



android

Android

System, platform and
application types

Administrative



- Tests 10p
- Project 40p
- Exam 50p

Course link

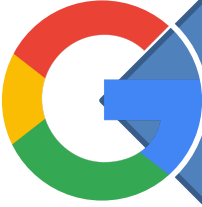





- upb-fils-mdad.github.io

Bibliography

1. Wallace Jackson, *Android Apps for Absolute Beginners*, Apress, 2017
2. Peter Späth, *Learn Kotlin for Android Development*, Apress 2019
3. Android Application Fundamentals,
<http://developer.android.com/guide/topics/fundamentals.html>

Google Android

-  Platform Developed by Google
-  Based upon Linux
-  Virtual Machine (Dalvik) & ART
-  Open Source

Android Platform

- Android
 - OS
 - Platform
- *Application* types
 - Activities
 - Services
 - Content providers
 - Broadcast Receivers

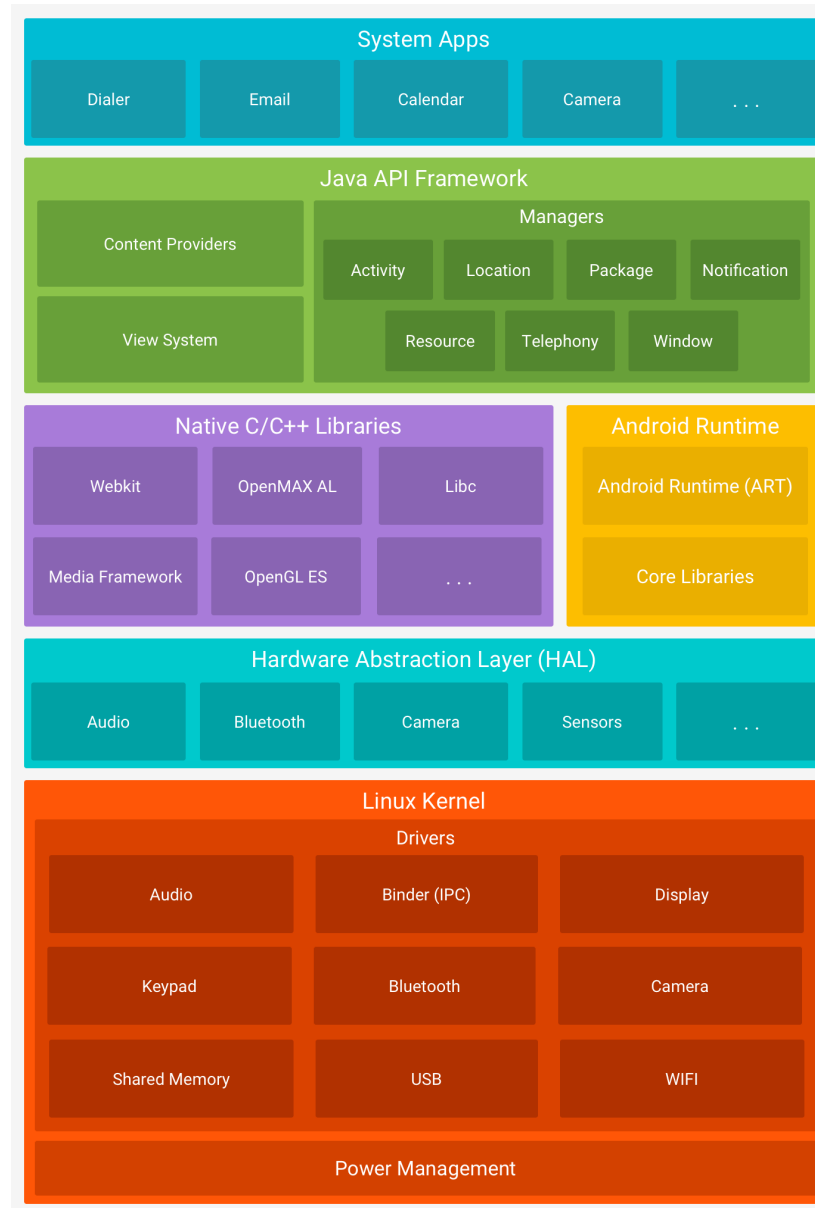


NOT only a OS

- Radio Firmware
 - Phone system
 - GSM/CDMA /UMTS
- **Linux**
 - Kernel 4.x and 5.x
 - Android 11 and newer
 - Optimised for ARM
- User Space Libraries
 - *Bionic*
 - *SQLite*
 - *WebKit*
- **Application platform**



Android Schematics



- OS
- *Not visible*
- Extended Machine
 - Hardware abstraction
- Contains *drivers*
- Manages
 - Processor
 - Peripherals
 - Audio
 - Video
 - GPS
 - WiFi
 - Input/Output
 - Network stack



Kernel - Optimizations

- Memory Management
 - **No *swap***
 - On demand application closing system
- Power management
 - WAIT_LOCK
- Specific IPC
 - Binder
 - AIDL
 - Synchronous call between processes



User Space Libraries



- Programming libraries
 - Link between the *kernel* and *programs*
 - Screen display
 - *printf (...)*
 - *scanf (...)*
 - Network access
 - *socket (...)*
- *Bionic*
 - *Libc* for Android

User Space Libraries

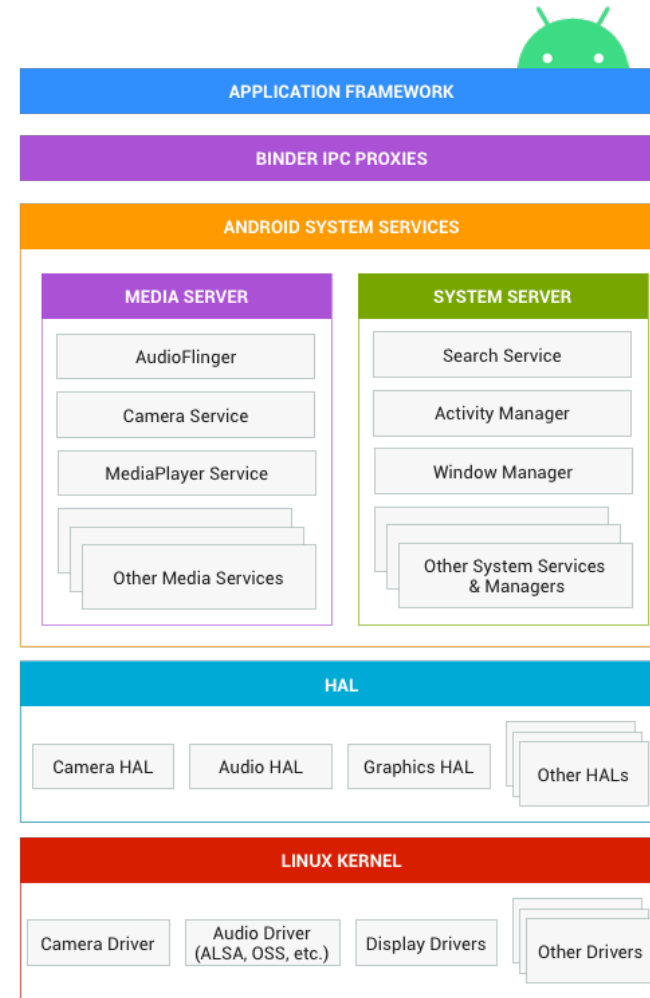


- SQLite
- WebKit
- Surfaces
- FreeType
- Media Framework
- OpenGL|ES
- SSL
- ...

Hardware Abstraction Layer



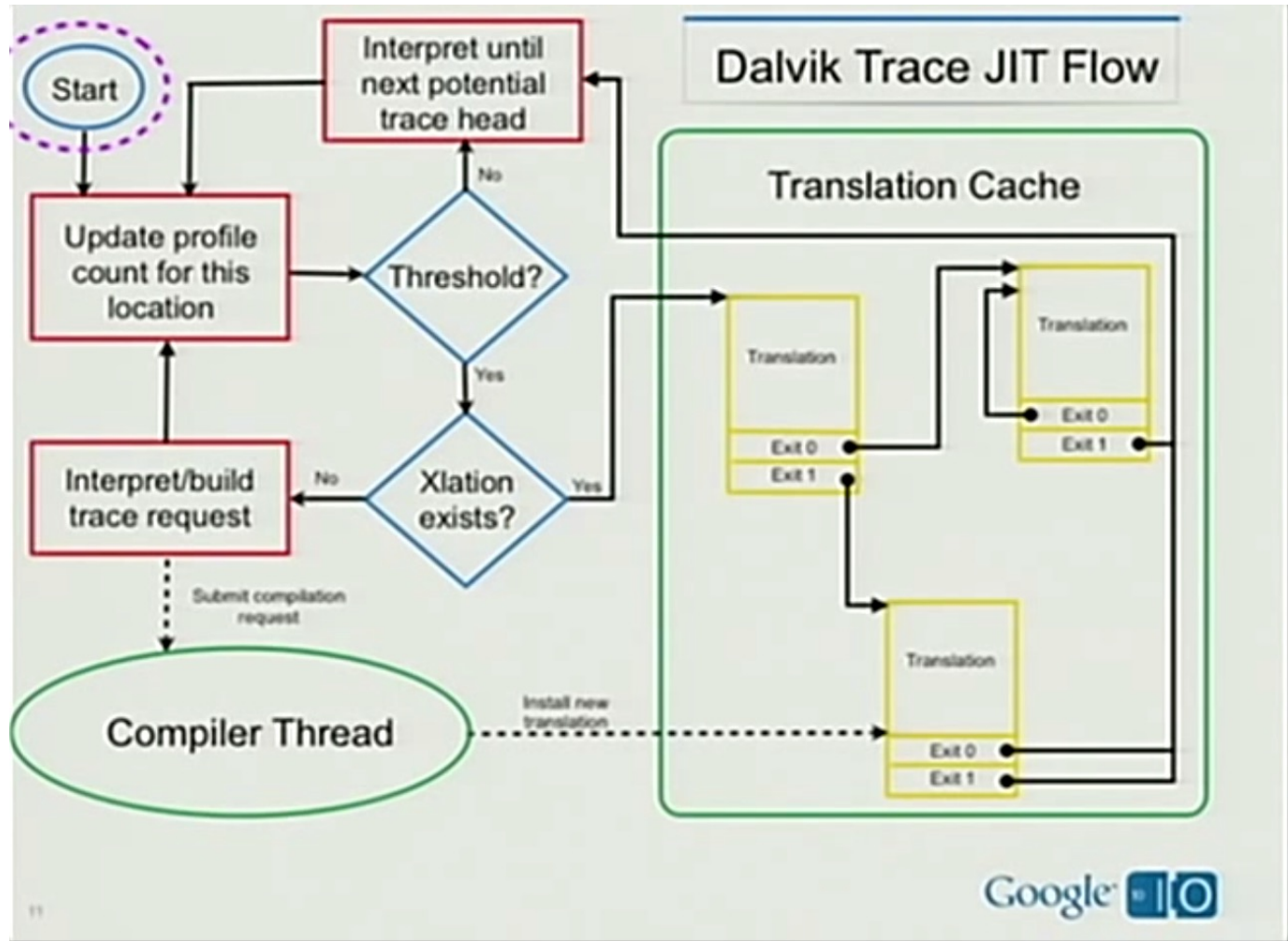
- Drivers
 - hardware dependent
 - vendor dependent
 - have to be licensed as GPL
- Drivers are abstracted by a service
 - the service is changed when hardware is changed



- Virtual Machine(Java)
 - **Java 1.5 SE**
 - Most of it
 - Missing
 - AWT / Swing
 - Printing
 - Other special components
 - Optimised for mobile
 - Small memory
 - Fast garbage collection
 - Different file format
 - .class -> **.dex**
- JIT Compiler



Dalvik JIT



ART - Android Runtime

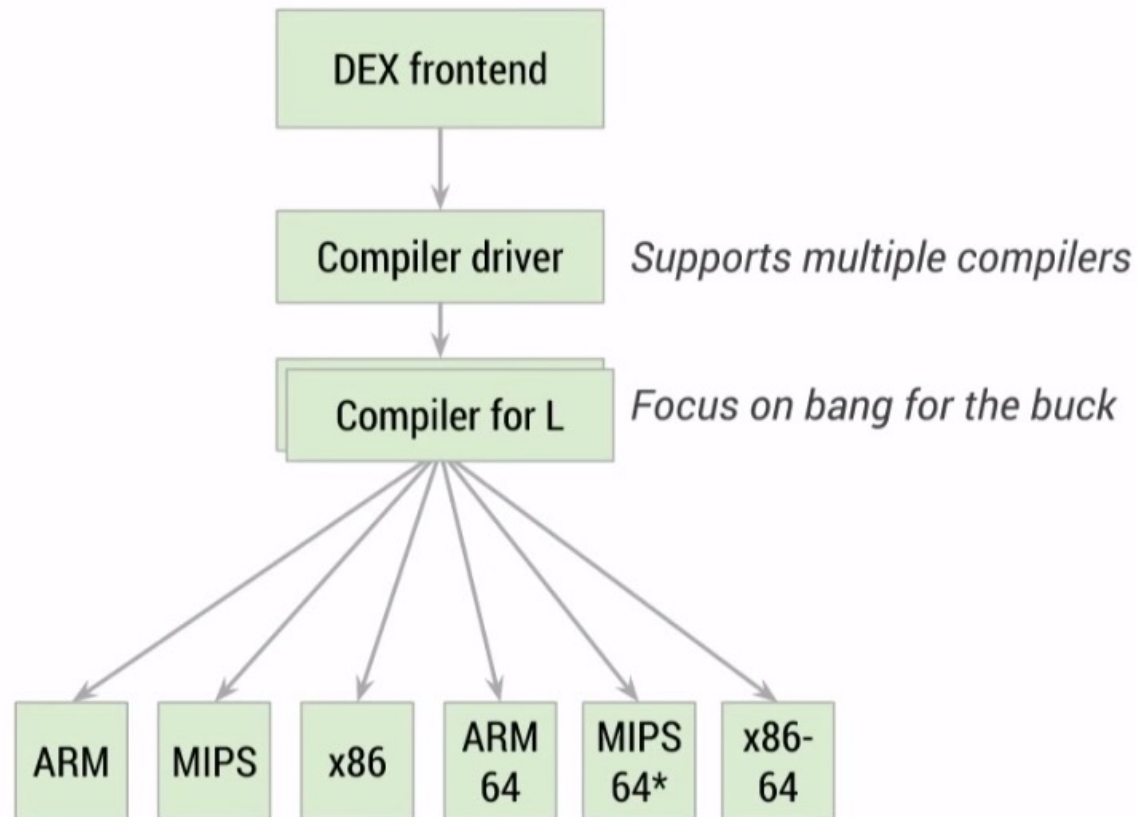


- Environment for compiler and executer
 - **Dalvik**
 - Different file format
 - **.dex -> .elf and odex**
- Ahead of Time compiling (AOT)
- Includes a memory allocator



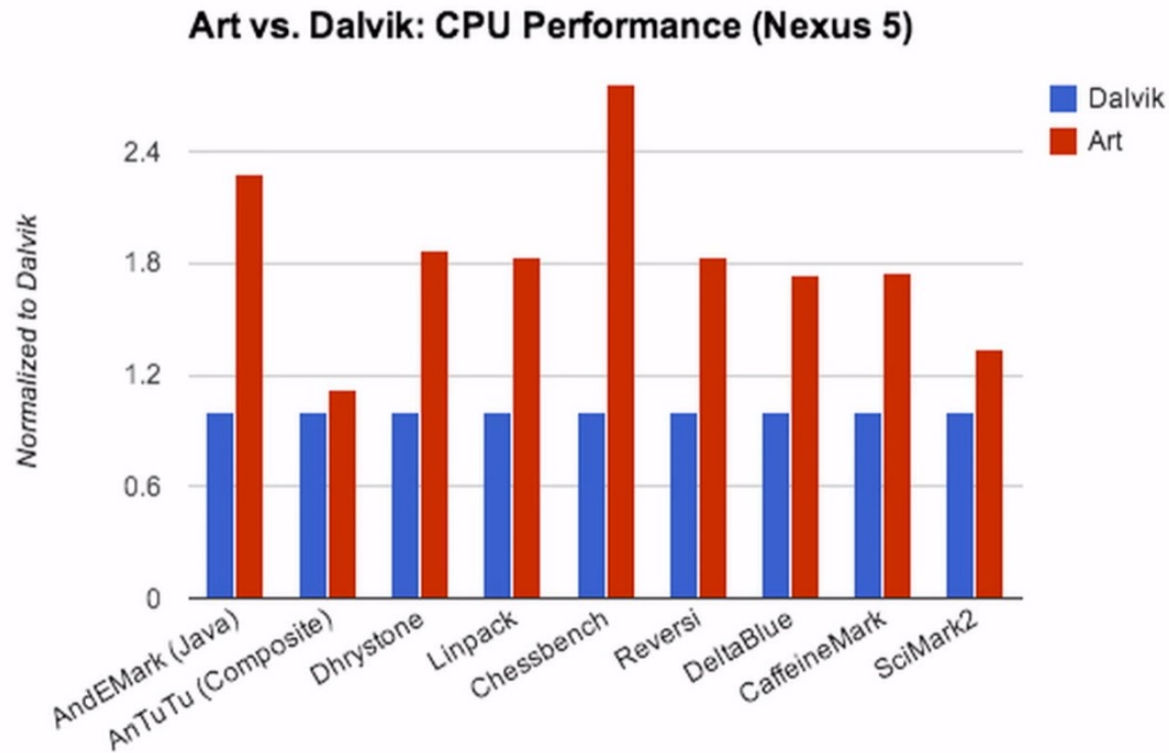
<https://source.android.com/devices/tech/dalvik>

Android ART



ART Performance

Performance Boosting Thing, realized

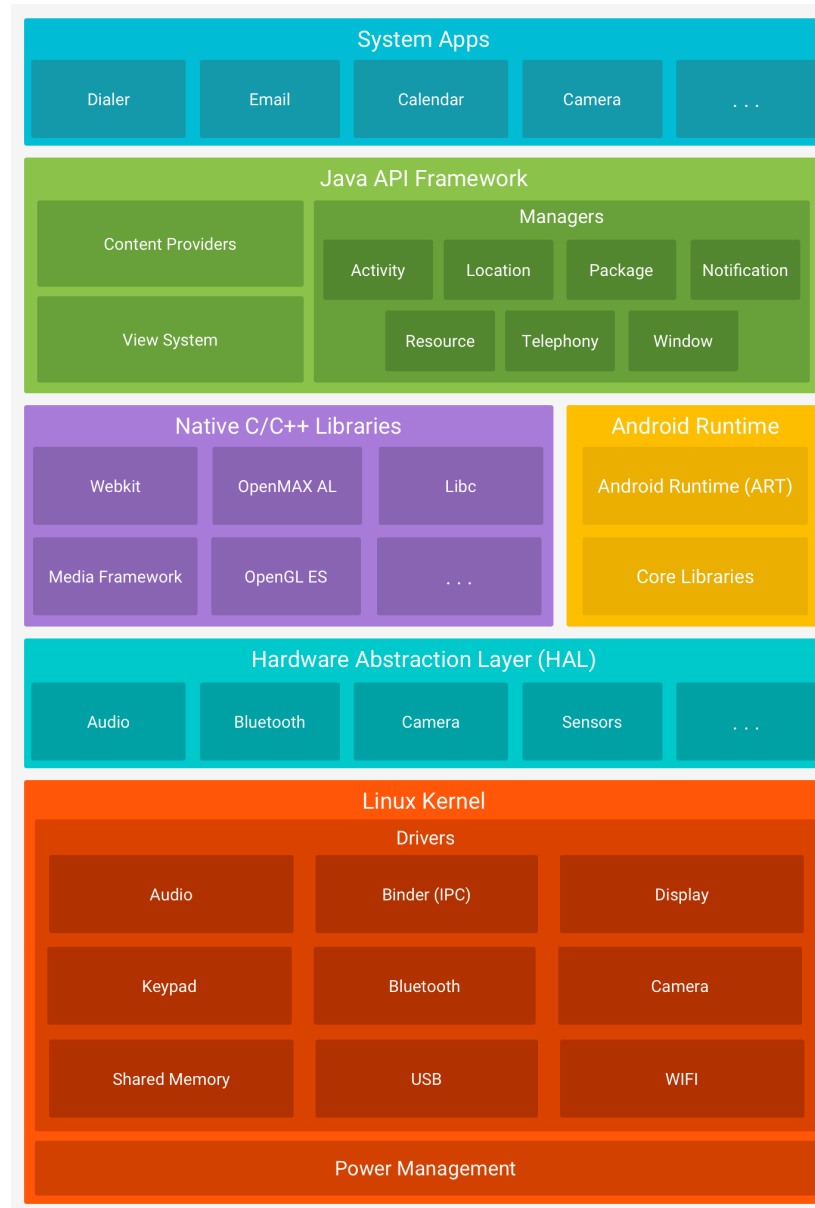


Android Libraries

- For Dalvik/ART
 - Not user space libraries!
- Written in Java/Kotlin
- Access to the device's functions
 - Phone
 - Messages
 - Sensors
- Services
 - Window Manager
 - Audio Manager



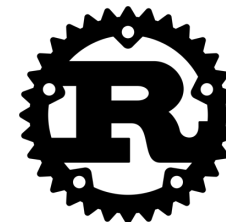
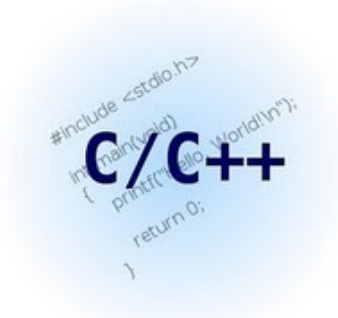
Android Schematics



Programming



- **Dalvik/ART (Application)**
 - in Java/Kotlin
 - High speed
 - Access to many libraries
- **PWA (Progressive WebApp)**
 - In the browser (WebKit)
 - Slow
 - JavaScript
- **Native Development Kit (NDK)**
 - C/C++
 - Limited number of libraries
 - High speed
 - JNI Support
 - Not recommended for standard applications
- **C/C++/Rust (services, used by vendors)**



Application Security

- **Implemented in the kernel**
 - Linux policy
 - *Ext3* file system
 - *SELinux*
 - Users can write only in their folder
 - Every application runs with its own user
 - **Determined by the digital signature!**
 - Group permissions
 - May write in
 - `/data/name.package.application /`
 - `/SDCard/`
 - **Works for any application type**
 - Dalvik / PWA / NDK / C/C++ / Rust



Application Security

- **Implemented in the Android Libraries and Services**
 - Permissions
 - Declared in the *Manifest*
 - Access device's functions
 - Network
 - Phone / messages
 - Photo
 - GPS
 - Access to another application's components
 - Permissions imposed by that application
 - User will be asked
 - at install (Android < 6)
 - at usage (Android >= 6)
 - **Works only for *Dalvik* / *ART* applications**
 - Native services have to check permissions themselves



Application & Services (Dalvik/ART)



- **There is no *main()***
- **Formed of components**
 - Activities
 - Services
 - Content Providers
 - Broadcast Receivers
- Components can run separately



Application Bundle (Dalvik/ART)

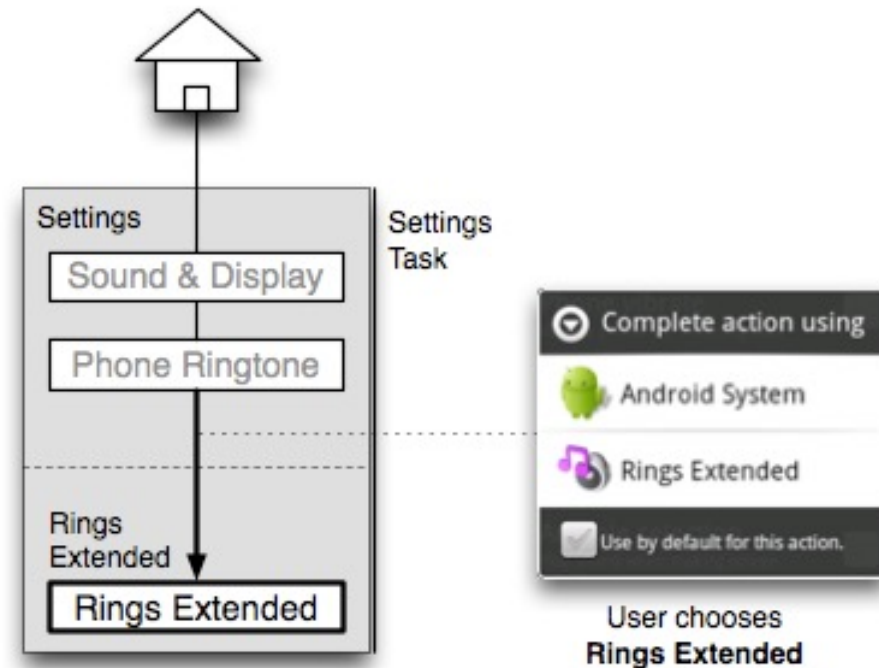
- **APK File**
 - JAR uncompressed
 - Components
 - *.dex* File
 - Resources
 - Images
 - XML Files
 - Manifest
 - File with information
 - **Digital signature**
 - Determines the user
 - For development
 - For production
 - Authentic
 - Self signed

ANDROID



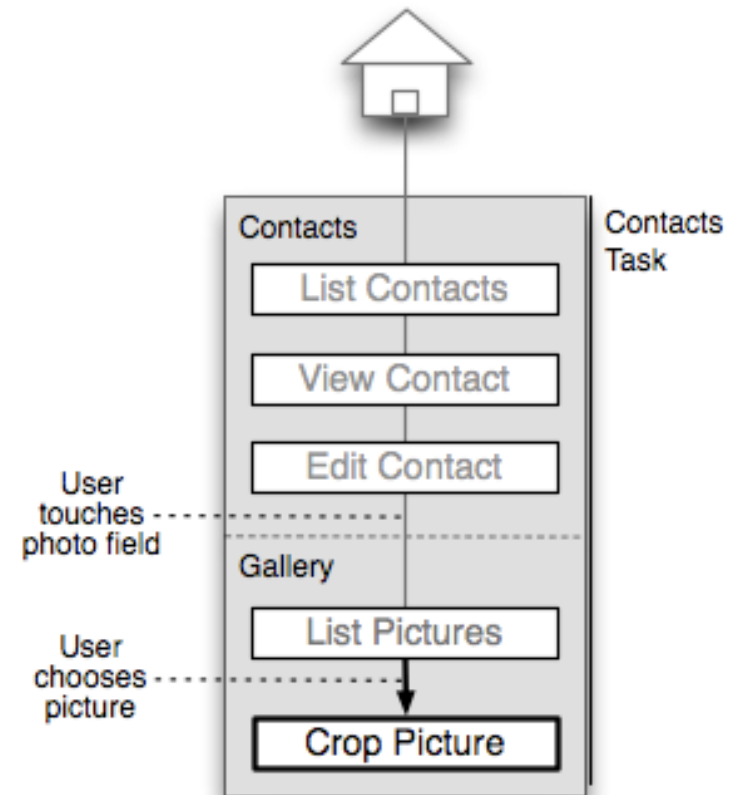
Task (UI Application)

- Runs in one process
 - usually!
 - There are exceptions
- Stack of activities
 - **Root activity**
 - Add
 - Display
 - *push*
 - Remove
 - Hide
 - *pop*
 - Activities from other applications



Task (UI Application)

- Runs in one process
 - usually!
 - There are exceptions
- Stack of activities
 - **Root activity**
 - Add
 - Display
 - *push*
 - Remove
 - Hide
 - *pop*
 - Activities from other applications



Conclusions



- Android Platform
 - Linux OS
 - Set of libraries for Android
- Programming ways
 - **Dalvik/ART – Java/Kotlin**
 - AJAX – Web
 - NDK – C/C++
- Android Applications are a set of components
 - Activities
 - Services
 - Content Providers
 - Broadcast Receivers
 - There is no *main()*
- Task – UI Applications
 - Set of Activities
 - Survive the process

Keywords



- Operating System
 - Kernel
 - User Space Library
- Linux
 - Process
- Dalvik
 - Activity
 - Service
 - Content Provider
 - Broadcast Receiver
- ART
- Security
 - Kernel (file system)
 - User Mode (Dalvik/ART)
- Task
 - Activities Stack

Questions

