What is the Vocabulary of Flaky Tests?

@gustavopinto

Gustavo Pinto

Breno Miranda

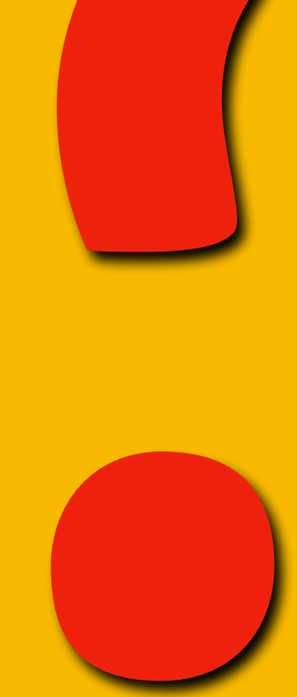
Supun Dissanayake

Marcelo d'Amorim

Christoph Treude

Antonia Bertolino

What is a flaky test?



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```java
public class TestIdentifyEncoder {
    @Test
    public void testCodingEmptySrcBuffer() throws Exception {
        final WritableByteChannelMock channel = new WritableByteChannelMock(64);
        final SessionOutputBuffer outbuf = new SessionOutputBufferImpl(1024, 128);
        final HttpTransportMetricsImpl metrics = new HttpTransportMetricsImpl();

        final IdentityEncoder encoder = new IdentityEncoder(channel, outbuf, metrics);
        encoder.write(CodecTestUtils.wrap("stuff"));

        final ByteBuffer empty = ByteBuffer.allocate(100);
        empty.flip();
        encoder.write(empty);
        encoder.write(null);
        encoder.complete();

        outbuf.flush(channel);
        final String s = channel.dump(Consts.ASCII);

        Assert.assertTrue(encoder.isCompleted());
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Runs: 1/1 x Errors: 0 x Failures: 0

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What do we know about flaky tests?

Luo @ FSE 2014

Thorve @ ICSME 2018

Empirical-based

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What do we know about flaky tests?

Luo @ FSE 2014

Thorve @ ICSME 2018

Bell @ ICSE 2018

Lam @ ICST 2019

Empirical-based

Dynamic detection of flakiness

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What do we know about flaky tests?

Luo @ FSE 2014

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Bell @ ICSE 2018

Lam @ ICST 2019

Empirical-based

Dynamic detection of flakiness

Static detection of flakiness

?

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How to statically detect if a test code is flaky

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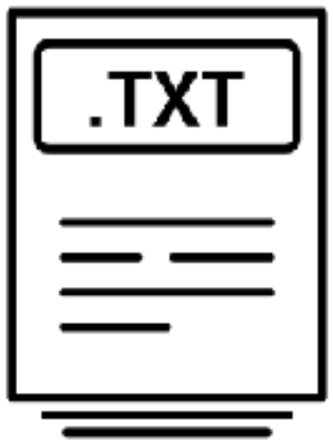
Flaky tests



Tokenized Flaky test

Machine Learning algorithms

Ranking of code identifiers associated with flakiness

Vocabulary of Flaky tests

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Flaky tests

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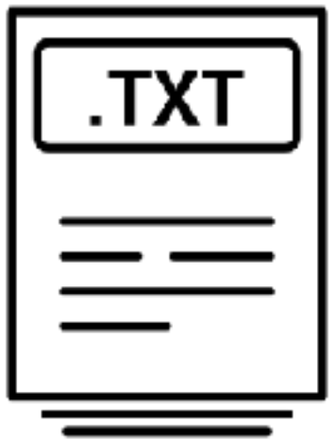

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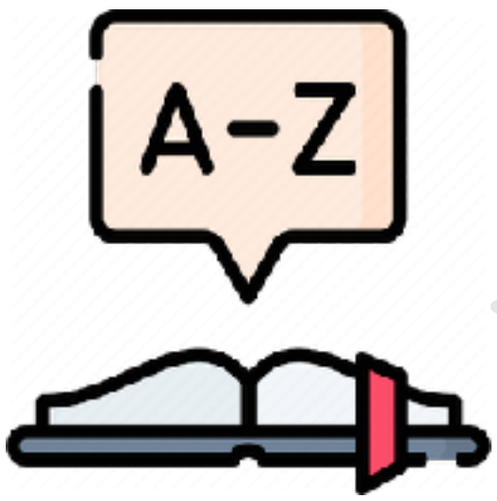

Vocabulary of Flaky tests

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Is this test flaky?

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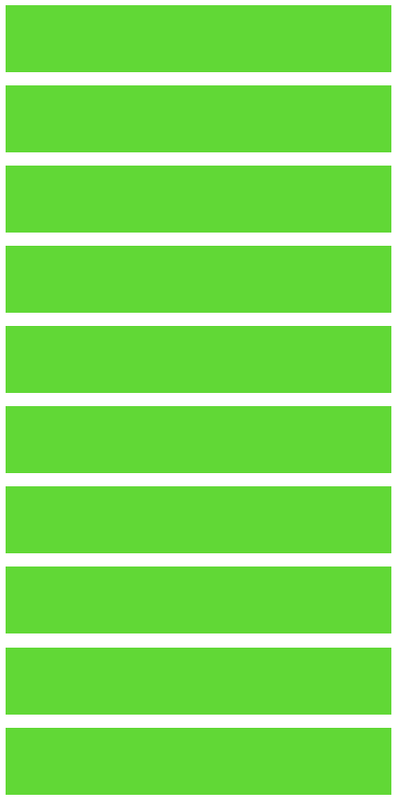

10 executions

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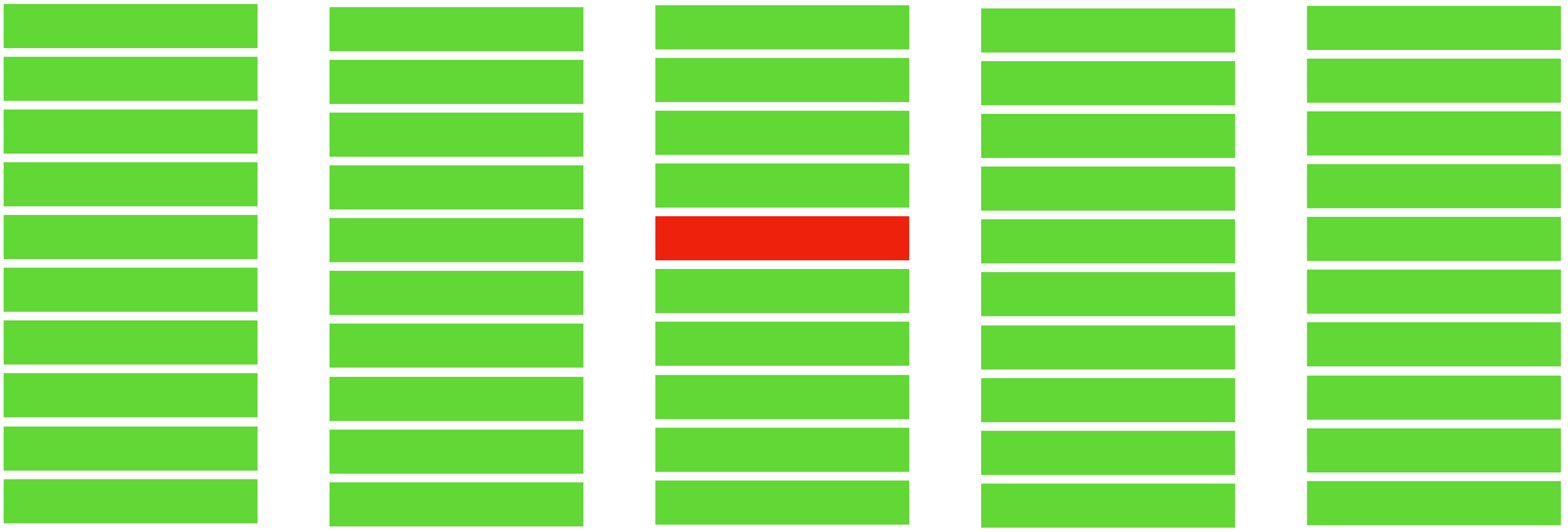

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GitHub Project
achilles
alluxio
ambari
assertj-core
checkstyle
commons-exec
dropwizard
hadoop
handlebars
hbase
hector
httpcore
jackrabbit-oak
jimfs
logback
ninja
okhttp
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spring-boot
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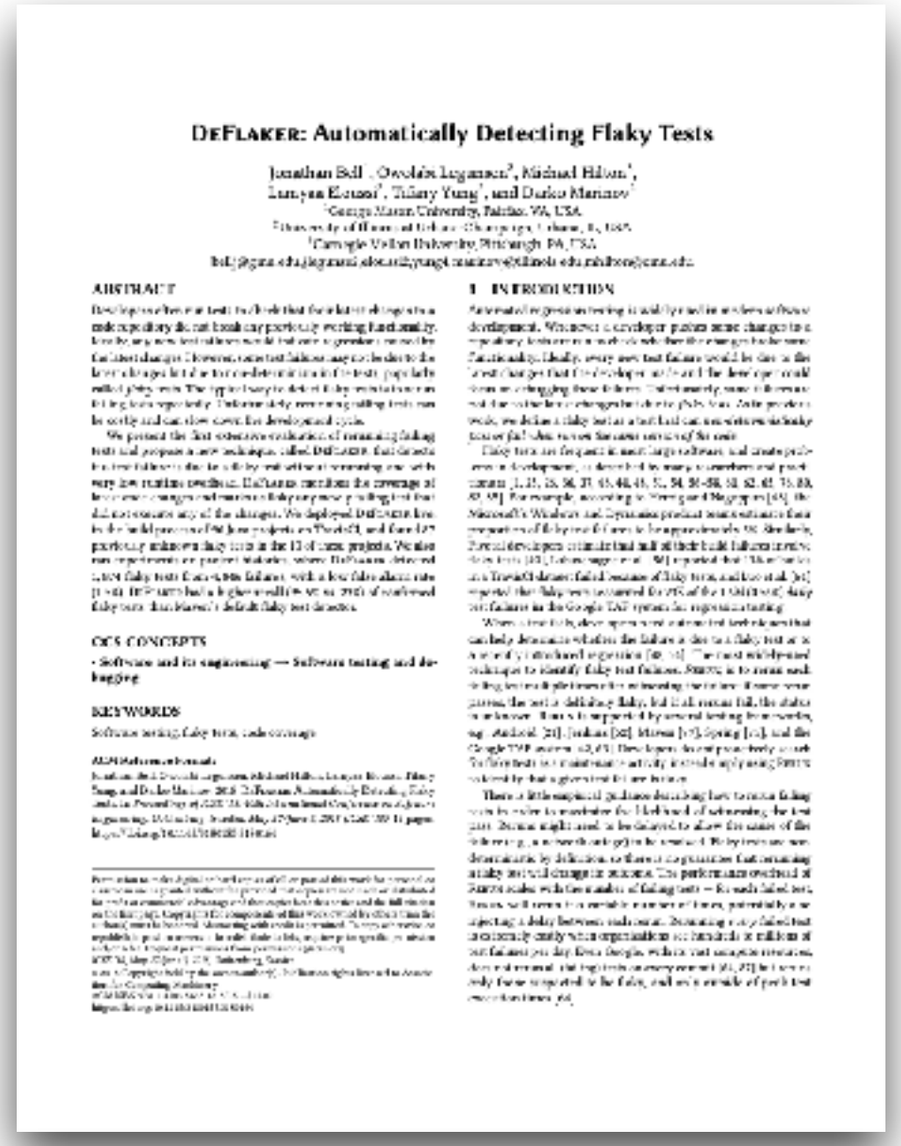
The same studied here



DeFlaker: Automatically Detecting Flaky Tests

Jonathan Bell[1], Owolabi Legunsen[2], Michael Hilton[1],
Lamyaa Eloussi[2], Tifany Yung[1], and Darko Marinov[1]
[1]George Mason University, Fairfax, VA, USA
[2]University of Illinois at Urbana-Champaign, Urbana, IL, USA
[3]Carnegie Mellon University, Pittsburgh, PA, USA
{bell,gyung}@gmu.edu,{legunse2,eloussi2}@illinois.edu,mhilton@cmu.edu,marinov@illinois.edu

ABSTRACT

1 INTRODUCTION

CCS CONCEPTS

• Software and its engineering → Software testing and debugging

KEYWORDS

Bell @ ICSE 2018

@gustavopinto

GitHub Project
achilles
alluxio
ambari
assertj-core
checkstyle
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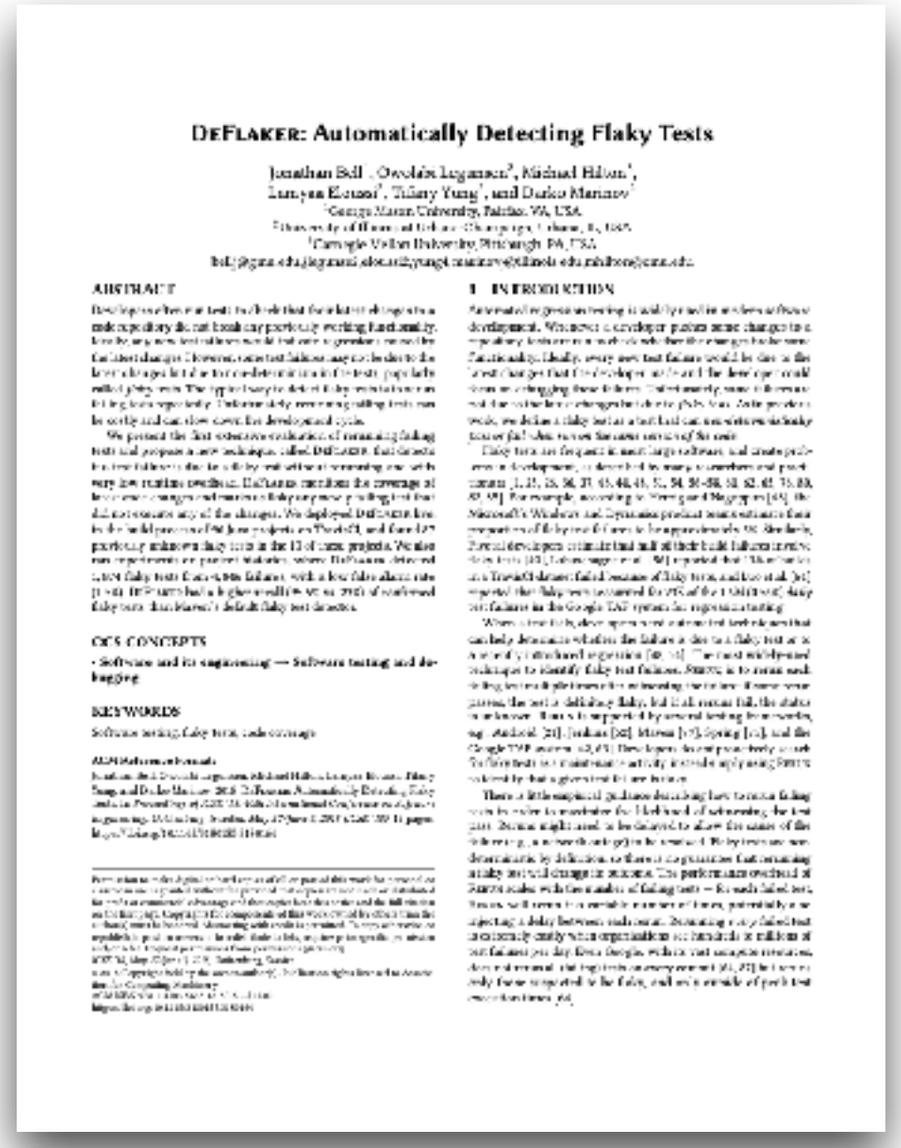
The same studied here



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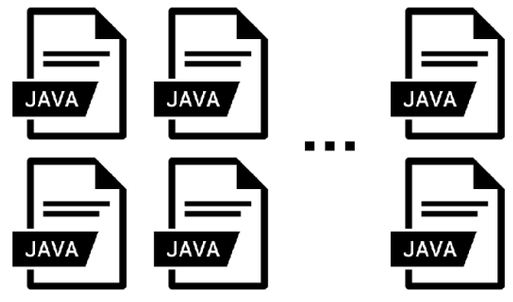

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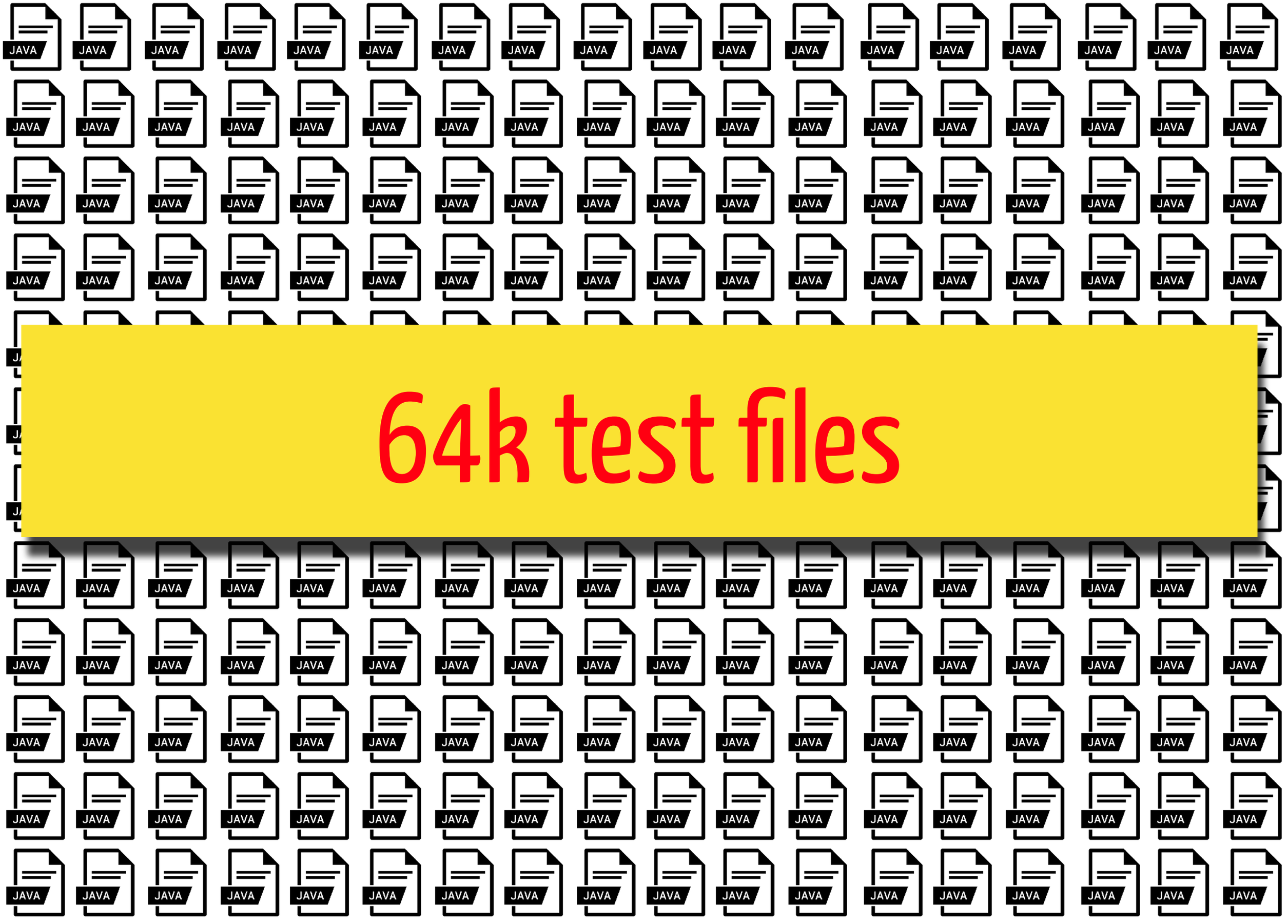
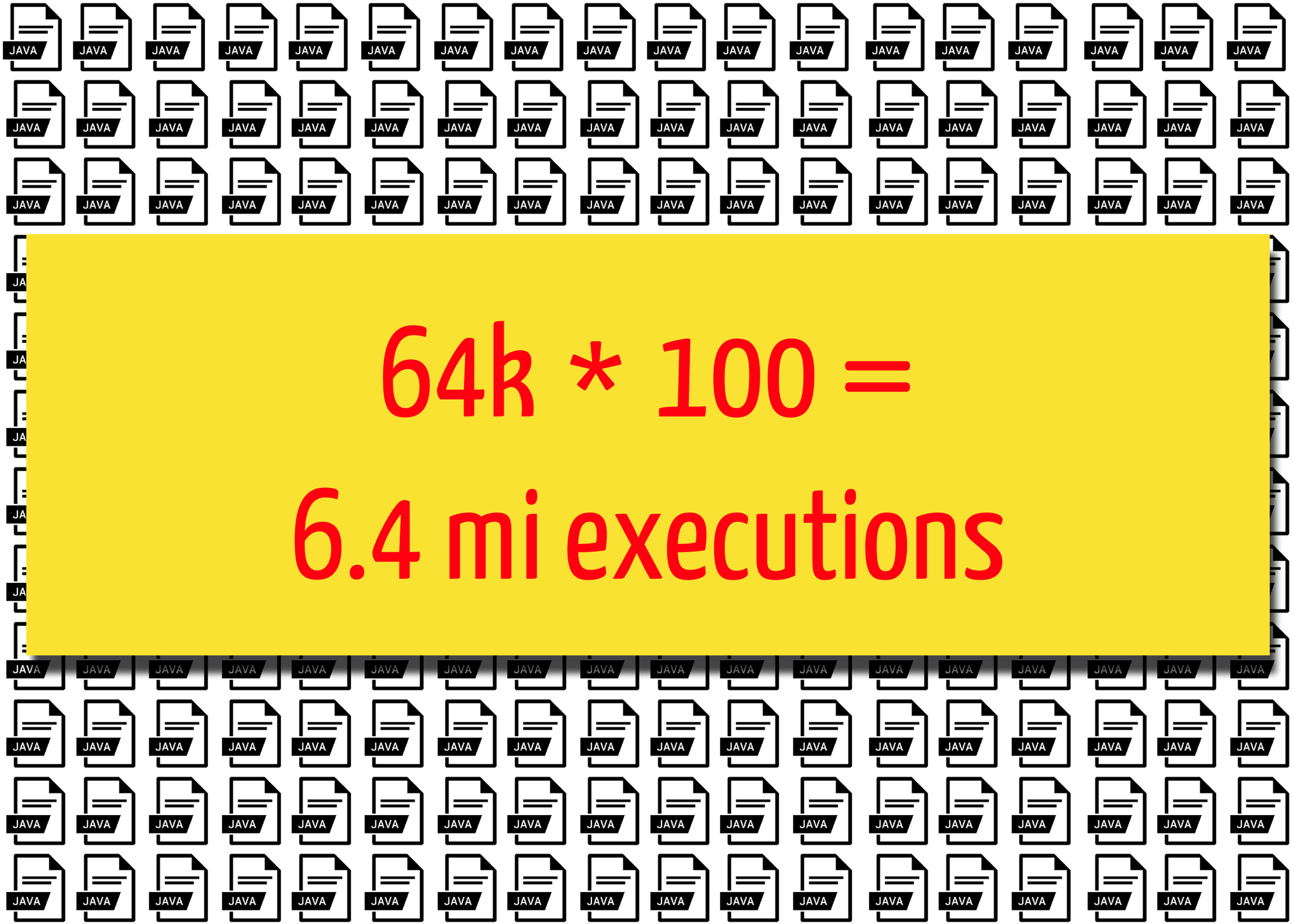
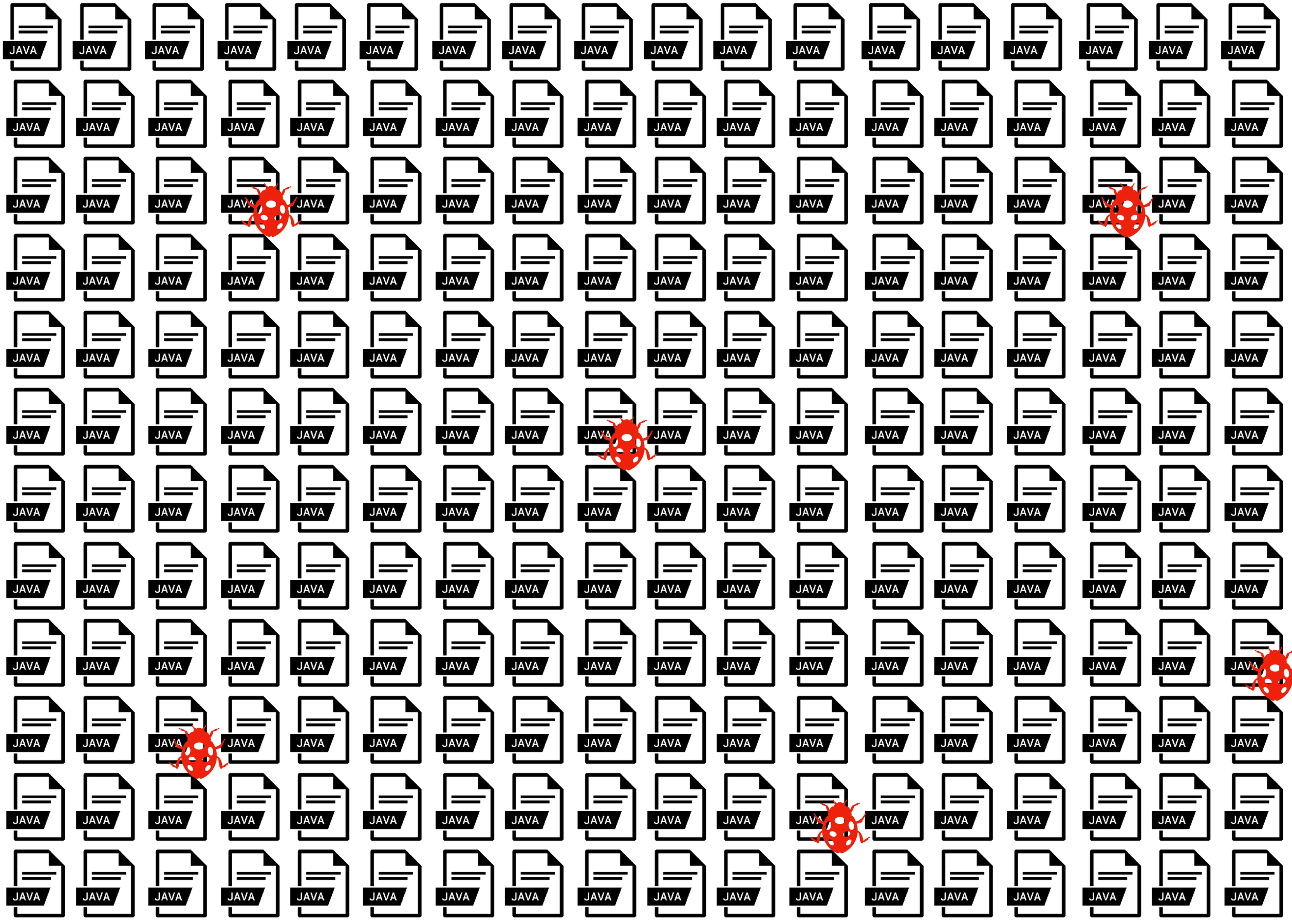

64k test files
@gustavopinto


64k * 100 =
6.4 mi executions
@gustavopinto


JAVA
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        assert.assert true(encoder.is completed());
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}
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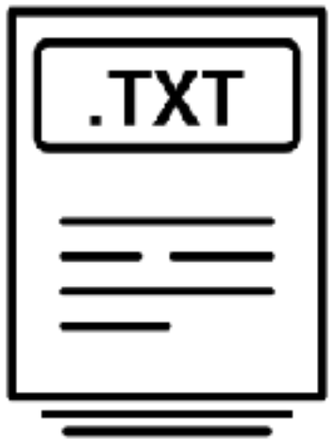
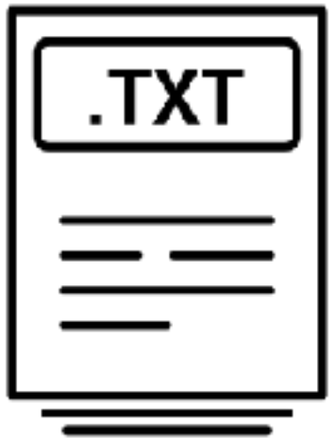


test identify encoder coding empty src buffer byte channel mock writable session output outbuf session http transport metrics impl identity codec utils wrap buffer allocate flip write complete flush dump consts ascii is completed assert equals

Known Flaky test



Tokenized Flaky test

Machine Learning algorithms

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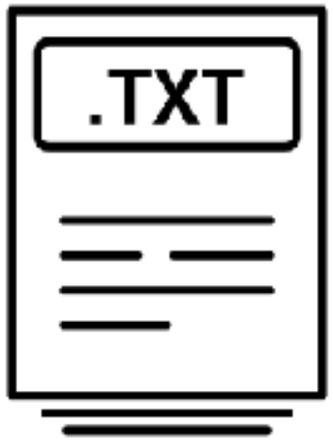
Known Flaky test



Tokenized Flaky test

Machine Learning algorithms

Weka

Nearest Neighbour

Support Vector Machine

Decision Tree

Naive Bayes

Random Forest

Implementation available at:
https://github.com/damorimRG/msr4flakiness/

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RQ1:

How prevalent are flaky tests?

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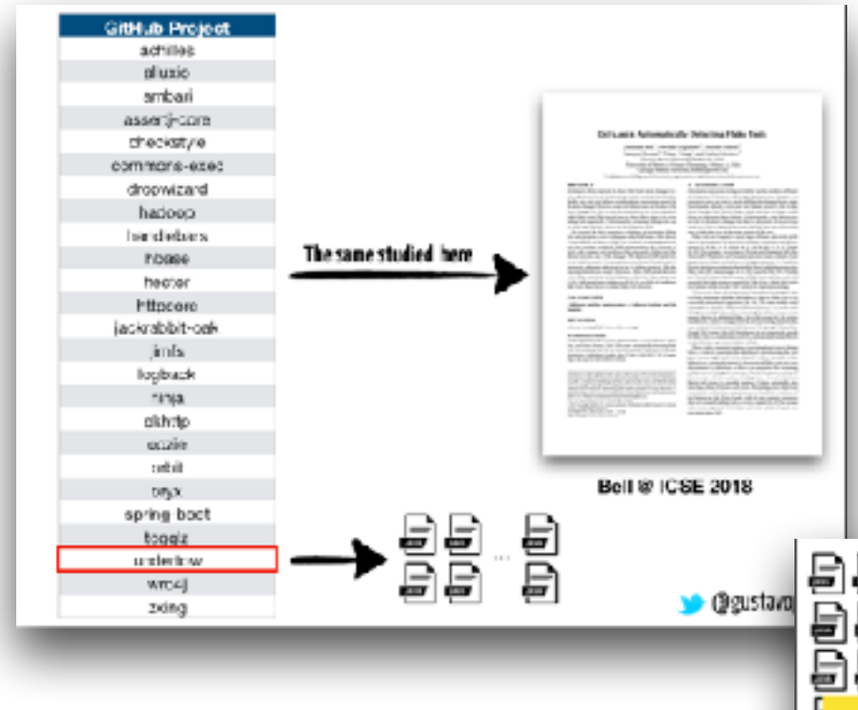
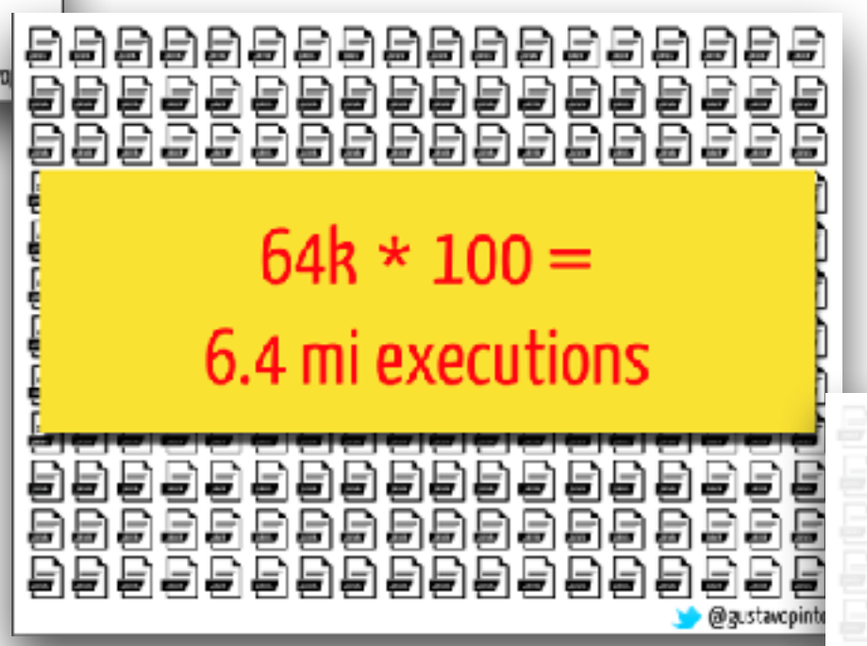
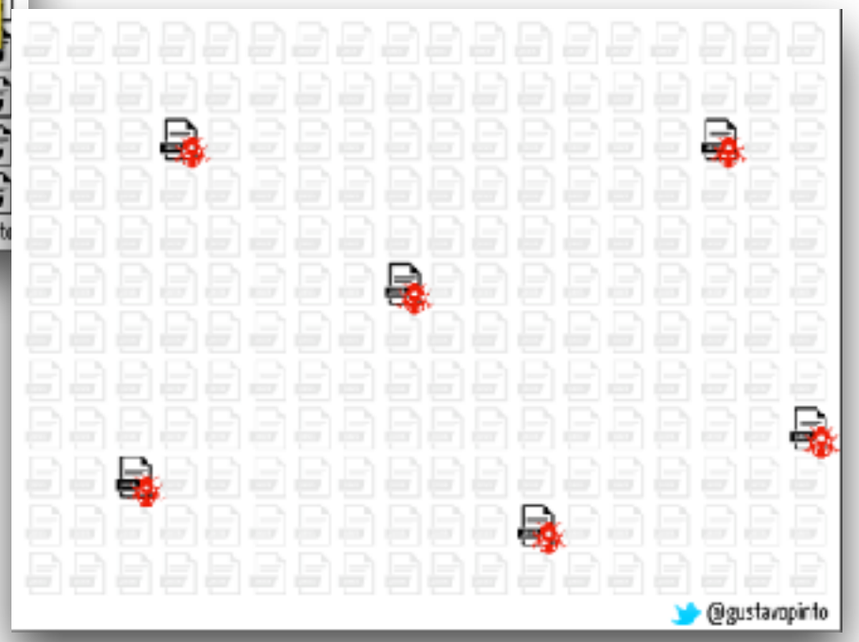
RQ1: How prevalent are flaky tests?







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RQ1: How prevalent are flaky tests?

Project	# Test	# Flaky	% Flaky
alluxio	3,034	12	0.4
hector	322	40	12.4
jackrabbit-oak	13,193	2	2
okhttp	1,682	19	19
undertow	609	2	2
wro4j	1,158	11	11

25% of the projects
have at least one flaky test

We found
86 flaky tests

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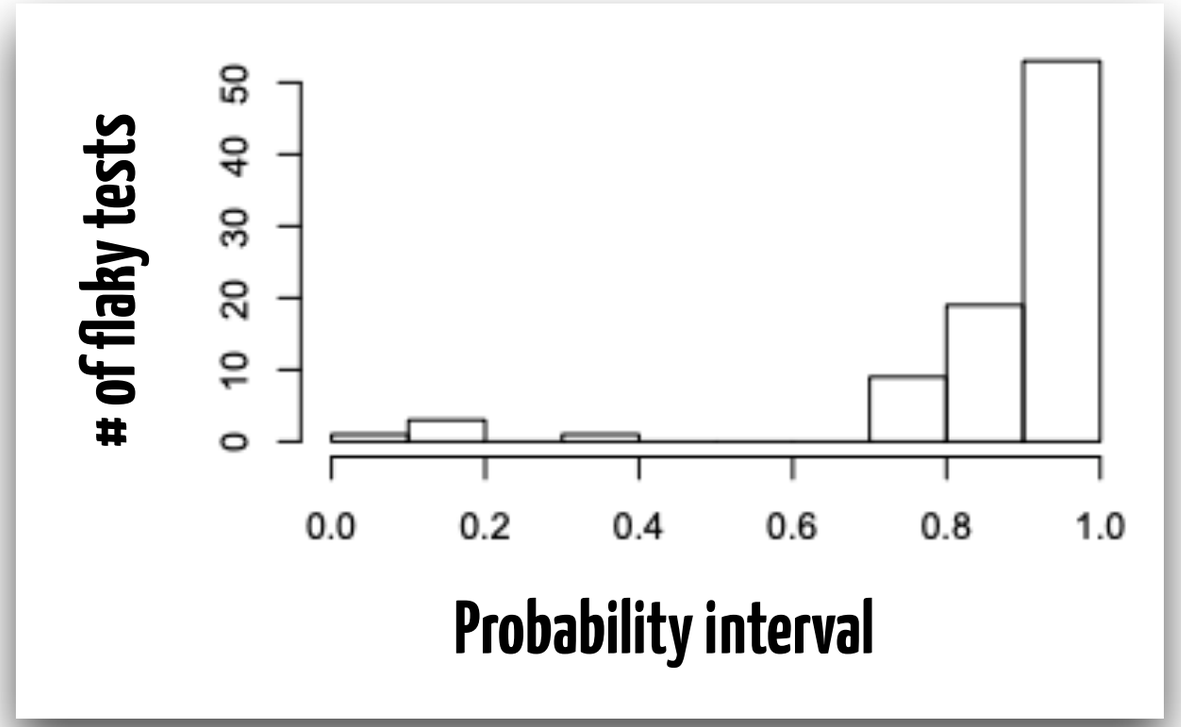

25% of the projects
have at least one flaky test

We found
86 flaky tests

70% (61 out of the 86)
passed more than 90%

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RQ2:

How accurately can we predict test flakiness?

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RQ2: Can we predict flakiness?

ML	Precision	Recall	F1	MCC	AUC
Random Forest	**0.99**	0.91	**0.95**	**0.90**	**0.98**
Decision Tree	0.98	0.88	0.89	0.77	0.91
Naive Bayes	0.93	0.80	0.86	0.74	0.93
Support Vector	0.93	**0.92**	0.93	0.85	0.92
Nearest Neighbour	0.97	0.88	0.92	0.85	0.93

Random Forest
achieved best precision

Tuning (e.g., # of trees)
Had no performance impact

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RQ3:

What value do different features add to the classifier?

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RQ3: What's the value of different features

Random Forest

Features	Precision	Recall	F1	MCC	AUC
All features	0.99	0.91	0.95	0.90	0.98
No stemming	0.99	0.91	0.95	0.90	0.98
No Stop W. removal	0.99	0.91	0.95	0.90	0.98
No Lowercasing	0.98	0.91	0.94	0.89	0.98
No Java Keywords	0.99	0.90	0.94	0.89	0.98

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RQ3: What's the value of different features

Random Forest

Features	Precision	Recall	F1	MCC	AUC
All features	0.99	0.91	0.95	0.90	0.98
No stemming	0.99	0.91	0.95	0.90	0.98
No Stop W. removal	0.99	0.91	0.95	0.90	0.98
No Lowercasing	0.98	0.91	0.94	0.89	0.98
No Java Keywords	0.99	0.90	0.94	0.89	0.98

Support Vector Machine

Features	Precision	Recall	F1	MCC	AUC
All features	0.93	0.92	0.93	0.85	0.93
No stemming	0.93	0.92	0.93	0.85	0.93
No Stop W. removal	0.93	0.92	0.93	0.85	0.93
No Lowercasing	0.91	0.93	0.92	0.84	0.92
No Java Keywords	0.93	0.92	0.93	0.85	0.93

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RQ3: What's the value of different features

Random Forest

Features	Precision	Recall	F1	MCC	AUC
All features	0.99	0.91	0.95	0.90	0.98
No stemming	0.99	0.91	0.95	0.90	0.98
No Stop W. removal	0.99	0.91	0.95	0.90	0.98
No Lowercasing	0.98	0.91	0.94	0.89	0.98
No Java Keywords	0.99	0.90	0.94	0.89	0.98

Support Vector Machine

Features	Precision	Recall	F1	MCC	AUC
All features	0.93	0.92	0.93	0.85	0.93
No stemming	0.93	0.92	0.93	0.85	0.93
No Stop W. removal	0.93	0.92	0.93	0.85	0.93
No Lowercasing	0.91	0.93	0.92	0.84	0.92
No Java Keywords	0.93	0.92	0.93	0.85	0.93

No performance impact

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RQ4:

Which test code identifiers are strongly associated with test flakiness?

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RQ4: What's the vocabulary?

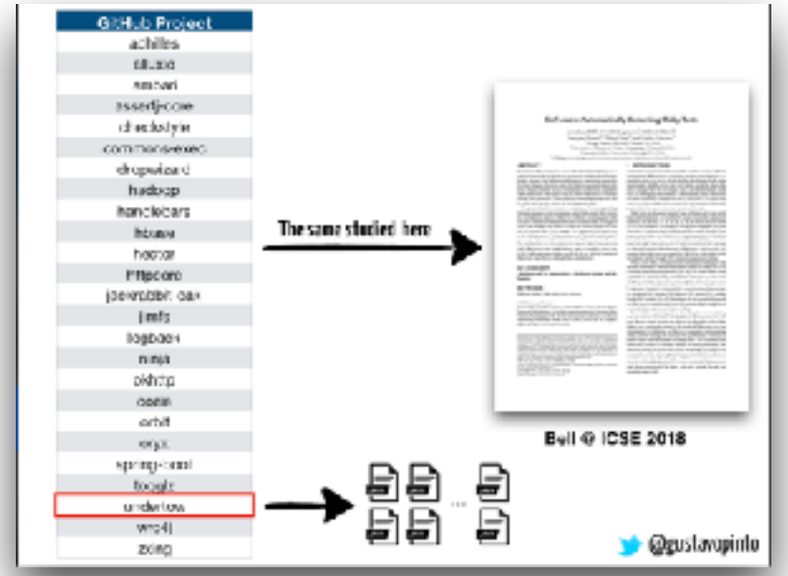
Features	inf. gain	Flaky # test	Flaky # projects	Non-Flaky # test	Non-Flaky # projects
job	0.20	524	2	4	1
table	0.14	406	4	8	2
id	0.14	552	9	52	4
action	0.13	387	3	8	2
oozie	0.13	274	1	0	0
services	0.13	371	2	7	1
coord	0.11	307	1	0	0
getid	0.11	287	4	1	1
coordinator	0.10	258	1	0	0
xml	0.10	147	2	6	2
workflow	0.09	207	1	0	0
getstatus	0.08	246	2	2	2
record	0.08	296	2	18	1
jpa	0.07	207	2	0	0
jpaservice	0.07	200	1	0	0
service	0.07	367	4	67	3

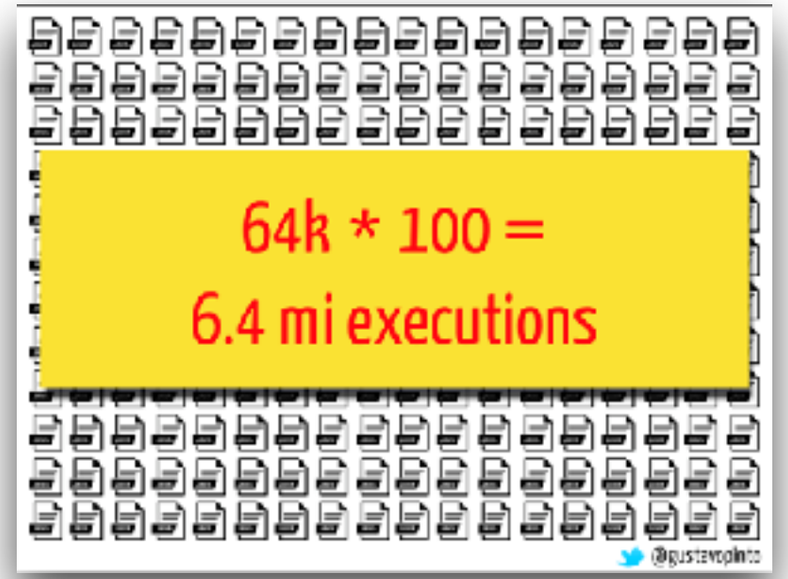
Many of them associated with

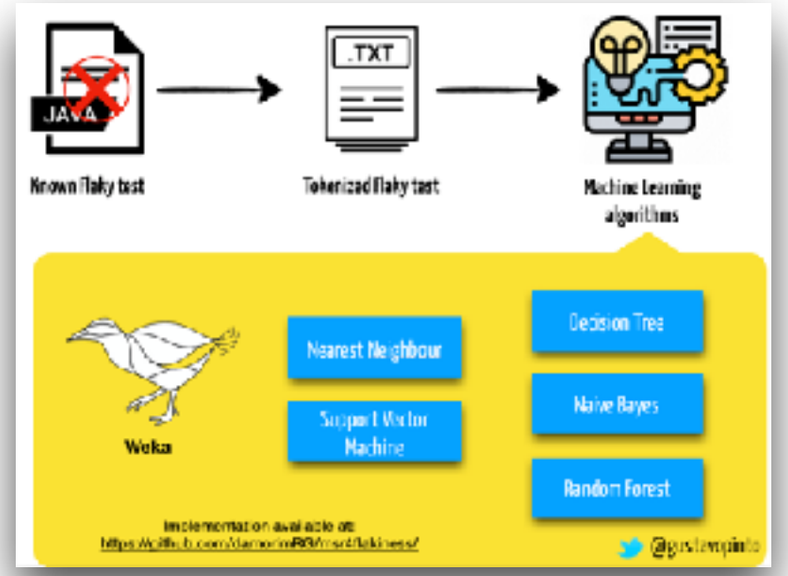
remote tasks

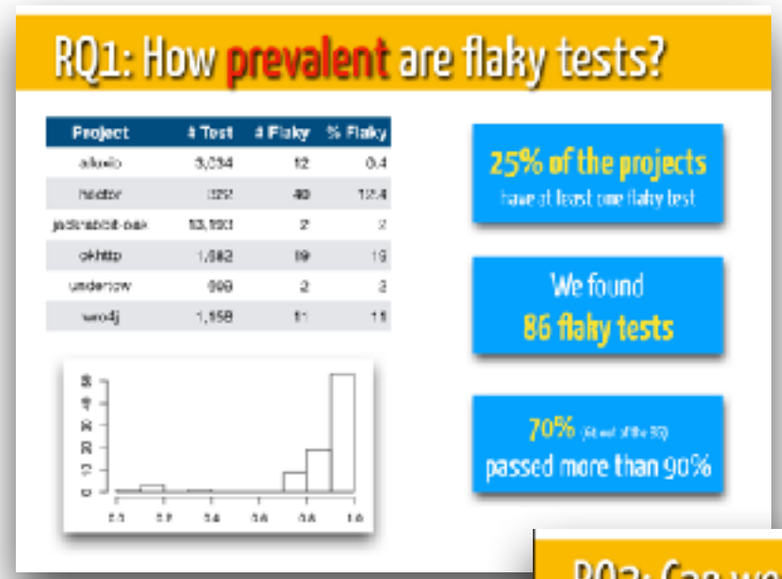
and/or

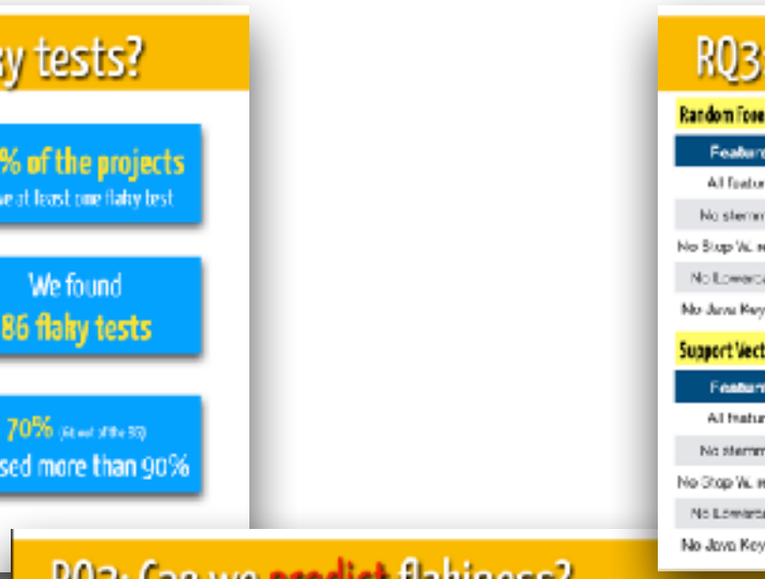
queue events

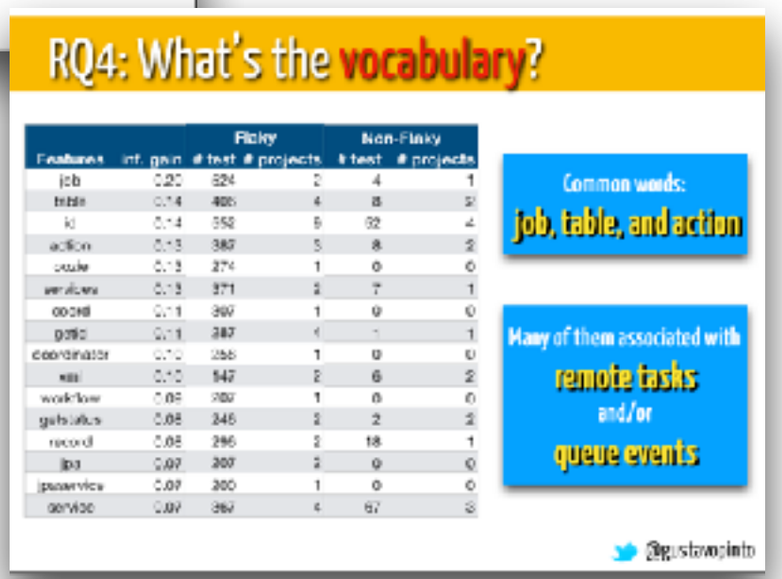












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