Google Developer Day 2009

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Debugging Arts of the Ninja Masters

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Google Developer Relations

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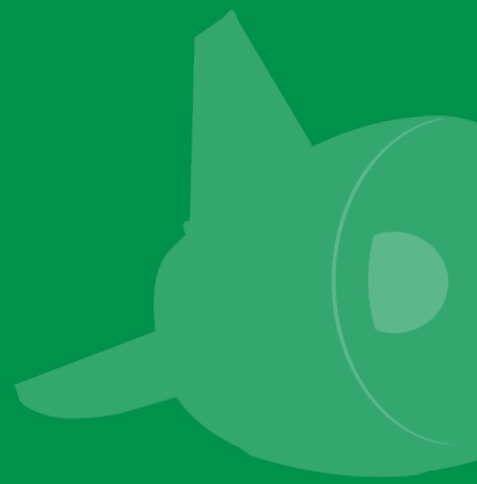
Agenda

- Tool tour
  - logcat
  - traceview
  - hierarchyviewer
- Real world usage
- Pop quiz!
- Q&A (pop quiz for me)



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logcat

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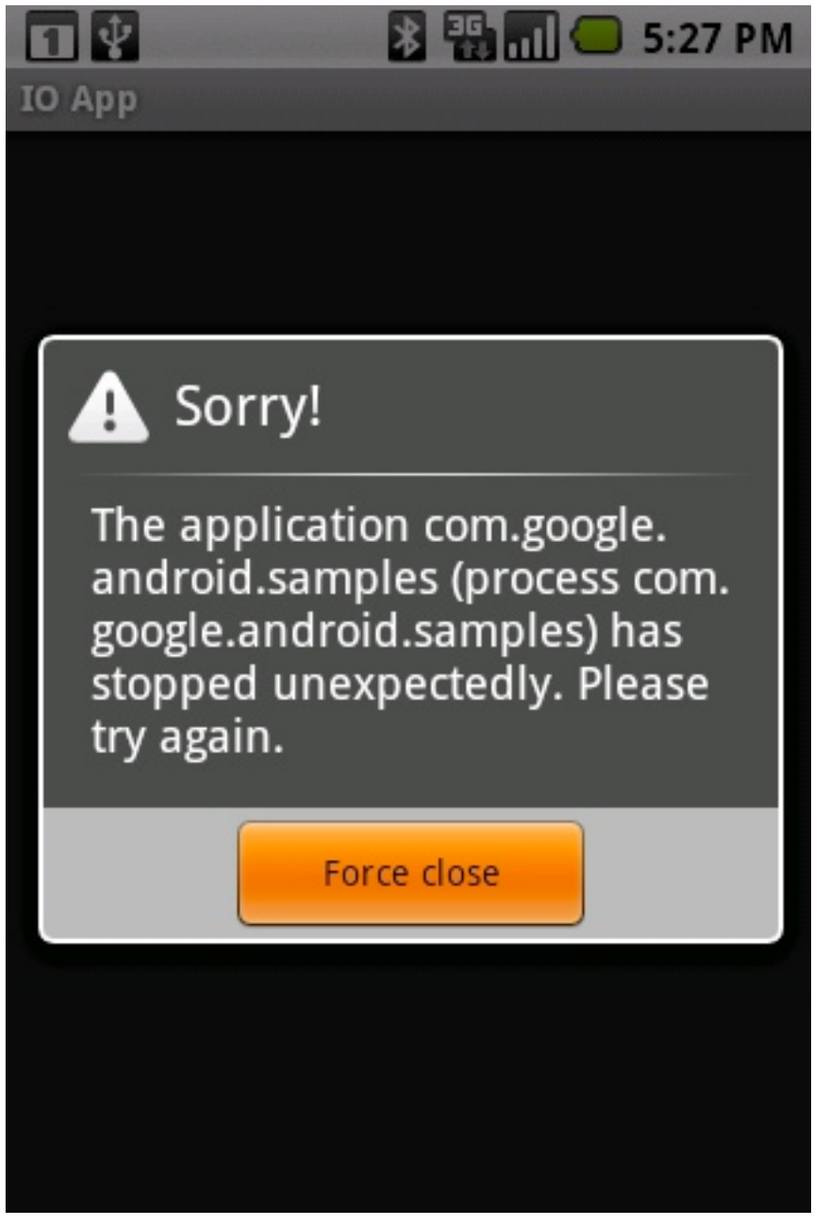
The dialog of death



Forensics

Where to begin the autopsy

```
E/AndroidRuntime( 1401): java.lang.RuntimeException: Unable to start activity ComponentInfo{com.google.android.samples/com.google.
android.samples.tasks.IoSampleApp}: java.lang.NullPointerException: uriString
E/AndroidRuntime( 1401):        at android.app.ActivityThread.performLaunchActivity(ActivityThread.java:2337)
E/AndroidRuntime( 1401):        at android.app.ActivityThread.handleLaunchActivity(ActivityThread.java:2353)
E/AndroidRuntime( 1401):        at android.app.ActivityThread.access$1800(ActivityThread.java:112)
E/AndroidRuntime( 1401):        at android.app.ActivityThread$H.handleMessage(ActivityThread.java:1758)
E/AndroidRuntime( 1401):        at android.os.Handler.dispatchMessage(Handler.java:99)
E/AndroidRuntime( 1401):        at android.os.Looper.loop(Looper.java:123)
E/AndroidRuntime( 1401):        at android.app.ActivityThread.main(ActivityThread.java:4021)
E/AndroidRuntime( 1401):        at java.lang.reflect.Method.invokeNative(Native Method)
E/AndroidRuntime( 1401):        at java.lang.reflect.Method.invoke(Method.java:521)
E/AndroidRuntime( 1401):        at com.android.internal.os.ZygoteInit$MethodAndArgsCaller.run(ZygoteInit.java:782)
E/AndroidRuntime( 1401):        at com.android.internal.os.ZygoteInit.main(ZygoteInit.java:540)
E/AndroidRuntime( 1401):        at dalvik.system.NativeStart.main(Native Method)
E/AndroidRuntime( 1401): Caused by: java.lang.NullPointerException: uriString
E/AndroidRuntime( 1401):        at android.net.Uri$StringUri.<init>(Uri.java:417)
E/AndroidRuntime( 1401):        at android.net.Uri$StringUri.<init>(Uri.java:407)
E/AndroidRuntime( 1401):        at android.net.Uri.parse(Uri.java:379)
E/AndroidRuntime( 1401):        at com.google.android.samples.tasks.IoSampleApp.syncWithServer(IoSampleApp.java:27)
E/AndroidRuntime( 1401):        at com.google.android.samples.tasks.IoSampleApp.checkStatus(IoSampleApp.java:23)
E/AndroidRuntime( 1401):        at com.google.android.samples.tasks.IoSampleApp.initUi(IoSampleApp.java:19)
E/AndroidRuntime( 1401):        at com.google.android.samples.tasks.IoSampleApp.onCreate(IoSampleApp.java:15)
E/AndroidRuntime( 1401):        at android.app.Instrumentation.callActivityOnCreate(Instrumentation.java:1123)
E/AndroidRuntime( 1401):        at android.app.ActivityThread.performLaunchActivity(ActivityThread.java:2300)
E/AndroidRuntime( 1401):        ... 11 more
I/Process (  245): Sending signal. PID: 1401 SIG: 3
```

logcat

Your news feed

```
D/dalvikvm(  245): GC freed 2534 objects / 115912 bytes in 283ms
I/ActivityManager(  245): Starting activity: Intent { act=android.intent.action.MAIN cat=[android.inten
t.category.LAUNCHER] flg=0x2800000 cmp=com.google.android.gm/.ConversationListActivity }
V/Gmail   (  498): onCreate(), id=com.google.android.gm.ConversationListActivity@435dea50
D/gmail-ls(  339): MailProvider.query: content://gmail-ls/labels/jmatt@google.com(null, null)
D/gmail-ls(  339): MailProvider.query: content://gmail-ls/conversations/jmatt@google.com(, null)
V/Gmail   (  498): onStart(), id=com.google.android.gm.ConversationListActivity@435dea50
V/Gmail   (  498): onResume()
I/ActivityManager(  245): Displayed activity com.google.android.gm/.ConversationListActivity: 794 ms (t
otal 1039 ms)
D/gmail-ls(  339): clearNewUnreadMailForNotificationLabelIfNeeded. Count: 51, label: -5/^^unseen-^i
D/gmail-ls(  339): sending notification. Adjusted values are label=2, oldCount=26400, newCount=0, unsee
nCount=0, getAttention=false
I/gmail-ls(  339): Sending notification intent: Intent { act=android.intent.action.PROVIDER_CHANGED dat
=content://gmail-ls/unread/^i typ=gmail-ls (has extras) }
D/gmail-ls(  339): clearNewUnreadMailForNotificationLabelIfNeeded. Count: 0, label: -6/^^unseen-^^vmi
I/ActivityManager(  245): Starting activity: Intent { cmp=com.google.android.gm/.HtmlConversationActivi
ty (has extras) }
V/Gmail   (  498): onSaveInstanceState(), id=com.google.android.gm.ConversationListActivity@435dea50
V/Gmail   (  498): onPause(), id=com.google.android.gm.ConversationListActivity@435dea50
D/gmail-ls(  339): MailProvider.query: content://gmail-ls/conversations/jmatt@google.com/13018744123995
72048/messages(null, null)
D/dalvikvm(  498): GC freed 4045 objects / 206296 bytes in 181ms
I/ActivityManager(  245): Displayed activity com.google.android.gm/.HtmlConversationActivity: 2477 ms (
total 2477 ms)
I/ActivityManager(  245): Process android.process.media (pid 1225) has died.
D/dalvikvm( 1012): GC freed 10663 objects / 613816 bytes in 189ms
D/Gmail   (  498): com.google.android.gm.HtmlConversationActivity@4362bf50 onKeyDown() keyCode:4 event:
KeyEvent{action=0 code=4 repeat=0 meta=0 scancode=158 mFlags=8}
D/gmail-ls(  339): MailProvider.delete(): removing label ^u from conversation 1301874412399572048
D/Gmail   (  498): com.google.android.gm.HtmlConversationActivity@4362bf50 onPause() finished
V/Gmail   (  498): onRestart(), id=com.google.android.gm.ConversationListActivity@435dea50
V/Gmail   (  498): onStart(), id=com.google.android.gm.ConversationListActivity@435dea50
V/Gmail   (  498): onResume()
D/gmail-ls(  339): clearNewUnreadMailForNotificationLabelIfNeeded. Count: 0, label: -5/^^unseen-^i
D/gmail-ls(  339): clearNewUnreadMailForNotificationLabelIfNeeded. Count: 0, label: -6/^^unseen-^^vmi
```

logcat Levels Defined

- [E]rror
  - A unexpected critical or non-recoverable failure happened
- [W]arning
  - Something bad happened, but it was handled gracefully
- [I]nfo
  - An important event occurred
- [D]ebug
  - Something happened that may be useful in isolating a problem
- [V]erbose
  - Something occurred in the normal course of operation that was expected.

A simple case

The code can't break!

```
public class UriReader extends Thread {
  public String uriToRead = null;
  @Override
  public void run() {
    DefaultHttpClient client = new DefaultHttpClient();
    HttpGet request = new HttpGet(uriToRead);
    try {
      InputStream reader =
        client.execute(request).getEntity().getContent();
      while (reader.read() != -1);
    } catch (ClientProtocolException e) {
      Log.w(TAG, "Protocol exception while reading URL.");
    } catch (IOException e) {
      Log.e(TAG, "General I/O exception, exact type is: " +
        e.getClass().getCanonicalName());
    }
  }
}
```

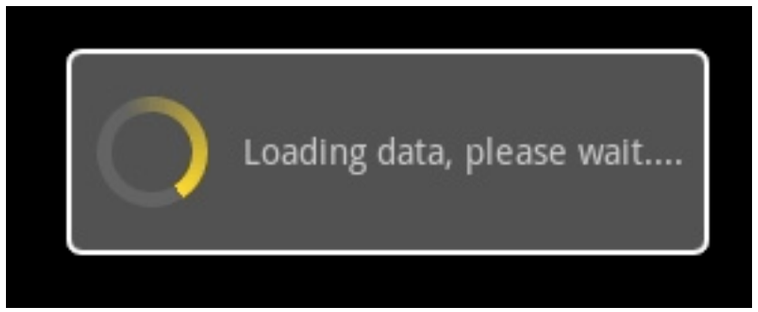
The scene of the crime

```
lease 7200 seconds
D/SettingsWifiEnabler( 1461): Received network state changed to NetworkInfo: type: WIFI[
], state: CONNECTED/CONNECTED, reason: (unspecified), extra: (none), roaming: false, fai
lover: false, isAvailable: true
D/WifiWatchdogService(  245): (android.server.ServerThread) GoogleGuest (00:0b:86:eb:f0:
60) requires the watchdog
I/ActivityManager(  245): Start proc com.android.mms for broadcast com.android.mms/.tran
saction.MmsSystemEventReceiver: pid=1720 uid=10013 gids={3003}
D/GpsLocationProvider(  245): state: DISCONNECTED apnName: epc.tmobile.com reason: dataD
isabled
I/ActivityManager(  245): processNextBroadcast: waiting for ProcessRecord{4388aa98 1720:
com.android.mms/10013}
D/GpsLocationProvider(  245): updateNetworkState available
D/GpsLocationProvider(  245): NetworkThread wait for 13551489ms
W/Smack/Packet(  339): notify conn break (IOEx), close connection
D/Smack   (  339): [XMPPConn] close connection, notifyClosed=false
I/jdwp    ( 1720): received file descriptor 20 from ADB
06:36 I/ddms: Created: [Debugger 8604-->1720 inactive]
I/jdwp    ( 1720): Ignoring second debugger -- accepting and dropping
D/SamplesUriReader( 1672): General I/O exception, exact type is: java.net.SocketExceptio
n
D/WifiWatchdogService(  245): 0% packet loss (acceptable is 25%)
D/WifiWatchdogService(  245): (WifiWatchdogThread) AP is alive: GoogleGuest (00:0b:86:eb
:f0:60)
```

Take a good look around

```
lease 7200 seconds
D/SettingsWifiEnabler( 1461): Received network state changed to NetworkInfo: type: WIFI[
], state: CONNECTED/CONNECTED, reason: (unspecified), extra: (none), roaming: false, fai
lover: false, isAvailable: true
D/WifiWatchdogService(  245): (android.server.ServerThread) GoogleGuest (00:0b:86:eb:f0:
60) requires the watchdog
I/ActivityManager(  245): Start proc com.android.mms for broadcast com.android.mms/.tran
saction.MmsSystemEventReceiver: pid=1720 uid=10013 gids={3003}
D/GpsLocationProvider(  245): state: DISCONNECTED apnName: epc.tmobile.com reason: dataD
isabled
I/ActivityManager(  245): processNextBroadcast: waiting for ProcessRecord{4388aa98 1720:
com.android.mms/10013}
D/GpsLocationProvider(  245): updateNetworkState available
D/GpsLocationProvider(  245): NetworkThread wait for 13551489ms
W/Smack/Packet(  339): notify conn break (IOEx), close connection
D/Smack   (  339): [XMPPConn] close connection, notifyClosed=false
I/jdwp    ( 1720): received file descriptor 20 from ADB
06:36 I/ddms: Created: [Debugger 8604-->1720 inactive]
I/jdwp    ( 1720): Ignoring second debugger -- accepting and dropping
D/SamplesUriReader( 1672): General I/O exception, exact type is: java.net.SocketExceptio
n
D/WifiWatchdogService(  245): 0% packet loss (acceptable is 25%)
D/WifiWatchdogService(  245): (WifiWatchdogThread) AP is alive: GoogleGuest (00:0b:86:eb
:f0:60)
```

The dialog of despair



Warning signs

What's that noise?

- Same process id, similar object count, similar sizes

```
D/dalvikvm( 1825): GC freed 7 objects / 313984 bytes in 121ms
D/dalvikvm( 1825): GC freed 6 objects / 316016 bytes in 115ms
D/dalvikvm( 1825): GC freed 7 objects / 318080 bytes in 120ms
D/dalvikvm( 1825): GC freed 6 objects / 320112 bytes in 123ms
D/dalvikvm( 1825): GC freed 7 objects / 322176 bytes in 122ms
D/dalvikvm( 1825): GC freed 7 objects / 324312 bytes in 120ms
D/dalvikvm( 1825): GC freed 20 objects / 326920 bytes in 115ms
D/dalvikvm( 1825): GC freed 6 objects / 328272 bytes in 120ms
D/dalvikvm( 1825): GC freed 7 objects / 330336 bytes in 118ms
D/dalvikvm( 1825): GC freed 6 objects / 332368 bytes in 116ms
D/dalvikvm( 1825): GC freed 7 objects / 334432 bytes in 119ms
D/dalvikvm( 1825): GC freed 6 objects / 336464 bytes in 115ms
D/dalvikvm( 1825): GC freed 7 objects / 338528 bytes in 119ms
D/dalvikvm( 1825): GC freed 6 objects / 340560 bytes in 120ms
D/dalvikvm( 1825): GC freed 7 objects / 342624 bytes in 114ms
D/dalvikvm( 1825): GC freed 6 objects / 344656 bytes in 120ms
D/dalvikvm( 1825): GC freed 7 objects / 346720 bytes in 115ms
D/dalvikvm( 1825): GC freed 6 objects / 348752 bytes in 138ms
```

Data Management

- Filters
  - TAG:SEVERITY
- Smart tagging
  - Meaningful
  - Related
- !SPAM
  - Precise
  - Concise
  - Privacy sensitive

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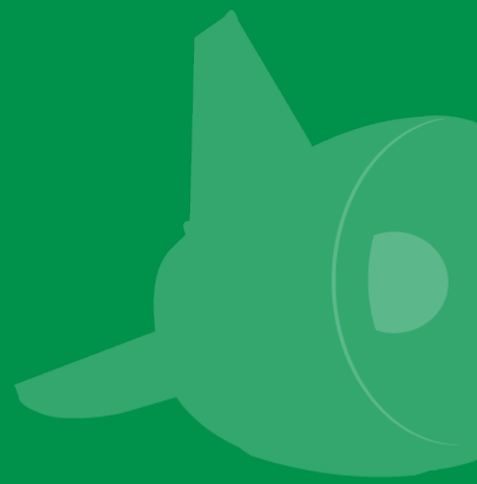

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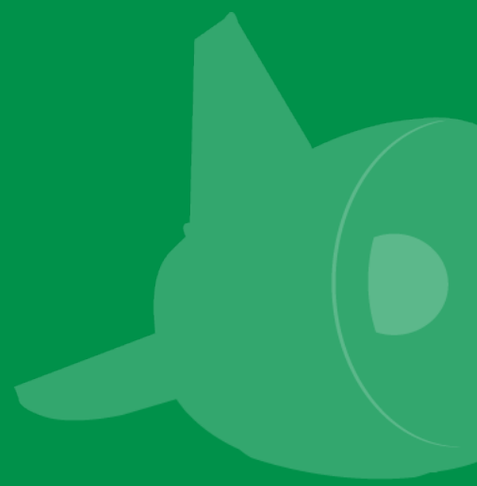

traceview

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tracing and traceview

- Records every function entry and exit point
- Records how long execution took
- Provides a graphical representation of collected data
  - Timeline view
  - Call tree view
- Is a must-use for any developer serious about performance

How to start tracing

- Starting and stopping trace data collection is simple

```
public class ProfiledActivity extends Activity {
  protected void onCreate(Bundle savedInstanceState) {
    Debug.startMethodTracing();
  }
  ...
  public void onPause() {
    Debug.stopMethodTracing();
  }
}
```

```
justin$ adb shell am profile com.example.foo profile start /
sdcard/trace_file
...
justin$ adb shell am profile com.example.foo stop
```

- Controls tracing for entire VM
- Tracing only what you need simplifies analysis
- Tracing has a big impact on performance

Execution timeline

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Function statistics

Name	Incl %	Inclusive	Excl %	Exclusive	Calls+Recur Calls/T	Time/Call
0 (toplevel)	100.0%	19761.933	0.8%	155.751	16+0	1235.121
1 java/lang/Thread.run ()V	35.7%	7048.340	0.0%	0.092	2+0	3524.170
2 java/util/concurrent/ThreadPoolExecutor$Worker.run ()\	35.7%	7048.248	0.0%	0.184	2+0	3524.124
3 java/util/concurrent/ThreadPoolExecutor$Worker.runTa:	35.6%	7042.510	0.0%	0.488	4+0	1760.628
4 com/google/android/apps/finance/CachedNetworkFetch	35.6%	7040.773	0.0%	1.161	4+0	1760.193
5 android/os/Handler.dispatchMessage (Landroid/os/Mes	28.9%	5701.541	0.0%	2.992	130+0	43.858
6 com/google/android/apps/finance/data/NewsRunnable	26.9%	5308.686	0.0%	0.092	2+0	2654.343
7 com/google/android/apps/finance/data/NewsRunnable	26.9%	5308.594	0.0%	0.031	2+0	2654.297
8 com/google/android/apps/finance/data/NewsManager.	26.9%	5308.563	0.0%	7.655	2+0	2654.282
9 android/view/ViewRoot.handleMessage (Landroid/os/Me	20.8%	4112.275	0.0%	3.574	46+0	89.397
10 org/json/JSONObject.<init> (Ljava/lang/String;)V	19.1%	3773.040	0.0%	0.183	2+0	1886.520
11 org/json/JSONObject.<init> (Lorg/json/JSONTokener;)'	19.1%	3772.491	0.3%	61.596	2+112	33.092
12 org/json/JSONTokener.nextValue ()Ljava/lang/Object;	19.1%	3770.417	0.8%	157.097	4+904	4.152
13 org/json/JSONArray.<init> (Lorg/json/JSONTokener;)V	19.1%	3766.174	0.1%	11.908	2+16	209.232
14 android/view/ViewRoot.performTraversals ()V	18.9%	3736.450	0.0%	6.502	18+0	207.581
15 android/os/Binder.execTransact (IIII)Z	18.2%	3605.227	0.1%	19.992	198+0	18.208
16 android/content/ContentProviderNative.onTransact (ILa	17.0%	3354.797	0.0%	7.353	30+0	111.827
17 org/json/JSONTokener.nextString (C)Ljava/lang/String;	14.1%	2795.441	2.7%	526.857	324+0	8.628
18 android/view/View.layout (IIII)V	11.5%	2278.992	0.1%	10.780	13+362	6.077
19 android/widget/FrameLayout.onLayout (ZIIII)V	11.5%	2277.437	0.0%	7.659	13+46	38.601
20 android/widget/LinearLayout.onLayout (ZIIII)V	11.5%	2273.438	0.0%	1.865	13+93	21.448

Function statistics

Details

Name	Incl %	Inclusive	Excl %	Exclusive	Calls+Recur Calls/Total	SORT Time/Call
▶ 1 java/lang/Thread.run ()V	35.7%	7048.340	0.0%	0.092	2+0	3524.170
▶ 2 java/util/concurrent/ThreadPoolExecutor$Worl	35.7%	7048.248	0.0%	0.184	2+0	3524.124

- Name
- “Incl %” - percentage of time including descendants
- Inclusive - raw execution time including descendants
- “Excl %” - percentage of time sans descendants
- Exclusive - time spent executing code only within this function
- “Calls+Recur Calls/Total” - Number of times this method is called
- Time/Call - Average execution time per call

Getting to the bottom (or top) of things

- The source of the issue may be above or below your code
- traceview allows you to easily navigate the call tree

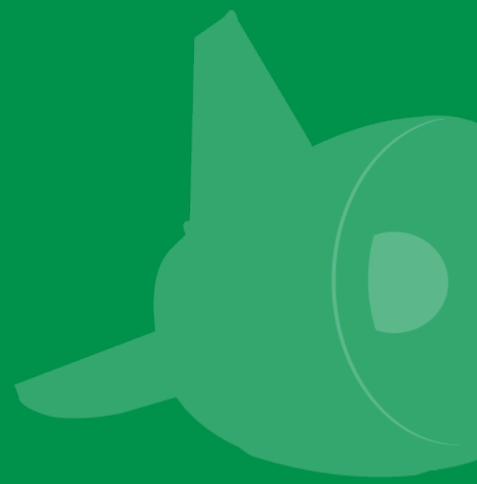
Getting to the bottom (or top) of things

- The source of the issue may be above or below your code
- traceview allows you to easily navigate the call tree

Name	Incl %	Inclusive	Exc
122 com/google/android/apps/finance/NetworkUtils.fetchUrl (Ljava/lang/String;)Ljava/lang/String;	2.9%	570.984	
123 java/lang/AbstractStringBuilder.append0 (Ljava/lang/String;)V	2.9%	568.250	
124 android/database/sqlite/SQLiteDatabase.rawQueryWithFactory (Landroid/database/sqlite/SQLiteDa	2.8%	553.196	
125 android/content/ContentProvider$Transport.query (Landroid/net/Uri;[Ljava/lang/String;Ljava/lang/	2.8%	551.144	
126 org/apache/harmony/luni/internal/net/www/protocol/http/HttpURLConnection.readln ()Ljava/lang/S	2.8%	545.346	
127 android/database/sqlite/SQLiteDirectCursorDriver.query (Landroid/database/sqlite/SQLiteDatabase	2.7%	543.124	
128 android/content/ContentValues$1.createFromParcel (Landroid/os/Parcel;)Ljava/lang/Object;	2.7%	540.862	
129 android/content/ContentValues$1.createFromParcel (Landroid/os/Parcel;)Landroid/content/Content	2.7%	540.066	
130 dalvik/system/VMDebug.startGC ()V	2.7%	539.948	
131 android/widget/LinearLayout.measureHorizontal (II)V	2.7%	535.739	
132 android/os/Parcel.readHashMap (Ljava/lang/ClassLoader;)Ljava/util/HashMap;	2.7%	535.639	
133 android/widget/CursorTreeAdapter.getChildrenCount (I)I	2.7%	535.339	
134 android/widget/BaseExpandableListAdapter.notifyDataSetChanged ()V	2.7%	535.066	
135 java/io/ObjectInputStream.readHierarchy (Ljava/lang/Object;Ljava/io/ObjectStreamClass;)V	2.7%	533.631	
136 android/widget/ExpandableListConnector$MyDataSetObserver.onChanged ()V	2.7%	529.633	
137 java/io/ObjectInputStream.readObjectForClass (Ljava/lang/Object;Ljava/io/ObjectStreamClass;)V	2.7%	529.479	
138 android/widget/ExpandableListView.dispatchDraw (Landroid/graphics/Canvas;)V	2.7%	528.504	
139 android/os/Parcel.readMapInternal (Ljava/util/Map;ILjava/lang/ClassLoader;)V	2.7%	528.164	
140 android/widget/LinearLayout.measureVertical (II)V	2.7%	527.069	
141 java/util/ArrayList.readObject (Ljava/io/ObjectInputStream;)V	2.7%	526.581	
142 com/google/android/apps/finance/HomeActivity$8.bindChildView (Landroid/view/View;Landroid/c	2.7%	525.294	

Optimize reality

- traceview gives you a lot of power, take advantage of it
- Design sensibly, build proof of concept, test, and optimize



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HierarchyViewer

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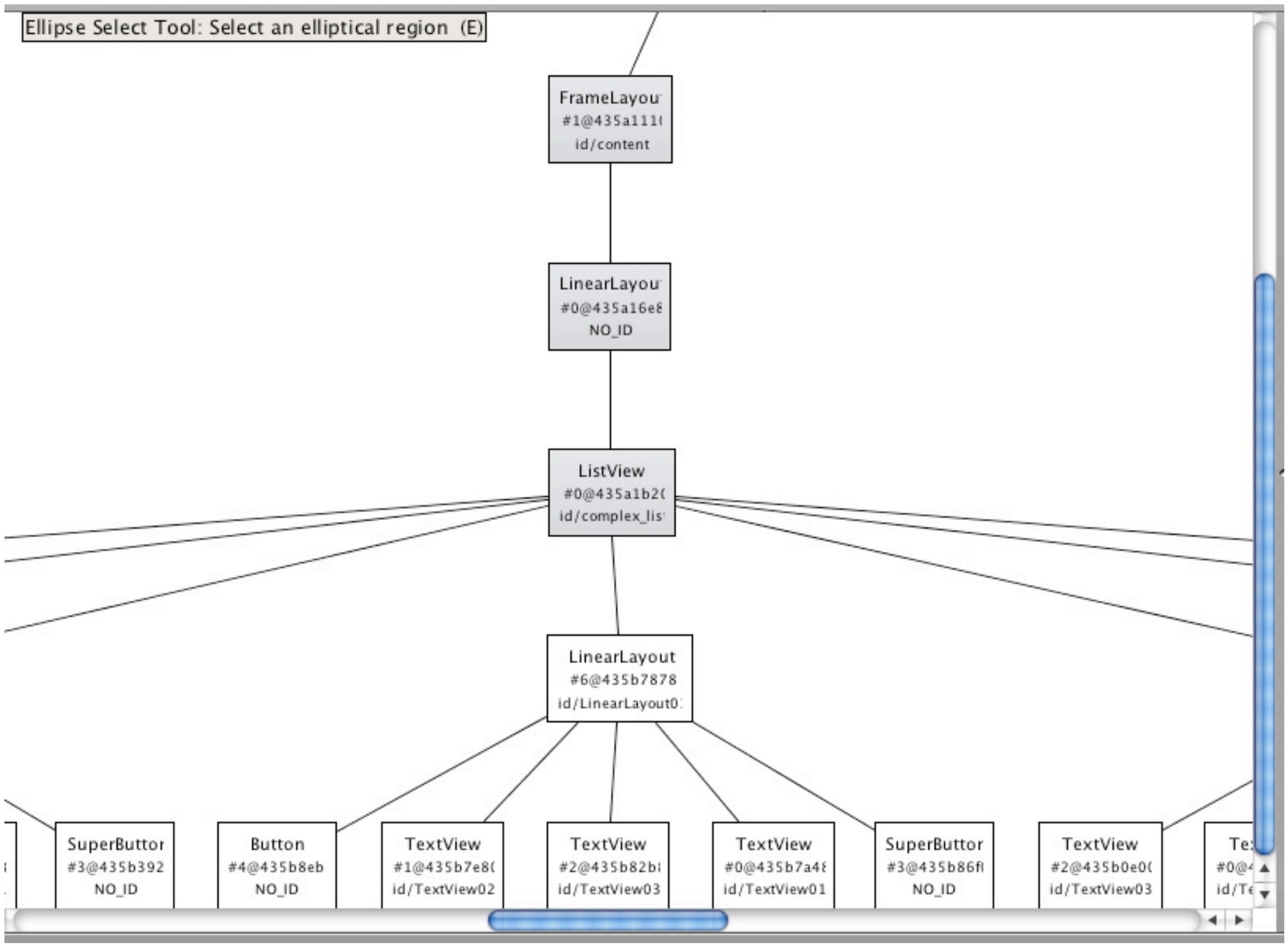
Exploring the UI with HierarchyViewer



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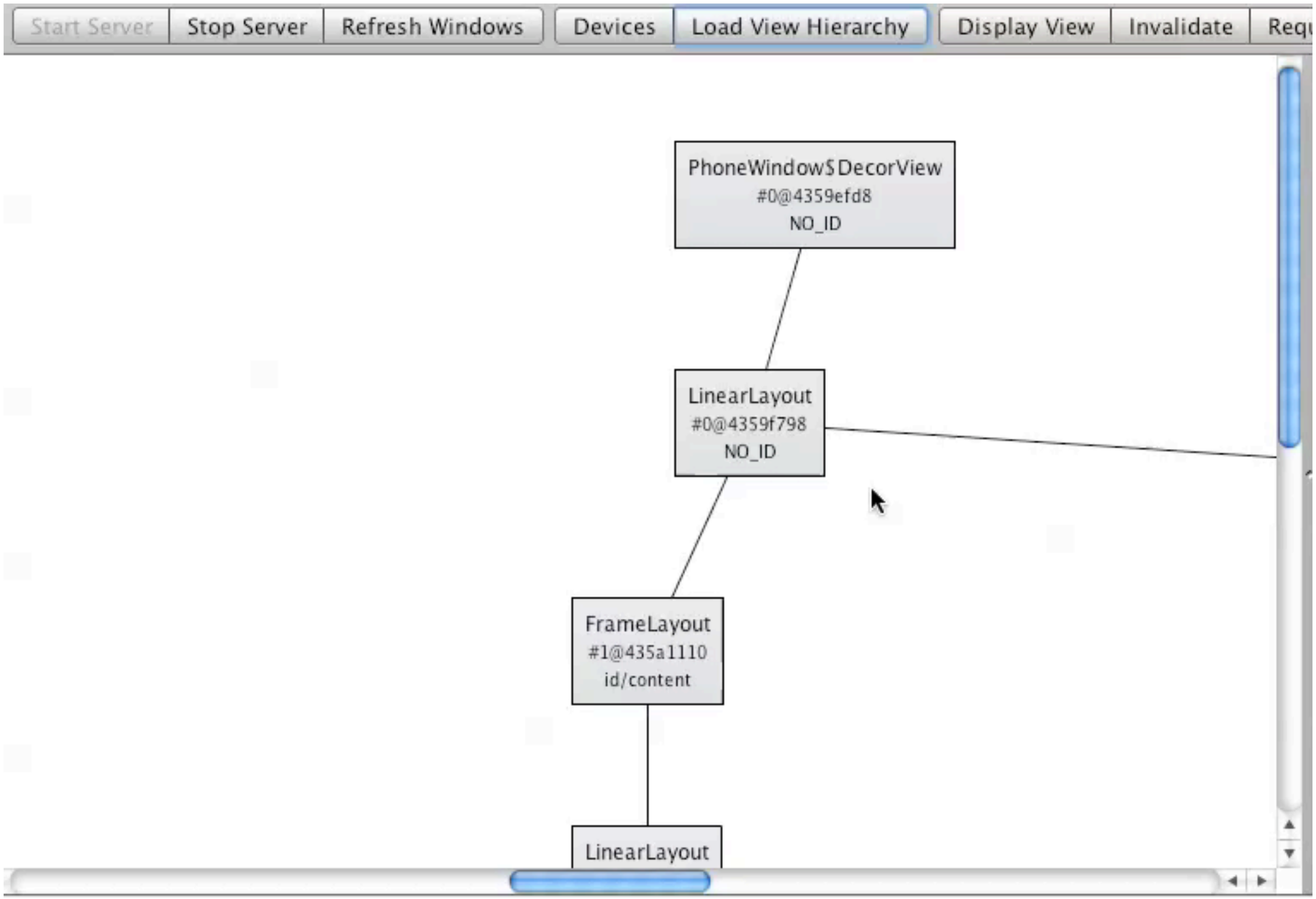
Climbing the tree

Climbing the tree



Questionable families

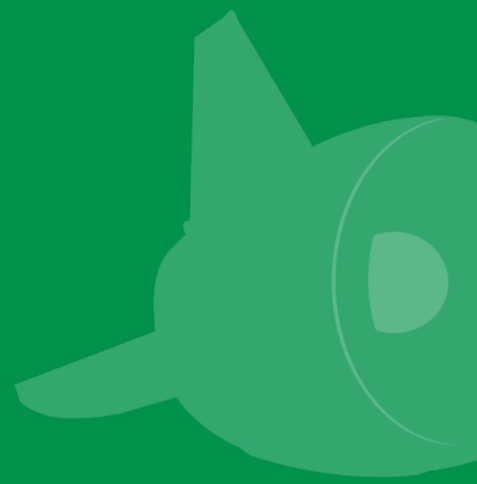
- “Infertile parents” - layout with no or single layout children

- “Clones” - parents with same-type children

<merge /> your @includes

- Merge is a placeholder layout
- Children of <merge> go into the layout where they are included

```
<merge xmlns:android="http://schemas.android.com/apk/res/
android">
    <TextView
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="@string/header_section"
        android:textColor="@colors/header_color" />
    <ImageView
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:src="@drawable/logo" />
</merge>
```



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Traveler's Tales: Betrayal

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TraceView on a shipping product

- Why is something running on the main thread for that long?
- Must be a network request someone forgot to move to a thread

com.ibm.icu4jni.util.Resources.getTimeZonesNative

- A call about time zones is taking this long?
- Wait, I’m not even doing anything with time zones

com.ibm.icu4jni.util.Resources.getTimeZonesNative

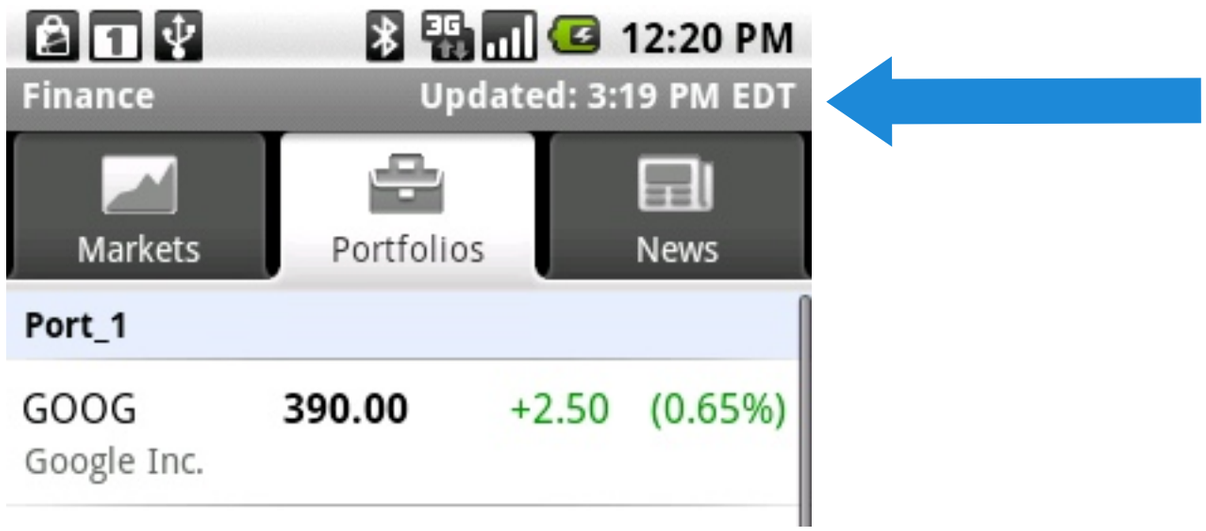
- A call about time zones is taking this long?
- Wait, I'm not even doing anything with time zones

Name	Incl %	Inclusive
28 com/ibm/icu4jni/util/Resources.getTimeZonesNative ([[Ljava/lang/String;Ljava/lang/String;)V	13.7%	2036.472
Parents		
27 com/ibm/icu4jni/util/Resources.createTimeZoneNamesFor (Ljava/lang/String;)[[Ljava/lang/Stri	100.0%	2036.472
Children		
self	100.0%	2036.472
(context switch)	0.0%	0.000
29 android/view/View.layout (IIII)V	12.0%	1784.042
30 android/widget/FrameLayout.onLayout (ZIIII)V	12.0%	1783.095
31 android/widget/LinearLayout.onLayout (ZIIII)V	12.0%	1781.785
32 android/widget/LinearLayout.layoutVertical ()V	12.0%	1781.662
33 android/widget/LinearLayout.setChildFrame (Landroid/view/View;IIII)V	12.0%	1779.140
34 android/widget/AbsListView.onLayout (ZIIII)V	11.8%	1757.338

com.ibm.icu4jni.util.Resources.getTimeZonesNative

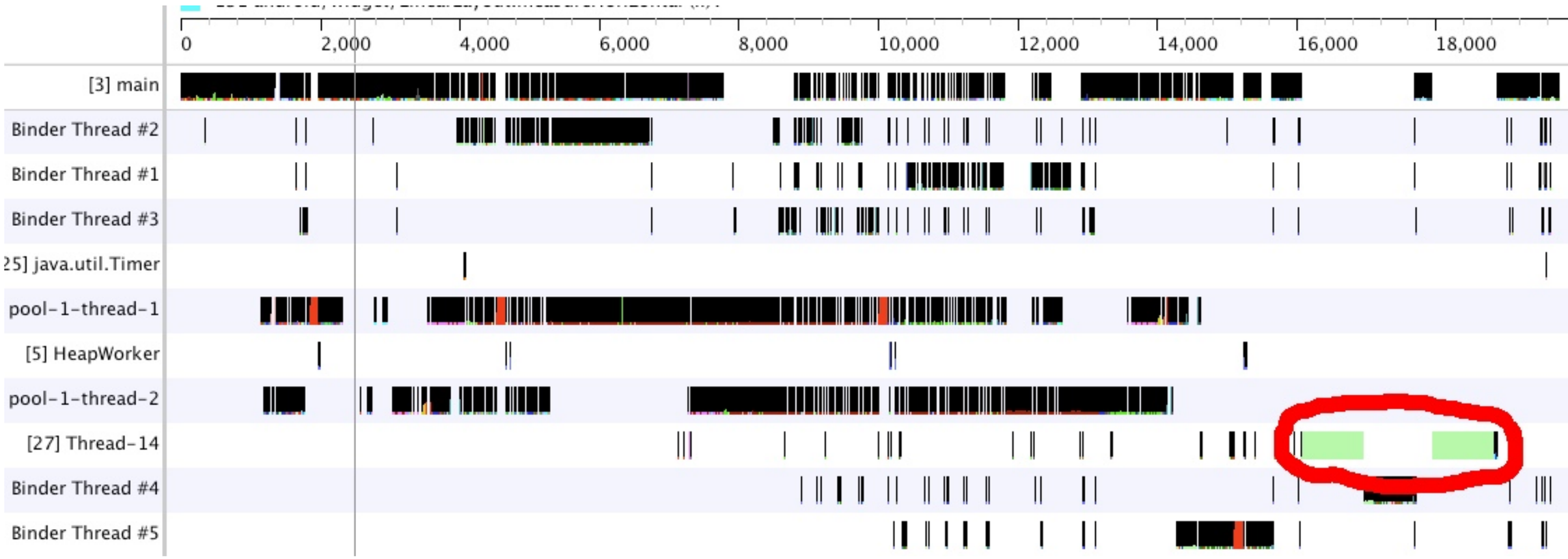
- A call about time zones is taking this long?
- Wait, I'm not even doing anything with time zones

Name	Incl %	Inclusive
28 com/ibm/icu4jni/util/Resources.getTimeZonesNative ([[Ljava/lang/String;Ljava/lang/String;)V	13.7%	2036.472
Parents		
27 com/ibm/icu4jni/util/Resources.createTimeZoneNamesFor (Ljava/lang/String;)[[Ljava/lang/Stri	100.0%	2036.472
Children		
self	100.0%	2036.472
(context switch)	0.0%	0.000
29 android/view/View.layout (IIII)V	12.0%	1784.042
30 android/widget/FrameLayout.onLayout (ZIIII)V	12.0%	1783.095
31 android/widget/LinearLayout.onLayout (ZIIII)V	12.0%	1781.785
32 android/widget/LinearLayout.layoutVertical ()V	12.0%	1781.662
33 android/widget/LinearLayout.setChildFrame (Landroid/view/View;IIII)V	12.0%	1779.140
34 android/widget/AbsListView.onLayout (ZIIII)V	11.8%	1757.338



Fixing the problem

- Move the call
- De-prioritize its execution
- Result: Better perceived startup time



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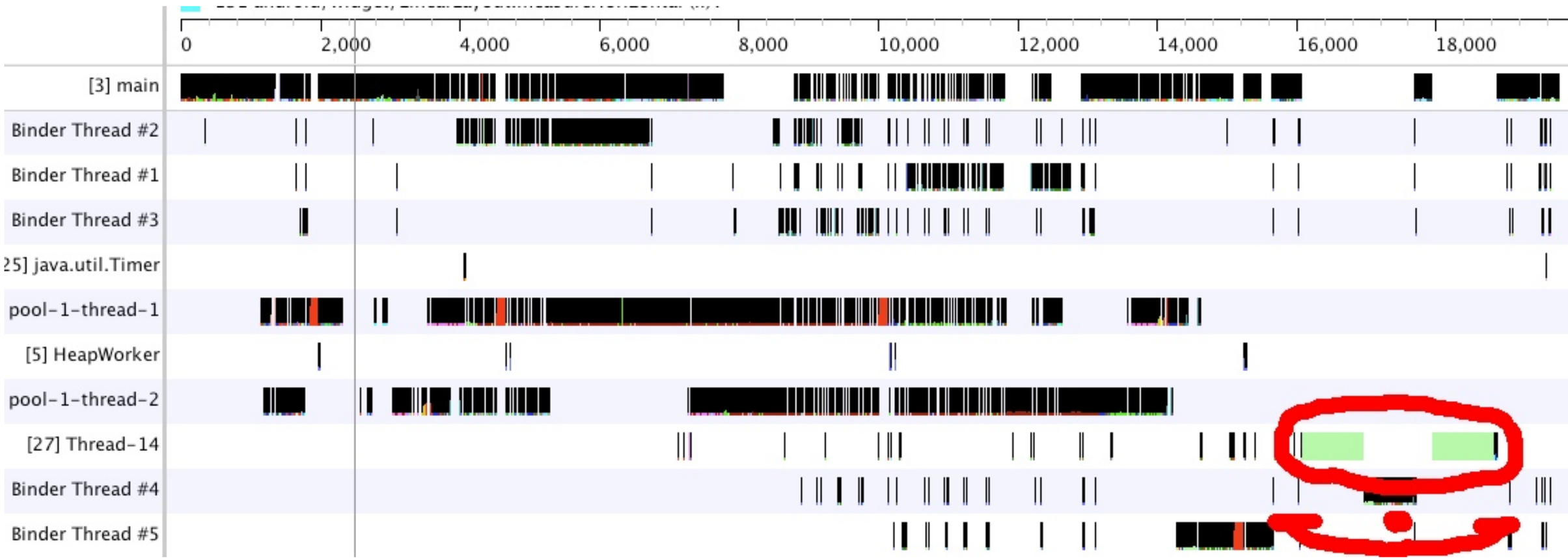
Fixing the problem

- Move the call
- De-prioritize its execution
- Result: Better perceived startup time



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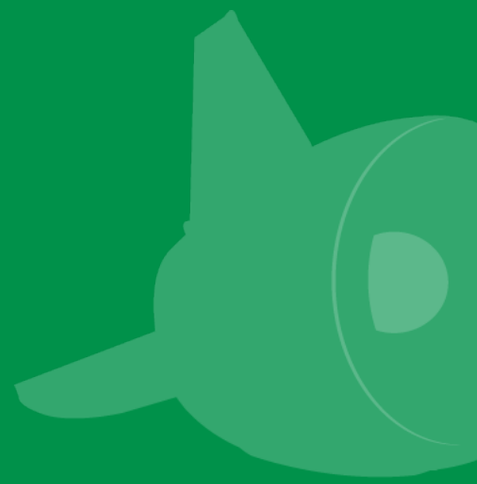
Key Learnings

- Trust no one
- A little profiling goes a long way
- Priority matters



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Traveler's Tales: Finding shortcuts

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Search for hidden inefficiencies

- Look at the function listing for less obvious performance issues

- Sort by exclusive execution
  - Shows inside which methods the program spends most of its time
  - Long average time methods with a few calls are good targets
  - Explore reducing and eliminating these calls

Search for hidden inefficiencies

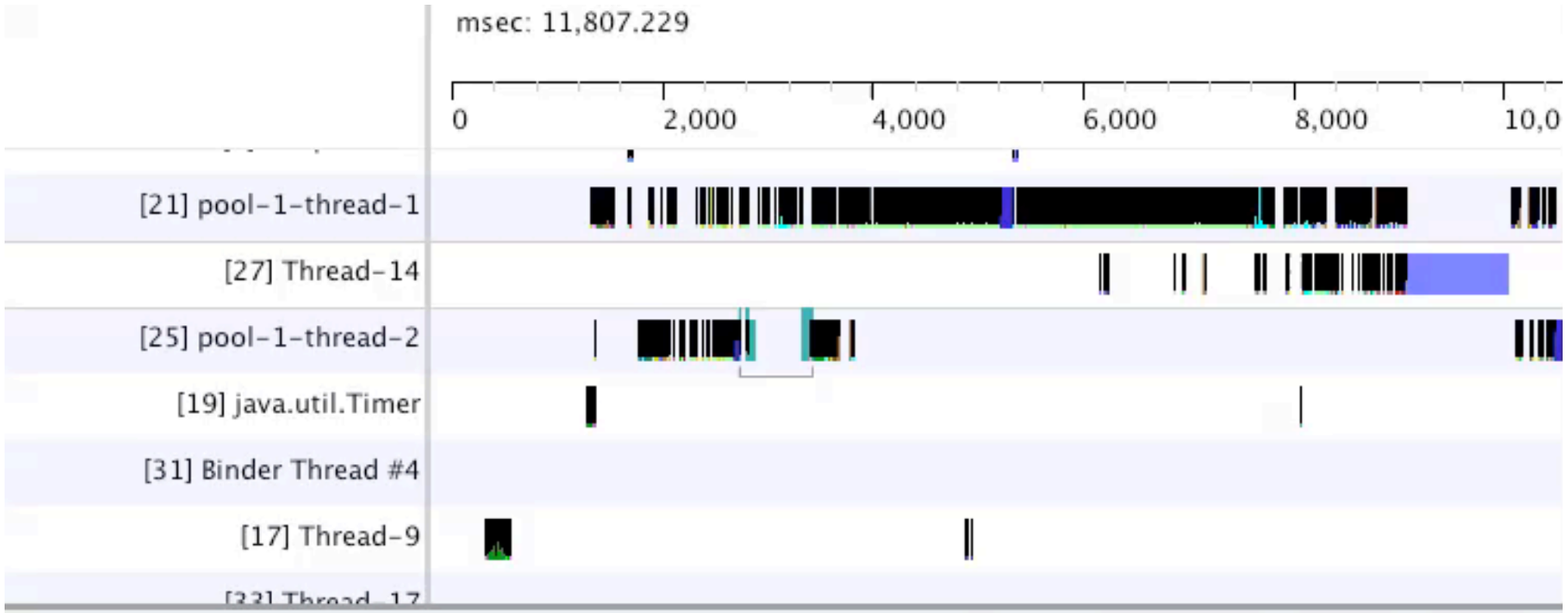
Name	SORT Excl %	Exclusive	Time/Call
32 com/ibm/icu4jni/util/Resources.getTimeZonesNative ([[Lja	10.2%	1987.793	1987.793
110 android/database/sqlite/SQLiteStatement.native_execute	3.0%	587.982	10.138
118 dalvik/system/VMDebug.startGC ()V	2.7%	533.904	133.476
121 java/lang/String.charAt (I)C	2.6%	512.878	0.010
71 org/json/JSONTokener.next ()C	2.4%	462.704	0.084
85 android/text/Layout.measureText (Landroid/text/TextPair	2.3%	443.190	1.744
153 android/graphics/Bitmap.nativeCompress (IIILjava/io/Ou	1.8%	345.855	176.712
46 org/json/JSONTokener.nextString (C)Ljava/lang/String;	1.5%	297.821	9.610
149 org/json/JSONTokener.more ()Z	1.4%	281.446	0.033
138 java/io/DataOutputStream.writeUTFBytes (Ljava/lang/Stri	1.4%	266.029	1.924
150 java/io/DataOutputStream.countUTFBytes (Ljava/lang/Str	1.2%	228.917	1.624
133 java/lang/AbstractStringBuilder.append0 (Ljava/lang/Stri	1.2%	225.583	0.093
119 java/lang/StringBuilder.append (C)Ljava/lang/StringBuild	1.1%	212.627	0.051
154 java/lang/AbstractStringBuilder.append0 (C)V	1.0%	200.260	0.029
226 java/lang/String.length ()I	1.0%	193.333	0.009
237 android/graphics/Paint.measureText (Ljava/lang/String;I	0.9%	180.724	0.282
163 android/text/StaticLayout.generate (Ljava/lang/CharSequ	0.9%	170.793	54.077
0 (toplevel)	0.7%	142.537	1394.854

Take a look around

- Explore ancestors and descendants of the method
- Use timeline line view to check what happens before and after the method

Take a look around

Take a look around



Name	Exclusive	SORT Excl %	Incl %	Inclusive
32 com/ibm/icu4jni/util/Resources.getTimeZonesNative ([[Ljava/lang/String	1987.793	10.2%	10.2%	1987.793
110 android/database/sqlite/SQLiteStatement.native_execute ()V	587.982	3.0%	3.0%	587.982
118 dalvik/system/VMDebug.startGC ()V	533.904	2.7%	2.7%	533.904
121 java/lang/String.charAt (I)C	512.878	2.6%	2.6%	512.878
71 org/json/JSONTokener.next ()C	462.704	2.4%	4.9%	952.564
85 android/text/Layout.measureText (Landroid/text/TextPaint;Landroid/tex	443.190	2.3%	4.0%	789.859
153 android/graphics/Bitmap.nativeCompress (IIILjava/io/OutputStream;[B)Z	345.855	1.8%	1.8%	353.424
46 org/json/JSONTokener.nextString (C)Ljava/lang/String;	297.821	1.5%	8.3%	1614.409
149 org/json/JSONTokener.more ()Z	281.446	1.4%	1.9%	380.486
138 java/io/DataOutputStream.writeUTFBytes (Ljava/lang/String;J)V	266.029	1.4%	2.3%	446.260
150 java/io/DataOutputStream.countUTFBytes (Ljava/lang/String;)J	228.917	1.2%	1.9%	376.862
133 java/lang/AbstractStringBuilder.append0 (Ljava/lang/String;)V	225.583	1.2%	2.4%	471.957

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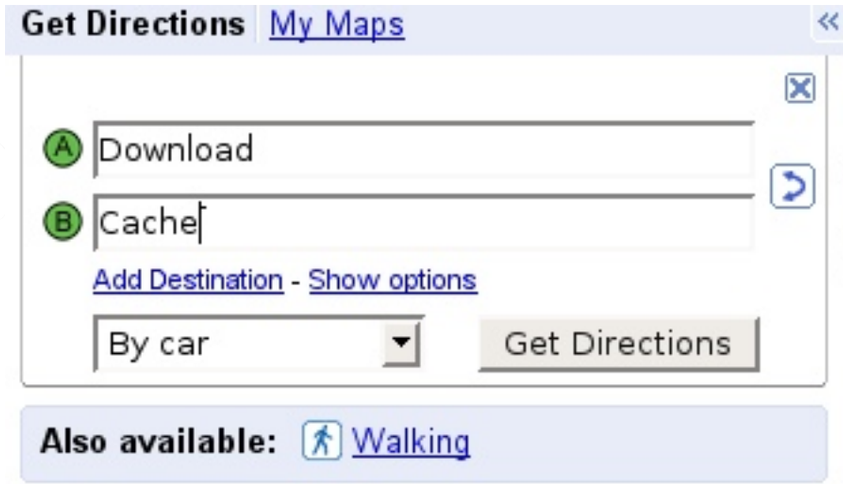
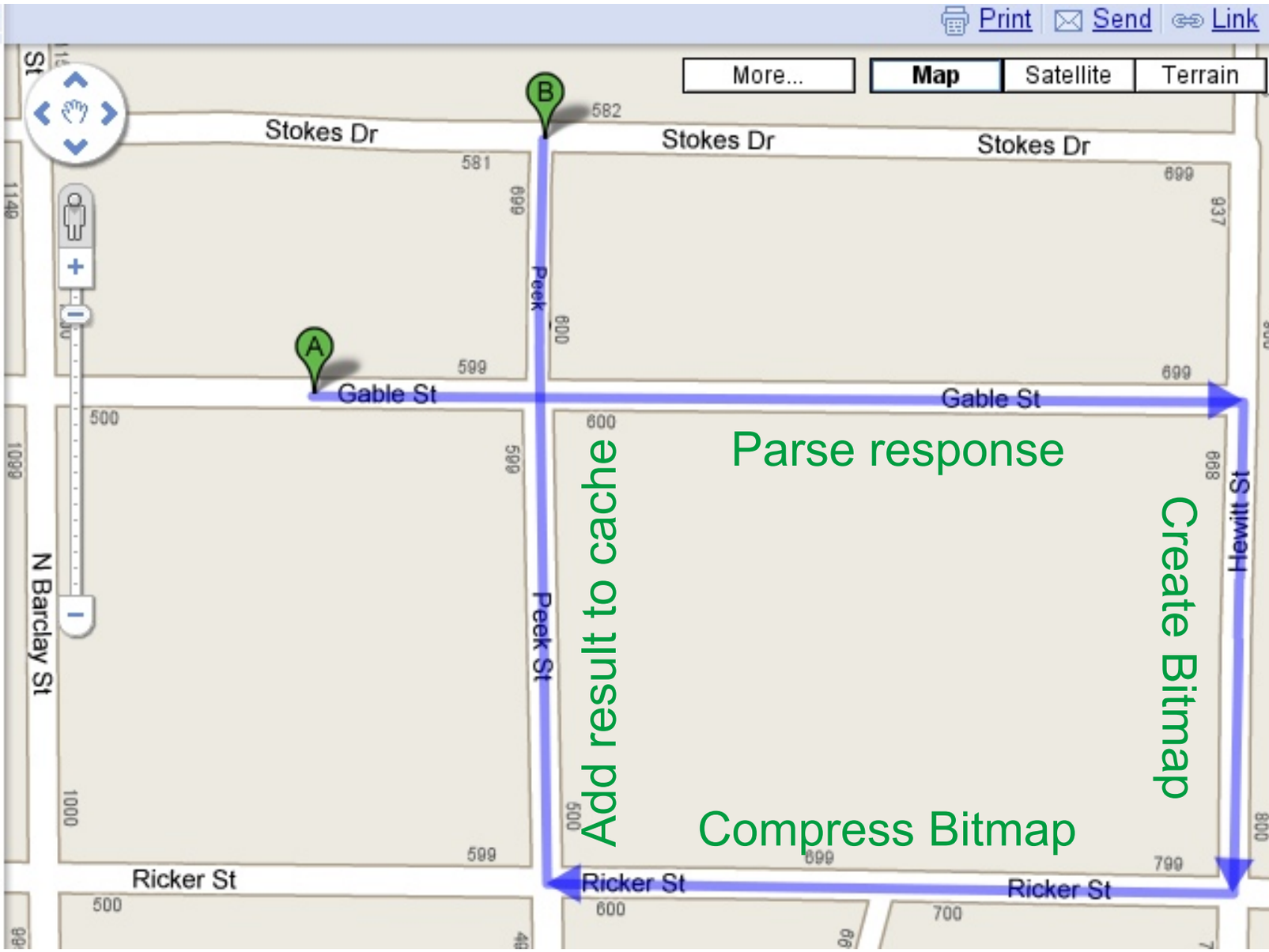
Iterate the route into a circle (square?)





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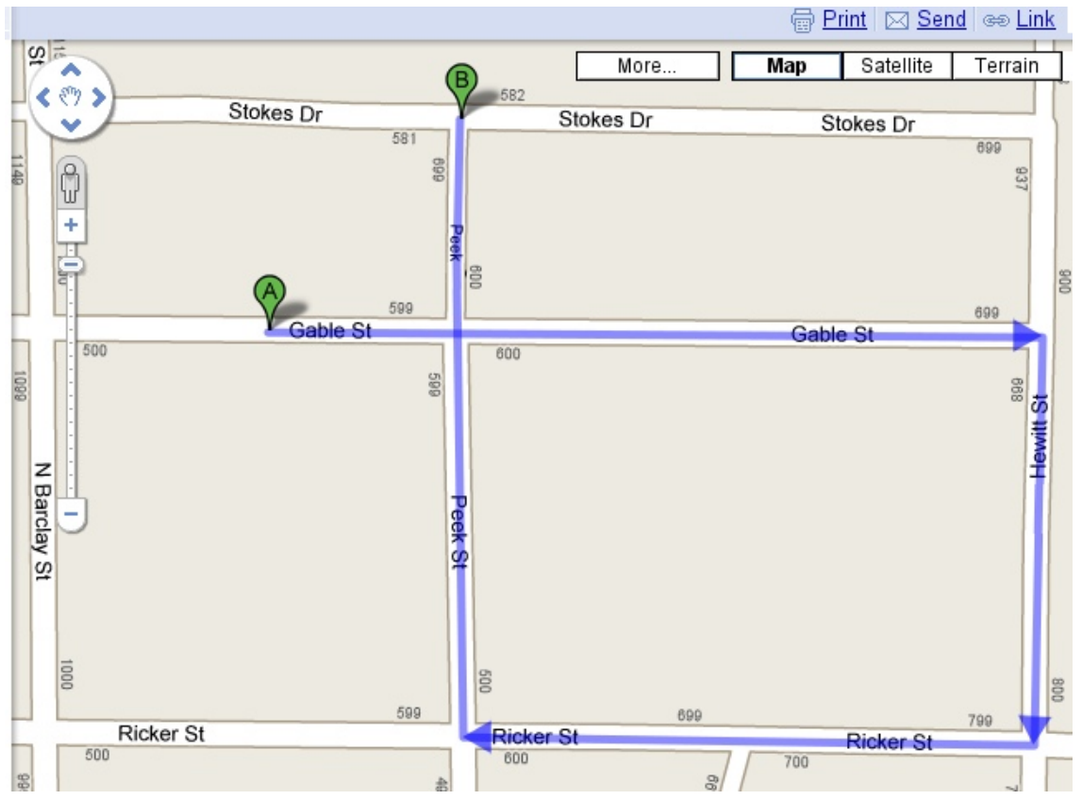
Fixing the problem

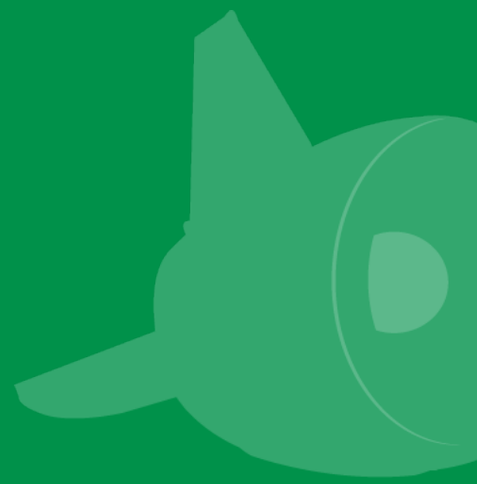
- Read in the full response
- Store the PNG
- Inflate Bitmap from PNG data
- Discard PNG data

- Result: Decrease startup time by 350ms
  - 2% in “debug time”, larger real time effect since its native code

Key Learnings

- Big is beautiful
- Explore the area first
- Three rights can make a left





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Traveler's Tales: Packing mistakes

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Sorting by inclusive execution

- Includes execution time of methods code and its descendants
- List is somewhat like a breadth-first traversal of the call tree

Sorting by inclusive execution

- Includes execution time of methods code and its descendants
- List is somewhat like a breadth-first traversal of the call tree

SORT Name	Inclusive	Calls+Recur Calls/
0 (toplevel)	19527.952	14+0
3191 android/app/Activity$ManagedCursor.<init> (Landroid/database/Cursor;)\	0.244	18+0
2101 android/app/Activity.createPendingResult (ILandroid/content/Intent;I)Landr	1.832	1+0
191 android/app/Activity.dispatchActivityResult (Ljava/lang/String;ILandroid/cont	234.588	1+0
817 android/app/Activity.findViewById (I)Landroid/view/View;	18.951	11+0
3894 android/app/Activity.getComponentName ()Landroid/content/ComponentN	0.031	1+0
1517 android/app/Activity.getSystemService (Ljava/lang/String;)Ljava/lang/Objec	4.639	20+0
3362 android/app/Activity.getWindow ()Landroid/view/Window;	0.182	17+0
4050 android/app/Activity.isChild ()Z	0.030	1+0
3386 android/app/Activity.makeVisible ()V	0.153	1+0
167 android/app/Activity.managedQuery (Landroid/net/Uri;[Ljava/lang/String;Lja	316.404	18+0
4051 android/app/Activity.onActivityResult (ILandroid/content/Intent;)V	0.030	1+0
4052 android/app/Activity.onPause ()V	0.030	1+0
3511 android/app/Activity.onPostCreate (Landroid/os/Bundle;)V	0.122	1+0
3669 android/app/Activity.onPostResume ()V	0.091	1+0
4053 android/app/Activity.onResume ()V	0.030	2+0
3768 android/app/Activity.onTitleChanged (Ljava/lang/CharSequence;I)V	0.061	1+0
3731 android/app/Activity.onWindowAttributesChanged (Landroid/view/WindowM	0.062	2+0
670 android/app/Activity.performPause ()V	27.405	1+0
3769 android/app/Activity.performRestart ()V	0.061	1+0

Taking a look at the code

```
try {
  List<MyDataType> itemsProcessed = new ArrayList<MyDataType>();
  for (int i = 0; i < source.getNumItems(); i++) {
    Item currentItem = source.get(i);
    MyDataType processedItem = new MyDataType(currentItem);
    itemsProcessed.add(processedItem);
    itemProcessedCallback(itemsProcessed);
  }
} catch (IOException e) {
  Log.W(TAG, “Reading data failed, retrying”);
} catch (JSONException e) {
  Log.E(TAG, “JSON parsing failed”);
}
```

- Items will be processed several times, this seems wrong

Fixing the problem

- Bug introduced when exception handling was refactored

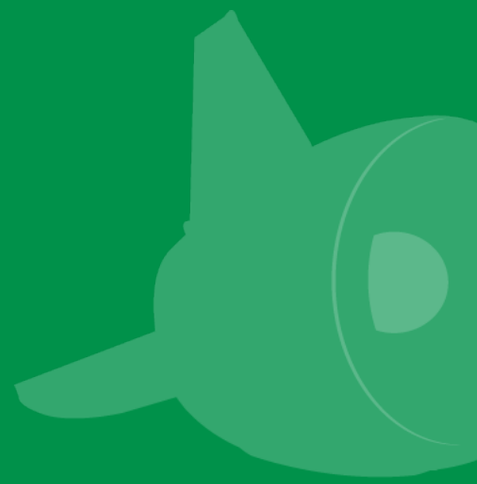
```
try {
  List<MyDataType> itemsProcessed = new ArrayList<MyDataType>();
  for (int i = 0; i < source.getNumItems(); i++) {
    Item currentItem = source.get(i);
    MyDataType processedItem = new MyDataType(currentItem);
    itemsProcessed.add(processedItem);
  }
  itemProcessedCallback(itemsProcessed);
} catch (IOException e) {
  Log.W(TAG, "Reading data failed, retrying");
} catch (JSONException e) {
  Log.E(TAG, "JSON parsing failed");
}
```

- Result: Fewer calls to callback, 5% decrease in startup time

Key Learnings

- Each angle of approach is valuable

- Analyzing performance can reveal unknown bugs



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Traveler's Tales: Consolidating containers

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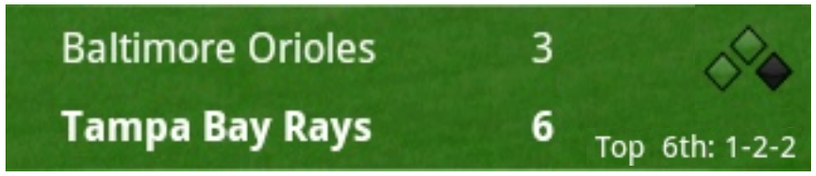
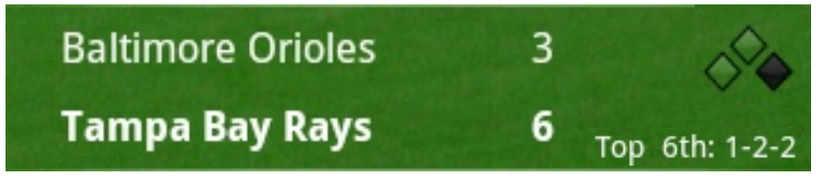
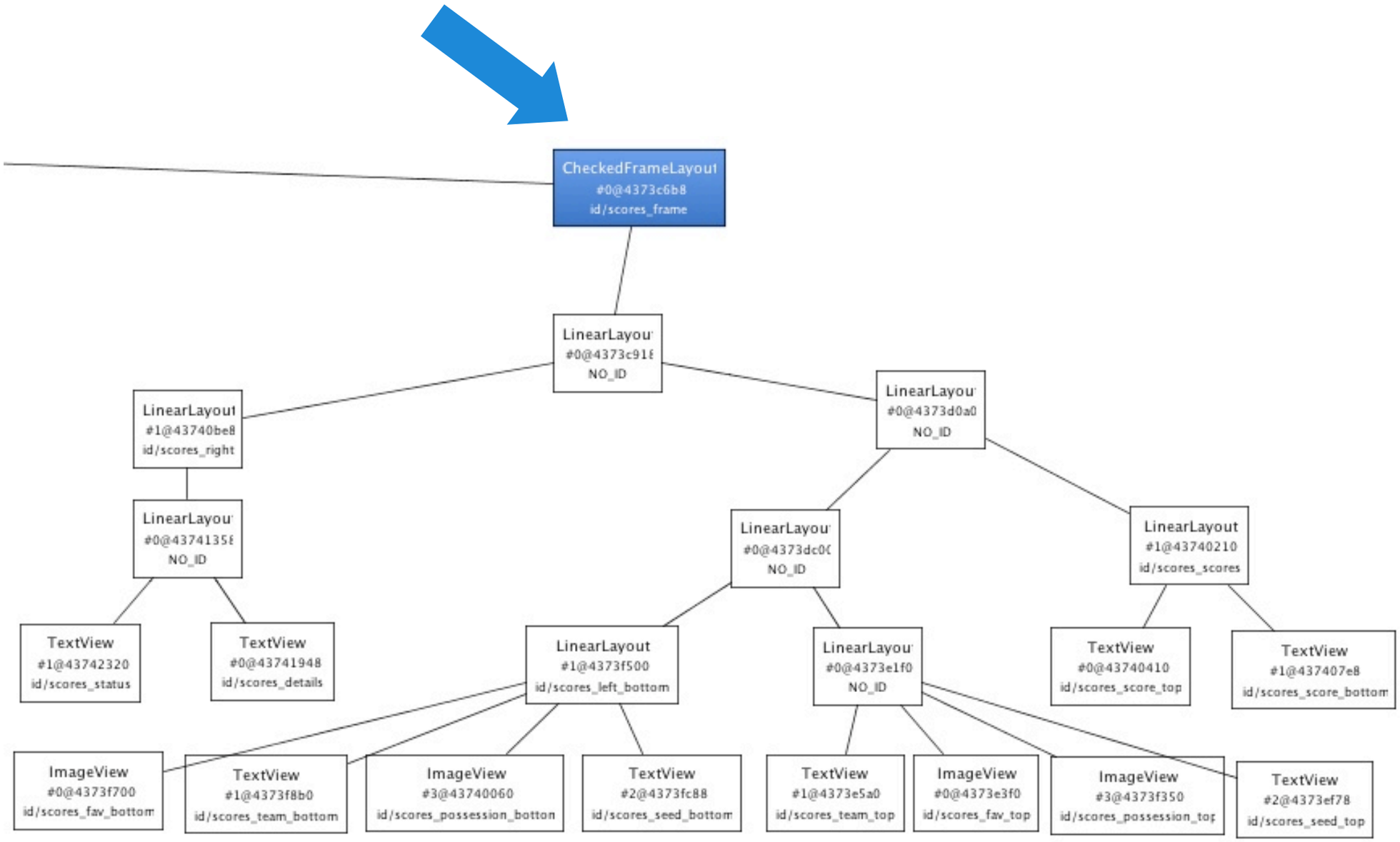
A “simple” layout examined



A “simple” layout examined





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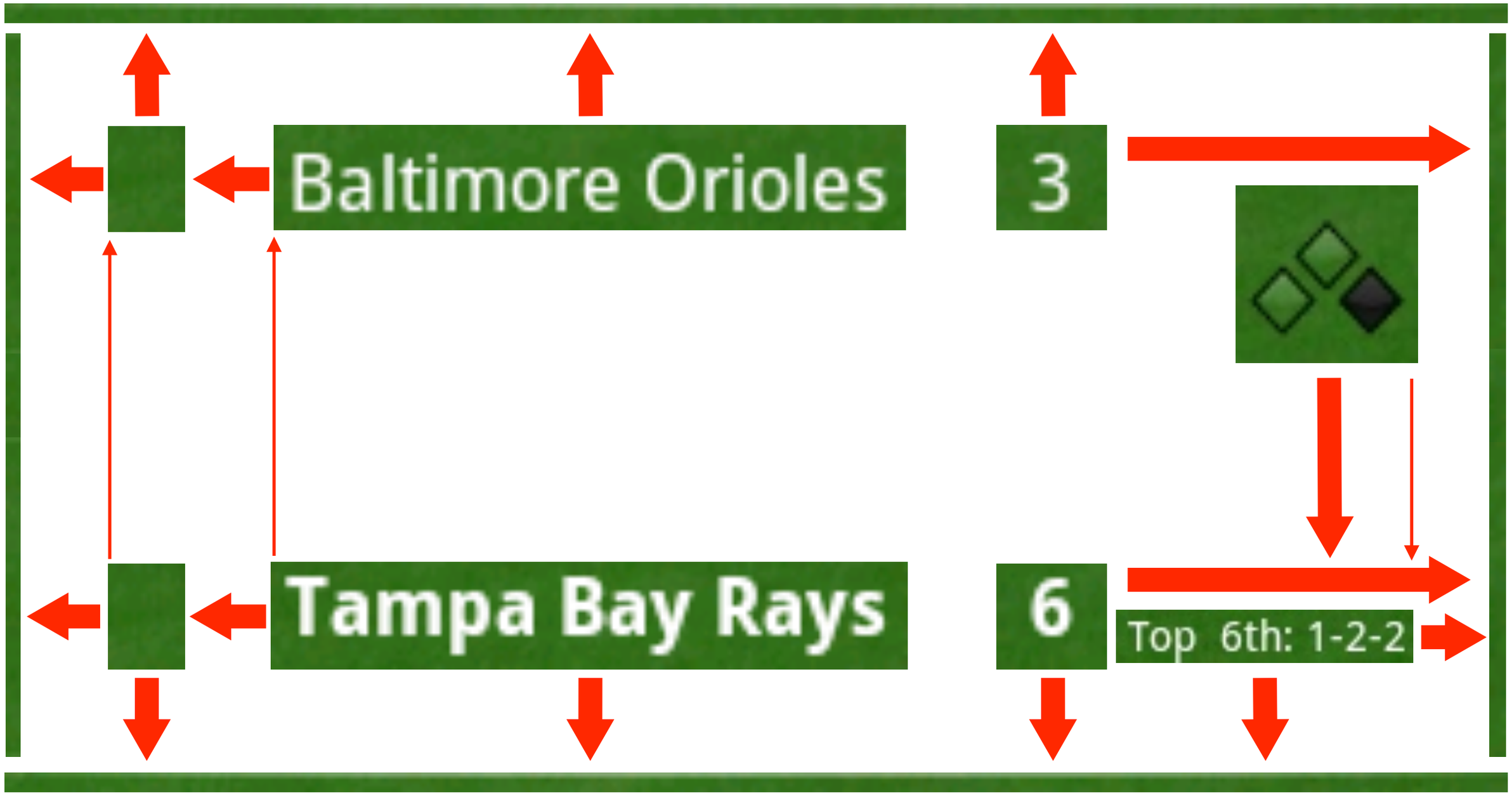
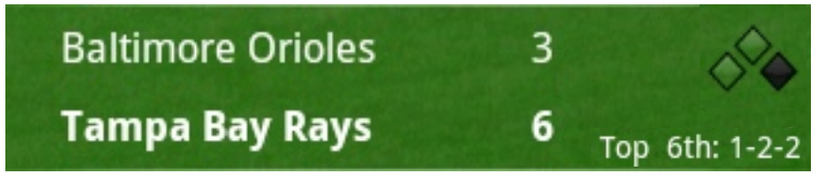
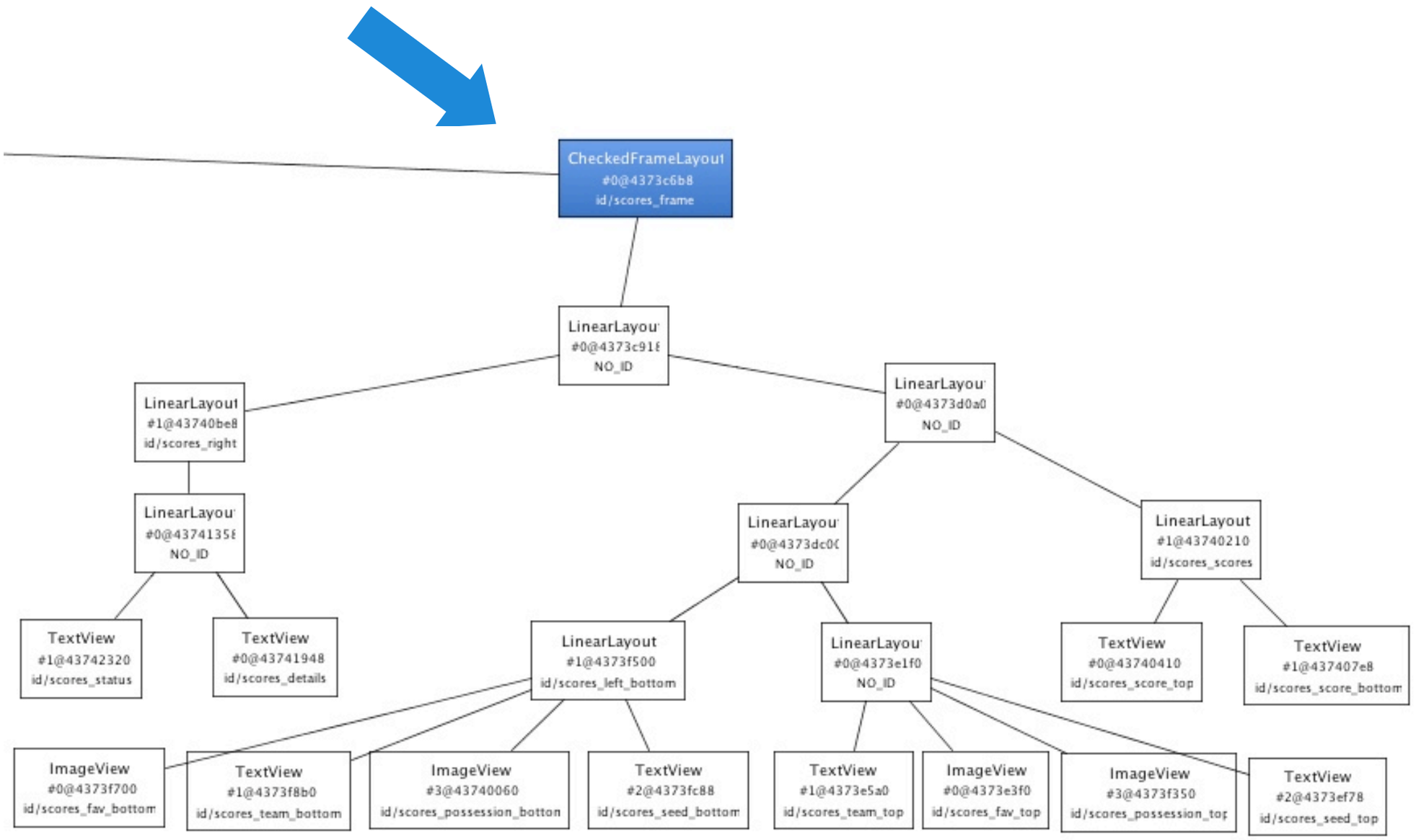
Fixing the Problem



Fixing the problem





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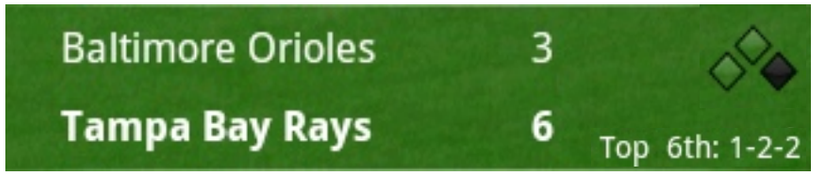
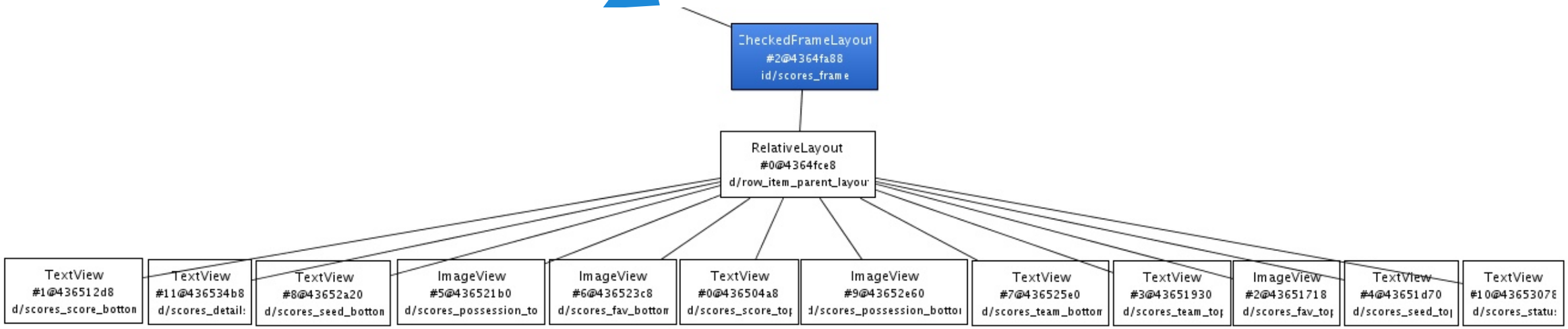
Fixing the problem





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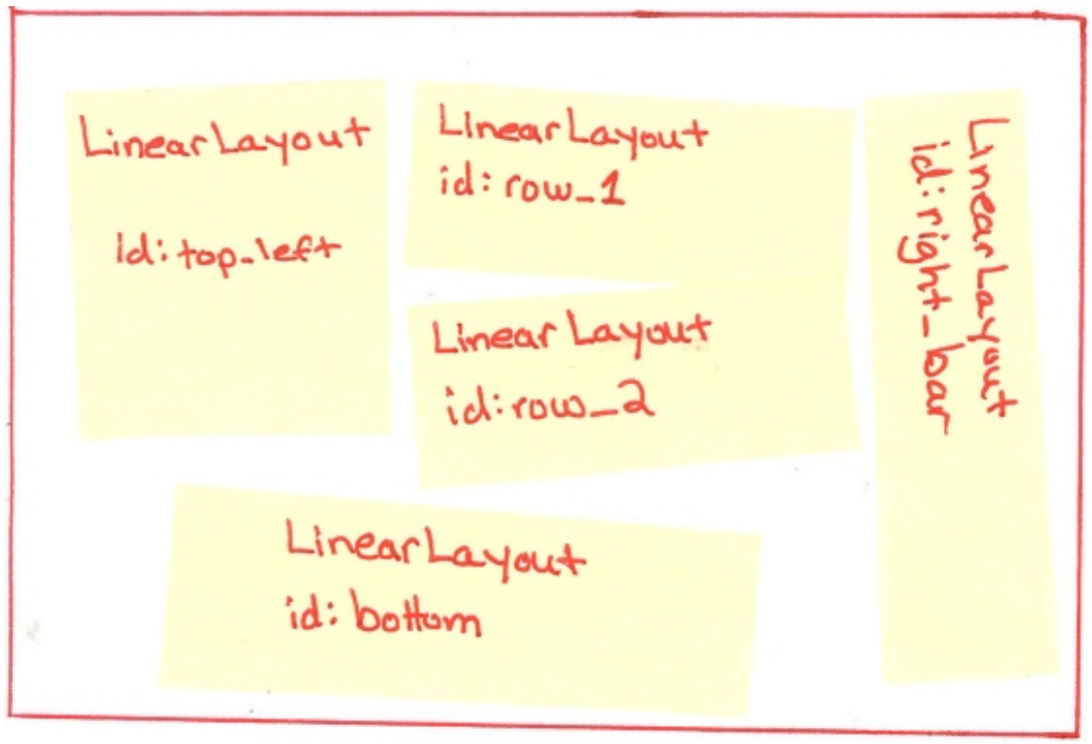
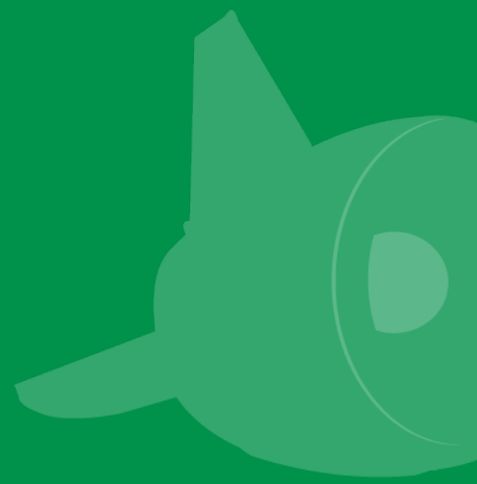
If it looks the same, who cares?

- Flatten for aerodynamic performance
- RelativeLayouts adapt to their environment
- RelativeLayouts force you to think

Key Learnings



- Layouts are code too and will evolve iteratively
- LinearLayouts are simple to visualize and understand, but can result in overly complex, less flexible hierarchies
- Rationalization needs to happen to keep the layout comprehensible and efficient



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Traveler's Tales: Squeaky wheels

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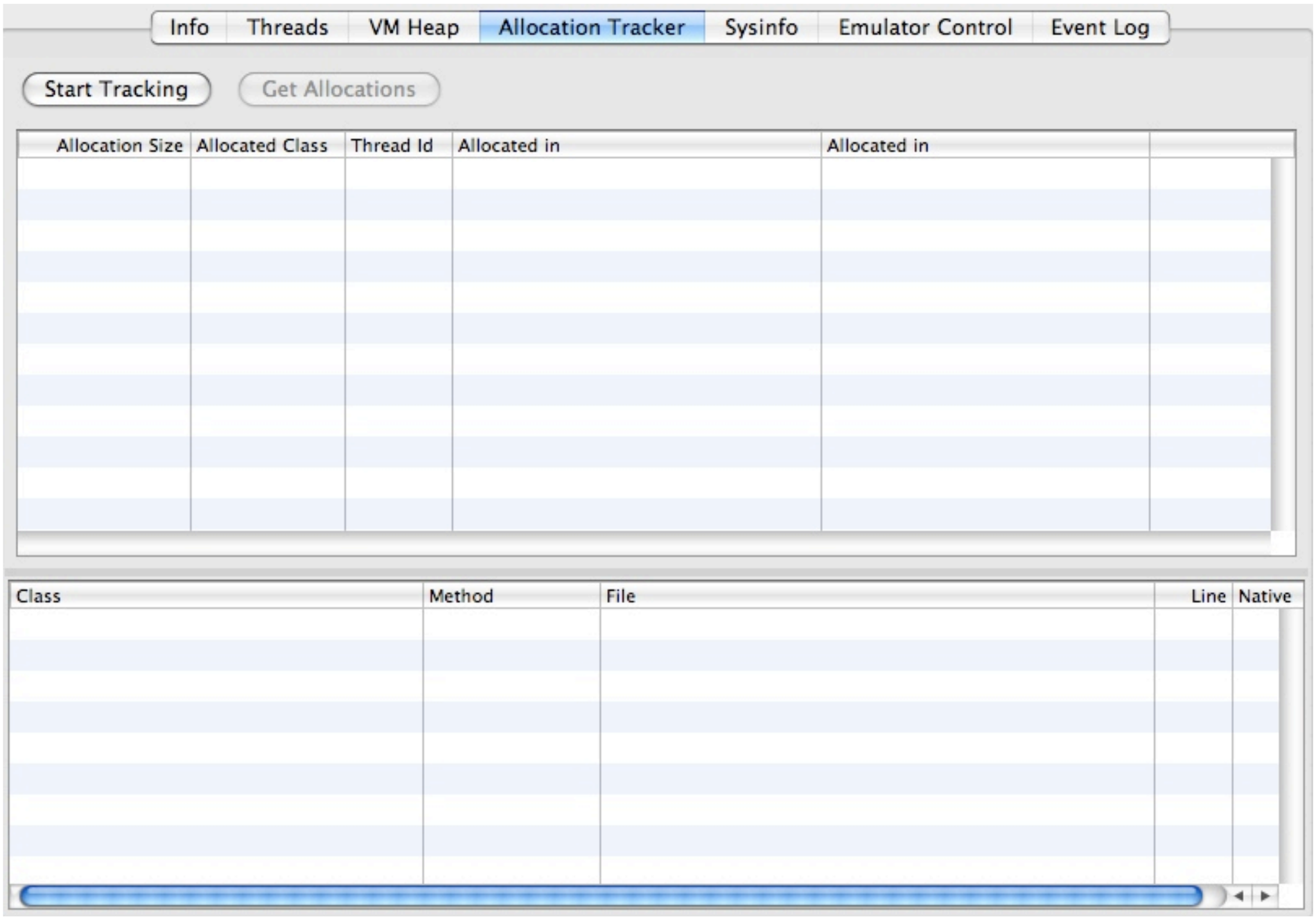
What's that noise?

- Same process id, similar object count, similar sizes

```
D/dalvikvm( 1825): GC freed 7 objects / 313984 bytes in 121ms
D/dalvikvm( 1825): GC freed 6 objects / 316016 bytes in 115ms
D/dalvikvm( 1825): GC freed 7 objects / 318080 bytes in 120ms
D/dalvikvm( 1825): GC freed 6 objects / 320112 bytes in 123ms
D/dalvikvm( 1825): GC freed 7 objects / 322176 bytes in 122ms
D/dalvikvm( 1825): GC freed 7 objects / 324312 bytes in 120ms
D/dalvikvm( 1825): GC freed 20 objects / 326920 bytes in 115ms
D/dalvikvm( 1825): GC freed 6 objects / 328272 bytes in 120ms
D/dalvikvm( 1825): GC freed 7 objects / 330336 bytes in 118ms
D/dalvikvm( 1825): GC freed 6 objects / 332368 bytes in 116ms
D/dalvikvm( 1825): GC freed 7 objects / 334432 bytes in 119ms
D/dalvikvm( 1825): GC freed 6 objects / 336464 bytes in 115ms
D/dalvikvm( 1825): GC freed 7 objects / 338528 bytes in 119ms
D/dalvikvm( 1825): GC freed 6 objects / 340560 bytes in 120ms
D/dalvikvm( 1825): GC freed 7 objects / 342624 bytes in 114ms
D/dalvikvm( 1825): GC freed 6 objects / 344656 bytes in 120ms
D/dalvikvm( 1825): GC freed 7 objects / 346720 bytes in 115ms
D/dalvikvm( 1825): GC freed 6 objects / 348752 bytes in 138ms
```

Allocation Tracker



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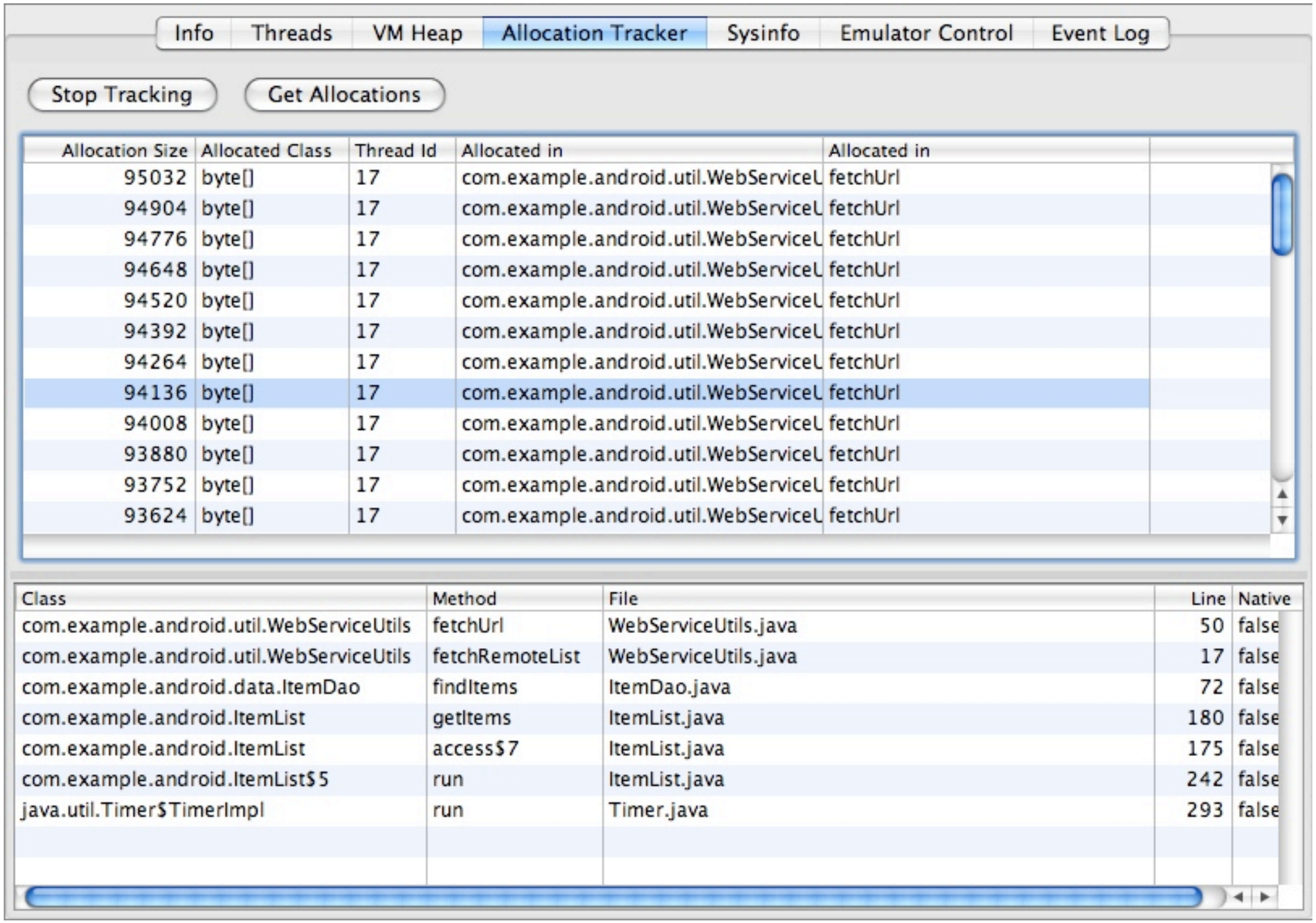
Allocation Tracking



Using the right tool

- Problem caused by old code
  - Used for speed and convenience, over-stayed its welcome

```
public static byte[] fetchUri(String url) {
  ...
  InputStream in = openUrl(url);
  byte[] response = new byte[0];
  byte[] readChunk = new byte[384];
  int byteSize = 0;
  while ( (byteSize = in.read(readChunk)) != -1) {
    byte[] alreadyRead = response;
    response = new byte[alreadyRead.length + byteSize];
    mergeArrays(response, alreadyRead, readChunk);
  }
}
```

Fixing the problem

- Rewrite code to fit the problem
- Anticipate larger read sizes, read in pieces, zipper together only at the end

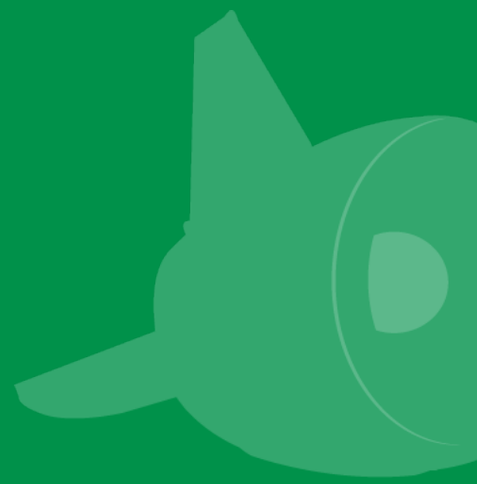
```
public static byte[] fetchUri(String url) {
  ...
  InputStream in = openUrl(url);
  ArrayList <byte[]> responsePieces = new ArrayList <byte[]>();
  byte[] readChunk = new byte[2048];
  int biteSize = 0;
  int responseSize = 0;
  while ( (biteSize = in.read(readChunk)) != -1) {
    responsePieces.add(readChunk);
    responseSize += biteSize;
    readChunk = new byte[2048];
  }
  byte[] fullResponse = new byte[responseSize];
  mergeArrays(fullResponse, responseSize);
}
```

- Result: 90% decrease in read times

Key Learnings

- Take care with reused or prototype code

- Log messages if code is used beyond tolerances



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Pop quiz!

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What's gone wrong?

```
E/AndroidRuntime( 1004): Uncaught handler: thread main exiting due to uncaught exception
E/AndroidRuntime( 1004): java.lang.StackOverflowError
E/AndroidRuntime( 1004):        at android.text.Styled.measureText(Styled.java:371)
E/AndroidRuntime( 1004):        at android.text.Layout.measureText(Layout.java:1600)
E/AndroidRuntime( 1004):        at android.text.StaticLayout.generate(StaticLayout.java:721)
E/AndroidRuntime( 1004):        at android.text.StaticLayout.<init>(StaticLayout.java:97)
E/AndroidRuntime( 1004):        at android.text.StaticLayout.<init>(StaticLayout.java:54)
E/AndroidRuntime( 1004):        at android.text.StaticLayout.<init>(StaticLayout.java:45)
E/AndroidRuntime( 1004):        at android.widget.TextView.makeNewLayout(TextView.java:4757)
E/AndroidRuntime( 1004):        at android.widget.TextView.onMeasure(TextView.java:4984)
E/AndroidRuntime( 1004):        at android.view.View.measure(View.java:7115)
E/AndroidRuntime( 1004):        at android.view.ViewGroup.measureChildWithMargins(ViewGroup.java:2875)
E/AndroidRuntime( 1004):        at android.widget.LinearLayout.measureChildBeforeLayout(LinearLayout.java:888)
E/AndroidRuntime( 1004):        at android.widget.LinearLayout.measureHorizontal(LinearLayout.java:619)
E/AndroidRuntime( 1004):        at android.widget.LinearLayout.onMeasure(LinearLayout.java:280)
E/AndroidRuntime( 1004):        at android.view.View.measure(View.java:7115)
E/AndroidRuntime( 1004):        at android.view.ViewGroup.measureChildWithMargins(ViewGroup.java:2875)
E/AndroidRuntime( 1004):        at android.view.View.measure(View.java:7115)
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E/AndroidRuntime( 1004):        at android.widget.LinearLayout.onMeasure(LinearLayout.java:280)
E/AndroidRuntime( 1004):        at android.view.View.measure(View.java:7115)
E/AndroidRuntime( 1004):        at android.view.ViewGroup.measureChildWithMargins(ViewGroup.java:2875)
E/AndroidRuntime( 1004):        at android.widget.LinearLayout.measureChildBeforeLayout(LinearLayout.java:888)
E/AndroidRuntime( 1004):        at android.widget.LinearLayout.measureHorizontal(LinearLayout.java:619)
E/AndroidRuntime( 1004):        at android.widget.LinearLayout.onMeasure(LinearLayout.java:280)
E/AndroidRuntime( 1004):        at android.view.View.measure(View.java:7115)
E/AndroidRuntime( 1004):        at android.view.ViewGroup.measureChildWithMargins(ViewGroup.java:2875)
E/AndroidRuntime( 1004):        at android.widget.LinearLayout.measureChildBeforeLayout(LinearLayout.java:888)
```

What's gone wrong?

```
E/AndroidRuntime( 1004):        at android.widget.LinearLayout.measureHorizontal(LinearLayout.java:619)
E/AndroidRuntime( 1004):        at android.widget.LinearLayout.onMeasure(LinearLayout.java:280)
E/AndroidRuntime( 1004):        at android.view.View.measure(View.java:7115)
E/AndroidRuntime( 1004):        at android.view.ViewGroup.measureChildWithMargins(ViewGroup.java:2875)
E/AndroidRuntime( 1004):        at android.widget.LinearLayout.measureChildBeforeLayout(LinearLayout.java:888)
E/AndroidRuntime( 1004):        at android.widget.LinearLayout.measureHorizontal(LinearLayout.java:619)
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E/AndroidRuntime( 1004):        at android.widget.LinearLayout.measureChildBeforeLayout(LinearLayout.java:888)
E/AndroidRuntime( 1004):        at an
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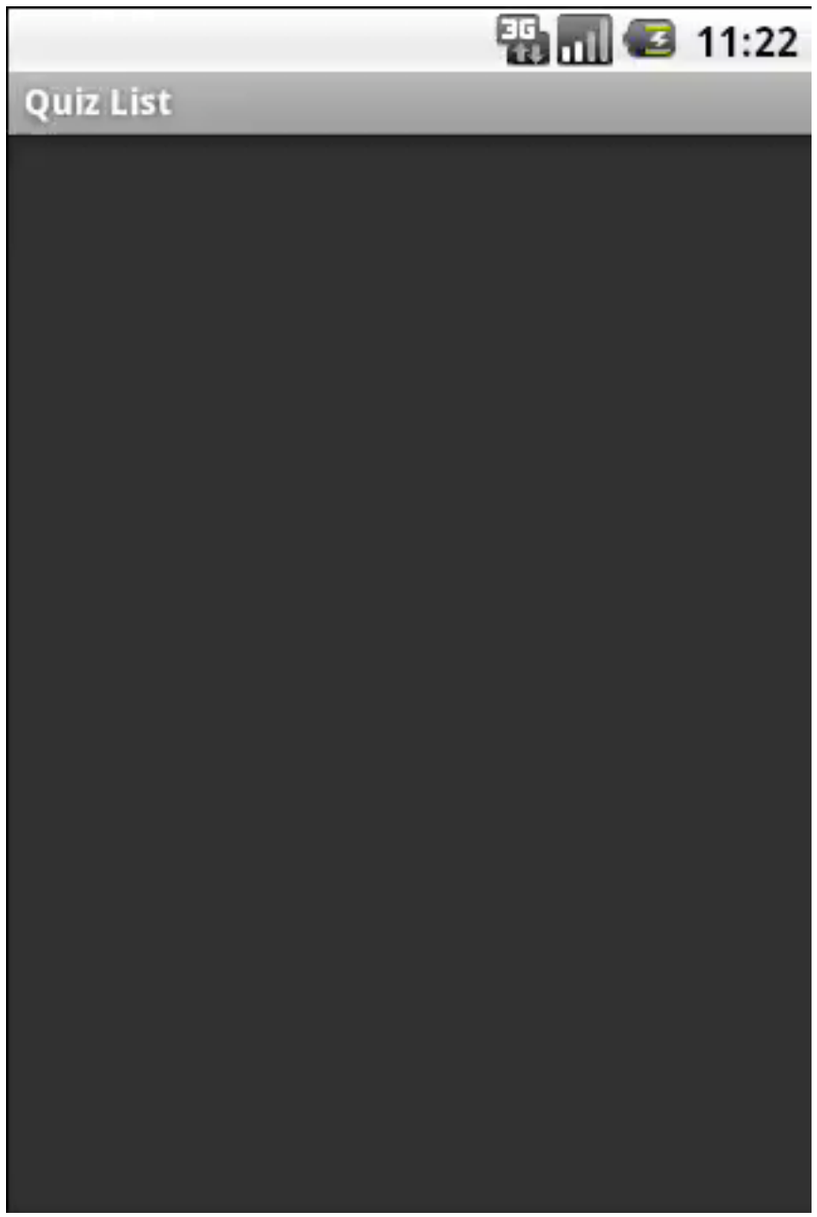
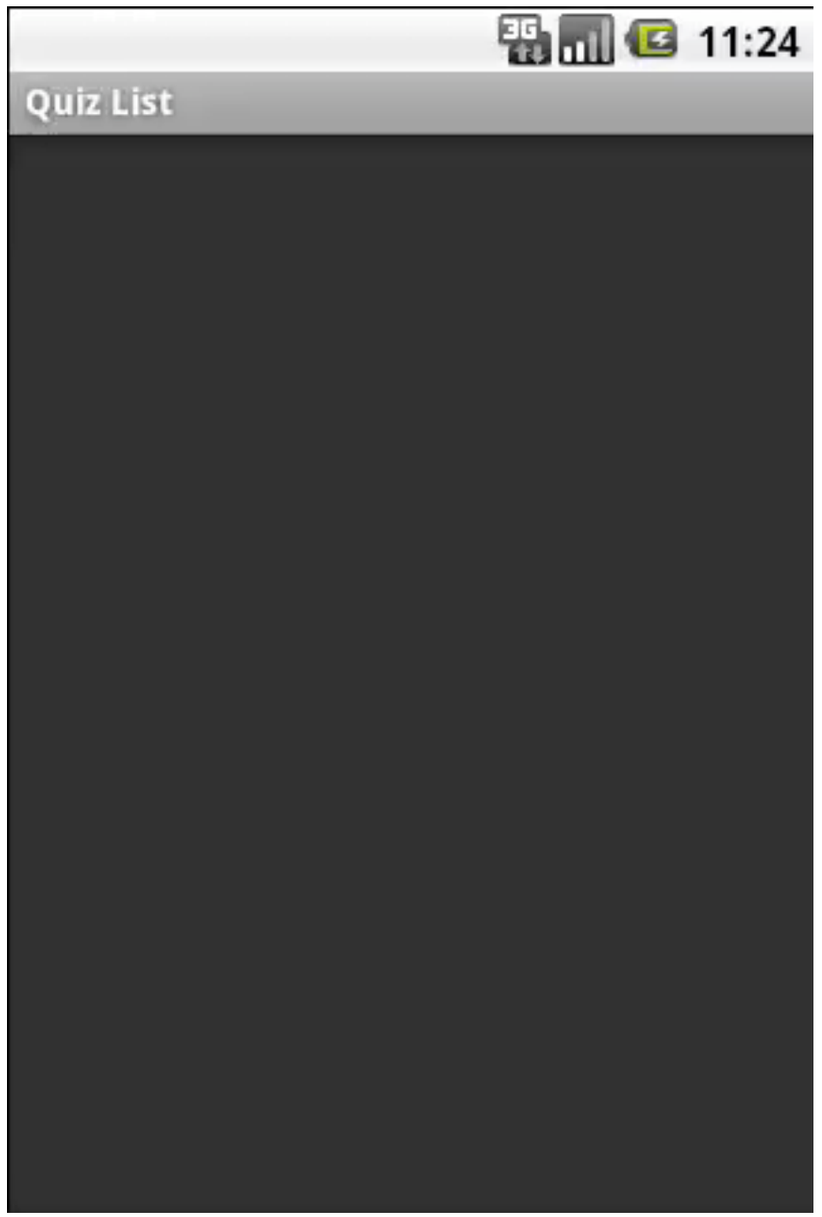
What change caused this slow down?





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