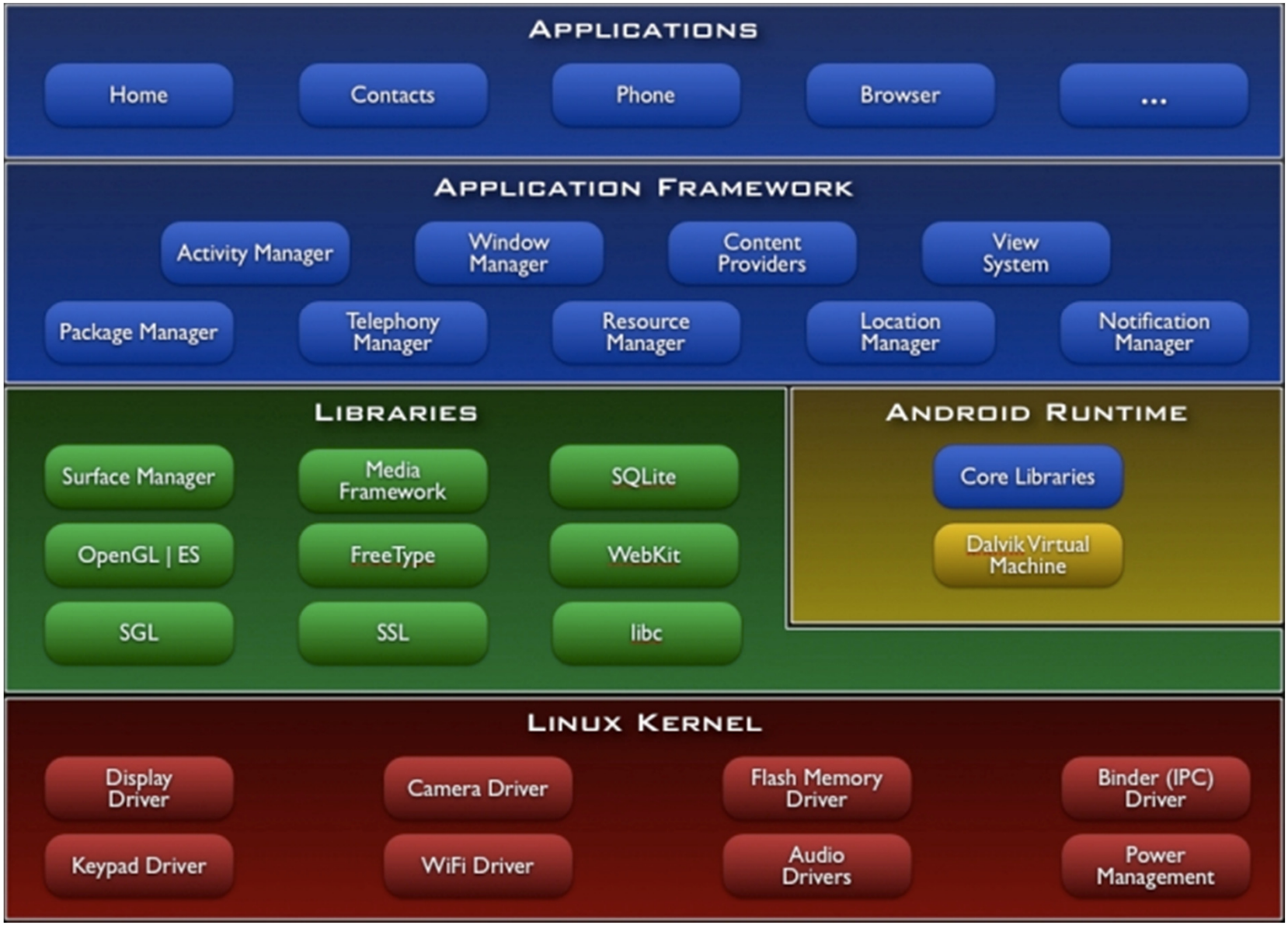
# CS378 - Mobile Computing

## Android Overview and Android Development Environment

# What is Android?

- A software stack for mobile devices that includes
  - An operating system
  - Middleware
  - Key Applications
- Uses Linux to provide core system services
  - Security
  - Memory management
  - Process management
  - Power management
  - Hardware drivers




http://developer.android.com/guide/basics/what-is-android.html

# Android Features

- **Application framework** enabling reuse and replacement of components
- **Dalvik virtual machine** optimized for mobile devices
- **Integrated browser** based on the open source WebKit engine
- **Optimized graphics** powered by a custom 2D graphics library; 3D graphics based on the OpenGL ES 1.0 specification (hardware acceleration optional)
- **SQLite** for structured data storage
- **Media support** for common audio, video, and still image formats (MPEG4, H.264, MP3, AAC, AMR, JPG, PNG, GIF)
- **GSM Telephony** (hardware dependent)
- **Bluetooth, EDGE, 3G, and WiFi** (hardware dependent)
- **Camera, GPS, compass, and accelerometer** (hardware dependent)
- **Rich development environment** including a device emulator, tools for debugging, memory and performance profiling, and a plugin for the Eclipse IDE

http://developer.android.com/guide/basics/what-is-android.html

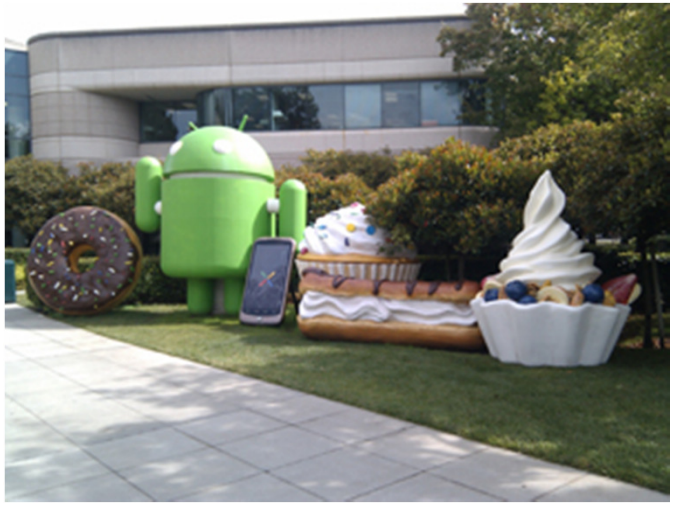
# A Short History Of Android

- 2001 Palm Kyocera 6035, combing PDA and phone
- 2003 - Blackberry smartphone released
- 2005
  - Google acquires startup Android Inc. to start Android platform.
  - Work on Dalvik VM begins
- 2007
  - Open Handset Alliance announced
  - Early look at SDK
  - June, iPhone released
- 2008
  - Google sponsors 1st Android Developer Challenge
  - T-Mobile G1 announced, released fall
  - SDK 1.0 released
  - Android released open source (Apache License)
  - Android Dev Phone 1 released

Pro Android by Hashimi & Komatineni (2009)

# Short History cont.

- 2009
  - SDK 1.5 (Cupcake)
    - New soft keyboard with “autocomplete” feature
  - SDK 1.6 (Donut)
    - Support Wide VGA
  - SDK 2.0/2.0.1/2.1 (Eclair)
    - Revamped UI, browser
- 2010
  - Nexus One released to the public
  - SDK 2.2 (Froyo)
    - Flash support, tethering
  - SDK 2.3 (Gingerbread)
    - UI update, system-wide copy-paste



# Short History cont.

- 2011
  - SDK 3.0 (Honeycomb) for tablets only
    - New UI for tablets, support multi-core processors, fragments
  - SDK 3.1 and 3.2
    - Hardware support and UI improvements
  - SDK 4.0 (Ice Cream Sandwich)
    - For Q4, combination of Gingerbread Honeycomb

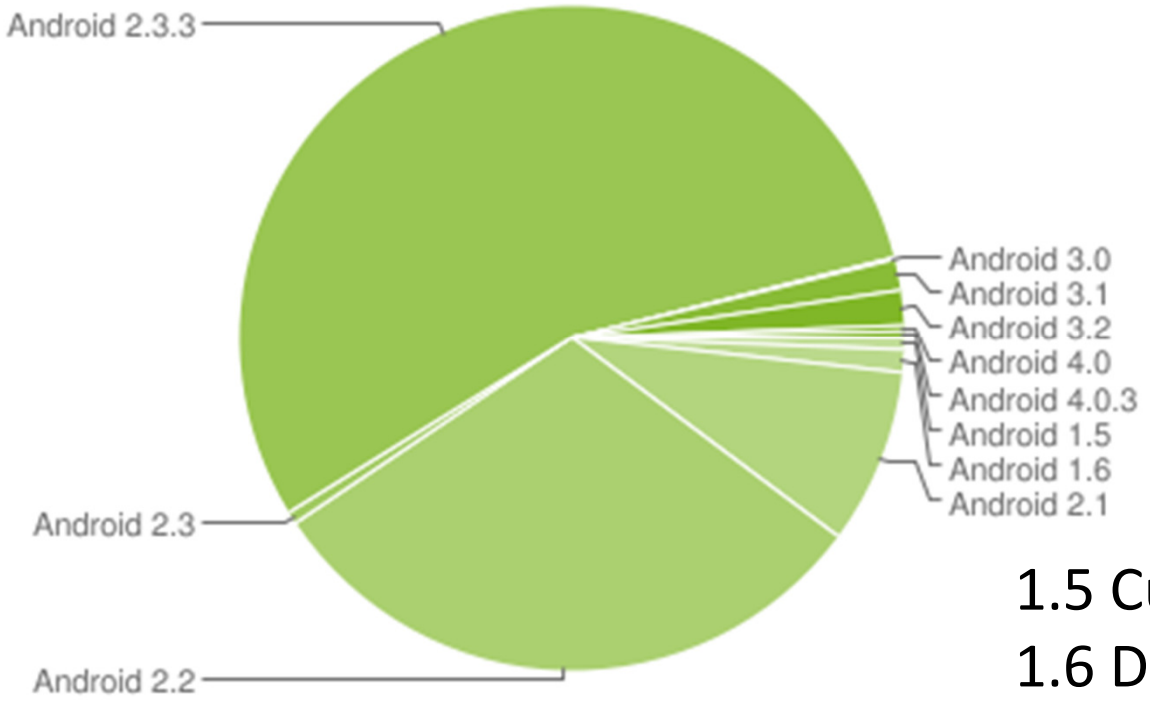
# Short History cont.

- 2012
  - Android 4.1, "Jelly Bean" announced late June 2012

**Top Smartphone Platforms**
**3 Month Avg. Ending May 2012 vs. 3 Month Avg. Ending Feb. 2012**
**Total U.S. Smartphone Subscribers Ages 13+**
**Source: comScore MobiLens**

| | Share (%) of Smartphone Subscribers | | |
|---|---|---|---|
| | Feb-12 | May-12 | Point Change |
| *Total Smartphone Subscribers* | *100.0%* | *100.0%* | *N/A* |
| Google | 50.1% | 50.9% | 0.8 |
| Apple | 30.2% | 31.9% | 1.7 |
| RIM | 13.4% | 11.4% | -2.0 |
| Microsoft | 3.9% | 4.0% | 0.1 |
| Symbian | 1.5% | 1.1% | -0.4 |

# Device Distribution Jan 2012




- Based on active devices
- Forward compatible
- Not necessarily backward compatible

1.5 Cupcake: 0.6%
1.6 Donut: 1.1%
2.1 Ecliar 8.5%
2.2 Froyo 30.4%
2.3 Gingerbread: 56%
3.X Honeycomb 3.3%
4.x Ice Cream Sand. 0.6%

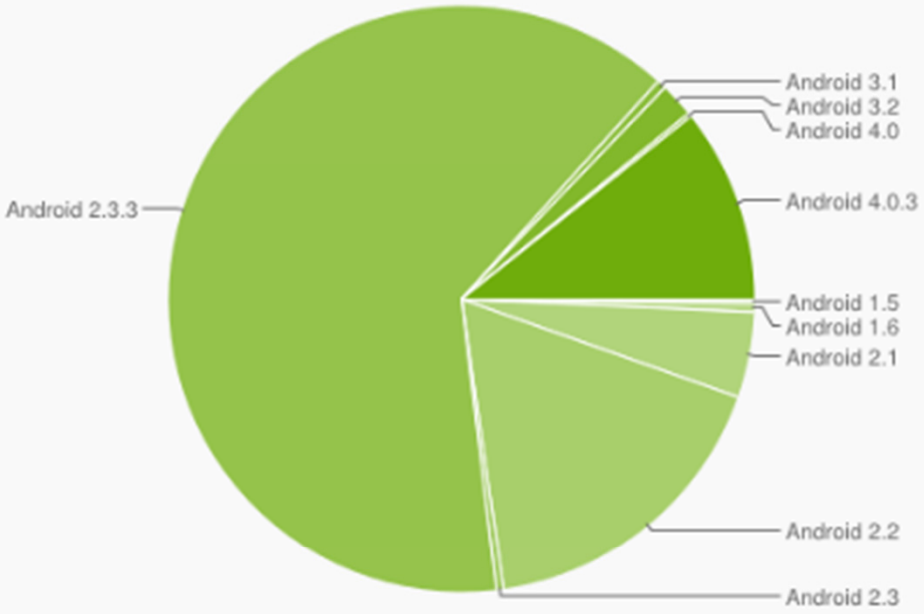
http://developer.android.com/resources/dashboard/platform-versions.html

# Device Distribution July 2012

## Current Distribution

The following pie chart and table is based on the number of Android devices that have accessed Google Play within a 14-day period ending on the data collection date noted below.

| Version | Codename | API Level | Distribution |
|---|---|---|---|
| 1.5 | Cupcake | 3 | 0.2% |
| 1.6 | Donut | 4 | 0.5% |
| 2.1 | Eclair | 7 | 4.7% |
| 2.2 | Froyo | 8 | 17.3% |
| 2.3 - 2.3.2 | Gingerbread | 9 | 0.4% |
| 2.3.3 - 2.3.7 | | 10 | 63.6% |
| 3.1 | Honeycomb | 12 | 0.5% |
| 3.2 | | 13 | 1.9% |
| 4.0 - 4.0.2 | Ice Cream Sandwich | 14 | 0.2% |
| 4.0.3 - 4.0.4 | | 15 | 10.7% |

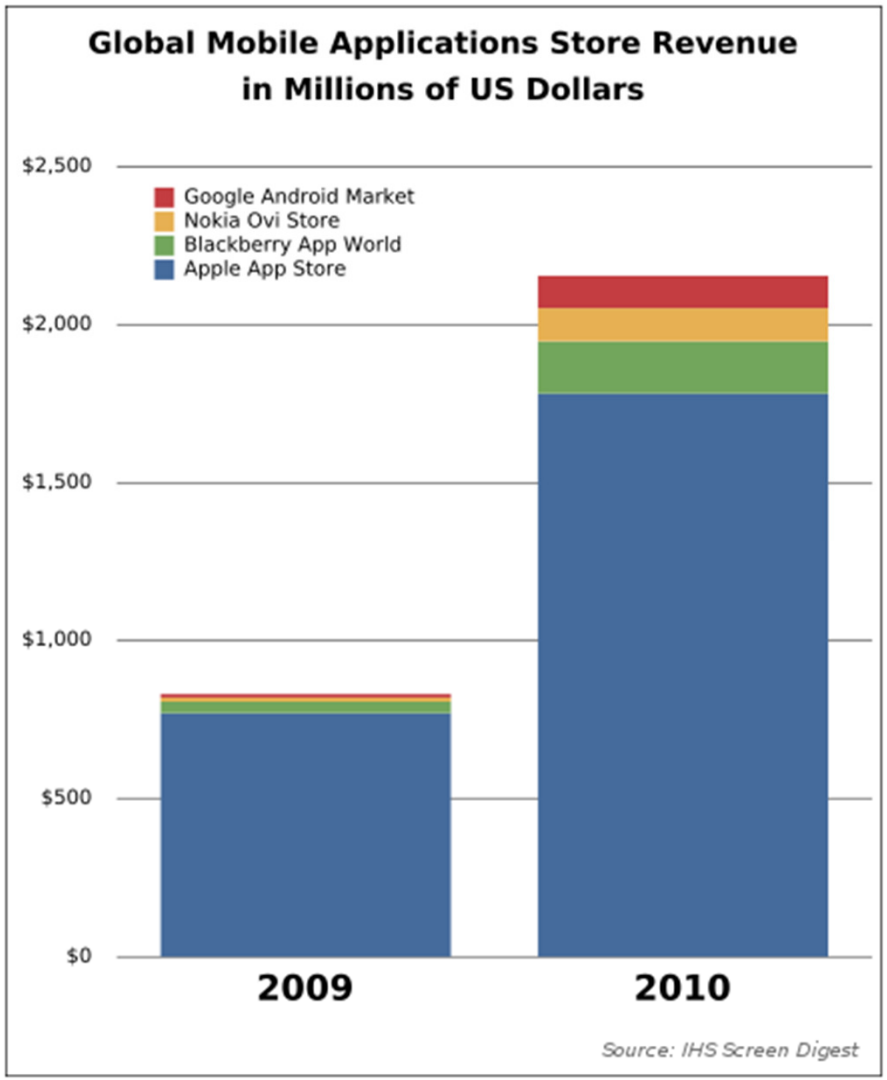


# Devices and Apps

- Estimated 400M activated devices (100M a year ago)
- 1M new activations per day
- Google Play (formerly Android Market)
  - ~600,000 apps, June 2012
  - 2/3 free, 1/3 paid
  - Apple App Store, ~650,000 apps June 2012
- What's old is new - Mac vs. PC
  iPhone vs. Android???

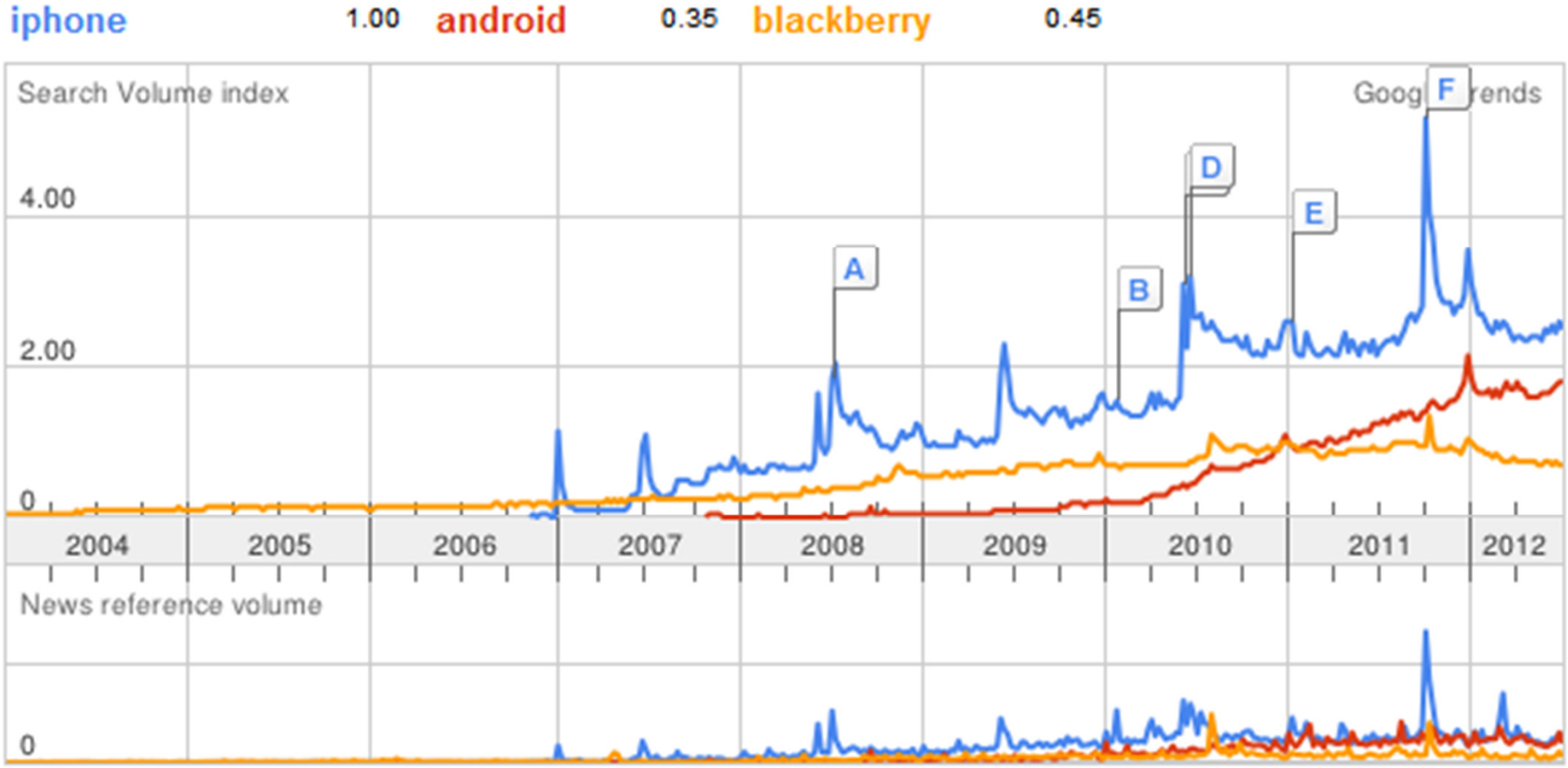
# iPhone vs. Android

# Developer Revenues




- Business Strategy: attract developers with comparison of revenue generated by applications, average revenue per user, which platform first

# Search Trends

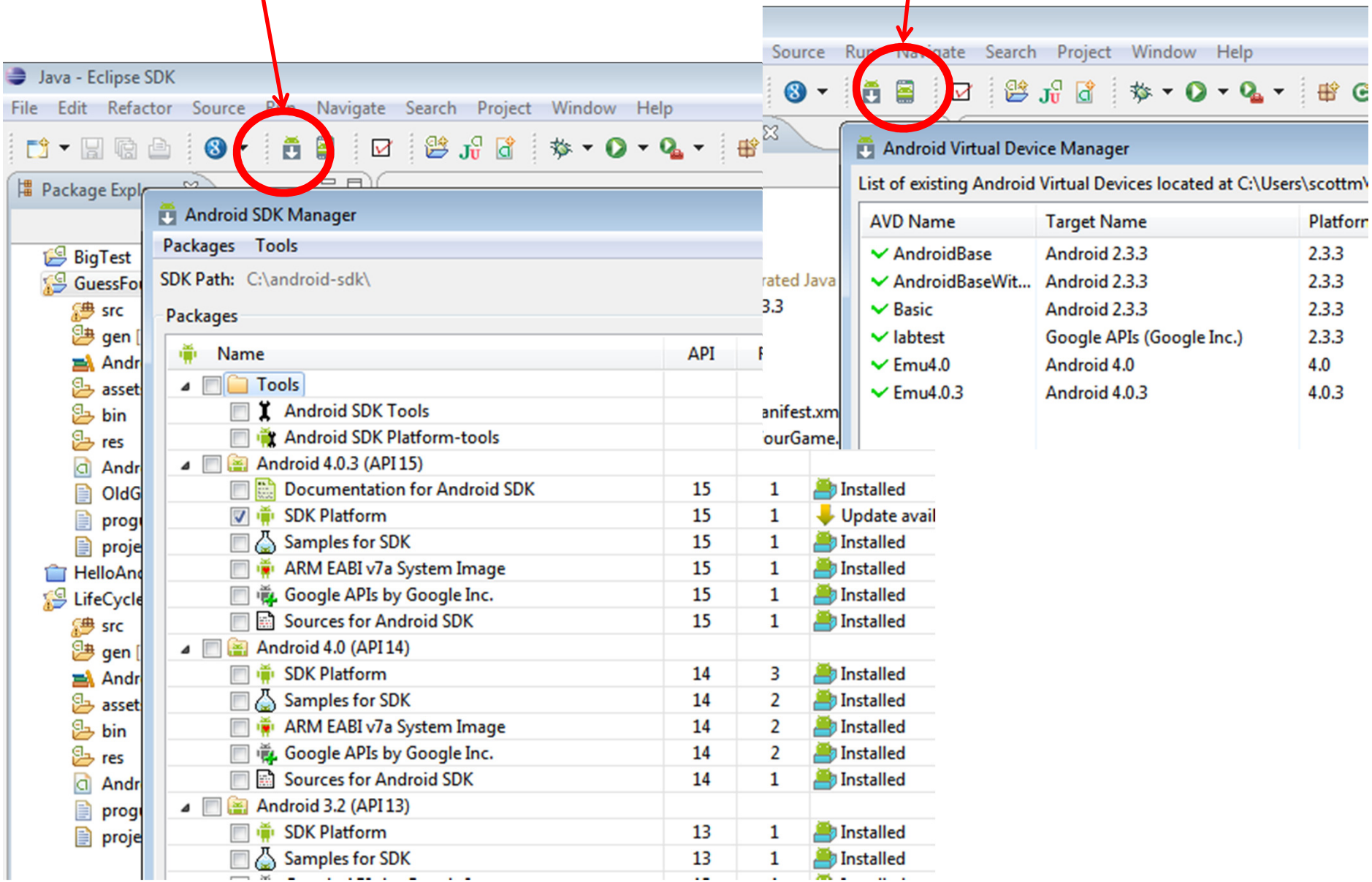


# Setup Development Environment

- Install JDK 5, 6, or 7
- Install Eclipse IDE (version 3.7 - Indigo)
  - recommended "Eclipse Classic"
- Download and unpack the Android SDK
- Install Android Development Tools (ADT) plugin for Eclipse
- Detailed install instructions available on Android site
  http://developer.android.com/sdk/installing.html

SDK Manager

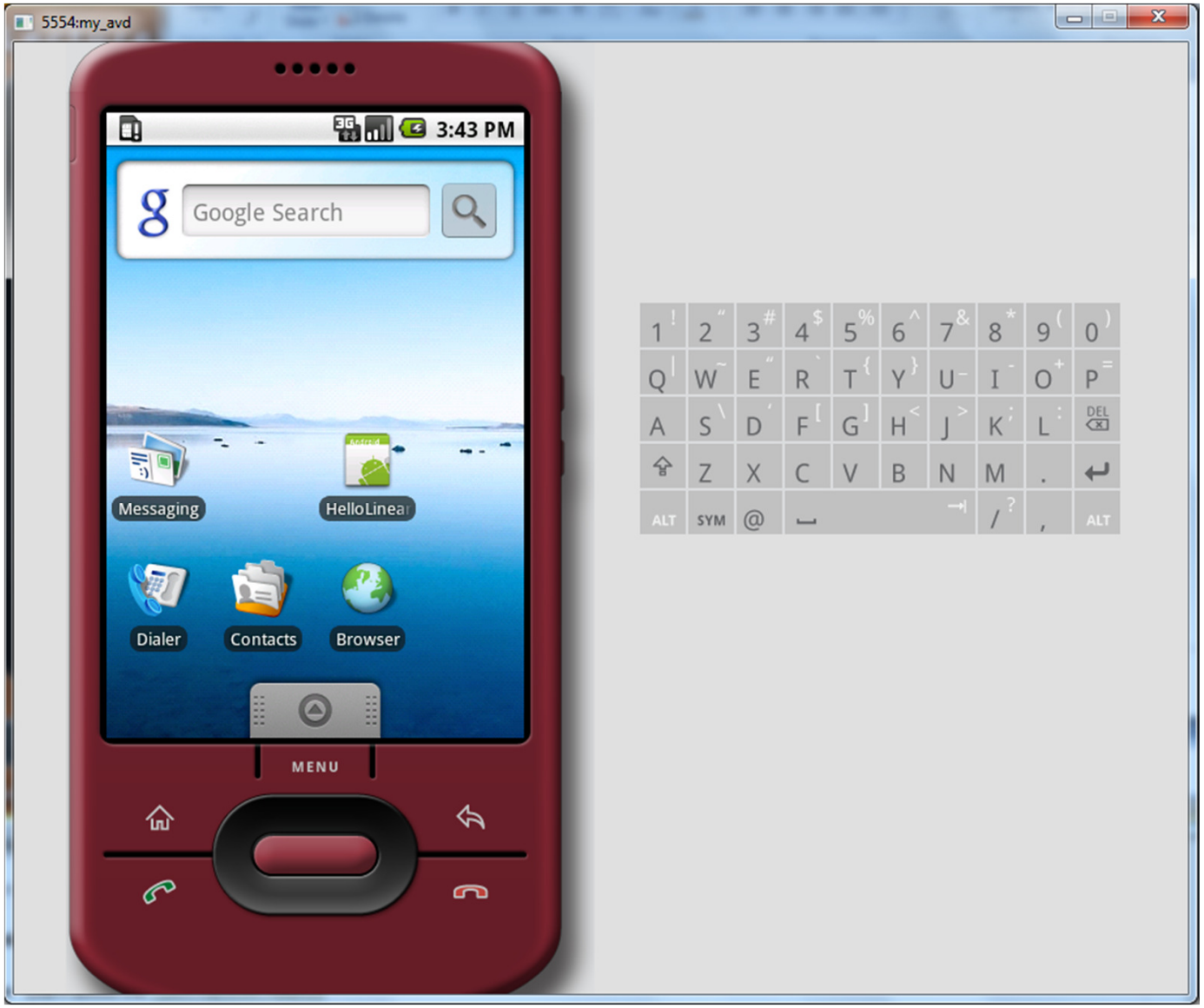
AVD Manager



# Android Emulator or AVD

- Emulator is essential to testing app but is not a substitute for a real device
- Emulators are called **Android Virtual Devices** (AVDs)
- Android SDK and AVD Manager allows you to create AVDs that target any Android API level
- AVD have configurable resolutions, RAM, SD cards, skins, and other hardware

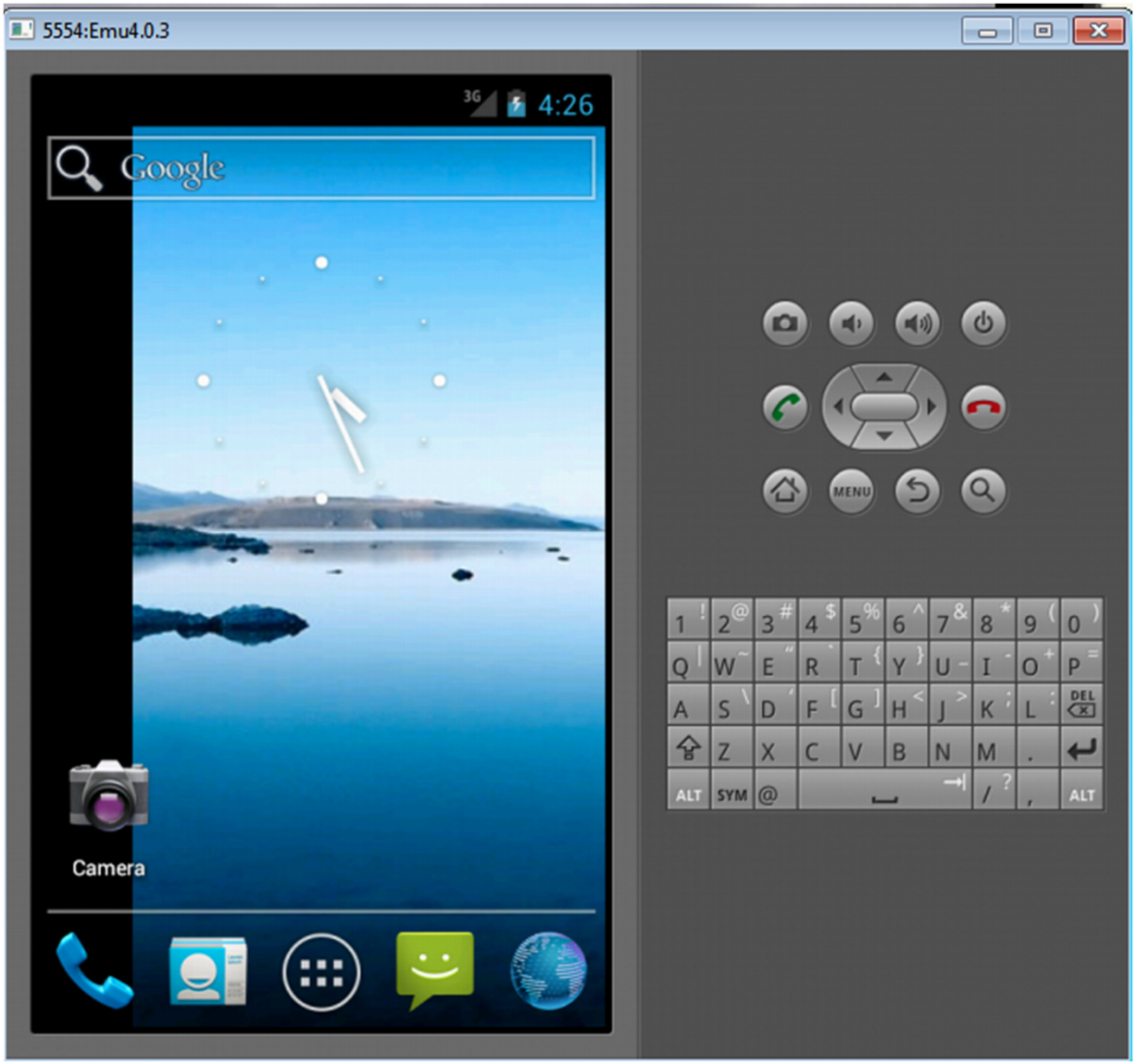
# Android Emulator: 1.6



# Android Emulator: 2.2

# Android Emulator: 3.0

# Android Emulator: 4.0



# Emulator Basics

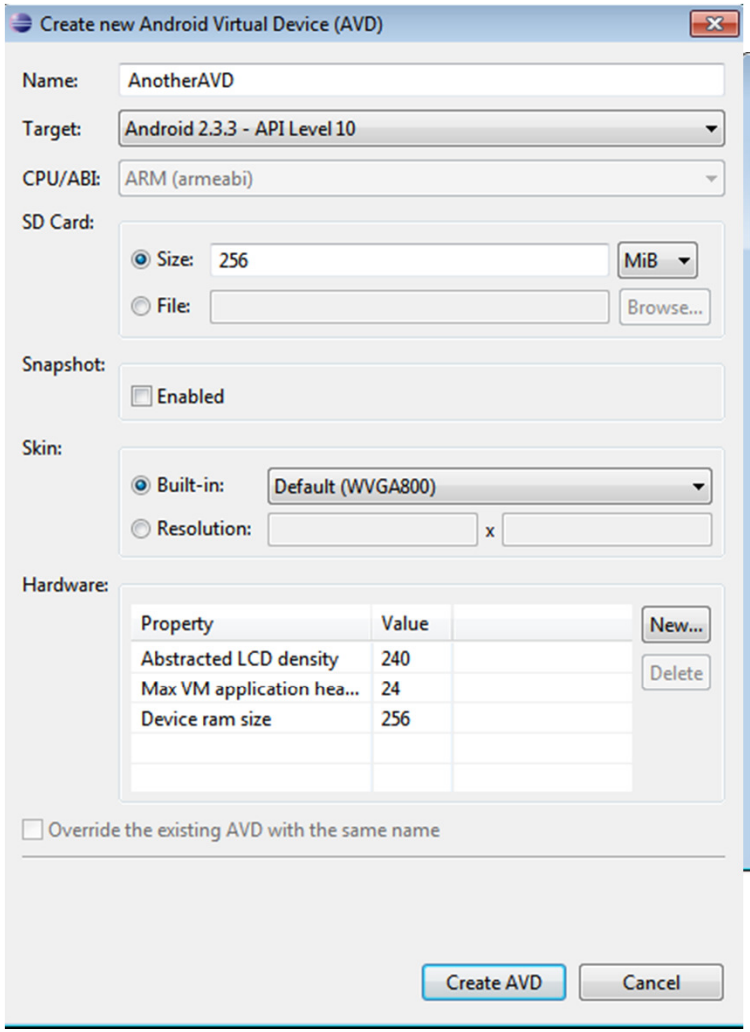
- Host computer's keyboard works
- Host's mouse works like finger
- Uses host's Internet connection
- Other buttons work: Home, Menu, Back, Search, volume up and down, etc.
- Ctrl-F11 toggle landscape → portrait
- Alt-Enter toggle full-screen mode
- More info at http://developer.android.com/guide/developing/devices/emulator.html

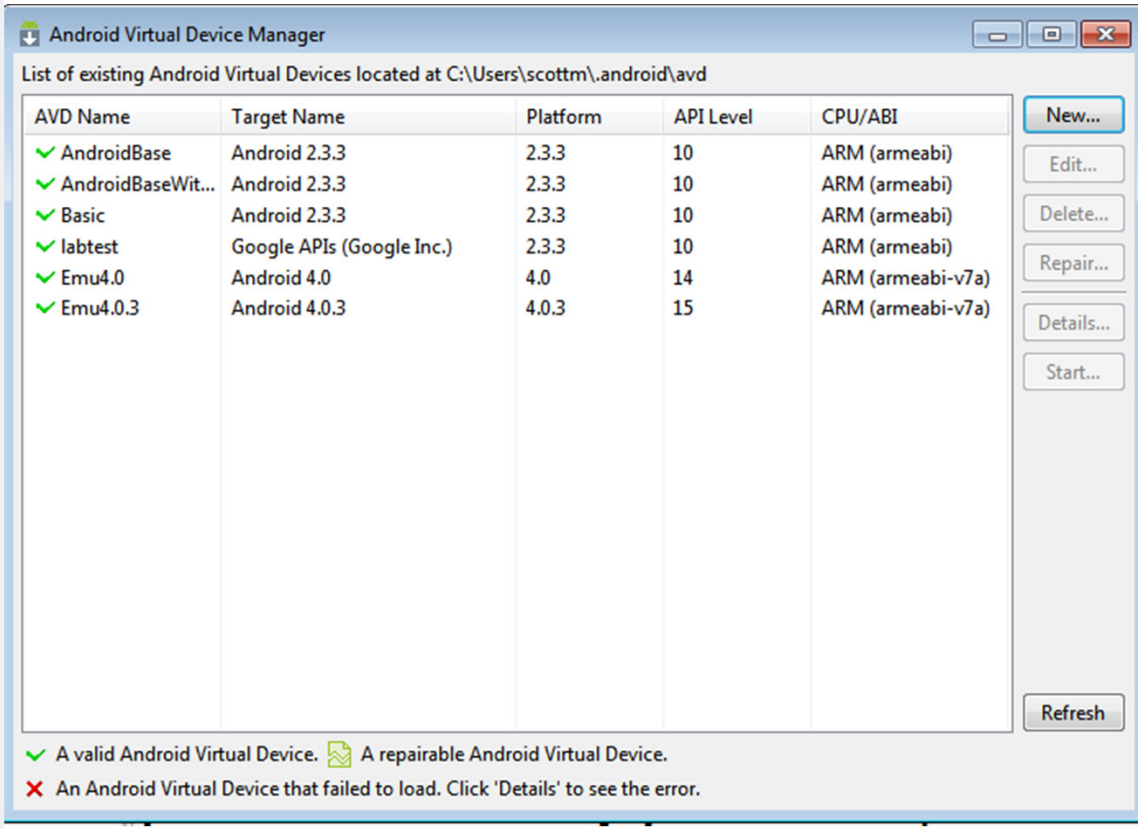
# Emulator Limitations

- No support for placing or receiving actual phone calls
  - Simulate phone calls (placed and received) through the emulator console
- No support for USB connections
- No support for camera/video capture (input)
- No support for device-attached headphones
- No support for determining connected state
- No support for determining battery charge level and AC charging state
- No support for determining SD card insert/eject
- No support for Bluetooth
- No support for simulating the accelerometer
  - Use OpenIntents's Sensor Simulator

That's why we need the dev phone!

# Create an AVD using AVD Manager




or use the command line

http://developer.android.com/guide/developing/devices/managing-avds-cmdline.html

# Android Runtime: Dalvik VM

- Subset of Java developed by Google
- Optimized for mobile devices (better memory management, battery utilization, etc.)
- Dalvik runs .dex files that are compiled from .class files
- Introduces new libraries
- Does not support some Java libraries like AWT, Swing
- http://developer.android.com/reference/packages.html

# Or From the Command Line

C:\android-sdk-windows\tools>**android create avd -n MyDevice -t android-8**
Android 2.2 is a basic Android platform.
Do you wish to create a custom hardware profile [no]
Created AVD 'MyDevice2' based on Android 2.2,
with the following hardware config:
hw.lcd.density=240
vm.heapSize=24

Device name

Target platform

C:\android-sdk-windows\tools>**emulator -avd MyDevice**

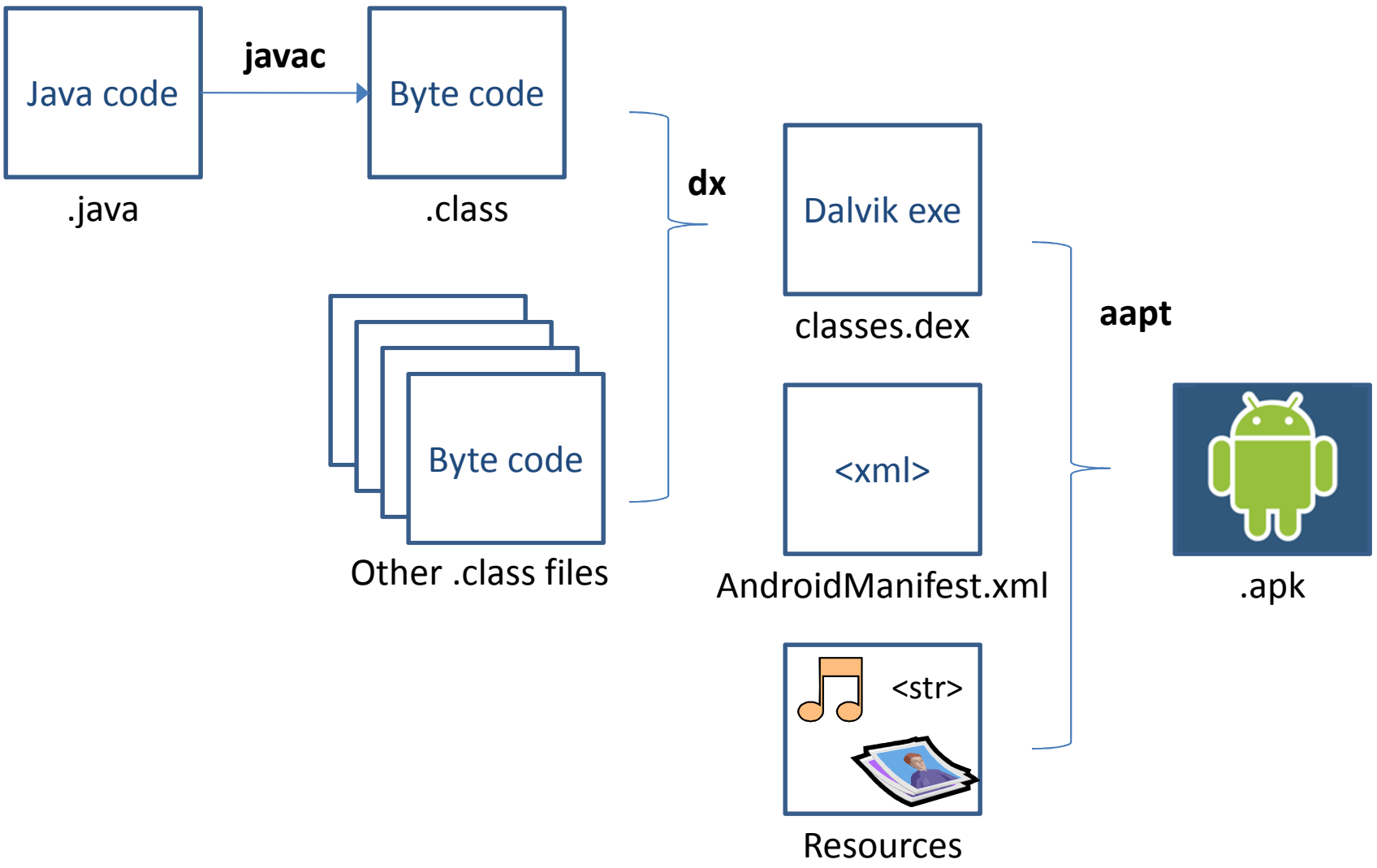
Launch device

More info:
http://developer.android.com/guide/developing/devices/managing-avds-cmdline.html

# Applications Are Boxed

- By default, each app is run in its own Linux process
  - Process started when app's code needs to be executed
  - Threads can be started to handle time-consuming operations
- Each process has its own Dalvik VM
- By default, each app is assigned unique Linux ID
  - Permissions are set so app's files are only visible to that app

# Producing an Android App



# Other Dev Tools

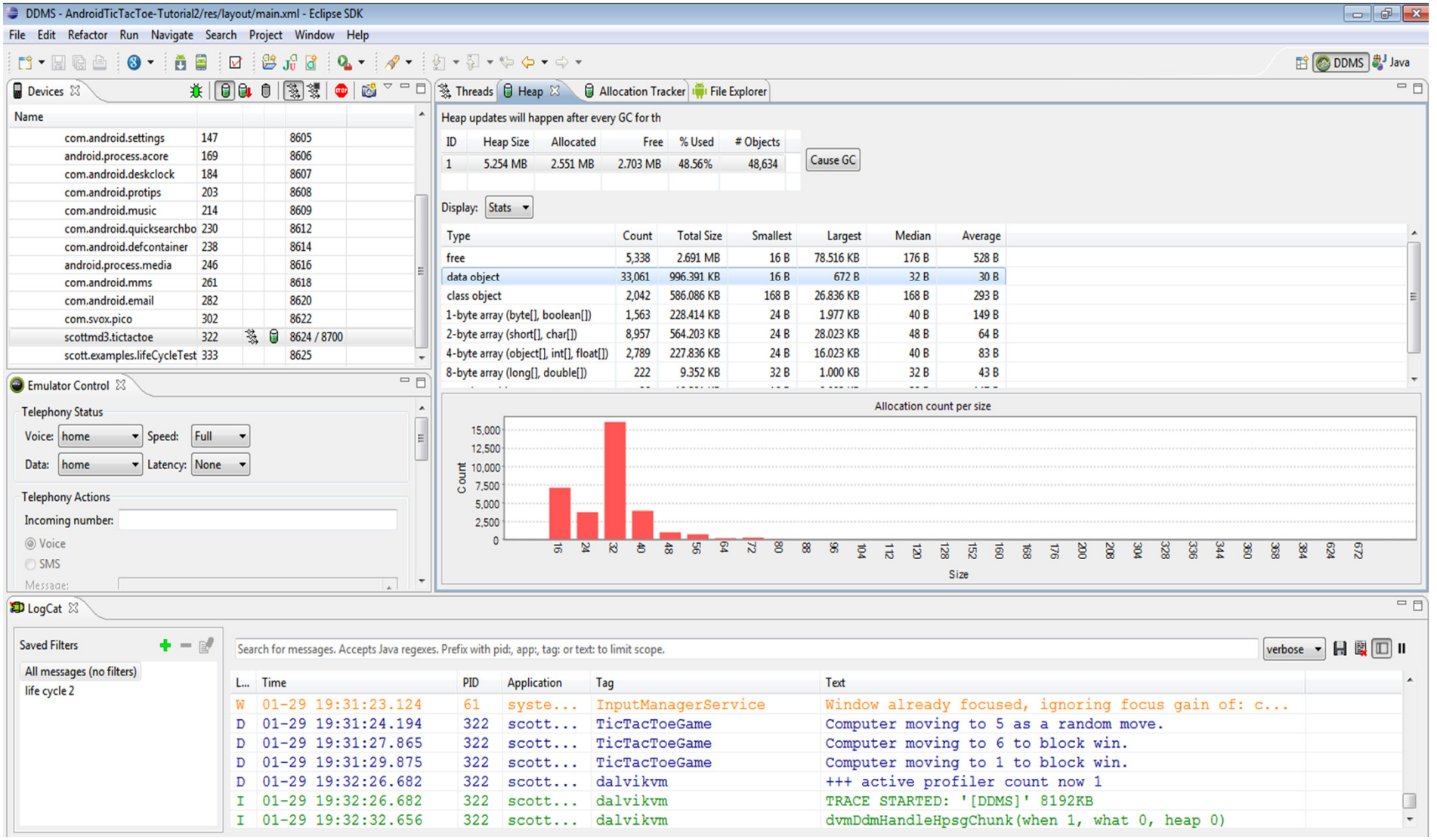
- Android Debug Bridge
- Part of SDK
- command line tool to communicate with an emulator or connected Android device
  - check devices attached / running
  - install apk's, **A**ndroid **P**ac**K**age files, "executables", can find samples on places besides Android Market (security?)
  - and more!

http://developer.android.com/guide/developing/tools/adb.html

# Dalvik Debug Monitor Server

- DDMS
- debugging tool
- "provides, screen capture on the device, thread and heap information on the device, logcat, process, and radio state information, incoming call and SMS spoofing, location data spoofing, and more."
- can interact with DDMS via Eclipse plugin, another view in Eclipse

# DDMS


DDMS - AndroidTicTacToe-Tutorial2/res/layout/main.xml - Eclipse SDK
File Edit Refactor Run Navigate Search Project Window Help
DDMS
Java
Devices
Name
com.android.settings 147 8605
android.process.acore 169 8606
com.android.deskclock 184 8607
com.android.protips 203 8608
com.android.music 214 8609
com.android.quicksearchbo 230 8612
com.android.defcontainer 238 8614
android.process.media 246 8616
com.android.mms 261 8618
com.android.email 282 8620
com.svox.pico 302 8622
scottmd3.tictactoe 322 8624 / 8700
scott.examples.lifeCycleTest 333 8625
Emulator Control
Telephony Status
Voice: home Speed: Full
Data: home Latency: None
Telephony Actions
Incoming number:
Voice
SMS
Message:
Threads Heap Allocation Tracker File Explorer
Heap updates will happen after every GC for th
ID Heap Size Allocated Free % Used # Objects
1 5.254 MB 2.551 MB 2.703 MB 48.56% 48,634
Cause GC
Display: Stats
Type Count Total Size Smallest Largest Median Average
free 5,338 2.691 MB 16 B 78.516 KB 176 B 528 B
data object 33,061 996.391 KB 16 B 672 B 32 B 30 B
class object 2,042 586.086 KB 168 B 26.836 KB 168 B 293 B
1-byte array (byte[], boolean[]) 1,563 228.414 KB 24 B 1.977 KB 40 B 149 B
2-byte array (short[], char[]) 8,957 564.203 KB 24 B 28.023 KB 48 B 64 B
4-byte array (object[], int[], float[]) 2,789 227.836 KB 24 B 16.023 KB 40 B 83 B
8-byte array (long[], double[]) 222 9.352 KB 32 B 1.000 KB 32 B 43 B
Allocation count per size
Count
15,000
12,500
10,000
7,500
5,000
2,500
0
16 24 32 40 48 56 64 72 80 88 96 104 112 120 128 152 160 168 176 200 208 304 328 336 344 360 368 384 624 672
Size
LogCat
Saved Filters
All messages (no filters)
life cycle 2
Search for messages. Accepts Java regexes. Prefix with pid:, app:, tag: or text: to limit scope.
verbose
L... Time PID Application Tag Text
W 01-29 19:31:23.124 61 syste... InputManagerService Window already focused, ignoring focus gain of: c...
D 01-29 19:31:24.194 322 scott... TicTacToeGame Computer moving to 5 as a random move.
D 01-29 19:31:27.865 322 scott... TicTacToeGame Computer moving to 6 to block win.
D 01-29 19:31:29.875 322 scott... TicTacToeGame Computer moving to 1 to block win.
D 01-29 19:32:26.682 322 scott... dalvikvm +++ active profiler count now 1
I 01-29 19:32:26.682 322 scott... dalvikvm TRACE STARTED: '[DDMS]' 8192KB
I 01-29 19:32:32.656 322 scott... dalvikvm dvmDdmHandleHpsgChunk(when 1, what 0, heap 0)