Android Development Tutorial

Slides Courtesy: Yi Huang

Contents

- What's Android
- Android architecture
- Android software development
- '*Hello World*' on Android
- More…

What’s Android

Android Phones

HTC G1

Samsung i7500

HTC Hero

Motorola Cliq

Sony X10

HTC Magic

Samsung Moment

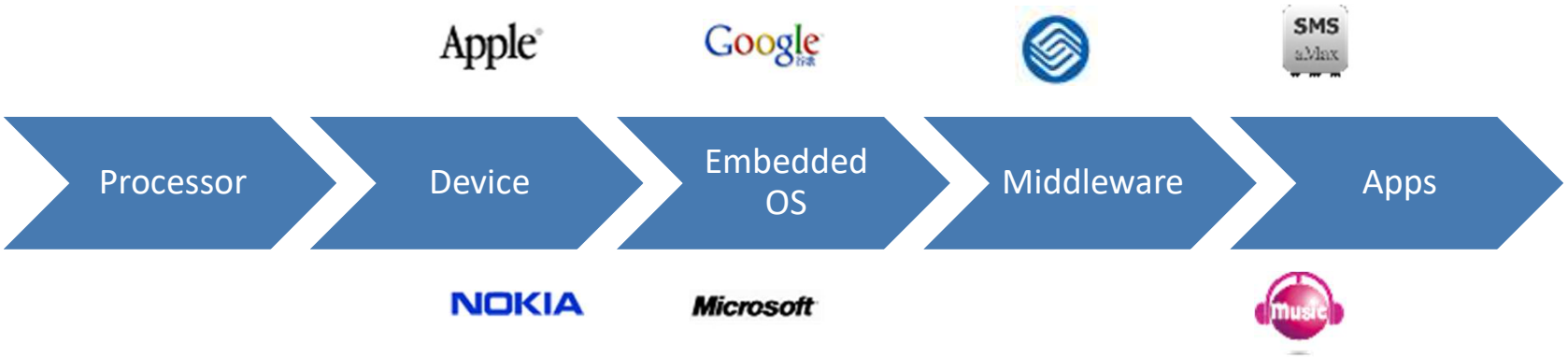
Motorola Droid

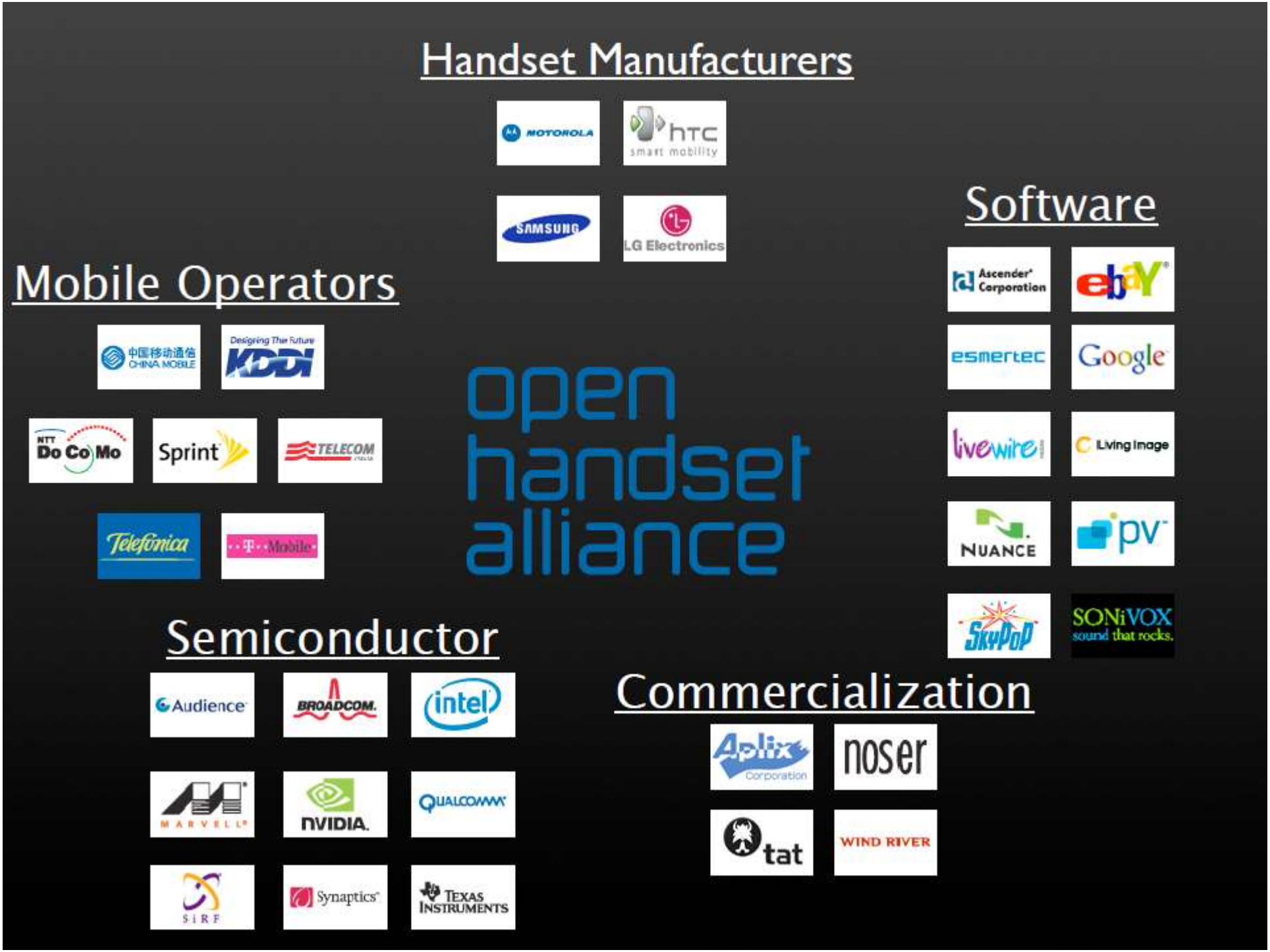
HTC Tattoo

nexus one

Mobile Devices

- It’s obvious that mobile device may take the place of PC in future
- OS plays a vital part




Handset Manufacturers
MOTOROLA
htc
smart mobility
SAMSUNG
LG Electronics
Software
Ascender Corporation
ebay
esmertec
Google
livewire
Living Image
NUANCE
pv
SkyPoP
SONiVOX
sound that rocks.
Mobile Operators
中国移动通信
CHINA MOBILE
Designing The Future
KDDI
NTT DoCoMo
Sprint
TELECOM
Telefonica
T-Mobile
open handset alliance
Semiconductor
Audience
BROADCOM.
intel
MARVELL
NVIDIA.
QUALCOMM
SiRF
Synaptics
Texas Instruments
Commercialization
Aplix Corporation
noser
tat
WIND RIVER

OHA and Android

- OHA(Open Handset Alliance) is a group of 71 technology and mobile companies, including Google, Intel, Dell, HTC and China Mobile…
- OHA's aim：
  - accelerate innovation in mobile phones
  - offer consumers a richer, less expensive, and better mobile experience
- OHA developed Android™, the first complete, open, and free mobile platform
- OHA was initially called up by Google, and Google is the 'captain'

What's Android

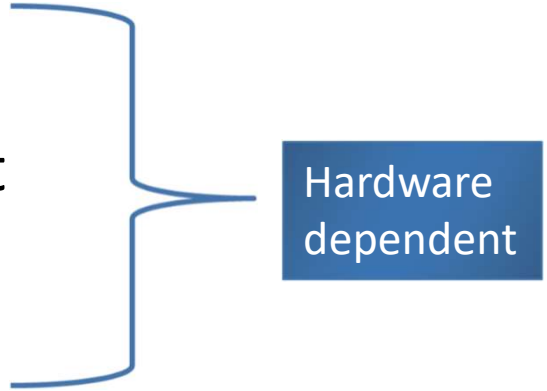
- Generally, Android is a software stack for mobile devices that includes an operating system, middleware and key applications
- Android is based on JAVA and all its applications are developed in JAVA
- The JAVA VM, known as Dalvik, is highly customized and optimized for mobile devices The core of Android
- **Android SDK** offers rich tools for android application development and many useful APIs。

Android Features #1

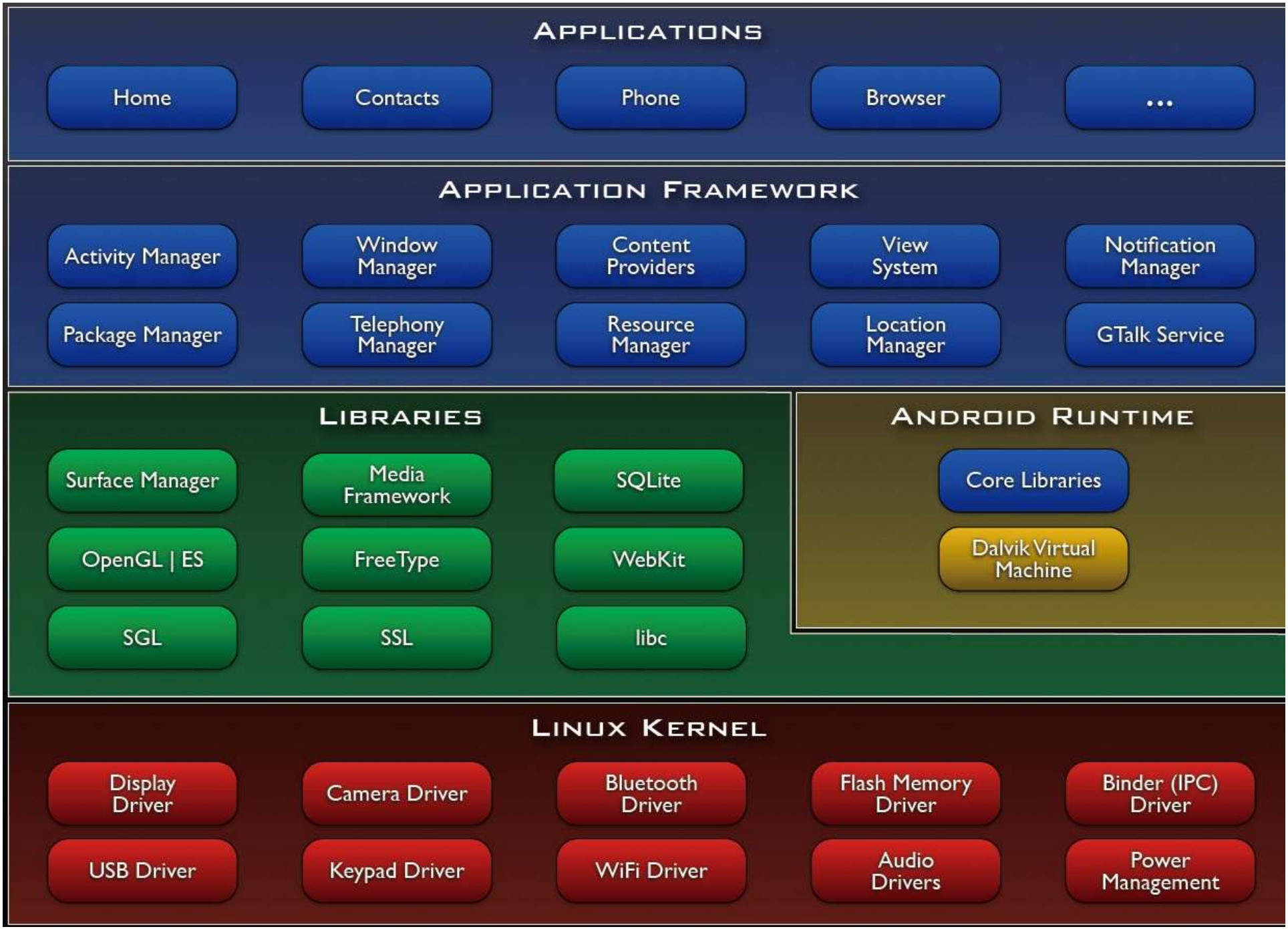
- Application framework enabling reuse and replacement of components
- Optimized Java virtual machine: Dalvik
- Optimized Graphics Processing, supporting 2D and 3D graphics(OpenGL ES 1.0)
- Integrated open source web browser: WebKit
- SQLite for structured data storage

Android Features #2

- Multimedia capability, supporting varieties of audio, video and still image formats
- GSM Telephony
- Bluetooth, EDGE, 3G and Wi-Fi support
- Camera, GPS, compass, accelerometer and other sensors support
- Rich development environment, including an emulator, debugging tools, memory probe tools, log tools and powerful eclipse plugins



Android architecture


Applications
Home
Contacts
Phone
Browser
...
Application Framework
Activity Manager
Window Manager
Content Providers
View System
Notification Manager
Package Manager
Telephony Manager
Resource Manager
Location Manager
GTalk Service
Libraries
Surface Manager
Media Framework
SQLite
OpenGL | ES
FreeType
WebKit
SGL
SSL
libc
Android Runtime
Core Libraries
Dalvik Virtual Machine
Linux Kernel
Display Driver
Camera Driver
Bluetooth Driver
Flash Memory Driver
Binder (IPC) Driver
USB Driver
Keypad Driver
WiFi Driver
Audio Drivers
Power Management

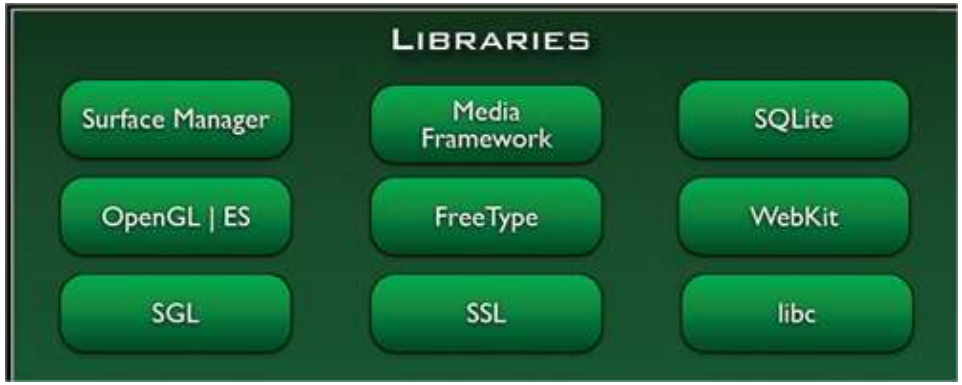
Linux Kernel

- Note that Android based on a Linux kernel not a Linux OS
- Supplies Security, Memory management, Process management, Network stack and Driver model
- Acts as an abstraction layer between the hardware and the rest of the software stack

Libraries

- Run in system background
- Using C/C++ Language
- 4 types of Libraries
  - Bionic Libc, system C libraries
  - Function Libraries, supporting multimedia, web browser, SQLite...
  - Native Servers
  - Hardware

    Abstraction Libraries



Core Libraries

- **System C library,** the standard C system library, tuned for embedded Linux-based devices
- **Media Libraries,** support playback and recording of many popular audio and video formats, as well as image files, including MPEG4, H.264, MP3, AAC, AMR, JPG, and PNG
- **Surface Manager,** manages access to the display subsystem and seamlessly composites 2D and 3D graphic layers from multiple applications
- **WebKit,** a modern web browser engine which powers both the Android browser and an embeddable web view
- **SGL**, the underlying 2D graphics engine
- **3D libraries,** an implementation based on OpenGL ES 1.0 APIs
- **FreeType** , bitmap and vector font rendering
- **SQLite** , a powerful and lightweight relational database engine

Andoid Runtime

- **The core of Android platform**
- Dalvik Virtual Machine
  - Register-based
  - Executes files in the Dalvik format
- Java core Libraries
  - Provides most of the functionality of the Java programming language.

Android Runtime (cont.)

- The functions of Java core libraries rely on the Dalvik VM and the underlying Linux kernel
- Multiple Dalvik VMs may run at the same time
- Every Android application runs in its own process, with its own instance of the Dalvik virtual machine
  - The "dx" tool in Android SDK can transform compiled JAVA class into the .dex format

Dalvik Virtual Machine

- Android custom implementation virtual machine
  - Provides application portability and runtime consistency
  - Runs optimized file format (.dex) and Dalvik bytecode
  - Java .class / .jar files converted to .dex at build time
- Designed for embedded environment
  - Supports multiple virtual machine processes per device
  - Highly CPU-optimized bytecode interpreter
  - Efficiently Using runtime memory
- Core Libraries
  - Core APIs for Java language provide a powerful, yet simple and familiar development platform

DVM vs. JVM

- DVM
  - Google
  - Dalvik executable
  - Only supports a subset of standard Java Library
- JVM
  - Sun
  - Java bytecode
- Some worries that Java world may be divided into different communities, each has its own Java standard

Application Framework

- Simplify the reuse of components
  - Applications can publish their capabilities and any other application may then make use of those capabilities
- Applications is a set of services and systems, include
  - Views system, content providers, resources manager and so on

Application Framework (cont.)

- **Activity Manager,** manages the lifecycle of applications and provides a common navigation backstack
- **Notification Manager,** enables all applications to display custom alerts in the status bar
- **Resource Manager**, providing access to non-code resources such as localized strings, graphics, and layout files
- **Content Providers,** access data from other applications (such as Contacts), or to share their own data
- **Views,** used to build an application, including lists, grids, text boxes, buttons, and even an embeddable web browser

Applications

- A set of core applications shipped with Android platform
  - an email client, SMS program, calendar, maps, browser, contacts, and others
- All written in Java
- Our applications are in the same level as these applications

Android software development

Development Environment

- IDE – Eclipse
- Eclipse plug-in - ADT
- Software Development Kit (SDK)
- Android Emulator
- Debugger

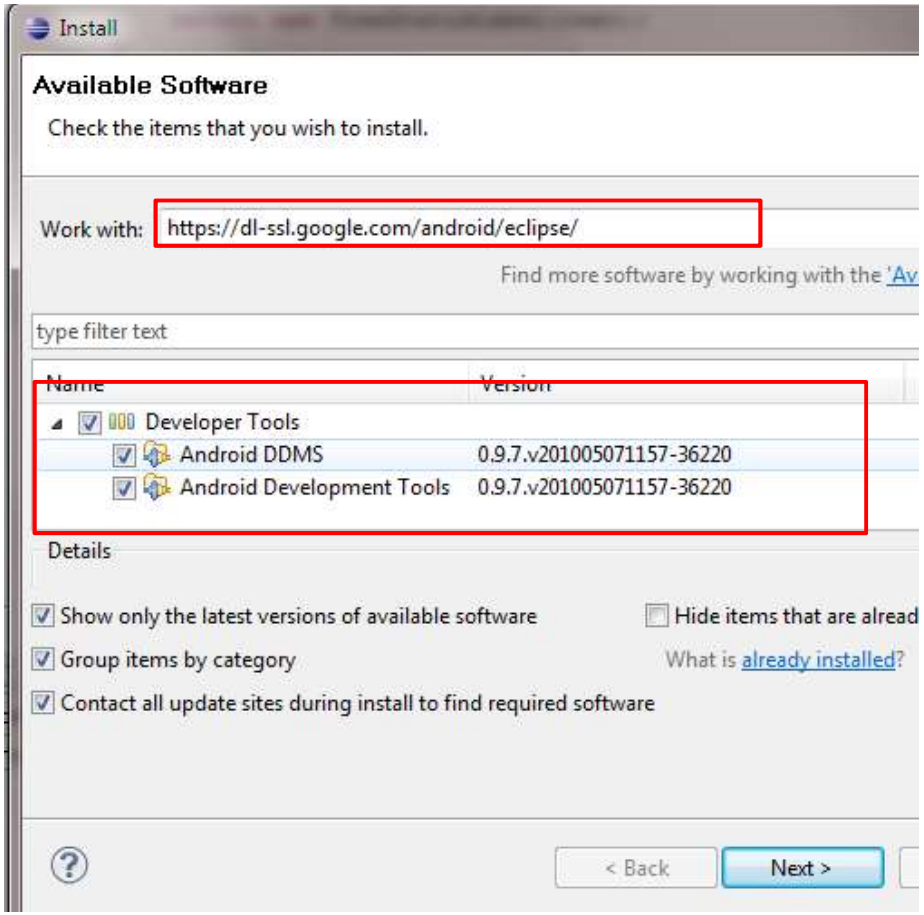
Setup Android SDK

- Download Android SDK and extract the zip file to an arbitrary folder
  - http://androidappdocs.appspot.com/sdk/index.html
  - E.g.: extract to C:\
  - The SDK will be used by ADT in eclipse

Platform	Package	Size	MD5 Checksum
Windows	android-sdk_r06-windows.zip	23293160 bytes	7c7fcec3c6b5c7c3df6ae654b27effb5
Mac OS X (intel)	android-sdk_r06-mac_86.zip	19108077 bytes	c92abf66a82c7a3f2b8493ebe025dd22
Linux (i386)	android-sdk_r06-linux_86.tgz	16971139 bytes	848371e4bf068dbb582b709f4e56d903

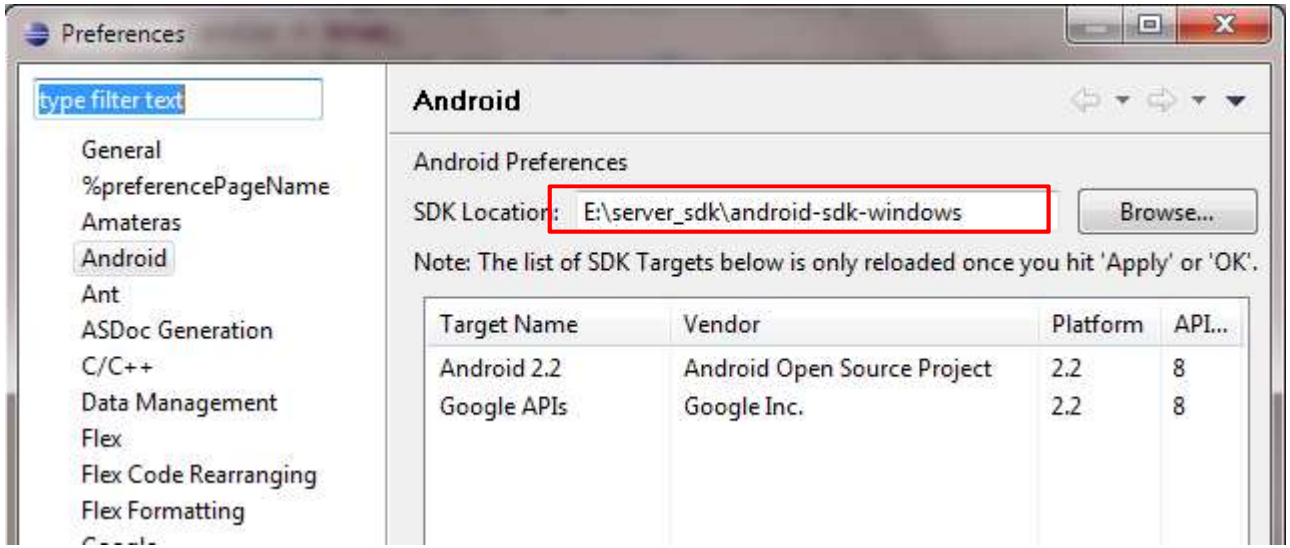
Setup ADT plugin

- Install Eclipse ADT plugin
  - Eclipse must be J2EE edition, 3.5 recommended
  - Update site: https://dl-ssl.google.com/android/eclipse/
  - Install all the plugins in the repository
  - Restart needed after installation



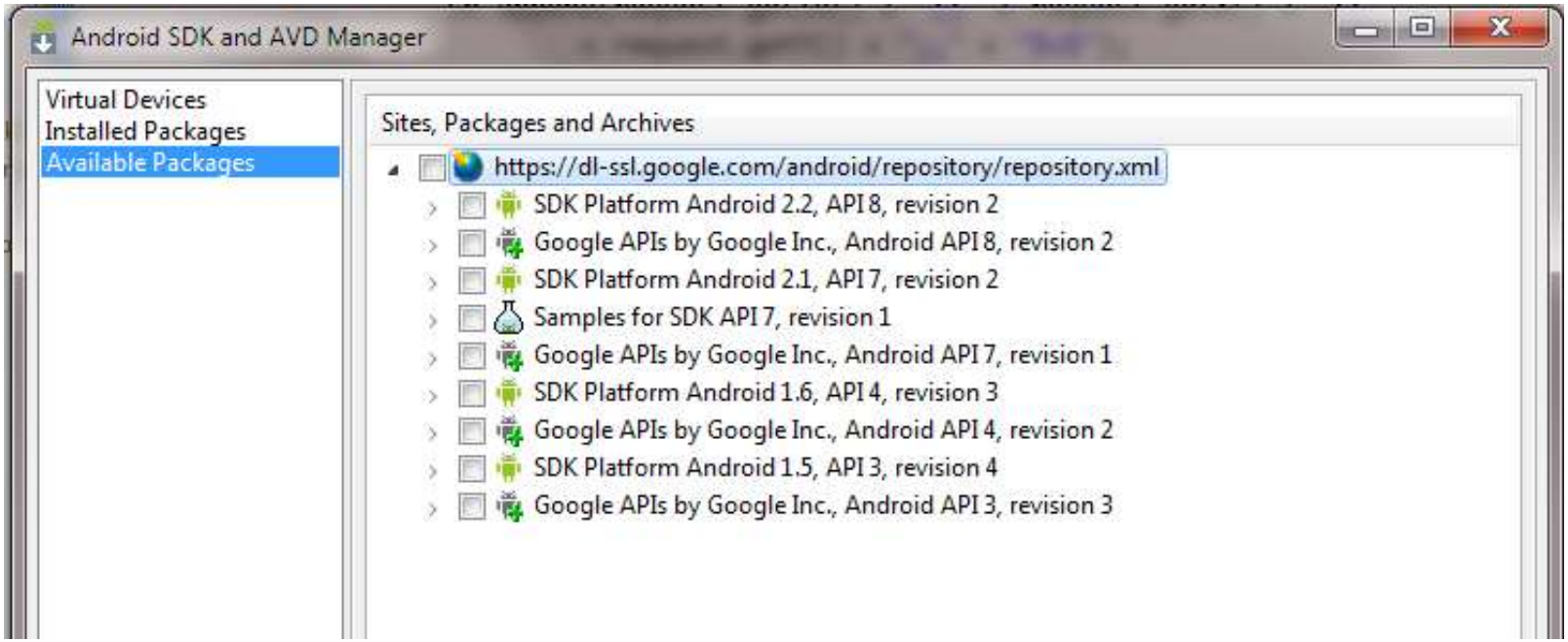
Configure ADT Plugin

- Open eclipse Window->Preferences, select Android
- Setup the SDK location as the folder where you extracted the downloaded SDK zip file



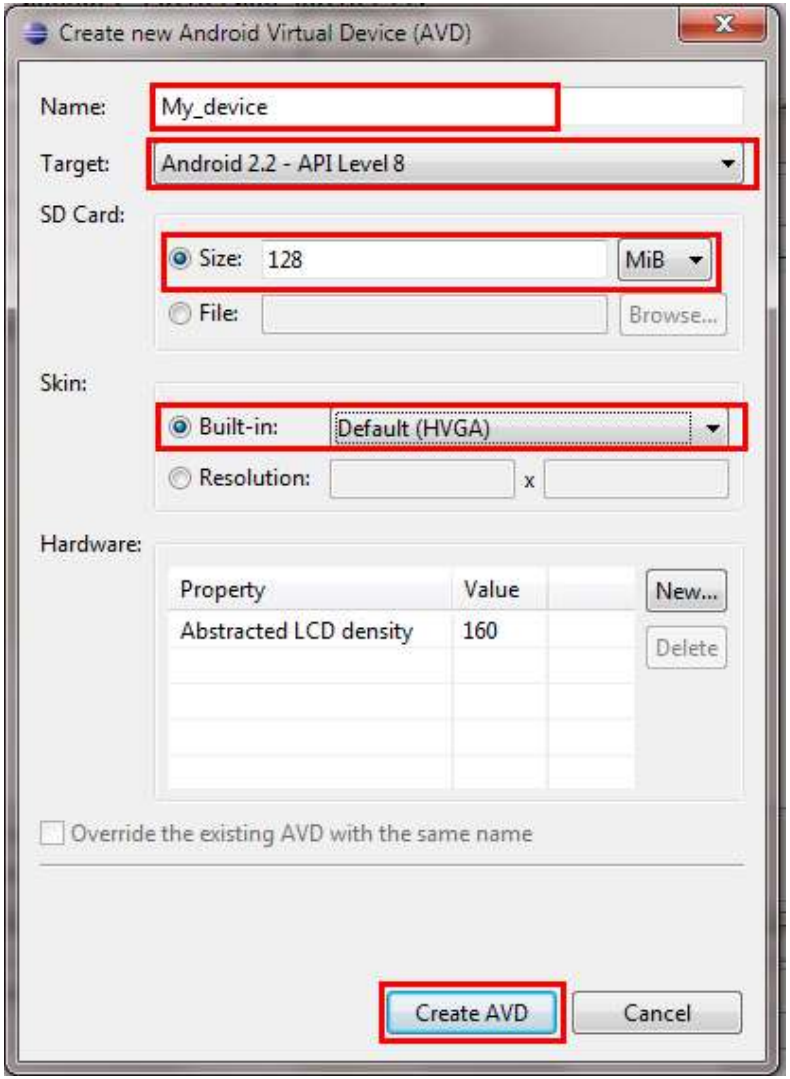
Setup SDK APIs

- Open Window->Android SDK and AVD Manager
- Click *Available Packages* and then choose proper APIs to install, the latest may be the best



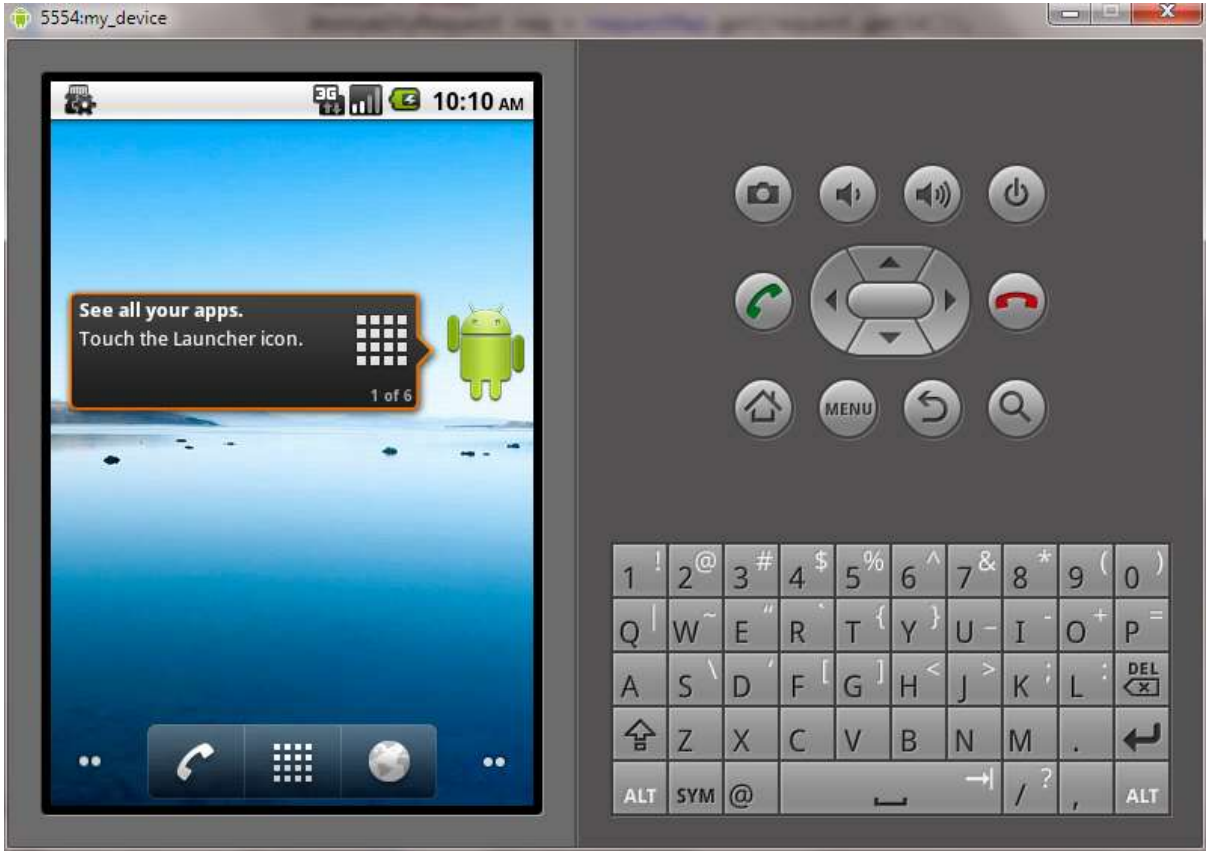
Setup Emulators

- After SDK APIs installation, click *Virtual Devices*
- Click *new, there will be a dialog*
  - input a name
  - choose a running target and a skin
  - specify the SD card size



Ready…

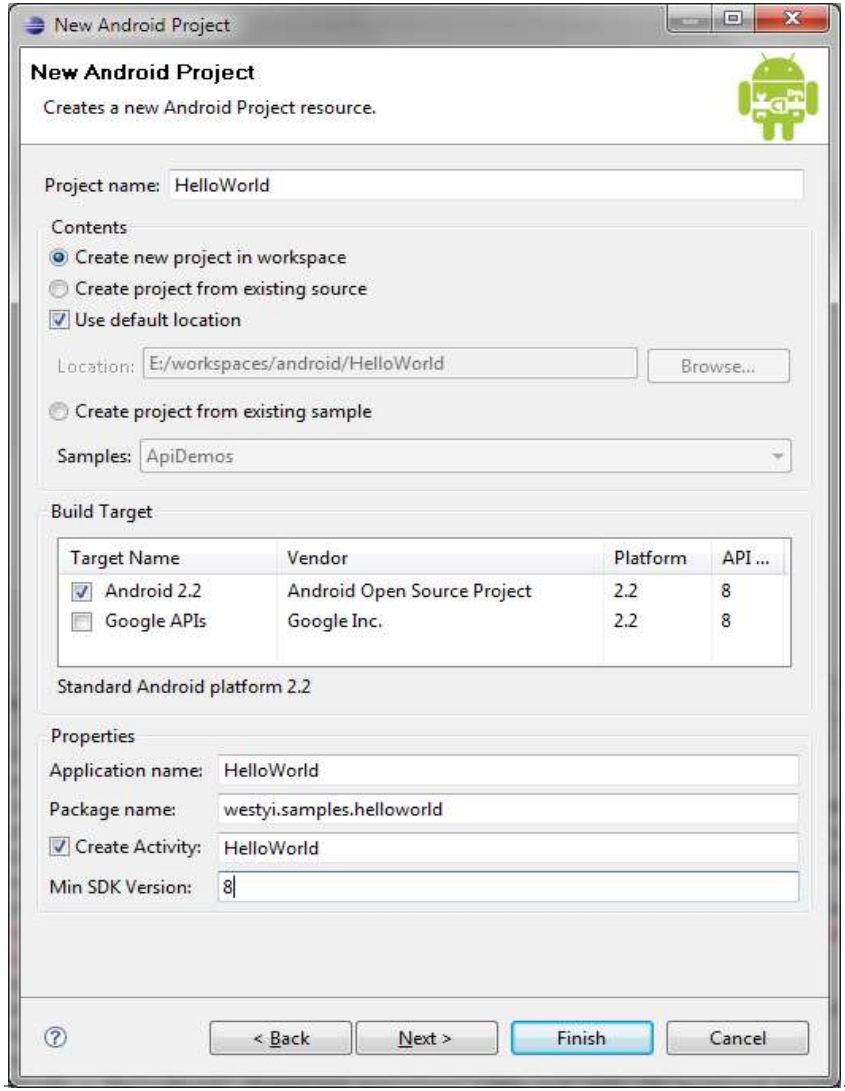
- Now you may start the AVD
  - Click start to start the new AVD
  - First start-up may take a very long time



‘Hello World’ on Android

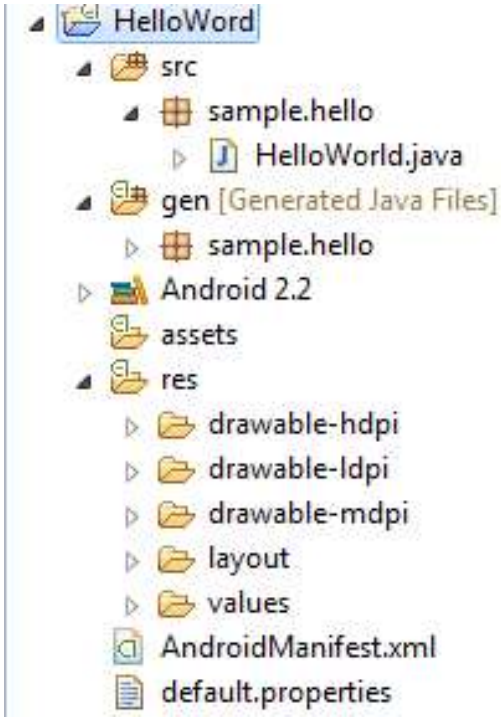
Create a new Android Project

- Open File->New->Android project
  - Project name
  - Build Target
  - Application name
  - Package name
  - Create Activity



Hello World Project

- src: source folder
- gen: SDK generated file
- android 2.2: reference lib
- assets: binary resources
- res: resource files and resource description files
- AndroidManifest.xml: application description file
- default.properties: project properties file



Say Hello World

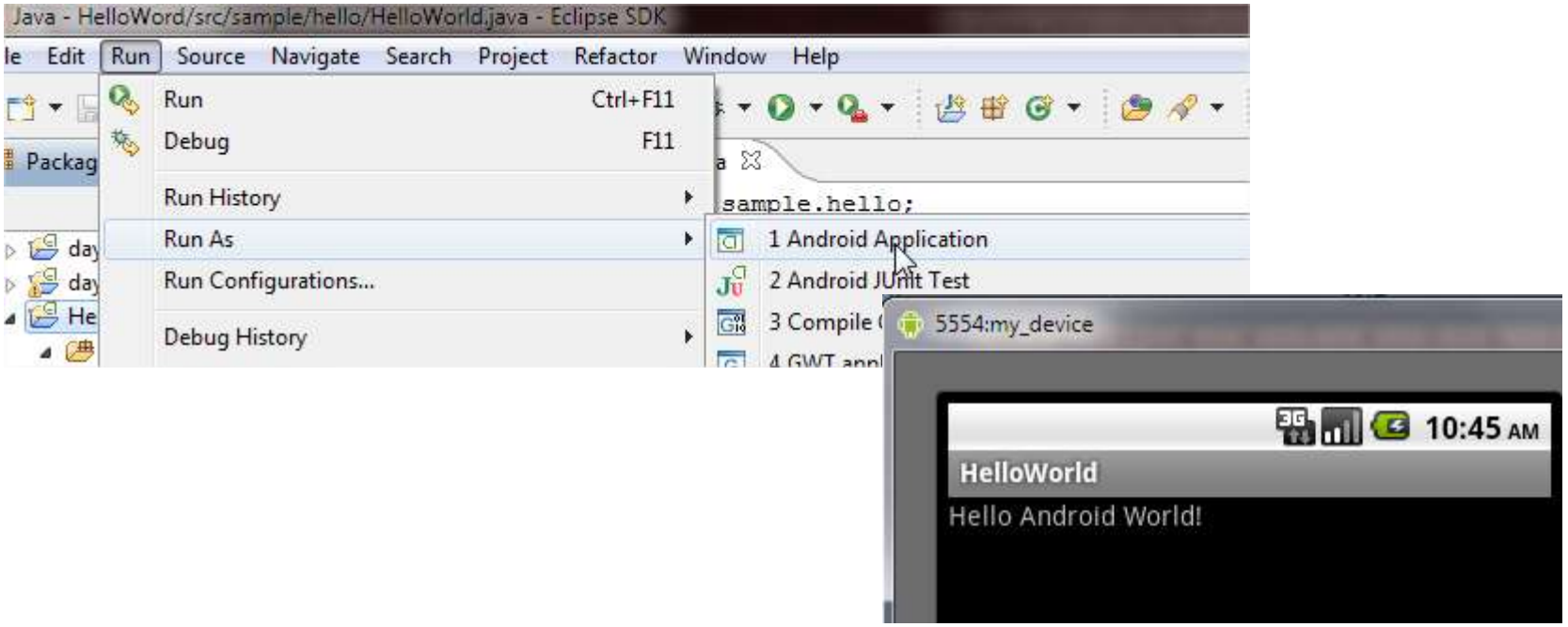
- modify HelloWorld.java

```
public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.main);
}
```

```
public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    TextView text = new TextView(this);
    text.setText("Hello Android World!");
    setContentView(text);
}
```

Run Hello World

- Select *HelloWorld* Project, Run->Run as->Android Application
- ADT will start a proper AVD and run HelloWorld app on it



Behind HelloWorld #1

- R.java, generated by Android SDK, represents all the resources of the app. resources are all in *res* folder
- resources are pre-compiled into binary format

```
/* AUTO-GENERATED FILE.  DO NOT MODIFY.
 *
 * This class was automatically generated by the
 * aapt tool from the resource data it found.  It
 * should not be modified by hand.
 */
package sample.hello;
public final class R {
    public static final class attr {
    }
    public static final class drawable {
        public static final int icon=0x7f020000;
    }
    public static final class layout {
        public static final int main=0x7f030000;
    }
    public static final class string {
        public static final int app_name=0x7f040001;
        public static final int hello=0x7f040000;
    }
}
```

Behind HelloWorld #2

- res/layout , contains layout declarations of the app, in XML format, UIs are built according to the layout file

main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout
    xmlns:android=http://schemas.android.com/apk/res/android
    android:orientation="vertical"
    android:layout_width="fill_parent"
    android:layout_height="fill_parent">
    <TextView android:layout_width="fill_parent"
        android:layout_height="wrap_content"
        android:text="@string/hello" />
</LinearLayout>
```

Linear Layout

TextView, display static text

A reference to String resource 'hello'

Behind HelloWorld #3

- res/values, contains string declarations or other values(e.g.:colors) of the app
  - string.xml, contains string resources

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
    <string name="hello">Hello World, HelloWorld!</string>
    <string name="app_name">HelloWorld</string>
</resources>
```

Behind HelloWorld #4

- res/drawable, contains all image resources
  - folders may have suffixes, app will choose the most suitable one, so do the other resources
  - three folders: drawable-ldpi, drawable-hdpi, drawable-mdpi, each contains an icon.png file
  - app will choose the proper icon according to the device DPI
  - reference name:@drawable/icon

- other folders we may use in future
  - menu, anim (animation), xml (preference and searchable)

Behind HelloWorld #5

- AndroidManifest.xml describe the application
  - declare app's name, version, icon, permission, etc…
  - declare the application's components: activity, service ,receiver or provider

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
package="sample.hello" android:versionCode="1" android:versionName="1.0">
<application android:icon="@drawable/icon" android:label="@string/app_name">
        <activity android:name=".HelloWorld" 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>
<uses-sdk android:minSdkVersion="8" />
</manifest>
```

Core Components-Activity #1

- Basically, An *activity* presents a **visual user interface** for one focused endeavor the user can undertake
- An application might consist of just one activity or several, each Activity is derived from `android.app.Activity` and should be declared in AndroidManifest.xml file
- Each activity is given a default window to draw in, the window may be full screen or smaller and on top of other window
- The visual content of the window is provided by a hierarchy of views — objects derived from the base View class
- Activity.setContentView() method is used to set a certain hierarchy of view objects

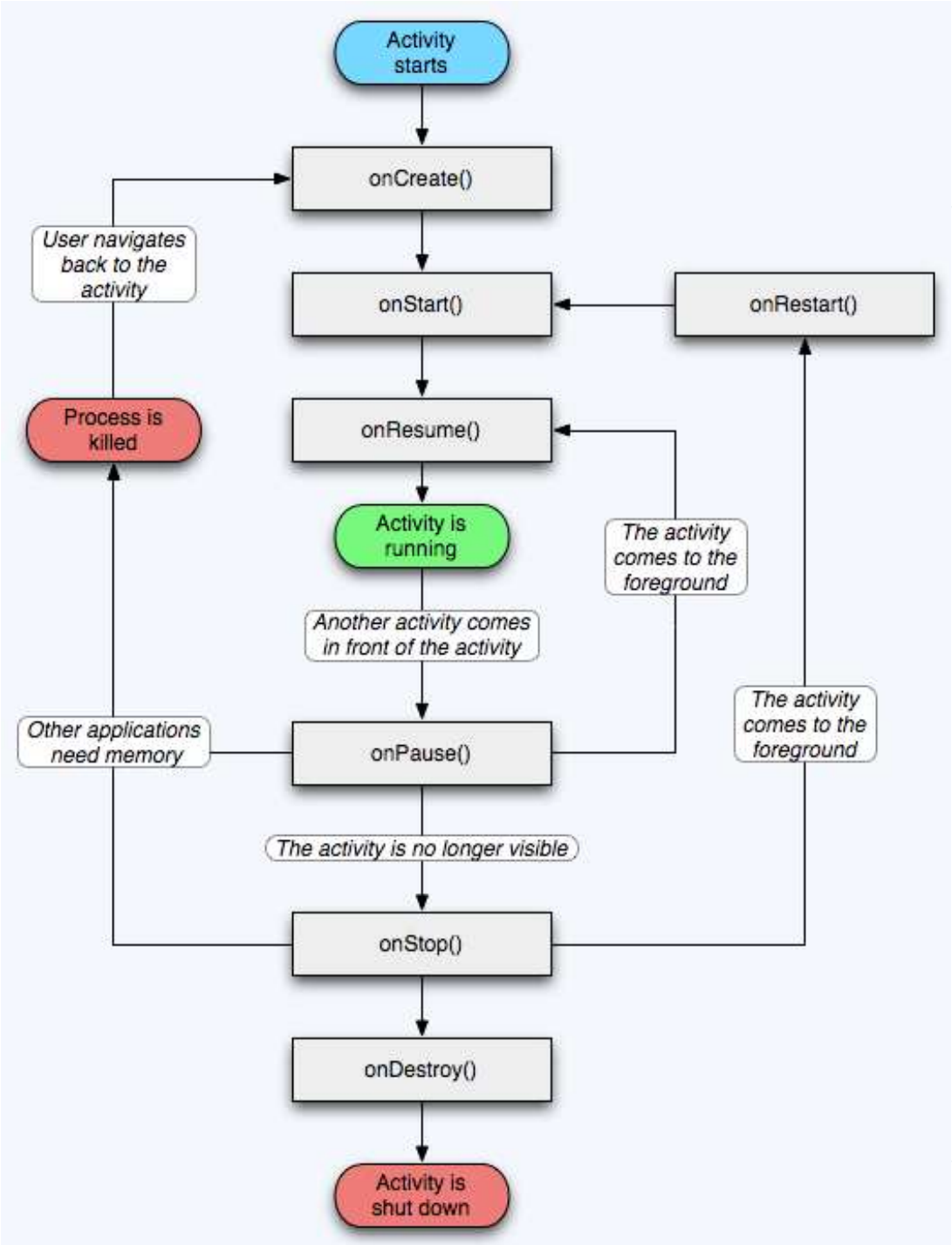
Core Components-Activity #2

- Activities are activated by asynchronous messages called *intents*
  - An intent is an Intent object that holds the content of the message
  - The action being requested or the URI of the data to act on
- The <intent-filter> label in AndroidManifest.xml file specifies the Intent that can start the Activity

```
<action android:name="android.intent.action.MAIN" />
<category android:name="android.intent.category.LAUNCHER" />
```

  - declares the main activity, it will be started automatically when the app starts
- An activity is launched (or given something new to do) by passing an Intent object to Context.startActivity() or Activity.startActivityForResult()

Activity lifecycle



Other Core Components

- Service
  - A *service* doesn't have a visual user interface, runs in the background for a period of time
- Broadcast receivers
  - a component that does nothing but receive and react to broadcast announcements
- Content providers
  - A *content provider* makes a specific set of the application's data available to other applications.
  - The data can be stored in the file system, in an SQLite database, or in any other manner that makes sense

Beyond HelloWorld #1

- Build up an app that you can input your greetings and display your greetings
  - Input: EditText
  - Display: TextView
  - Of course, we have to add an button
- Edit res/layout/main.xml file to add these components
  - each has an android:id property, used to reference it in code

```
<EditText android:text="" android:id="@+id/editText"
    android:layout_width="fill_parent" android:layout_height="wrap_content"></EditText>
<Button android:text="Show Greetings" android:id="@+id/showBtn"
    android:layout_width="wrap_content" android:layout_height="wrap_content"></Button>
<TextView android:layout_width="fill_parent" android:id="@+id/textView"
    android:layout_height="wrap_content" android:text="@string/hello" />
```

Beyond HelloWorld #2

- modify HelloWorld.java
  - firstly get the references declared in main.xml

```
setContentView(R.layout.main);

final EditText edit = (EditText) findViewById(R.id.editText);
final TextView view = (TextView) findViewById(R.id.textView);
final Button btn = (Button)findViewById(R.id.showBtn);
```

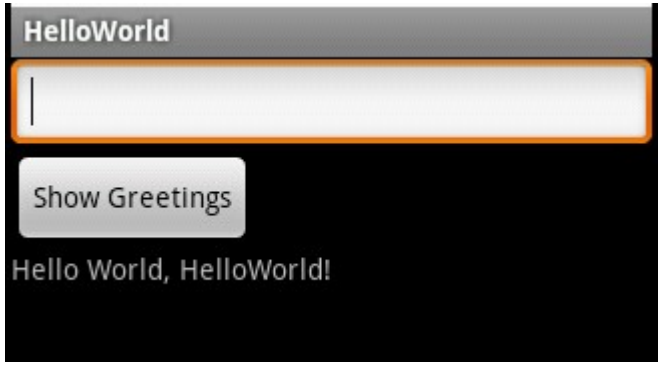
  - then add event response for Button

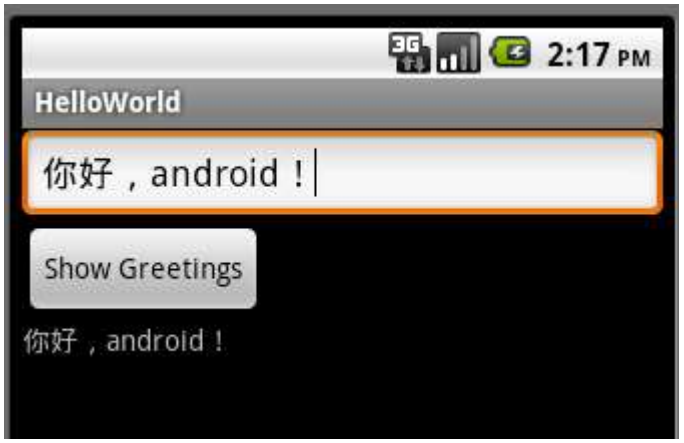
```
btn.setOnClickListener(new OnClickListener(){

    @Override
    public void onClick(View arg0) {
        view.setText(edit.getText());
    }
});
```

Beyond HelloWorld #3

- Finished!
- Run->Run as->Android Application





- Quite easy, isn't it?

More…

Useful Materials

Android Official Site

- http://www.android.com

Android SDK, Tutorial, Concepts and API docs

- http://androidappdocs.appspot.com/index.html

Android Development Community

- http://www.anddev.org/

30 Days Android Apps Development

- http://bakhtiyor.com/category/30-days-of-android-apps/

Thank U so much!