





#### College of William & Mary - SEMERU - Department of Computer Science

Automatically Discovering, Reporting and Reproducing Android Application Crashes

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#### **ICST** 16 Chicago, IL Tuesday, April 12th, 2016







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## MANUALTESTING



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## MANUALTESTING



AUTOMATED TESTING

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AUTOMATED TESTING

Image: Control of the con	<pre>Concentration = adb shell logcat = 120x40 tikwe( \$40): &amp;C_CONCURRENT freed 761K, 13% free \$867K/6744K, paused @ms+@ms, total \$ms</pre>

### AUTOMATED TESTING



- V/MusicFXControlPanelReceiver( 1370): Audio session: 4
- //MusicFXControlPanelEffect( 1370): closeSession(android.app.ReceiverRestrictedContext#527b1204, com.android.music, 4)

## CATEGORIES OF AUTOMATED TESTING APPROACHES FOR MOBILE APPS

- Model-based input generation
- Random-based input generation
- Record and replay
- Others (Manual Testing Frameworks)

## THE CURRENT STATE OF AUTOMATED MOBILE APPLICATION TESTING

Tool Name	Instr.	GUI Exploration	Types of Events	Crash Resilient	Replayable Test Cases	NL Crash Reports	Emulators, Devices
Dynodroid	Yes	Guided/Random	System, GUI, Text	Yes	No	No	No
EvoDroid	No	System/Evo	GUI	No	No	No	N/A
AndroidRipper	Yes	Systematic	GUI, Text	No	No	No	N/A
MobiGUItar	Yes	Model-Based	GUI, Text	No	Yes	No	N/A
A3E DFS	Yes	Systematic	GUI	No	No	No	Yes
A3E Targeted	Yes	Model-Based	GUI	No	No	No	Yes
Swifthand	Yes	Model-Based	GUI, Text	N/A	No	No	Yes
PUMA	Yes	Programmable	System, GUI, Text	N/A	No	No	Yes
ACTEve	Yes	Systematic	GUI	N/A	No	No	Yes
VANARSena	Yes	Random	System, GUI, Text	Yes	Yes	No	N/A
Thor	Yes	Test Cases	Test Case Events	N/A	N/A	No	No
QUANTUM	Yes	Model-Based	System, GUI	N/A	Yes	No	N/A
AppDoctor	Yes	Multiple	System, GUI, Text	Yes	Yes	No	N/A
ORBIT	No	Model-Based	GUI	N/A	No	No	N/A
SPAG-C	No	Record/Replay	GUI	N/A	N/A	No	No
JPF-Android	No	Scripting	GUI	N/A	Yes	No	N/A
MonkeyLab	No	Model-based	GUI, Text	No	Yes	No	Yes
CrashDroid	No	Manual Rec/Replay	GUI, Text	Manual	Yes	Yes	Yes
SIG-Droid	No	Symbolic	GUI, Text	N/A	Yes	No	N/A
CrashScope	No	Systematic	GUI, Text, System	Yes	Yes	Yes	Yes

## THE CURRENT STATE OF AUTOMATED MOBILE APPLICATION TESTING



## LIMITATIONS OF AUTOMATED MOBILE TESTING AND DEBUGGING

- Lack of detailed, easy to understand testing results for faults/ crashes<sup>1</sup>
- No easy way to reproduce test scenarios<sup>1</sup>
- Not practical from a developers viewpoint
- Few approaches enable different strategies capable of generating text and testing contextual features

<sup>1</sup>S. R. Choudhary, A. Gorla, and A. Orso. Automated Test Input Generation for Android: Are we there yet? In 30th IEEE/ACM International Conference on Automated Software Engineering (ASE 2015), 2015



## PAST STUDIES OF MOBILE CRASHES AND BUGS

- Many crashes can be mapped to well-defined, externally inducible faults<sup>1</sup>
- **Contextual features**, such as network connectivity and screen rotation, account for many of these externally inducible faults<sup>12</sup>
- These dominant root causes can affect many different user execution paths<sup>1</sup>

<sup>&</sup>lt;sup>1</sup>L. Ravindranath, S. Nath, J. Padhye, and H. Balakrishnan. Automatic and scalable fault detection for mobile applications. MobiSys '14 <sup>2</sup>R. N. Zaeem, M. R. Prasad, and S. Khurshid. Automated generation of oracles for testing user-interaction features of mobile apps, ICST '14



## OUR SOLUTION: CRASHSCOPE

- Completely automated approach
- Generates detailed, expressive bug reports and repayable scripts
- A practical tool, requiring no instrumentation framework, or modification to the OS or applications
- Capable of running on both physical devices and emulators
- Differing execution strategies able to test contextual features



## CRASHSCOPE DESIGN





## CRASHSCOPE DESIGN



## CRASHSCOPE DESIGN



## CRASHSCOPE: ANALYSIS















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uiautomator	Fuel consumption	+ :
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- Activity
- Checkable, Checked, Clickable, Long Clickable?
- Component Index
- Current Window
- Enabled?
- XML\_ID
- Component Type
- Position (Absolute and Relative)
- Text
- Screenshot →





'73', 'me.kuehle.carreport/.gui.ReportActivity', '0', '0', '1', '1', 'me.kuehle.carreport/.gui.ReportActivity#null.FrameLayout.FrameLayout.LinearLayout.FrameLayout .Spinner.CheckedTextView.TextView.ImageButton.FrameLayout.FrameLayout.ImageButton.ListView.Lin earLayout', '1', '1', '0', '64', 'me.kuehle.carreport:id/btnMenu', '0', 'android.widget.ImageButton', '0', '1104', '194', 'TopRight', '0', '0', '', '64', 'me.kuehle.carreport\_\_1\_gui.png'







'73', 'me.kuehle.carreport/.gui.ReportActivity', '0', '0', '1', '1', 'me.kuehle.carreport/.gui.ReportActivity#null.FrameLayout.FrameLayout.LinearLayout.FrameLayout .Spinner.CheckedTextView.TextView.ImageButton.FrameLayout.FrameLayout.ImageButton.ListView.Lin earLayout', '1', '1', '0', '64', 'me.kuehle.carreport:id/btnMenu', '0', 'android.widget.ImageButton', '0', '1104', '194', 'TopRight', '0', '0', '', '64', 'me.kuehle.carreport\_\_1\_gui.png'

> CrashScope Database



## CRASHSCOPE STRATEGIES

- GUI-Traversal: Top-Down & Bottom Up
- Text Entry: Expected, Unexpected, No Text
- Contextual Features: Enabled or Disabled

## CRASHSCOPE: REPORT AND SCRIPT GENERATION





## CRASHSCOPE DEMO





## CRASHSCOPE DEMO



Contextual information pplication Name & Version: GnuCash 1.0.3 Android Version: 4.4.4 Date reported: 2015-08-17	
pplication Name & Version: GnuCash 1.0.3 Android Version: 4.4.4 Date reported: 2015-08-17	
Android SDK built for x86 C PORTRAIT 1200x1920	
on Legend:	
)  💥 = Accelerometer ON/OFF 🔿 🔆 = Network ON/OFF ♀   💓 = GPS ON/OFF 🏮   💥 = Magnetometer	ON/OFF 🔒 🛛 💥 = Temperature Sensor ON/OFF
Steps to Reproduce	
e following touch events and inputs will reproduce the crash on the device, app version, and android version	specified above:
lease note that the following steps are representative, you may not have to perform every action or type all of the text	t characters in order to reproduce the crash.
Tap on the "Expenses" CheckedTextView, which is located on the Center of the screen.	Expenses
)≈ o 🔰 🖗 ↑	
Tap on the "Income" CheckedTextView, which is located on the Center of the screen.	Income 📝
) 🗢 🗣 📦 🌡	1
Tap on the "Accests" CheckedTextV/acc, which is located on the Center of the server	
ap of the Assets Checked lextview, which is located on the Center of the screen.	Assets
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Tap on the "Entertainment" CheckedTaytView, which is located on the Center of the screen	
	Entertainment
/~~ V 🔰 🕲	
Tap on the "Insurance" CheckedTextView, which is located on the Center of the screen.	
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/ 🐨 ¥ ⊌ 🛞	
Tap on the "Expenses" CheckedTextView, which is located on the Center of the screen.	Foregas

Step 7 Tap on the "Income" CheckedTextView, which is located on the Center of the screen.	Income
(Dood is a	
Quá, A 👩 🖗	
+	
Step 8 Tap on the "Assets" CheckedTextView, which is located on the Center of the screen.	Assets 🖌
Qué, A 👩 🛞	
+	
Step 9 Tap on the "Entertainment" CheckedTextView, which is located on the Center of the screen.	Entertainment
N. A. A. 👩 🛞	
+	
Step 10 Tap on the "Insurance" CheckedTextView, which is located on the Center of the screen.	Insurance 🗹
	·
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+	
Step 11 Tap on the "Cancel" Button, which is located on the Center left of the screen.	Cancel
*	
Step 12 Tap on the "Accounts" LinearLayout, which is located on the Top left of the screen.	Accounts .
(八令 🗣 🖬 🖁	
Top on the # Touth four which is located on the Top dabt of the server	
step 13 Tap on the "Textview, which is located on the Top right of the screen.	+
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1	
Step 14. Type"sphyzyfrig%sz" on the "Account name" EditText, which is located on the Center of the screen.	Constant and the second s
Type option in the second number cannot in the board of the borden.	internation z
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1	
Step 15 Tap on the ** Spinner, which is located on the Center of the screen.	dae
	mar A
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+	
Step 16 Tap on the "US Dollar" CheckedTextView, which is located on the Top of the screen.	US Dollar
	[]
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Type"Itmjfwjqss%sz" on the "Account name" EditText, which is located on the Center of the screen. (1)  0  11  8.	Verterhold of
Tap on the "Cancel" Button, which is located on the Center left of the screen.	× Canol
↓ Seep 19 Long-touch on the ** TextView, which is located on the Top right of the screen.	
↓ Swp 20 Tap on the ** ImageButton, which is located on the Top right of the screen.	
Tap on the "Export OFX" LinearLayout, which is located on the Top right of the screen.     Or ♀ ↓ &	Export OFX
↓ Step 22 Tap on the ** Spinner, which is located on the Center of the screen.	parts.
↓ Step 23 Tap on the "Share file" CheckedTextView, which is located on the Center of the screen.	Due Se.
↓ Smp 24 Tap on the "Export all transactions" CheckBox, which is located on the Center left of the screen.	Export all transactions
↓ Step 25 Tap on the "Delete after export" CheckBox, which is located on the Center left of the screen. ()	Delete after export
↓ Step 20 Tap on the "Cancel" Button, which is located on the Center left of the screen. ② ◆ ◆ 🏭 🌡	× Canot
↓ Step 27 Tap on the "Create Account" Button, which is located on the Center of the screen.	Create Account
↓ Stype"inhphsjgfi%isz" on the "Account name" EditText, which is located on the Center of the screen. () ♥ ♥ 👔 🌡	Terhathsiafi el
Tap on the "Save" Button, which is located on the Center right of the screen.     (1) 중 ♀ ↓	√ See



3 Crash Application Screen-Flow (Go top)							
Step 1 →	Step 2 → ***** + 1	Step 3 →	Step 4 →	Step 5 → 24 3 4 24 3 4 + 1	Step 6 →		
Select accounts to overle       Depresen       Norsha       Norsha       Assets       Dimentalisment       Dimentalisment       Dimentalisment       Dimentalisment	Select accounts to create       Express       income       income       Assets       Ententainment       Income       Creat       Creat       Creat       Creat       Creat	Cenercia       Cenercia       Incurio       Assets       Cenercia       Distributioner       Distributioner       Distributioner       Distributioner       Distributioner	Select accounts to preate Expenses Invarie Asets Extentaiement Extentaiement Genet Oradin Josefin	Select accounts to create       Expenses       Income       Assets       Extensionnett       Income       Creat       Creat	Select accounts to-preate Express   Rearie  Assets  Assets  Cenel  Const Toronal  Cenel  Const Toronal  Const T		
Step 7 +			Step 10	Step 11	Step 12 →		
Select accounts to oneare Depreses IF Poone I Assets IF	Select accounts to searce Express & // None & //	Select accounts to create Express V Roome V Anno V	Select accounts to create Expresse // Income // Asset	Select accounts to create Expenses & Income & Asses C	No annual tha tha Singing		
Etherligannent inf Penarannen inf Genot Drass Annam	Exertainment F	Interfacement	Configuration	Entransient	Create Account		





#### 4 Crash Pruned Stack Trace

#### (Go top)

E/SQLiteLog(17653): (1) near "inhphsjgf": syntax error E/AndroidRuntime(17653): FATAL EXCEPTION: main E/AndroidRuntime(17653): Process: org.gnucash.android, PID: 17653 E/AndroidRuntime(17653): android.database.sqlite.SQLiteException: near "inhphsjgf": syntax error (code 1): , while compiling: SELECT \_i d, uid FROM accounts WHERE uid = ''inhphsjqf-d724114f522e' at android.database.sqlite.SQLiteConnection.nativePrepareStatement(Native Method) E/AndroidRuntime(17653): E/AndroidRuntime(17653): at android.database.sqlite.SQLiteConnection.acquirePreparedStatement(SQLiteConnection.java:889) E/AndroidRuntime(17653): at android.database.sqlite.SQLiteConnection.prepare(SQLiteConnection.java:500) E/AndroidRuntime(17653): at android.database.sqlite.SQLiteSession.prepare(SQLiteSession.java:588) E/AndroidRuntime(17653): at android.database.sqlite.SQLiteProgram.(SQLiteProgram.java:58) E/AndroidRuntime(17653): at android.database.sqlite.SQLiteQuery.(SQLiteQuery.java:37) E/AndroidRuntime(17653): at android.database.sqlite.SQLiteDirectCursorDriver.guery(SQLiteDirectCursorDriver.java:44) at android.database.sqlite.SQLiteDatabase.rawQueryWithFactory(SQLiteDatabase.java:1314) E/AndroidRuntime(17653): E/AndroidRuntime(17653): at android.database.sqlite.SQLiteDatabase.queryWithFactory(SQLiteDatabase.java:1161) E/AndroidRuntime(17653): at android.database.sqlite.SQLiteDatabase.query(SQLiteDatabase.java:1032) E/AndroidRuntime(17653): at android.database.sqlite.SQLiteDatabase.query(SQLiteDatabase.java:1200) E/AndroidRuntime(17653): at org.gnucash.android.db.AccountsDbAdapter.getAccountID(AccountsDbAdapter.java:166) E/AndroidRuntime(17653): at org.gnucash.android.db.AccountsDbAdapter.addAccount(AccountsDbAdapter.java:76) at org.gnucash.android.ui.accounts.NewAccountDialogFragment\$1.onClick(NewAccountDialogFragment.java:156 E/AndroidRuntime(17653): E/AndroidRuntime(17653): at android.view.View.performClick(View.java:4438) at android.view.View\$PerformClick.run(View.java:18422) E/AndroidRuntime(17653): E/AndroidRuntime(17653): at android.os.Handler.handleCallback(Handler.java:733) E/AndroidRuntime(17653): at android.os.Handler.dispatchMessage(Handler.java:95) E/AndroidRuntime(17653): at android.os.Looper.loop(Looper.java:136) at android.app.ActivityThread.main(ActivityThread.java:5001) E/AndroidRuntime(17653): E/AndroidRuntime(17653): at java.lang.reflect.Method.invokeNative(Native Method) E/AndroidRuntime(17653): at java.lang.reflect.Method.invoke(Method.java:515) E/AndroidRuntime(17653): at com.android.internal.os.ZygoteInit\$MethodAndArgsCaller.run(ZygoteInit.java:785) E/AndroidRuntime(17653): at com.android.internal.os.ZygoteInit.main(ZygoteInit.java:601) E/AndroidRuntime(17653): at dalvik.system.NativeStart.main(Native Method)



## EVALUATION

- Two Empirical Studies
- Study I: Crash Detection Capabilities
- Study 2: Crash Report Reproducibility and Readability

# STUDY I: CRASH DETECTION & COVERAGE

- **RQ**<sub>1</sub>: Crash Detection Effectiveness?
- RQ<sub>2</sub>: Orthogonality of Crashes?
- RQ3: Effectiveness of Individual Strategies?
- RQ<sub>4</sub>: Does Crash Detection Correlate with Code Coverage?

## STUDY I: EXPERIMENTAL SETUP

Tool Name	Android Version	Tool Type		
Monkey	Any	Random		
A3E Depth-First	Any	Systematic		
GUI-Ripper	Any	Model-Based		
Dynodroid	v2.3	Random-Based		
PUMA	v4.1+	Random-Based		

- 61 subject applications from the Androtest<sup>1</sup> toolset
- Each testing tool was run 5 separate times for I hour, whereas CrashScope ran through all strategies
- Monkey was limited by the number of events

<sup>1</sup>S. R. Choudhary, A. Gorla, and A. Orso. Automated Test Input Generation for Android: Are we there yet? In 30th IEEE/ACM International Conference on Automated Software Engineering (ASE 2015), 2015

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## STUDY I: CRASH RESULTS

#### Unique Crashes Discovered With Instrumented Crashes in Parentheses

Арр	A3E	GUI- Ripper	Dynodroid	PUMA	Monkey (All)	CrashScope
A2DP Vol	1	0	0	0	0	0
aagtl	0	0	1	0	1	0
Amazed	0	0	0	0	1	0
HNDroid	1	1	1	2	1	1
BatteryDog	0	0	1	0	1	0
Soundboard	0	1	0	0	0	0
AKA	0	0	0	0	1	0
Bites	0	0	0	0	1	0
Yahtzee	1	0	0	0	0	1
ADSDroid	1	1	1	1	1	1
PassMaker	1	0	0	0	1	1
BlinkBattery	0	0	0	0	1	0
D&C	0	0	0	0	1	0
Photostream	1	1	1	1	1	0
AlarmKlock	0	0	1	0	0	0
Sanity	1	1	0	0	0	0
MyExpenses	0	0	1	0	0	0
Zooborns	0	0	0	0	0	2
ACal	1	2	2	0	1	1
Hotdeath	0	2	0	0	0	1
Total	8 (21)	9 (5)	9 (6)	4 (0)	12 (1)	8 (0)

## ----

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Amazed	0	0	0	0	1	0
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Soundboard	0	1	0	0	0	0
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Total	8 (21)	9 (5)	9 (6)	4 (0)	12 (1)	8 (0)

## STUDY I: STATEMENT COVERAGE RESULTS



Average Statement Coverage Results for the Comparative Study

Reported in Average %

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Average Statement Coverage Results for the Comparative Study

Reported in Average %

## STUDY I: SUMMARY OF FINDINGS

- RQ1: CrashScope is nearly as effective at discovering crashes as the other tools, without reporting crashes caused by instrumentation
- RQ<sub>2&3</sub>: CrashScope's differing strategies led to the discovery of unique crashes
- **RQ4:** Higher statement coverage does not necessarily correspond with crash detection capabilities

# STUDY 2: REPRODUCIBILITY & READABILITY

• RQ5: Reproducibility of CrashScope Reports?

RQ<sub>6</sub>:Readability of CrashScope Reports?

## STUDY 2: EXPERIMENTAL SETUP

- 8 Real-World Crash Reports from Open Source Apps
- I 6 Graduate Students from the College of William & Mary

Application Name	# of Reproduction Steps
BMI	4
Schedule	7
adsdroid	2
Anagram-solver	7
Eyecam	14
GNU Cash	29
Olam	2
CardGame Scores	23

- Each student attempted to reproduce 8 bugs: 4 from the original reports, 4 from CrashScope Reports
- Participants used a Nexus 7 tablet for reproduction

## STUDY 2: REPRODUCIBILITY RESULTS

Type of Crash Report	# of Total/Non- Reproducible Reports
Original Bug Reports	59/64
CrashScope Bug Reports	60/64





## STUDY 2: READABILITY RESULTS

Question	CrashScope Mean	CrashScope StdDev	Original Mean	Original StdDev
UX1: I think I would like to have this type of bug report frequently.	4.00	0.89	3.06	0.77
UX2: I found this type of bug report unnecessarily complex.	2.81	1.04	2.125	0.96
UX3: I thought this type of bug report was easy to read/understand.	4.00	0.82	3.00	0.97
UX4: I found this type of bug report very cumbersome to read.	2.50	1.10	2.44	0.81
UX5: I thought the bug report was very useful for reproducing the crash.	4.13	0.62	3.44	0.89



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UX5: I thought the bug report was very useful for reproducing the crash.	4.13	0.62	3.44	0.89



## STUDY 2: SUMMARY OF FINDINGS

 RQ<sub>5</sub>: Reports generated by CrashScope are about as reproducible as human written reports extracted from open-source issue trackers

 RQ<sub>6</sub>:Reports generated by CrashScope are more readable and useful from a developers' perspective compared to human-written reports.



## CRASHSCOPE: A PRACTICAL TOOL

CrashScope   Log in ×				Kevin
C n localhost:8080/CrashScope/				F 🏠 🗔 😳 🚍
	Project Crash	Scope		
	Sign in to start your se	ssion		
	kpmoran@cs.wm.edu			
		<b>A</b>	۰	
	Remember me	Sign In		
	I forgot my password What's CrashScope?			
	I want to use CrashScope!			



## CRASHSCOPE: A PRACTICAL TOOL

CrashScope   Log in ×				Kevin
C n localhost:8080/CrashScope/				F 🏠 🗔 😳 🚍
	Project Crash	Scope		
	Sign in to start your se	ssion		
	kpmoran@cs.wm.edu			
		<b>A</b>	۰	
	Remember me	Sign In		
	I forgot my password What's CrashScope?			
	I want to use CrashScope!			



Physical Device or Emulator



a Burdan concerning the Concerning that the concerning the concern
#/gerymetrion_audio(_183): out_write() limiting sleep time 41473 to 10000
1/krivityNanagar( 595): 51AIT oB (actuandroid intent.action.NACN Flaubc200000 opuusm.android.gallary14/.app.5
tivity) from pid 1070
W.StateMenager(1959): starilitete class com.android.gollorybi.app.AlbanGrifiage
WAYC ( 1576): this device does not have MC suggery
2/Melvikow(1178): 62,000000007 Front 1266, BK From 30706/11128, paramet Benelers, Solal Sen.
2/Gillery.Buildat/geo( 129): anty-characteria classi alleas Apendingui
2/Gillery. Buillat/get( 228): report yes: Loui album
2/Millery-Willieflync( 228): unlyndare: pissa Apendingel
S/Gillery. Buillet/unct (200): request synci picesa
5/1081. ( 1190) loaded /system/titregt/1081, generative, so
5/ C 11701: RestEnceditarilget() We must Connection established Bol747145, 114 1179
5/1086. C 1170: basked /system/tib/rgh/108115-1_08.geryectum.ap
5/10814 C 11701: Loaded /system/UD/spl/UD/LEst_generation.so
BT0L promotion 1170: editoricontrib on implemented
E/Spenitkendereri, 1576); Gritting W00,7007081,5021 Ande GradienCache
E/[penilRenderer: 1576): W0.7187081.5121: 16584
E/SpenikRenderer: 15765: Getting WELTOFORLSIZE from Cadees::Unitionatraintac)
E/Speniskenderer( 1576): W0.710706.5121: 16584
S/Spenikkenderer( 1576): Endtling debug mode #
6/ ( 1576): NortExpection::get() New Heat Connection established Bol/hid/Me, tid 1585
L'ActivityReneger( 585): Histored com.android.gelleryMd/app.SelleryMctivity: «Himm Costal «Himm)
0/delvikum( 1570): 02,0300388887 frand 586, 56 fran 34286/35726, paused deaview, total Sea
1/Gilostilian( 1576): orderteenburgen: 1200x1774, gild: com.google.android.gien_jri.Alleg10537850c
1/Giloctilies( 1576): layout content pone 138641774 (compensation #)
0/WeileletelteteTrecker(_SHC): default: setFolicyDeteTratie(endiled-true)
1/ActivityNenager( 595): STAIT of (actuandroid intent_action.NACN satu[android intent_category.HDM2] FiguRoid00
-com.android.launcher/iom.android.launcher2.launcher2.from pid 585
Ordelvikum(1985): 90,708,80300 Frond 1076, 148 From 90036/116286, passed das, total das
2/Weivitom Reap(_SHC): Grow Reap (Frag case) to 10-20048 for SEDELD-Syte allocation.
Arkelvikow(1985): SC.JOR.BLOC Frond 76, 138 From 198708/110998, passed Am., total Am.
Cristivitum( 185): 02,708,8000 Freed 1586, 188 Free 99286/10996, paused Geo, total Geo
0/WaitebeteDracker( SMD): default: setFolioyDetaDoalle(enablasiotrue)
2/Worlfication(android_SWI): sanotTook pigeom.android.gellerybi satthackandroid.app.ThreaterRoit/Listian
sp#LTSPresi
BTDL_prymoliur(_685): sglburFaceHittle not implemented
W/StateManager( 12/M): saveltate
WithiteReager(1559); sawiitate class com.android.gatterybi.app.#Ituntethige
Legecy2- Review and a





Арр	A3E	GUI- Ripper	Dynodroid	PUMA	Monkey (All)	CrashScope
A2DP Vol	1	0	0	0	0	0
aagti	0	0	1	0	1	0
Amazed	0	0	0	0	1	0
HNDroid	1	1	1	2	1	1
BatteryDog	0	0	1	0	1	0
Soundboard	0	1	0	0	0	0
AKA	0	0	0	0	1	0
Bites	0	0	0	0	1	0
Yahtzee	1	0	0	0	0	1
ADSDroid	1	1	1	1	1	1
PassMaker	1	0	0	0	1	1
BlinkBattery	0	0	0	0	1	0
D&C	0	0	0	0	1	0
Photostream	1	1	1	1	1	0
AlarmKlock	0	0	1	0	0	0
Sanity	1	1	0	0	0	0
MyExpenses	0	0	1	0	0	0
Zooborns	0	0	0	0	0	2
ACal	1	2	2	0	1	1
Hotdeath	0	2	0	0	0	1
Total	8 (21)	9 (5)	9 (6)	4 (0)	12 (1)	8 (0)



Physical Device or Emulator



a Burdan concerning the Concerning that the concerning the concern
#/gerymetrion_audio(_183): out_write() limiting sleep time 41473 to 10000
1/krivityNanagar( 595): 51AIT oB (actuandroid intent.action.NACN Flaubc200000 opuusm.android.gallary14/.app.5
tivity) from pid 1070
W.StateMenager(1959): starilitete class com.android.gollorybi.app.AlbanGrifiage
WAYC ( 1576): this device does not have MC suggery
2/Melvikow(1178): 62,000000007 Front 1266, BK From 30706/11128, paramet Benelers, Solal Sen.
2/Gillery.Buildat/geo( 129): anty-characteria classi alleas Apendingui
2/Gillery. Buillat/get( 228): report yes: Loui album
2/Millery-Willieflync( 228): unlyndare: pissa Apendingel
S/Gillery. Buillet/unct (200): request synci picesa
5/1081. ( 1190) loaded /system/titregt/1081, generative, so
5/ C 11701: RestEnceditarilget() We must Connection established Bol747145, 114 1179
5/1086. C 1170: basked /system/tib/rgh/108115-1_08.geryectum.ap
5/10814 C 11701: Loaded /system/UD/spl/UD/LEst_generation.so
BT0L promotion 1170: editoricontrib on implemented
E/Spenitkendereri, 1576); Gritting W00,7007081,5021 Ande GradienCache
E/[penilRenderer: 1576): W0.7187081.5121: 16584
E/SpenikRenderer: 15765: Getting WELTOFORLSIZE from Cadees::Unitionatraintac)
E/Speniskenderer( 1576): W0.710706.5121: 16584
S/Spenikkenderer( 1576): Endtling debug mode #
6/ ( 1576): NortExpection::get() New Heat Connection established Bol/hid/Me, tid 1585
L'ActivityReneger( 585): Histored com.android.gelleryMd/app.SelleryMctivity: «Himm Costal «Himms)
0/delvikum( 1570): 02,0300388887 frand 586, 56 fran 34286/35726, paused deaview, total Sea
1/Gilostilian( 1576): orderteenburgen: 1200x1774, gild: com.google.android.gien_jri.Alleg10537850c
1/Giloctilies( 1576): layout content pone 138641774 (compensation #)
0/WeileletelteteTrecker(_SHC): default: setFolicyDeteTratie(endiled-true)
1/ActivityNenager( 595): STAIT of (actuandroid intent_action.NACN satu[android intent_category.HDM2] FiguRoid00
-com.android.launcher/iom.android.launcher2.launcher2.from pid 585
Ordelvikum(1985): 90,708,80300 Frond 1076, 148 From 90036/116286, passed das, total das
2/Weivitom Reap(_SHC): Grow Reap (Frag case) to 10-20048 for SEDELD-Syte allocation.
Arkelvikow(1985): SC.JOR.BLOC Frond 76, 138 From 198708/110998, passed Am., total Am.
Cristivitum( 185): 02,708,8000 Freed 1586, 188 Free 99286/10996, paused Geo, total Geo
0/WaitebeteDracker( SMD): default: setFolioyDetaDoalle(enablasiotrue)
2/Worlfication(android_SWI): sanotTook pigeom.android.gellerybi satthackandroid.app.ThreaterRoit/Listian
sp#LTSPresi
BTDL_prymoliur(_685): sglburFaceHittle not implemented
W/StateManager( 12/M): saveltate
WithiteReager(1559); sawiitate class com.android.gatterybi.app.#Ituntethige
Legery:- textmorad





Арр	A3E	GUI- Ripper	Dynodroid	PUMA	Monkey (All)	CrashScope
A2DP Vol	1	0	0	0	0	0
aagti	0	0	1	0	1	0
Amazed	0	0	0	0	1	0
HNDroid	1	1	1	2	1	1
BatteryDog	0	0	1	0	1	0
Soundboard	0	1	0	0	0	0
AKA	0	0	0	0	1	0
Bites	0	0	0	0	1	0
Yahtzee	1	0	0	0	0	1
ADSDroid	1	1	1	1	1	1
PassMaker	1	0	0	0	1	1
BlinkBattery	0	0	0	0	1	0
D&C	0	0	0	0	1	0
Photostream	1	1	1	1	1	0
AlarmKlock	0	0	1	0	0	0
Sanity	1	1	0	0	0	0
MyExpenses	0	0	1	0	0	0
Zooborns	0	0	0	0	0	2
ACal	1	2	2	0	1	1
Hotdeath	0	2	0	0	0	1
Total	8 (21)	9 (5)	9 (6)	4 (0)	12 (1)	8 (0)



Physical Device or Emulator



a Building of Control 1975, ALC 1987, Control 1988, Long of the Lines of Long
#/gerymetrion_audia(111): out_write() limiting sleep time 41473 to 10000
1/kriiit/Managar( 595): 57627 uB (actuandroid.intent.action.NBCN Flaubc200000 ompuses.android.gellery16/.app.5
tivity) from pid 1078
W.StateMenager(1959): starilitete class com.android.gollorybi.app.AlbanGrifuge
WAYC ( 1576): this device does not have MC support
2/Melvikow(1178): 62,000000007 Front 1296, BK From 20706/11128, paramet Beneles, hetel 3m.
2/Gillery.Buildat/geo( 129): antyrctore: Local album Apendings1
2/Gillery. Buillat/get( 228): repart age: Loui allows
2/Millery-Willieflync( 1278): unfyndane: pissa Apendingel
S/Gillery. Buillet/uncl_1220): request sync: picesa
5/1081. ( 1190) loaded /system/tit/egt/1081.genyettion.so
5/ C 11701: RestEnceditarilget() We must Connection established Bol745744, tod 1179
5/1086. C 1170: basked /system/tib/rgh/tibil15/1,08.peryection.ap
5/10814 C 11701: Loaded /system/UD/spl/UD/15-1, generation.so
BTOL promotion: 1270: egilarizabilitib not implemented
E/Spenitkenderert 1576; Griting W00,7007081,5021 Ande Gradientache
E/[penilRenderer: 1576): W0.7107081.5121: 16584
E/SpenikRenderer: 15765: Getting WELTOFORLSIZE from Caches::Unitionstraintac)
E/Speniskenderer( 1576): W0.710704.5121: 16584
S/Spenikkenderer( 1576): Endtling debug mode #
0/ ( 1578): NortExpection::get() New Heat Connection established Bub7bid(Ne, tid 1585
L'ActivityReneger( 585): Hislayed com.android.gelleryMd/app.felleryMctivity: «Himm Costal «Himm)
0/delvikum( 1570): 02,000000000 frond 500, 50 from 34200/31720, paused Amarina, total Sma
1/Gilbertilan( 1576): ordertsenDungal: 1200x1774, gild: com.google.android.gine.jri.Ailag10527850c
1/Giloctilies( 1576): layout content pone 1300x1274 (compensation #)
0/WeileletelteteTrecker(_SHS): default: setFolicyDeteEnable(enabled-true)
1/ActivityNenager( 585): STAIT oB (actuandroid.intent.action.NACN satu[android.intent.catagory.ND43] FiguRoid608
-com.android.launcherlism.android.launcherl.launcherl from pid S85
2/delvilue(
Initiation heap( SHC): Grow heap (frag case) to 10.20048 for SEDELDayte allocation.
Arkelvikow(1985): SC./OR.80355 Frond 76, 138 From 194708/110048, passed Am., Initial Am.
Cristivitum( 185): 02,708,8000 Freed 1586, 188 Free 9928/125896, paused Ges, total Ges
0/WaitebulateTracker( SBC): default: setFilingDataDate(enablaintrac)
D/Wolfication(android app. SED): sanotTook pigeom.android.getteryld settlackondroid.app.ThereterSkit/isettarG
sp#LTSPresi
B-TOL_privection(_685): sgTburFaceHittlb not implemented
W/StateManager( 12/0): saveltate
Within Manager( 1578); sanditate class cae_android_patterybi.app.#DivefetPage
Legecy2- RevErBorard





Арр	A3E	GUI- Ripper	Dynodroid	PUMA	Monkey (All)	CrashScope
A2DP Vol	1	0	0	0	0	0
aagti	0	0	1	0	1	0
Amazed	0	0	0	0	1	0
HNDroid	1	1	1	2	1	1
BatteryDog	0	0	1	0	1	0
Soundboard	0	1	0	0	0	0
AKA	0	0	0	0	1	0
Bites	0	0	0	0	1	0
Yahtzee	1	0	0	0	0	1
ADSDroid	1	1	1	1	1	1
PassMaker	1	0	0	0	1	1
BlinkBattery	0	0	0	0	1	0
D&C	0	0	0	0	1	0
Photostream	1	1	1	1	1	0
AlarmKlock	0	0	1	0	0	0
Sanity	1	1	0	0	0	0
MyExpenses	0	0	1	0	0	0
Zooborns	0	0	0	0	0	2
ACal	1	2	2	0	1	1
Hotdeath	0	2	0	0	0	1
Total	8 (21)	9 (5)	9 (6)	4 (0)	12 (1)	8 (0)



Physical Device or Emulator



a Building of Control 1975, ALC 1987, Control 1988, Control 198
#/gerymetrion_audia(111): out_write() limiting sleep time 41473 to 10000
1/kriiit/Managar( 595): 57627 uB (actuandroid.intent.action.NBCN Flaubc200000 cmpuses.android.gellery16/.app.5
tivity) from pid 1078
W.StateMenager(1959): starilitete class com.android.gollorybi.app.AlbanGrifuge
WAYC ( 1576): this device does not have MC support
2/Melvikow(1178): 62,000000000 Frond 1266, BK From 20206/11128, paramet Beneles, hetel 3m.
2/Gillery.Buildat/geo( 129): anty-characteria Local album Apendingui
2/Gillery. Buillat/get( 228): repart age: Loui allows
S/Millery-Willieflync( 1278): untynibre: plana Apendingel
Schillery. Buillettyne: 2000: request sync: picesa
5/1081. ( 1190) loaded /system/tit/egt/1081.genyettion.so
5/ C 11701: RestEnceditarilget() We must Connection established Bol745744, tod 1179
5/1086 C 1170: basked /system/tib/rgh/108115-1_08.geryection.ap
5/10814 C 11701: Loaded /system/UD/spl/UD/15-1, generation.so
BTOL promotion: 1270: egilarizabilitib not implemented
E/Spenitkenderert 1576; Griting W00,7007081,5021 Ande Gradientache
E/[penilRenderer: 1576): W0.7107081.5121: 16584
E/SpenikRenderer: 15765: Getting WELTOFORLSIZE from Caches::Unitionstraintac)
E/Speniskenderer( 1576): W0.710704.5121: 16584
S/Spenikkenderer( 1576): Endtling debug mode #
0/ ( 1578): NortExpection::get() New Heat Connection established Bub7bid(Ne, tid 1585
L'ActivityReneger( 585): Hislayed com.android.gelleryMd/app.felleryMctivity: «Himm Costal «Himm)
0/delvikum( 1570): 02,000000000 frond 500, 50 from 34200/31720, paused Amarina, total Sma
1/Gilbertilan( 1576): ordertsenDungal: 1200x1774, gild: com.google.android.gine.jri.Ailag10527850c
1/Giloctilies( 1576): layout content pone 1300x1274 (compensation #)
0/WeileletelteteTrecker(_SHS): default: setFolicyDeteEnable(enabled-true)
1/ActivityNenager( 585): STAIT oB (actuandroid.intent.action.NACN satu[android.intent.catagory.ND43] FiguRoid608
-com.android.launcherlism.android.launcherl.launcherl from pid S85
2/delvilue(
Initiation heap( SHC): Grow heap (frag case) to 10.20048 for SEDELDayte allocation.
Arkelvikow(1985): SC./OR.80355 Frond 76, 138 From 194708/110048, passed Am., Initial Am.
Cristivitum( 185): 02,708,8000 Freed 1586, 188 Free 9928/125896, paused Ges, total Ges
0/WaitebulateTracker( SBC): default: setFilingDataDate(enablaintrac)
D/Wolfication(android app. SED): sanotTook pigeom.android.getteryld settlackondroid.app.ThereterSkit/isettarG
sp#LTSPresi
B-TOL_privection(_685): sgTburFaceHittlb not implemented
W/StateManager( 12/0): saveltate
Within Manager( 1578); sanditate class cae_android_patterybi.app.#DivefetPage
Legecy2- RevErBorard





Арр	A3E	GUI- Ripper	Dynodroid	PUMA	Monkey (All)	CrashScope
A2DP Vol	1	0	0	0	0	0
aagti	0	0	1	0	1	0
Amazed	0	0	0	0	1	0
HNDroid	1	1	1	2	1	1
BatteryDog	0	0	1	0	1	0
Soundboard	0	1	0	0	0	0
AKA	0	0	0	0	1	0
Bites	0	0	0	0	1	0
Yahtzee	1	0	0	0	0	1
ADSDroid	1	1	1	1	1	1
PassMaker	1	0	0	0	1	1
BlinkBattery	0	0	0	0	1	0
D&C	0	0	0	0	1	0
Photostream	1	1	1	1	1	0
AlarmKlock	0	0	1	0	0	0
Sanity	1	1	0	0	0	0
MyExpenses	0	0	1	0	0	0
Zooborns	0	0	0	0	0	2
ACal	1	2	2	0	1	1
Hotdeath	0	2	0	0	0	1
Total	8 (21)	9 (5)	9 (6)	4 (0)	12 (1)	8 (0)



Physical Device or Emulator



a Building of Control 1975, ALC 1987, Control 1988, Control 198
#/gerymetrion_audia(111): out_write() limiting sleep time 41473 to 10000
1/kriiit/Managar( 595): 57627 uB (actuandroid.intent.action.NBCN Flaubc200000 cmpuses.android.gellery16/.app.5
tivity) from pid 1078
W.StateMenager(1959): starilitete class com.android.gollorybi.app.AlbanGrifuge
WAYC ( 1576): this device does not have MC support
2/Melvikow(1178): 62,000000000 Frond 1266, BK From 20206/11128, paramet Beneles, hetel 3m.
2/Gillery.Buildat/geo( 129): anty-characteria Local album Apendingui
2/Gillery. Buillat/get( 228): repart age: Loui allows
S/Millery-Willieflync( 1278): untynibre: plana Apendingel
Schillery. Buillettyne: 2000: request sync: picesa
5/1081. ( 1190) loaded /system/tit/egt/1081.genyettion.so
5/ C 11701: RestEnceditarilget() We must Connection established Bol745744, tod 1179
5/1086 C 1170: basked /system/tib/rgh/108115-1_08.geryection.ap
5/10814 C 11701: Loaded /system/UD/spl/UD/15-1, generation.so
BTOL promotion: 1270: egilarizabilitib not implemented
E/Spenitkenderert 1576; Griting W00,7007081,5021 Ande Gradientache
E/[penilRenderer: 1576): W0.7107081.5121: 16584
E/SpenikRenderer: 15765: Getting WELTOFORLSIZE from Caches::Unitionstraintac)
E/Speniskenderer( 1576): W0.710704.5121: 16584
S/Spenikkenderer( 1576): Endtling debug mode #
0/ ( 1578): NortExpection::get() New Heat Connection established Bub7bid(Ne, tid 1585
L'ActivityReneger( 585): Hislayed com.android.gelleryMd/app.felleryMctivity: «Himm Costal «Himm)
0/delvikum( 1570): 02,000000000 frond 500, 50 from 34200/31720, paused Amarina, total Sma
1/Gilbertilan( 1576): ordertsenDungal: 1200x1774, gild: com.google.android.gine.jri.Ailag10527850c
1/Giloctilies( 1576): layout content pone 1300x1274 (compensation #)
0/WeileletelteteTrecker(_SHS): default: setFolicyDeteEnable(enabled-true)
1/ActivityNenager( 585): STAIT oB (actuandroid.intent.action.NACN satu[android.intent.catagory.ND43] FiguRoid608
-com.android.launcherlism.android.launcherl.launcherl from pid S85
2/delvilue(
Initiation heap( SHC): Grow heap (frag case) to 10.20048 for SEDELE-Syste allocation.
Arkelvikow(1985): SC./OR.80355 Frond 76, 138 From 198708/110098, passed Am., Inital Am.
Cristivitum( 185): 02,708,81102 Freed 5584, 188 Free 9928/110996, paused Ges, total Ges
0/Waitsbuightetracker( SBD): default: setFilingDataDate(enditability)
D/Wolfication(android app. Transfer(Wolf) and pages and old aptroph antibackandroid app. Transfer(Wolf) and
sp#LTSPresi
B-TOL_privection(_685): sgTburFaceHittlb not implemented
W/StateManager( 12/0): saveltate
Within Manager( 1578); sanditate class cae_android_patterybi.app.#DivefetPage
Legecy2- RevErBorard





Арр	A3E	GUI- Ripper	Dynodroid	PUMA	Monkey (All)	CrashScope
A2DP Vol	1	0	0	0	0	0
aagti	0	0	1	0	1	0
Amazed	0	0	0	0	1	0
HNDroid	1	1	1	2	1	1
BatteryDog	0	0	1	0	1	0
Soundboard	0	1	0	0	0	0
AKA	0	0	0	0	1	0
Bites	0	0	0	0	1	0
Yahtzee	1	0	0	0	0	1
ADSDroid	1	1	1	1	1	1
PassMaker	1	0	0	0	1	1
BlinkBattery	0	0	0	0	1	0
D&C	0	0	0	0	1	0
Photostream	1	1	1	1	1	0
AlarmKlock	0	0	1	0	0	0
Sanity	1	1	0	0	0	0
MyExpenses	0	0	1	0	0	0
Zooborns	0	0	0	0	0	2
ACal	1	2	2	0	1	1
Hotdeath	0	2	0	0	0	1
Total	8 (21)	9 (5)	9 (6)	4 (0)	12 (1)	8 (0)



## THE CRASHSCOPETEAM



Mario



Chris



Carlos



Dr. Denys Poshyvanyk

## Thank you!

Any Questions?



http://www.cs.wm.edu/semeru/data/ICST16-CrashScope/