



SARA

Record and Replay for Android

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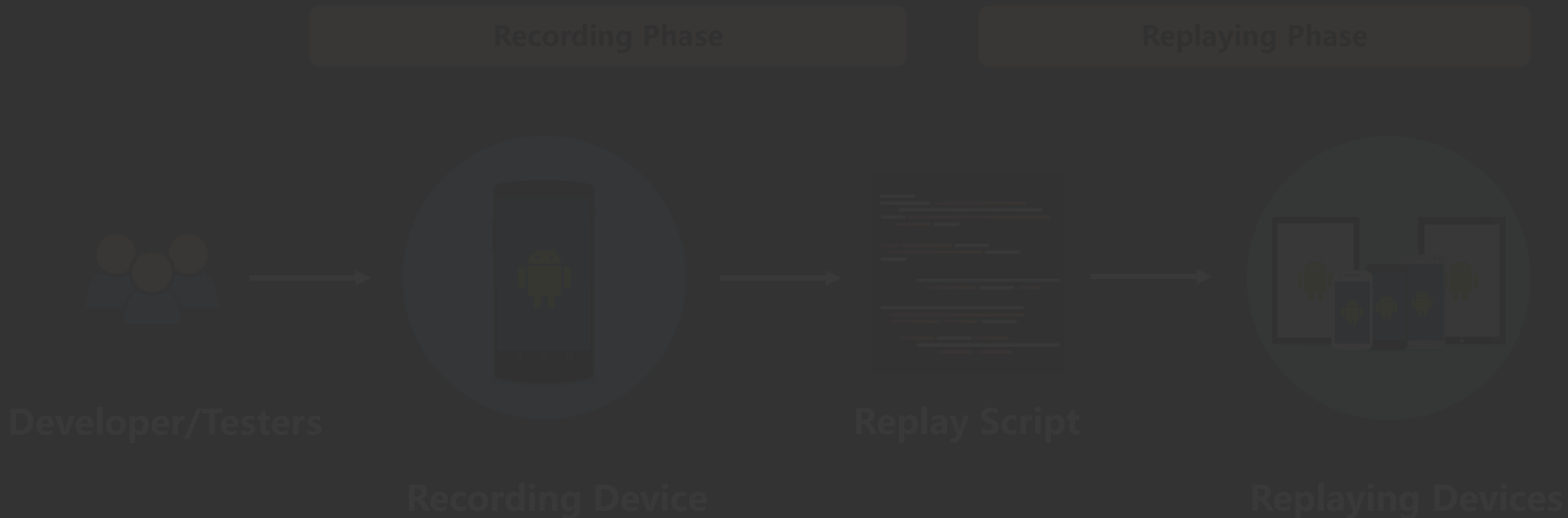
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Functionality of Record & Replay





Functionality of Record & Replay

- Allow developers to test apps on different devices at once



Fragmentation of Device and OS



Functionality of Record & Replay

- Allow developers to test apps on different devices at once



Fragmentation of Device and OS

- Automate the process of Regression Testing



Recently, *features* and *constraints* from WeChat development team have been proposed



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Desired Features

- ✓ Sensitive to Coordinate
- ✓ Sensitive to Widgets
- ✓ Sensitive to Timing
- ✓ Insensitive to State

Constraints in practice

- ⊘ No custom OS
- ⊘ No instrumentation on app
- ⊘ No root access
- ⊘ No source code

Challenges in Providing all features under constraints



Challenges in Providing all features under constraints



■ Recording and Replaying Rich Sources of Inputs

No Source Code and Custom OS

Challenges in Providing all features under constraints



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No Source Code and Custom OS

■ Efficiently Recording Motion Events Based on Widgets

Recording the widgets under interaction usually introduces large time overhead

Challenges in Providing all features under constraints



■ Recording and Replaying Rich Sources of Inputs

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■ Replaying Events on Different Devices

There are alternate UI layouts and UI resources for different screen resolutions and sizes

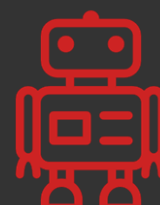
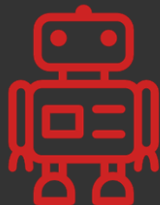


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Recording Phase

Self-replaying Phase

Replaying Phase



Developer/Testers

Replay Agent

Replay Agent

Recording Device

Recording Device

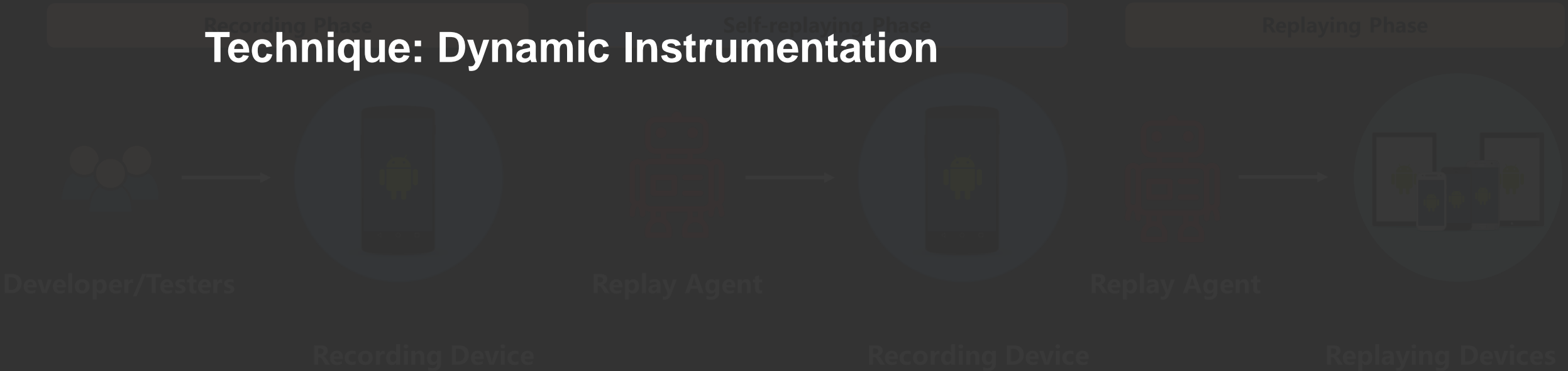
Replaying Devices



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■ Recording and Replaying Rich Sources of Inputs

Technique: Dynamic Instrumentation





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■ Recording and Replaying Rich Sources of Inputs

Recording Phase Self-replaying Phase Replaying Phase

Technique: Dynamic Instrumentation

■ Efficiently Recording Motion Events Based on Widgets

Technique: Self-replay mechanism

Developer/Testers

Replay Agent

Replay Agent

Recording Device

Recording Device

Replaying Devices



SARA

■ Recording and Replaying Rich Sources of Inputs

Technique: Dynamic Instrumentation

■ Efficiently Recording Motion Events Based on Widgets

Technique: Self-replay mechanism

■ Replaying Events on Different Devices

Technique: Adaptive replay method



Evaluation of SARA

50 highly popular Apps from Google Play

100M Downloads

5 usage scenarios for each App

3 different Android devices

**Different screen sizes and
OS versions**



Evaluation of SARA

■ Record & Replay on Same Device

Tool	Replayable Scenarios
SARA	85.6%
RERAN	9.6%
appetizer	59.2%



Evaluation of SARA

■ Record & Replay on Same Device

Main Causes of Failures

- 20%** Incorrect soft keyboard input (**Bug of the instrumentation tool**)
- 20%** Imprecise timing between events (**Overhead of instrumentation**)
- 14%** Non-deterministic states of App



Evaluation of SARA

■ Record & Replay on Different Device

Tool	Replayable Scenarios
SARA	83.5%
appetizer	70.0%



Evaluation of SARA

■ Record & Replay on Different Device

Main Causes of Failures

Inaccurate View Hierarchy (**Caused by UIAutomator2**)

Breaking Change of UI



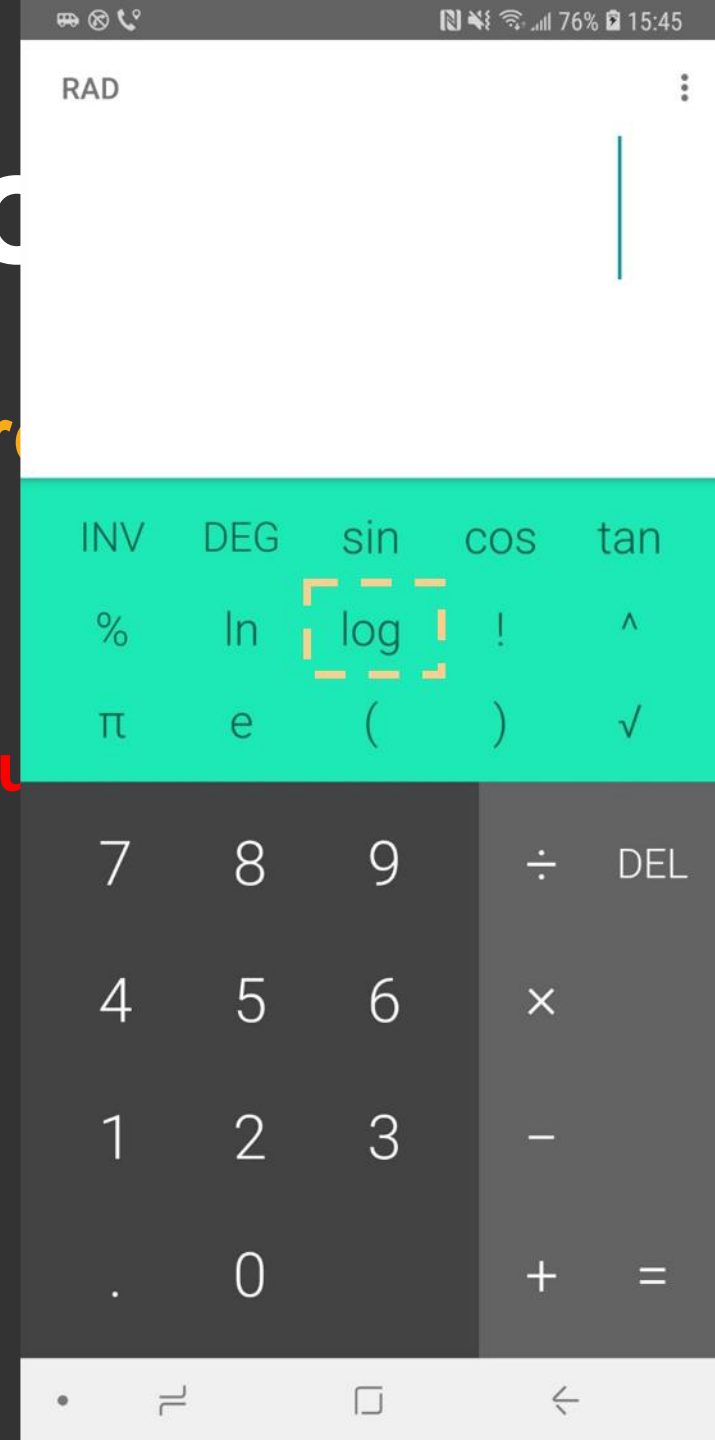
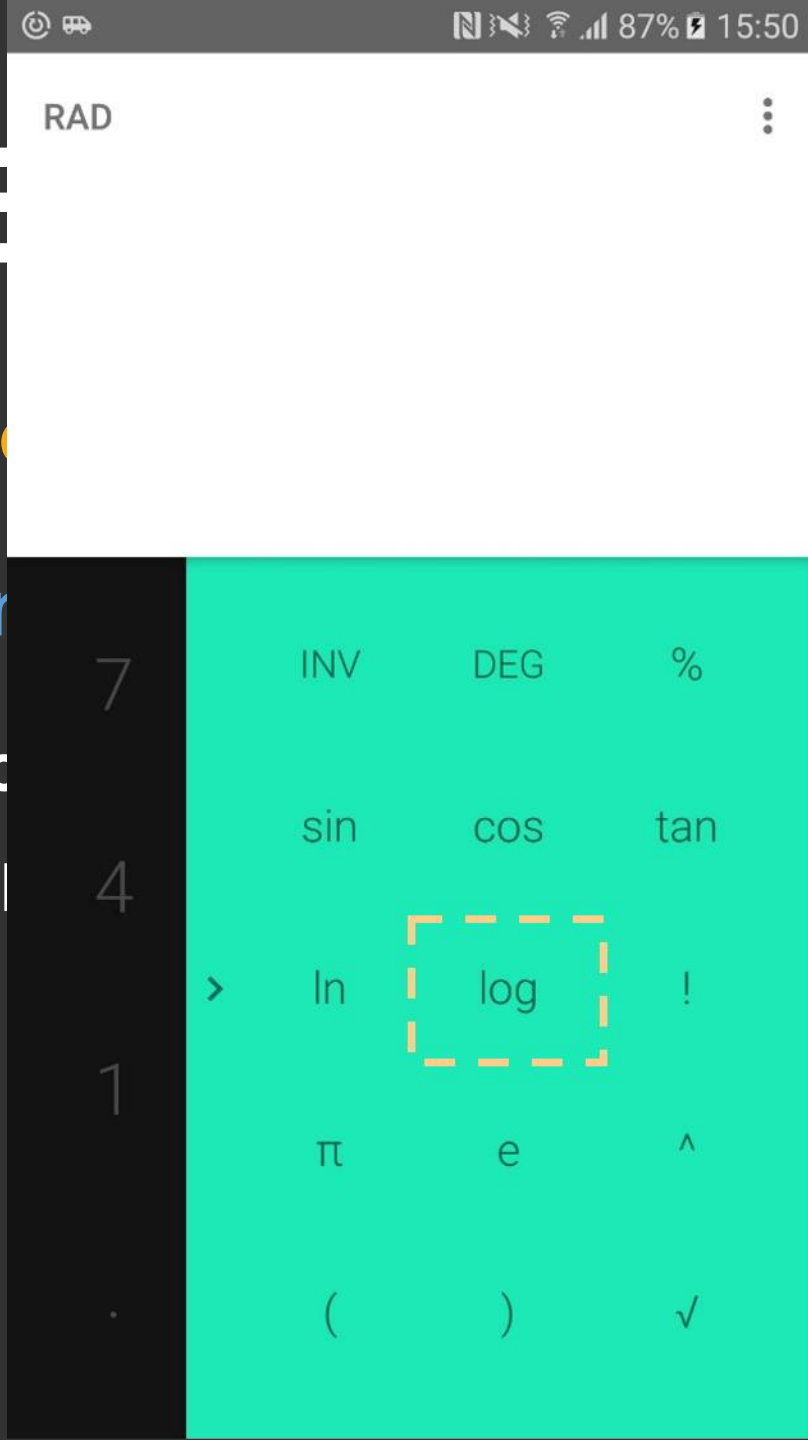
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■ Rec

Main

Inacc

Break



Demo Video