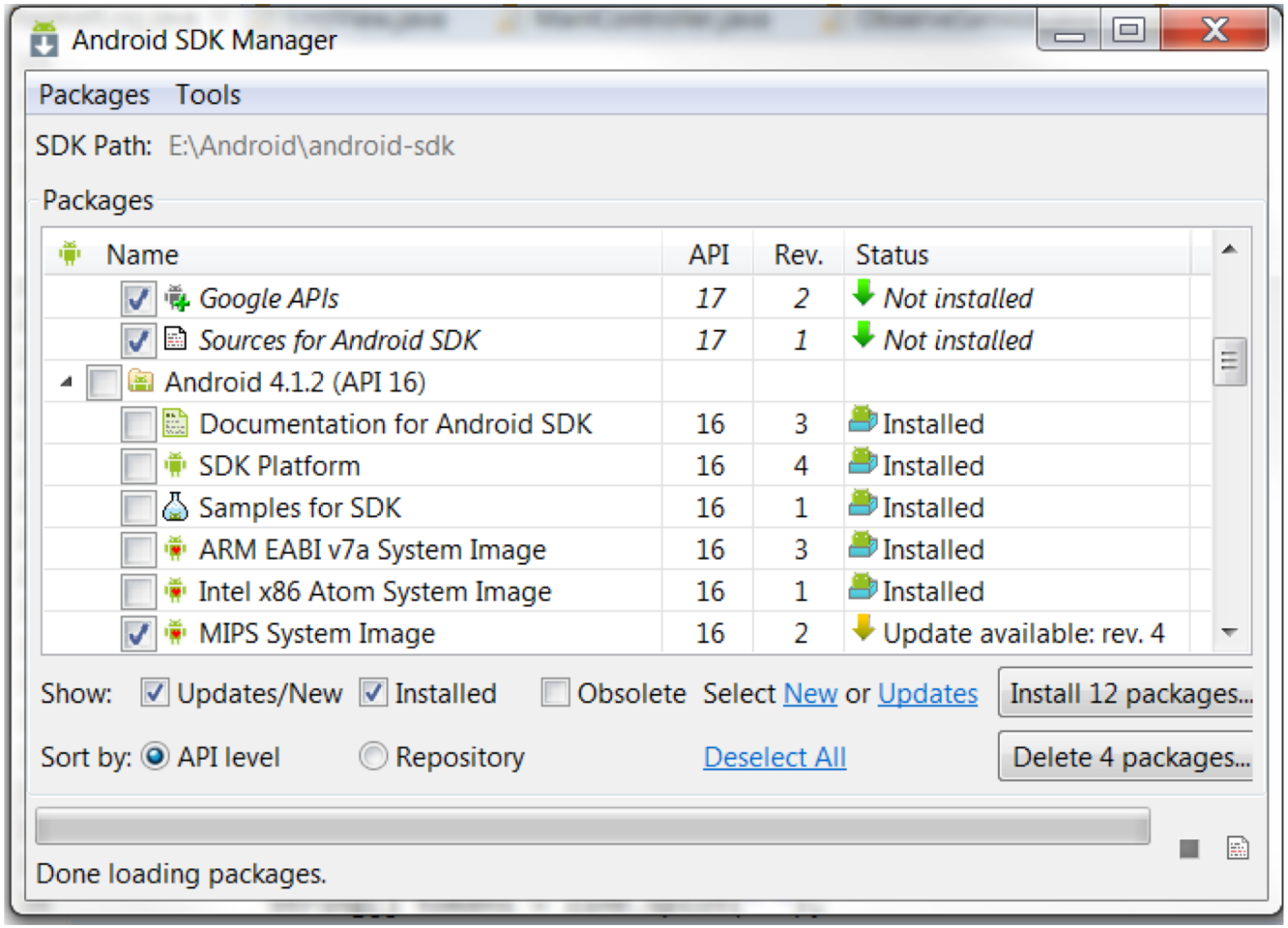
4. Install Android SDK Components





•Click "Window" and choose "Android SDK Manager", or click the same button on "Tool Bar"

• Select the platforms you want to support. You can either choose all, or pick-and-choose what you want to develop for



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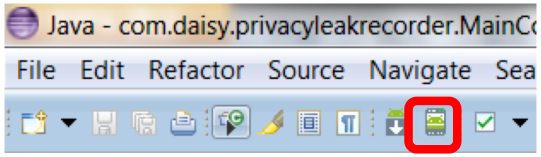
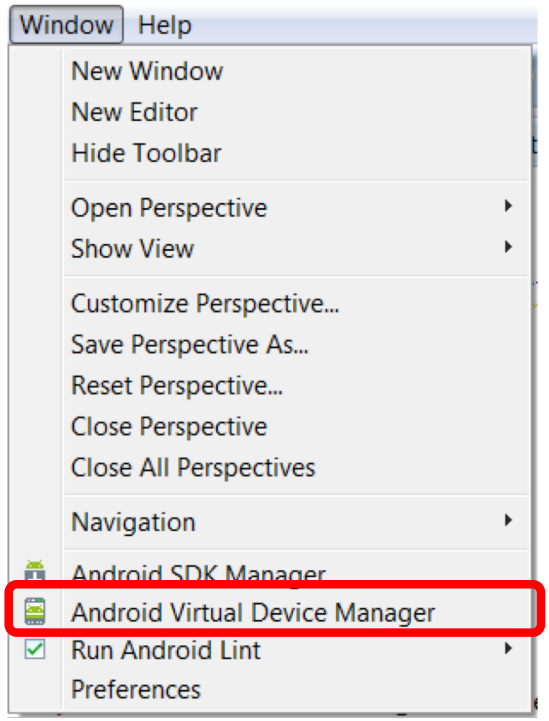
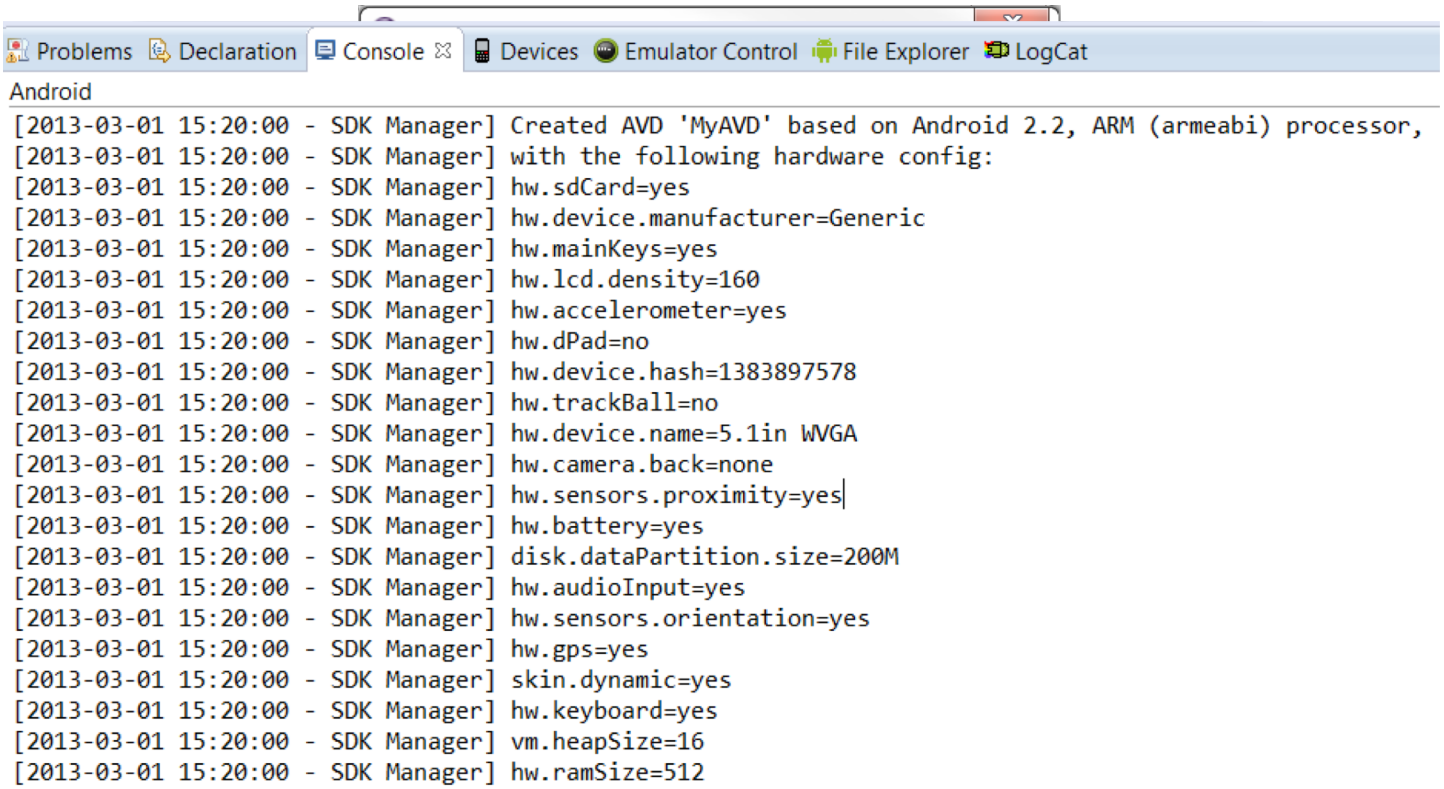
Create Your Android Virtual Devices (AVDs)



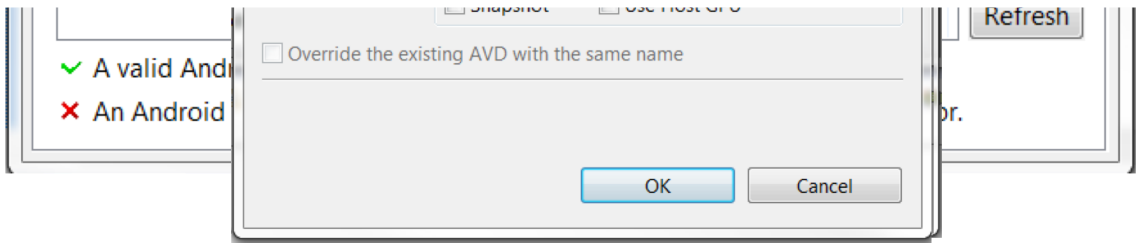


- Click "Window" and choose "Android Virtual Device Manager", or click the same button on "Tool Bar"

- Click "New"-> input "AVD Name"-> select "Device" and Target you want to use-> set size of SD card based on you need



- Console shows successful info



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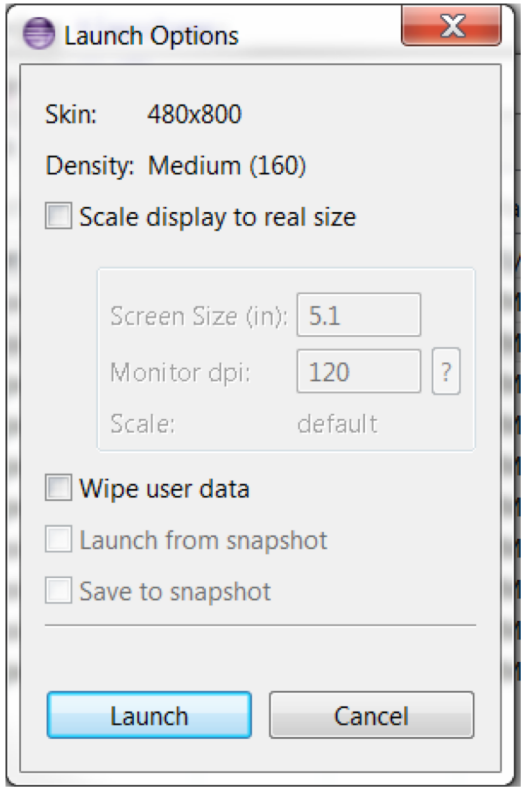
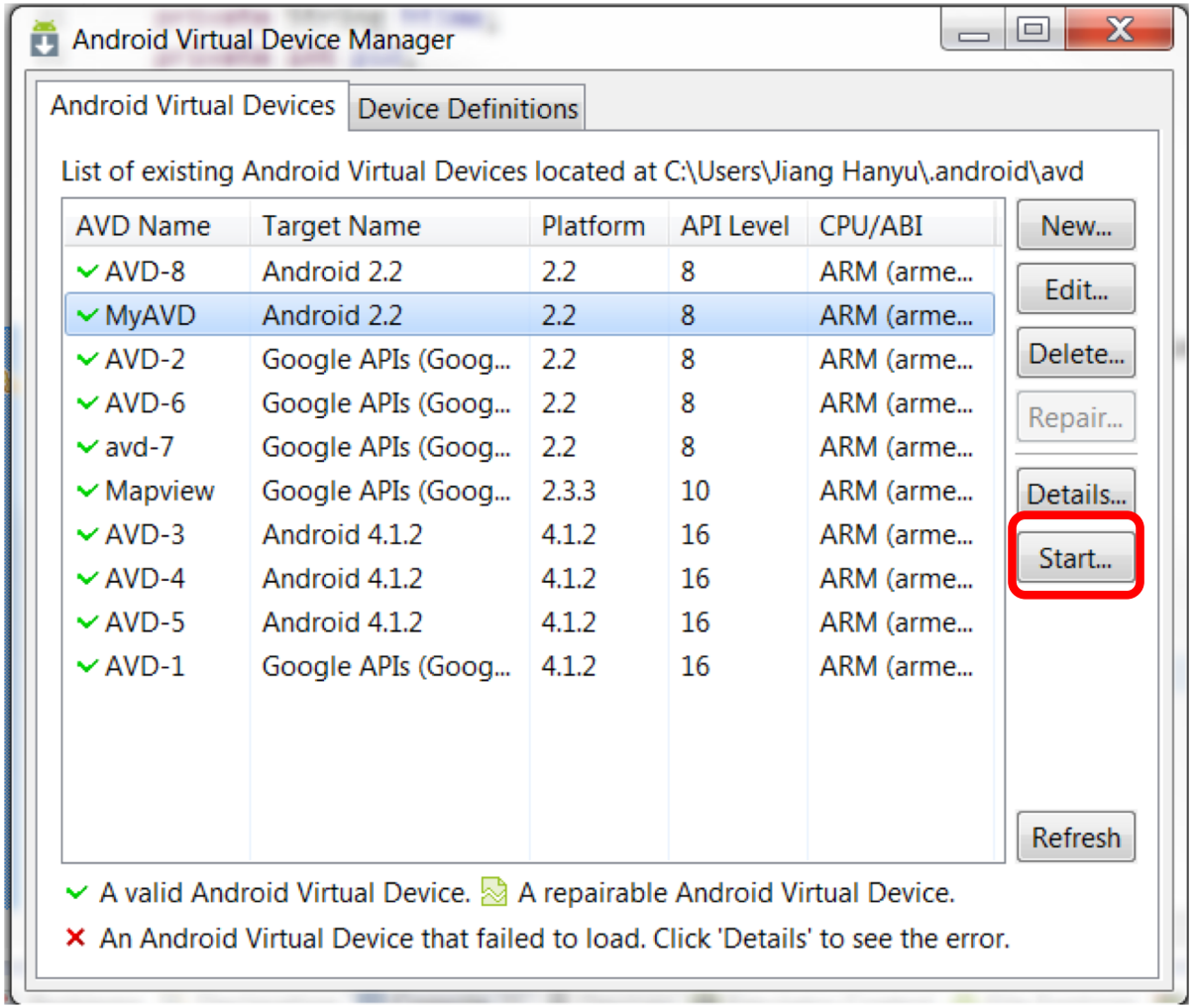
Run Your New AVD



•Also Click "Android Virtual Device Manager", or click the same button on "Tool Bar"

• Select your new AVD and click Start-> Click "Launch"



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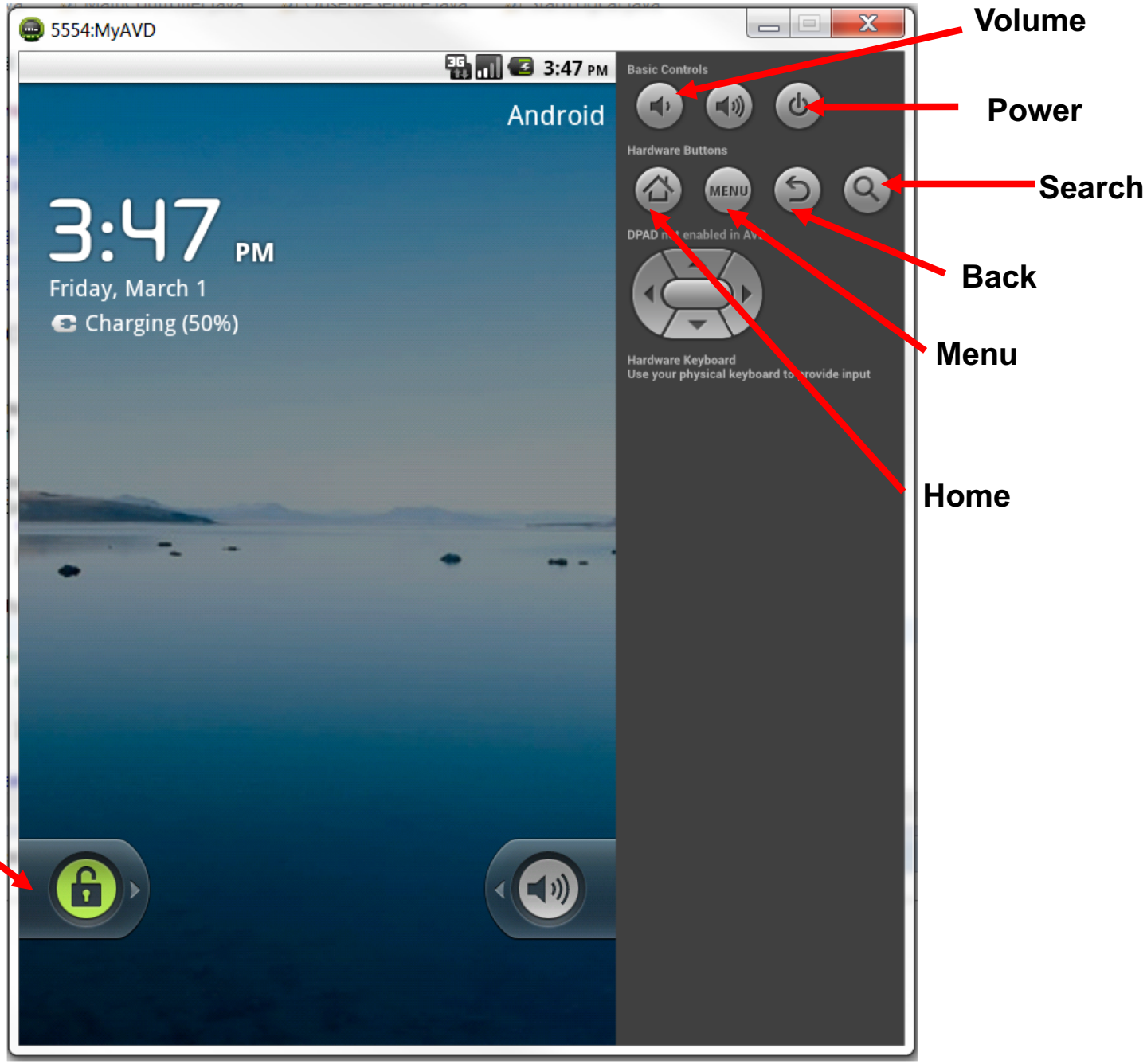
AVD Interface



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New an Android Application

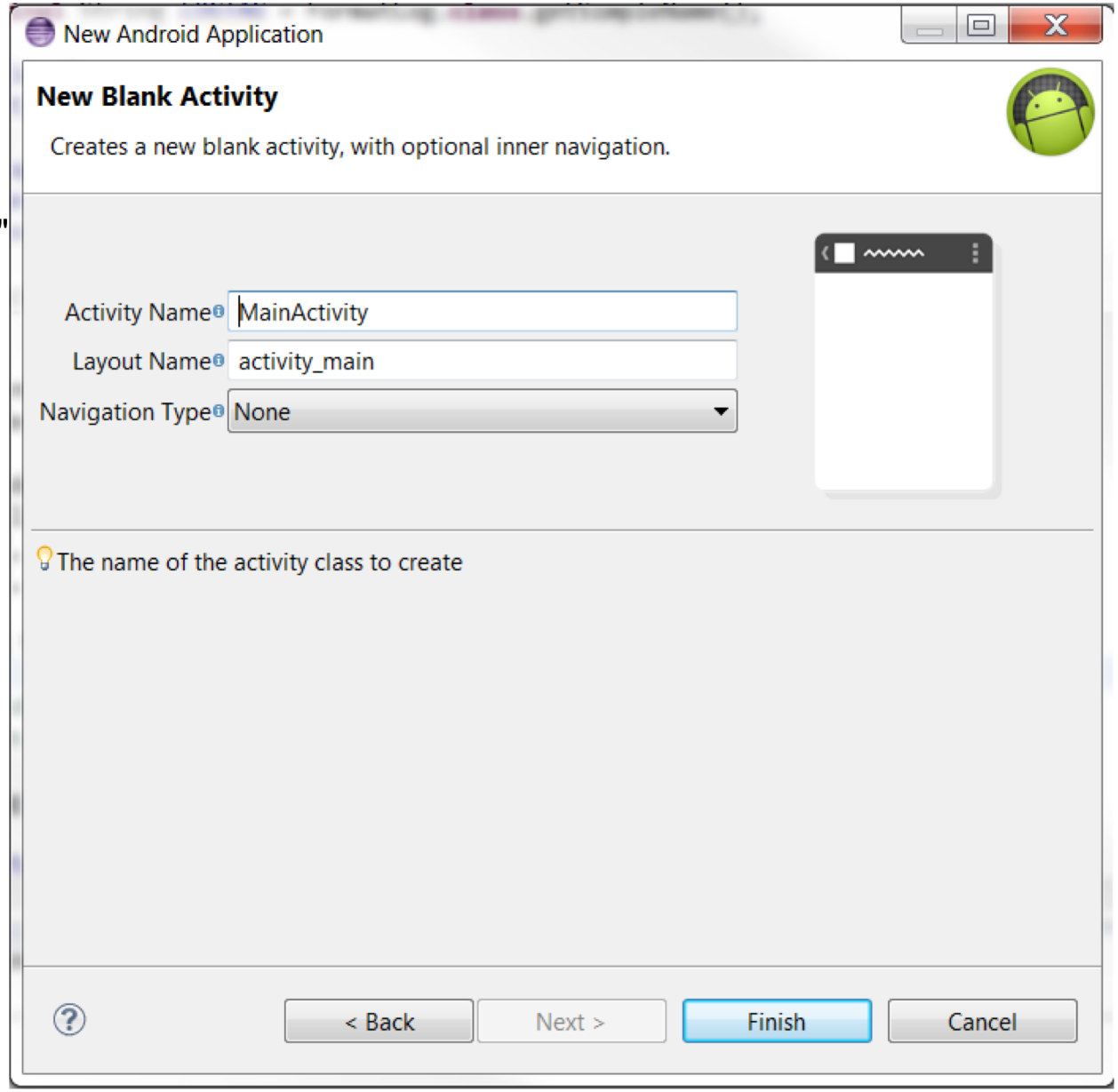
•Click "File"-> Select "New"-> "Other"

•Choose "Android Application Project" -> "Next"

•Input "Application name"

•Select "Target SDK" and "Compile With" based on your AVD-> "Next"

•Keep clicking "Next" and "finish"



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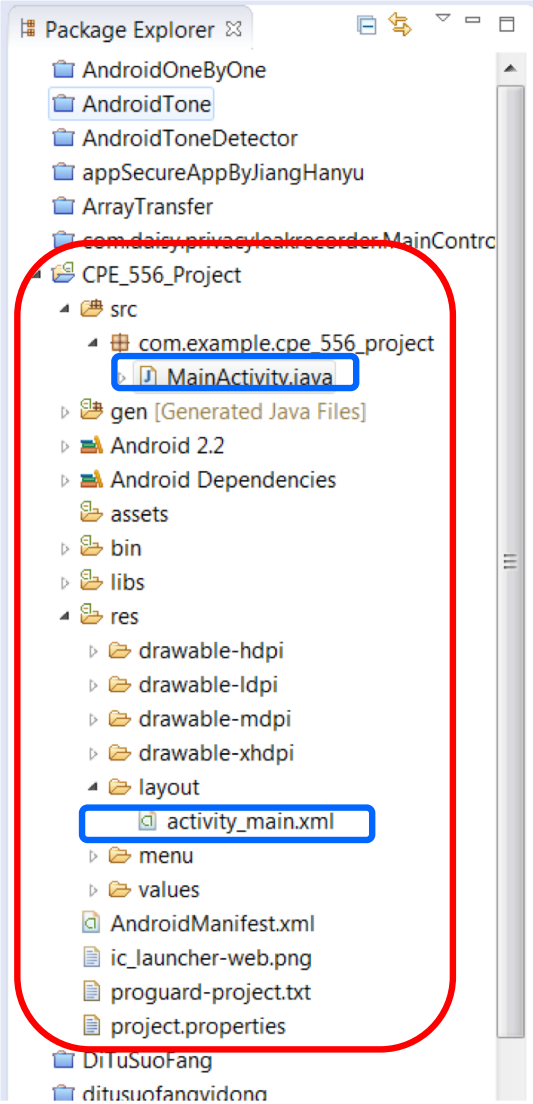
Programming at Android Platform



•Edit your codes in the "**MainActivity.java**" file

•Edit your screen layout at "**activity_main.xml**" file. Any widgets used must be stated at XML file first.

•Some codes have been provided by Eclipse automatically when you new an Android application like below figure.

activity_main.xml | MainActivity.java

```java
package com.example.cpe_556_project;

import android.os.Bundle;

public class MainActivity extends Activity {

    @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.activity_main, menu);
        return true;
    }

}
```

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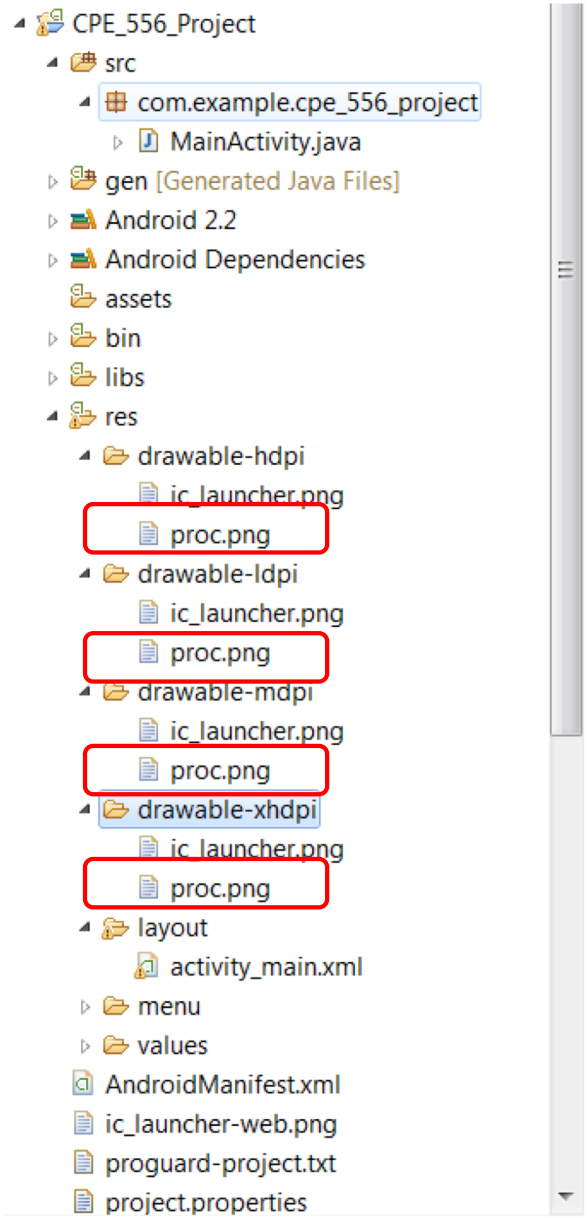
Programming Demo



- First, find an image file which name cannot include capitals.
- Second, copy this file to those four file folders.

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Programming Demo

Create three types of widgets:

•TextView (created automatically) shows text info

•ImageView shows image file

•Button provide user with a click-action

activity_main.xml | MainActivity.java

```xml
<RelativeLayout 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"
    tools:context=".MainActivity" >

    <TextView
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_centerHorizontal="true"
        android:layout_centerVertical="true"
        android:text="@string/hello_world" />

    <ImageView
        android:id="@+id/image1"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_centerInParent="true"
        android:visibility="invisible"
        android:src="@drawable/proc" />


    <Button
        android:id="@+id/button1"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_centerHorizontal="true"
        android:layout_marginTop="70dp"
        android:text=" Hello "
        android:textStyle="bold"
        />

</RelativeLayout>
```

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Programming Demo

- Red blocks represent manual input codes.

- Blue block represents some
- Classes need import.

activity_main.xml | MainActivity.java

```java
1  package com.example.cpe_556_project;
2
3  import android.os.Bundle;
4  import android.app.Activity;
5  import android.view.Menu;
6  import android.view.View;
7  import android.widget.Button;
8  import android.widget.ImageView;
9
10 public class MainActivity extends Activity {
11     ImageView imageView;
12     Button button;
13     @Override
14     protected void onCreate(Bundle savedInstanceState) {
15         super.onCreate(savedInstanceState);
16         setContentView(R.layout.activity_main);
17
18         //Coding by myself
19         imageView= (ImageView)findViewById(R.id.image1);
20         button= (Button)findViewById(R.id.button1);
21         button.setOnClickListener(new Button.OnClickListener(){
22             public void onClick(View v) {
23                 imageView.setVisibility(View.VISIBLE);
24             }
25         });
26     }
27
28     @Override
29     public boolean onCreateOptionsMenu(Menu menu) {
30         // Inflate the menu; this adds items to the action bar if it is present.
31         getMenuInflater().inflate(R.menu.activity_main, menu);
32         return true;
33     }
34
35 }
36
```

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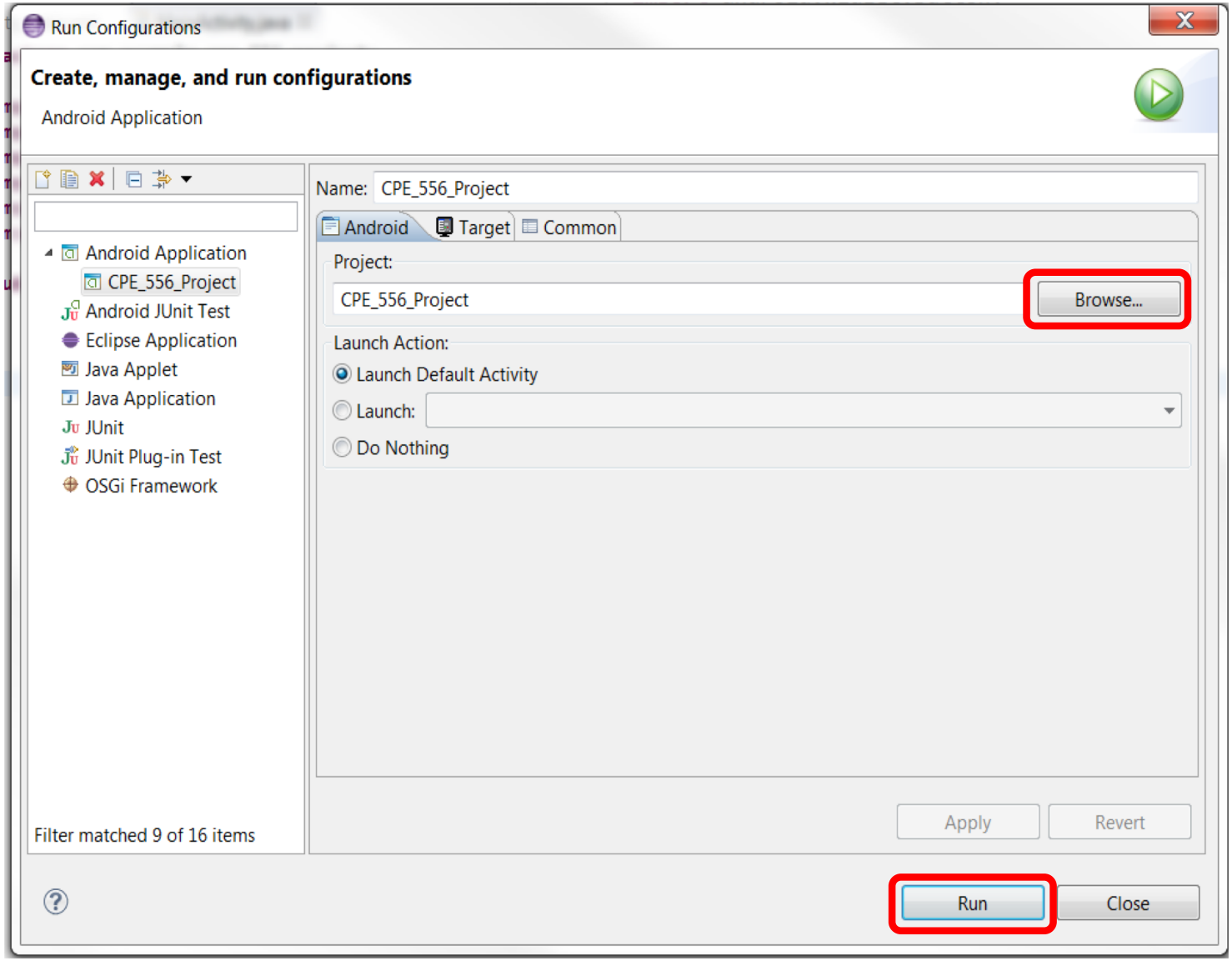
Programming Demo

- Right click name of your project-> select "Run As"-> choose "Android Application"

- Select your project by clicking "Browse"-> click "Run"



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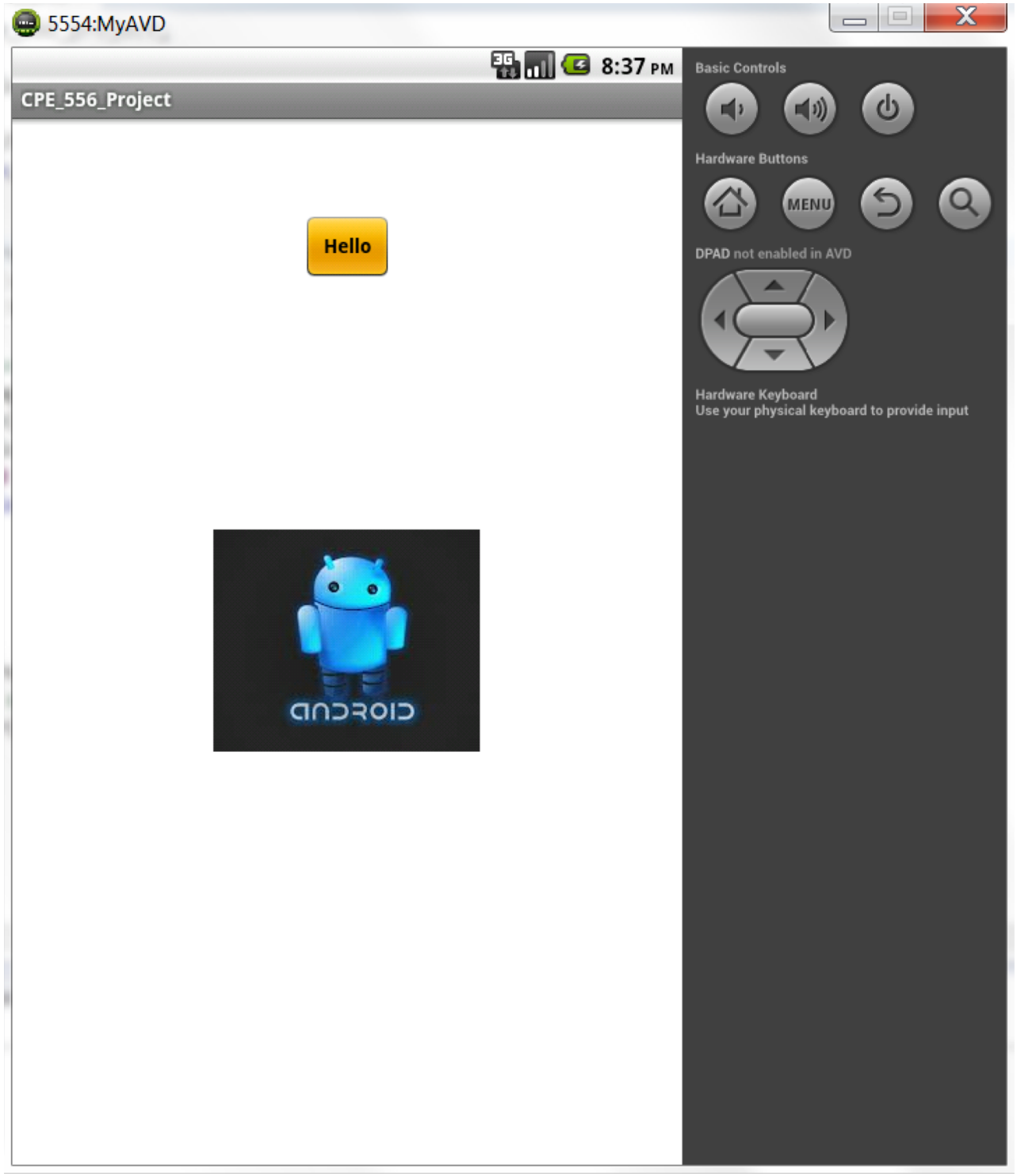
Programming Demo

•First page is "Hello world!"

•Then, click "Hello" button to show a picture



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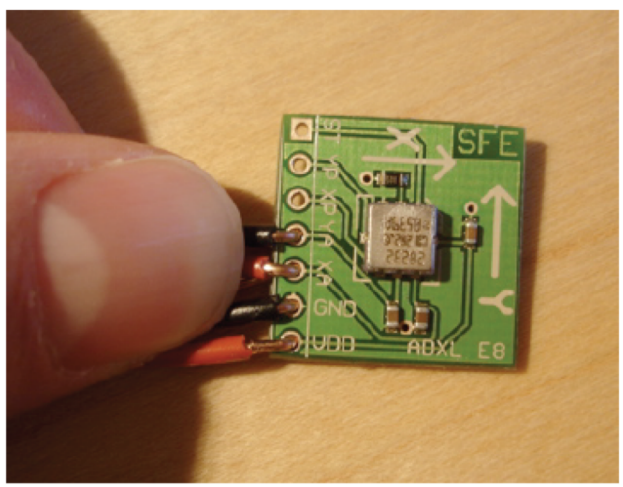
Smartphone Hardware Sensors

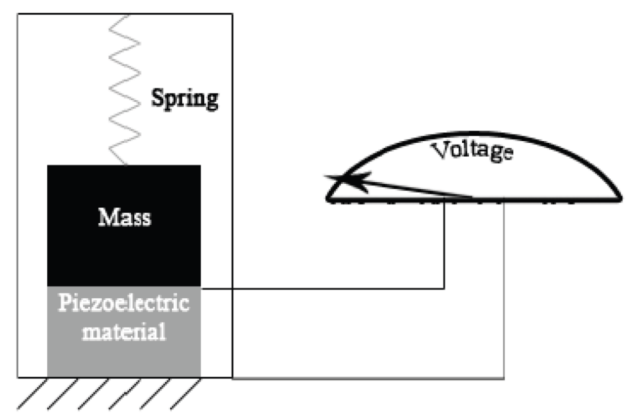
Accelerometer

- Measures proper acceleration (acceleration it experiences relative to freefall), felt by people or objects
- Units: **m/s^2** or **g**
- Most smartphone accelerometers trade large value range for high precision, iPhone 4 range: ±2g, precision 0.018g

Example	G Force
Standing on earth at sea level	1g
Bugatti Veyron from 0 to 100 km/h (2.4s)	1.55g
Space Shuttle, maximum during launch and reentry	3g
Formula 1 car, peak lateral in turns	5-6g
Death or serious injury	50g
Shock capability of mechanical Omega watches	5000g

Smartphone accelerometer (piezoelectric):





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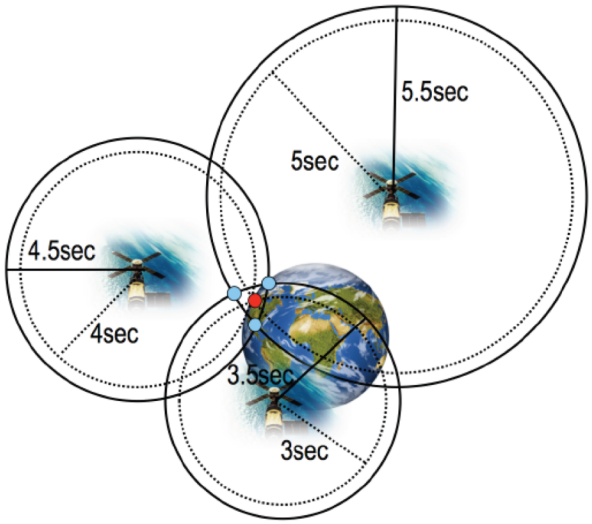
GPS

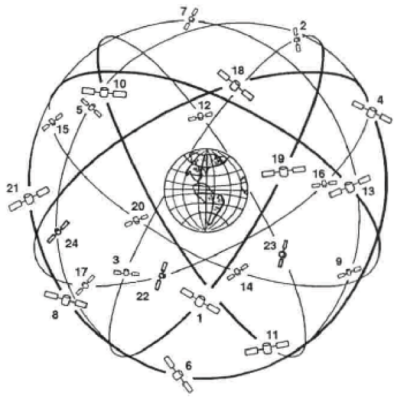
➢**Location sensors detect the location of the smartphone using either:**

•GPS
•Lateration/Triangulation of cell towers or wifi networks (with database of known locations for towers and networks)

•Location of associated cell tower or wifi network

➢**Connection to 3 satellites is required for 2D fix (latitude/longtitude), 4 satellites for 3D fix (altitude)**





➢**Caveats**

•GPS will not work indoors
•GPS quickly kills your battery

•A location fix takes a long period of time

•Building reflects and occulde satellite signals - thereby reducing precision of positioning in urban environments

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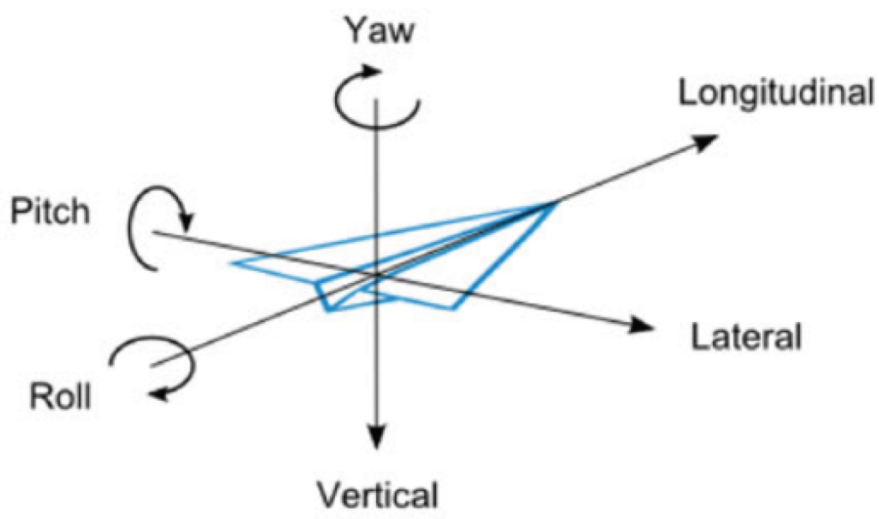
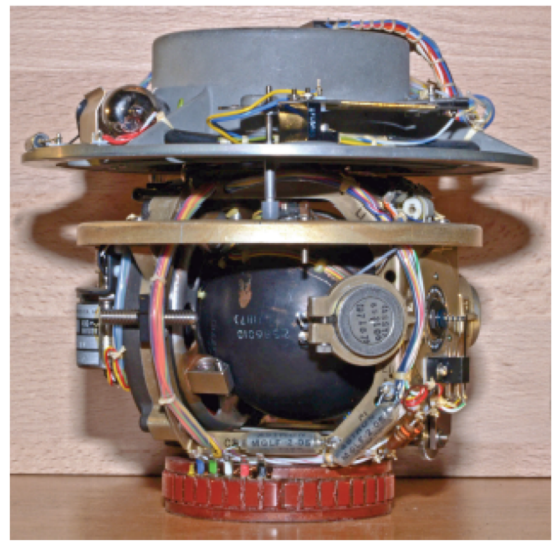
Gyroscope

•Detects the current orientation of the device, or changes in the orientation

•Precisely: orientation can be computed from the angular rate that is detected by the gyroscope, expressed in rad/s on 3 axis:





Magnetometer

- Measure the strength of earth's magnetic field
- Strength is expressed in tesla [T]

Example	Field strength
Earth's magnetic field on the equator (0° latitude)	31μT (0.00031T)
Typical fridge magnet	5mT (0.005T)
Strong neodymium magnet	1.25T
MRI system	1.5T – 3T

- Smartphones provide raw manetometer data and a computed compass bearing

➢Applications:

- **Compass**, of course - rotate maps/interfaces/graphics according to bearing
- **Tricorder**, detect magnets, force fields, klingon shield strength

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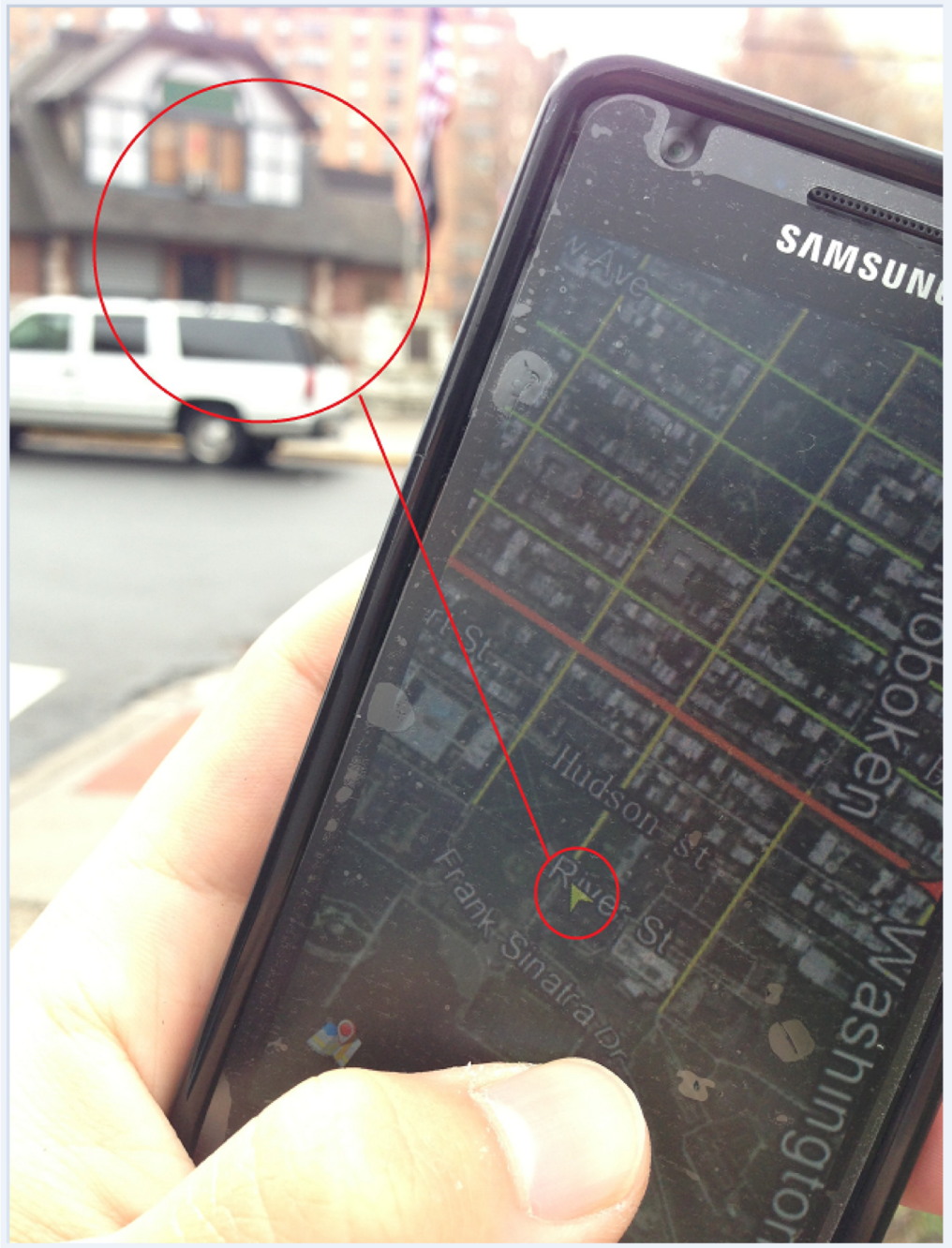
You can design some interesting things with those Sensors

Demo:
A map application with
GPS module



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