Deep Dynamic Analysis of Android Applications

By

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Contents

	List	of Figures	v
	List	of Tables	vi
	Abst	tract	vii
	Ack	nowledgments	ix
1	Intr	oduction	1
2	Bac	kground	3
	2.1	Android At a Glance	3
		2.1.1 The Android Software Stack	3
	2.2	The Anatomy of an Android Application	6
	2.3	The Android SDK	8
•	ъ		10
3	Rela	ated Work	10
	3.1	Android Dynamic Analysis	10
		3.1.1 Andrubis	11
		3.1.2 A3E	12
4	\mathbf{Des}	ign and Methodology	13
	4.1	The Pyandrazzi Data Flow	13
		4.1.1 APK metadata extraction	14
		4.1.2 Instrumentation Features	16
		4.1.3 Automated UI Exploration	18
		4.1.4 Exploration Modes	18
5	Eva	luation and Practical Applications	21
	5.1	Coverage Evaluation	22
	5.2	Performance Evaluation	25
	5.3	Practical Applications	26

	5.3.1	Evaluating a Re-writing-based Android Host Intrusion Detection	
		System	26
	5.3.2	Finding Ad Fraud in Mobile Applications	29
6	Limitation	as and Future Work	34

36

7 Conclusion



LIST OF FIGURES

2.1	The Android Stack	4
2.2	The Android Activity Lifecycle, reproduced from the Android documen-	
	tation $[1]$	6
4.1	Pyandrazzi Component Diagram	14
5.1	Signature for PJApps malware family	27
5.2	Logcat output for Application infected with PJApps	28

LIST OF TABLES

5.1	Results of Method Coverage Analysis for 1750 Top Google Play Applica-	
	tions % (Method Coverage / Number of App Traces) $\ldots \ldots \ldots$	22
5.2	Results of Method Coverage Analysis for 50 Manually-tested Top Google	
	Play Applications (% Method Coverage / Number of App Traces) $\ . \ . \ .$	23
5.3	Duration of Coverage Experiments (h:mm:ss)	25
5.4	Boot time of Android Emulators by API level and Architecture (mm:ss) .	26
5.5	Results of Random UI Introspection	29
5.6	Results of executing 7500 apps with Pyandrazzi that had no previous ad	
	activity [2]	30

Abstract

Deep Dynamic Analysis of Android Applications

The smartphone revolution has brought about many new computing paradigms, which aim to improve upon the computing landscape as we knew it. Chief among these is the "app", packetizing and trivializing the distribution and installation of software. This has led to a boom in the mobile software industry, but also an increased burden on security researchers to ensure the millions of apps available do not harm users.

This paper presents a partial solution to that problem, Pyandrazzi, a practical dynamic analysis system for Android applications. Pyandrazzi aims to be more scalable, more compatible, and more thorough than any existing system, and to provide more informative data to analysts than was previously thought possible. The system is a true black-box solution, and is able to perform this analysis without any source code or prior knowledge of the application whatsoever. Unlike other similar systems, which rely heavily on unrealistic modifications to Android, our system employs the original Android virtual machine and libraries, to provide a more natural environment for apps, and to ease portability to new Android versions. Novel contributions include an algorithm for more thoroughly exploring application modeled on common user interface design patterns, a platform version-independent means of obtaining method trace data, and a method of using this data to calculate the method coverage of an application execution.

To evaluate the performance and coverage of the system, we used 1750 of the top applications from the dominant Google Play app market, and executed them under a variety of conditions. We demonstrate that the algorithm we developed is more effective than random user interface interactions at achieving method coverage of an application. We then discuss the performance of the system, which can execute all 1750 apps, for two minutes of run-time each, under heavy instrumentation, in about 7 hours.

We then explore two practical applications of the system. The first is a Host-based Intrusion Detection System (HIDS) concept implemented using application re-writing techniques. The system uses signatures based on high-level API call activity, as opposed to binary fingerprints or system call traces used in other systems. In our tests, we were able to reliably detect three families of malware for which we created signatures with zero false positives.

Secondly, we explore Pyandrazzi's role in a recent study of advertising fraud on Android, covering over 130,000 Android applications. The system was used to analyze those apps that did not generate ad-related traffic without user interaction. Of the 7,500 apps without such traffic, we found that 12.8% of applications would have generated ad traffic, if they had been properly interacted with via their user interfaces. We then explore augmenting Pyandrazzi to avoid interacting with advertising so that fraudulent behaviors can be better detected. Using a set of rules based on advertising industry standards and common design patterns, we were able to avoid ad-related interactions in 97.6 percent of a test set of 1,000 apps.

-viii-

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