CMSC436: Programming Handheld Systems
The Android Platform
The Android Platform

A software stack for mobile devices:
- OS kernel and interfaces, system libraries, frameworks & key apps

Android SDK for creating apps
- Libraries & development tools
- Lots of documentation. Start browsing today!

See: http://developer.android.com/training
The Android Architecture

System Apps

Java API Framework

Native C/C++ Libraries

Hardware Abstraction Layer (HAL)

Android Runtime

Linux Kernel
The Android Architecture
Linux Kernel – Standard Services

Security
Memory & process management
File & network I/O
Device drivers
Linux Kernel - Android-Specific

Power management

Low memory killer

Interprocess communication (IPC)
The Android Architecture

- System Apps
- Java API Framework
- Native C/C++ Libraries
- Android Runtime
- Hardware Abstraction Layer (HAL)
- Linux Kernel
Hardware Abstraction Layer (HAL)

Provides standard interfaces between Java API framework and device hardware.

Defines and interface for various hardware classes, such as Camera, Audio, Graphics, etc.

Android loads library modules for hardware components on demand.
The Android Architecture

System Apps

Java API Framework

Native C/C++ Libraries

Webkit
OpenMAX AL
Libc
Media Framework
OpenGL ES
...
Libraries

Bionic libc        Webkit
Surface Manager   OpenGL
Media Framework   SQLite
FreeType          SSL
The Android Architecture

- System Apps
  - Native C/C++ Libraries
    - Webkit
    - OpenMax AL
    - Libc
    - Media Framework
    - OpenGL ES
    - ...
  - Android Runtime
    - Android Runtime (ART)
    - Core Libraries

- Hardware Abstraction Layer (HAL)

- Linux Kernel
Android Runtime

Two main components

Core Java libraries with some Java 8 feature support
Android Runtime (ART)
Core Java Libraries

Basic java classes -- java.*, javax.*
App lifecycle -- android.*
Internet/Web services -- org. *
Unit testing -- junit.*
Java 8 support

Android does not support all Java 8 language features

Some supported features (in API level 24 or higher)

- Lambda expressions
- Method references
- java.util.function and java.util.stream

See:

https://developer.android.com/studio/write/java8-support
Android Runtime (ART)

Since Android 5.0, apps are executed in a managed runtime environment.

On older platforms, apps run in the Dalvik Virtual Machine.
ART Design Goals

Designed for resource-constrained environments

- Slower CPU
- Less RAM
- Limited battery life
Typical Workflow

App written in Java
Compiled to Java bytecode files
Tool chain converts java bytecode files to a single dex-formatted bytecode file
Virtual machine executes bytecode file
ART

Compiles dex bytecode to native binary for improved runtime performance

Applies system-dependent optimizations at installation time, runtime, and in background

Results in faster execution at cost of larger executable
The Android Architecture

System Apps

Native C/C++ Libraries

Android Runtime

Hardware Abstraction Layer (HAL)

Linux Kernel
Package Manager

Keeps track of app packages on device
Window Manager

Manages the windows comprising an app
View System

Provides common user interface elements
  e.g., icons, text entry boxes, buttons and more
Tabs
Resource Manager

Manages non-compiled resources

  e.g., strings, graphics, & layout files
Activity Manager

Manages app lifecycle and navigation stack
ContentProvider

Inter-application data sharing
Location Manager

Provides location & movement information
User’s Location
Notification Manager

Place notification icons in the status bar area when important events occur
The Android Architecture

- System Apps
  - Dialer
  - Email
  - Calendar
  - Camera
  - ...
- Java API Framework
- Native C/C++ Libraries
- Android Runtime
- Hardware Abstraction Layer (HAL)
- Linux Kernel
Applications

Standard apps include:

- Home – main screen
- Contacts – contacts database
- Phone – dial phone numbers
- Browser – view web pages
- Email reader – compose & read email messages
Applications

Nothing special about these apps
You can substitute your own or 3rd party app for any of them
Next

Android Development Environment