

Google™



A Beginner's Guide to Android

Reto Meier
May 19, 2010

@retomeier

What is Android?

- An open source, open platform for mobile development
- All the SDK, API, and platform source is available
- No licensing, no app review
- Replace any system app with your own

developer.android.com

Android Best Practices for Beginners

Reto Meier
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Your Choice



Your Consequences

Sorry!
Activity Badly Written Activity (in application Badly Written Application) is not responding.
Force close

Rate it!
★☆☆☆☆
Poor
OK Cancel

Uninstall application?
This application will be removed from your phone.
OK Cancel

Comments

Michael 4/9/2010 ★☆☆☆☆
It sucks on Droid. Doesn't work. Uninstall. ✕

FREE ★☆☆☆☆

1,000-5,000 downloads 19 ratings

Installed ★★★★★

My review

★★★★★
My rating

Post a comment

>250,000 downloads 59415 ratings

Agenda

- The Five Deadly Sins
- The Five Glorious Virtues
- Two Practical Examples

The Five Deadly Sins



The Five Deadly Sins



S L O T H

Be Fast. Be Responsive.

The Golden Rules of Performance

- Don't do work that you don't need to do
- Don't allocate memory if you can avoid it

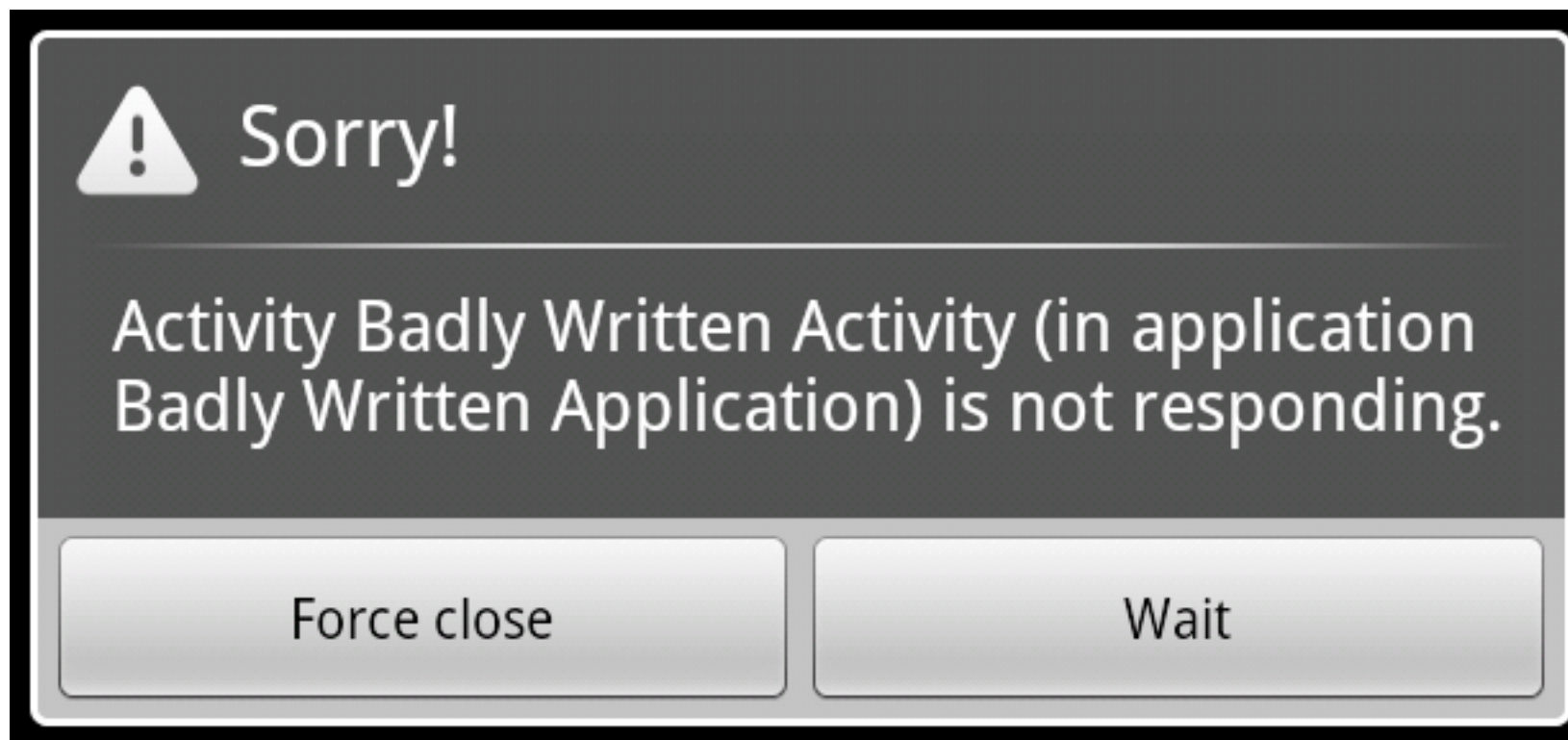
Performance Pointers

- Optimize judiciously
- **Avoid creating objects**
- Use native methods
- Prefer Virtual over Interface
- Prefer Static over Virtual
- Avoid internal setters and getters
- Declare constants final
- Avoid float and enums
- Use package scope with inner classes

Responsiveness

- Avoid modal Dialogues and Activities
 - Always update the user on progress (ProgressBar and ProgressDialog)
 - Render the main view and fill in data as it arrives
- "Application Not Responding"
 - Respond to user input within **5 seconds**
 - Broadcast Receiver must complete in **10 seconds**
- Users perceive a lag longer than **100 to 200ms**
- Use Threads and AsyncTasks within Services

Application Not Responding



Responsiveness

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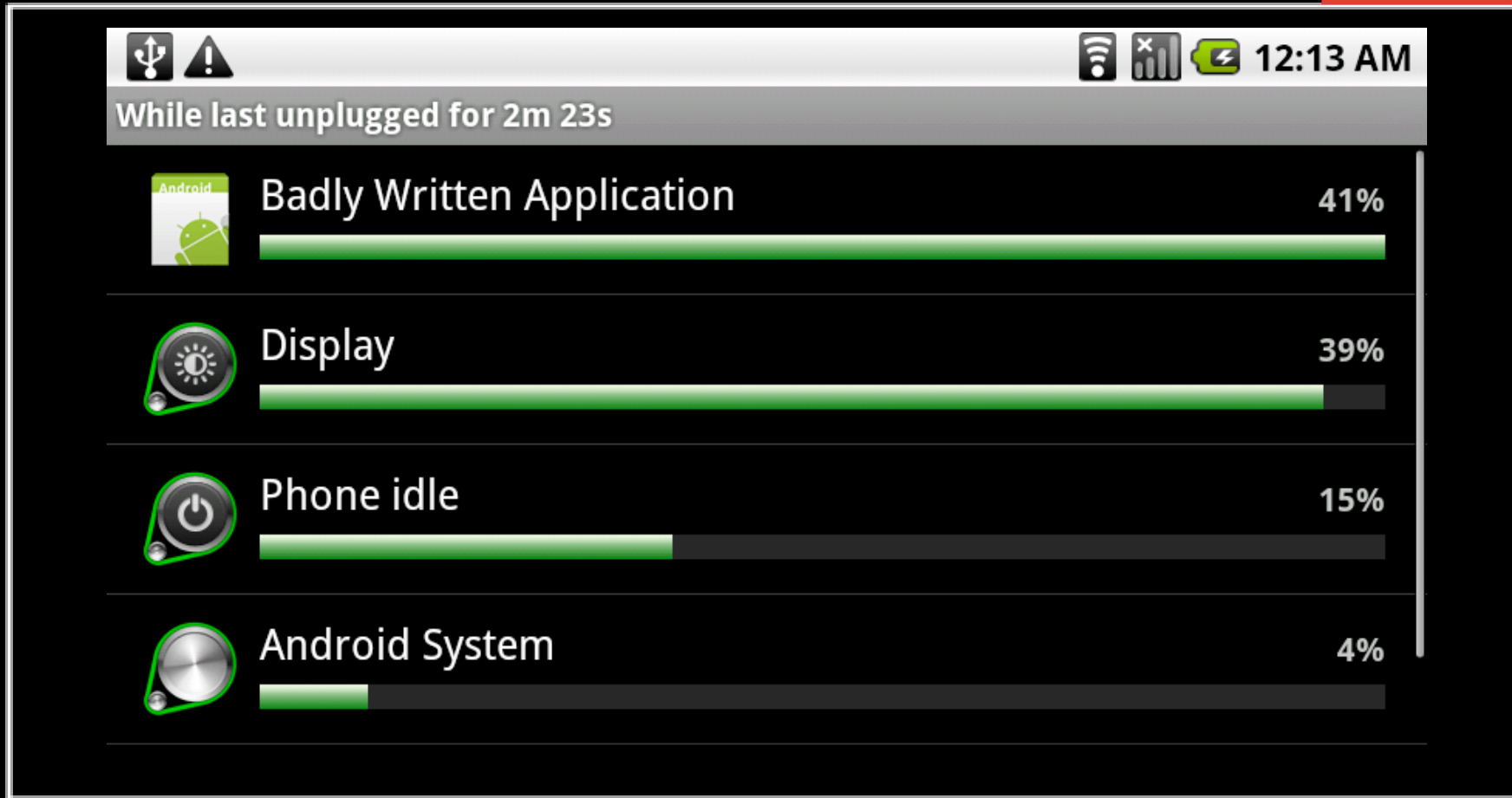
AsyncTask

```
protected void doInBackground(Void... arg0) {  
    // Do time consuming processing  
    publishProgress();  
    return null;  
}
```

```
protected void onProgressUpdate(Void... arg0) {  
}
```

```
protected void onPostExecute(Void result) {  
}
```


The Five Deadly Sins



GLUTTONY

Use system resources responsibly

Gluttony

Don'ts

- **DON'T** over use WakeLocks
- **DON'T** update Widgets too frequently
- **DON'T** update your location unnecessarily
- **DON'T** use Services to try to override users or the system

Dos

- **DO** share data to minimize duplication
- **DO** use Receivers and Alarms not Services and Threads
- **DO** let users manage updates
- **DO** minimize resource contention

What is a WakeLock?

- Force the CPU to keep running
- Force the screen to stay on (or stay bright)
- Drains your battery quickly *and* efficiently

```
PowerManager pm =  
    (PowerManager) getSystemService (Context.POWER_SERVICE) ;  
  
PowerManager.WakeLock wl =  
    pm.newWakeLock (PowerManager.SCREEN_DIM_WAKE_LOCK,  
        "My Wakelock") ;  
  
wl.acquire (10000) ;  
    // Screen and power stays on  
wl.release () ;
```

Using WakeLocks

- Do you really need to use one?
- Use the minimum level possible
 - `PARTIAL_WAKE_LOCK`
 - `SCREEN_DIM_WAKE_LOCK`
 - `SCREEN_BRIGHT_WAKE_LOCK`
 - `FULL_WAKE_LOCK`
- Release as soon as you can
- Specify a timeout
- Don't use them in Activities

Window Managed WakeLocks

- No need for permissions
- No accidentally leaving the screen from the background

```
getWindow().addFlags(  
    WindowManager.LayoutParams.FLAG_KEEP_SCREEN_ON);
```

The Five Deadly Sins



HOSTILITY

Don't fight your users

Hostility

- User experience should be your top priority

Hostility

- User experience should be your top priority
- Respect user expectations for navigating your app

Doing what the user expects with respect to navigation flow is absurdly important for overall user satisfaction.

Respect User Expectations for Navigation

- The back button should **always** navigate back through previously seen screens
- Always support trackball navigation
- Understand your navigation flow when entry point is a notification or widget
- Navigating between application elements should be easy and intuitive

Hostility

- User experience should be your top priority
- Respect user expectations for navigating your app
- **Don't hijack the native experience**

Don't Hijack the Native Experience

- Don't hide the status bar
- Back button should always navigate through previous screens
- Use native icons consistently
- Don't override the menu button
- Put menu options behind the menu button

Hostility

- User experience should be your top priority
- Respect user expectations for navigating your app
- Don't hijack the native experience
- **Respect user preferences**

Respect User Preferences

- Use only enabled location-based services
- Ask permission before transmitting location data
- Only transfer data in the background if user enabled

```
ConnectivityManager cm = (ConnectivityManager)
    getSystemService(Context.CONNECTIVITY_SERVICE);
```

```
boolean backgroundEnabled =
    cm.getBackgroundDataSetting();
```

The Five Deadly Sins



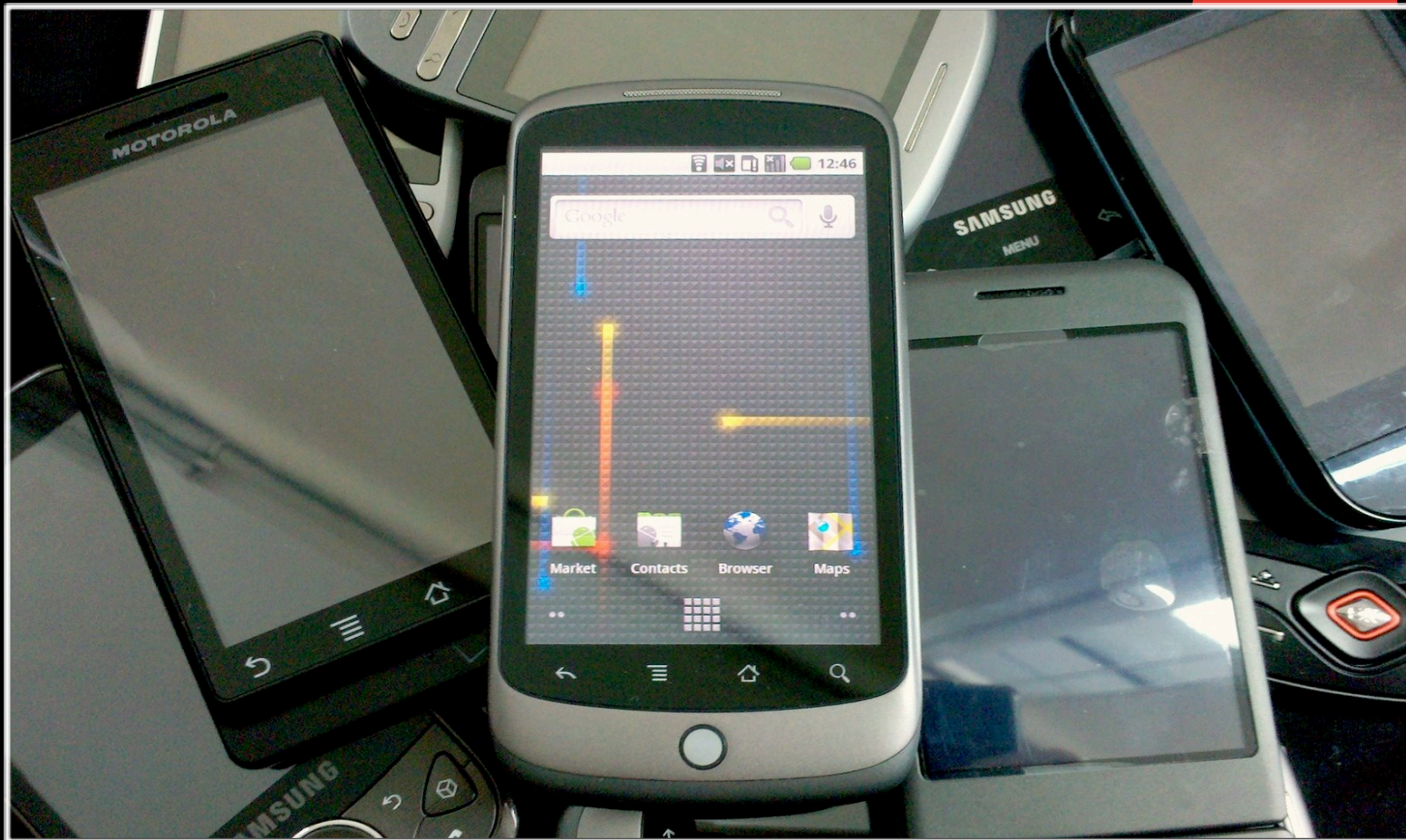
ARROGANCE

Don't fight the system

Arrogance

- Don't use undocumented APIs
- Seriously. Don't use undocumented APIs
- Make your app behave consistently with the system
- Respect the application lifecycle model

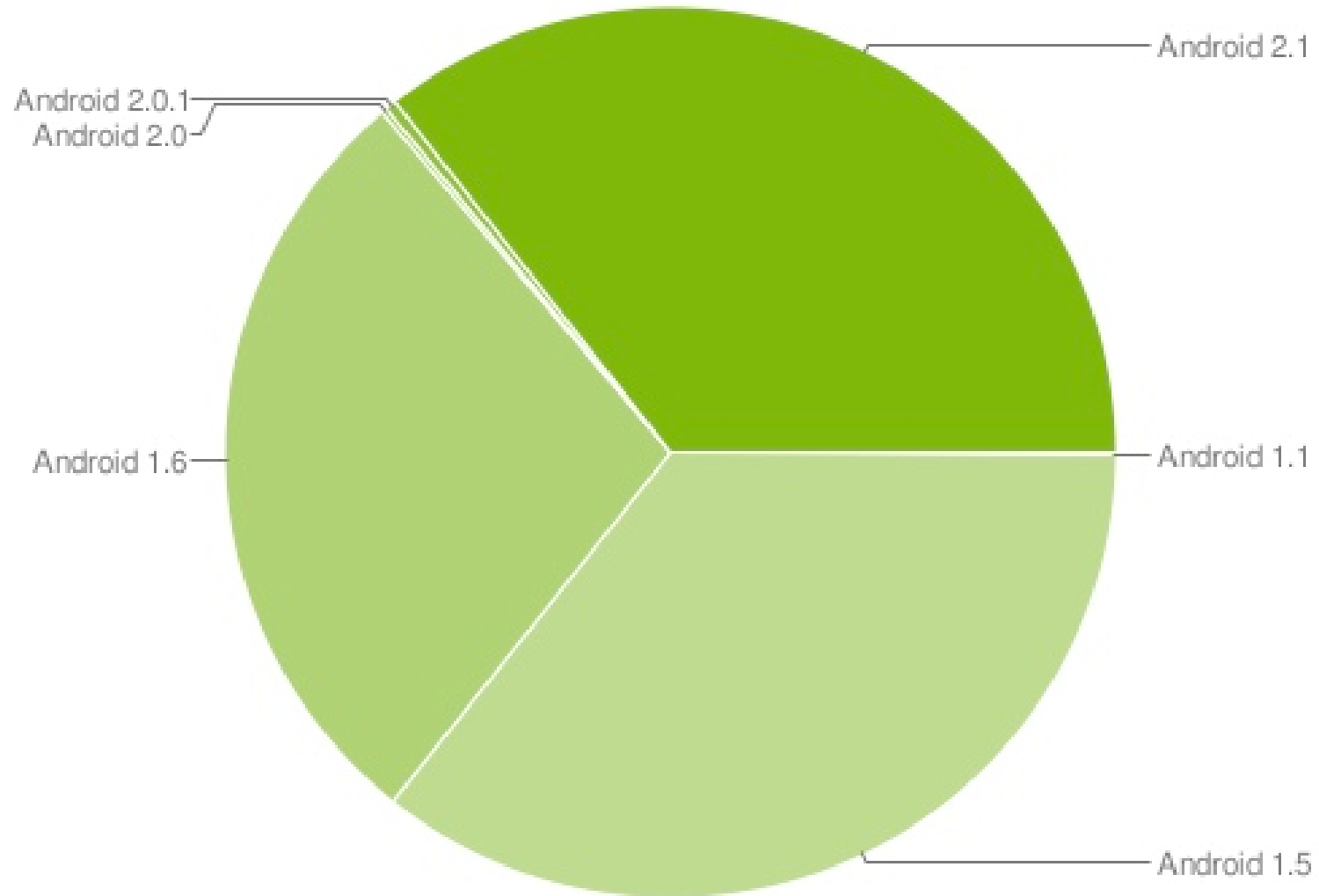
The Five Deadly Sins



DISCRIMINATION

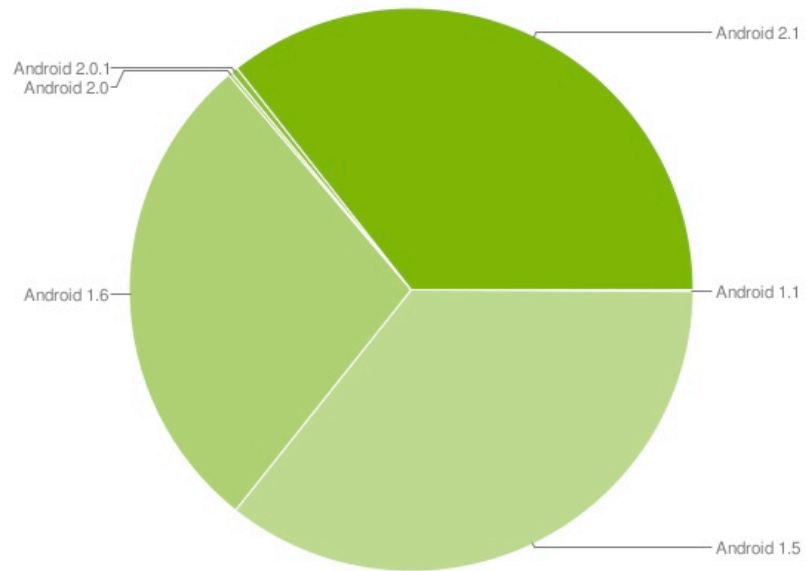
Design for everyone

Discrimination



Discrimination

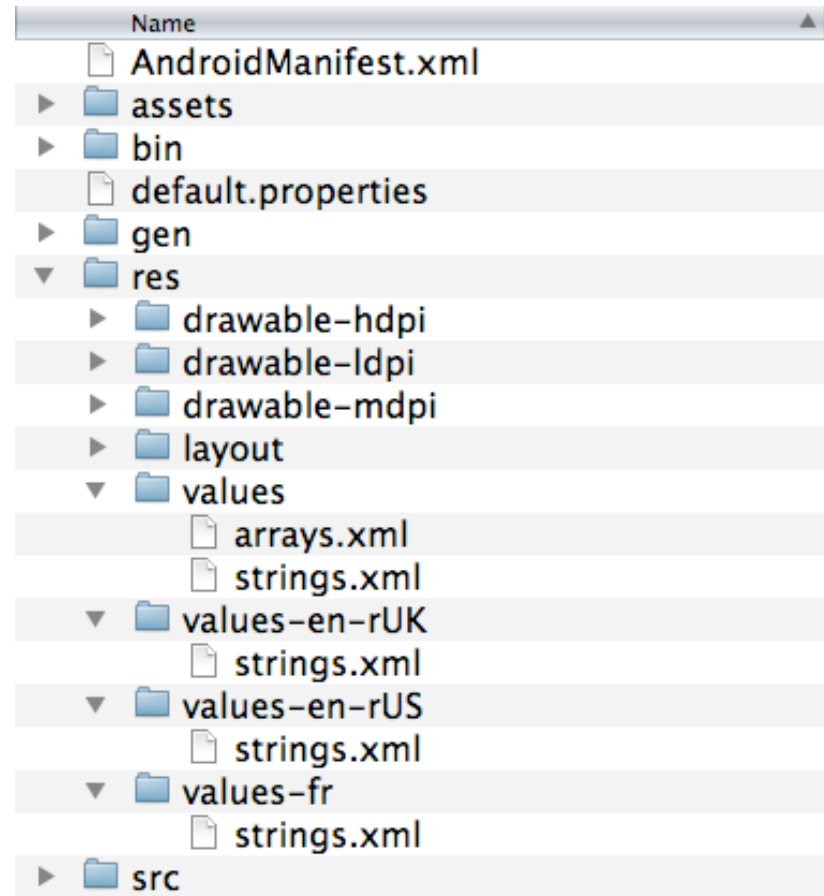
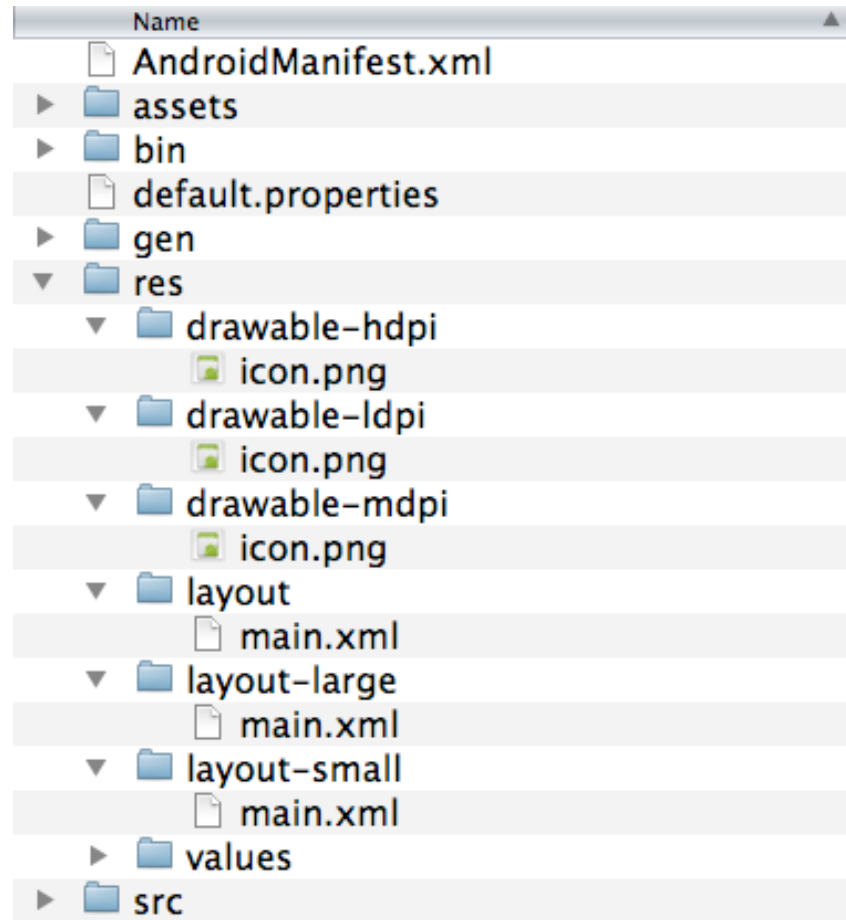
- Don't make assumptions about screen size or resolution
- Never hard-code string values in code (or XML)
- Use Relative Layouts and device independent pixels
- Optimize assets for different screen resolutions
- Use reflection to determine what APIs are available



Store Values as Resources

- Define strings, colors, dimensions, and arrays
- Also store images and layouts
- Never rely on hard-coded values
- Reference resources in code and XML
- System will select from the right resource folder

Resource Hierarchy



Agenda

- The Five Deadly Sins
- **The Five Glorious Virtues**
- Two Practical Examples

The Five Glorious Virtues



The Five Glorious Virtues



BEAUTY

Hire a designer

Beauty

- Programmers are not designers!
- 4.15pm today "Android UI Design Patterns"
- Create assets optimized for all screen resolutions
 - Start with vectors or high-res raster art
 - Scale down and optimize for supported screen
- Support resolution independence
- Use tools to optimize your implementation
 - layoutopt
 - hierarchyviewer

The Five Glorious Virtues



GENEROSITY

Share and consume

Where and OpenTable

12:44

American (New) Citysearch

RNM Restaurant in San Francisco
"Delicious small plates. \$25 Prix Fixe Menu. Tues-Sat. 5:30-7pm."
within distance: **unrestricted**

Sauce
131 Gough St
San Francisco, CA
0.1 mi
Restaurants, Catering, Late Night Dining, Dancing, French
50 reviews
★★★★★

DD
687 McAllister St (beneath Indigo restaurant)
San Francisco, CA

We have a coupon in San Francisco!
Bocanova

12:45

Overview In words Reviews Map

Your Rating: ★★★★★

(415) 252-1369

Check-in Been Here

View the Menu
Website
Flag Venue Incorrect
Share this place

Save

Reserve Now

We have a coupon in San Francisco!
North Beach Pizza (Stanyan)

Where and OpenTable

12:45

Find a Table

LOCATION

Sauce

DATE & TIME

Fri, May 14, 2010 7:00PM

PARTY SIZE

2

Find a Table

12:46

Sauce



American
131 Gough St
San Francisco CA, 94102

Party Size 2

Date Friday May 14, 2010

6:45PM 7:00PM 7:15PM

Sauce writes...

At Sauce we serve what we like to call "Social Cuisine" — American comfort fare so good you'll want everyone at the table to try a bite. It's shared food without the tiny plates. Come sample Chef Ben's creations along with some drinks in the intimate Supper Club; cozy up to the beautiful redwood bar for a signature cocktail; or enjoy a meal in

Generosity

- Use Intents to leverage other people's apps
- Define Intent Filters to share your functionality

Using Intents to Start Other Apps

- Works just like your own Activity
- Can pass data back and forth between applications
- Return to your Activity when closed

```
String action = "com.hotelapp.ACTION_BOOK";
```

```
String hotel = "hotel://name/" + selectedhotelName;  
Uri data = Uri.parse(hotel);
```

```
Intent bookingIntent = new Intent(action, data);  
startActivityForResult(bookingIntent);
```

Activity Intent Filters

- Indicate the ability to perform an action on data
- Specify an action you can perform
- Specify the data you can perform it on

```
<activity android:name="Booking" android:label="Book">
  <intent-filter>
    <action android:name="com.hotelapp.ACTION_BOOK" />
    <data android:scheme="hotel"
          android:host="name" />
  </intent-filter>
</activity>
```

Activity Intent Filters

```
@Override
public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(r.layout.main);

    Intent intent = getIntent();

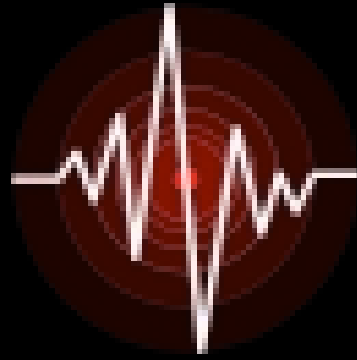
    String action = intent.getAction();
    Uri data = intent.getData();

    String hotelName = data.getPath();

    // TODO Provide booking functionality

    setResult(RESULT_OK, null);
    finish();
}
```


The Five Glorious Virtues



UBIQUITY

Be more than an icon

Ubiquity

- Create widgets
- Surface search results into the Quick Search Box
- Live Folders
- Live Wallpapers
- Expose Intent Receivers to share your functionality
- Fire notifications

The Five Glorious Virtues



UTILITY

Be useful. Be interesting.

Ocado



£0.00 no items

Hi Kristy



Book a delivery



Your next available slot is currently 10.00AM - 11.00AM, Sat (15/05/10)



My orders

You have no current orders



Start shopping



View instant shop

Your basket is currently empty



£0.00 no items

Fruit Apples & Pears

Bought before



Pink Lady Apples Waitrose
4 per pack

£1.98 (49.5p each)

Add

Life 5 days guaranteed*
(average 9)



Braeburn Apples Waitrose
4 per pack

£1.38 (34.5p each)

Add

Life 7 days guaranteed*
(average 8)



Ocado Everyday Pink Lady
Apples 4 per pack

£1.89

Add

Life 7 days guaranteed*
(average 9)



Perfectly Ripe Conference
Pears Waitrose 4 per pack

£1.98 (49.5p each)

Add



£0.00 no items

Fruit, Vegetable... Fruit

Speak now

Cancel

View all 186 items >

Apples & Pears (38) >

Bananas (5) >

Citrus (20) >

Grapes (10) >

Melons & Pineapples (12) >

Berries (14) >

Stone Fruit (7) >

Exotic Fruit (13) >

Utility & Entertainment

- Create an app that solves a problem
- Present information in the most useful way possible
- Create games that are ground breaking and compelling

The Five Glorious Virtues



EPIC (NESS)

Be legendary

Epicnessicity

- Don't be satisfied with *good*
- Create unique solutions
- Invent new paradigms
- Leverage the hardware

Agenda

- The Five Deadly Sins
- The Five Glorious Virtues
- **Two Practical Examples**

Services and Alarms

Don't be "That Guy"

- Let the runtime kill your background Service
- Let your users kill your foreground Service
- Kill your own Service
- Don't even start your Service
- Do you even need a Service?
- Use Alarms
- Use inexact Alarms

Let the Runtime Kill Your Service

START_NOT_STICKY

- Services that perform a single action
- Action is performed regularly (polling!)
- Reduces resource contention

```
@Override
public int onStartCommand(Intent intent, int flags,
                          int startId) {
    // Start an AsyncTask to do work
    return Service.START_NOT_STICKY;
}
```

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Let Your Users Kill Your Service

- Only use a foreground Service if it's necessary
 - User is directly interacting with it
 - Music playback
- Provide clear options for disabling your Service
- Always use an ongoing notification
- Once it's been stopped, don't restart it without user action!

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Kill Your Own Service

- Services should only be running when needed
- Complete a task, then kill the Service

```
stopSelf () ;
```

Kill Your Own Service

```
@Override
public int onStartCommand(Intent i, int f, int sId) {
    myTask.execute();
    return Service.START_NOT_STICKY;
}
AsyncTask<Void, Void, Void> myTask = new AsyncTask<Void, Void, Void>() {
    @Override
    protected Void doInBackground(Void... arg0) {
        // TODO Execute Task
        return null;
    }

    @Override
    protected void onPostExecute(Void result) {
        stopSelf();
    }
};
```


Don't be "That Guy"

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Alarms and Intent Receivers

- Schedule updates and polling
- Listen for system or application events
- No Service. No Activity. No running Application.

Intent Receivers

```
<receiver android:name="MyReceiver">  
  <intent-filter>  
    <action android:name="REFRESH_THIS" />  
  </intent-filter>  
</receiver>
```

```
public class MyReceiver extends BroadcastReceiver {  
  @Override  
  public void onReceive(Context context, Intent i) {  
    Intent ss = new Intent(context, MyService.class);  
    context.startService(ss);  
  }  
}
```

Alarms

```
String alarm = Context.ALARM_SERVICE;  
AlarmManager am;  
am = (AlarmManager) getSystemService (alarm) ;  
  
Intent intent = new Intent ("REFRESH_THIS") ;  
PendingIntent op;  
op = PendingIntent.getBroadcast (this, 0, intent, 0) ;  
  
int type = AlarmManager.ELAPSED_REALTIME_WAKEUP ;  
long interval = AlarmManager.INTERVAL_FIFTEEN_MINUTES ;  
long triggerTime = SystemClock.elapsedRealtime () +  
                    interval ;  
  
am.setRepeating (type, triggerTime, interval, op) ;
```

Don't be "That Guy"

- Let the runtime kill your background Service
- Let your users kill your foreground Service
- Kill your own Service
- Don't even start your Service
- Do you even need a Service?
- Use Alarms and Intent Receivers
- **Use inexact Alarms**

Inexact Alarms

- All the Alarm goodness
- Now with less battery drain!

```
int type = AlarmManager.ELAPSED_REALTIME_WAKEUP;  
long interval = AlarmManager.INTERVAL_FIFTEEN_MINUTES;  
long triggerTime = SystemClock.elapsedRealtime() +  
                    interval;
```

```
am.setInexactRepeating(type, triggerTime,  
                        interval, op);
```


Location Based Services

Location Based Services

```
String serviceName = Context.LOCATION_SERVICE;  
lm = locationManager.getSystemService(serviceName);
```

```
LocationListener l = new LocationListener() {  
    public void onLocationChanged(Location location) {  
        // TODO Do stuff when location changes!  
    }  
  
    public void onProviderDisabled(String p) {}  
    public void onProviderEnabled(String p) {}  
    public void onStatusChanged(String p, int s, Bundle e) {}  
};
```

```
lm.requestLocationUpdates("gps", 0, 0, l);
```

Location Based Services

- How often do you need updates?
- What happens if GPS or Wifi LBS is disabled?
- How accurate do you need to be?
- What is the impact on your battery life?
- What happens if location 'jumps'?

Restricting Updates

- Specify the minimum update frequency
- Specify the minimum update distance

```
int freq = 5 * 60000; // 5mins  
int dist = 1000;      // 1000m
```

```
lm.requestLocationUpdates("gps", freq, dist, 1);
```

Use Criteria to Select a Location Provider

```
Criteria criteria = new Criteria();
criteria.setPowerRequirement(Criteria.POWER_LOW);
criteria.setAccuracy(Criteria.ACCURACY_FINE);
criteria.setAltitudeRequired(false);
criteria.setBearingRequired(false);
criteria.setSpeedRequired(false);
criteria.setCostAllowed(false);

String provider = lm.getBestProvider(criteria, true);

lm.requestLocationUpdates(provider, freq, dist, 1);
```

Use Criteria to Select a Location Provider

- Specify your requirements and preferences
 - Allowable power drain
 - Required accuracy
 - Need for altitude, bearing, and speed
 - Can a cost be incurred?
- Find the best provider that meets your criteria
- Relax criteria (in order) until a provider is found
- Can limit to only active providers
- Can use to find all matching providers

Implement a Back-off Pattern

- Use multiple Location Listeners
 - Fine and coarse
 - High and low frequency / distance
- Remove listeners as accuracy improves

Location Based Services

```
lm.requestLocationUpdates (bestprovider, freq, dist, 1);  
lm.requestLocationUpdates (coarseProvider, 0, 0, lcoarse);  
lm.requestLocationUpdates (bestprovider, 0, 0, lbounce);
```


Location Based Services

```
private LocationListener lbounce = new LocationListener() {  
    public void onLocationChanged(Location location) {  
        runLocationUpdate();  
        if (location.getAccuracy() < 10) {  
            lm.removeUpdates(lbounce);  
            lm.removeUpdates(lcoarse);  
        }  
    }  
    [...]  
};
```

```
private LocationListener lcoarse = new LocationListener() {  
    public void onLocationChanged(Location location) {  
        runLocationUpdate();  
        lm.removeUpdates(lcoarse);  
    }  
    [...]  
};
```

Summary

- Be good
- Don't be lazy
- Think about performance
- Think about the user experience
- Respect your users
- Respect the system
- Think BIG!

Questions?

- Twitter **@retomeier**
- Stack Overflow tag: **android**
- **developer.android.com**

- Use Wave for Q&A *right now*

<http://bit.ly/ioandroid1>

Google™

