An Introduction to Android for Developers

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Introduction

Goals

GUC

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Introduction Goals

- Get you Started with Android Development
- Get the Environment Set Up and Working
- Create Some Demo Apps (Tutorials)
- Demonstrate the Tools / Environment
- Introduction to the Documentation
  - (Which is changing...)
- Build Enthusiasm (you can do it)

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Introduction Goals

- Differences from Other Environments
  - UI - Declarative XML Layout
  - Activities
  - Intents / Intent Receivers
  - Services
  - Content Providers
  - Application Life Cycle
- Project Structure
  - Files, Resources, Building

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Tools

- SDK
  - Command line tools (adb, aidl, etc.)
  - Supporting Libraries
- IDE (We will use Eclipse)
  - Eclipse Plugin
  - Included:
    - Debugger
    - Profiler
    - Resource Building
    - Deployment

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Not Covered

- Java Development Basics
- Similarities to Other Environments
- Parts that Aren't Ready
  - Syncing etc.
- Anything We Can't Get to in time!
- Get you going, not teach you everything

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GUI Creation / Layouts

GUI

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GUI Creation

- Different from
  - Java Swing
  - Java ME
- Layouts
  - res/layout - XML Files Go Here
  - Layouts - Can be Nested
- Strings / i18n
  - res/values/strings.xml
  - Deployment

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GUI Creation

- IDs / Lookup
  - Used to Bridge Views / Java Code
  - @+id/myname Syntax
- Resource Building
  - Eclipse Plugin Builds into R.java
  - Efficient Resource Creation / Representation
  - Less Chance of Programatic Errors (Intellisense)
- XML Declarative Faster to Develop

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Layout Basics

- Views
  - Basic Building Blocks
  - TextView, EditText, Button, ImageView, Checkbox, Lists, etc
- Layouts
  - FrameLayout : Each Child a Layer
  - LinearLayout : Single Row / Column
  - RelativeLayout : Relative to Parent / Other Views
  - TableLayout : Rows and Columns - HTML like
  - AbsoluteLayout : <x,y> Coords - Discouraged
- Layouts can be Nested

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Layout Parameters

- Parameters Control Many Aspects
- Some are More Common:
  - <android:layout_width> and <android:layout_height>
    - “wrap_content”, “fill_parent”, values...
  - <android:layout_weight>
    - Relative amount of available space to use
- Most are in the Docs
  - Class Reference documentation most useful

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When Things Go Wrong

- Android is still early-release software
- Most problems fall within two areas
  - Build Problems
    - R class not updated or running old code
    - Look at console and problems pane
    - Clean Build
  - Communication breakdown to emulator
    - Code not deploying, errors, debugger failure
      - Use DDMS Reset ADB option
      - Or: quit eclipse and emulator, adb kill-server

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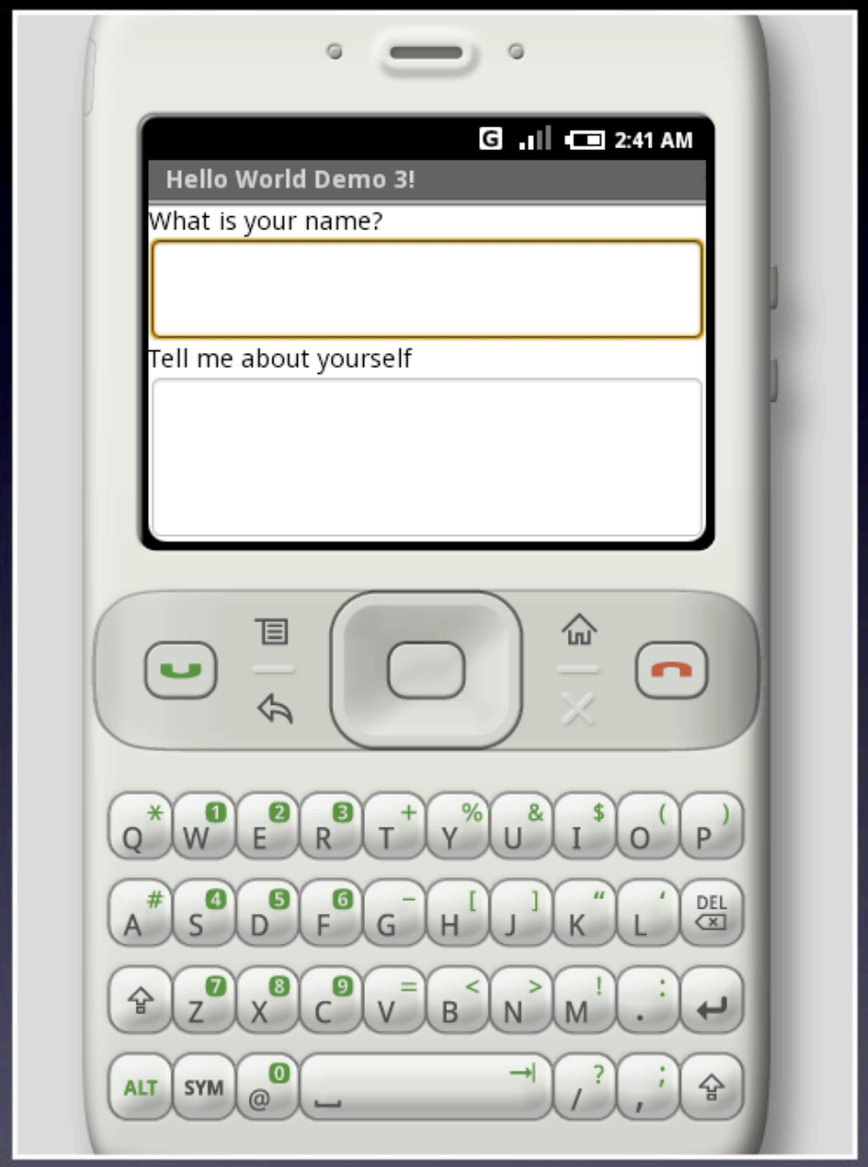
Hello World Demo

First Project with Eclipse

Layout Experimentation



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Concepts

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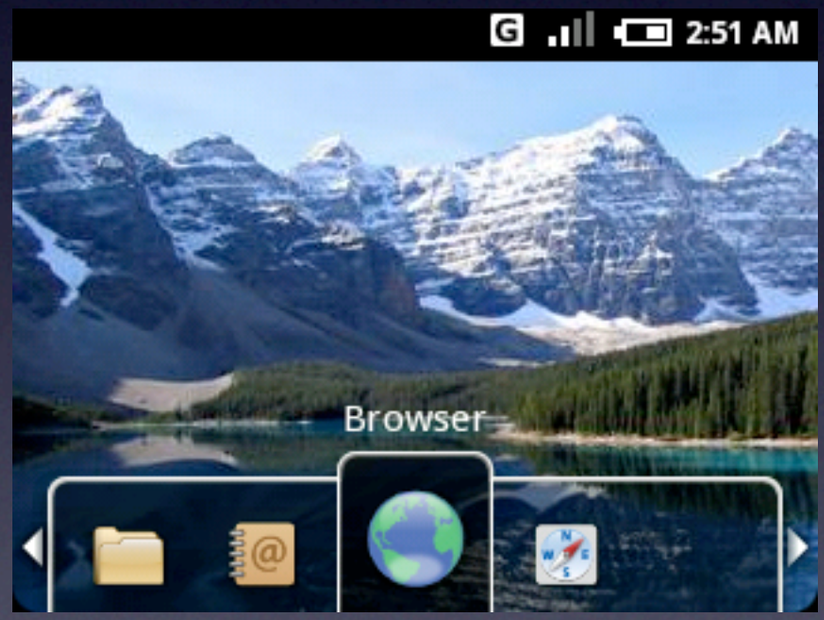
Activities

- Typically corresponds to one screen in the UI
  - Can be faceless
  - Can be in a floating window
  - Can return a value
  - Can be embedded



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Intents & IntentFilters

- Intents: description of what you want done
- IntentFilter: what an Activity or IntentReceiver can do
- Activities publish their IntentFilters in AndroidManifest.xml

Intents & IntentFilters

- Forward navigation is accomplished by resolving Intents
  - Caller calls startActivity(intent) (or startSubActivity...)
  - System picks Activity whose IntentFilter best matches intent
  - New Activity is informed of the Intent

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IntentReceivers

- Respond to alarms and notifications
  - Including those originating externally
- Will wake up your process if necessary
- System can broadcast intents: data connection, phone state changed, etc
- Apps can invent and broadcast their own intents

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IntentReceivers

- IntentReceivers can (should) start Services for lengthy tasks (e.g. downloading new data)
- IntentReceivers can put up UI notifications
- Register IntentReceivers in AndroidManifest.xml
- Can also attach IntentReceivers to other objects so they can receive notifications (Activities, Views, etc.)

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Services

- Faceless classes that run in the background
  - Music player, network download, etc.
- Services run in your application's process or their own process
- Your code can bind to Services in your process or another process
- Once bound, you communicate with Services using a remotable interface defined in IDL

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ContentProviders

- Enable data sharing across applications
- Provide uniform APIs to:
  - query data (returns a Cursor)
  - delete, update, and insert rows
- Hide underlying implementation
- Work across processes

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ContentProviders

- All content is represented by URIs
  - Convenience methods mean clients don't need to know syntax
- ContentProviders own URIs based on authority, e.g. content://contacts/...
- ContentProviders are responsible for mapping URIs they own to a MIME type

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Quick Dial Code Walkthrough

Eclipse Import + Code Walkthrough

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Life Cycle & Bundles

Application Lifecycle

- Applications run in their own processes
  - Many Activities, Services, etc. can run in the same process
- Processes are started and stopped as needed to run an application's components
- Processes killed to reclaim resources

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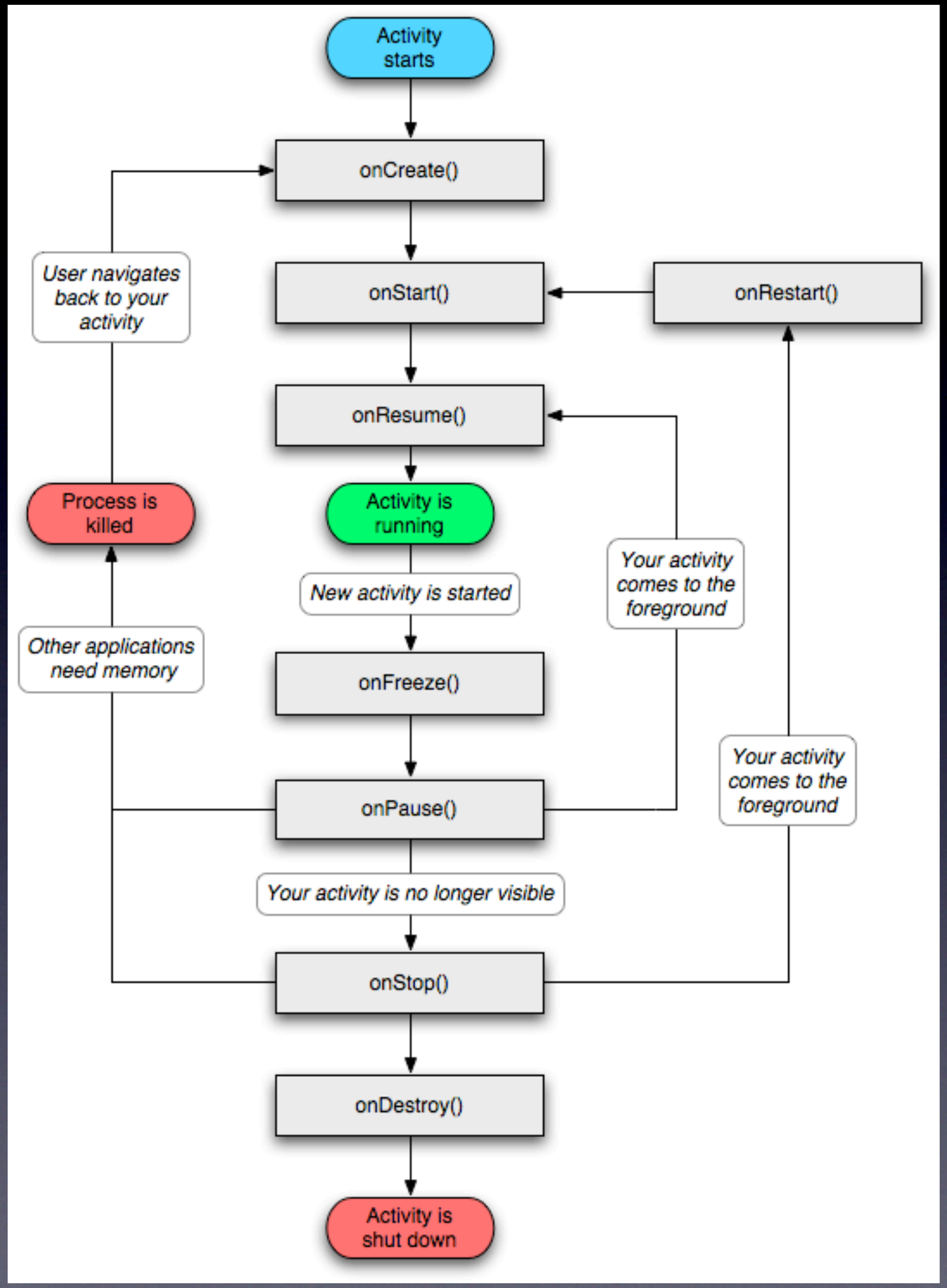

Life Cycle of an Application

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Activities

- Designed to be reused and replaced
  - Your application can invoke Activities from another application
  - Another application can invoke your Activities
- Existing Activities can be replaced with a new Activity that fulfills the same contract

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Activity Lifecycle

- An Application can have Several Activities
- Activities can be started with
  - startActivity() - Synchronous
  - startSubActivity() - Asynchronous, with handler callback
- Each Activity has its Own Life Cycle
- Messages can be Passed with Bundles
- Like Services on a Bus

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Bundles

- Similar in concept to a simple Map
- Can put data into Bundle under a name
  - bundle.putString(“name”, <data object>)
- Can also be retrieved by name
  - bundle.getString(“name”)
- Bundles used to pass messages/store state
- onFreeze() has outState bundle passed in
- Data stored in outstate handed back to onCreate as the icicle bundle

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Storage / Persistence

- Normally handled by ContentProvider
  - Front end to File, DB, Online Service, etc.
- SQL Lite is Available to Developers
  - Simple SQL DB
- Can also access flat files
- Online communication yet to be formalized

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Note Pad Example

See the Tutorial in the SDK

Multi-stage exercise to illustrate the basics.

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ROOT

Resources, Packaging and Security

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Resources

- Added under the res/ folder
  - layout, drawable, anim, values, xml, raw
  - layout for declarative layout files
  - drawable/anim for bitmaps, transitions, etc.
  - values includes strings, arrays, colors, dimensions, styles and more
  - xml for general XML files available at runtime
  - raw for binary files (e.g. sound)
- Compiled into the apk
  - Read through API convenience methods
  - e.g. XML access looks like a pull parser

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Assets

- Similar to Resources, but...
  - InputStream access to Assets
  - Placed under assets folder
  - Looks like a “root” folder to app
  - Read only access
- Any kind of file
  - Stored on device - watch the size

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APK files

- Android Packages
  - All class files and resources needed to run
    - Class files recoded to dex
  - Manifest defines activities and other facets
- DEX
  - Dalvik Executable
  - More compressed form than bytecode
  - Third party libs can be converted to dex
- APK is the application
  - Install - put APK in data/app
  - Uninstall - remove APK

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Security

- Unique Users for Apps
  - App completely sandboxed
  - Sharing only via ContentProviders, Activities, IntentReceivers, Services, etc.
  - Strong, linux-backed security
- Access to Restricted Features
  - Must be declared in the Manifest
  - Still working on rest of security model
  - Some kind of trusted authority
  - Advanced users should have fine grained control

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Other APIs

GUI

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2D Graphics

- Similar to the Java 2d API
  - Canvas passed in to graphics methods
  - Drawable Resources
  - Alpha channel available
  - Supports transformations (e.g. Rotate, Scale)
- Custom Graphical Components
  - Extend View
  - Override onDraw()
  - Override onMeasure() - setMeasuredDimension()
  - Other Optional Overrides: onKeyDown(), onKeyUp(), onMotionEvent(), etc.

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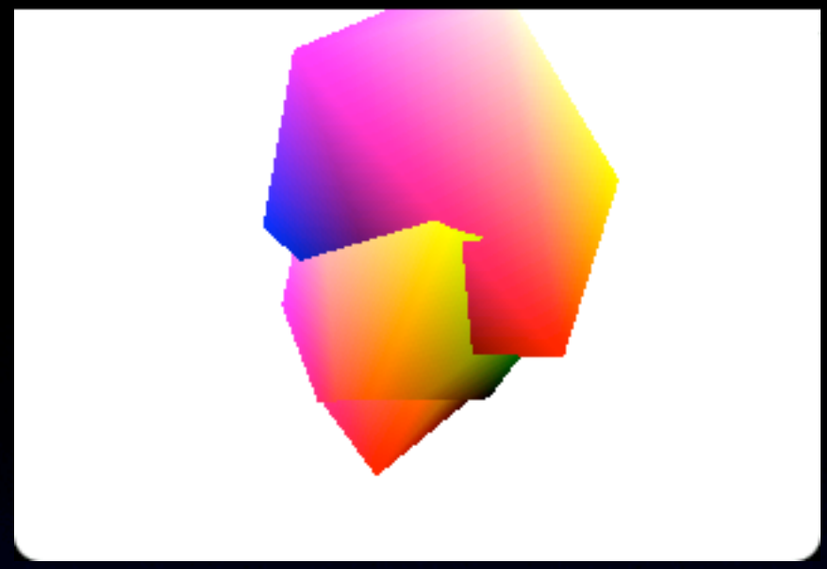
3D Graphics



- Optional Hardware Support
- OpenGL ES 1.0 (+ some 1.1 features)
  - Corresponds to OpenGL 1.3 for desktop
- Using the API
  - Extend View
  - Obtain handle to OpenGLContext
  - Obtain handle to GL object in onDraw()

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Location Based Services

- Optional Hardware Support for GPS
  - But Cell ID supported on all devices
- LocationProvider
  - Part of the android.location package
  - Use LocationManager to get location and bearing
  - Context.getSystemService (Context.LOCATION_SERVICE)
- Mock LocationProviders
  - Test in the Emulator
  - /data/misc/location/<provider_name>
  - class, kml, nmea, track file support

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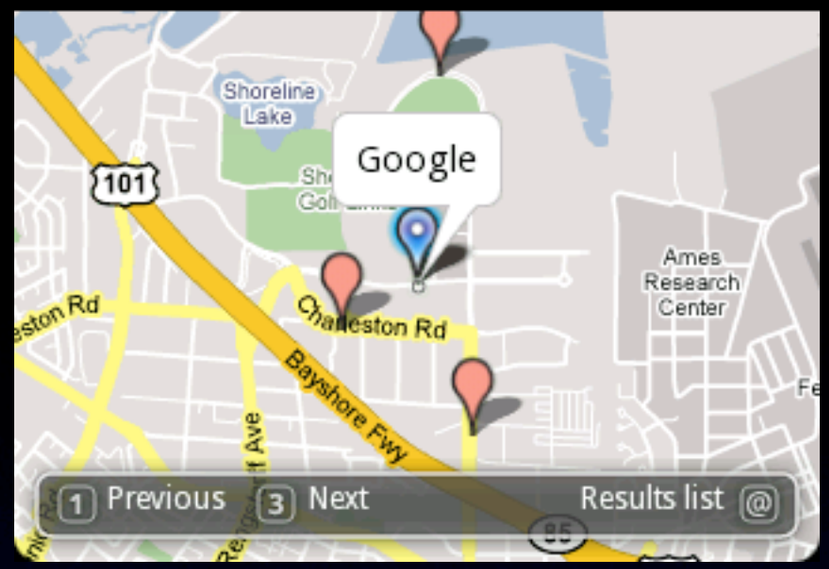
Maps



- Natural complement to LBS
- MapView and MapActivity
  - MapActivity easier to use
  - MapView can be embedded in your app
- MapView more flexible
  - Can surround with your own controls
  - And, can trigger events in your own activity
  - But, more involved API
  - Must be created in a MapActivity subclass

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Media

- Play back and Record media files
- Audio, Picture and Video
  - CODECs still being decided
- Access through Intents
  - Stream from a URL
  - Set MIME type to help decide action
- Also, class level API
  - Embed playback (e.g. sound effects)
  - Recording

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XMPP

- Alternative to SMS for message passing
- Can pass richer content, including bundles
  - Strings only at present
- Can fire Intents
- Server initiated push

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Low-Level H/W Access

- APIs not yet available
- Will cover low-level hardware, e.g.
  - Bluetooth
  - WiFi

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Learning More

Learning More

- Sample Apps
  - Lunar Lander, Snake - 2d graphics, game
  - Notepad - ContentProvider, Painting override
  - SampleCode - Layouts, Services, Intents & Receivers, much more
- Online
  - groups.google.com/group/android-developers
  - /android-beginners, /android-discuss, /android-internals, /android-challenge
  - http://android.com
  - http://code.google.com/android

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Documentation

- Currently Being Improved
  - Class Documentation Coverage
  - Accessibility
  - Additions - Like Samples, Tutorials, etc.
- Demo
  - Tutorials
  - Class References
    - Including Layout Parameters
  - What's Included in the Class Libs?

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Command Line Tools

- ADB
  - adb shell - command line into emulator/device
    - Simple unix-like shell
    - Can delete apk files from data/app
    - adb install - add packages
- Emulator
  - Many command line flags
    - Different resolution, options, etc.
- Other Commands
  - See documentation for aidl, aapt, etc.
- Don’t have to use Eclipse

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Questions?

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