HCI – Mobile devices Smartphones

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Smartphones Market Share 2011 Q2

Operating System	2Q11 Units	2Q11 Market Share (%)	2Q10 Units	2Q10 Market Share (%)
Android	46,775.9	43.4	10,652.7	17.2
Symbian	23,853.2	22.1	25,386.8	40.9
iOS	19,628.8	18.2	8,743.0	14.1
Research In Motion	12,652.3	11.7	11,628.8	18.7
Bada	2,055.8	1.9	577.0	0.9
Microsoft	1,723.8	1.6	3,058.8	4.9
Others	1,050.6	1.0	2,010.9	3.2
Total	107,740.4	100.0	62,058.1	100.0

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Smartphones Market Share 2013 Q3

Worldwide Smartphone Sales to End Users by Operating System in 3Q13 (Thousands of Units)

Operating System	3Q13 Units	3Q13 Market Share (%)	3Q12 Units	3Q12 Market Share (%)
Android	205,022.7	81.9	124,552.3	72.6
iOS	30,330.0	12.1	24,620.3	14.3
Microsoft	8,912.3	3.6	3,993.6	2.3
BlackBerry	4,400.7	1.8	8,946.8	5.2
Bada	633.3	0.3	4,454.7	2.6
Symbian	457.5	0.2	4,401.3	2.6
Others	475.2	0.2	683.7	0.4
Total	250,231.7	100.0	171,652.7	100.0

Source: Gartner (November 2013)

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Introduction

- What makes a phone smart?
  - Makeing phone calls
  - Sms, mms, email
  - Built in camera
  - GPS
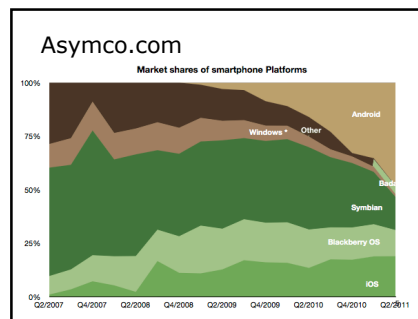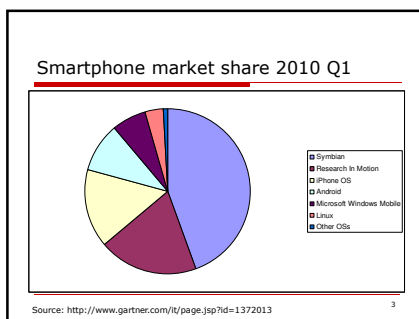 - WWW
- Real user demand or just technical novelty?

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Asymco.com

Market shares of smartphone Platforms

Table 3
Worldwide Mobile Phone Sales to End Users by Vendor in 1Q15 (Thousands of Units)

Company	1Q15 Units	1Q15 Market Share (%)	1Q14 Units	1Q14 Market Share (%)
Samsung	97,986	21.3	110,046	24.5
Apple	60,177	13.1	43,062	9.6
Microsoft	33,002	7.2	49,689	11.1
LG Electronics	19,637	4.3	14,882	3.3
Lenovo*	19,280	4.2	17,292	3.9
Huawei	18,590	4.0	14,574	3.2
Xiaomi	14,740	3.2	9,634	2.1
TCL Communication	14,189	3.1	11,956	2.7
ZTE	12,600	2.7	13,845	3.1
Micromax	8,158	1.8	7,791	1.7
Others	161,901.9	35.2	156,195.0	34.8
Total	460,261.7	100.0	448,966.1	100.0

Source: Gartner (May 2015)
*The results for Lenovo include sales of mobile phones by Lenovo and Motorola both in 1Q15 and 1Q14.

Smartphone market share 2010 Q1

- Symbian
- Research In Motion
- iPhone OS
- Android
- Microsoft Windows Mobile
- Linux
- Other OSs

Source: http://www.gartner.com/it/page.jsp?id=1372013

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Smartphones Market Share 2012 Q3

Table 2
Worldwide Mobile Device Sales to End Users by Operating System in 3Q12 (Thousands of Units)

Operating System	3Q12 Units	3Q12 Market Share (%)	3Q11 Units	3Q11 Market Share (%)
Android	122,480.0	72.4	60,490.4	52.5
iOS	23,550.3	13.9	17,295.3	15.0
Research In Motion	8,946.8	5.3	12,701.1	11.0
Bada	5,054.7	3.0	2,478.5	2.2
Symbian	4,404.9	2.6	19,500.1	16.9
Microsoft	4,058.2	2.4	1,701.9	1.5
Others	683.7	0.4	1,018.1	0.9
Total	169,178.6	100.0	115,185.4	100.0

Source: Gartner (November 2012)

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Global Smartphone Vendor Marketshare (%)	Q3 '14	Q3 '15
Samsung	24.5%	23.7%
Apple	12.2%	13.6%
Huawei	5.1%	7.5%
Lenovo-Motorola	7.6%	5.3%
Xiaomi	5.6%	5.0%
Others	45.1%	44.9%
Total	100.0%	100.0%

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Smartphone features

- ARM (Advanced RISC Machine)
- 32(/64) bits
- Fix/floating point calculations
- Low energy consumption
- Preemptív multitasking
- Multithreading
- Memory protection

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Symbian

- History
  - 2005: Symbian 9.1
    - Code signing, Symbian signed
  - 2006: 9.2 – Bluetooth 2.0
  - 2006: 9.3 – Natív wifi, HSDPA
  - 2007: Symbian 9.5
    - Digital TV API
    - Built in P.I.P.S.
    - Runtime RAM defregmentation
  - 2008: Symbian 5th edition
    - Touch screen
  - 2010: the future is Maemo+QT?

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Symbian

- History
  - 1980 Psion
  - 1991-98: Epoc 16: Psion Series 3
  - 1997: Epoc 32 OS: Psion Series 5
  - 1998: Symbian Kft: Ericsson, Nokia, Motorola, Psion
  - Epoc Release 5 aka Symbian OS v5
  - 2000-2003: Symbian OS 6.0, 6.1
  - 2003: Symbian 7.0, 7.0s (UIQ)

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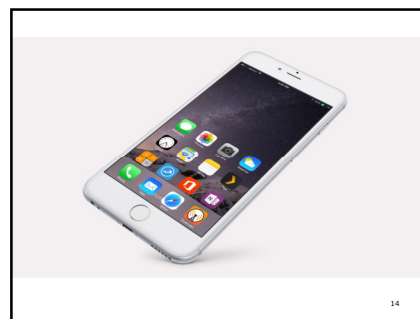
Kinetic scroll

- $a=dv/dt=(s/t^2)$ -   'friction'
- Normal direction, opposite direction
- MacOSX: Smart Scroll X
- Built in Windows 7
- Basic feature in touch screen devices
- There is no default solution

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Symbian

- History
  - 2004: Psion sells its share
  - 2004: first Bluetooth worm
  - 2004: Symbian OS 8.0, 8.1
  - 2004: Symbian OS 9.0 developer edition
    - C is not supported
    - Incompatible on source code and on binary level as well.

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Apple iPhone

- From iPhone 4 it supports multitask
- Vector based UI
- App Store
- Success
  - UI
    - Kinetic scroll
  - New paradigm
  - User loyality
- Only Apple development environment
  - XCode (Objective C)

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Apple iPhone – the dark side

- Phone functions: First generation
  - During phone calls the touch screen wasn't disabled
  - To start a new call from Contacts:
    - Phone -> Contacts -> first letter of the name -> scroll up/down -> visual search -> call (approx. 4 seconds)
    - Ideal: T9 search (approx. 1 second)

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Apple iPhone – the dark side

☐ Phone functions: 4th generation
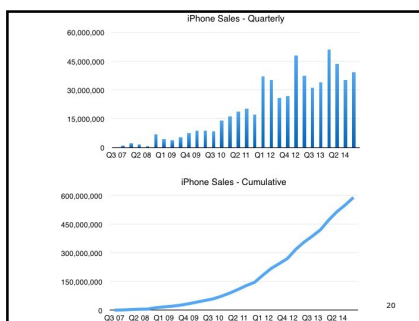 ■ The call is dropped or 3G dissapears if the user touches some part of the phone

6-pack

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iPhone 4

☐ „Retina display": 960x640 resolution 3.5"-en (326 ppi)
☐ Advanced gyroscope (like Wiimote)
☐ HD video record and edit on the mobile (iMovie)
☐ Better battery time (30-40% more)
☐ Video call (only with WiFi)

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iPhone 5s new features

☐
☐
☐
☐
☐
☐
☐
☐
☐

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iPhone Sales - Quarterly
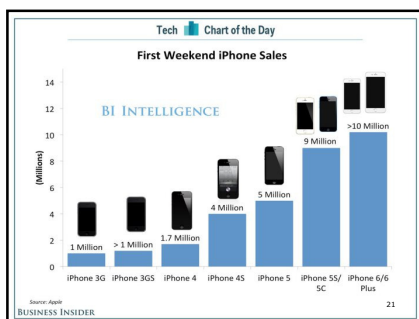
iPhone Sales - Cumulative

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iPhone 5 new features

☐ Bigger (4"), brighter screen
☐ 4G LTE
☐ 3 microphones, noise reduction
☐ New headphones
☐ Better camera
☐ FaceTime over cellular network
☐ Better email application
☐ Better Facebook and Twitter integration
☐ Better Siri

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iPhone 6 new features

☐ 4.7" (750x1334px, 326 PPI)
☐ 5.5" (1080x1920px, 401 PPI)
☐ New, slim design
☐ 64 bit ARMv8 CPU
☐ 1080p HD 60fps video capture
☐ NFC
☐ iOS 8
☐ Barometer
☐ Health app

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Tech ■ Chart of the Day

First Weekend iPhone Sales

BI INTELLIGENCE

Source: Apple
BUSINESS INSIDER

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iPhone 5c new features

☐
☐
☐
☐
☐
☐

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iPhone 7 new features

☐ Lack of 3.5mm jack ('lighting port')
☐ More processing power
☐ Better camera w/ optical zoom (7 Plus)
☐ 3D touch
☐ Stereo speakers
☐ Waterproof
☐ New home button (flat, haptic feedback)

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iPhone vs Android

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Google Android

- ☐ What is Google Android?
  - ■ Software pack, which contains:
    - ☐ Operating system
    - ☐ Middleware (APIs)
    - ☐ Basic Applications
  - ■ Linux based
    - ☐ Security
    - ☐ Memory managment
    - ☐ Process management

History

- ☐ 2011
  - ■ 2.3.4
    - ☐ Better soft-keyboard, copy-paste, better performance, SIP (VoIP) support, NFC (Near Field Communication)
  - ■ 3.0 (Honeycomb)
    - ☐ For tablets (pl. Motorola Xoom)
  - ■ 4.0 (Ice Cream Sandwich)
    - ☐ Announced: 19th October 2011.
    - ☐ Face-recognition, data traffic monitoring, standardized address book (Facebook + phone), offline email search, etc.

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iPhone vs Android

iPhone	Android
☐ Device specific	☐ Multiplatform
☐ Apple controls the development	☐ Free development
☐ Google internet applications	☐ Own (Google) internet applications
☐ Good DRM	☐ DRM free
☐ iTunes, iPod	☐ No history
☐ AppStore	☐ Android Market

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Google Android

- ☐ 2005
  - ■ Google starts Android Inc.
  - ■ Dalvik VM development starts
- ☐ 2007
  - ■ Open Handset Alliance established
    - ☐ Members today: Google, HTC, Sony, Dell, Intel, Motorola, Qualcomm, Texas Instruments, Samsung, LG, T-Mobile, Nvidia és Wind River Systems
  - ■ SDK (Software Development Kit): first version

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History

- ☐ 2012: 4.1.x (Jelly Bean – API level 16)
  - ■ Smoother graphics
    - ☐ Triple buffering
    - ☐ VSYNC
  - ■ Better accessibility
  - ■ User defined keyboard layout
  - ■ Switchable notifications by applications
  - ■ Offline speech recognizer
  - ■ Better voice-search
  - ■ Better camera app
  - ■ Google Chrome
  - ■ 3rd party launcher support (widget)

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Google Android

Google Android

- ☐ 2009
  - ■ First Google Android Developer Challange
  - ■ 1.5 (CupCake)
    - ☐ New soft-keyboard with auto complete
  - ■ 1.6 (Donut)
- ☐ 2010
  - ■ 2.0 / 2.0.1 / 2.1 (Éclair)
  - ■ Google Nexus One
  - ■ 2.3 (Gingerbread)

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History

- ☐ 2012: 4.2 (Jelly Bean – API level 17)
  - ■ Better panoramic photo
  - ■ „Gesture typing" (like swipe keyboard)
  - ■ Wireless screen support
  - ■ Better accessibility: Pintch zoom after 3 taps. Speech output and gesture based navigation. Google TalkBack.
  - ■ New clock app.
  - ■ "Daydream" screensaver, lock screen widgets.

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History

- 2013: 4.3. (Jelly Bean – API level 18)
  - Bluetooth low energy.
  - OpenGL ES 3.0
  - Dial pad auto-complete
  - 4K resolution support
  - New camera UI
  - Better logging and debug.
  - 5 new languages
    - RTL (right-to-left) language support

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History

- 2015: Android Marshmallow (API level 23)
  - Fingerprint Authentication
  - Confirm Credential
  - Auto Backup for Apps
  - Direct Share
  - Voice Interactions
  - Assist API
  - Adoptable Storage Devices
  - Improved Bluetooth Low Energy Scanning
  - 4K Display Mode, Audio Features, Video Features, Flashlight API, Camera reprocessing, etc.

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Android fregmentation

- Different brands
- Different operating systems
- Different sensors

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History

- 2013: 4.4. (KitKat – API level 19-20)
  - New UI, transparent status bar
  - Low RAM device API
  - Wireless printing
  - Chrome based WebView
  - Step detector and step counter API
  - Built-in screen recording
  - Better accessibility API
  - "Immersive„ full screen view, soft-keys are accessed by gestures
  - New experimental VM: ART (can be switched on in „Developer options")
    - PRODUCT_RUNTIMES := runtime_libdvm_default
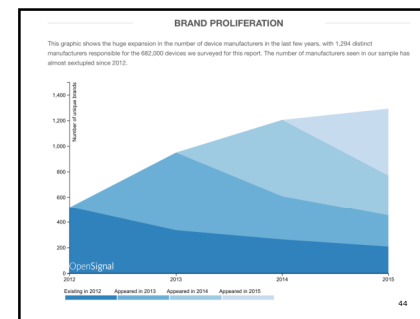   - PRODUCT_RUNTIMES += runtime_libart

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History

- 2016: Android Nougat (API level 24)
  - Split Screen, drag-n-drop among screens

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BRAND PROLIFERATION

This graphic shows the huge expansion in the number of device manufacturers in the last few years, with 1,294 distinct manufacturers responsible for the 682,000 devices we surveyed for this report. The number of manufacturers seen in our sample has almost sextupled since 2012.

OpenSignal

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History

- 2014: Android Lollipop (API level 21)
  - Smartphone, tablet, smartwatch, TV, car
  - Material design: new, responsive UI
  - New types of notifications
  - Better battery life
  - Audio in and out over USB
  - Guest accounts
  - Security: encrypted content
  - ART: Android Runtime insted of Dalvik
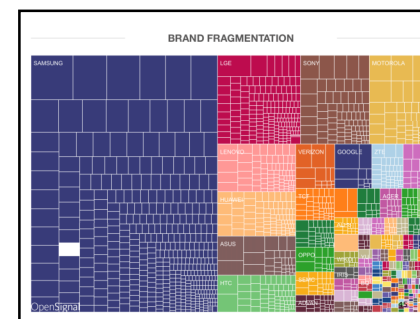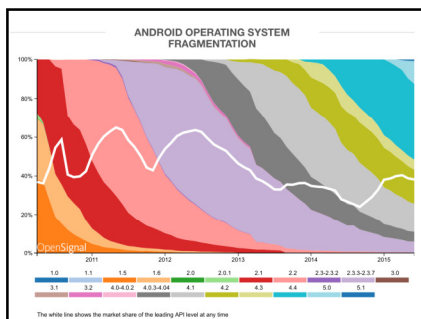 - 64 bit ARM, MIPS and x86 support
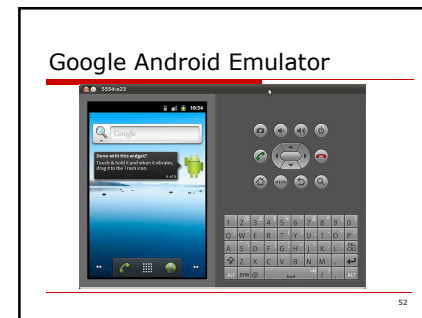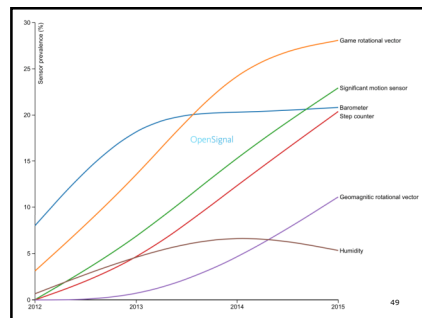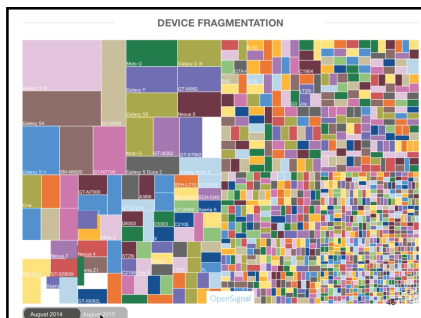 - Interopability

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History

- 2016: Android Nougat (API level 24)
  - Vulkan API: 3D engine
  - VR: DayDream ready
  - Better battery management
  - File-based encryption
  - Direct Boot: faster boot
  - Separate wallpaper for lock screen

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BRAND FRAGMENTATION

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DEVICE FRAGMENTATION

August 2014

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Google Android Emulator

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ANDROID OPERATING SYSTEM FRAGMENTATION

The white line shows the market share of the leading API level at any time
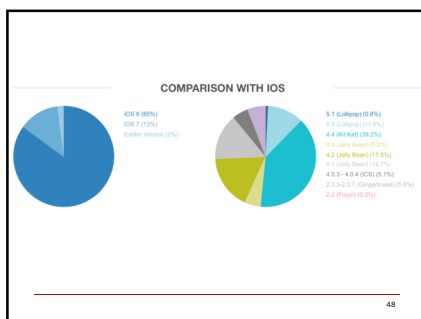
Android Runtime: Dalvik VM

- Java parts, Google development
- Optimized for mobile platforms (better memory management, better performance, etc.)
- Runs .dex files, which are compiled from .class files
- New class libraries
- Some JAVA class library is not supported (eg. AWT, Abstract Window Toolkit)
- 4.3, 4.4: experimental ART VM
- 5.0: ART VM: faster, less CPU usage, less battery

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Google Android Emulator

- ARM CPU
- 16 bit LCD
- One or more keyboards (QWERTY, NUMPAD)
- Audio in- and output
- Flash memory emulation
- GSM emulation
- Very slow

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COMPARISON WITH IOS

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Android Runtime

- The applications are sandboxed
  - Applications runs as separate Linux processes
  - A Dalvik VM belongs to all processes separetely
  - All application has a unique Linux ID
    - The application can access only it's own files.
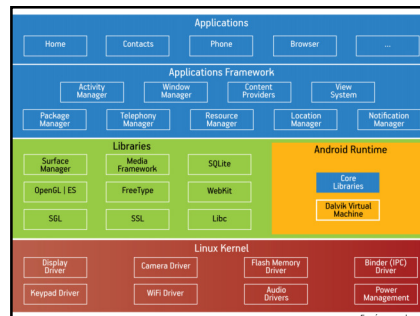
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Google Android Emulator

- Restrictions
  - No voice calls
  - USB connection is not emulated
  - Camera / video not emulated
  - Headphone not emulated
  - Etc.

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Google Android development environment

- ☐ Eclipse Bundle vs Android Studio
- ☐ Android SDK
- ☐ Android NDK
- ☐ More:
  http://developer.android.com/sdk/installing.html

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Forrás: google.com

## Android Memory Management

- ☐ Similar to .NET and JAVA: Garbage Collector
- ☐ Process life cycle
  - ■ Priority handling
  - ■ Process stop
  - ■ Process kill
- ☐ Same priority: older one is killed
- ☐ Parent-child priority:
  - ■ The priority of a service (or a content provider) is inherited by the process that uses it (or it can be higher).

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Google Android development environment

- ☐ Native code: Android NDK
  - ■ C, C++
  - ■ Native libraries (libc, libm, libz, liblog, stb.)
  - ■ JNI interface
- ☐ Supported architectures
  - ■ ARMv5TE
  - ■ ARMv7-A
  - ■ x86

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Google Android application

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Android Memory Management

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Android Application

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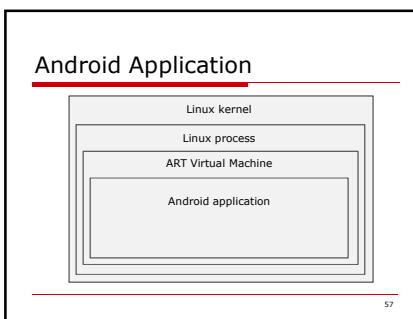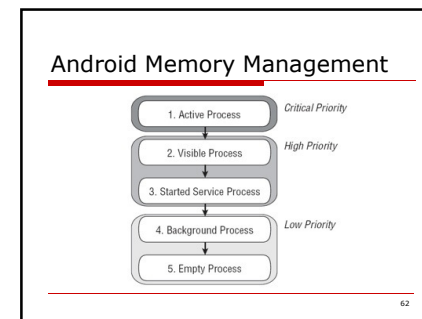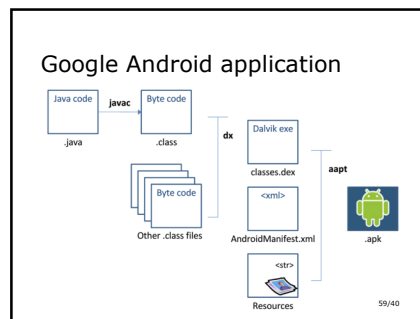
Google Android application

- ☐ **Activity:** UI views (eg. play/stop button)
- ☐ **Services:** the engine
  - ■ Eg. music playback
- ☐ **Background Receivers:** notifications from user / system events
  - ■ Eg. Low battery
- ☐ **Content provider:** content sharing among applications

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Android Memory Management

- ☐ Active process
  - ■ Activity, foreground processes
  - ■ Activity, Service or Broadcast Receiver, that runs the onReceive event handler function.
  - ■ Service, that runs the onStart, onCreate, or onDestroy event handler function.

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Android Memory Management

- ☐ Visible process
  - ▪ Not fullscreen or transparent.
- ☐ Started service process
  - ▪ Process that runs a service. Has the same priority as foreground processes. Only stops in case of higher priority processes.
- ☐ Background process
  - ▪ Process that has an activity, which is not visible and do not use any service. Last-seen-first-killed.
- ☐ Empty process
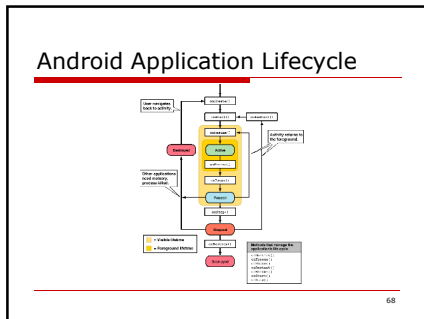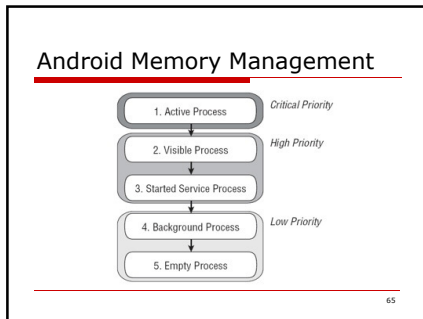 - ▪ Left processes at the end of the life-cycle. „Cache."

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```
/* (non-Javadoc)
 * @see android.app.Activity#onRestart()
 */
@Override
protected void onRestart() {
    super.onRestart();
    Log.i(TAG, "On Restart ......");
}
/* (non-Javadoc)
 * @see android.app.Activity#onResume()
 */
@Override
protected void onResume() {
    super.onResume();
    Log.i(TAG, "On Resume ......");
}
/* (non-Javadoc)
 * @see android.app.Activity#onStart()
 */
@Override
protected void onStart() {
    super.onStart();
    Log.i(TAG, "On Start ......");
}
/* (non-Javadoc)
 * @see android.app.Activity#onStop()
 */
@Override
protected void onStop() {
    super.onStop();
    Log.i(TAG, "On Stop ......");
}
}
```

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Android Studio Demo

- ☐ Mock-up (paper, Balsamiq, Pencil Project)
- ☐ 2 activity
- ☐ Device Manager
- ☐ Buttons
  - ▪ http://angrytools.com/android/button/
- ☐ Layouts
- ☐ Custom UI element
- ☐ Navigation Editor
- ☐ Monkey test tool
- ☐ Memory monitor

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Android Memory Management

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Android Application Lifecycle

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```
public class TestActivity extends Activity {
    /** Called when the activity is first created. */
    private final static String TAG = "TestActivity";
    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);
        Log.i(TAG, "On Create ......");
    }
    /* (non-Javadoc)
     * @see android.app.Activity#onDestroy()
     */
    @Override
    protected void onDestroy() {
        super.onDestroy();
        Log.i(TAG, "On Destroy ......");
    }
    /* (non-Javadoc)
     * @see android.app.Activity#onPause()
     */
    @Override
    protected void onPause() {
        super.onPause();
        Log.i(TAG, "On Pause ......");
    }
```

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