

Automatically Translating Bug Reports into Test Cases for Mobile Apps

Mattia Fazzini



Martin Prammer



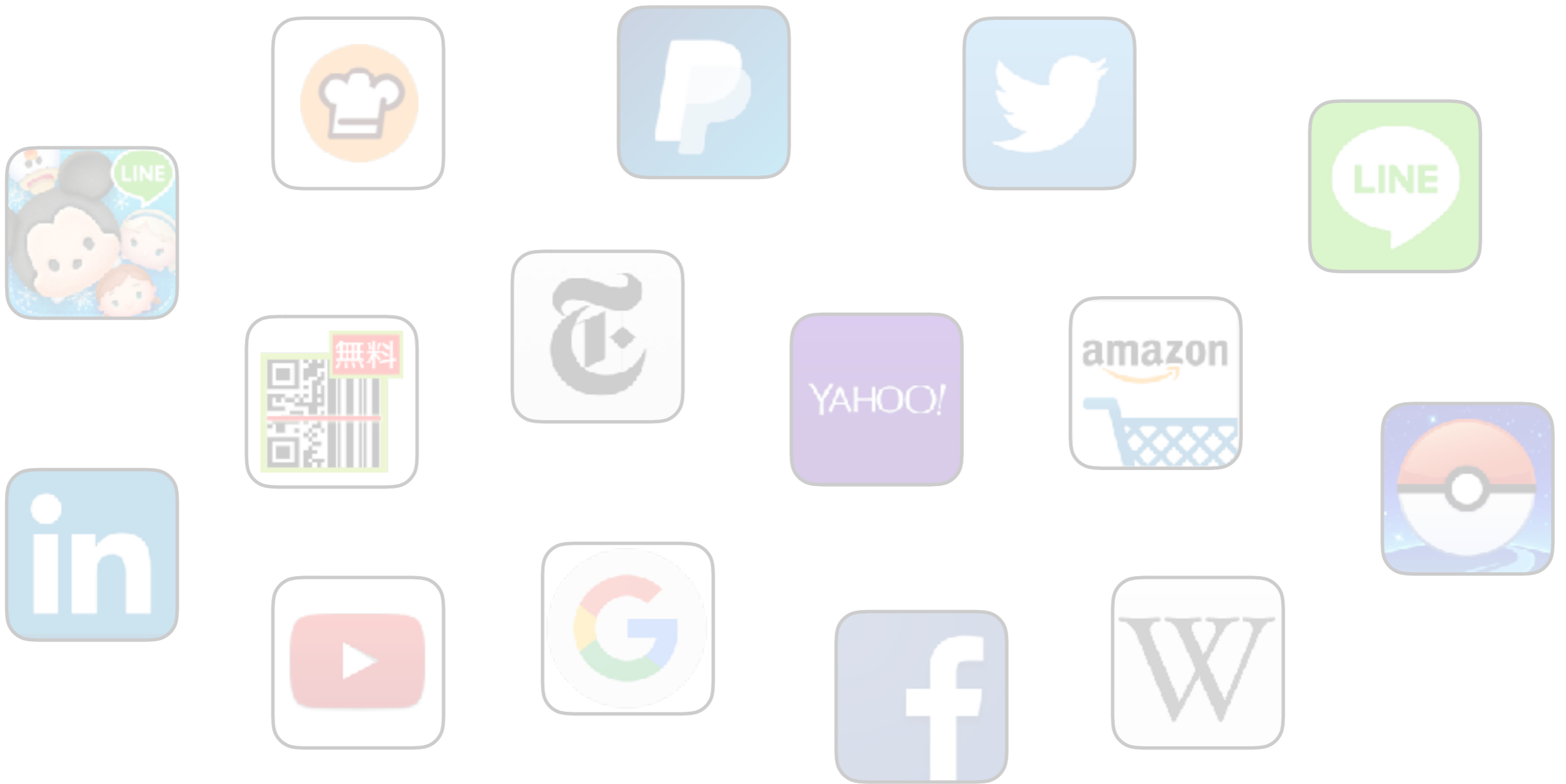
Marcelo d'Amorim



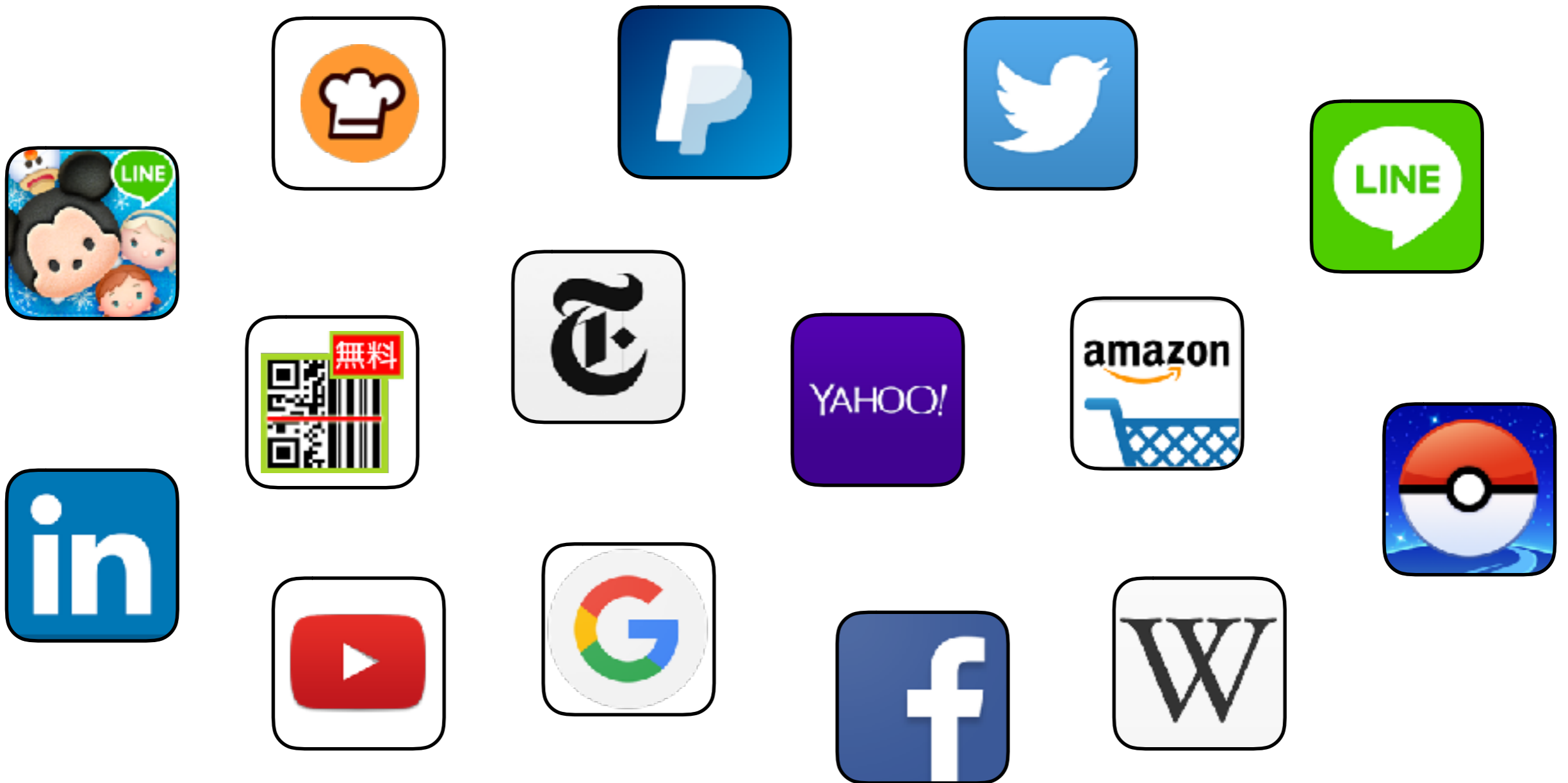
Alessandro Orso



Mobile Applications



Mobile Applications



Failures



Bug Reports

Arkonos commented on Jul 5, 2017

FC upon selecting weekly backup from

Steps to reproduce:
Settings -> Backup -> Backup frequency
100% for me, no other frequency settings
Once after such crash, the app would not
reproduce this.
Pretty sure the same thing happened

Version:
Phone: N
Android
LineageOS
Kernel:3.

Trolldemorted commented on May 19, 2017

I have:

open and closed issues for
<https://github.com/WhisperSys>

Description

es.

```
runtime(30920): Shutting down  
runtime(30920): FATAL EXCEPTION:  
runtime(30920): Process: org  
runtime(30920): java.lang.IllegalStateException  
runtime(30920): at org
```

Onko commented on Mar 24, 2017

<Text paragraph>

<Logcat information>

Steps to reproduce the behavior

1. Start a new post
2. Type something
3. Tap on the Publish button
4. The app crashes

<Text paragraph>

afwang commented on

I found this crash on [v](#)
[redreader_crash_log_f](#)

Reproduction steps:

1. Launch redreader
subscribed subscribed
2. Tap the refresh button in the app bar
3. Swipe down while the subscribed si

I think it might help to reproduce if you'r
speed is throttled.

QuantumBadger added the

Mar 28, 2017

```
runtime(30920): Shutting down  
runtime(30920): FATAL EXCEPTION:  
runtime(30920): Process: org  
runtime(30920): java.lang.IllegalStateException  
runtime(30920): at org
```

Tweet opens with selected account

Actual behavior

Twidere crashes

Steps to reproduce

Longpress retweet icon underneath t



Goal

Arkonos commented on Jul 5, 2017

FC upon selecting weekly backup from

Trolldemorted commented on May 19, 2

I have:

open and closed issues for

Automatically translate descriptions on how to reproduce bugs into test cases

3. Swipe down while the subscribed s

I think it might help to reproduce if you'r speed is throttled.

QuantumBadger added the **Live**

Steps to reproduce

Longpress retweet icon underneath t

Motivating Example

Bug Report

Onko commented on Mar 24, 2017

<Text paragraph>

<Logcat information>

Steps to reproduce the behavior

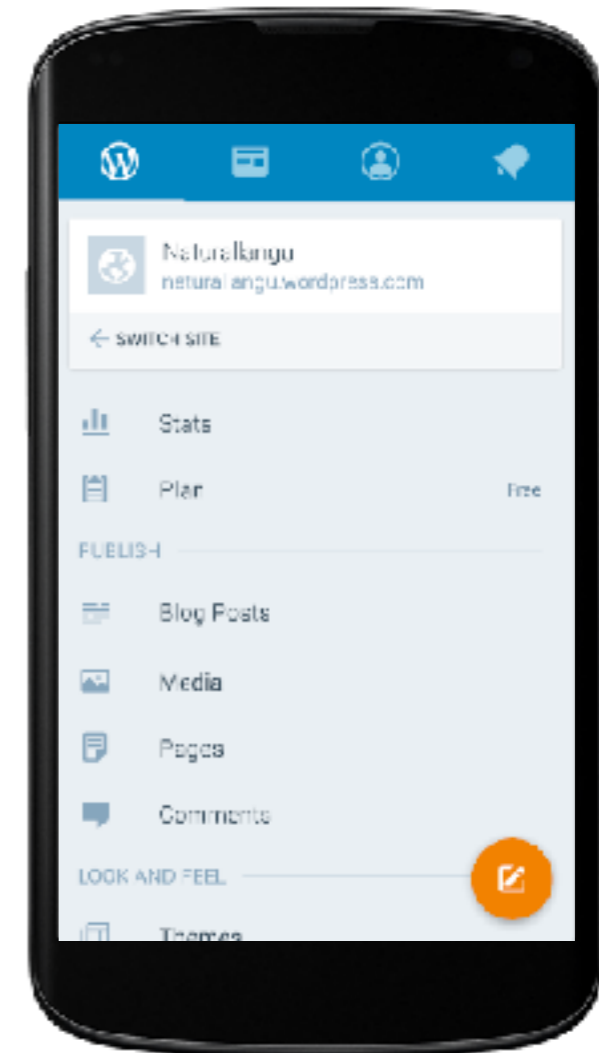
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<Text paragraph>

Developer



WORDPRESS App



Motivating Example

Bug Report

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Steps to reproduce the behavior

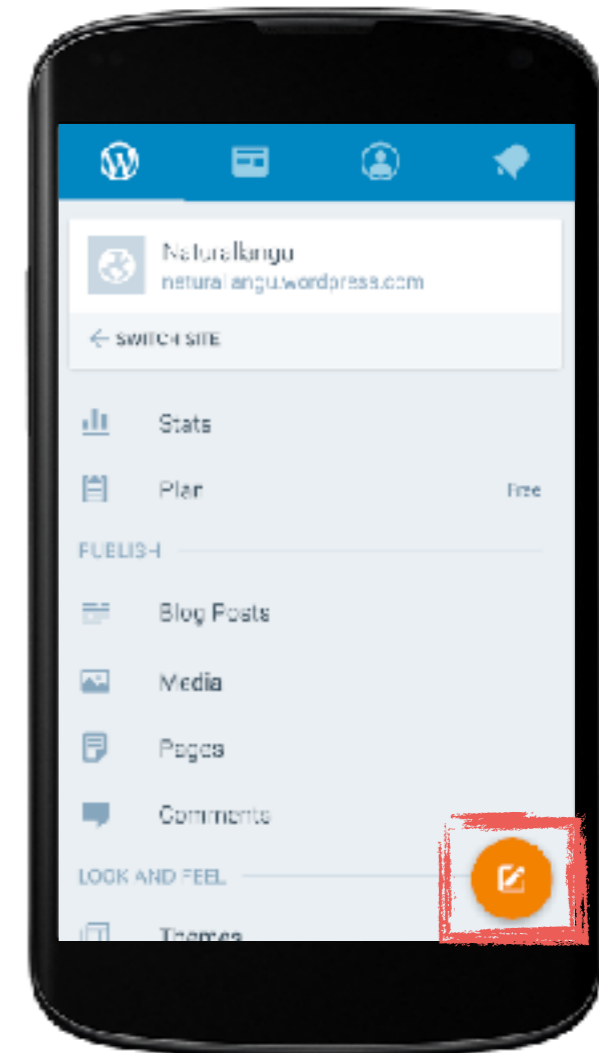
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WORDPRESS App



Motivating Example

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WORDPRESS App



Motivating Example

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WORDPRESS App



Motivating Example

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Steps to reproduce the behavior

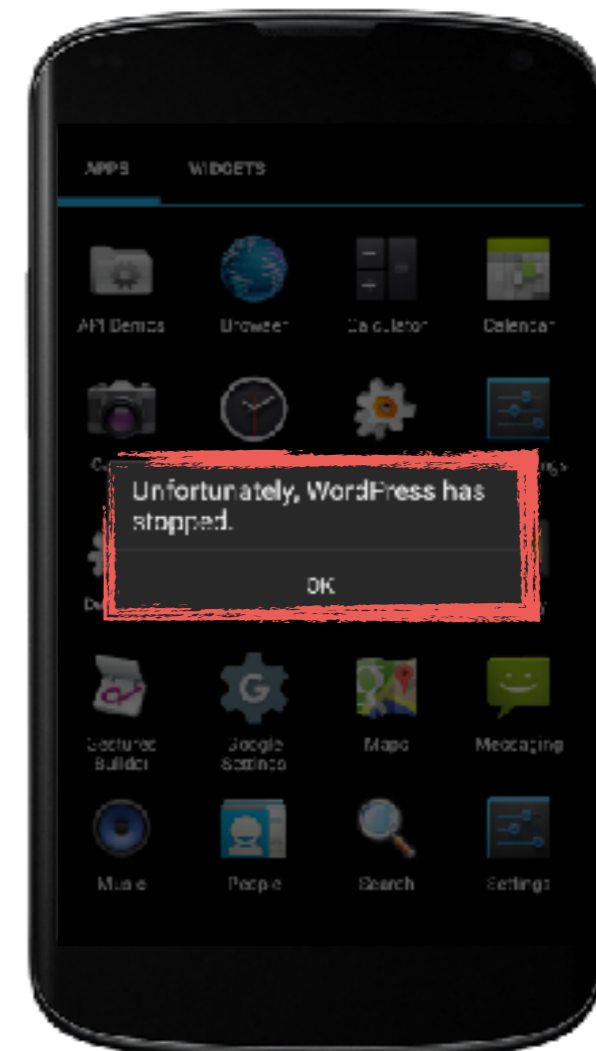
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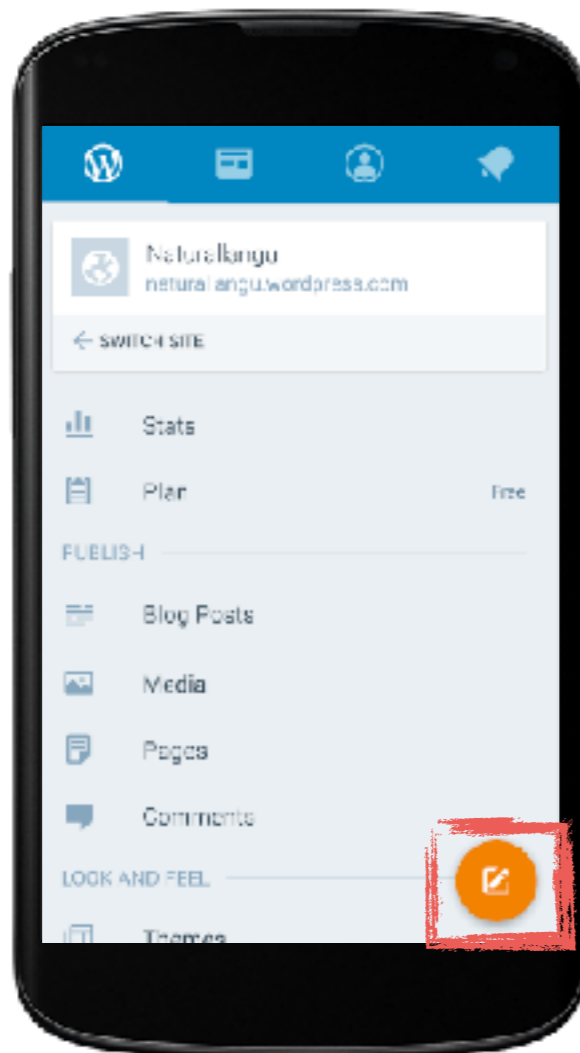


WORDPRESS App



Motivating Example

WORDPRESS App



Developer



Test Case

```
public void test() {  
  
    //start a new post  
    onView(  
        withId(R.id.fab_button))  
        .perform(click());  
  
    //type something  
    onView(  
        withId(R.id.post_title))  
        .perform(typeText("GrbcVK9I"));  
  
    //tap on the publish button  
    onView(  
        withId(R.id.menu_save_post))  
        .perform(click());  
}
```

Motivating Example

WORDPRESS App



Developer

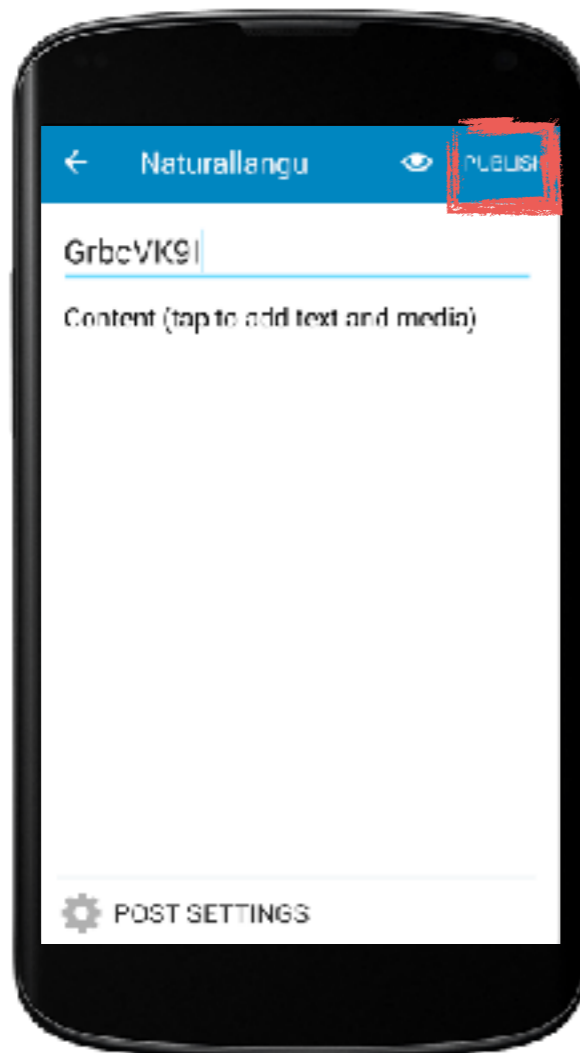


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Motivating Example

WORDPRESS App



Developer



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Motivating Example

Bug Report

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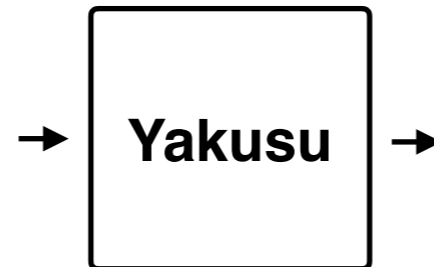
<Text paragraph>

<Logcat information>

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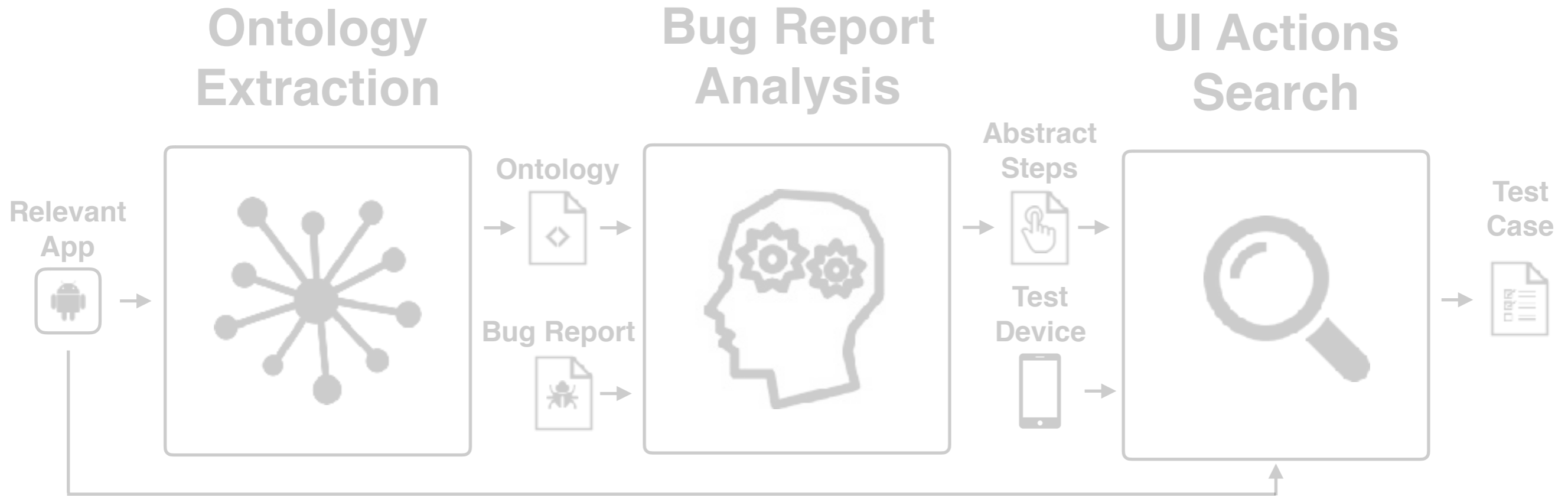
<Text paragraph>



Test Case

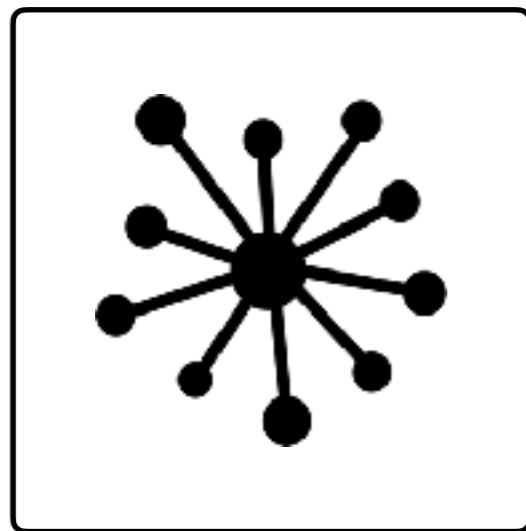
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```

Yakusu Overview



Yakusu Overview

Ontology Extraction



Relevant App



Ontology



Bug Report



Bug Report Analysis



Abstract Steps



Test Device



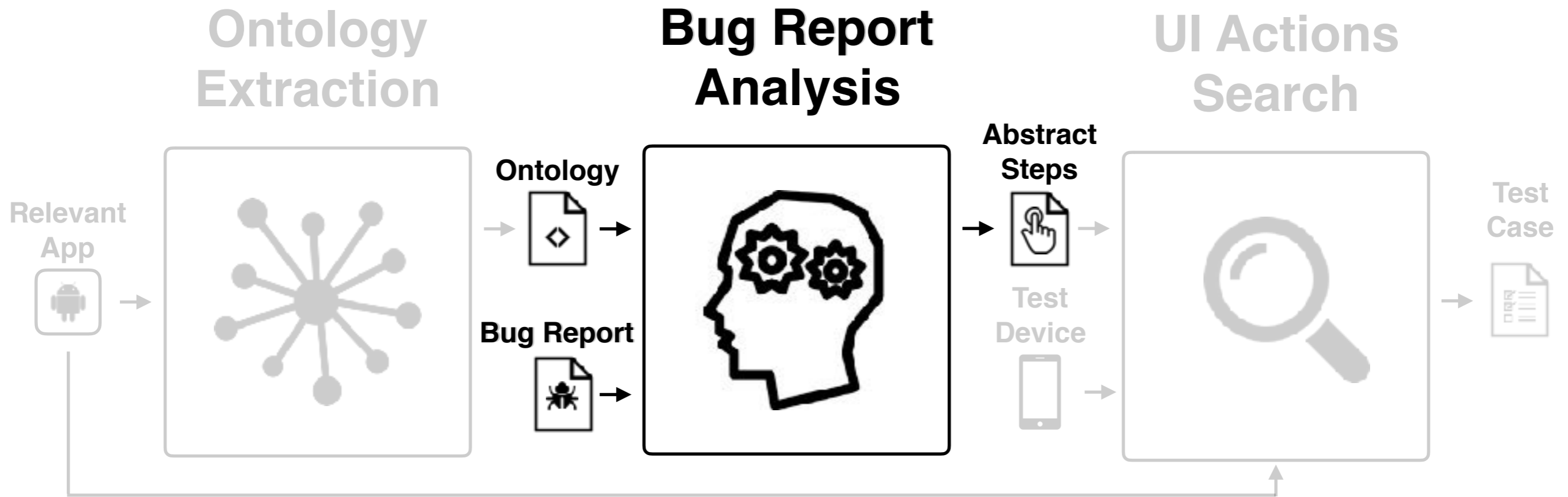
UI Actions Search



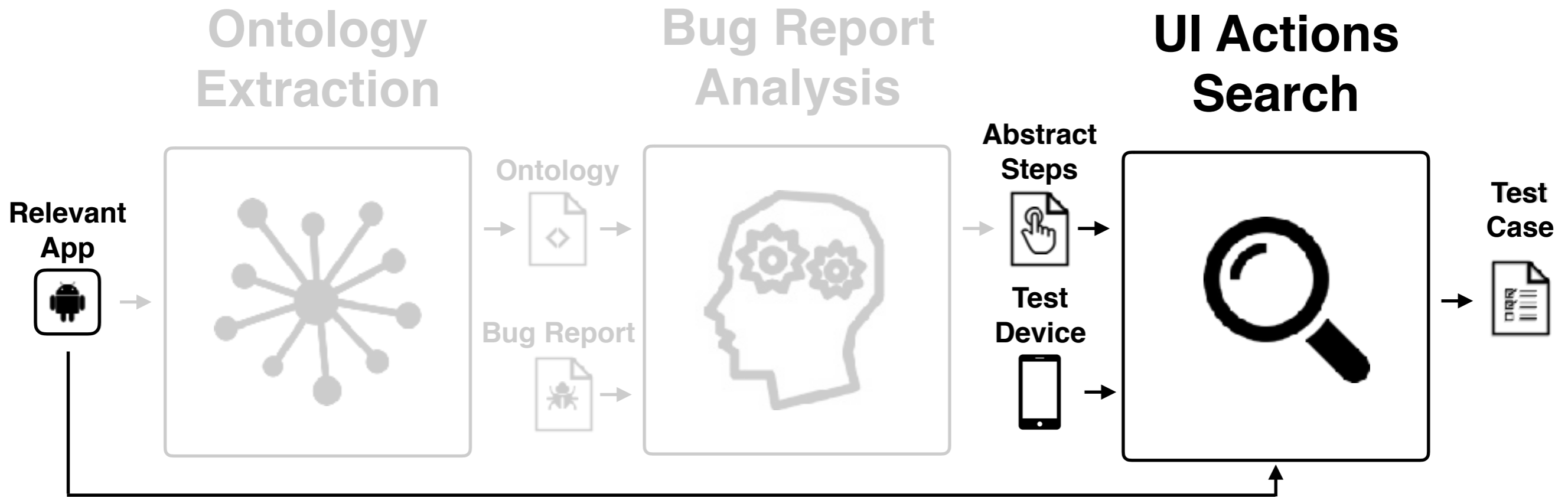
Test Case



Yakusu Overview



Yakusu Overview



Ontology Extraction

Relevant App



Ontology



UI Element Properties



Example



GrbcVK9I

Content (tap to add text and media)

Ontology Extraction

Relevant App



Ontology



UI Element Properties

< label , icon , identifier >

Example



< Publish , , menu save post >

GrbcVK9I

Content (tap to add text and media)

Ontology Extraction

Relevant App



Ontology



UI Element Properties



Example

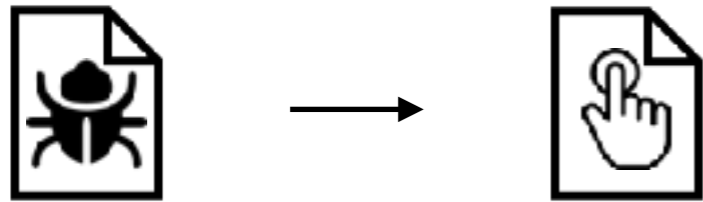


GrbcVK9I

Content (tap to add text and media)

Bug Report Analysis

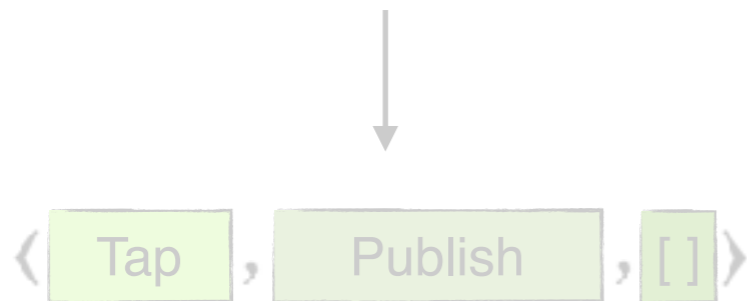
Bug Report Abstract Steps



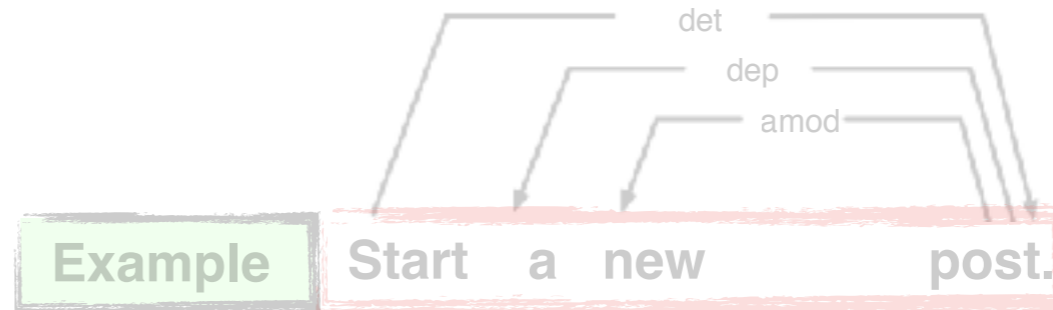
Abstract Step



Dependency Tree (Case #1)



Dependency Tree (Case #2)

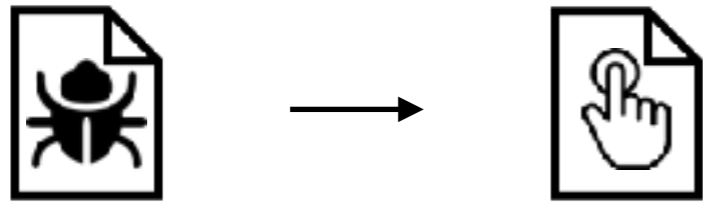


Ontology



Bug Report Analysis

Bug Report Abstract Steps



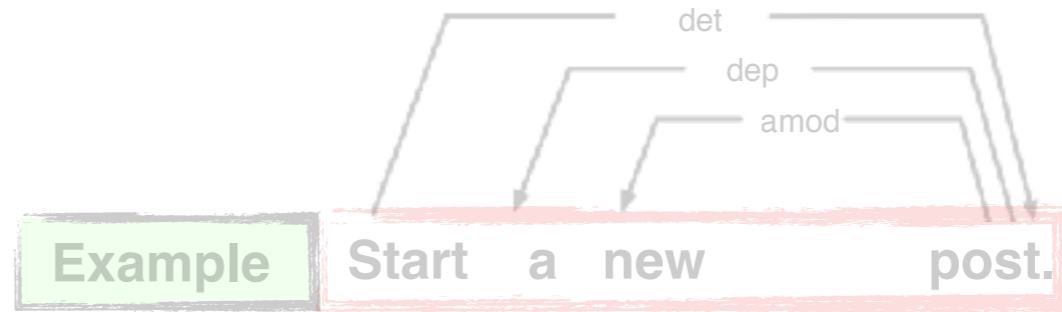
Abstract Step



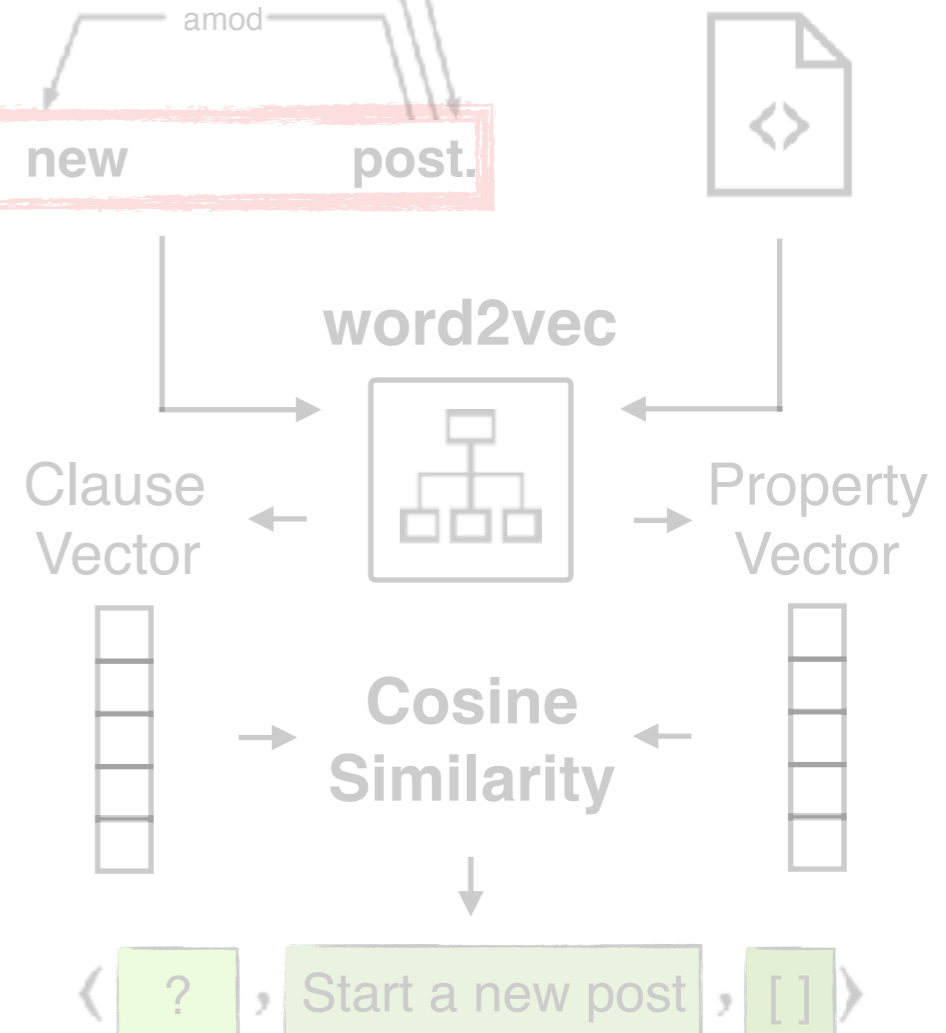
Dependency Tree (Case #1)



Dependency Tree (Case #2)

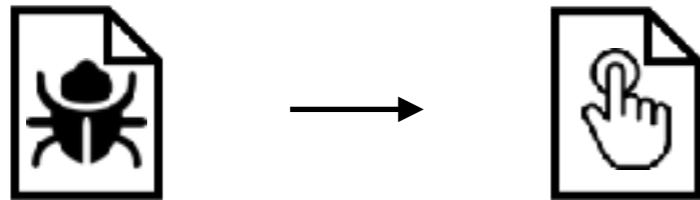


Ontology



Bug Report Analysis

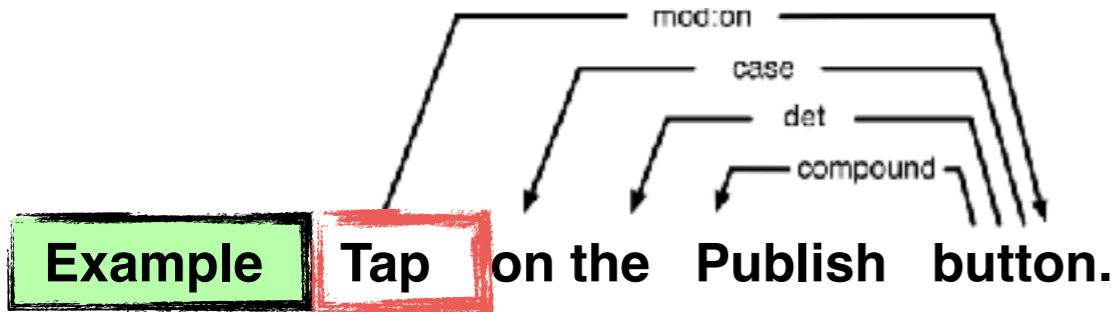
Bug Report Abstract Steps



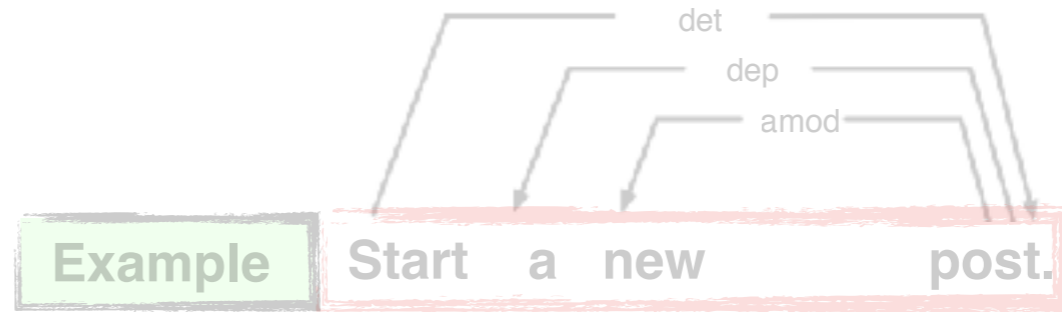
Abstract Step



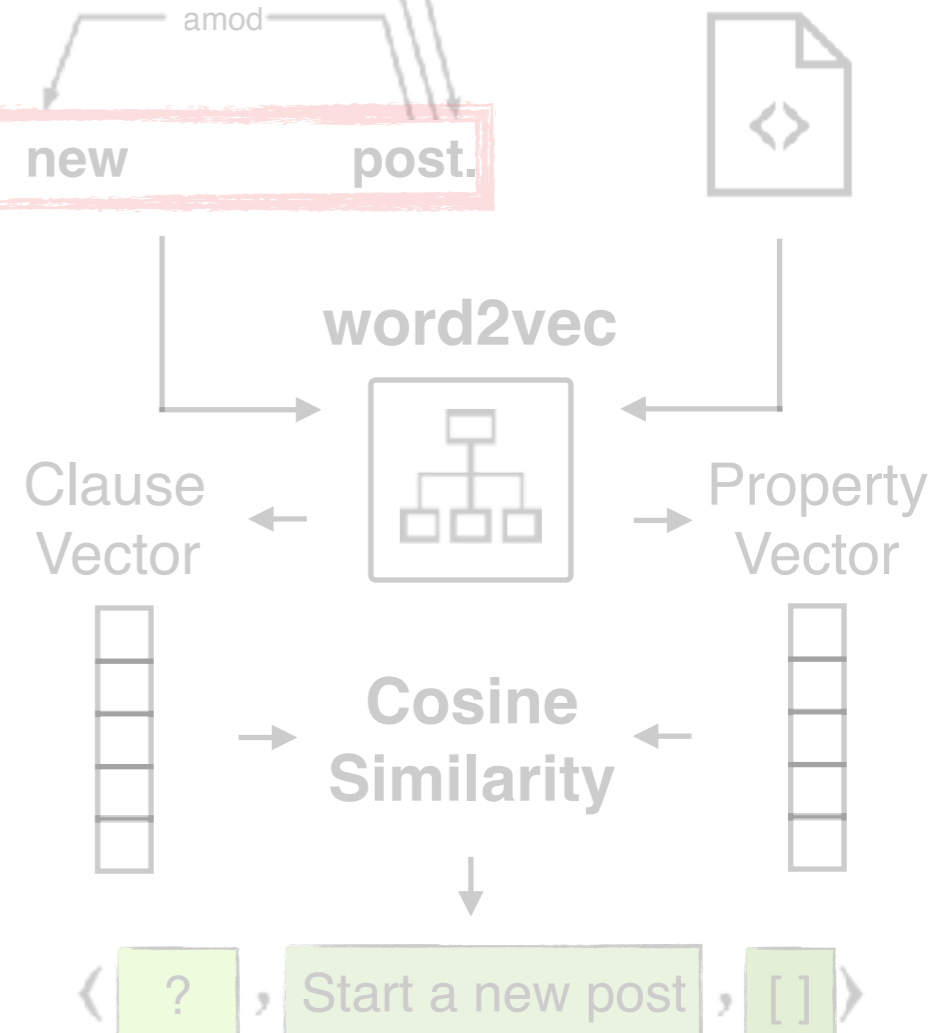
Dependency Tree (Case #1)



Dependency Tree (Case #2)

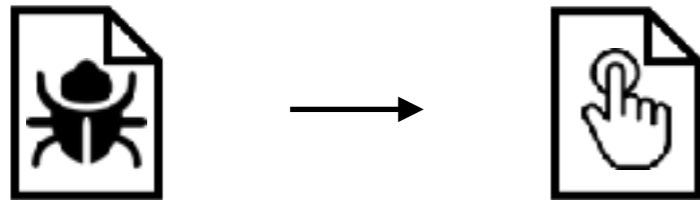


Ontology



Bug Report Analysis

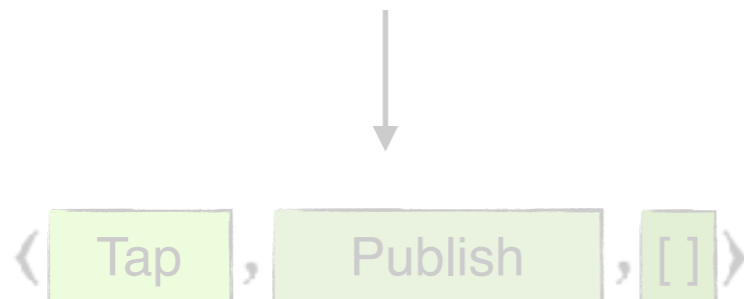
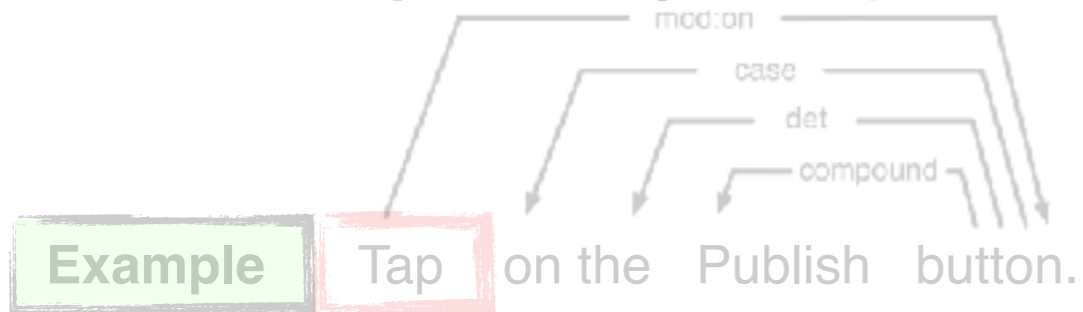
Bug Report Abstract Steps



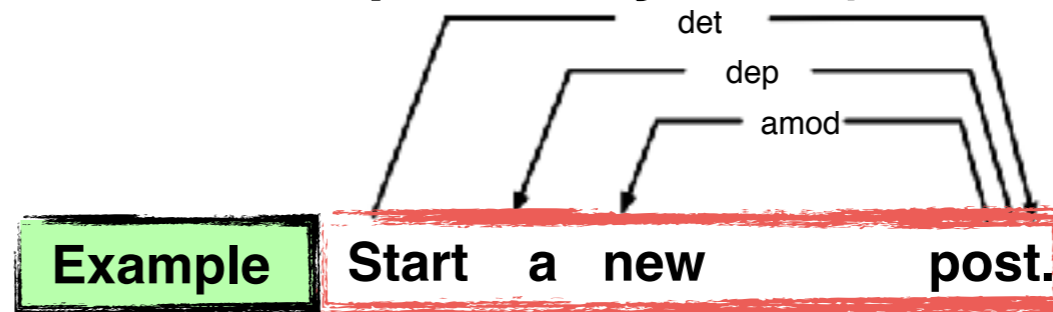
Abstract Step



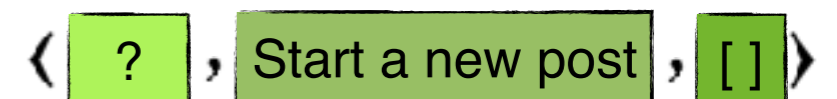
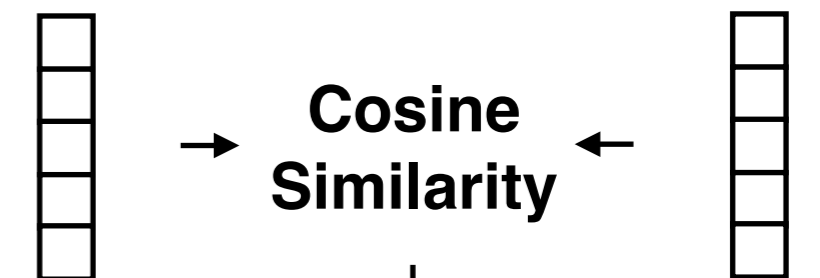
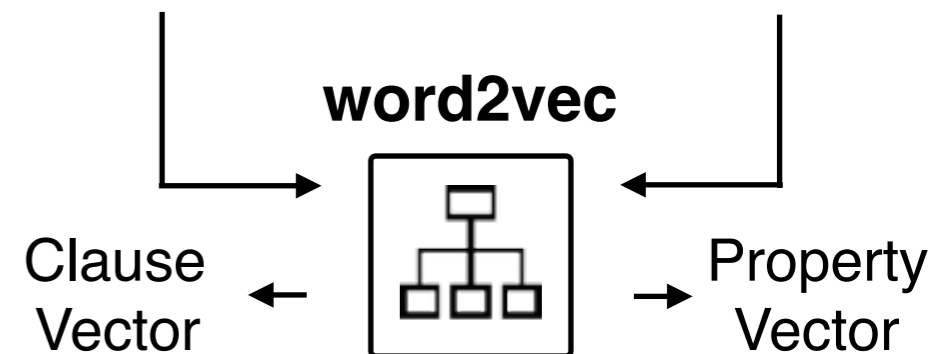
Dependency Tree (Case #1)



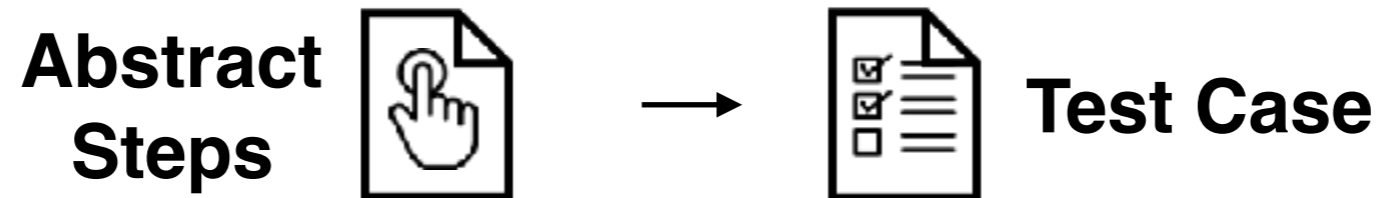
Dependency Tree (Case #2)



Ontology



UI Actions Search

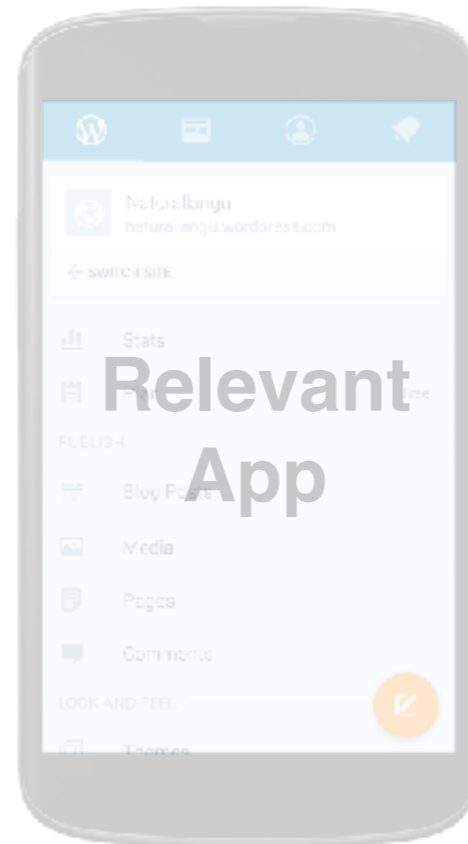


Abstract Step

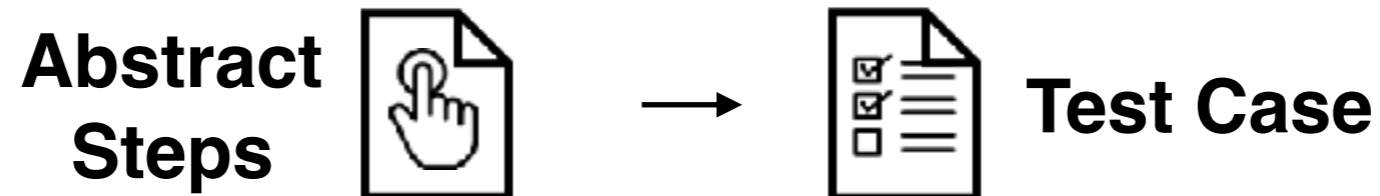
UI Action



Test Device

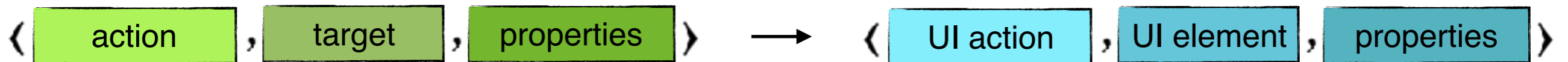


UI Actions Search

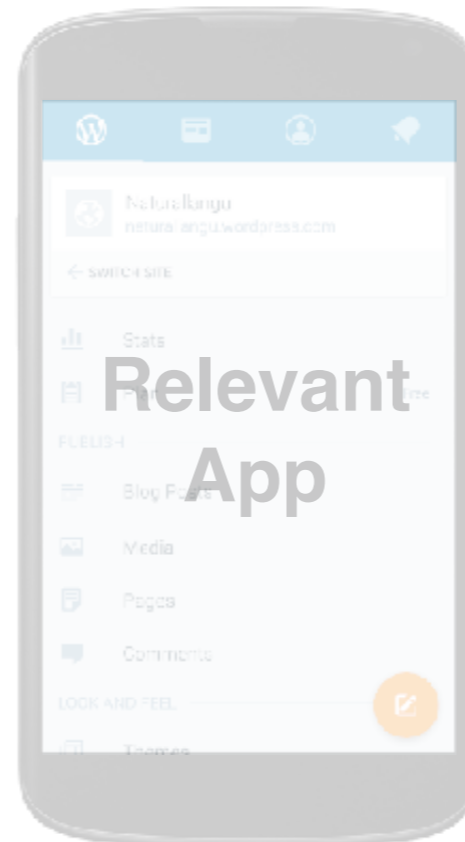


Abstract Step

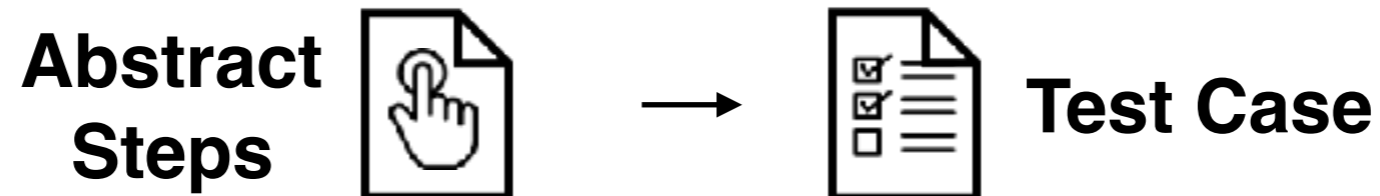
UI Action



Test Device

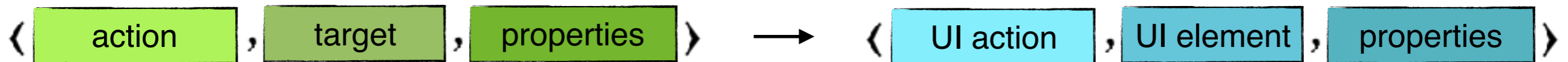


UI Actions Search

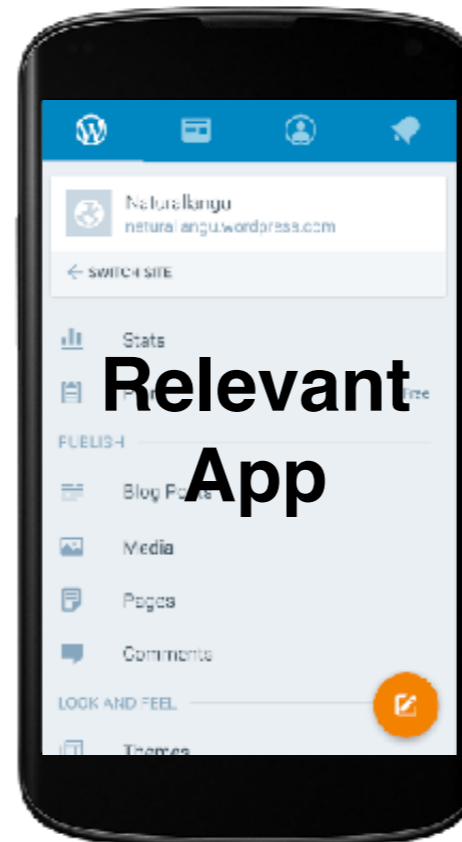


Abstract Step

UI Action



Test Device

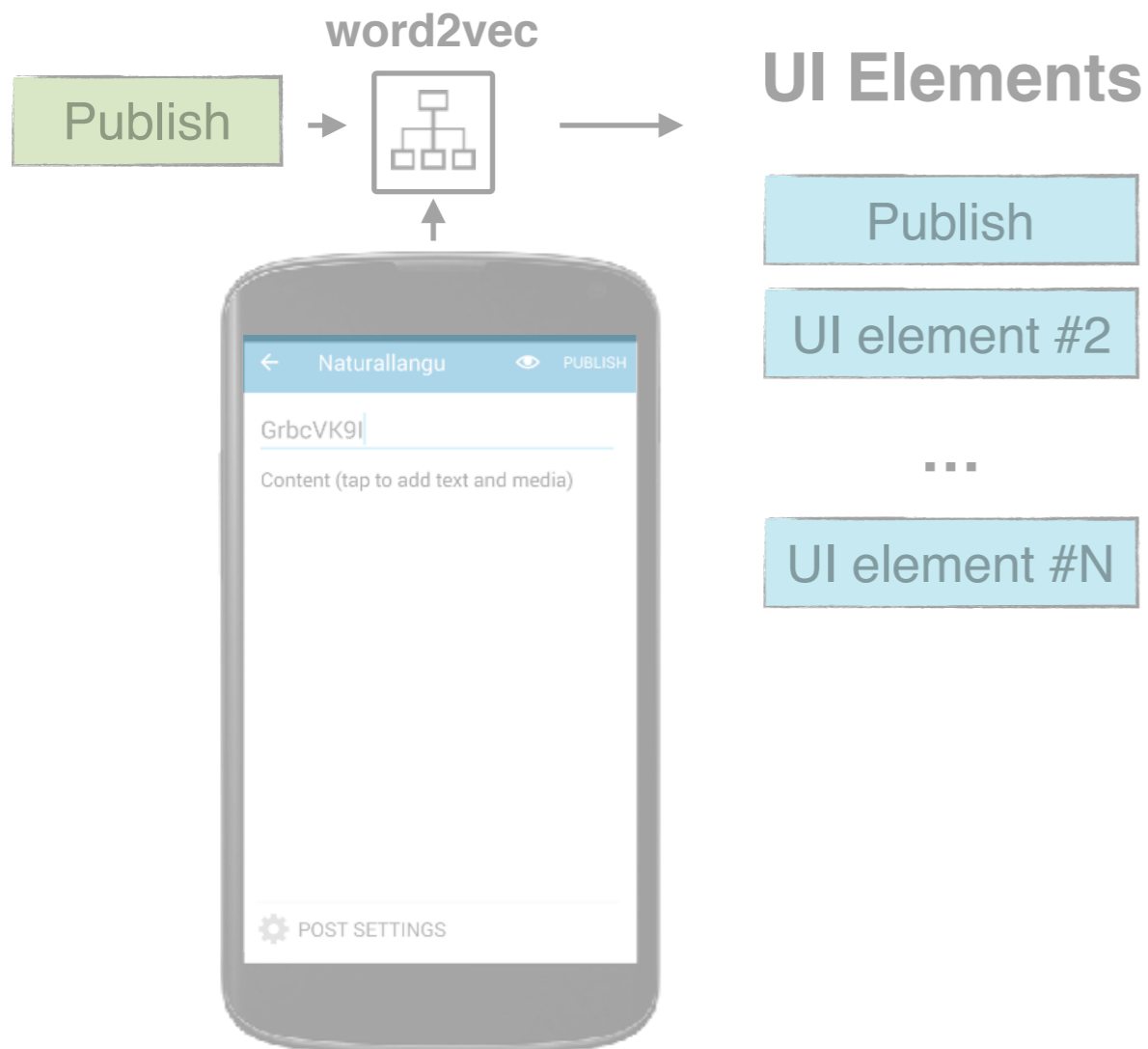


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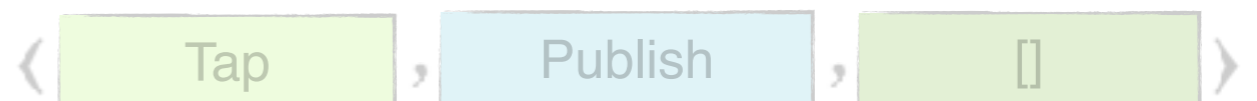
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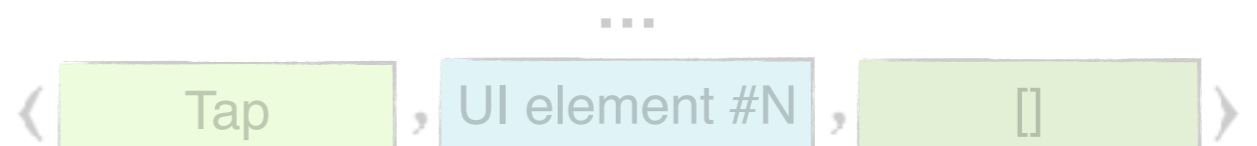
Find UI Element



Current Execution



Forked Executions



Random UI Action Generation

UI Actions Search

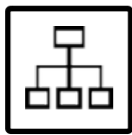
Abstract Step



Find UI Element

word2vec

Publish



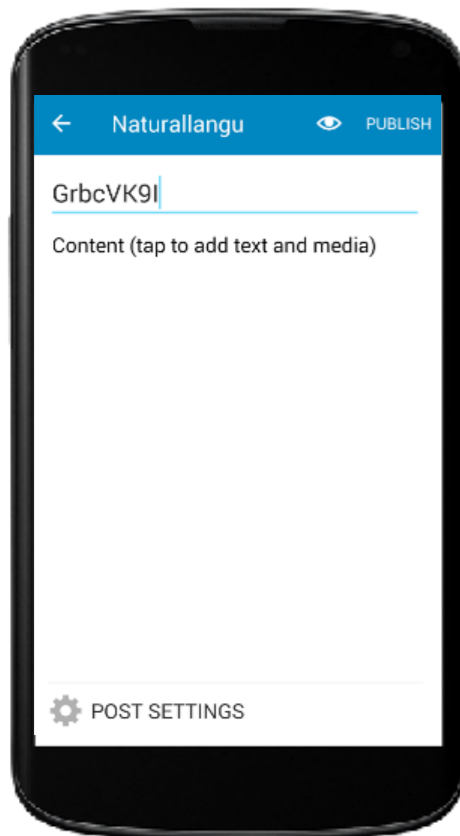
UI Elements

Publish

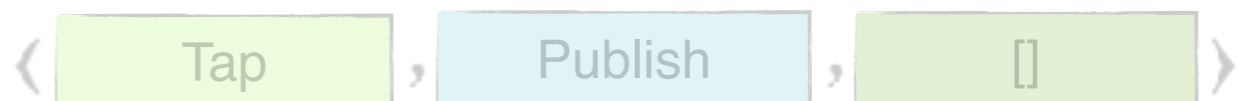
UI element #2

...

UI element #N



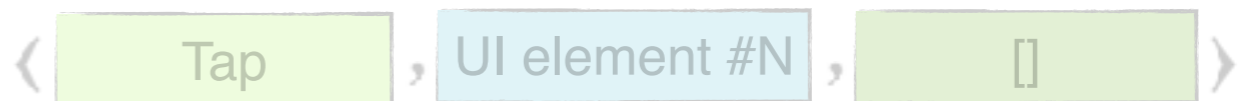
Current Execution



Forked Executions



...



Random UI Action Generation

UI Actions Search

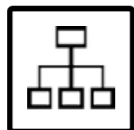
Abstract Step



Find UI Element

word2vec

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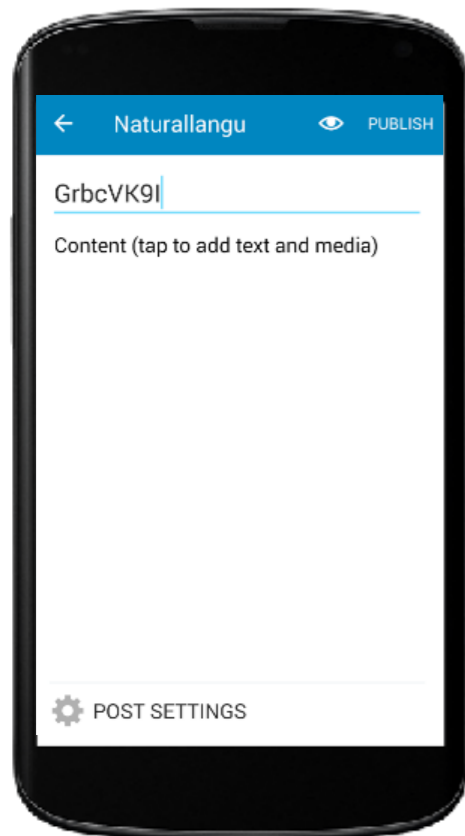
UI Elements

Publish

UI element #2

...

UI element #N



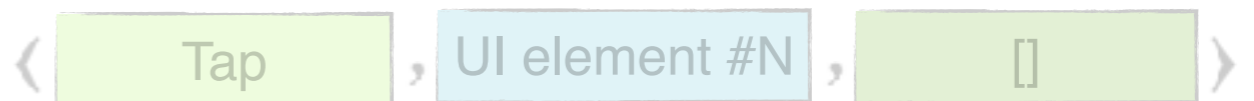
Current Execution



Forked Executions



...



Random UI Action Generation

UI Actions Search

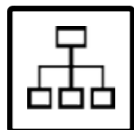
Abstract Step



Find UI Element

word2vec

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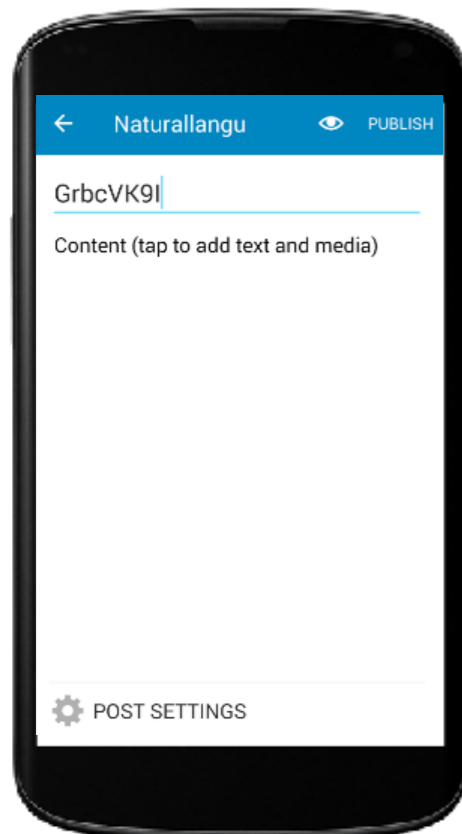
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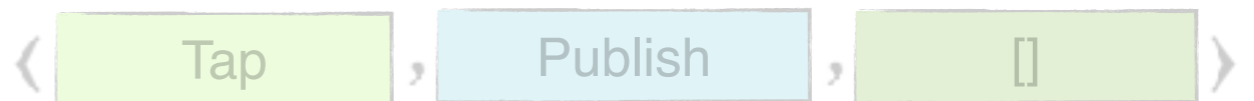
UI element #2

...

UI element #N



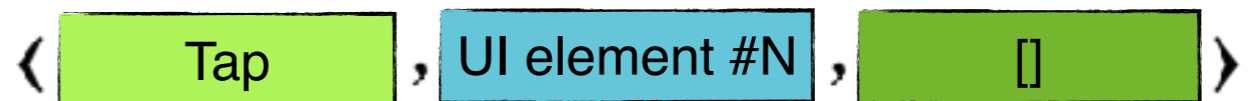
Current Execution



Forked Executions



...



Random UI Action Generation

UI Actions Search

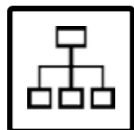
Abstract Step



Find UI Element

word2vec

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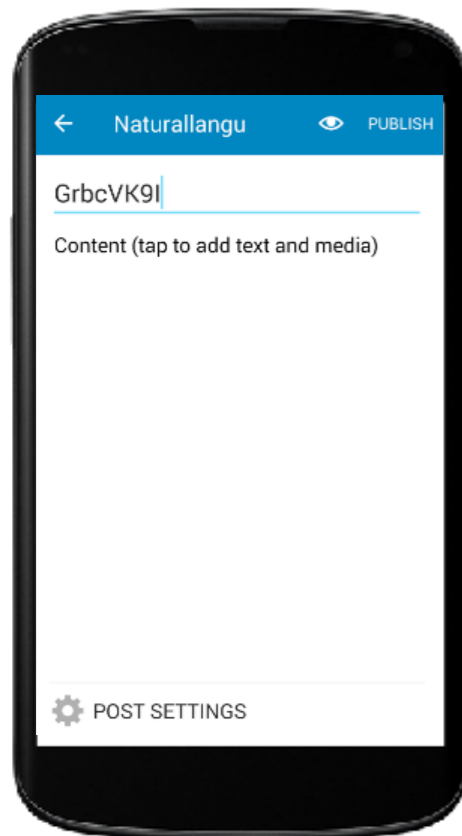
UI Elements

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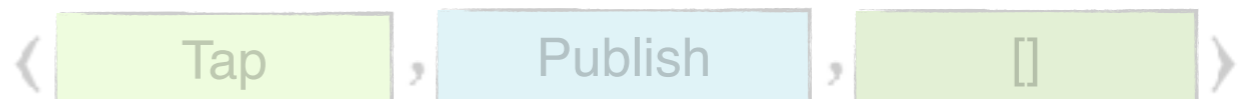
UI element #2

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UI element #N



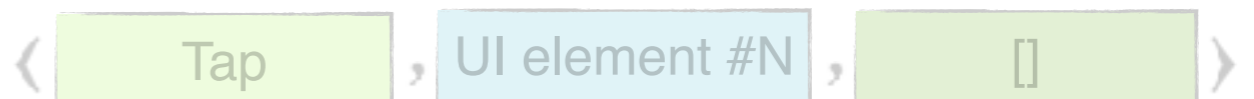
Current Execution



Forked Executions



...



Random UI Action Generation

UI Actions Search

UI Actions

“Start a new post”



“Type something”



“Tap on the publish button”



Test Case

```
public void test() {  
  
    //start a new post  
    onView(  
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    //type something  
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Empirical Evaluation

Research Questions:

RQ1: Can YAKUSU translate bug reports written in natural language into executable test cases?

RQ2: What is the cost of running YAKUSU?

Empirical Evaluation

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RQ1: Can YAKUSU translate bug reports written in natural language into executable test cases?

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Empirical Evaluation

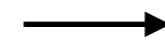
Research Questions:

RQ1: Can YAKUSU translate bug reports written in natural language into executable test cases?

RQ2: What is the cost of running YAKUSU?

Benchmarks and Setup

GitHub



Bug Report



x 100

Could not
Build



x 9

Could not
Reproduce Manually



x 29

Available
Reports



x 62

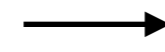
Successfully
Generated Tests



x 37

Benchmarks and Setup

GitHub



Bug Report



x 100

**Could not
Build**



x 9

**Could not
Reproduce Manually**



x 29

Available
Reports



x 62

Successfully
Generated Tests



x 37

Benchmarks and Setup

GitHub



Bug Report



x 100

**Could not
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**Could not
Reproduce Manually**



x 29

**Available
Reports**



x 62

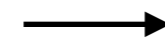
**Successfully
Generated Tests**



x 37

Benchmarks and Setup

GitHub



Bug Report



x 100

**Could not
Build**



x 9

**Could not
Reproduce Manually**



x 29

**Available
Reports**



x 62

**Successfully
Generated Tests**



x 37

RQ1

ID	Name	Actions		Steps		Search				Tests	
		A_e	A_i	AS	AS_g	S_g	S_p	H	R	TC_s	TC_a
01	TACHIYOMI	4	1	-	4	10	1	1	-	5	-
03	TWIDERE	2	-	2	-	12	1	-	-	2	-
05	SIGNAL	1	-	1	-	2	1	-	-	1	-
08	REDREADER	2	-	2	2	5	1	-	-	4	2
14	SILENCE	1	-	1	-	2	1	-	-	1	-
23	K-9 MAIL	3	-	3	-	8	1	-	-	3	-
25	NEXTCLOUD	1	2	1	-	1	1	1	1	3	-
27	BUTTERKNIFE	1	-	1	-	3	1	-	-	1	-
35	ODK COLLECT	2	-	1	4	11	3	-	-	2	-
39	PIX-ART MESSENGER	3	-	3	-	2	1	-	-	3	-
40	YALP STORE	5	-	4	1	11	1	-	-	5	-
50	OCREADER	3	-	3	-	8	2	-	-	3	-
51	WORDPRESS	3	-	2	1	2	1	-	-	3	-
52	SIGNAL	2	1	2	-	3	1	-	4	6	3
57	OPEN EVENT	1	1	1	1	3	2	1	-	2	-
68	TAGMO	1	1	1	1	10	1	-	3	4	2
69	ANKIDROID	5	-	5	-	8	1	-	-	5	-
73	K-9 MAIL	2	-	2	-	6	3	-	-	2	-
74	CLUTTR	2	-	2	-	6	1	-	-	2	-
78	NEXTCLOUD	2	1	2	-	1	1	1	-	3	-
84	K-9 MAIL	1	-	-	1	2	1	-	-	1	-
95	MIFOSX	2	3	2	-	3	1	1	2	5	-
96	SCREENRECORDER	3	2	3	-	1	1	2	-	5	-
97	NEXTCLOUD	1	1	-	2	4	2	1	-	2	-
99	FLASHCARDS	3	-	2	1	6	2	-	3	4	1

RQ1

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01	TACHIYOMI	4	1	-	4	10	1	1	-	5	-
03	TWIDERE	2	-	2	-	12	1	-	-	2	-
05	SIGNAL	1	-	1	-	2	1	-	-	1	-
08	REDREADER	2	-	2	2	5	1	-	-	4	2
14	SILENCE	1	-	1	-	2	1	-	-	1	-
23	K-9 MAIL	3	-	3	-	8	1	-	-	3	-
25	NEXTCLOUD	1	2	1	-	1	1	1	1	3	-
27	BUTTERKNIFE	1	-	1	-	3	1	-	-	1	-
35	ODK COLLECT	2	-	1	4	11	3	-	-	2	-
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40	YALP STORE	5	-	4	1	11	1	-	-	5	-
50	OCREADER	3	-	3	-	8	2	-	-	3	-
51	WORDPRESS	3	-	2	1	2	1	-	-	3	-
52	SIGNAL	2	1	2	-	3	1	-	4	6	3
57	OPEN EVENT	1	1	1	1	3	2	1	-	2	-
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7 bug reports had at least one step without explicit action

19 bug reports reproduced exploring only one execution

6 bug reports reproduced exploring more than one execution

4 test cases with additional actions

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01	TACHIYOMI	4	1	-	4	10	1	1	-	5	-
03	TWIDERE	2	-	2	-	12	1	-	-	2	-

RQ1: Can YAKUSU translate bug reports written in natural language into executable test cases?

We consider the results encouraging as YAKUSU is already able to generate test cases for a good number of bug reports.

78	NEXTCLOUD	2	1	2	-	1	1	1	-	3	-
84	K-9 MAIL	1	-	-	1	2	1	-	-	1	-
95	MIFOSX	2	3	2	-	3	1	1	2	5	-
96	SCREENRECORDER	3	2	3	-	1	1	2	-	5	-
97	NEXTCLOUD	1	1	-	2	4	2	1	-	2	-
99	FLASHCARDS	3	-	2	1	6	2	-	3	4	1

Future Work

Extend ontology

Learn macro-step associated with the app

Interpret non-crashing failures from bug reports

Generate test cases from written/spoken test specifications

Identify duplicate bug reports

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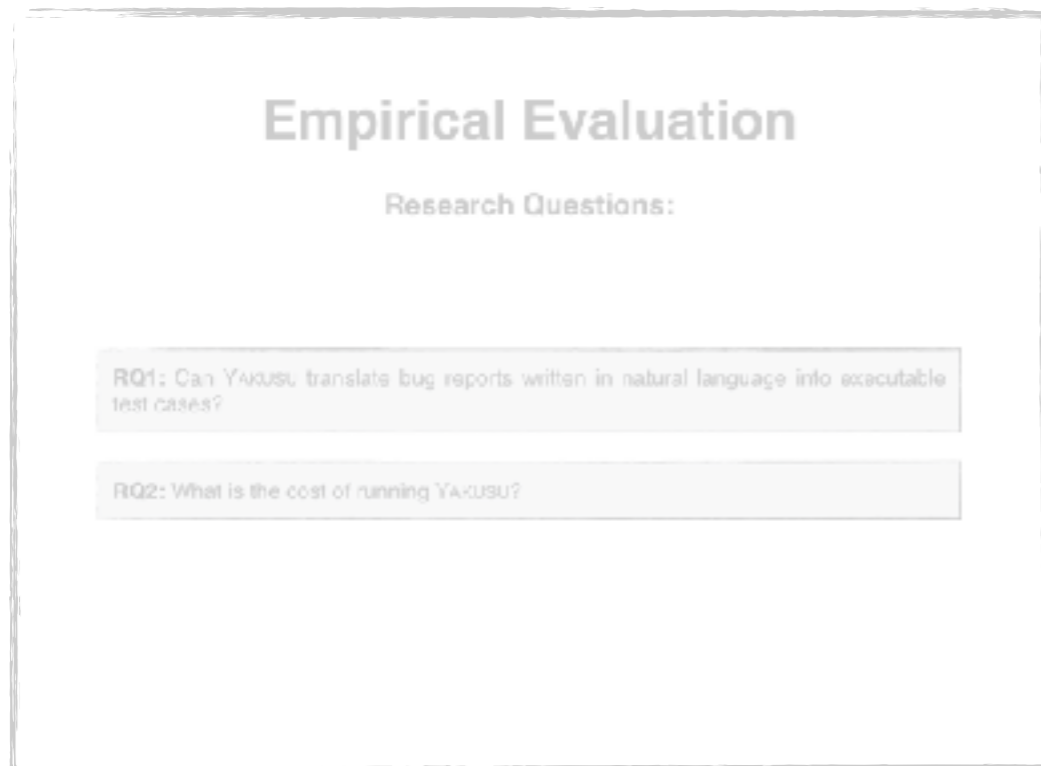
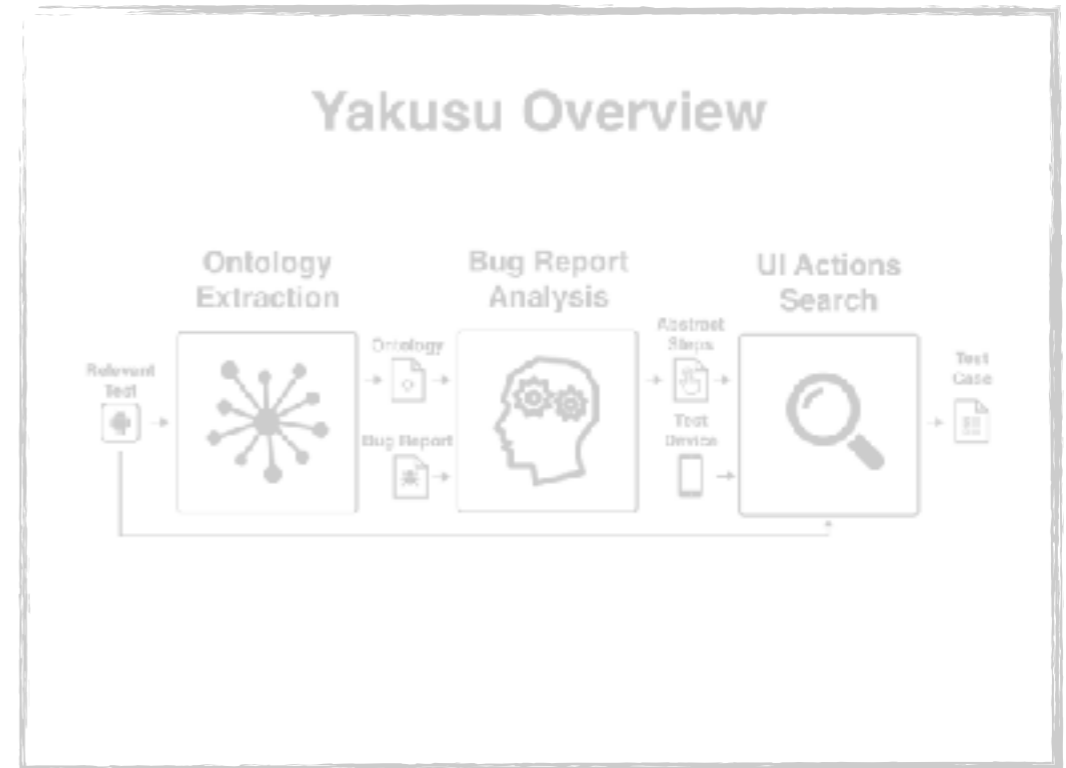
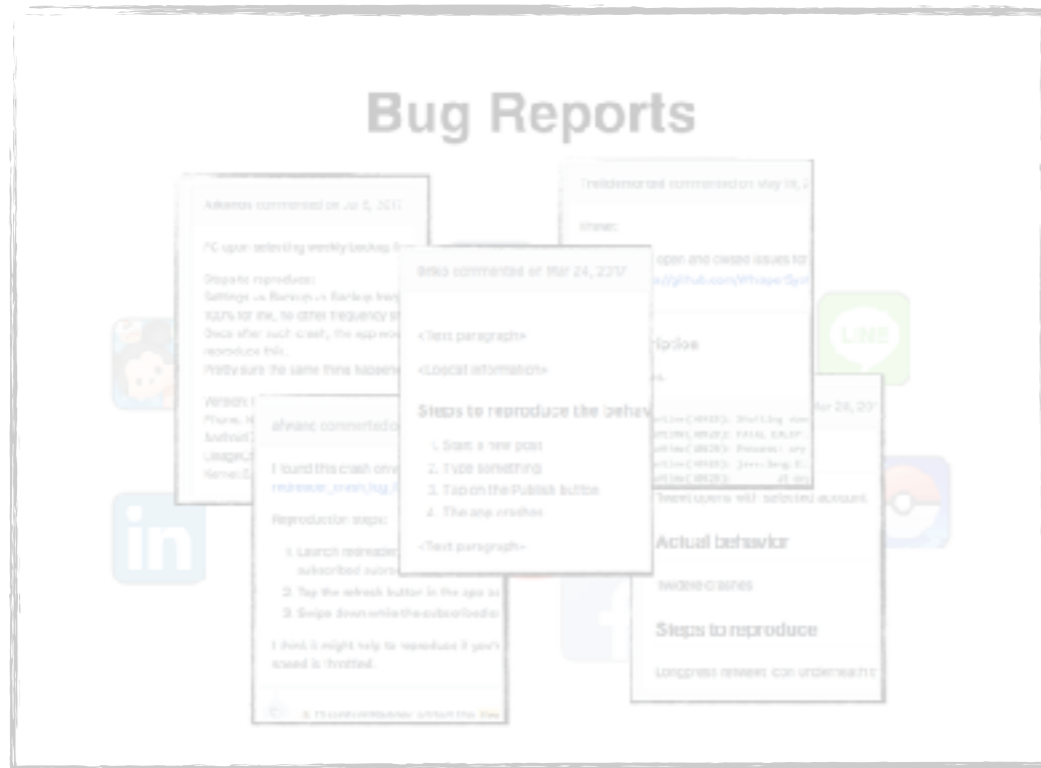
Learn macro-step associated with the app

Interpret non-crashing failures from bug reports

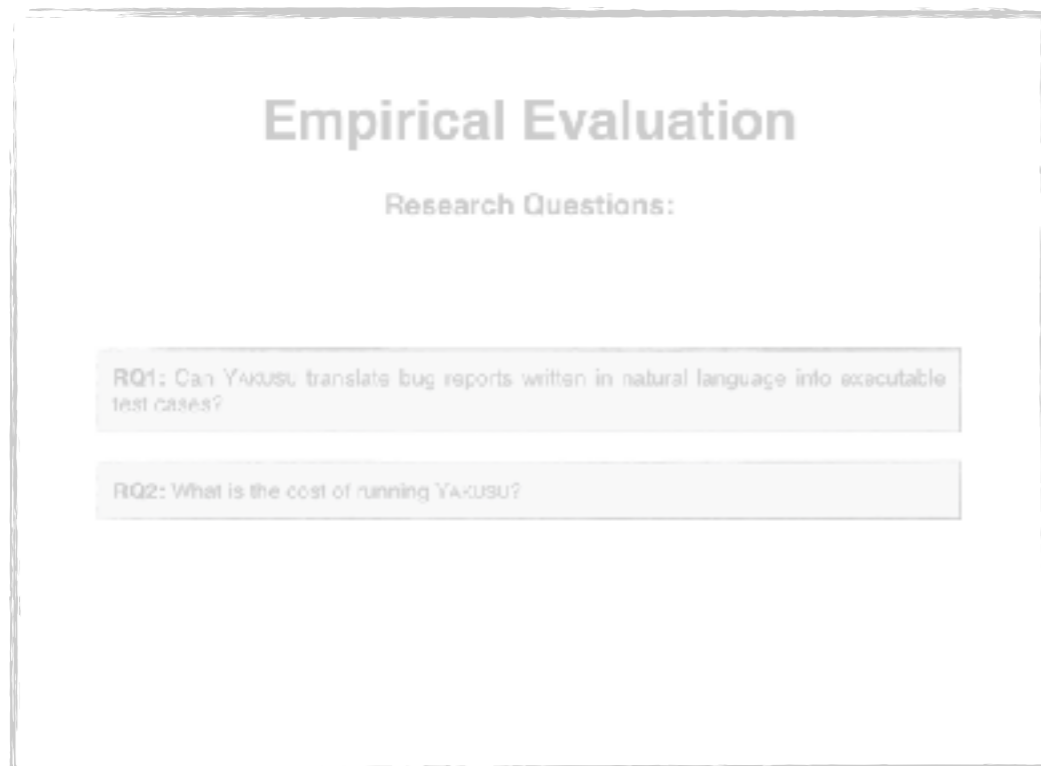
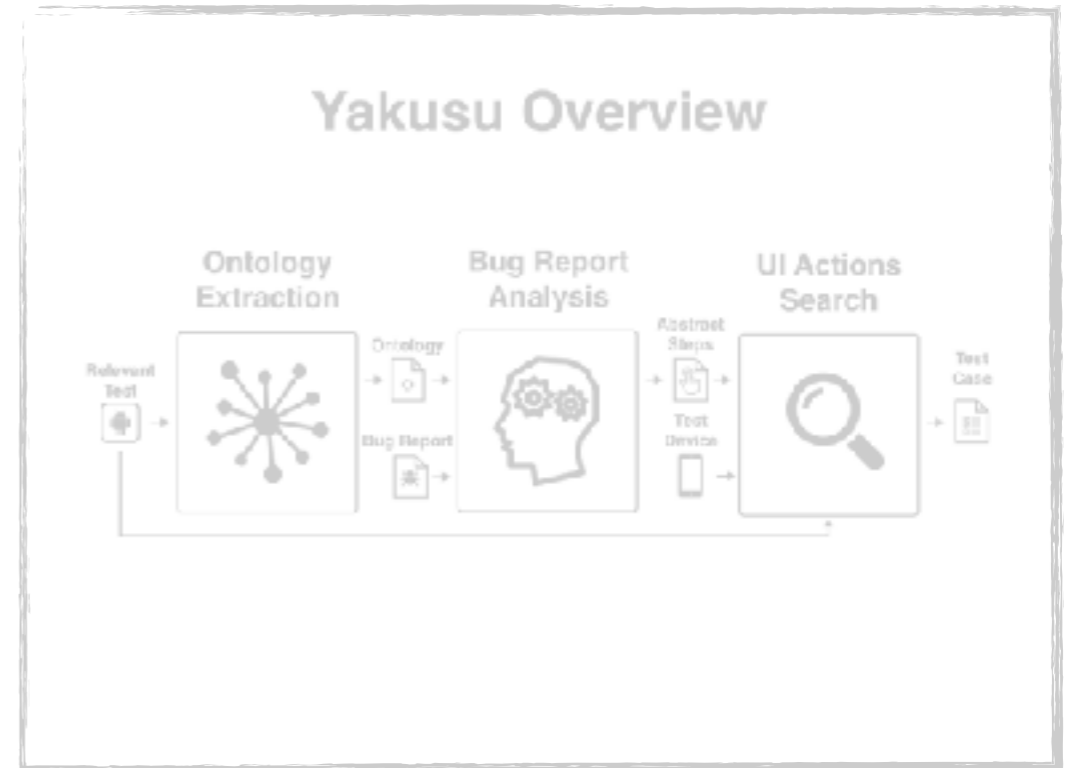
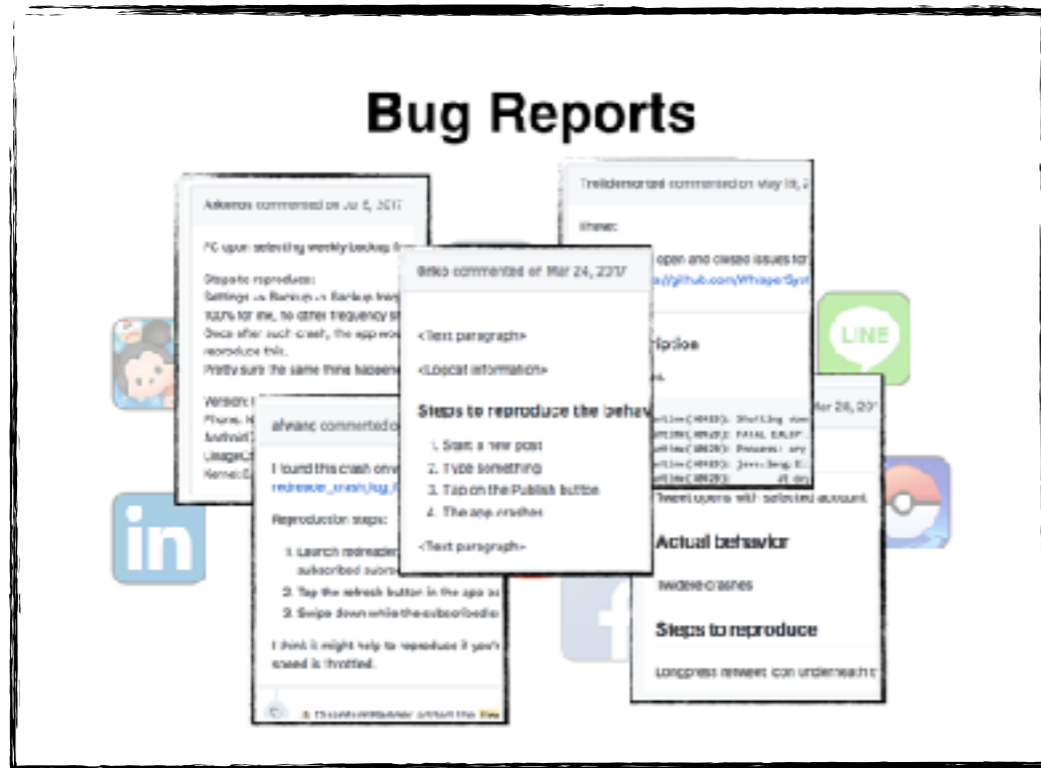
Generate test cases from written/spoken test specifications

Identify duplicate bug reports

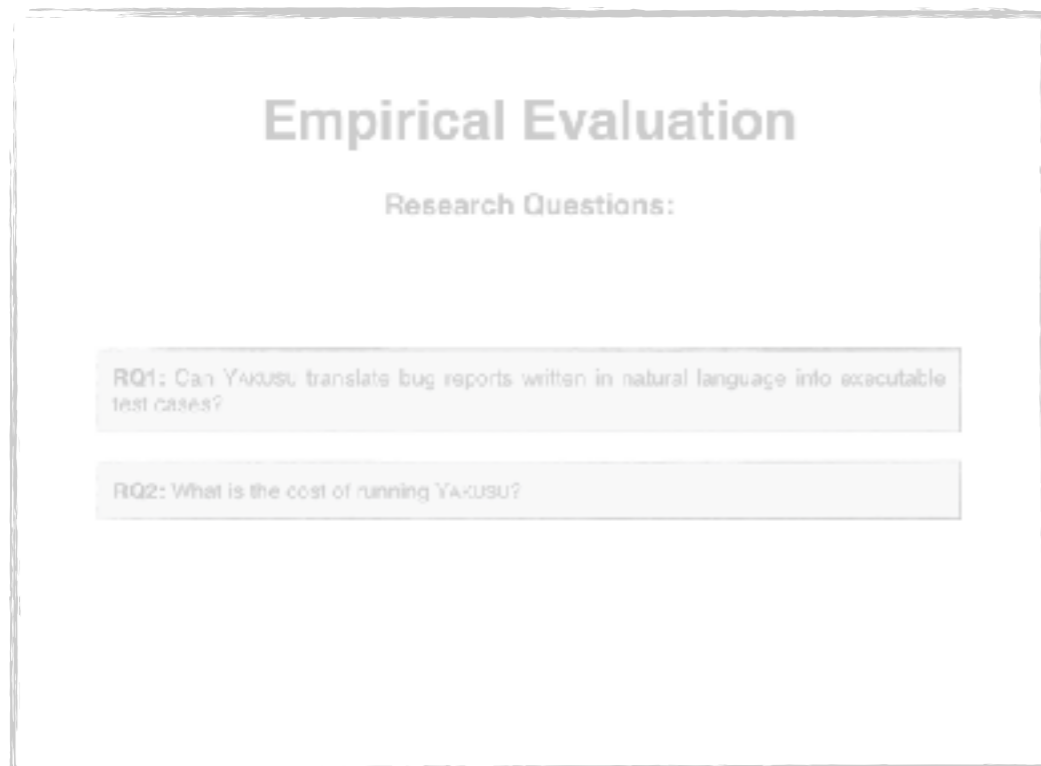
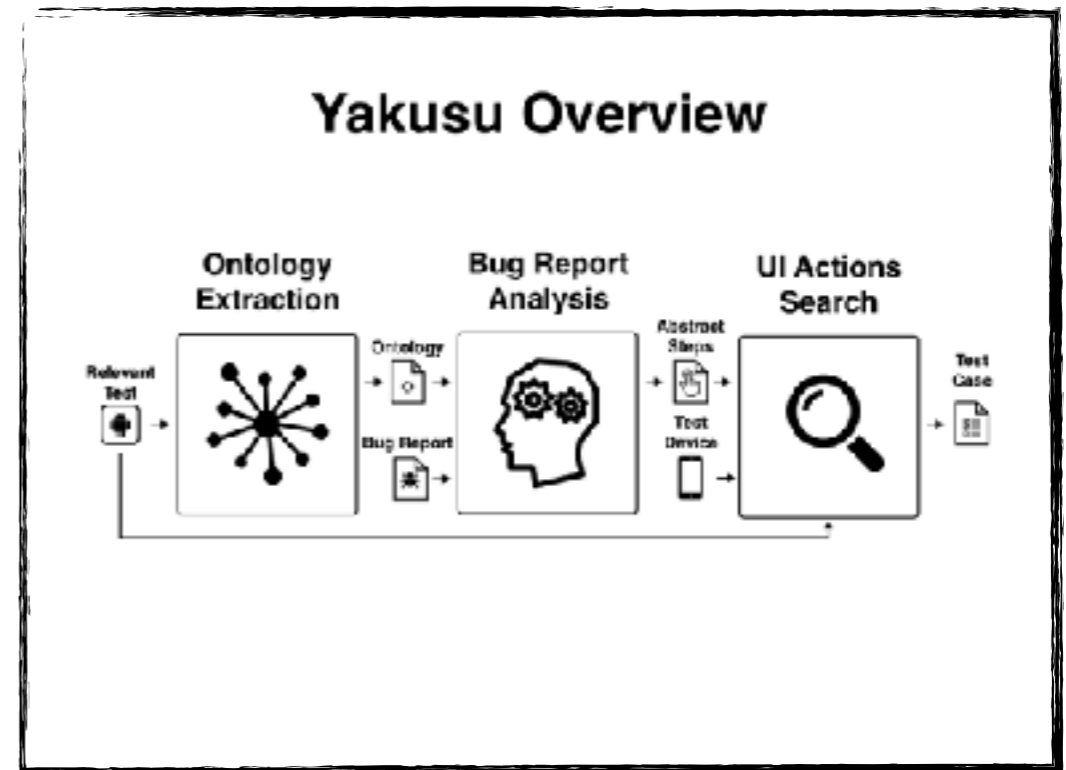
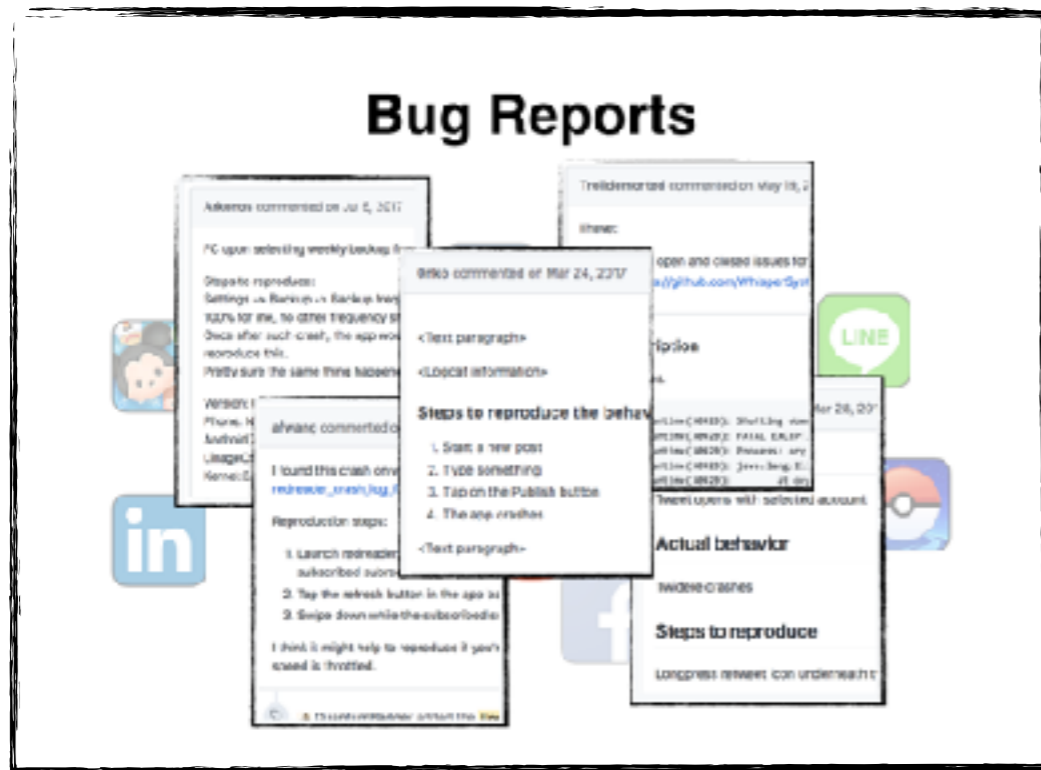
Summary



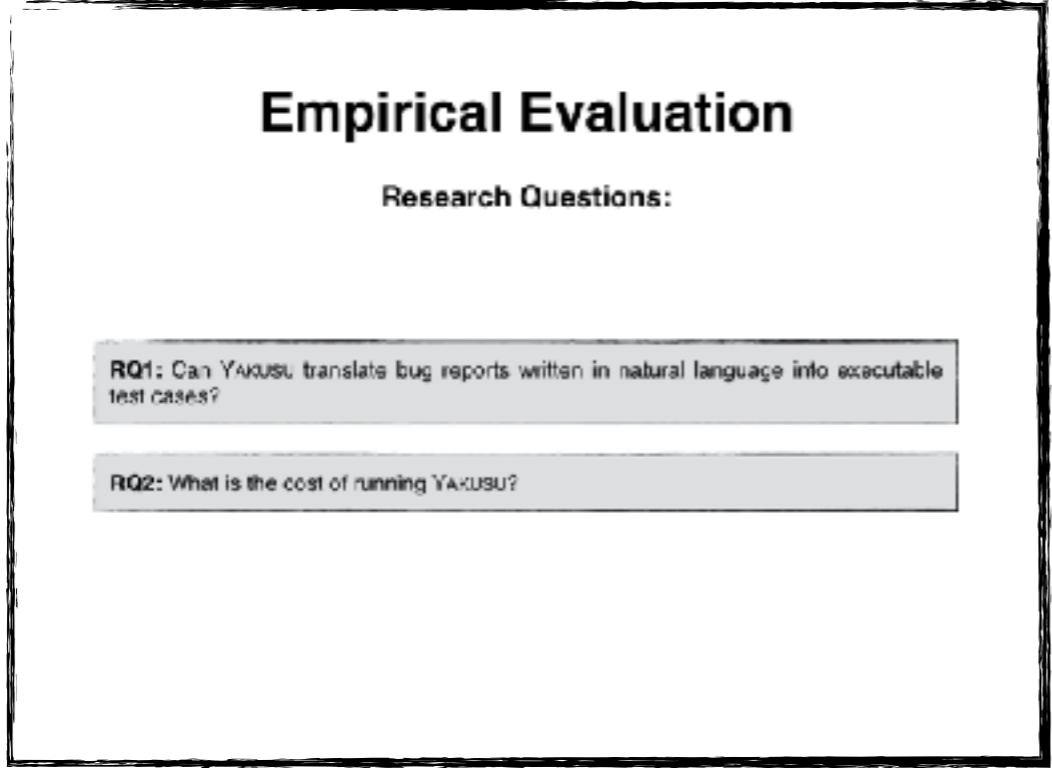
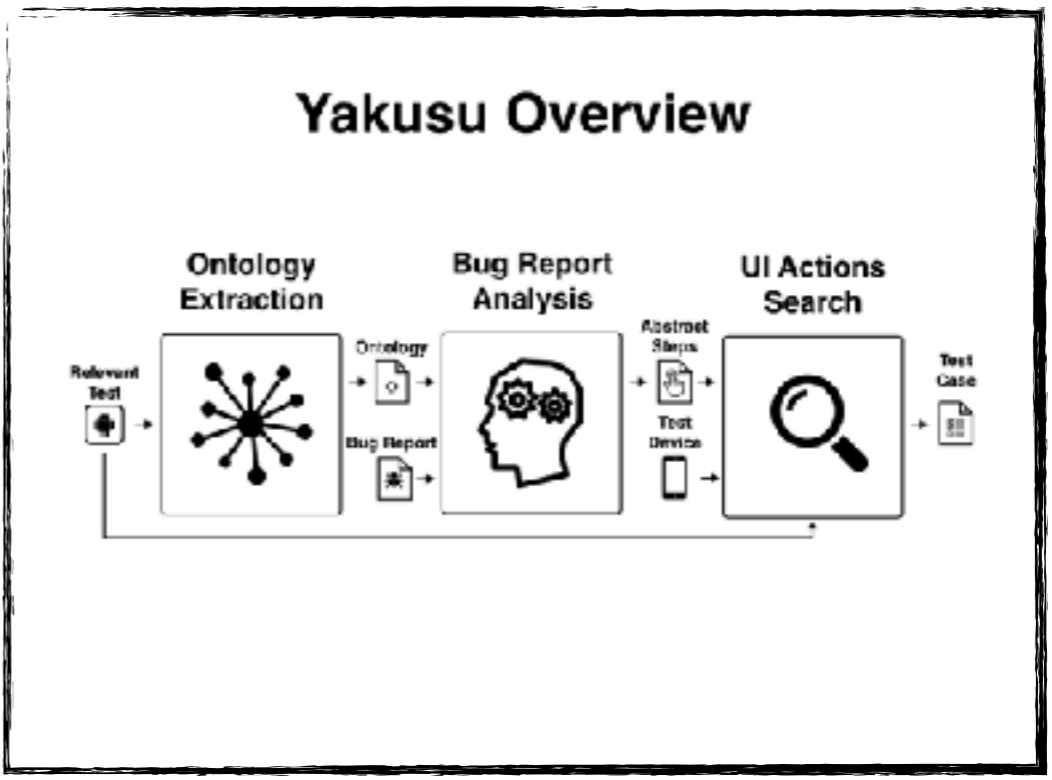
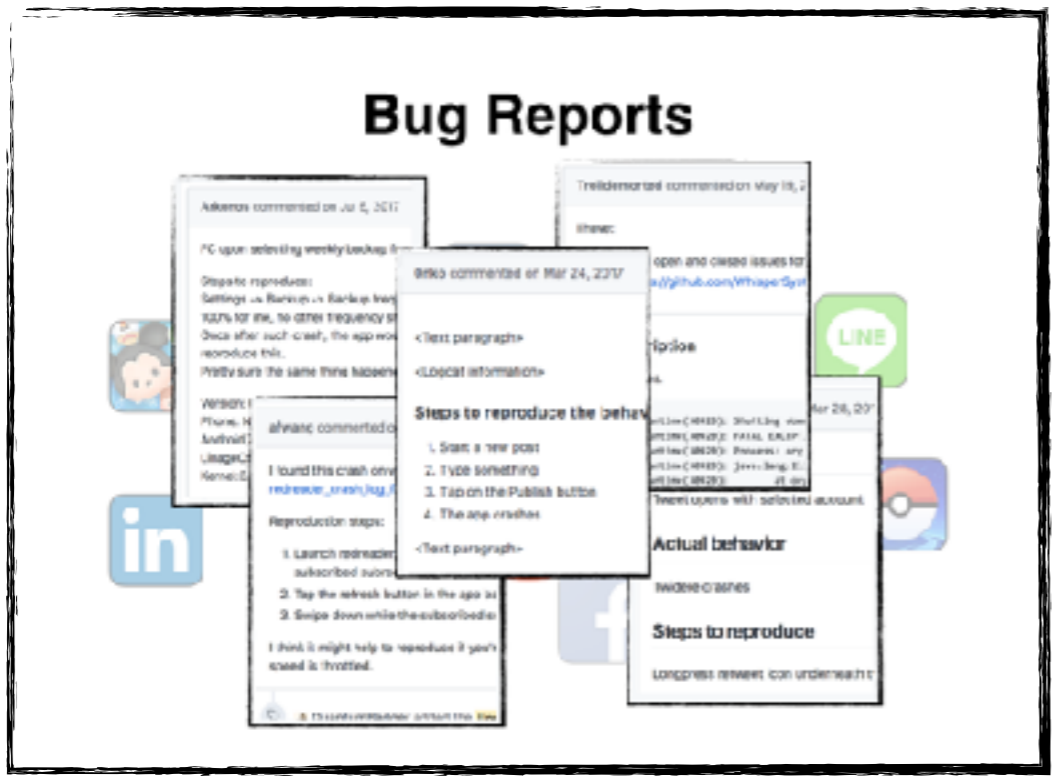
Summary



Summary



Summary

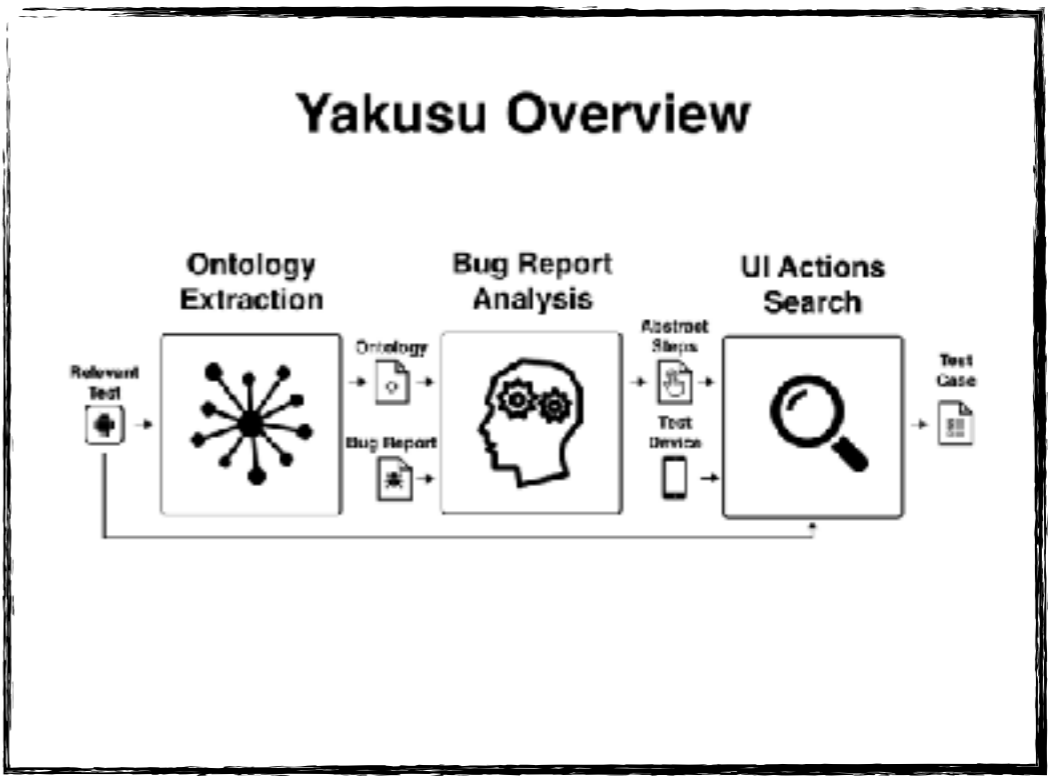


Summary

Bug Reports

Examples of bug report content:

- Steps to reproduce:
 1. Open a new post
 2. Type something
 3. Tap on the Publish button
 4. The app crashes
- Actual behavior: [Crash]
- Steps to reproduce:
 1. Search reloaded subscribed users
 2. Tap the refresh button in the app
 3. Swipe down while the subscribed...



Empirical Evaluation

Research Questions:

- RQ1: Can YAKUSU translate bug reports written in natural language into executable test cases?
- RQ2: What is the cost of running YAKUSU?

Future Work

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- Learn macro-step associated with the app
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