

Google™





Debugging Arts of the Ninja Masters

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Agenda

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

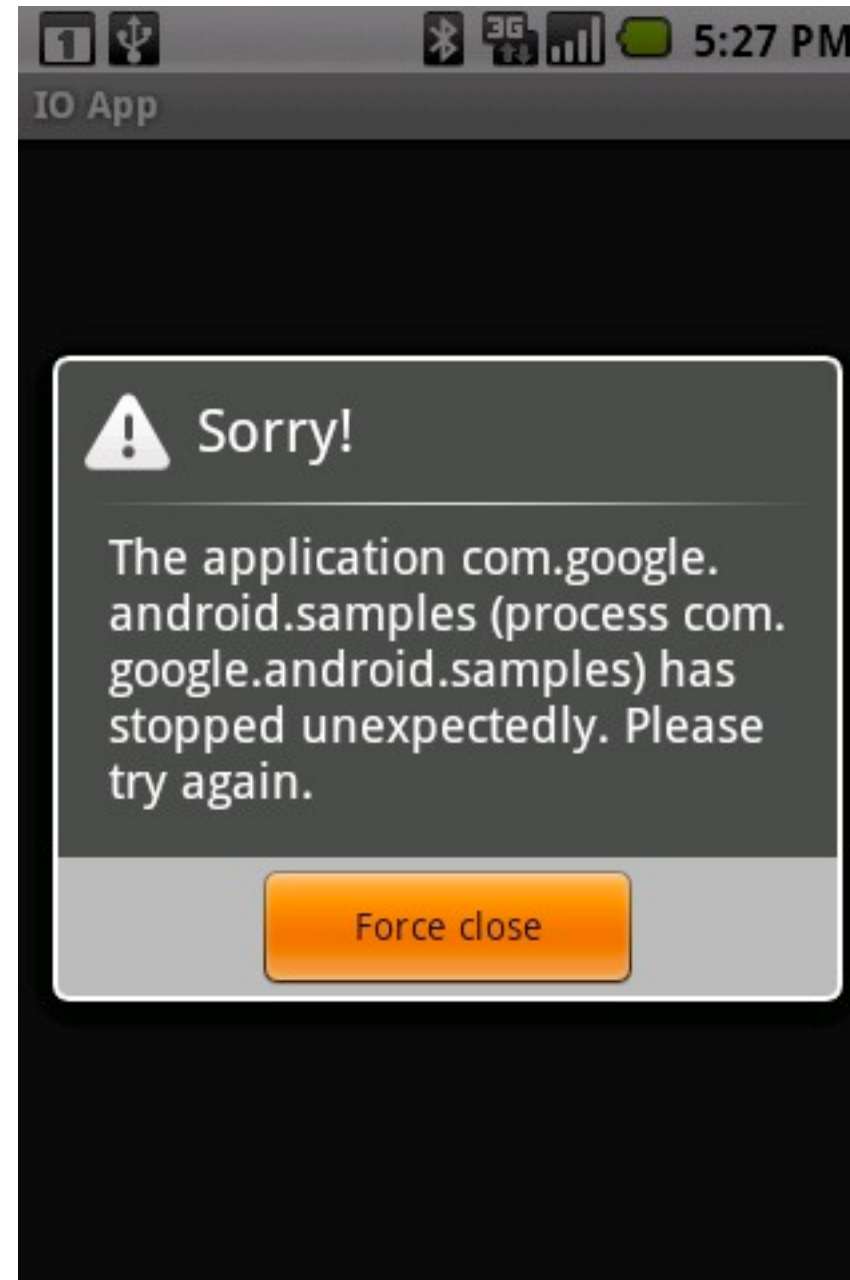




logcat



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.intent.category.LAUNCHER] flg=0x28000000 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 (total 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, unseenCount=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/.HtmlConversationActivity (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/1301874412399572048/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());
        }
    }
}
```

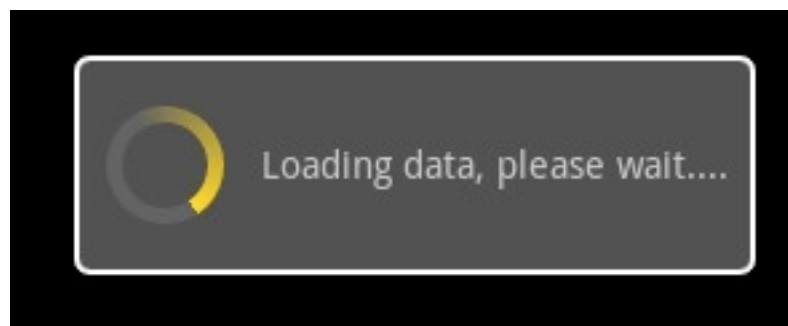
The scene of the crime

```
lease 7200 seconds
D/SettingsWifiEnabler( 1461): Received network state changed to NetworkInfo: type: WIFI[
], state: CONNECTED/CONNECTED, reason: (unspecified), extra: (none), roaming: false, failo
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, failo
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
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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





traceview



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



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 ()V	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/M	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 (III)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 (III)V	11.5%	2278.992	0.1%	10.780	13+362	6.077
▶ 19 android/widget/FrameLayout.onLayout (ZIII)V	11.5%	2277.437	0.0%	7.659	13+46	38.601
▶ 20 android/widget/LinearLayout.onLayout (ZIII)V	11.5%	2273.438	0.0%	1.865	13+93	21.448
▶ 21 android/widget/LinearLayout.onLayout (ZIII)V	11.5%	2273.333	0.1%	18.541	13+60	21.140

Function statistics

Details

Name	Incl %	Inclusive	Excl %	Exclusive	Calls+Recur Calls/Total	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
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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/URLConnection.readIn ()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	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/cr	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

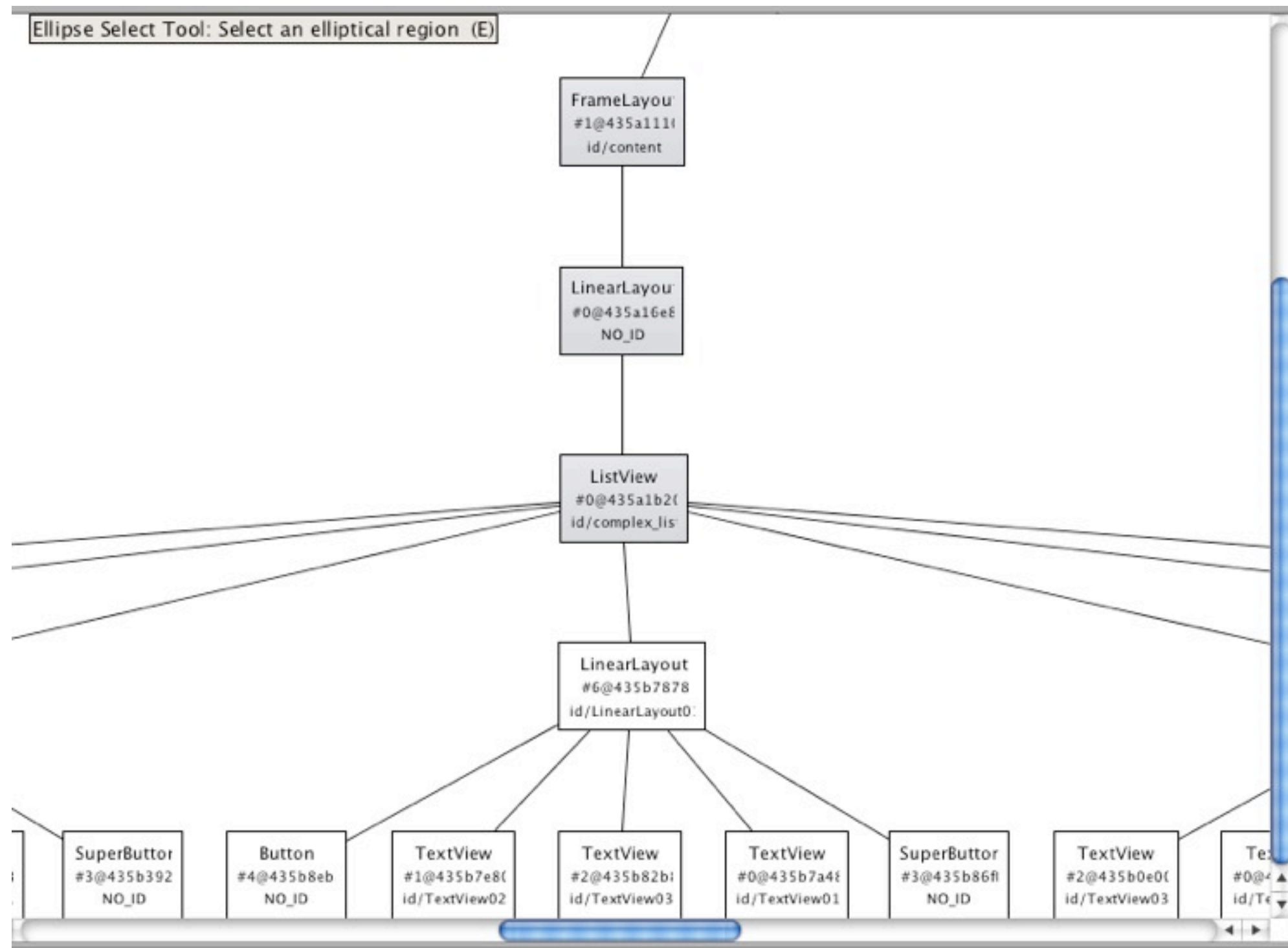




HierarchyViewer

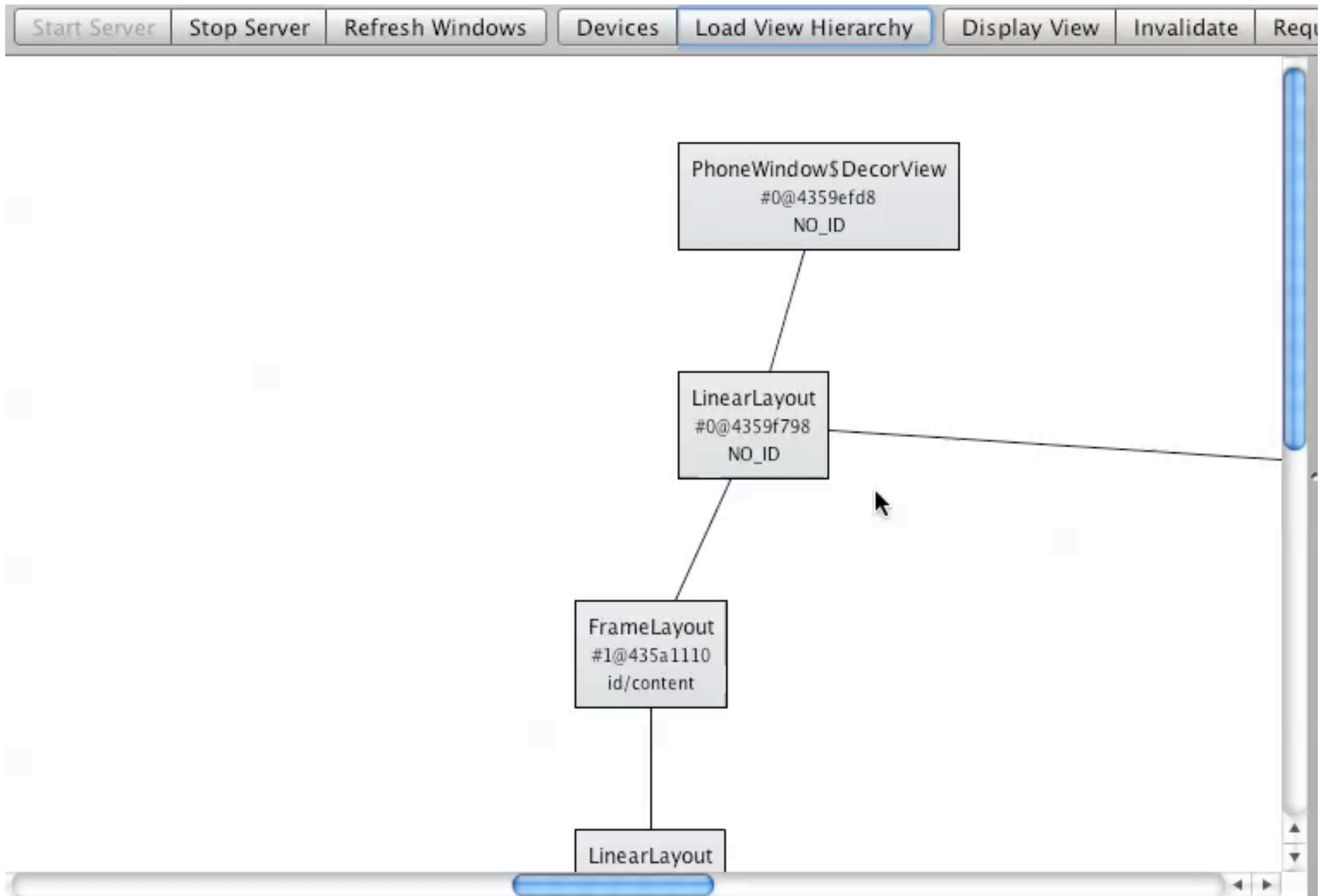


Exploring the UI with HierarchyViewer



Climbing the tree

Climbing the tree



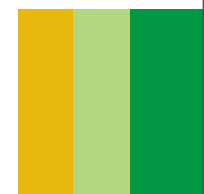
Questionable families

- “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>
```





Traveler's Tales: Betrayal



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

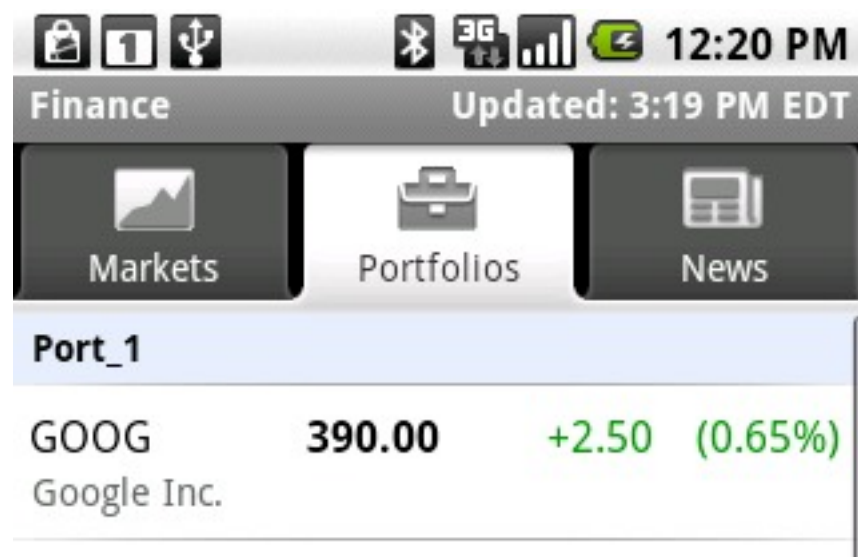
- A call about time zones is taking this long?
- Wait, I'm not even doing anything with time zones

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 (III)V	12.0%	1784.042
30 android/widget/FrameLayout.onLayout (ZIII)V	12.0%	1783.095
31 android/widget/LinearLayout.onLayout (ZIII)V	12.0%	1781.785
32 android/widget/LinearLayout.layoutVertical ()V	12.0%	1781.662
33 android/widget/LinearLayout.setChildFrame (Landroid/view/View;III)V	12.0%	1779.140
34 android/widget/AbsListView.onLayout (ZIII)V	11.8%	1757.338

com.ibm.icu4jni.util.Resources.getTimeZonesNative

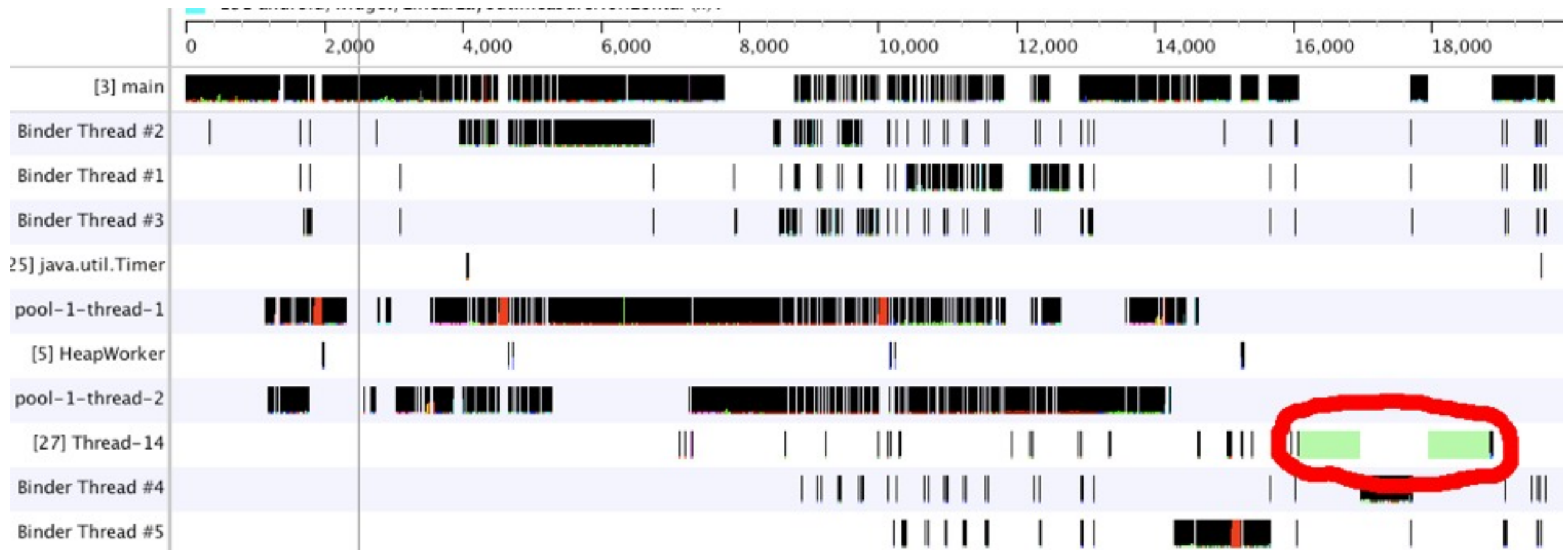
- A call about time zones is taking this long?
- Wait, I'm not even doing anything with time zones

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 (III)V	12.0%	1784.042
30 android/widget/FrameLayout.onLayout (ZIII)V	12.0%	1783.095
31 android/widget/LinearLayout.onLayout (ZIII)V	12.0%	1781.785
32 android/widget/LinearLayout.layoutVertical ()V	12.0%	1781.662
33 android/widget/LinearLayout.setChildFrame (Landroid/view/View;III)V	12.0%	1779.140
34 android/widget/AbsListView.onLayout (ZIII)V	11.8%	1757.338



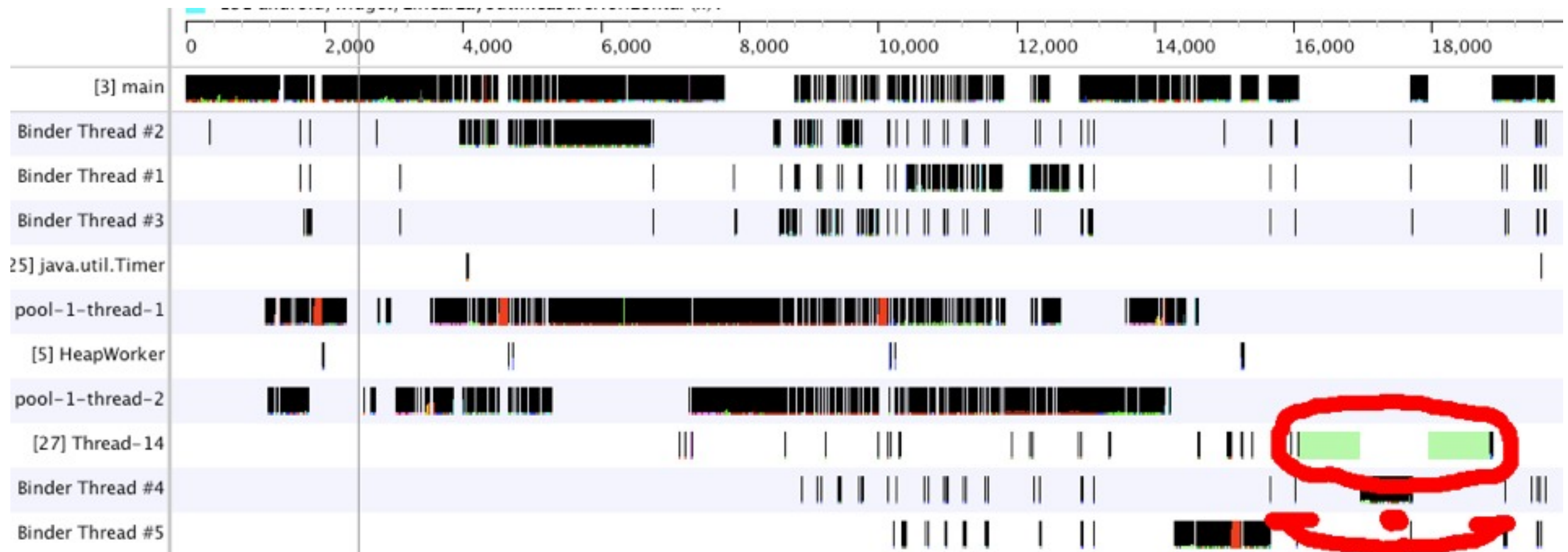
Fixing the problem

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



Fixing the problem

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



Key Learnings

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





Traveler's Tales: Finding shortcuts



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

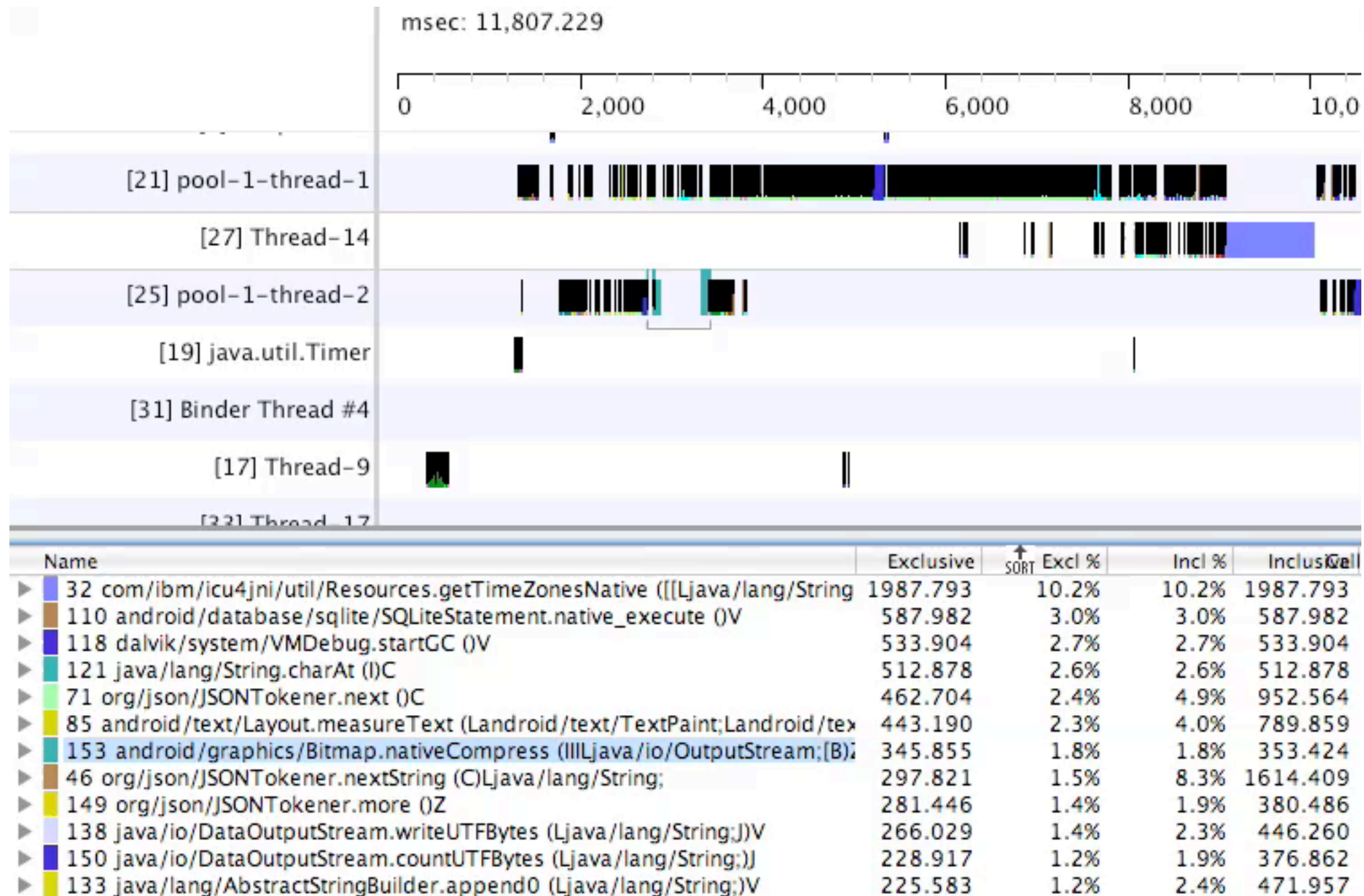
Name	↑ SORT	Excl %	Exclusive	Time/Call
▶ 32 com/ibm/icu4jni/util/Resources.getTimeZonesNative ([[Lja		10.2%	1987.793	1987.793
▶ 110 android/database/sqlite/SQLiteStatement.native_execute		3.0%	587.982	10.138
▶ 118 dalvik/system/VMDebug.startGC ()V		2.7%	533.904	133.476
▶ 121 java/lang/String.charAt (I)C		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 (IIIjava/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

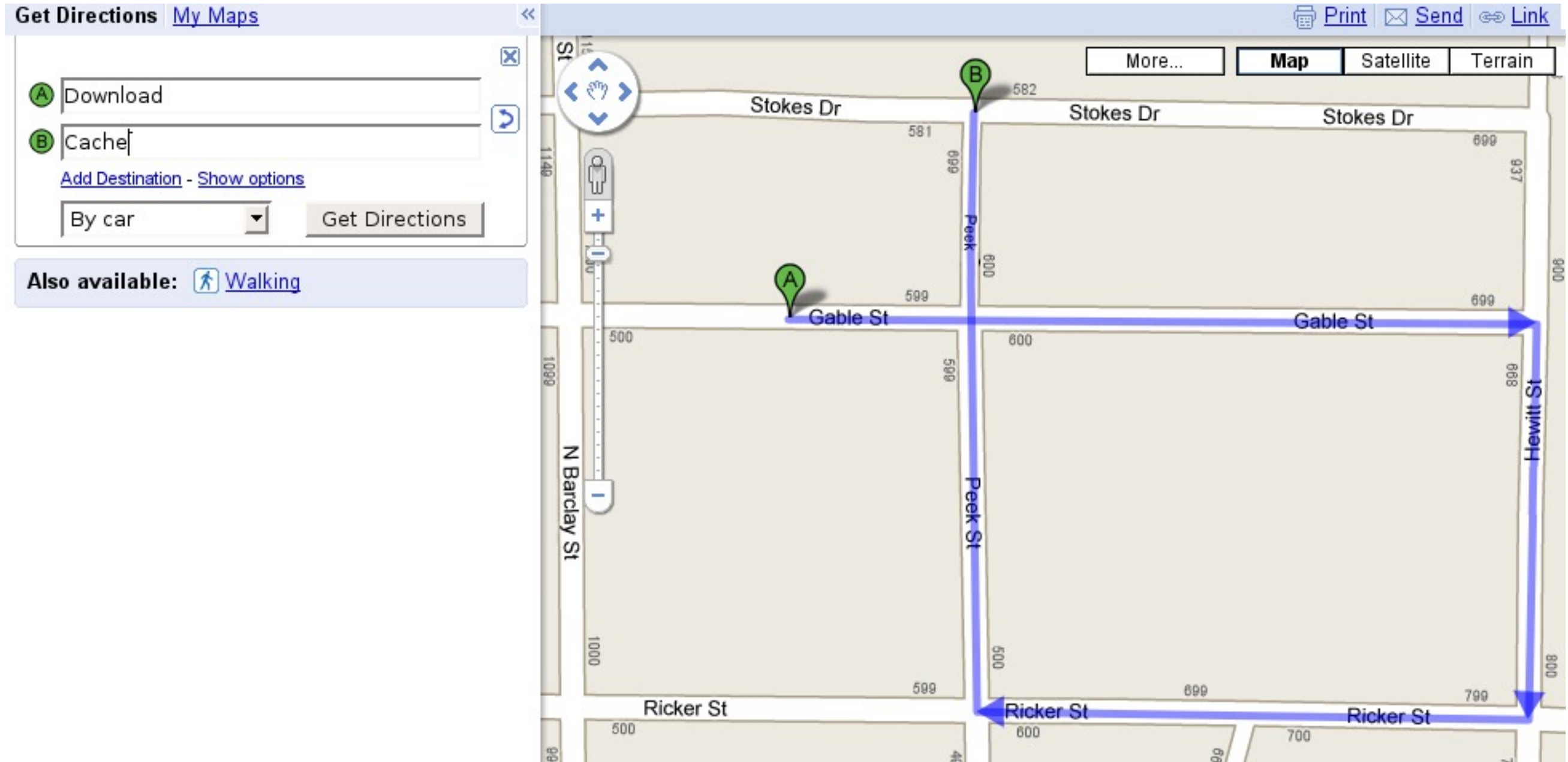
- Explore ancestors and descendants of the method
- Use timeline line view to check what happens before and after the method

Take a look around

Take a look around



Iterate the route into a circle (square?)



Iterate the route into a circle (square?)

The image shows a Google Maps interface with a route calculated between two points, A and B. Point A is located at the intersection of Gable St and Ricker St. Point B is located at the intersection of Stokes Dr and Ricker St. The route is shown as a blue line with arrows indicating the direction of travel. The route starts at point A, goes east on Gable St to point B, then south on Stokes Dr, west on Ricker St, and back north on Gable St to point A, forming a square loop. The text "Parse response" is written in green in the center of the map area. The interface includes a "Get Directions" sidebar on the left with input fields for "Download" and "Cache", a "By car" dropdown, and a "Get Directions" button. The top right of the map area has buttons for "Print", "Send", and "Link". The map itself shows a grid of streets including Stokes Dr, Gable St, Ricker St, and N Barclay St, with various address numbers visible.

Iterate the route into a circle (square?)

The image shows a Google Maps interface with a square route highlighted in blue. The route starts at point A (Gable St), goes east to point B (Stokes Dr), then south to Ricker St, west to N Barclay St, and back north to Gable St. The route is labeled with street names: Stokes Dr, Gable St, Ricker St, and N Barclay St. The map shows a grid of streets with house numbers. On the left, the 'Get Directions' panel is visible, showing the route from A to B. The panel includes a 'Download' button, a 'Cache' button, a 'By car' dropdown, and a 'Get Directions' button. Below the panel, it says 'Also available: Walking'. On the right, there are buttons for 'Print', 'Send', and 'Link'. The map is in 'Map' mode, with 'Satellite' and 'Terrain' options also visible. The text 'Parse response' is written in green in the center of the map, and 'Create Bitmap' is written vertically in green on the right side of the map.

Get Directions [My Maps](#)

A Download

B Cache

[Add Destination](#) - [Show options](#)

By car

Also available: [Walking](#)

Print Send Link

More... **Map** Satellite Terrain

Stokes Dr

Gable St

Ricker St

N Barclay St

Parse response

Create Bitmap

Iterate the route into a circle (square?)

The screenshot shows a Google Maps interface with a square route highlighted in blue. The route starts at point A (Gable St), goes east to point B (Stokes Dr), then south to Ricker St, and finally west back to point A. The map includes street names like Stokes Dr, Gable St, Ricker St, and N Barclay St. On the left, the 'Get Directions' panel shows the route from A to B. On the right, there are green annotations: 'Parse response' near the top right, 'Create Bitmap' vertically along the right edge, and 'Compress Bitmap' near the bottom right. The top right of the map has buttons for 'Print', 'Send', 'Link', 'More...', 'Map', 'Satellite', and 'Terrain'.

Iterate the route into a circle (square?)

The screenshot shows the Google Maps interface with a square route highlighted in blue. The route starts at point A (Gable St), goes east to point B (Stokes Dr), then south to Ricker St, and finally west back to point A. The map includes street names like Stokes Dr, Gable St, Ricker St, and N Barclay St. On the left, the 'Get Directions' sidebar is visible, showing points A and B, and a 'Get Directions' button. On the right, there are map controls like 'Print', 'Send', 'Link', and map style buttons ('Map', 'Satellite', 'Terrain').

Annotations in green text are overlaid on the route:

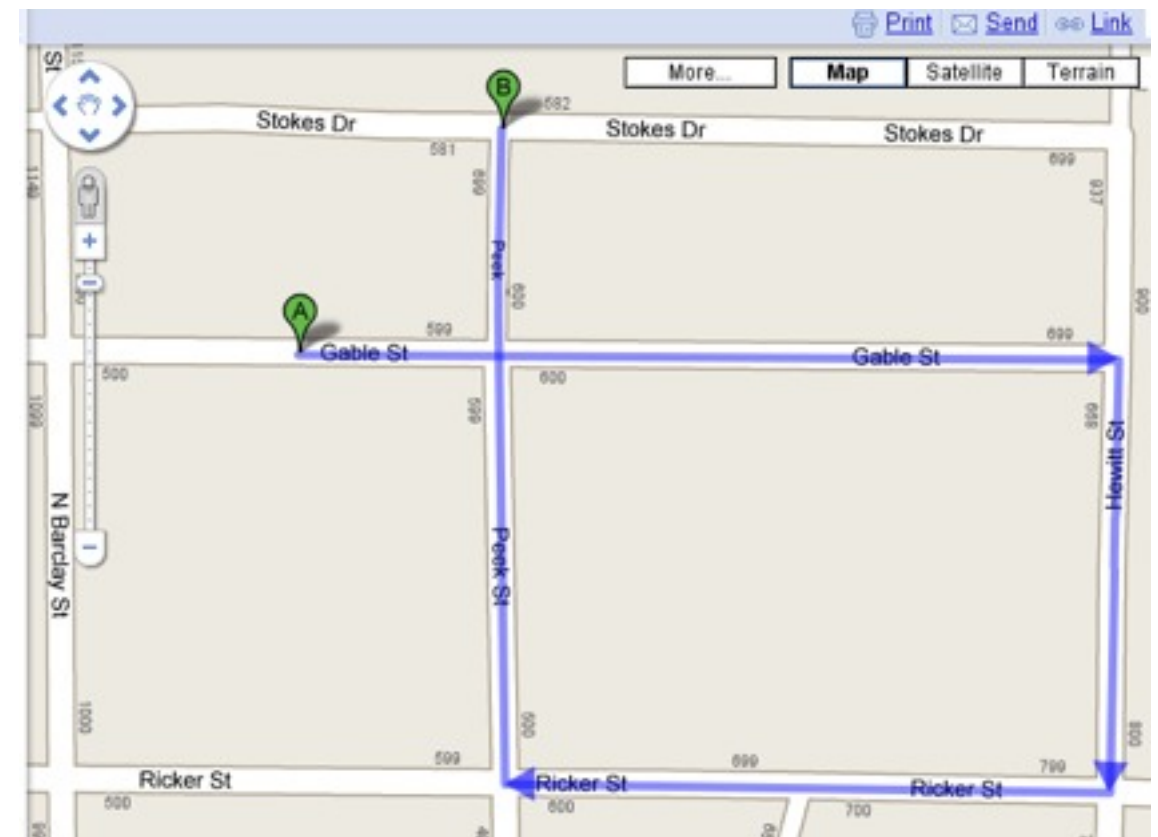
- Parse response** (horizontal, top right)
- Create Bitmap** (vertical, right side)
- Compress Bitmap** (horizontal, bottom right)
- Add result to cache** (vertical, left side)

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







Traveler's Tales: Packing mistakes



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		Inclusive	Recur Calls
Name			
0 (toplevel)	19527.952	14+0	
3191 android/app/Activity\$ManagedCursor.<init> (Landroid/database/Cursor;)V	0.244	18+0	
2101 android/app/Activity.createPendingResult (ILandroid/content/Intent;)ILandroid/content/PendingResult;	1.832	1+0	
191 android/app/Activity.dispatchActivityResult (Ljava/lang/String;ILandroid/content/Intent;)V	234.588	1+0	
817 android/app/Activity.findViewById (ILandroid/view/View;)Landroid/view/View;	18.951	11+0	
3894 android/app/Activity.getComponentName ()Landroid/content/ComponentName;	0.031	1+0	
1517 android/app/Activity.getSystemService (Ljava/lang/String;)Ljava/lang/Object;	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;Ljava/lang/String;[Ljava/lang/String;)Landroid/database/Cursor;	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.onCreate (Landroid/os/Bundle;)V	0.122	1+0	
3669 android/app/Activity.onResume ()V	0.091	1+0	
4053 android/app/Activity.onResume ()V	0.030	2+0	
3768 android/app/Activity.onTitleChanged (Ljava/lang/CharSequence;)V	0.061	1+0	
3731 android/app/Activity.onWindowAttributesChanged (Landroid/view/WindowAttributes;)V	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






Traveler's Tales: Consolidating containers

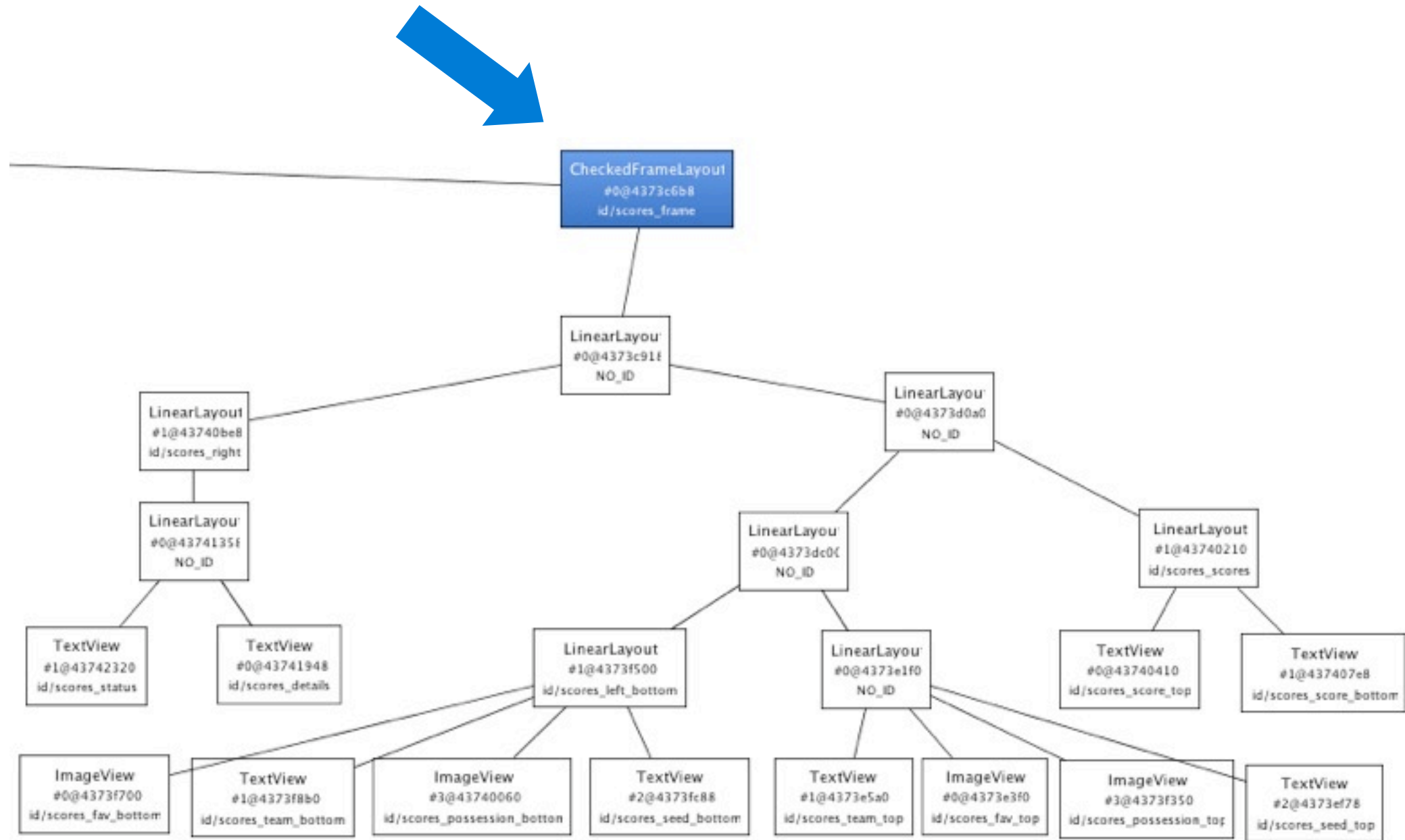


A “simple” layout examined

Baltimore Orioles	3	
Tampa Bay Rays	6	
Top 6th: 1-2-2		

A “simple” layout examined

Baltimore Orioles	3	
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Fixing the Problem



Baltimore Orioles

3

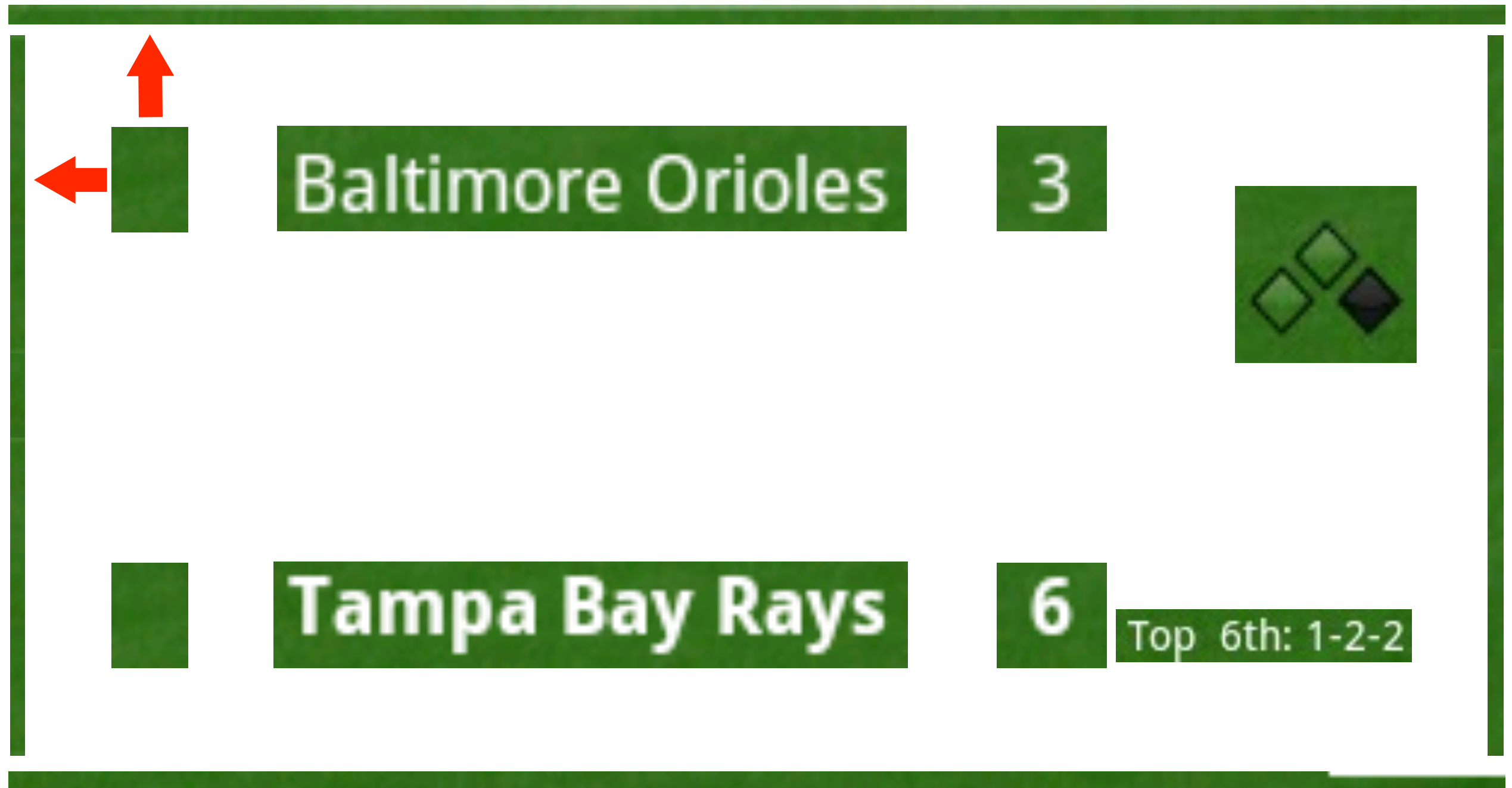


Tampa Bay Rays

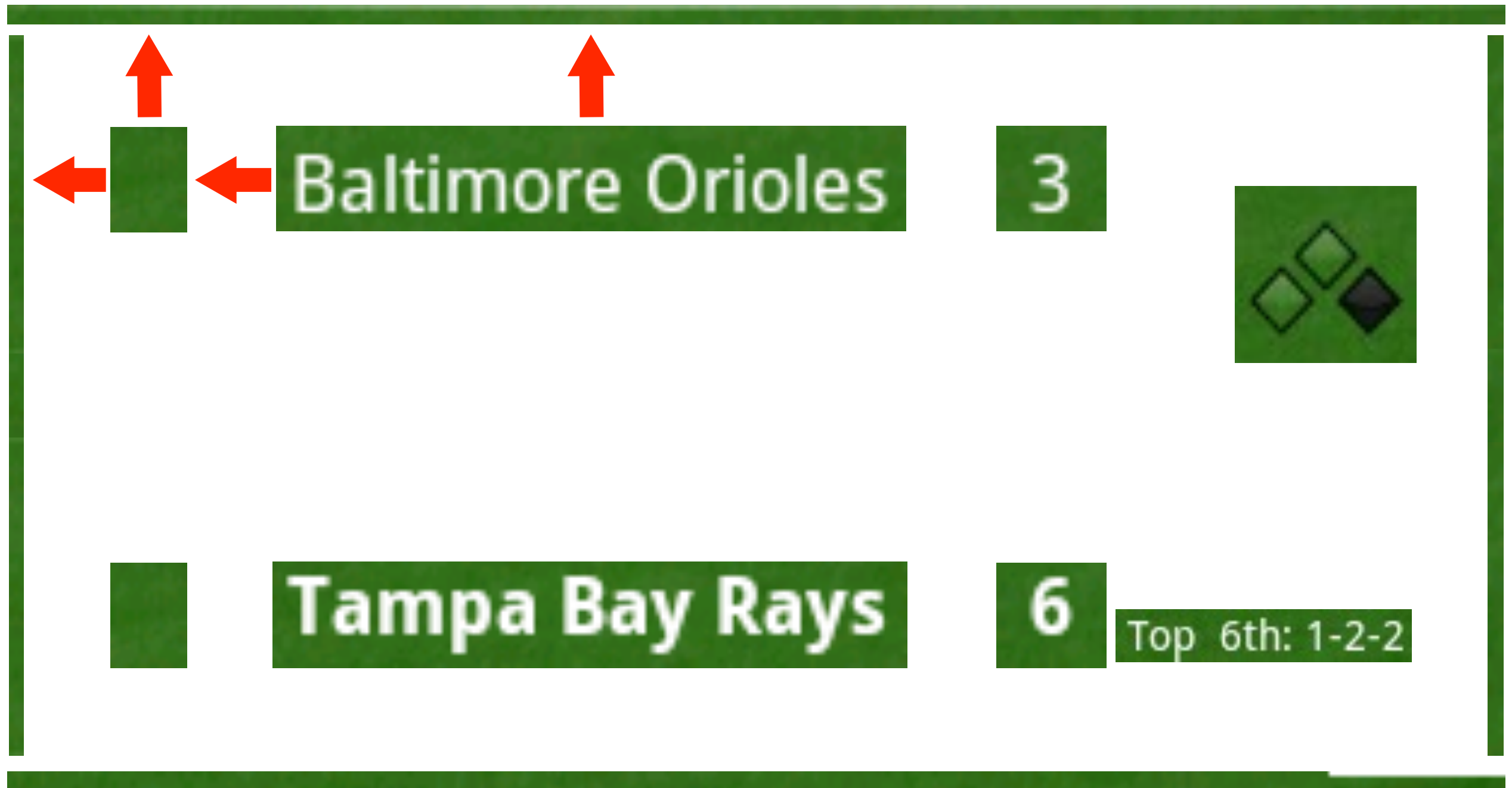
6

Top 6th: 1-2-2

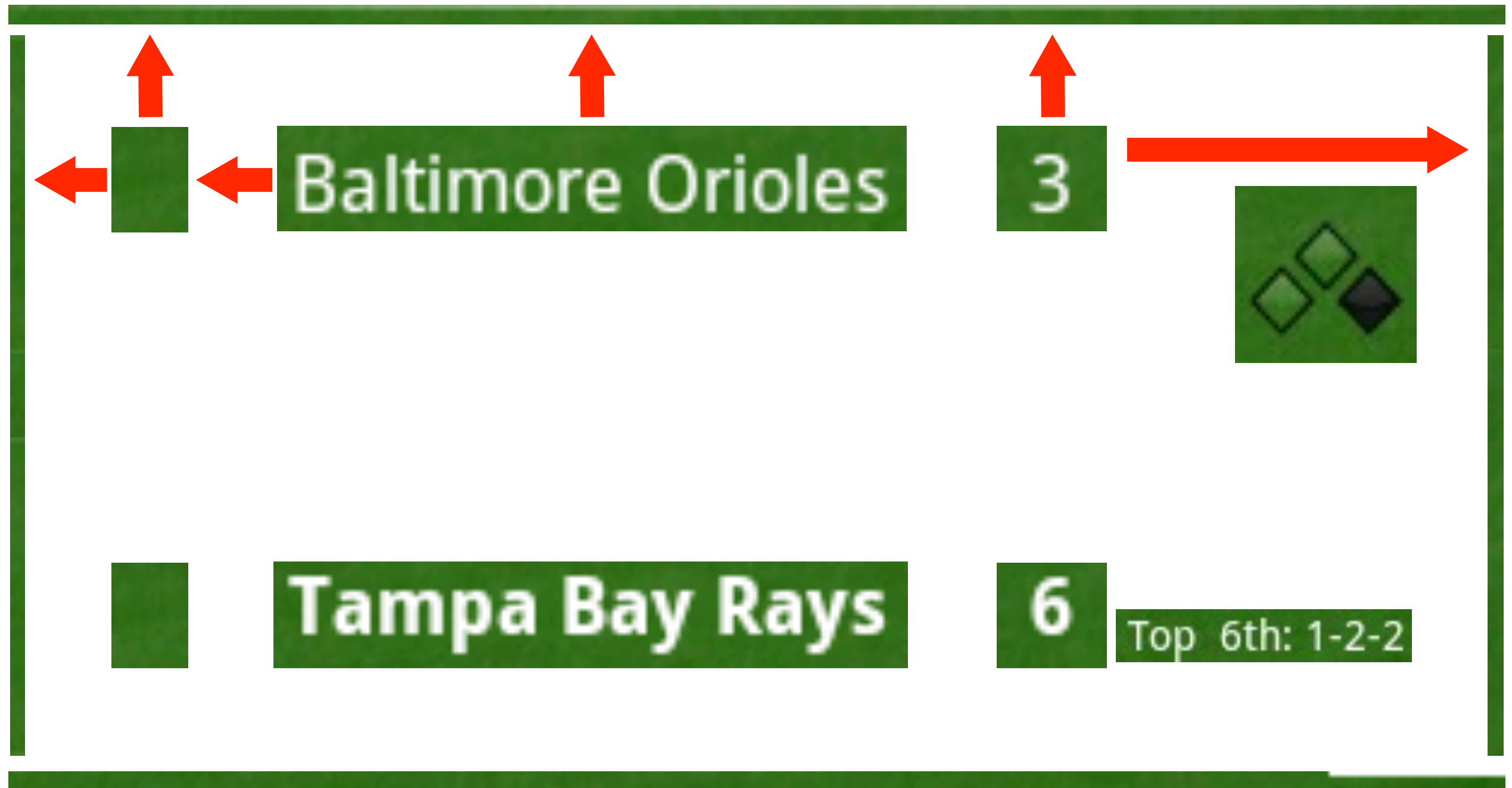
Fixing the Problem



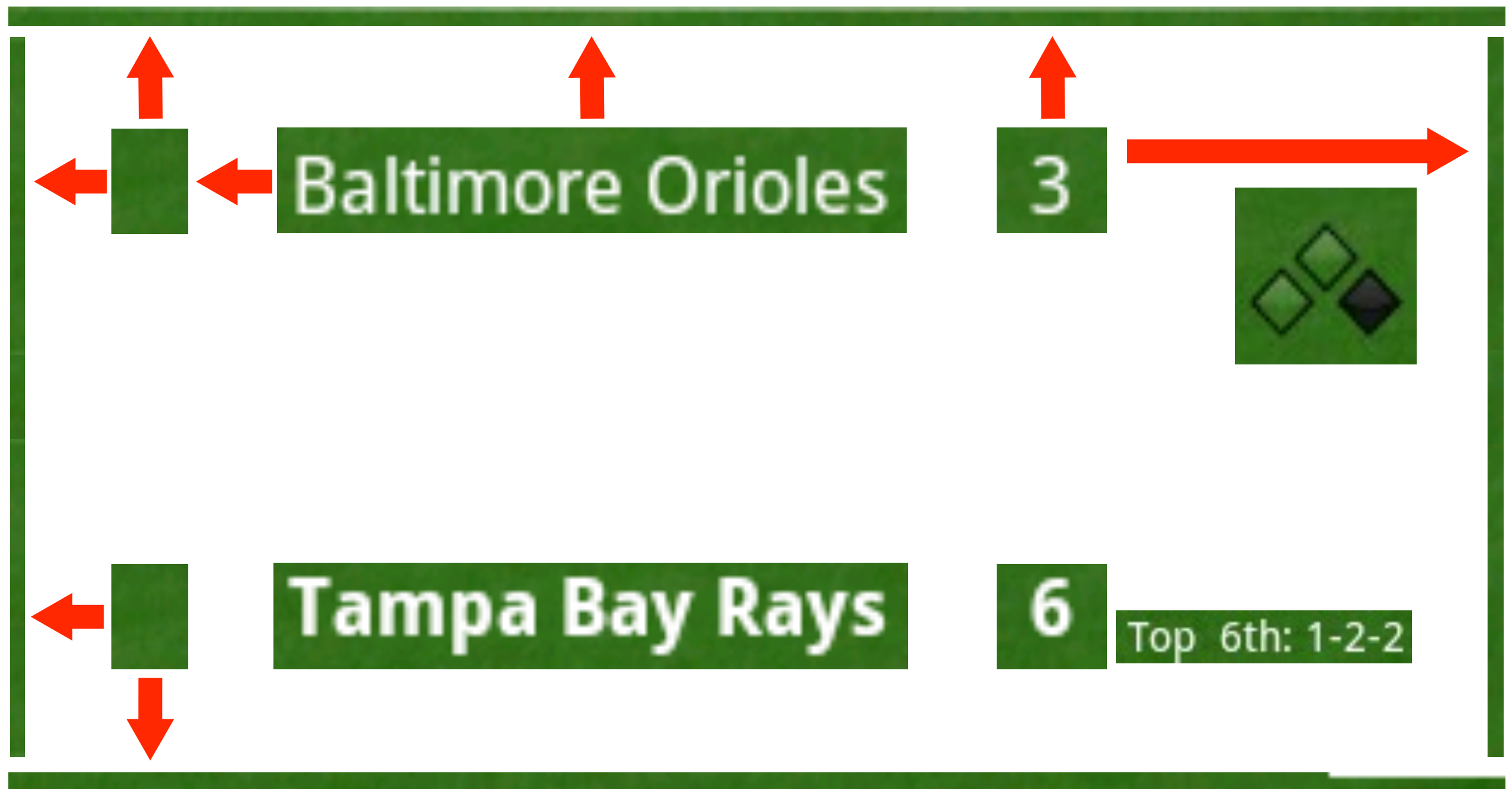
Fixing the Problem



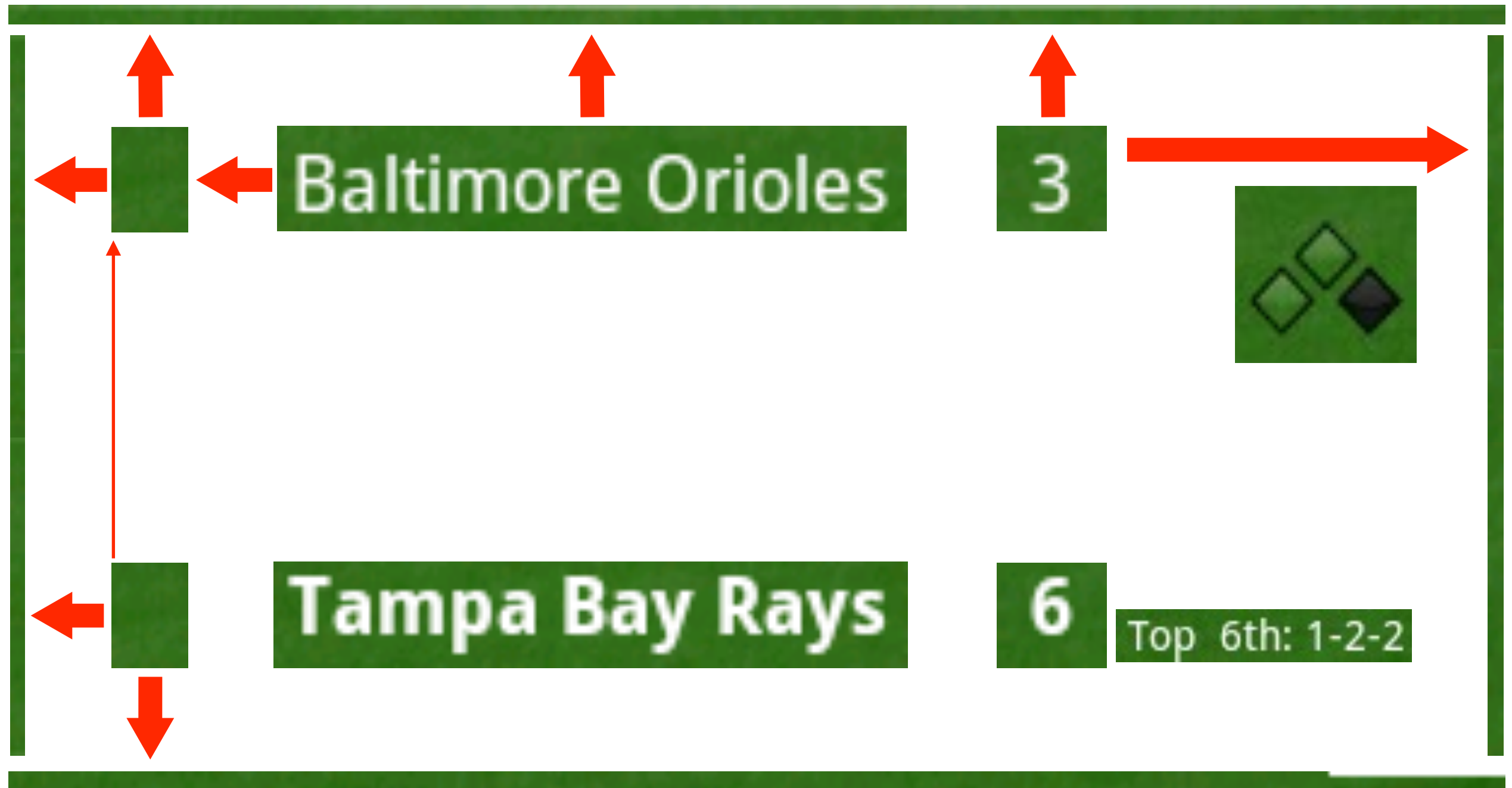
Fixing the Problem



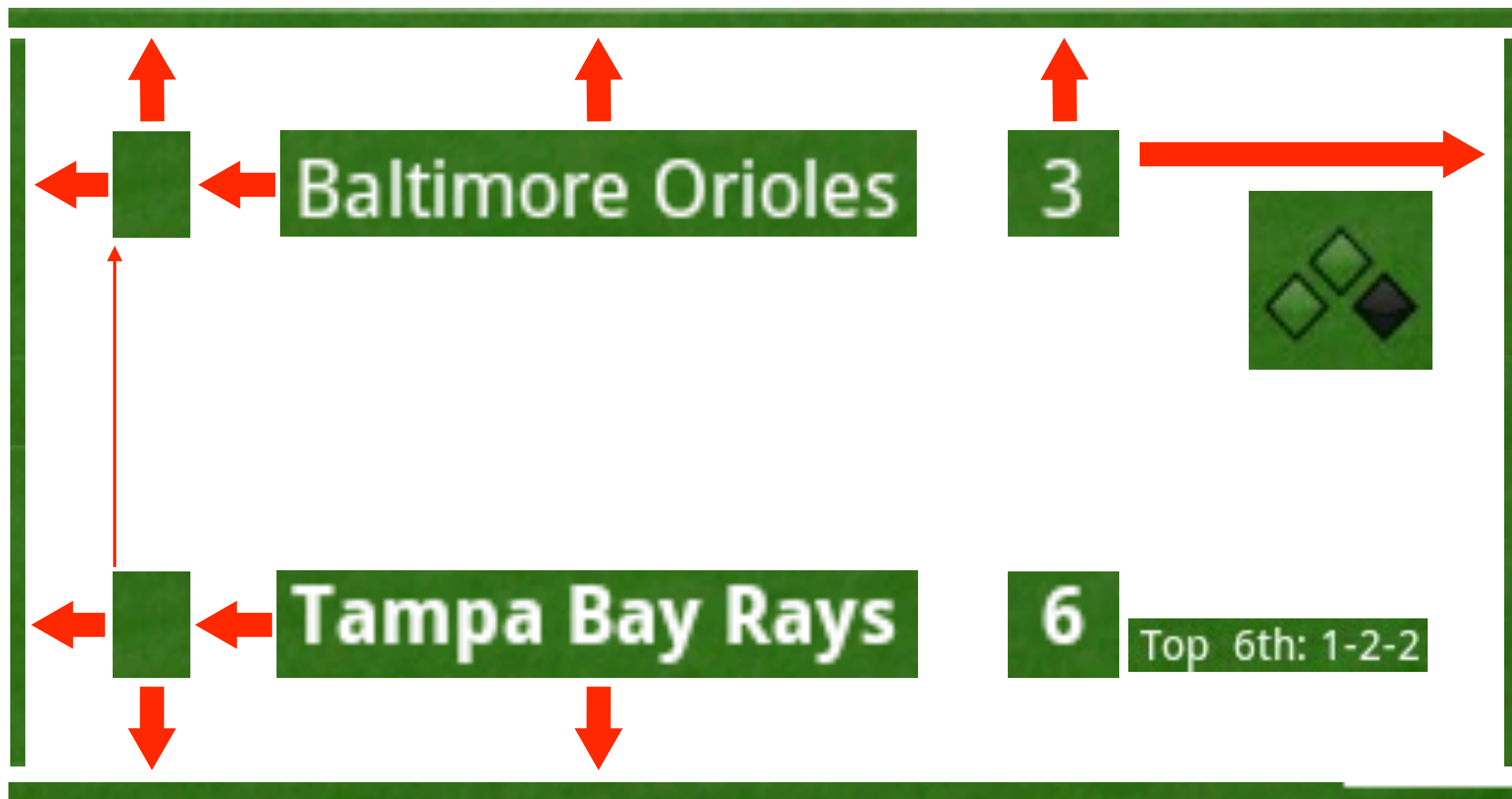
Fixing the Problem



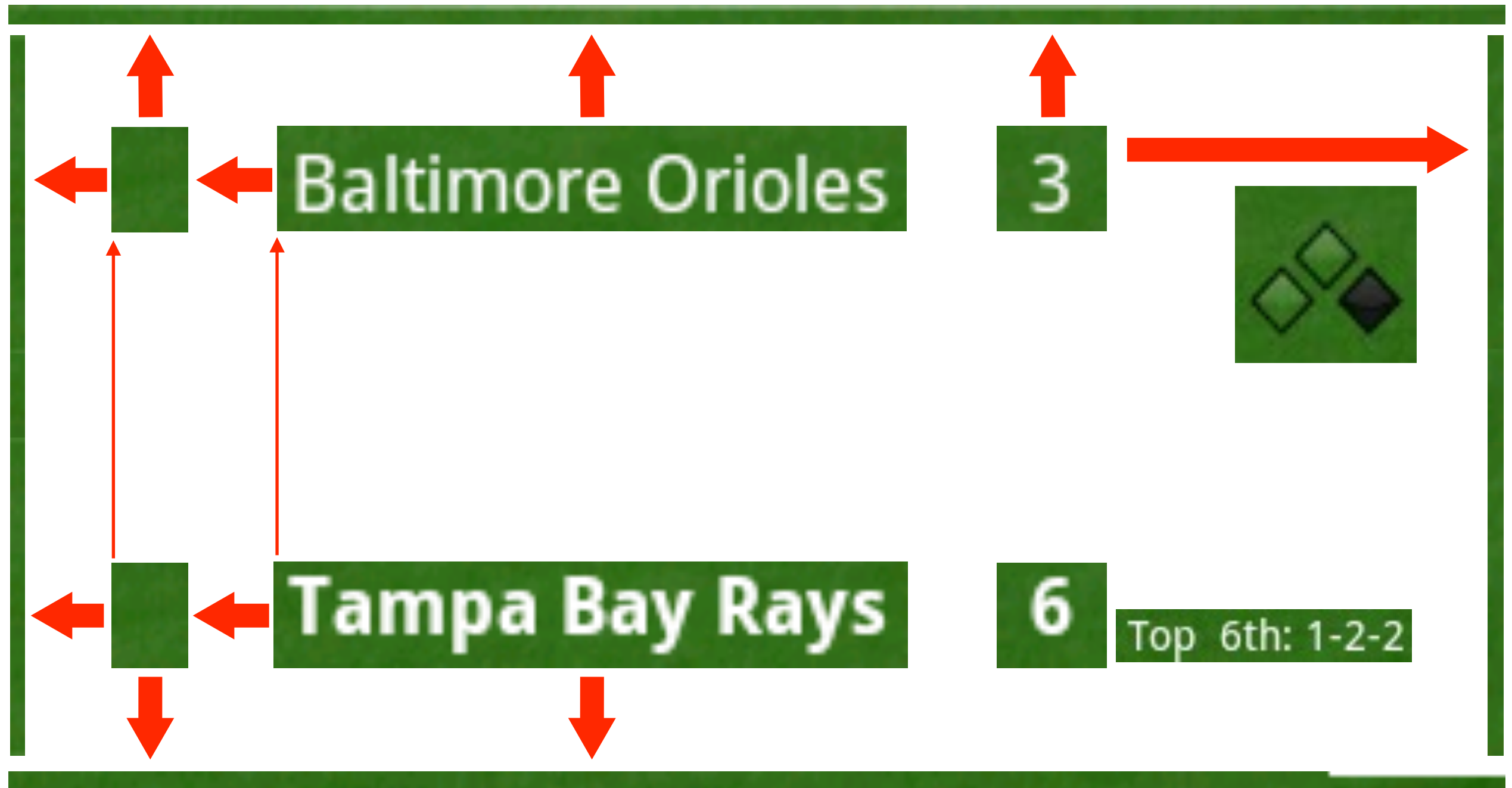
Fixing the Problem



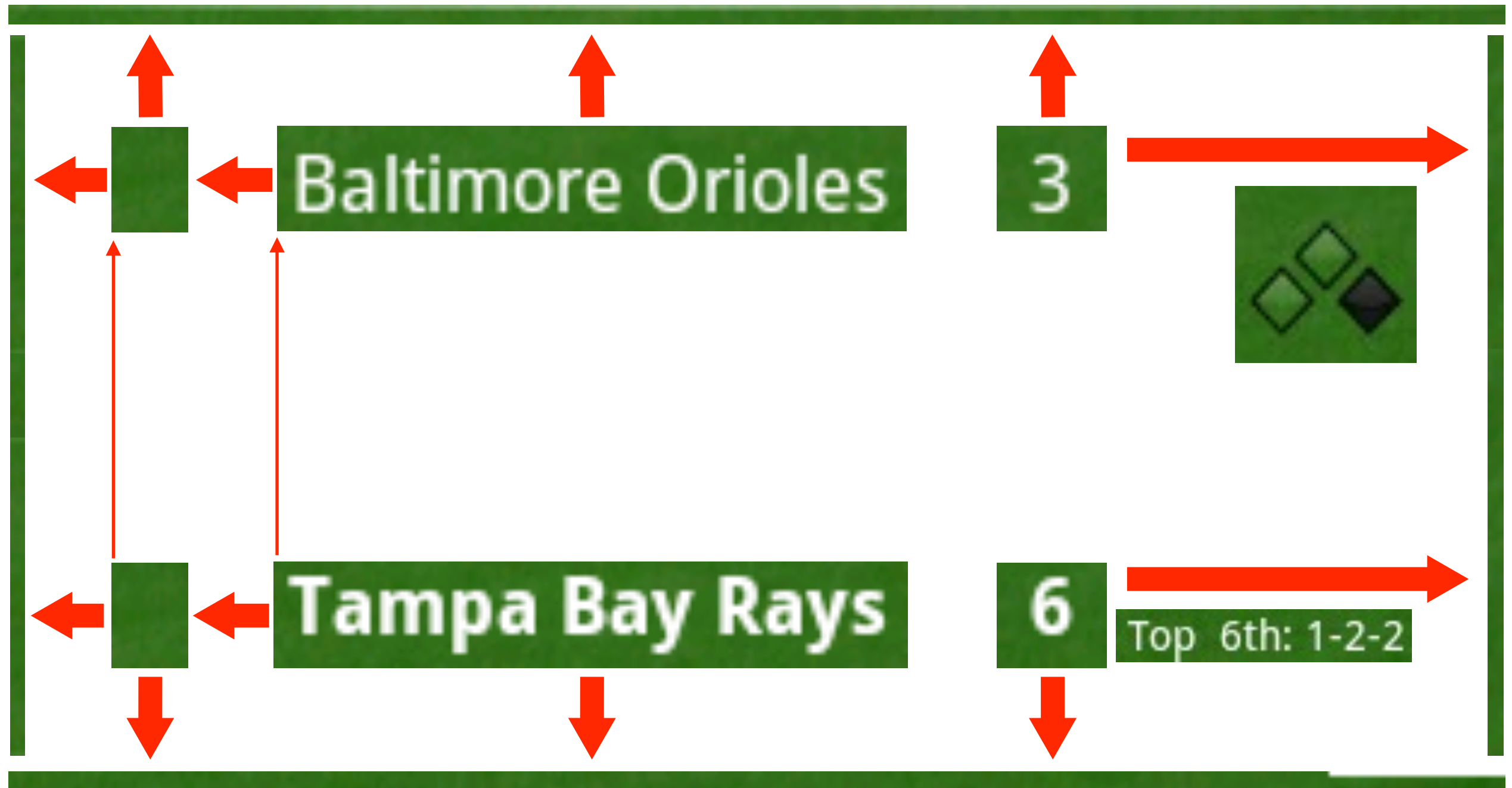
Fixing the Problem



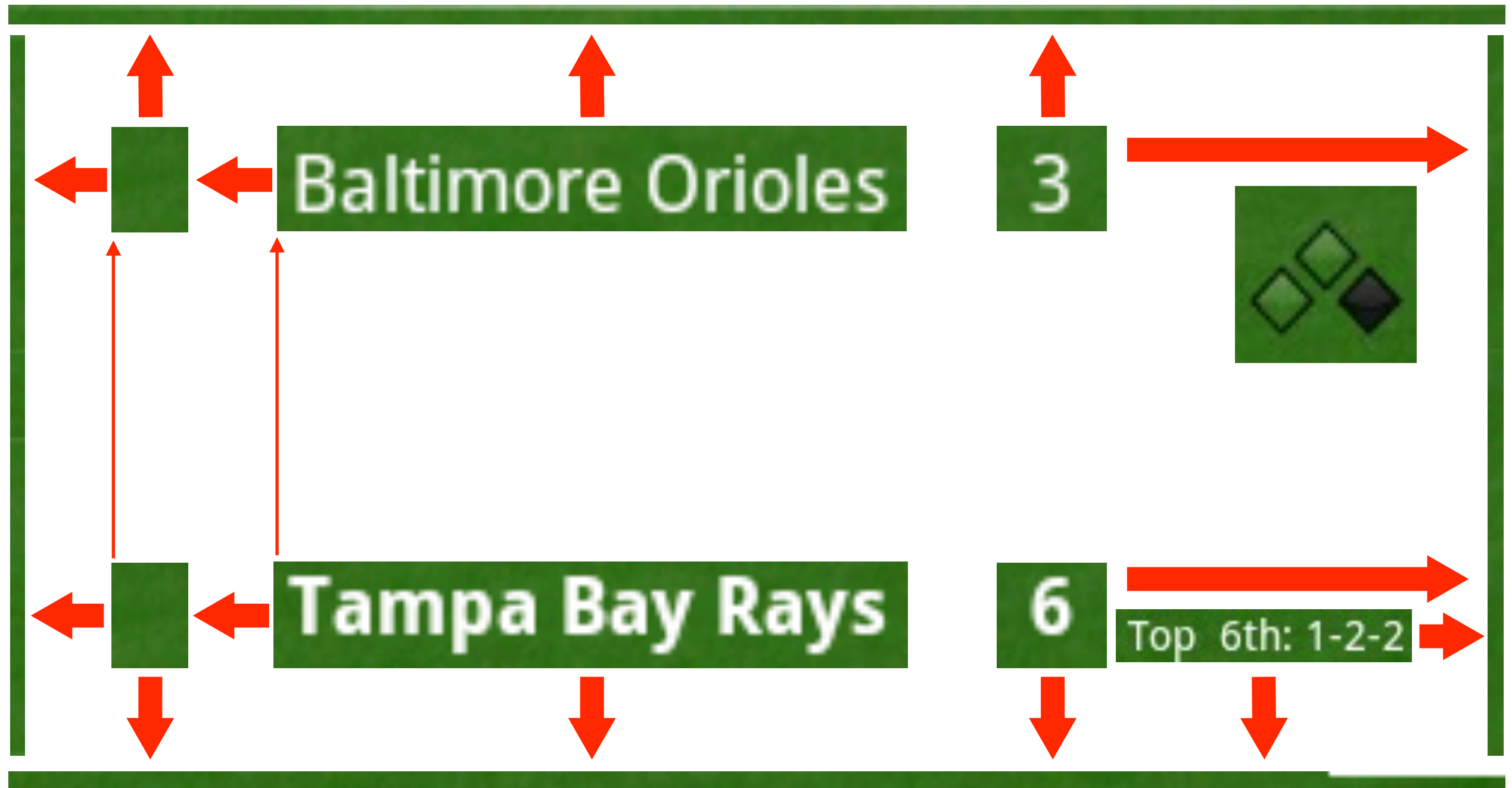
Fixing the Problem



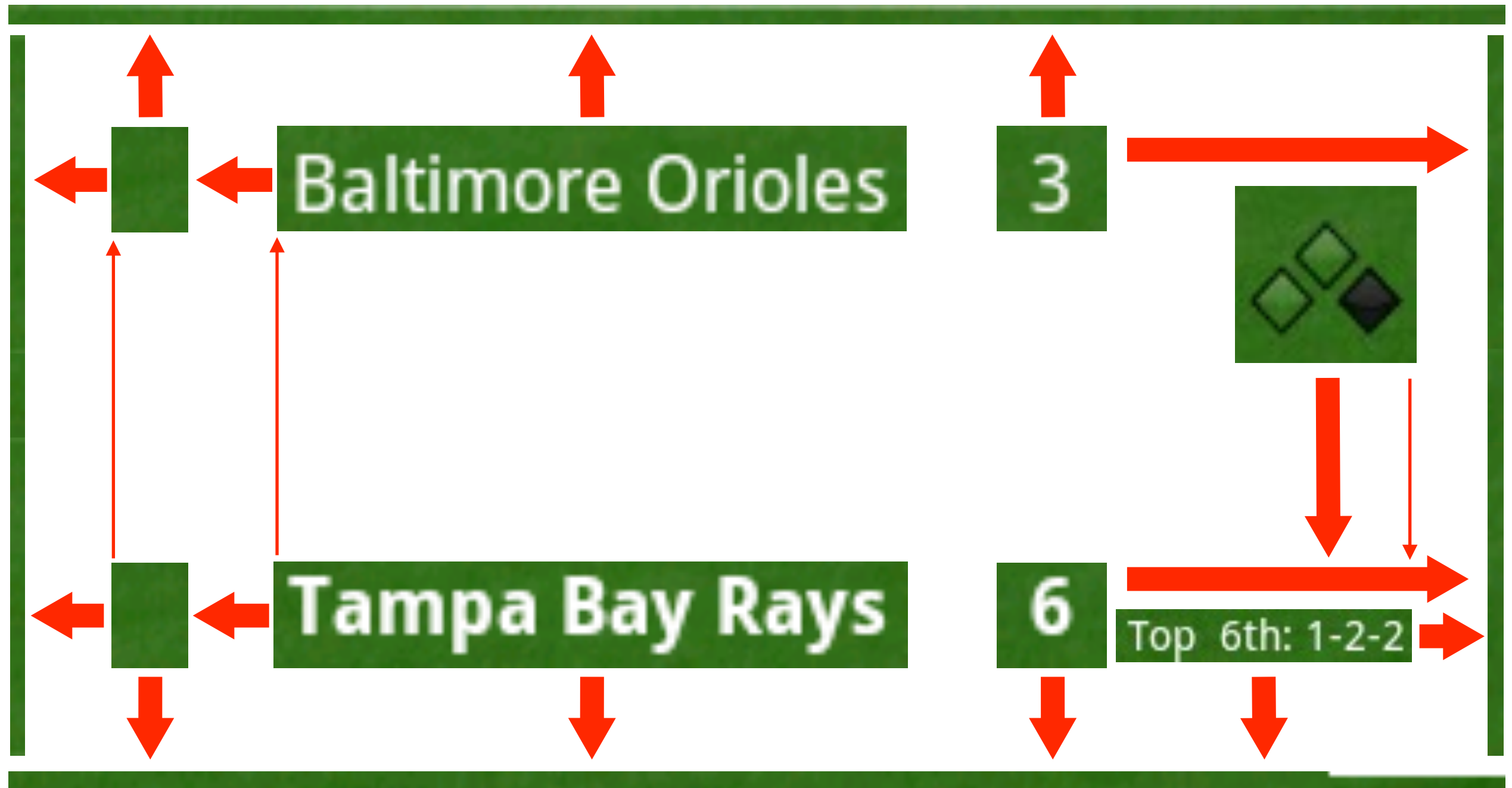
Fixing the Problem




Fixing the Problem

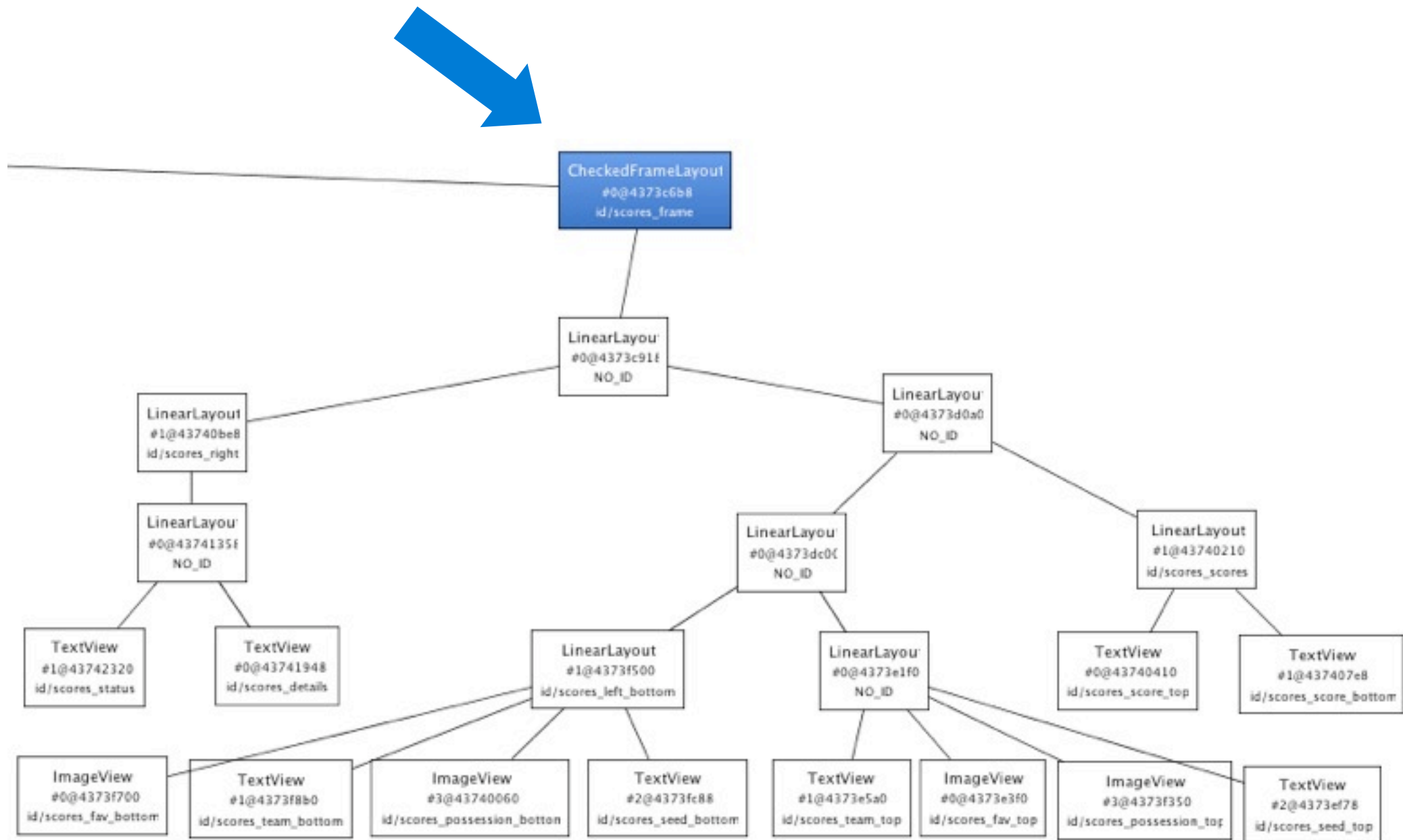


Fixing the Problem



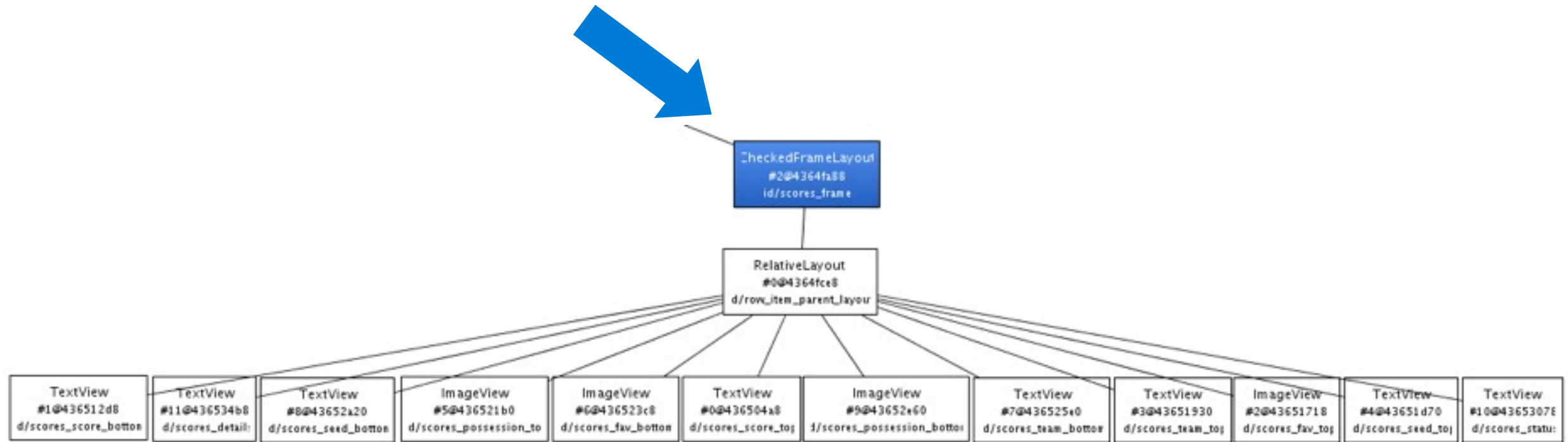
Fixing the problem

Baltimore Orioles	3	
Tampa Bay Rays	6	
Top 6th: 1-2-2		



Fixing the problem

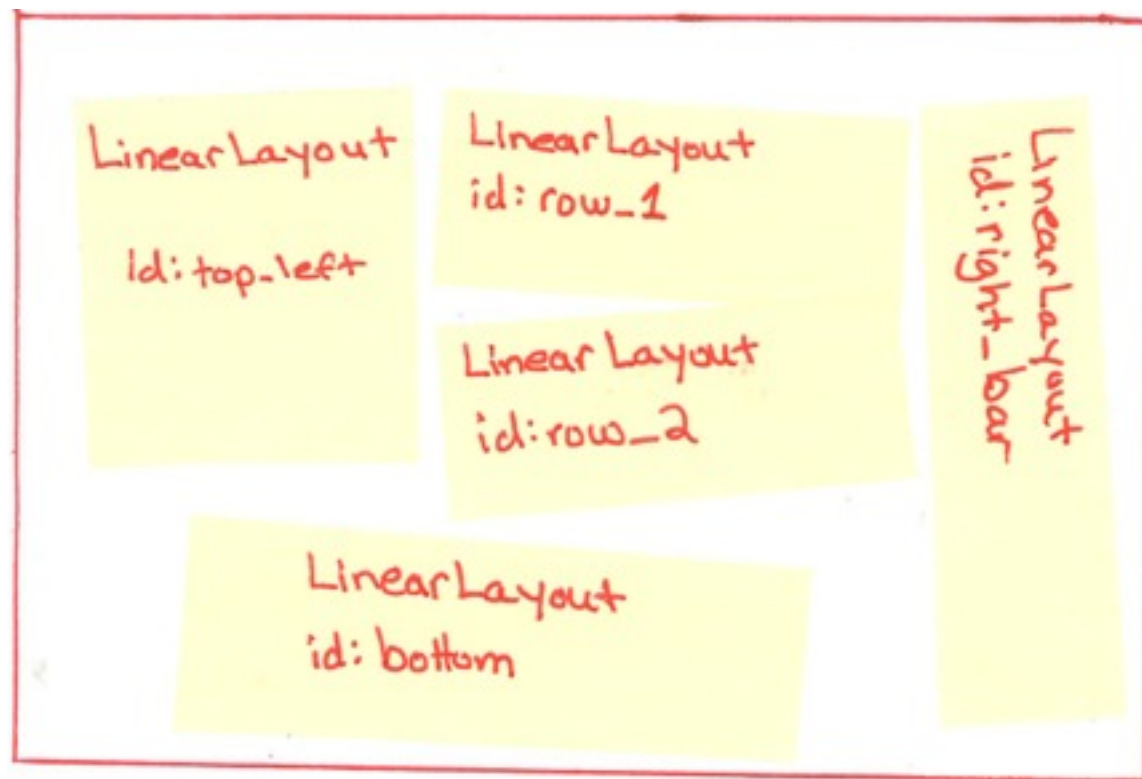
Baltimore Orioles	3	
Tampa Bay Rays	6	
		Top 6th: 1-2-2



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





Traveler's Tales: Squeaky wheels

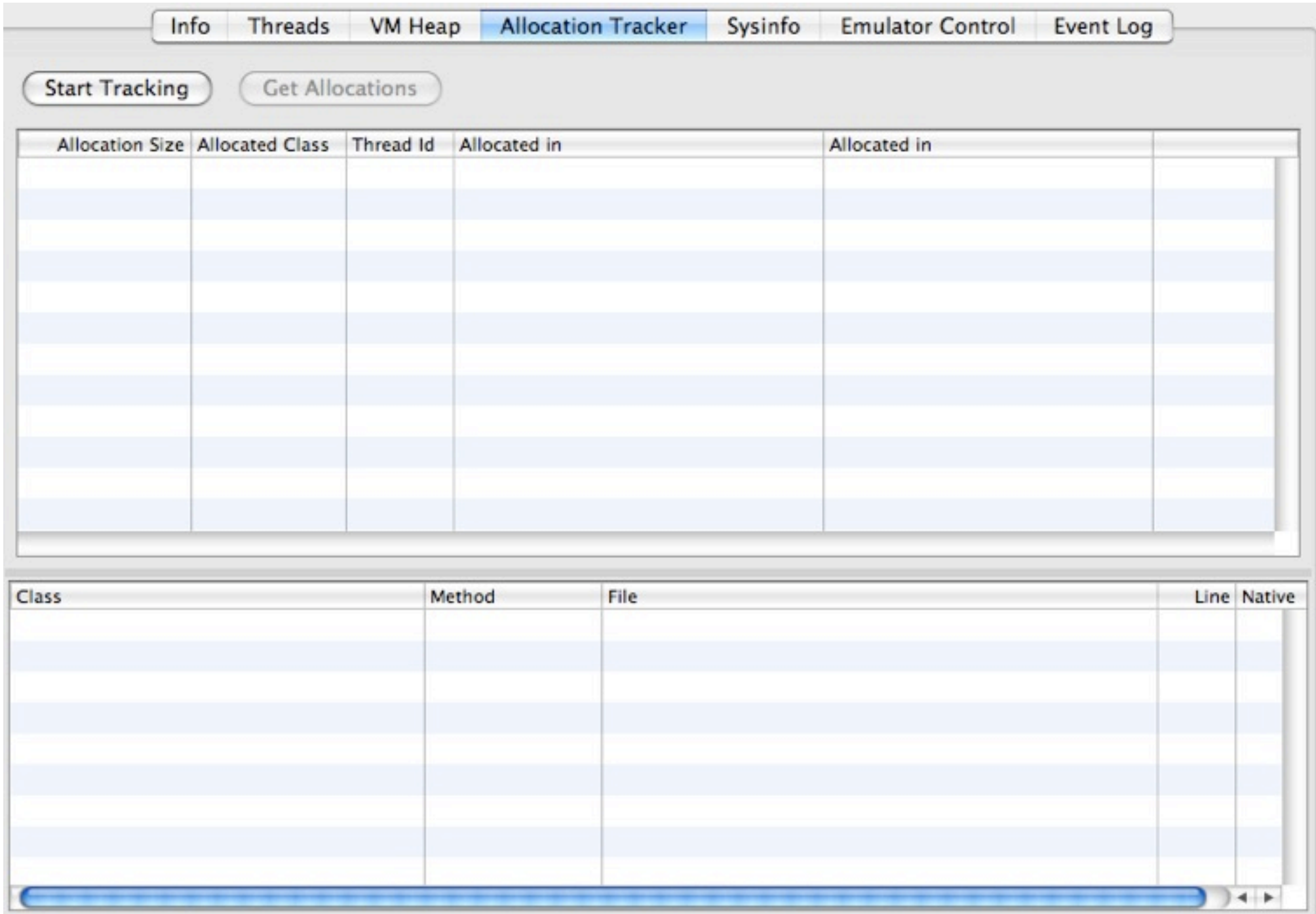


What's that noise?

- 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



Allocation Tracking

Info Threads VM Heap **Allocation Tracker** Sysinfo Emulator Control Event Log

Stop Tracking Get Allocations

Allocation Size	Allocated Class	Thread Id	Allocated in	Allocated in
95032	byte[]	17	com.example.android.util.WebServiceU	fetchUrl
94904	byte[]	17	com.example.android.util.WebServiceU	fetchUrl
94776	byte[]	17	com.example.android.util.WebServiceU	fetchUrl
94648	byte[]	17	com.example.android.util.WebServiceU	fetchUrl
94520	byte[]	17	com.example.android.util.WebServiceU	fetchUrl
94392	byte[]	17	com.example.android.util.WebServiceU	fetchUrl
94264	byte[]	17	com.example.android.util.WebServiceU	fetchUrl
94136	byte[]	17	com.example.android.util.WebServiceU	fetchUrl
94008	byte[]	17	com.example.android.util.WebServiceU	fetchUrl
93880	byte[]	17	com.example.android.util.WebServiceU	fetchUrl
93752	byte[]	17	com.example.android.util.WebServiceU	fetchUrl
93624	byte[]	17	com.example.android.util.WebServiceU	fetchUrl

Class	Method	File	Line	Native
com.example.android.util.WebServiceUtils	fetchUrl	WebServiceUtils.java	50	false
com.example.android.util.WebServiceUtils	fetchRemoteList	WebServiceUtils.java	17	false
com.example.android.data.ItemDao	findItems	ItemDao.java	72	false
com.example.android.ItemList	getItems	ItemList.java	180	false
com.example.android.ItemList	access\$7	ItemList.java	175	false
com.example.android.ItemList\$5	run	ItemList.java	242	false
java.util.Timer\$TimerImpl	run	Timer.java	293	false

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





Pop quiz!



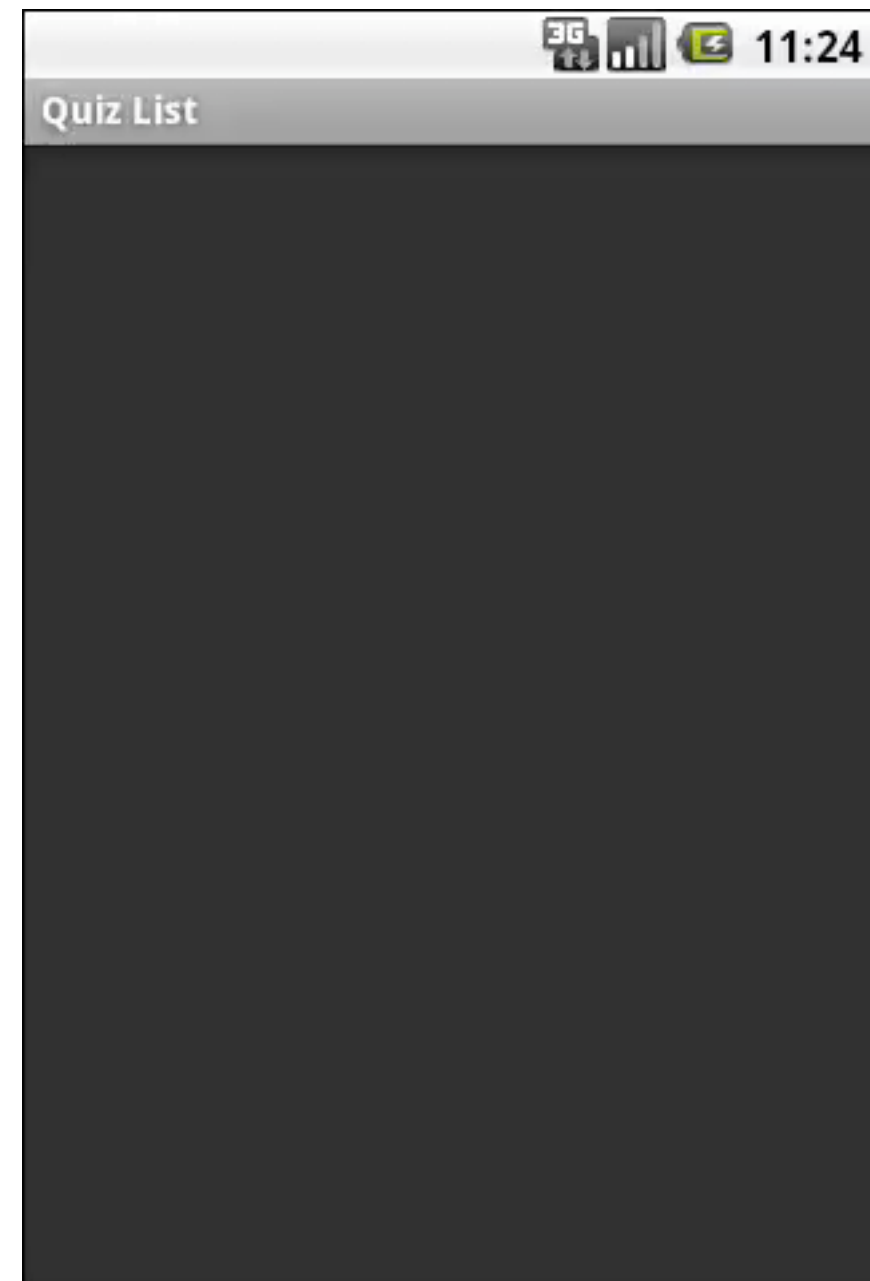
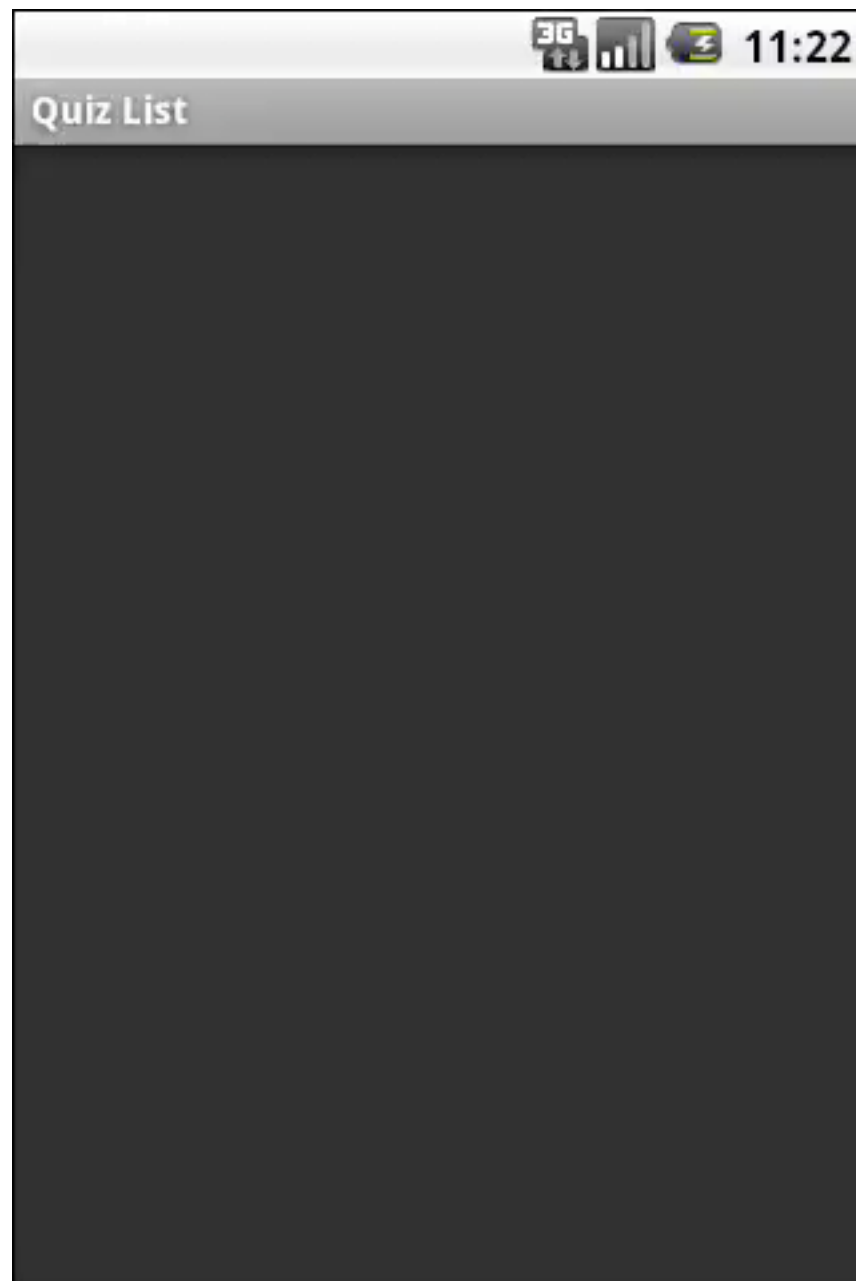
What's gone wrong?

```
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.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)
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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)
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E/AndroidRuntime( 1004):     at android.widget.LinearLayout.onMeasure(LinearLayout.java:280)
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E/AndroidRuntime( 1004):     at android.view.ViewGroup.measureChildWithMargins(ViewGroup.java:2875)
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```

What's gone wrong?

```
E/AndroidRuntime( 1004): at android.widget.LinearLayout.measureHorizontal(LinearLayout.java:619)
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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)
F/AndroidRuntime( 1004): at an
```

What change caused this slow down?



Q&A

