Flaky Tests

How to deal with them

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- 5+ years at Red Hat in Brno, Czech Republic
- Involved in integration middleware projects:
  - Hawtio, Camel Spring Boot, Camel Quarkus, Camel-K
- Side projects:
  - Red Hat Summer Camp Brno - an IT camp for high-school students
  - Leading a seminar on Tests in practice at Masaryk University in Brno

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What we'll discuss today

- What are Flaky Tests?
- Origins of Flaky Tests
- Good Practices
- Q&A

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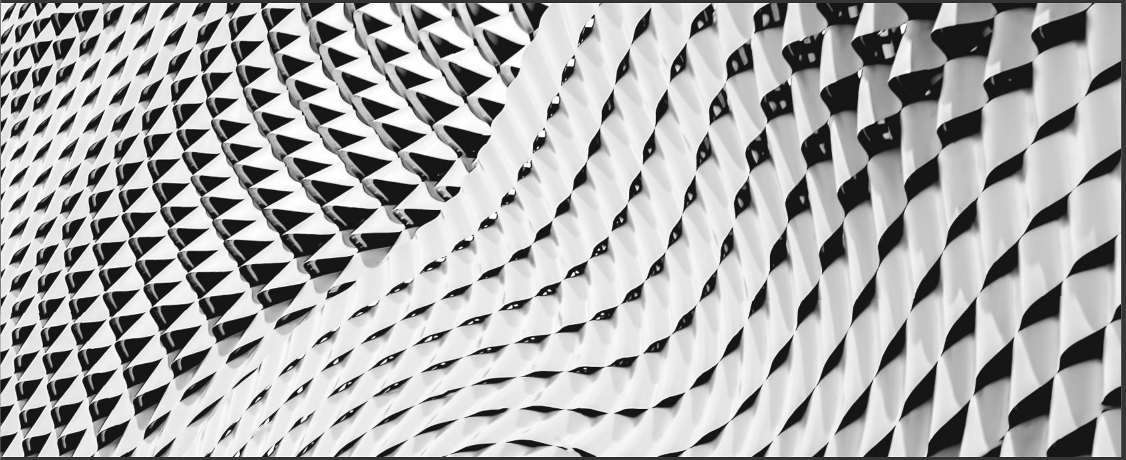
What are Flaky Tests?



Flaky tests are defined as tests that return both passes and failures despite no changes to the code or the test itself.

Source:
https://www.jetbrains.com/teamcity/ci-cd-guide/concepts/flaky-tests/

Flaky Tests

To pass or to fail - that’s the question

```
driver.navigate().to("https://www.google.com/");
driver.findElement(By.name("q")).sendKeys("SFSCon");
driver.findElement(By.cssSelector("[type=submit]")).click();

assertEquals(9, driver.findElement(By.cssSelector("#ires .g")).size());
```

Source:
https://selenide.org/blog.html

Flaky Tests

To pass or to fail – that's the question

- What can go wrong?
- Which line of the code may break the test?

Source:
https://selenide.org/blog.html

Flaky Tests

To pass or to fail - that's the question

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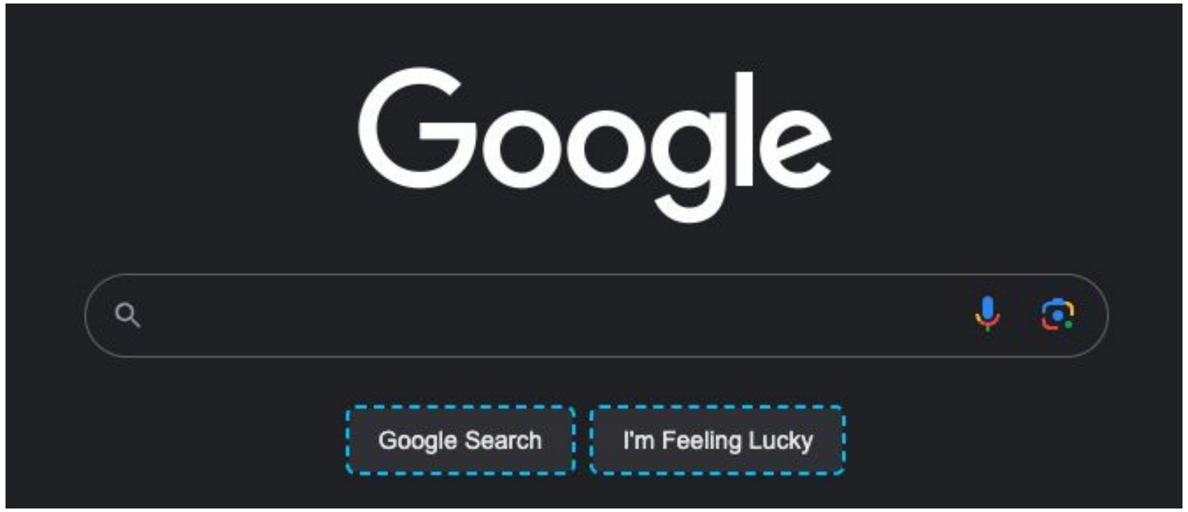
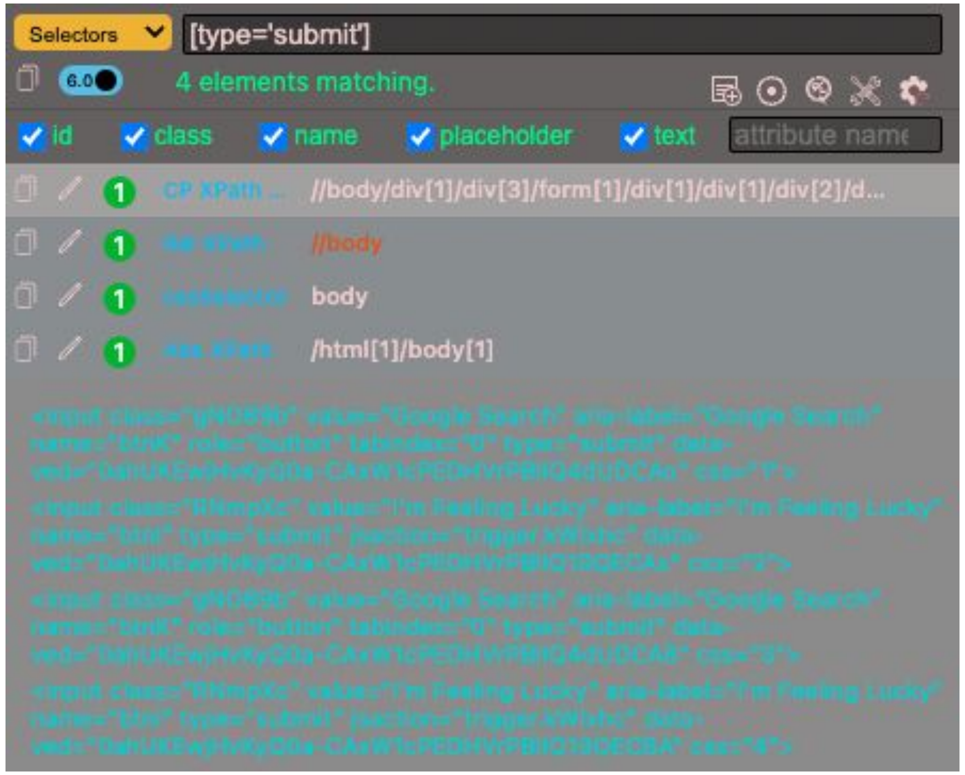
Flaky Tests

To pass or to fail – that's the question



- 4 matching elements – 2 of them are hidden
- Possible fix is to modify the third line of the code

```
driver.findElement(By.name("btnK")).click();
```



```
[type='submit']
4 elements matching.
1  CP XPath ...  //body/div[1]/div[3]/form[1]/div[1]/div[1]/div[2]/d...
1  [illegible]   //body
1  [illegible]   body
1  [illegible]   /html[1]/body[1]

<input class="gNO89b" value="Google Search" aria-label="Google Search" name="btnK" role="button" tabindex="0" type="submit" data-ved="[illegible]" css="1">
<input class="RNmpXc" value="I'm Feeling Lucky" aria-label="I'm Feeling Lucky" name="btnI" type="submit" jsaction="trigger.kWlxhc" data-ved="[illegible]" css="2">
<input class="gNO89b" value="Google Search" aria-label="Google Search" name="btnK" role="button" tabindex="0" type="submit" data-ved="[illegible]" css="3">
<input class="RNmpXc" value="I'm Feeling Lucky" aria-label="I'm Feeling Lucky" name="btnI" type="submit" jsaction="trigger.kWlxhc" data-ved="[illegible]" css="4">
```

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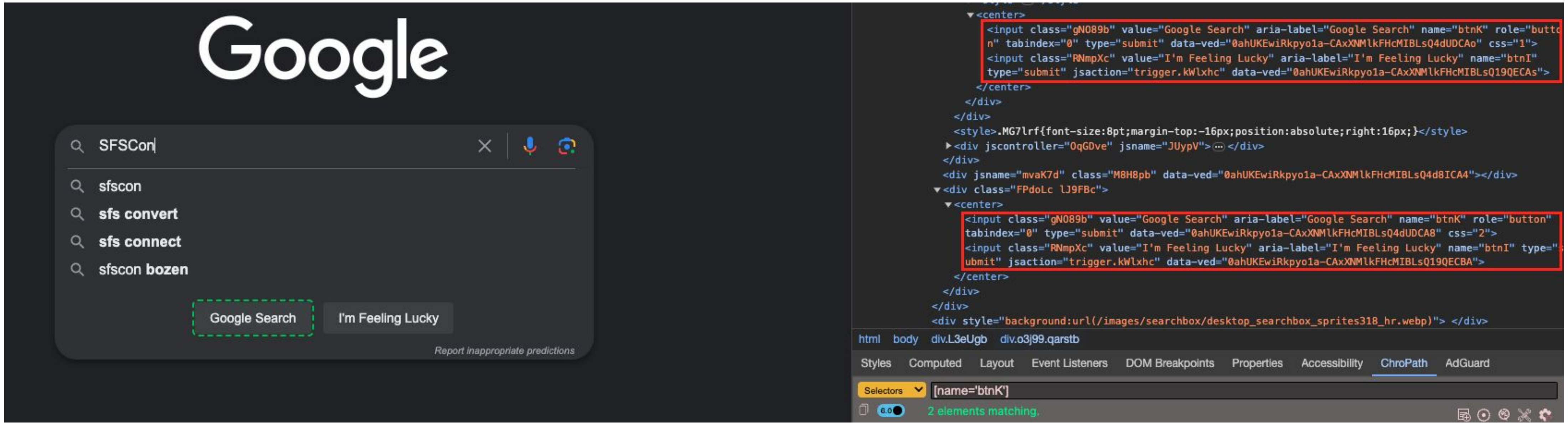
Flaky Tests

To pass or to fail – that's the question



```
▼<center>
  <input class="gNO89b" value="Google Search" aria-label="Google Search" name="btnK" role="butto
  n" tabindex="0" type="submit" data-ved="0ahUKEwiRkpyo1a-CAxXNMlkFHcMIBLsQ4dUDCAo" css="1">
  <input class="RNmpXc" value="I'm Feeling Lucky" aria-label="I'm Feeling Lucky" name="btnI"
  type="submit" jsaction="trigger.kWlxhc" data-ved="0ahUKEwiRkpyo1a-CAxXNMlkFHcMIBLsQ19QECAs">
 </center>
</div>
</div>
<style>.MG7lrf{font-size:8pt;margin-top:-16px;position:absolute;right:16px;}</style>
▶<div jscontroller="OqGDve" jsname="JUypV"> ⋯ </div>
</div>
<div jsname="mvaK7d" class="M8H8pb" data-ved="0ahUKEwiRkpyo1a-CAxXNMlkFHcMIBLsQ4d8ICA4"></div>
▼<div class="FPdoLc lJ9FBc">
 ▼<center>
   <input class="gNO89b" value="Google Search" aria-label="Google Search" name="btnK" role="button"
   tabindex="0" type="submit" data-ved="0ahUKEwiRkpyo1a-CAxXNMlkFHcMIBLsQ4dUDCA8" css="2">
   <input class="RNmpXc" value="I'm Feeling Lucky" aria-label="I'm Feeling Lucky" name="btnI" type="
   ubmit" jsaction="trigger.kWlxhc" data-ved="0ahUKEwiRkpyo1a-CAxXNMlkFHcMIBLsQ19QECBA">
  </center>
 </div>
</div>
<div style="background:url(/images/searchbox/desktop_searchbox_sprites318_hr.webp)"> </div>
```

html body div.L3eUgb div.o3j99.qarstb
Styles Computed Layout Event Listeners DOM Breakpoints Properties Accessibility ChroPath AdGuard
Selectors

```
[name='btnK']
2 elements matching.
```

- However, the flakiness is still present
- When filling a search bar – the dropdown list hides the first search button and another one shows up

Flaky Tests

To pass or to fail - that’s the question

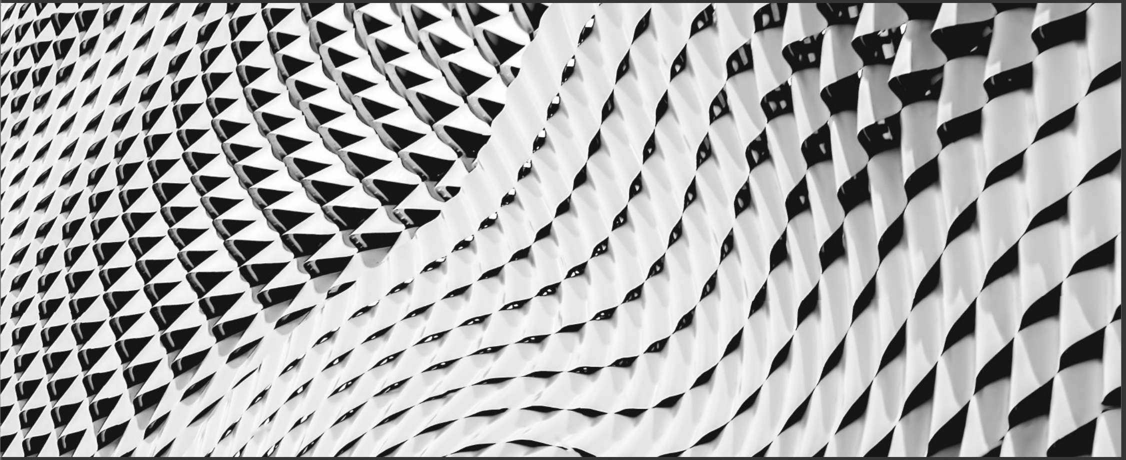
One of the solution might be using a framework with smart built-in timeouts and retries

- In case of Selenide framework (free and open-source):

```
@Test
public void userCanLogin() {
    open("https://www.google.com");
    $(byName("q")).setValue("selenide");
    $("[name=btnK]").click();
    $$("#ires .g").shouldHave(size(10));
}
```

Source:
https://selenide.org/

Origins of Flaky Tests



Flaky Tests

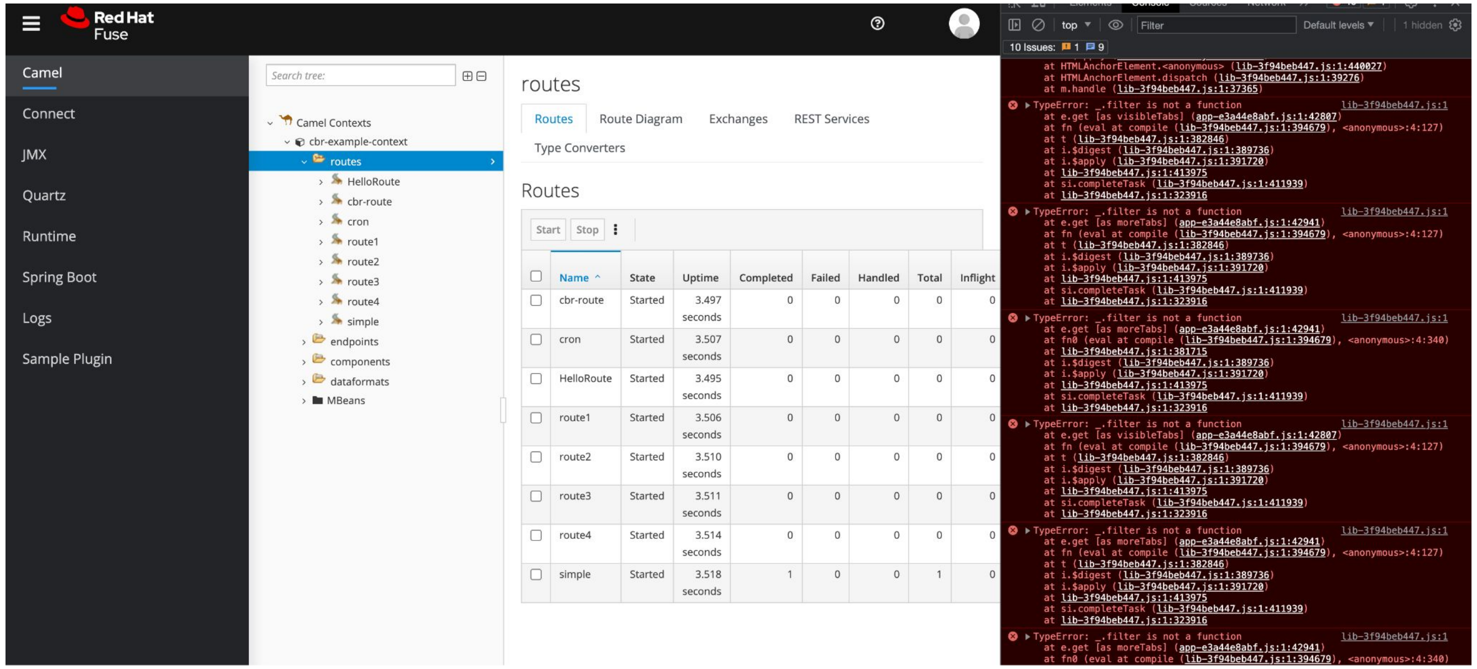
There are many reasons why flaky tests may show up in your test pipelines

- Test Environment
  - Lack of memory and space, caching issues
  - Docker and Jenkins issues
- Connection
  - Requests and responses speed and their order
- Test Frameworks
  - Versions mismatch, dropped support, bugs

Test Frameworks

Test Frameworks

- `TypeError: _.filter is not a function`
- Nothing is clickable
- Affects only automation
- Unstuck only after refresh
- Manually works fine



Routes

	Name	State	Uptime	Completed	Failed	Handled	Total	Inflight
☐	cbr-route	Started	3.497 seconds	0	0	0	0	0
☐	cron	Started	3.507 seconds	0	0	0	0	0
☐	HelloRoute	Started	3.495 seconds	0	0	0	0	0
☐	route1	Started	3.506 seconds	0	0	0	0	0
☐	route2	Started	3.510 seconds	0	0	0	0	0
☐	route3	Started	3.511 seconds	0	0	0	0	0
☐	route4	Started	3.514 seconds	0	0	0	0	0
☐	simple	Started	3.518 seconds	1	0	0	1	0

```
    at HTMLAnchorElement.<anonymous> (lib-3f94beb447.js:1:440027)
    at HTMLAnchorElement.dispatch (lib-3f94beb447.js:1:39276)
    at m.handle (lib-3f94beb447.js:1:37365)
▸ TypeError: _.filter is not a function                          lib-3f94beb447.js:1
    at e.get [as visibleTabs] (app-e3a44e8abf.js:1:42807)
    at fn (eval at compile (lib-3f94beb447.js:1:394679), <anonymous>:4:127)
    at t (lib-3f94beb447.js:1:382846)
    at i.$digest (lib-3f94beb447.js:1:389736)
    at i.$apply (lib-3f94beb447.js:1:391720)
    at lib-3f94beb447.js:1:413975
    at si.completeTask (lib-3f94beb447.js:1:411939)
    at lib-3f94beb447.js:1:323916
▸ TypeError: _.filter is not a function                          lib-3f94beb447.js:1
    at e.get [as moreTabs] (app-e3a44e8abf.js:1:42941)
    at fn (eval at compile (lib-3f94beb447.js:1:394679), <anonymous>:4:127)
    at t (lib-3f94beb447.js:1:382846)
    at i.$digest (lib-3f94beb447.js:1:389736)
    at i.$apply (lib-3f94beb447.js:1:391720)
    at lib-3f94beb447.js:1:413975
    at si.completeTask (lib-3f94beb447.js:1:411939)
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▸ TypeError: _.filter is not a function                          lib-3f94beb447.js:1
    at e.get [as moreTabs] (app-e3a44e8abf.js:1:42941)
    at fn0 (eval at compile (lib-3f94beb447.js:1:394679), <anonymous>:4:340)
    at lib-3f94beb447.js:1:381715
    at i.$digest (lib-3f94beb447.js:1:389736)
    at i.$apply (lib-3f94beb447.js:1:391720)
    at lib-3f94beb447.js:1:413975
    at si.completeTask (lib-3f94beb447.js:1:411939)
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```

Test Frameworks

The root cause:

- Updating to Selenium 4.12.0 caused the issue #12659 where Selenium overwrites _ sign

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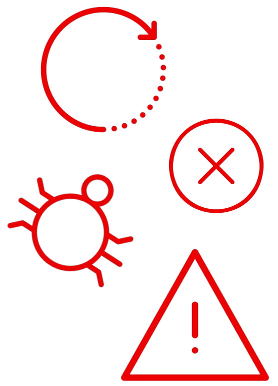
Test Frameworks

- It’s not always a good idea to blindly update all versions of frameworks in your project
  - Lost support (e.g. dropped java 8 support)
  - A new bug is introduced

- Version mismatch of frameworks is also a common issue
  - A new version may bring new requirements and changes in a code



Test Environment

Test Environment

```
12:37:39 @fuseConsoleTemplate @fuseConsoleOperator @fuseConsoleOperatorHub
12:37:39 Scenario Outline: Check filtering of pods by name                                  #
src/test/resources/org/jboss/fuse/console/openshift/fuse_console/homepage/homepage.feature:13
12:37:39   When User filters table on Fuse Console Home page by "Name" of string "spring-boot-2-camel" #
org.jboss.fuse.hawtio.stepdefinitions.openshift.FuseConsoleStepDefs.userFiltersTableOnFuseConsoleHomePageByOfString(java.lang.String,java.lang.String)
12:37:39   Then The pods list is filtered by string "spring-boot-2-camel"                   #
org.jboss.fuse.hawtio.stepdefinitions.openshift.FuseConsoleStepDefs.podsListIsFilteredByStringInColumn(java.lang.String)
12:38:26
12:38:26 @fuseConsoleTemplate @fuseConsoleOperator @fuseConsoleOperatorHub
12:38:26 Scenario: Open container page                                                  #
src/test/resources/org/jboss/fuse/console/openshift/fuse_console/pods/eap/camel/endpoints/camel_endpoints.feature:5
12:38:26   Given User filters table on Fuse Console Home page by "Name" of string "eap-camel-cdi" #
org.jboss.fuse.hawtio.stepdefinitions.openshift.FuseConsoleStepDefs.userFiltersTableOnFuseConsoleHomePageByOfString(java.lang.String,java.lang.String)
12:38:26   When User connects to "eap-camel-cdi" pod                                       #
org.jboss.fuse.hawtio.stepdefinitions.openshift.FuseConsoleStepDefs.userConnectsToPod(java.lang.String)
12:38:26   Then Page is loaded                                                             # org.jboss.fuse.hawtio.stepdefinitions.openshift.FuseConsoleStepDefs.pageIsLoaded()
12:38:26   And Tree menu element "camelContexts" is shown                                  #
org.jboss.fuse.hawtio.stepdefinitions.openshift.FuseConsoleStepDefs.elementIsShown(java.lang.String)
12:38:26       Element not found {By.xpath: //li[@id='camelContexts']}
12:38:26 Expected: visible
12:38:26 Screenshot: file:/mnt/hudson_workspace/workspace/fuse-7.12-fuse-console-operator/jbossqe-fuse/hawtio-related-tests/hawtio-openshift-
tests/build/reports/tests/1698320305670.0.png
12:38:26 Page source: file:/mnt/hudson_workspace/workspace/fuse-7.12-fuse-console-operator/jbossqe-fuse/hawtio-related-tests/hawtio-openshift-
tests/build/reports/tests/1698320305670.0.html
12:38:26 Timeout: 20 s.
12:38:26 Caused by: NoSuchElementException: no such element: Unable to locate element: {"method":"xpath","selector":"//li[@id='camelContexts']"}
```

Test Environment

Rebuild a job helped to get it passed

- However, the job was still failing and passing in a random order

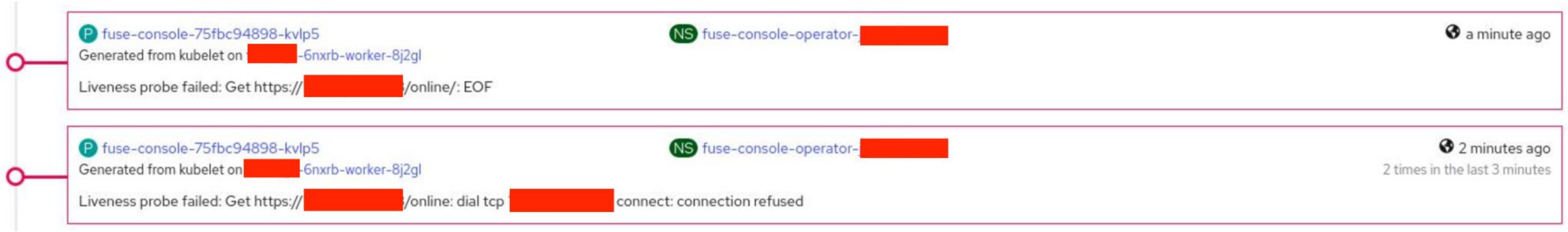
What could go wrong?

- Lost Internet connection when pulling images or it met pulling limits
- Lost connection to a testing machine
- Lack of memory and space
- Error while building and deploying quickstarts for the app under test
- etc.

Test Environment

What actually happened

- An application deployed on OpenShift become unstable after a while
- Continuously stopping and restarting accompanied by the error Liveness probe failed



```
P fuse-console-75fbc94898-kvlp5                    NS fuse-console-operator-[redacted]            a minute ago
Generated from kubelet on [redacted]-6nxrb-worker-8j2gl
Liveness probe failed: Get https://[redacted]/online/: EOF

P fuse-console-75fbc94898-kvlp5                    NS fuse-console-operator-[redacted]            2 minutes ago
Generated from kubelet on [redacted]-6nxrb-worker-8j2gl                          2 times in the last 3 minutes
Liveness probe failed: Get https://[redacted]/online: dial tcp [redacted] connect: connection refused
```

- The application's pod on OpenShift didn't show detailed error messages

Test Environment

It turned out that

- It was caused by the app's pod exceeding its memory allocation on OpenShift
- The resources weren't defined by default

What helped us is to edit app's deployment configuration to increase the memory allocation

-
  ```
  spec:
    resources:
      limits:
        cpu: "1"
        memory: 100Mi
      requests:
        cpu: 200m
        memory: 32Mi
  ```

Test Environment: Resources

- Clean up clusters, terminate unnecessary machines, remove namespaces/projects;
- Keep track of internal shared repositories, their space and do clean up jobs;
- Do not create machines with large resources for low-cost work;

Test Environment: Automation

- If you have pipelines in parallel using the same resources and sharing the same cluster
  - Avoid job deadlocks
  - Add checks, conditions, timeouts

Test Environment: Infrastructure

- Connection is stable
- VPN is up
- Nothing is overloading network
- No outages are happening

Application under test

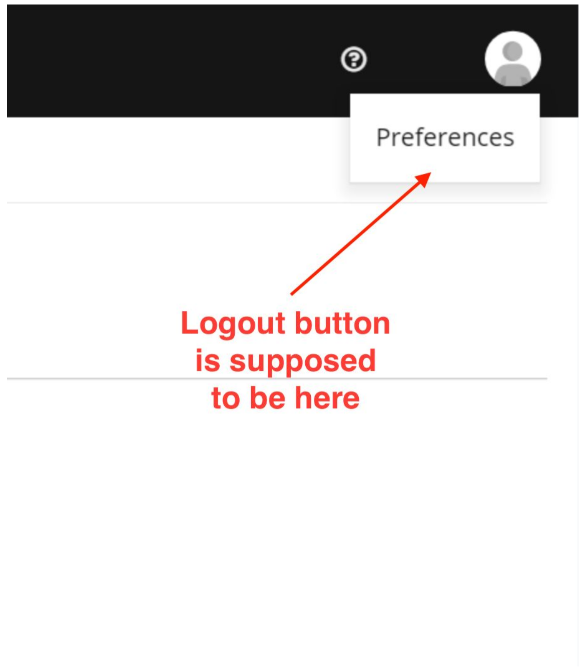
Application under test

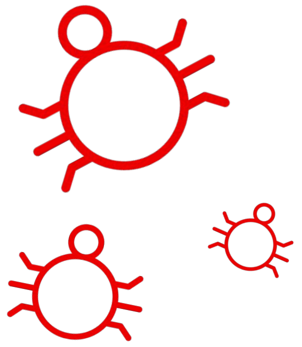
Also, flaky tests occur due to changes such as new features or new bugs introduced by developers

- Performance
- Bugs in the application
- Runtimes

Application under test

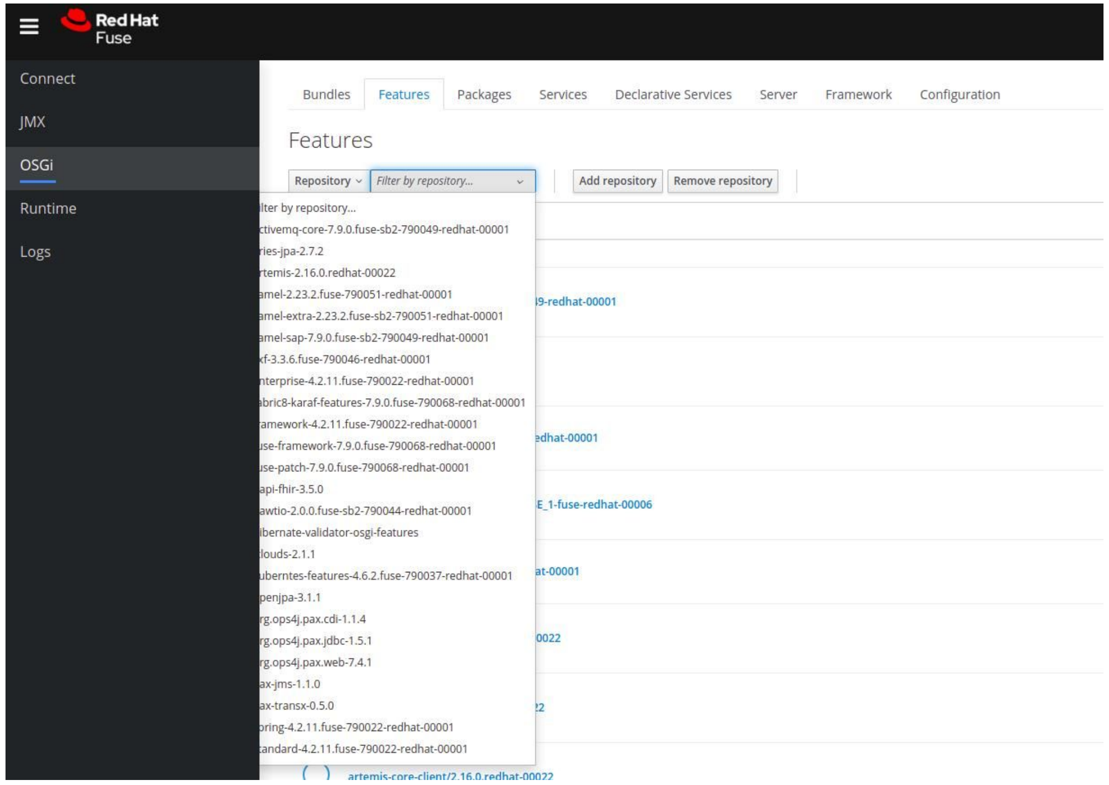
- The loading order of the modules was not explicitly defined
- Sometimes, rendering of the page was faster than modules get loaded
- It caused a missing Logout button and therefore failures of the tests





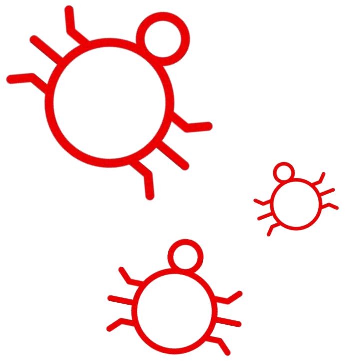
Application under test

- A broken layout for drop-down menu
- Tests were mostly passing
- Tests are running in a background with no UI
- It required us to do a manual testing to find it

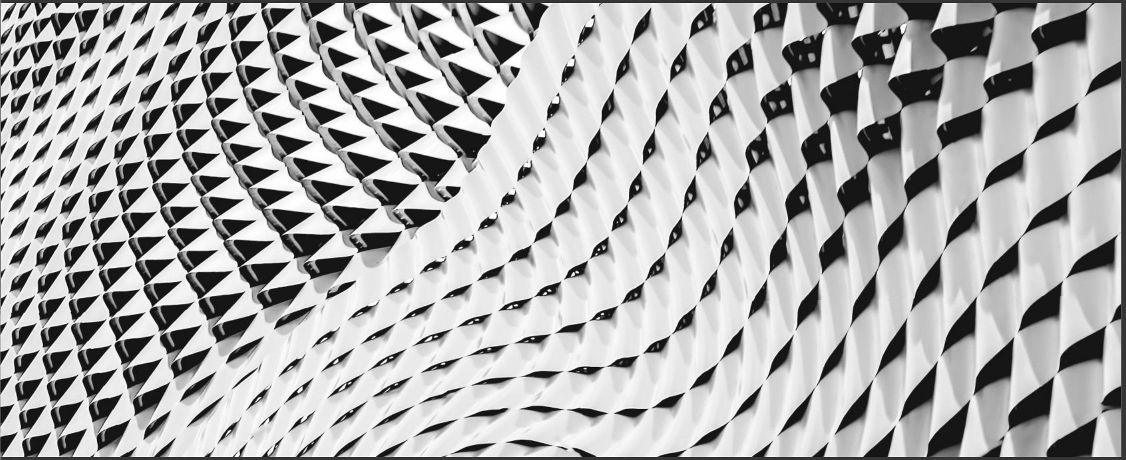


```
lter by repository...
ctivemq-core-7.9.0.fuse-sb2-790049-redhat-00001
ries-jpa-2.7.2
rtemis-2.16.0.redhat-00022
amel-2.23.2.fuse-790051-redhat-00001
amel-extra-2.23.2.fuse-sb2-790051-redhat-00001
amel-sap-7.9.0.fuse-sb2-790049-redhat-00001
xf-3.3.6.fuse-790046-redhat-00001
nterprise-4.2.11.fuse-790022-redhat-00001
abric8-karaf-features-7.9.0.fuse-790068-redhat-00001
amework-4.2.11.fuse-790022-redhat-00001
use-framework-7.9.0.fuse-790068-redhat-00001
use-patch-7.9.0.fuse-790068-redhat-00001
api-fhir-3.5.0
awtio-2.0.0.fuse-sb2-790044-redhat-00001
ibernate-validator-osgi-features
louds-2.1.1
uberntes-features-4.6.2.fuse-790037-redhat-00001
penjpa-3.1.1
rg.ops4j.pax.cdi-1.1.4
rg.ops4j.pax.jdbc-1.5.1
rg.ops4j.pax.web-7.4.1
ax-jms-1.1.0
ax-transx-0.5.0
pring-4.2.11.fuse-790022-redhat-00001
andard-4.2.11.fuse-790022-redhat-00001
```

```
9-redhat-00001
edhat-00001
E_1-fuse-redhat-00006
at-00001
0022
2
artemis-core-client/2.16.0.redhat-00022
```



Good Practices



Good Practices

- Consider test frameworks with built-in timeouts and smart retries
- Do not use common locators but unique ones
- Collaborate with developers
- Beware of version updates

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Good Practices

- Keep an eye on infrastructure
  - Space, memory, hanging jobs and machines
- It’s always good to know your application under test
- Be familiar with the application infrastructure
  - To develop tests effectively with low cost
  - To decrease number of potential flaky tests and issues
  - Easily debug

Flakiness consumes resources and time from the Product Team and this costs money.

Q&A

Find me online

Thank you