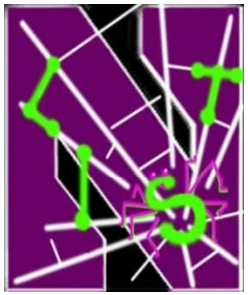


AppsPlayground: Automatic Security Analysis of Smartphone Applications

Vaibhav Rastogi, Yan Chen, and William Enck[†]

Lab for Internet and Security Technology, Northwestern University

[†]North Carolina State University

Android Threats

- Privacy leakage
  - Users often have no way to know if there are privacy leaks
  - Even legitimate apps may leak private information without informing user
- Malware
  - Number increasing consistently
  - Need to analyze new kinds

flickr.com/photos/panda_security_france/

Requirements

- Large number of apps in online app stores
  - Google Play has over 700,000 apps
  - This number is constantly increasing
- Offline analysis is important to protect users
- Need a *scalable* and *automatic* approach to tackle threats
- Possible techniques: dynamic analysis and static analysis

Dynamic vs. Static

	Dynamic Analysis	Static Analysis
Coverage	Some code not executed	Mostly sound
Accuracy	False negatives	False positives
Dynamic Aspects (reflection, dynamic loading)	Handled without additional effort	Possibly unsound for these
Execution context	Easily handled	Difficult to handle
Performance	Usually slower	Usually faster

AppsPlayground

- A system for offline dynamic analysis
  - Includes multiple **detection** techniques for dynamic analysis
- Challenges
  - Techniques must be light-weight
  - Automation requires good **exploration** techniques

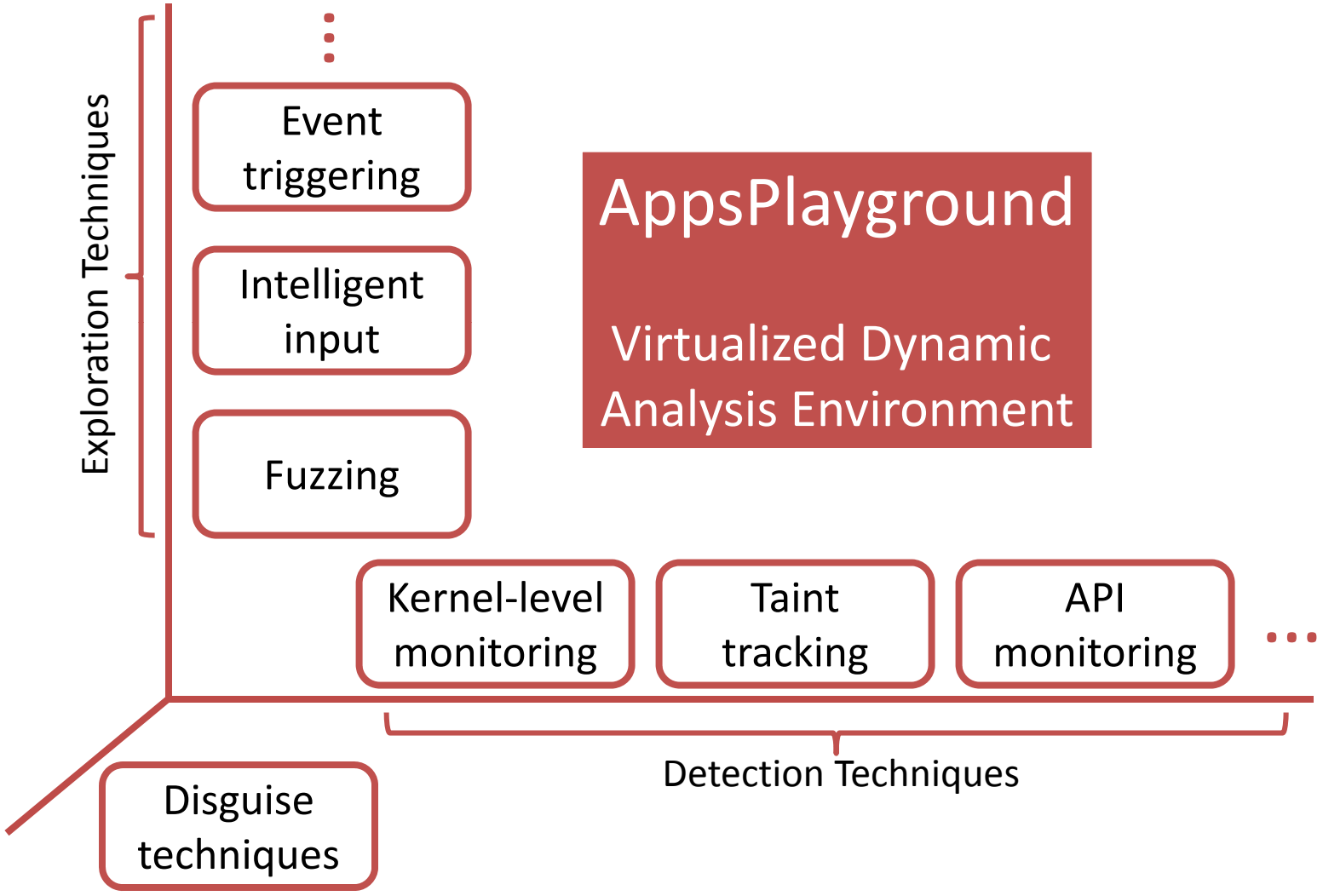
Outline

- Architecture
- Applications and Results
- Related Work
- Conclusion and Future Work

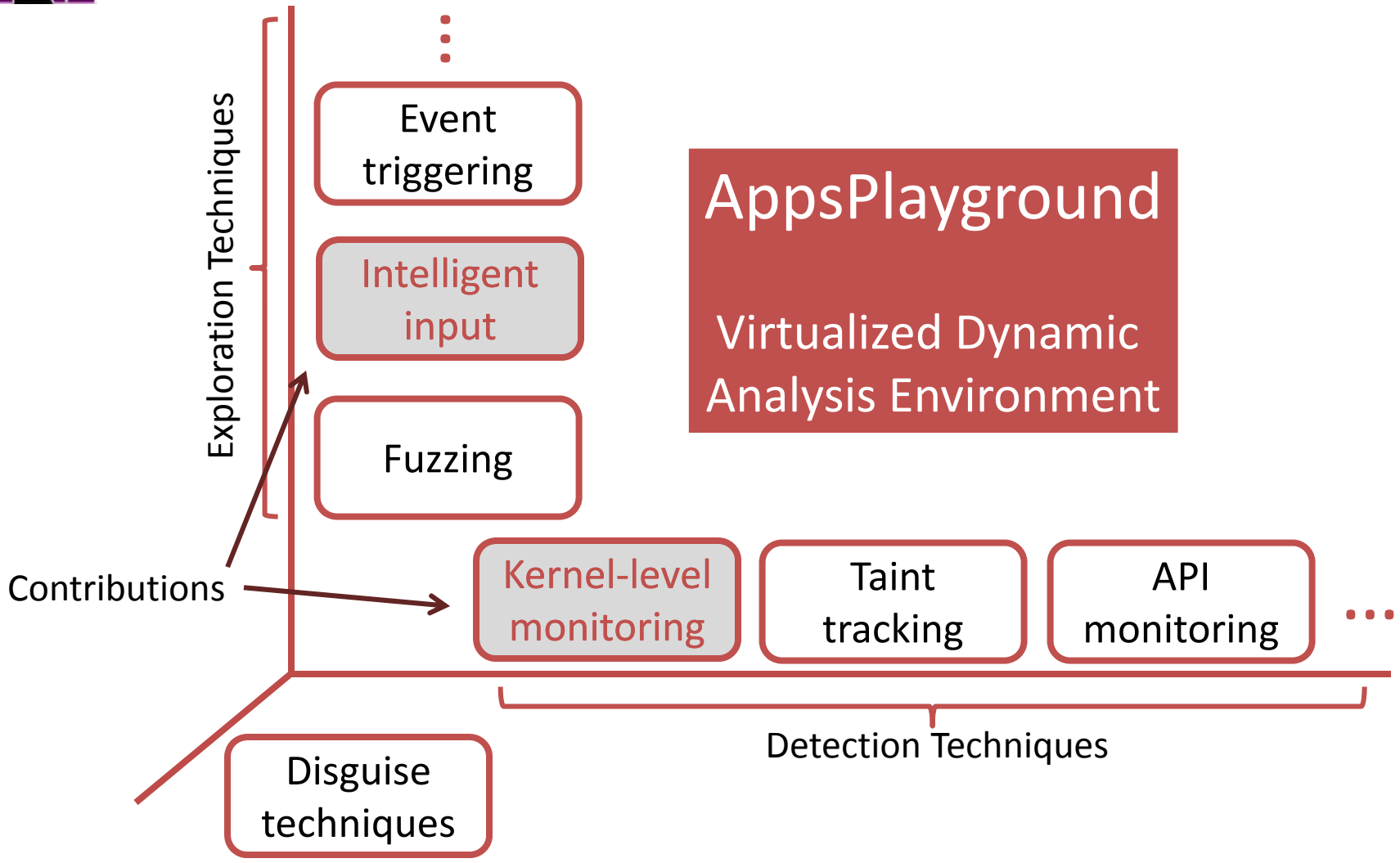
Outline

- Architecture
- Applications and Results
- Related Work
- Conclusion and Future Work

Architecture

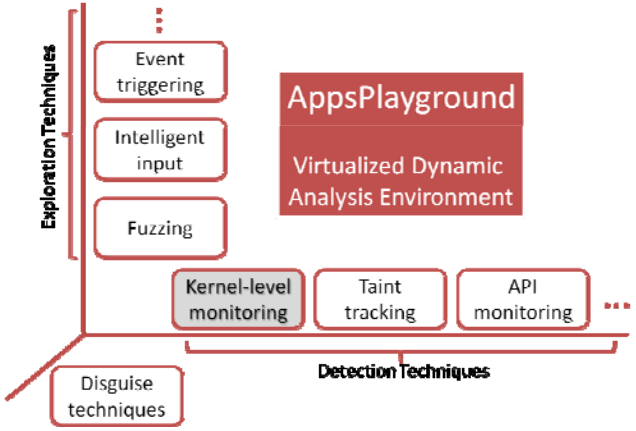


Architecture



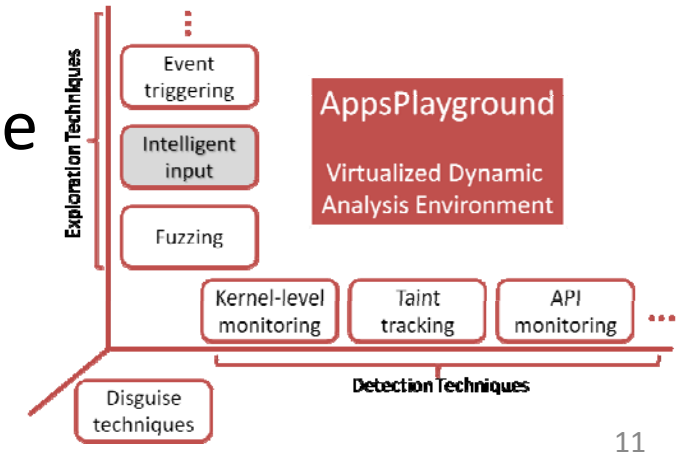
Kernel-level Monitoring

- Useful for malware detection
- Most root-capable malware can be logged for vulnerability conditions
- Rage-against-the-cage
  - Number of live processes for a user reaches a threshold
- Exploid / Gingerbreak
  - Netlink packets sent to system daemons



Intelligent Input

- Fuzzing is good but has limitations
- Another black-box GUI exploration technique
- Capable of filling meaningful text by inferring surrounding context
  - Automatically fill out zip codes, phone numbers and even login credentials
  - Sometimes increases coverage greatly



Disguise Techniques

- Make the virtualized environment look like a real phone
  - Phone identifiers and properties
  - Data on phone, such as contacts, SMS, files
  - Data from sensors like GPS
  - Cannot be perfect

Outline

- Architecture
- Applications and Results
- Related Work
- Conclusion and Future Work

Privacy Leakage Results

- AppsPlayground automates TaintDroid
- Large scale measurements - 3,968 apps from Android Market (Google Play)
  - 946 leak some info
  - 844 leak phone identifiers
  - 212 leak geographic location
  - Leaks to a number of ad and analytics domains

Malware Detection

- Case studies on DroidDream, FakePlayer, and DroidKungfu
- AppsPlayground's detection techniques are effective at detecting malicious functionality
- Exploration techniques can help discover more sophisticated malware

Exploration Effectiveness

- Measured in terms of code coverage
  - 33% mean code coverage
    - More than double than trivial
    - Black box technique
    - Some code may be dead code
    - Use symbolic execution in the future
- Fuzzing and intelligent input both important
  - Fuzzing helps when intelligent input can't model GUI
  - Intelligent input could sign up automatically for 34 different services in large scale experiments

Outline

- Architecture
- Applications and Results
- Related Work
- Conclusion and Future Work

Related Work

- Google Bouncer
  - Similar aims; closed system
- DroidScope, Usenix Security'12
  - Malware forensics
  - Mostly manual
- SmartDroid, SPSM'12
  - Uses static analysis to guide dynamic exploration
  - Complementary to our approach

Conclusions and Future Work

- AppsPlayground is a system for large-scale, automatic dynamic analysis of Android apps
  - Multiple detection, exploration, and disguise techniques
- Future work
  - Symbolic execution
  - Improve disguise techniques
- Release
  - Check back soon at http://list.northwestern.edu/mobile.html