

**CSC 472 / 372**  
**Mobile Application**  
**Development for Android**



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## Outline

- What is mobile computing?
- The convergence: *mobile + computing*
- The story of Android

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2

**What is Mobile Computing?**

- Computing technologies centered around mobile devices.
- (a computing device that is)  
... *an iPod, a Phone, an Internet communicator, ...*  
— Steve Jobs, 2007

Mobile Computing =  
Computation + Mobility + Connectivity

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3

## Elements of Mobile Computing

- Mobile hardware, devices
  - CPU, GPU, memory, network connectivity
- Mobile software
  - Mobile platforms, OS and apps
- Mobile connectivity
  - Wireless Internet, WIFI, Bluetooth, cellular network
- Human Computer Interaction
  - Alternative input mechanisms: touch, motion, voice
  - User interface design

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4

**Newton Message Pad**  
**Apple Computer, 1993**

- The first commercially available hand-held computer
- Weight: 1.4 lb
- Handwriting recognition



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## Palm Pilot 1000

### US Robotics, 1996

- The first commercially successful personal digital assistant (PDA)
- Stylus input
- Graffiti handwriting recognition
- Infrared port

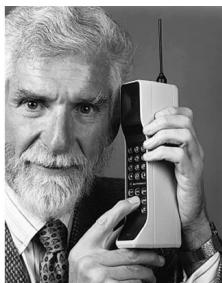


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### Motorola DynaTAC 1983, Motorola Corp.

- Inventor, Martin Cooper
- The first cell phone approved for commercial use.
- Weight: 2lb



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7

### The Convergence of Wireless Internet & Hand-Held Computers

*Mobile + Computing*



### BlackBerry Quark 2003, Research in Motion

- The first device with integrated cell phone and e-mail
- QWERTY keyboard
- SMS



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### iPhone June 2007, Apple Computer

- The first integrated smart phone
- Multi-touch interface
- Virtual keyboard
- WIFI & 3G



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### iPad Tablet Computer April 2010, Apple Computer

- The first commercially successful tablet computer



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12

Hello Android!



## Birth of Google, Stanford Univ. Larry Page & Sergey Brin, c. 1996

- Ph.D. students at Stanford University
- Incorporated on September 4, 1998
- Eric Schmidt became the first CEO in March 2001
- IPO on August 19, 2004
  - \$85 (2-for-1 split in 2014)
  - 8/19/2015: \$660.90
  - + 1,555%



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16

## Android, the Beginning

- Android Inc. founded by Andy Rubin & Rich Miner, in October 2003, in Palo Alto, CA
  - Develop an advanced operating system for smart devices
- Acquired by Google on August 2005
- Android OS introduced in November 2007
  - First Android smartphone: HTC Dream, released in 2008
- Eric Schmidt resigned from Apple's Board of Directors on August 3, 2009
  - Beginning of a tumultuous saga with Apple Inc.

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17

## Open Handset Alliance (OHA)

- A consortium of 84 companies, formed in 2007
- Develop Android, as a complete, open, and free mobile platform
- Members include: Google, HTC, Sony, Dell, Intel, Motorola, Qualcomm, TI, Samsung, LG, T-Mobile, Sprint, Nvidia
- Members are contractually forbidden from producing devices that are based off incompatible forks of Android



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18

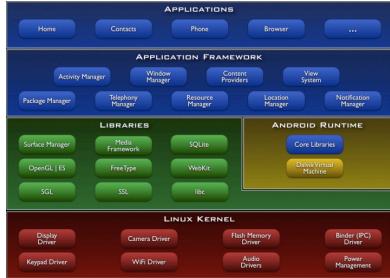
## Android Platform

- A software platform for mobile devices
  - Phones, tablets, cameras, wearables, TVs, autos
- Android is based on Linux kernel
  - Only the kernel
  - Exclude most Linux libraries and utilities
  - Add Android specific drivers
- Optimized for resource-constrained devices
  - Slower CPU
  - Less memory
  - Limited battery life, low power consumption

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19

## Android System Architecture



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## Android System Architecture

- Linux Kernel
  - Device drivers, power management, ...
- Libraries
  - Media, graphics, files, network, security, database, ...
  - Android libraries, runtime (VM)
- Android application framework
  - Activities, views, resource, notification, location, ...
- Applications
  - Home, Contact, Phone, Browser, ...

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## Android and Java

- Android apps are written in Java
  - Supports Java 6 & 7. No Java 8 support
  - Include most class libraries in Java SE, not all.
    - No AWT/Swing. No RMI
- Android Java libraries
  - basic java classes – java.\* , javax.\*
  - app lifecycle – android.\*
  - Internet/Web services – org.\*
  - Unit testing – junit.\*

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## Android Runtime

- Two main components
  - Runtime Java libraries
  - ART virtual machine (VM)
- Android apps are executed by the *Android Runtime* (ART) VM
  - ART VM is not compatible with JVM
  - Executes dex code, not Java byte code
  - Needs to compile Java byte code to dex code
  - ART replaces Dalvik VM in Android 4.4

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23

## The Life of Android Apps

- Android apps are written in Java
- Java source code is compiled to Java byte code (.class) files
- Android DX Compiler converts Java byte code files to a single dex byte code file (**classes.dex**)
  - May include 3<sup>rd</sup> party Java libraries
- Packaged into an Android package (.apk)
  - Deployed onto a device or emulator
- Android runtime VM executes dex byte code.

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24

## Android Version History

- Android alpha/beta (ver. 1.0, API level 1, 2) – 2007-2008
- Cupcake (ver. 1.5, API level 3) – 2009
- Doughnut (ver. 1.6, API level 4) – 2009
- Eclair (ver. 2.0–2.1, API level 5, 6, 7) – 2009-2010
- Froyo (ver. 2.2–2.2.3, API level 8) – 2010
- Gingerbread (ver. 2.3–2.3.7, API level 9, 10) – 2010-2011



Android Garden

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25

## Android Version History

- Honeycomb (ver. 3.0–3.2.6, API level 11, 12, 13) – 2011
- Ice Cream Sandwich (ver. 4.0–4.0.4, API level 14, 15) – 2011-2012
- Jelly Bean (ver. 4.1–4.3.1, API level 16, 17, 18) – 2012-2013
- KitKat (ver. 4.4–4.4.4, API level 19, 20) – 2013-2014
- Lollipop (ver. 5.0–5.1.1, API level 21, 22) – 2014-2015
- Marshmallow (ver. 6.0, API level 23) – 2015



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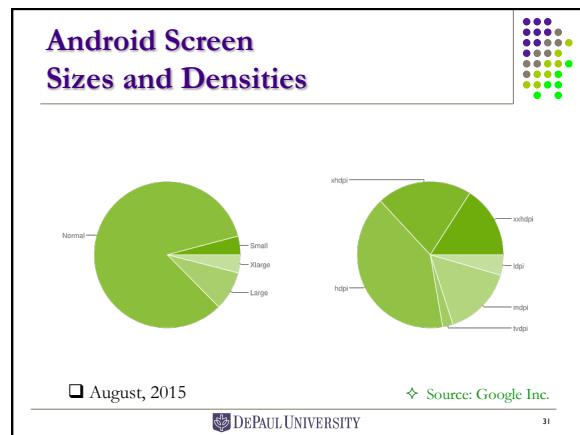
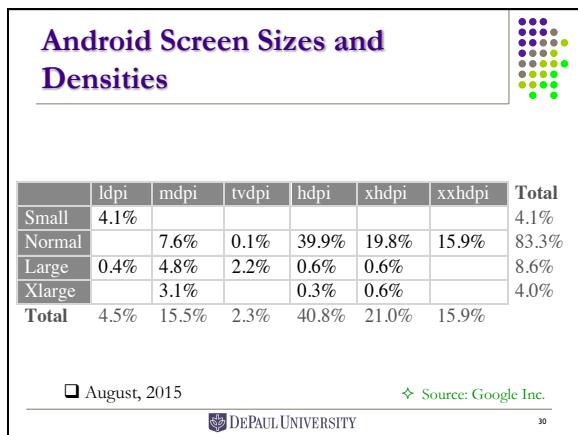
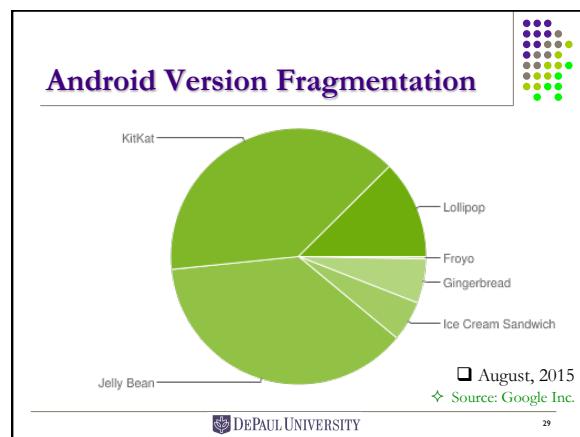
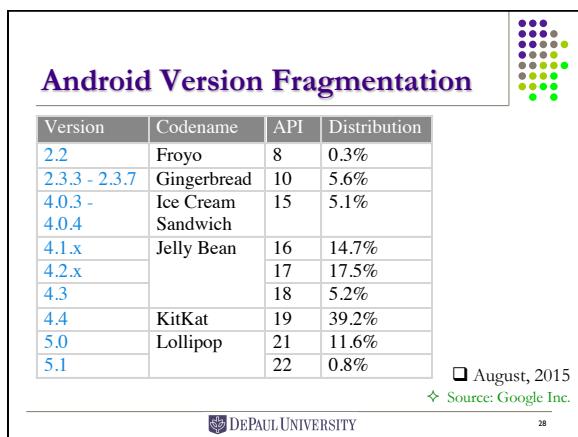
26

## Android Device Adoption



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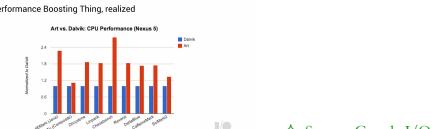
27



- ### UI Improvements
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- New *material* theme
    - A design for visual, motion, and interaction
    - View shadows
    - Animation, touch feedback, reveal effect, transition
  - New widgets for complex views
  - Notifications
  - Web view
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## Performance Improvements

- New Android Runtime (ART)
  - Ahead-of-Time (AOT) compilation
  - Improved garbage collection (GC)
  - Improved debugging support



❖ Source: Google I/O

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## Android Wear

- Connects Android phone/tablet (4.3 or higher) to wearable devices.
- New Ware API
  - Notifications
  - Sync with handheld apps
  - Voice action
  - Customized UI
  - Design styles and patterns



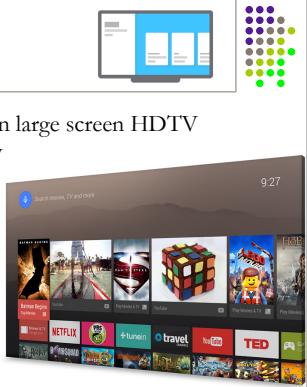
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35

## Android TV

Optimized apps to run on large screen HDTV

- Customized UI for TV
- Navigation
- Browse
- Search
- Recommendation
- Games for TV

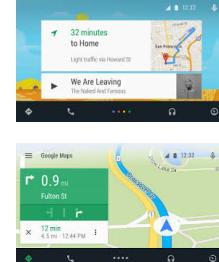


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## Android Auto

- Connect Android device to an Android compatible vehicle
- Control Android apps through vehicle's screen and controls
  - Media UI
  - Notifications
  - Voice actions



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## Next ...

- Get to know Android
- Set up Android development environments
- Develop your first Android app



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39