CS 646 Android Mobile Application Development
Spring Semester, 2015
Doc 21 Strings, Accessibility, Performance
Apr 23, 2015

Programming Blind

Blind

```
try {
      blah
} catch (Exception e) {
        Log.i("as4","something wrong: " + e.getStackTrace());
}
```

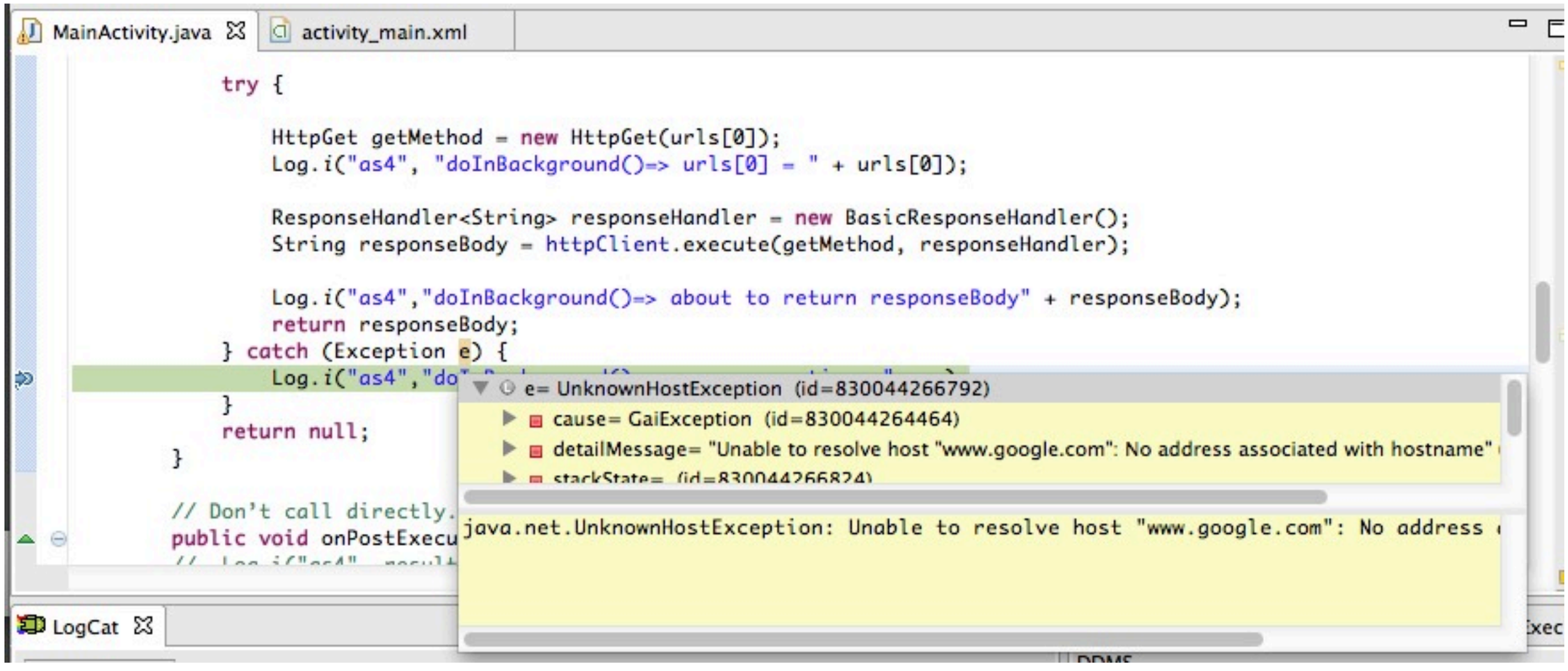
04-09 09:39:01.799: I/as4(14465): something wrong=> error executing: [Ljava.lang.StackTraceElement;@427e4698

Not So Blind

```
try {
      blah
} catch (Exception e) {
        Log.i("as4","something wrong: " + e);
}
```

04-09 09:40:55.314: I/as4(14574): doInBackground()=> error executing: java.net.UnknownHostException: Unable to resolve host "www.google.com": No address associated with hostname

Less Blind - Debug



Strings

Fonts

Android 1-2.x

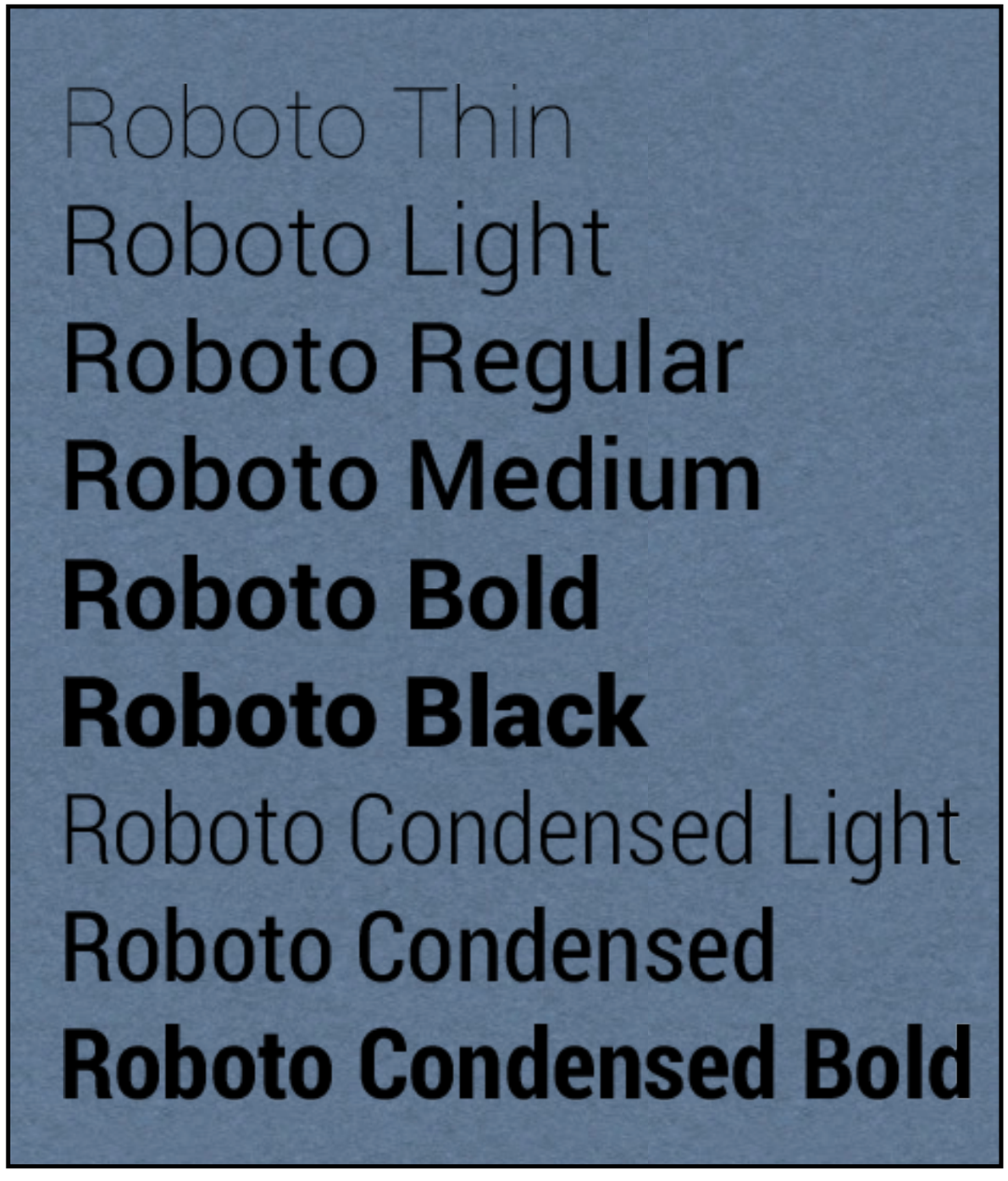
Droid

Grumpy wizards make toxic brew for the evil Queen and Jack.

Fonts

Android 3+

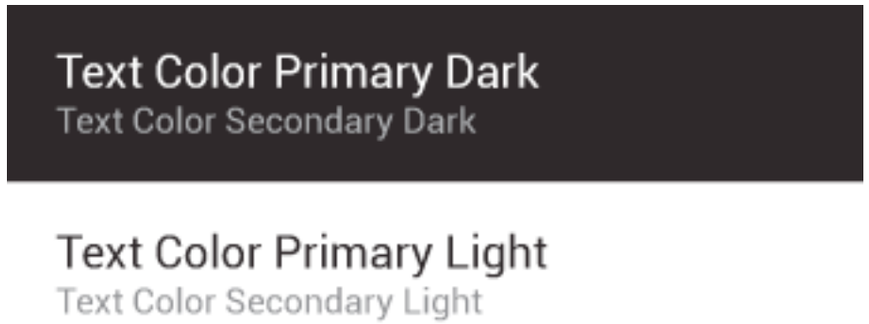
Roboto



Standard sizes used in Android

Text Size Micro	12sp
Text Size Small	14sp
Text Size Medium	18sp
Text Size Large	22sp

Primary, Secondary, Light, Dark



Fonts

Typeface

- sans (normal)
- serif
- monospace

Style

- normal
- bold
- italic
- bold|italic

Size

- sp (scaled pixels)
- px (pixels)
- dp (density-inpendent pixels)
- in (inches)
- mm (millinmeters)

```
<TextView
    android:text="Hello, serif"
    android:typeface="serif"
    android:textSize="24sp"
/>
```

```
<Button
    android:text="Hi"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:textStyle="italic"
    android:typeface="serif">
</Button>
```


http://mobile.tutsplus.com/tutorials/android/customize-android-fonts/

Other Fonts

You have to install them in your project

String Formats

String result=String.format("%d + %d = %d", 2, 3, 5);
result == "2 + 3 = 5"

s	String	format("%s %s", "hello", "Hello");	hello Hello
S	Uppercase string	format("%S %S", "hello", "Hello");	HELLO HELLO
c	Character	format("%c %c", 'd', 'E');	d E
C	Uppercase character	format("%C %C", 'd', 'E');	D E

f	Decimal floating point	format("%f", 123.456f);
		format("%.1f", 123.456f);
		format("%1.5f", 123.456f);
		format("%10f", 123.456f);
		format("%6.0f", 123.456f);
			123.456001
			123.5
			123.45600
			123.456001
			123

b,B	Boolean	format("%b %b", true, false);
		format("%B %B", true, false);
		format("%b", null);
		format("%b", "hello");
			true false
			TRUE FALSE
			false
			true

For more formatting characters see http://developer.android.com/reference/java/util/Formatter.html

Positional Formatting

```
String result=String.format("%2$d + %1$d = %3$d", 2, 3, 5);
result == "3 + 2 = 5"
```

String Formatting in strings.xml

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
    <string name="hello">Hello %2$s, my name is %1$s, I\'m %3$d</string>
</resources>
```

```
hello=getString(R.string.hello, "Roger", "World", 21);
```

```
String helloTemplate=getString(R.string.hello);
String hello=String.format(helloTemplate, "Roger", "World", 21);
```

String Formatting for Views

```
public class StringsActivity extends Activity {

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

        String helloTemplate=getString(R.string.hello);
        String hello=String.format(helloTemplate, "Roger", "World", 21);
        TextView helloView = (TextView)findViewById(R.id.hello_view);
        helloView.setText(hello);

        hello=getString(R.string.hello, "Roger", "World", 21);
        ((TextView)findViewById(R.id.hello_shorter)).setText(hello);
    }
}
```

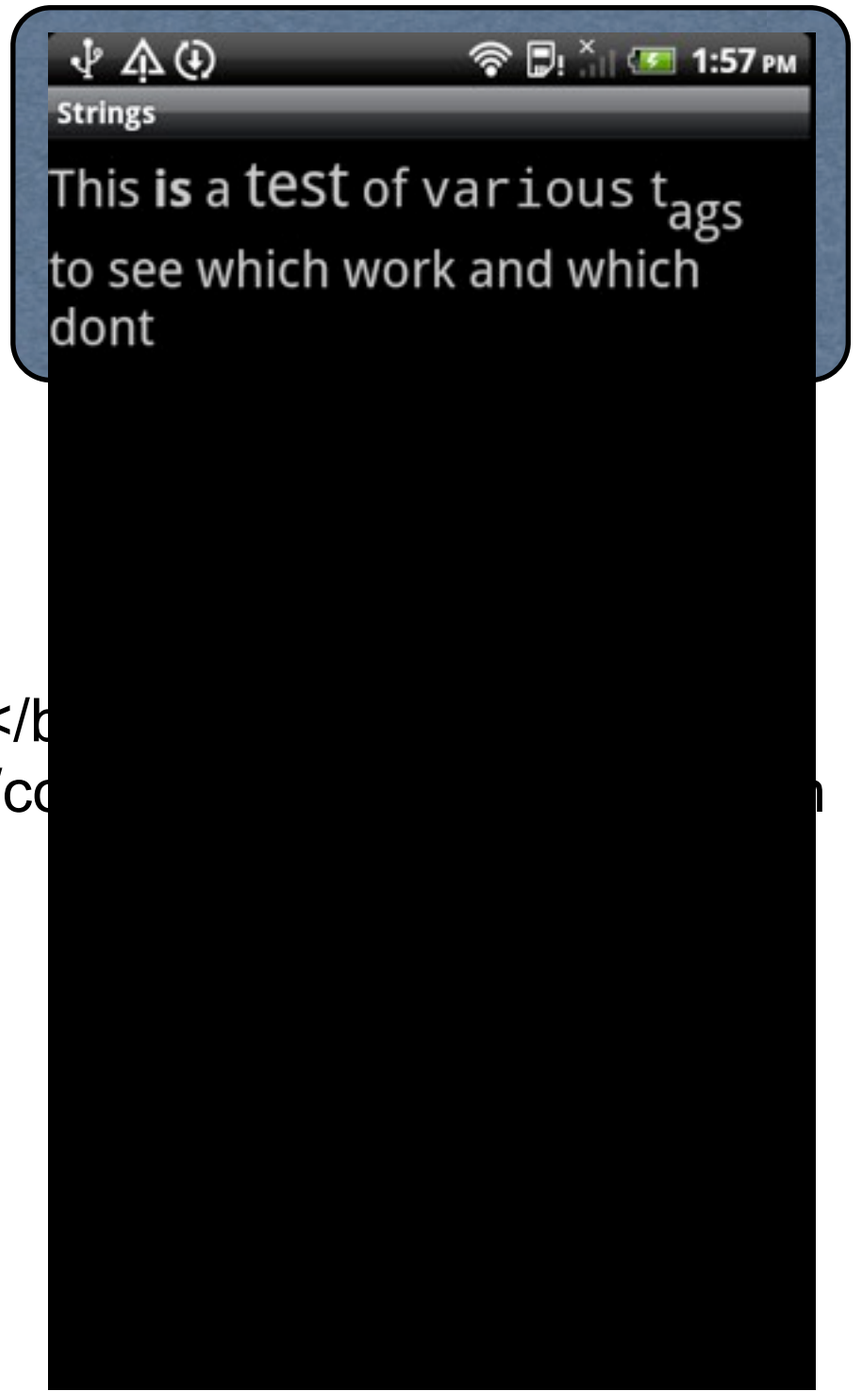
Use Positional parameters

```
<string name="hello">Hello %2$s, my name is %1$s, I\'m %3$d</string>
```

When you internationalize the strings parameter positions may change

Simple Styled Text

You can use inline tags in String resources
<b>,<i>, <small>, <big>, <sup>, <sub>




```
<?xml version="1.0" encoding="utf-8"?>
<resources>

    <string name="hello">This <b>is</b> a <big>test</b
t<sub>ags</sub> to <em>see</em> <code>which</co
dont</string>
    <string name="app_name">Strings</string>

</resources>
```

Reading the Stylized Text

```
public class StringsActivity extends Activity {

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

        CharSequence hello = getText(R.string.hello);
        TextView helloView = (TextView)findViewById(R.id.hello_view);
        helloView.setText(hello);
    }
```

Stylized Text with Formatting

Possible but ugly

Need to entity escape angle brackets

%1$s

Allen, Grant (2011-12-21). Beginning Android 4 (p. 245). Apress. Kindle Edition.

Html Text

You can use WebView to display Text

```
WebView score = (WebView) findViewById(R.id.score);
String summary = "<html><body>You scored <b>192</b> points.</body></html>";
score.loadData(summary, "text/html", null);
```

Encoding
base64
URL encoded

Styles - DRY

Style defines values for attributes of UI element
Define them in res/values/styles.xml
Use same style for multiple elements

In res/values/styles/.xml

```
<style name="bigred">
      <item name="android:textSize">30sp</item>
      <item name="android:textColor">#FFFF0000</item>
  </style>
```

In res/layout/activity_main.xml

```
<TextView
      style="@style/bigred"
      android:layout_width="wrap_content"
      android:layout_height="wrap_content"
      android:text="@string/hello_world" />
```

What Attributes can be in a Style

Look up a UI element class doc

It has a list of XML attributes

Class Overview

Displays text to the user and optionally allows them to edit it. A TextView is a complete te
allow editing; see `EditText` for a subclass that configures the text view for editing.

XML attributes

See `TextView Attributes`, `View Attributes`

Summary

Nested Classes		
enum	TextView.BufferType	
interface	TextView.OnEditorActionListener	Interface definition for a callback to
class	TextView.SavedState	User interface state that is stored by

XML Attributes	
Attribute Name	*Related Method*
android:autoLink	setAutoLinkMask(int)
android:autoText	setKeyListener(KeyListener)
android:bufferType	setText(CharSequence,TextView.BufferType)

Existing Styles

```
<TextView
    android:id="@+id/textView1"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="Large Text"
    android:textAppearance="?android:attr/textAppearanceLarge" />
```

Indicates a theme

Theme

Themes are styles applied to an Activity or application

In Manifest

```
<application
        android:label="@string/app_name"
        android:theme="@style/AppTheme" >
```

res/values/styles.xml

```
<resources>
    <style name="AppBaseTheme" parent="android:Theme.Light">
        <!--
            Theme customizations available in newer API levels can go in
            res/values-vXX/styles.xml, while customizations related to
            backward-compatibility can go here.
        -->
    </style>

    <!-- Application theme. -->
    <style name="AppTheme" parent="AppBaseTheme">
        <!-- All customizations that are NOT specific to a particular API-level can go here.
-->
    </style>

</resources>
```

For list of Styles/Themes in Android

http://developer.android.com/reference/android/R.style.html

Accessibility

Accessibility

degree to which a product, device, service, or environment is available to as many people as possible

Accessibility Features of Android

Talkback

Captions

Large Text

Magnifications gestures

Speak Passwords

Touch & Hold delay

For Talkback

Audio descriptions

Navigation via directional controller

- External devices
- Gestures in Android 4.1+

Audio Descriptions

Add android:contentDescription to each

ImageButton, ImageView, EditText, CheckBox

```
<ImageButton
   android:id=”@+id/add_note_button”
   android:src=”@drawable/add_note”
   android:contentDescription=”@string/add_note”/>
```

When accessibility is turned on

Talkback will speak contentDescription

EditText

Provide an android:hint attribute

What content are they expected to enter

Focus Navigation

Android UI controls are focusable by default

If create new controls that need focus make sure to set

android:focusable="true"

Controlling focus order

Provide focus order of elements

android:nextFocusDown
Defines the next view to receive focus when the user navigates down

android:nextFocusLeft
Defines the next view to receive focus when the user navigates left

android:nextFocusRight
Defines the next view to receive focus when the user navigates right

android:nextFocusUp
Defines the next view to receive focus when the user navigates up

Controlling focus order

```
<LinearLayout android:orientation="horizontal"
    ... >
  <EditText android:id="@+id/edit"
    android:nextFocusDown=”@+id/text”
    ... />
  <TextView android:id="@+id/text"
    android:focusable=”true”
    android:text="Hello, I am a focusable TextView"
    android:nextFocusUp=”@id/edit”
    ... />
</LinearLayout>
```

Custom View & Accessibility

Need to:

- Handle directional controller clicks
- Implement Accessibility API methods
- Send AccessibilityEvent objects specific to your custom view
- Populate AccessibilityEvent and AccessibilityNodeInfo for your view

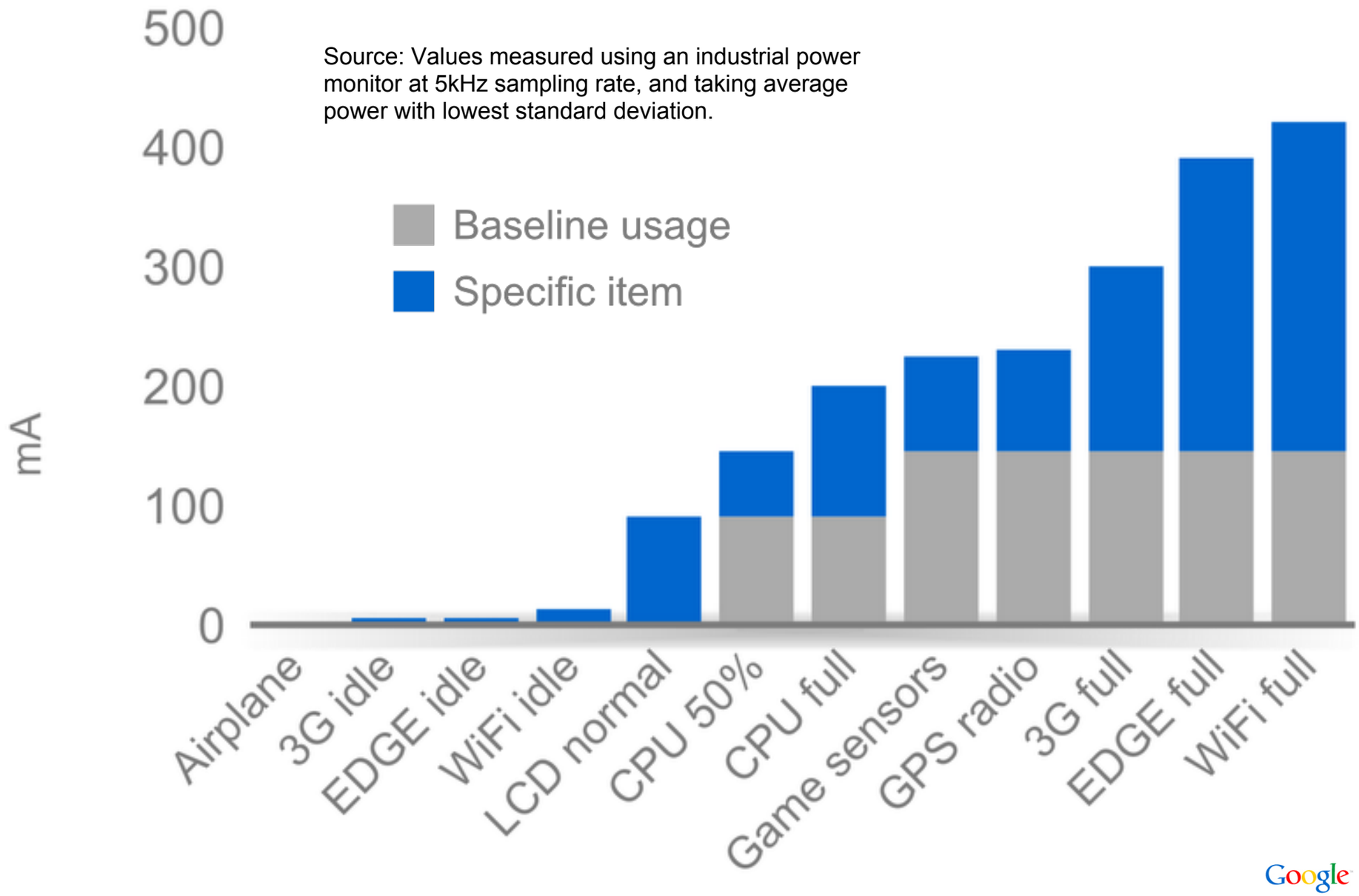
Battery

Some Battery Information

	1420 mAh
Droid	1300 mAh
Nexus S	1500 mAh
iPad	~6500 mAh
MacBook Pro 17	8800 mAh

Where does it all go?

Source: Values measured using an industrial power monitor at 5kHz sampling rate, and taking average power with lowest standard deviation.



Thursday, April 23, 15

Coding for Lije - Battery Life, That is, Jeff Sharkey, May 27, 2009, http://www.google.com/events/io/2009/sessions/CodingLifeBatteryLife.html

What costs the most?

- **Waking up in the background** when the phone would otherwise be sleeping
  - App wakes up every 10 minutes to update
  - Takes about 8 seconds to update, 350mA
- Cost during a given hour:
  - 3600 seconds * 5mA = **5mAh resting**
  - 6 times * 8 sec * 350 mA = **4.6mAh updating**
- Just *one app* waking up can trigger cascade

What costs the most?

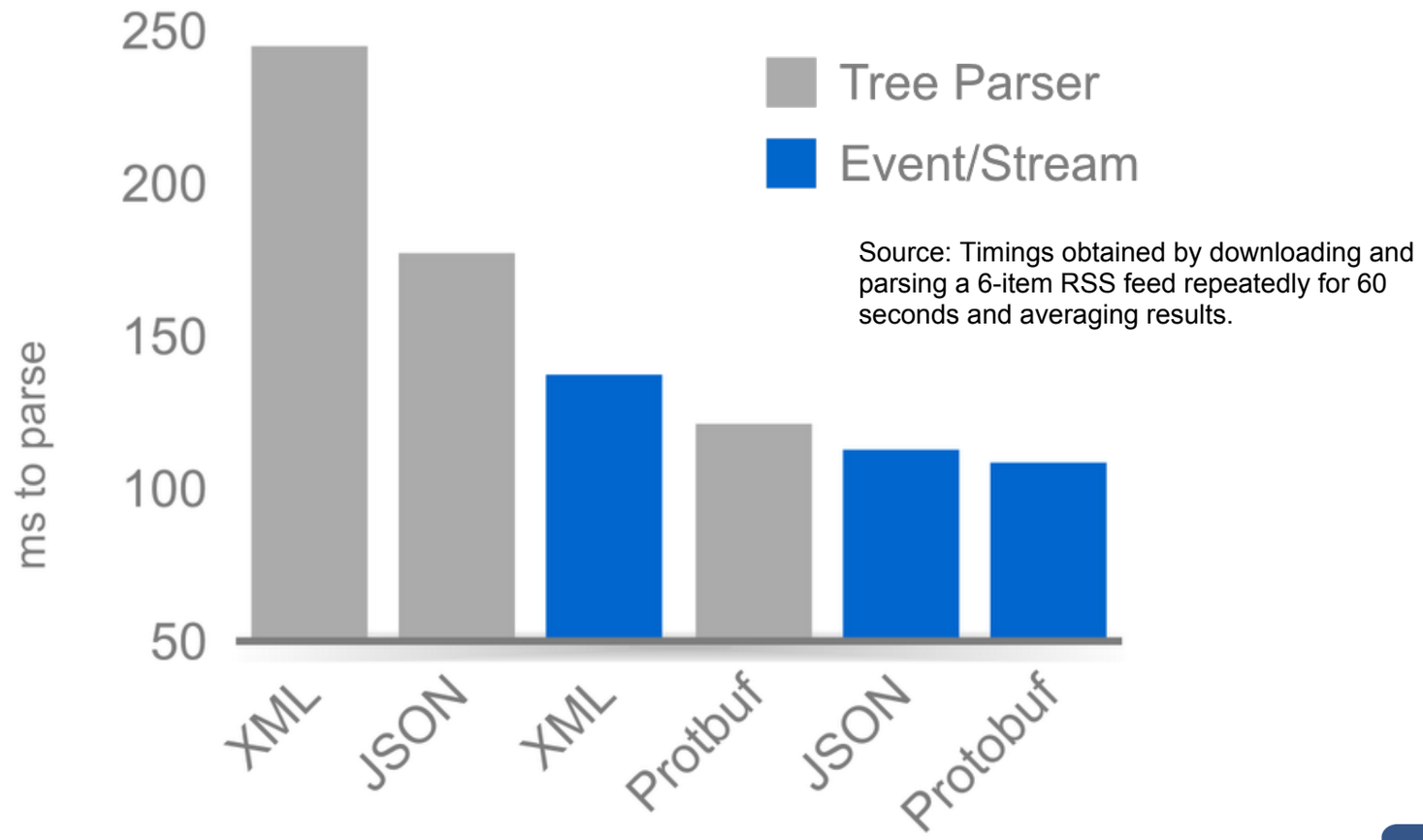
- **Bulk data transfer** such as a 6MB song:
  - EDGE (90kbps): 300mA * 9.1 min = **45 mAh**
  - 3G (300kbps): 210mA * 2.7 min = **9.5 mAh**
  - WiFi (1Mbps): 330mA * 48 sec = **4.4 mAh**
- Moving between cells/networks
  - Radio ramps up to associate with new cell
  - BroadcastIntents fired across system
- Parsing textual data, regex without JIT

XML Verses JSON

How can we do better?

Networking

- Use an **efficient data format and parser**



Source: Timings obtained by downloading and parsing a 6-item RSS feed repeatedly for 60 seconds and averaging results.

Thursday, April 23, 15

Source:http://dl.google.com/io/2009/pres/W_0300_CodingforLife-BatteryLifeThatIs.pdf

Hardware Acceleration

Android Drawing

Before Android 3.0

Android did not use GPU for rendering your views

All your views were rendered using software

Android 3.0+ allows you to use GPU for graphics

Android 4.0+ - Default - use GPU for Drawing

GPU For Drawing

Lot faster

No issues unless implementing onDraw in a view

Not all drawing operations are supported on GPU

Unsupported Drawing Operations

Canvas

- clipPath()
- clipRegion()
- drawPicture()
- drawPosText()
- drawTextOnPath()
- drawVertices()

Paint

- setLinearText()
- setMaskFilter()
- setRasterizer()

Operations with Different Behavior on GPU

Canvas

- clipRect():
  - XOR, Difference and ReverseDifference clip modes are ignored.
  - 3D transforms do not apply to the clip rectangle
- drawBitmapMesh(): colors array is ignored
- drawLines(): anti-aliasing is not supported
- setDrawFilter(): can be set, but is ignored

Paint

- setDither(): ignored
- setFilterBitmap(): filtering is always on
- setShadowLayer(): works with text only

ComposeShader

- ComposeShader can only contain shaders of different types
- ComposeShader cannot contain a ComposeShader

If have unsupported operations

Turn off GPU for that part of the app

Controlling Hardware Acceleration

Can control hardware acceleration at

- Application
- Activity
- Window
- View

Application level

Turn on hardware acceleration for entire application

<application android:hardwareAccelerated="true"

Activity Level

```
<application android:hardwareAccelerated="true">
    <activity ... />
    <activity android:hardwareAccelerated="false" />
</application>
```

Window level

```
getWindow().setFlags(
    WindowManager.LayoutParams.FLAG_HARDWARE_ACCELERATED,
    WindowManager.LayoutParams.FLAG_HARDWARE_ACCELERATED);
```

Can't turn hardware acceleration off at window level

View Level

myView.setLayerType(View.LAYER_TYPE_SOFTWARE, null);

Can't enable hardware acceleration at View level

Drawing Model - Software

When invaliate() is called on a view A

All views that intersect A are redrawn

This means that the onDraw method is called each view intersecting A

Even if view has not changed its onDraw method is called

May mask a bug

if you forget to call invalidate on a view it may be redrawn

Draw model - Hardware accelerated

When view is first drawn

- Its on draw method is called
- Result is saved (display list)

When invalidate() is called on a view

- Only that view's onDraw method is called

ART

Dalvik

Android's Java Virtual Machine

Named after a fishing village in Iceland

Just-In-Time (JIT) compiling

- Eclipse compiles app to byte code
- When run app compile byte code to machine code

JIT - Just in Time

Eclipse (javac) compiles app to byte code

On device each time run app

Dalvik compiles byte code to machine code

Pros & Cons of JIT

Pros

- Developer compiles once App runs on multiple architectures
- Binary is smaller
- Some optimizations can only be done at run time

Cons

- JIT is done when app is running
- Slower start up
- Delays when app runs new code

ART - Android Runtime

New in Android 4.4

Default in Android 5.0

Uses Ahead Of Time (AOT) compilation

- Developer still compiles app to byte code
- When app is installed on device app is compiled to machine code

App take longer to install

App
- Larger
- Should start faster
- Run faster

Android 4.4 Art Performance

Linpack

	Dalvik	ART	Gain
Single Thread	135	149	+10.8%
Multi-Thread	336	383	+13.8

AnTuTu Benchmark

	Dalvik	ART	Gain
UX Multitask	3,593	3,421	-1.02%
CPU Integer	3,050	2,887	-5.34%
CPU Float-point	1,774	2049	+17.02%

Source: http://www.androidpolice.com/2013/11/12/meet-art-part-2-benchmarks-performance-wont-blow-away-today-will-get-better/