A Longitudinal Analysis of Bloated Java Dependencies

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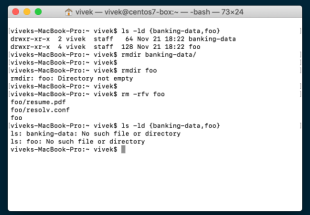
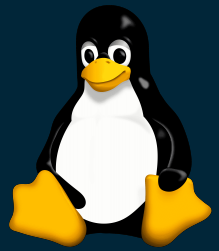
Software Bloat

Code that is packaged in an application but that is not necessary for building and running the application.

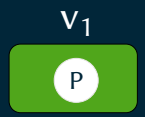


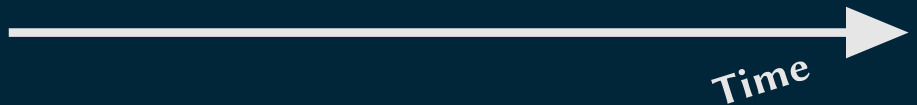


Question

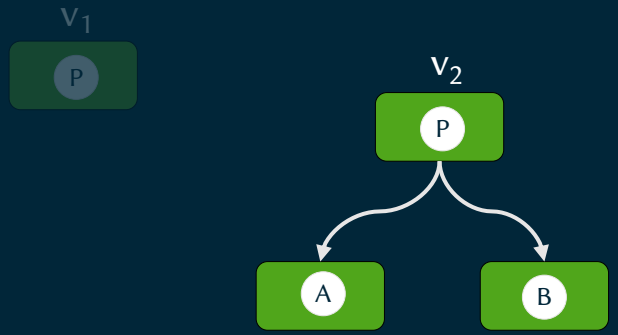
Will this piece of bloated code be needed in the future?

Bloated Dependencies Over Time



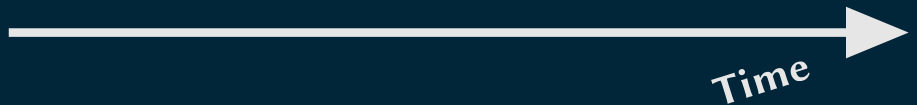


Bloated Dependencies Over Time



pom.xml

```
<dependencies>
  <dependency>
    <groupId>org.A</groupId>
    <artifactId>A</artifactId>
  </dependency>
  <dependency>
    <groupId>org.B</groupId>
    <artifactId>B</artifactId>
  </dependency>
</dependencies>
```



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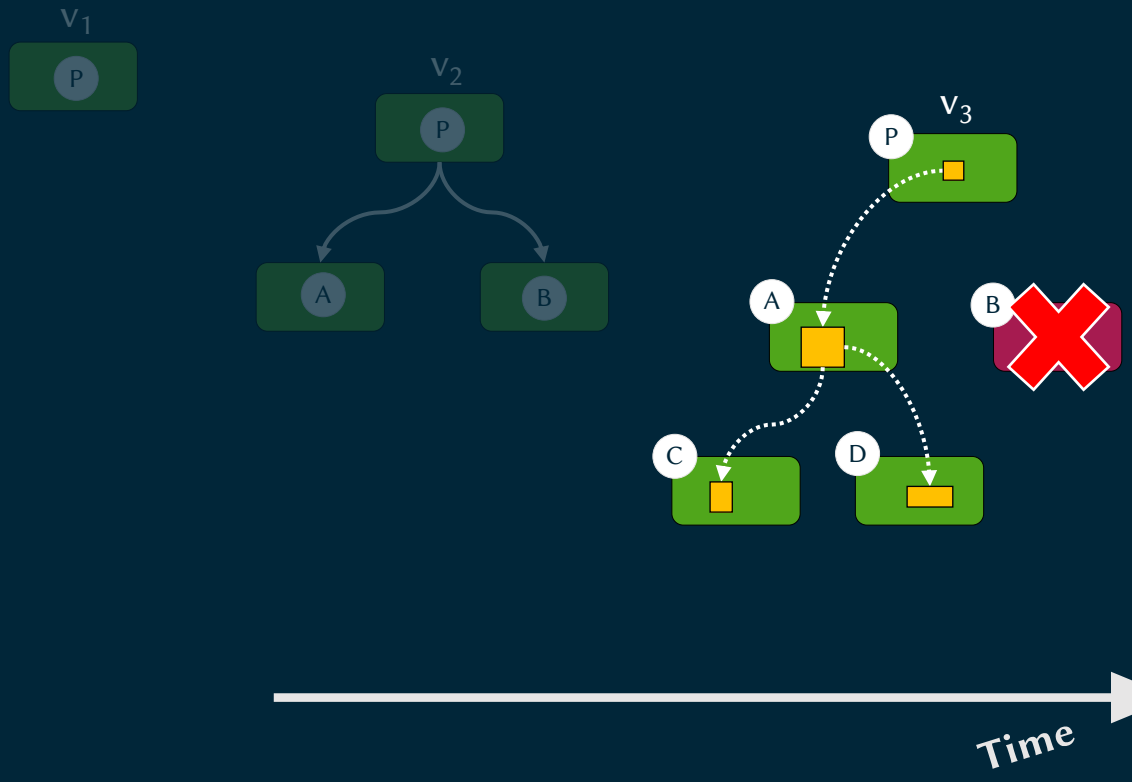
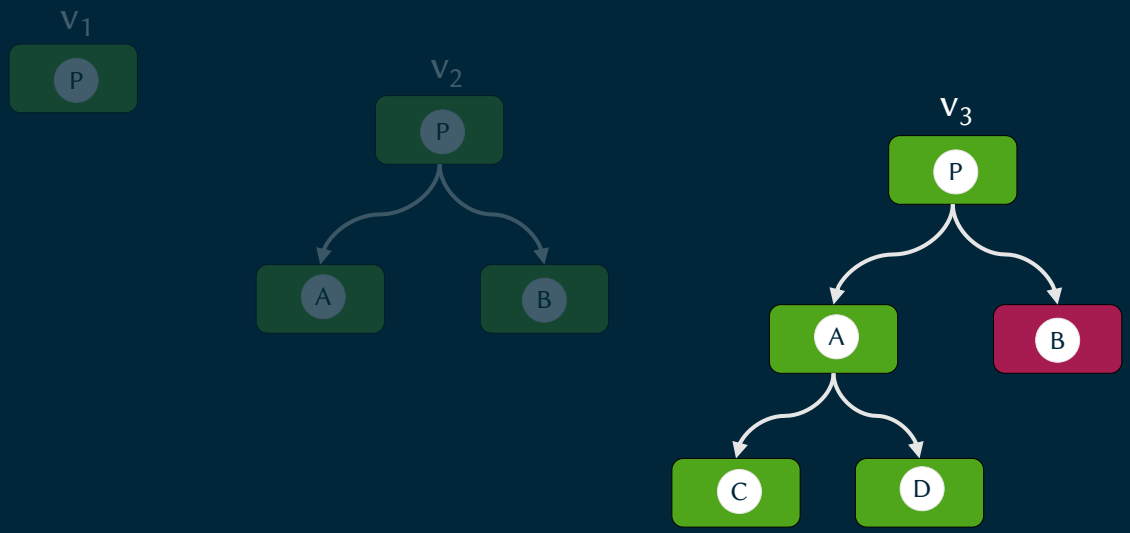
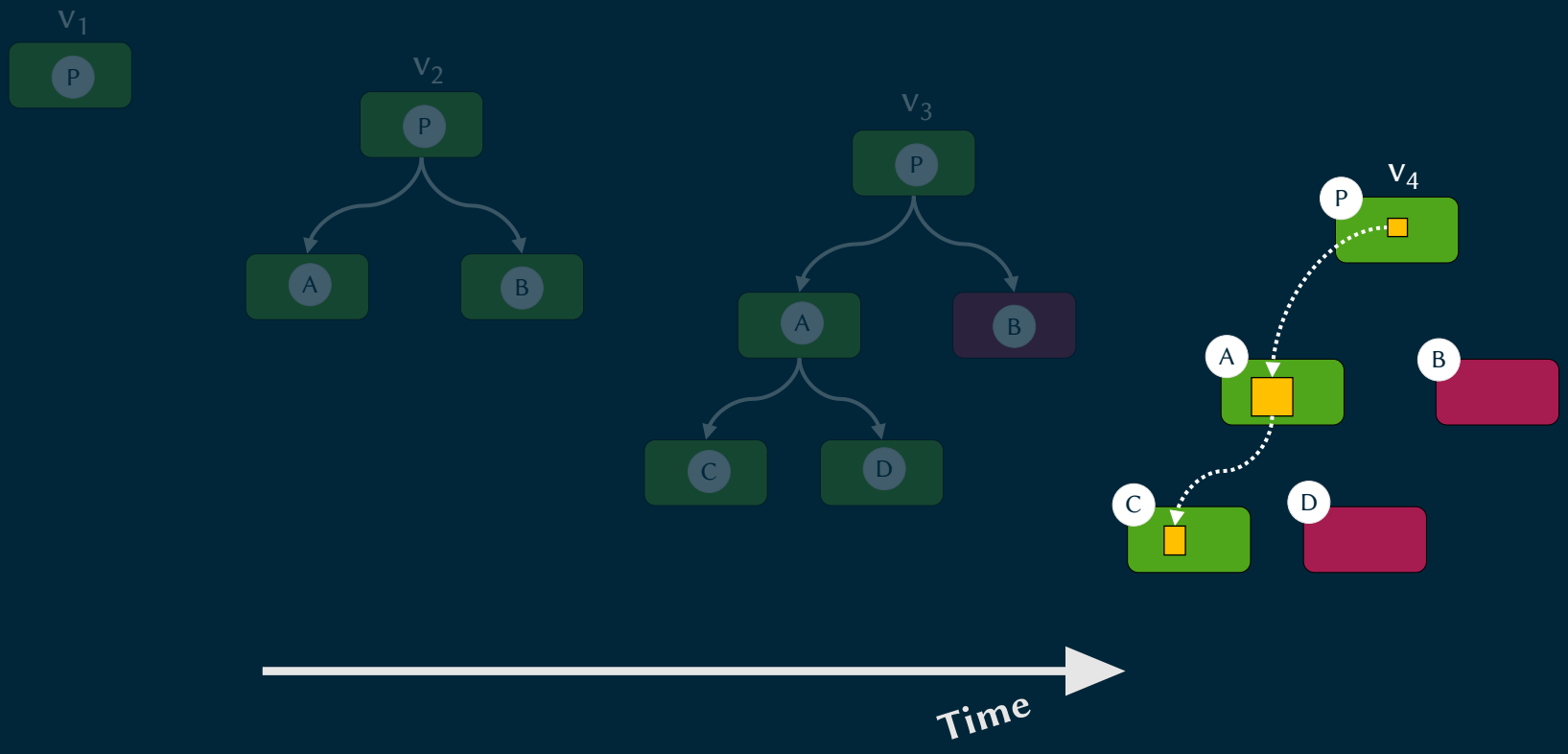


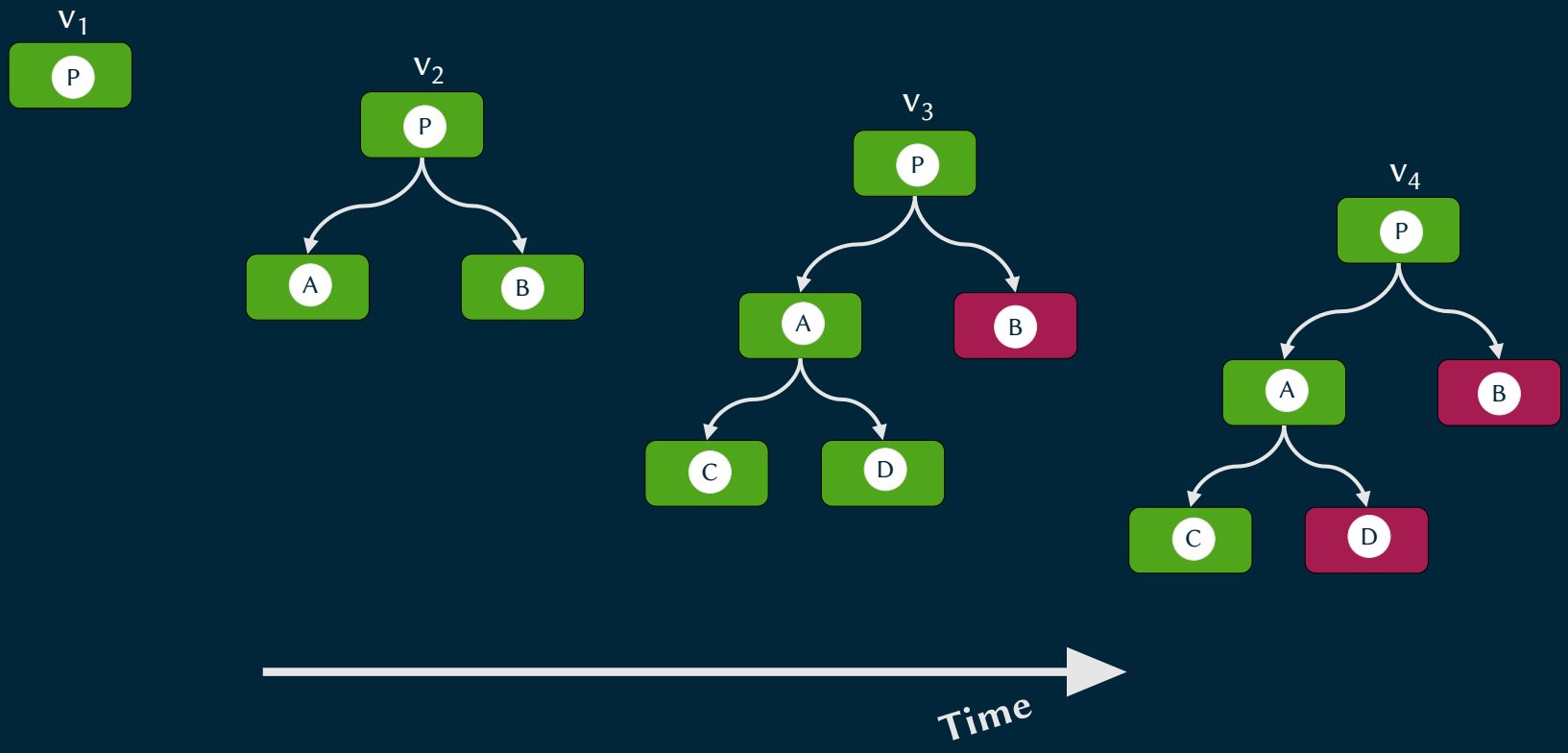
Bloated Dependencies Over Time



Bloated Dependencies Over Time



Bloated Dependencies Over Time



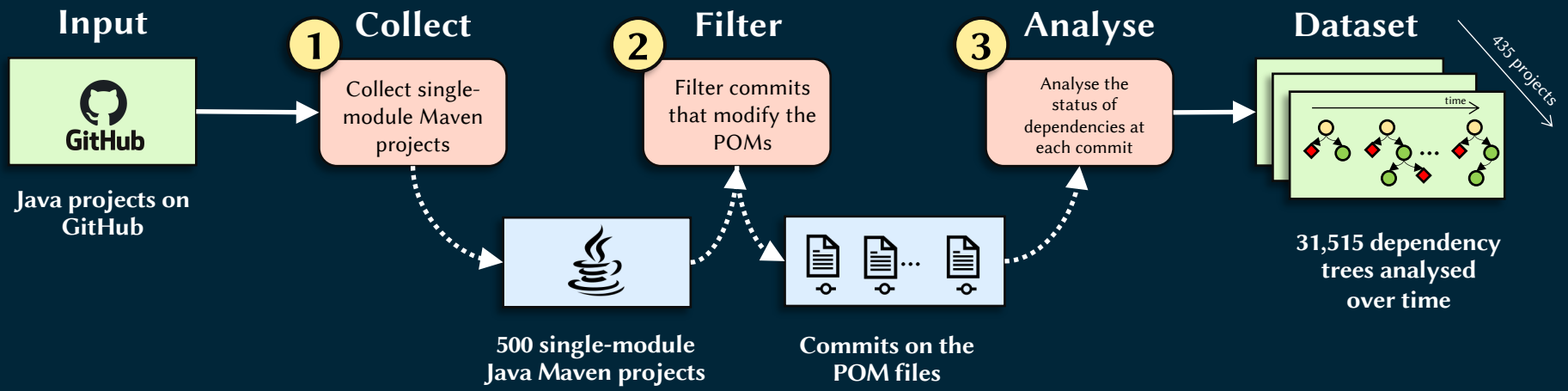
Research Questions

- **RQ1:** How does the amount of bloated dependencies evolve across releases?
- **RQ2:** Do bloated dependencies stay bloated across time?
- **RQ3:** Do developers maintain dependencies that are bloated?
- **RQ4:** What development practices change the usage status of dependencies?

Research Questions

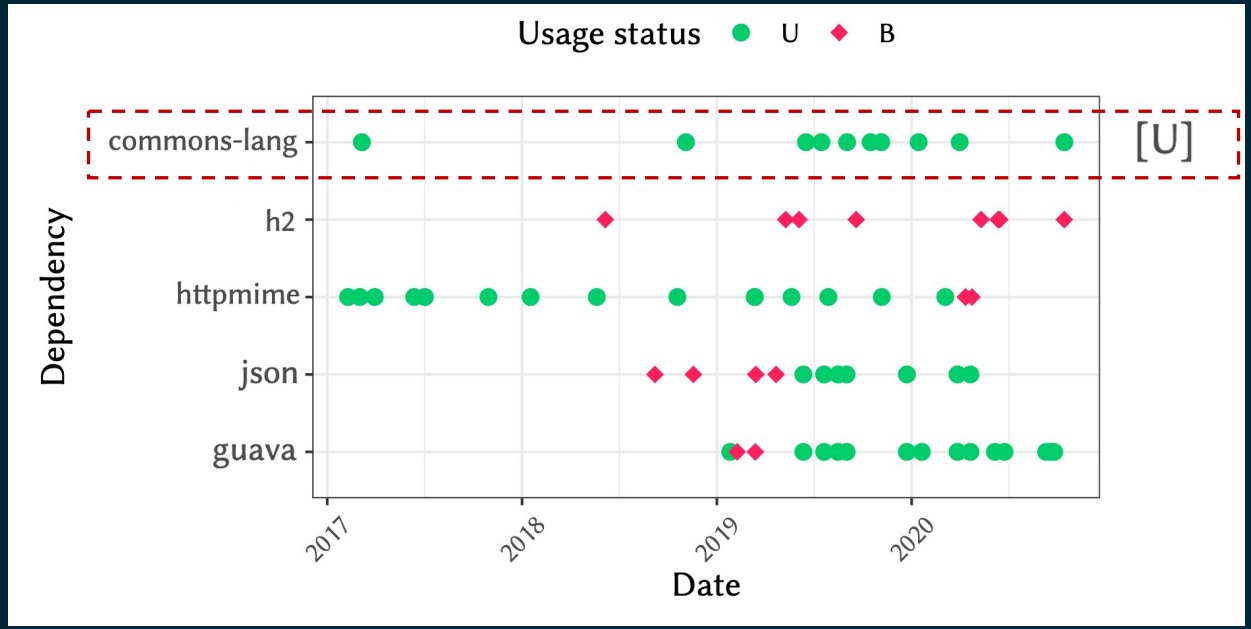
- **RQ2:** Do bloated dependencies stay bloated across time?
- **RQ3:** Do developers maintain dependencies that are bloated?

Data Collection Pipeline



Research Question #2

RQ2: Do bloated dependencies stay bloated across time?



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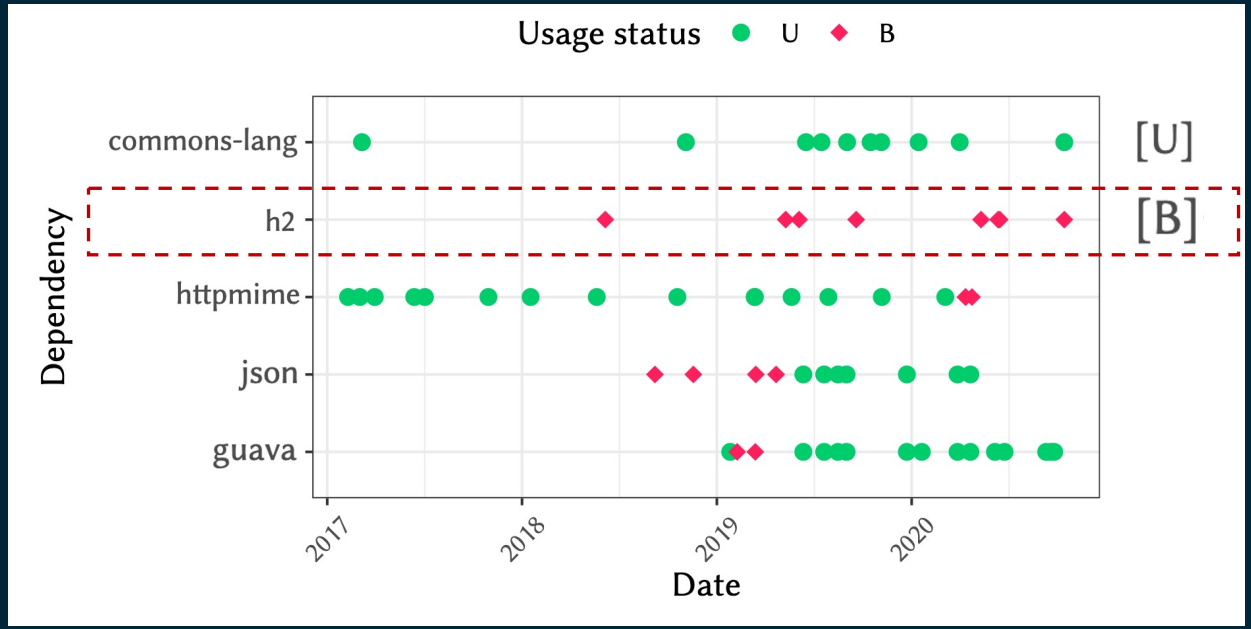

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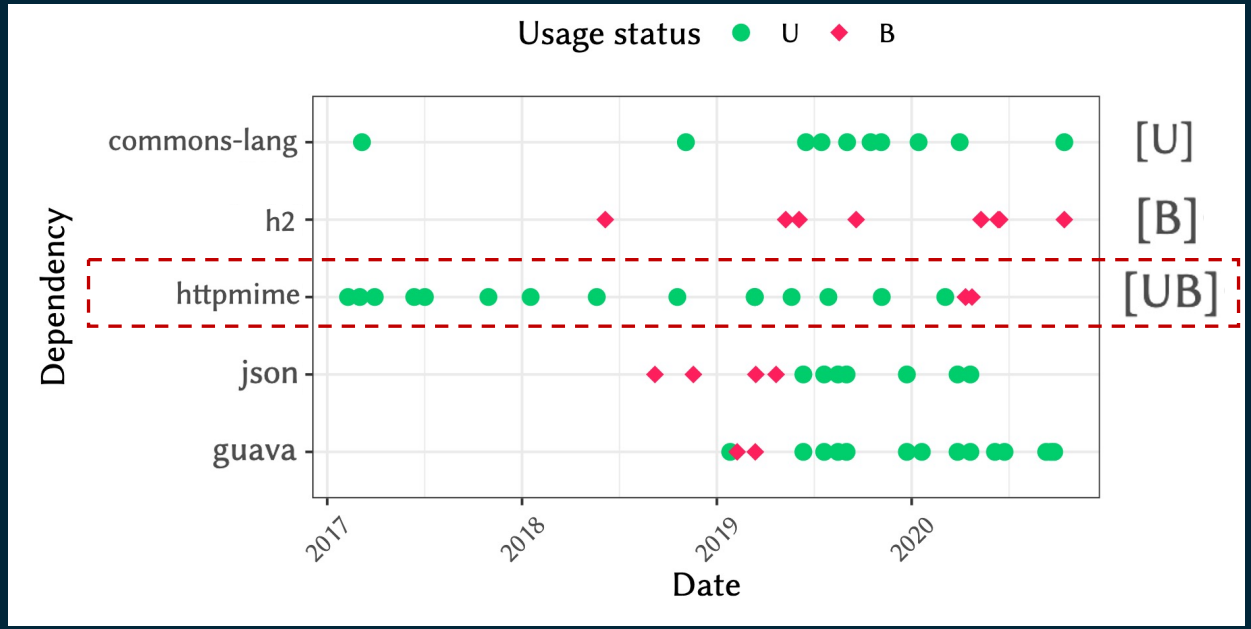

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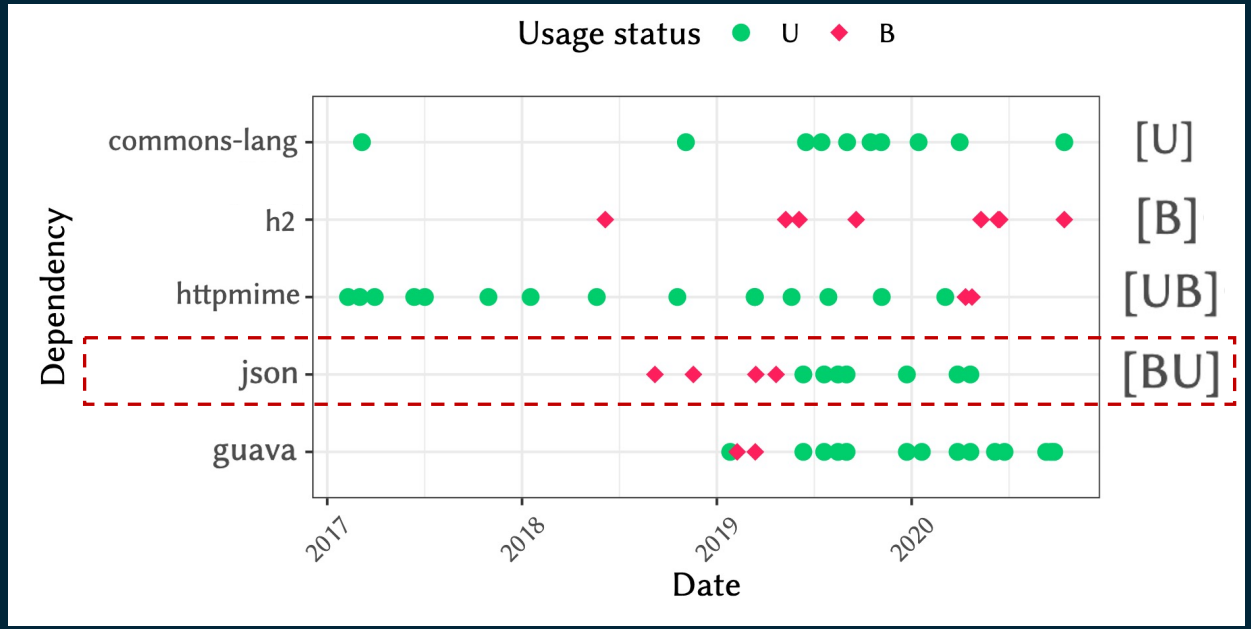

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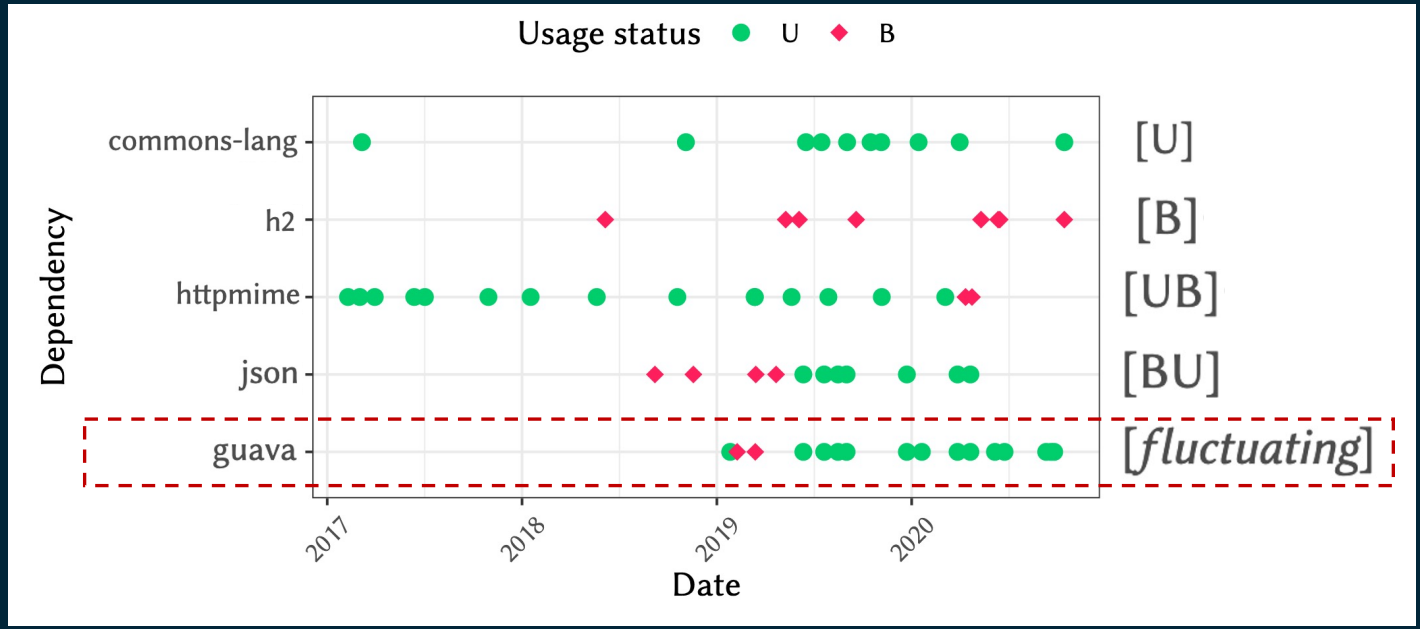

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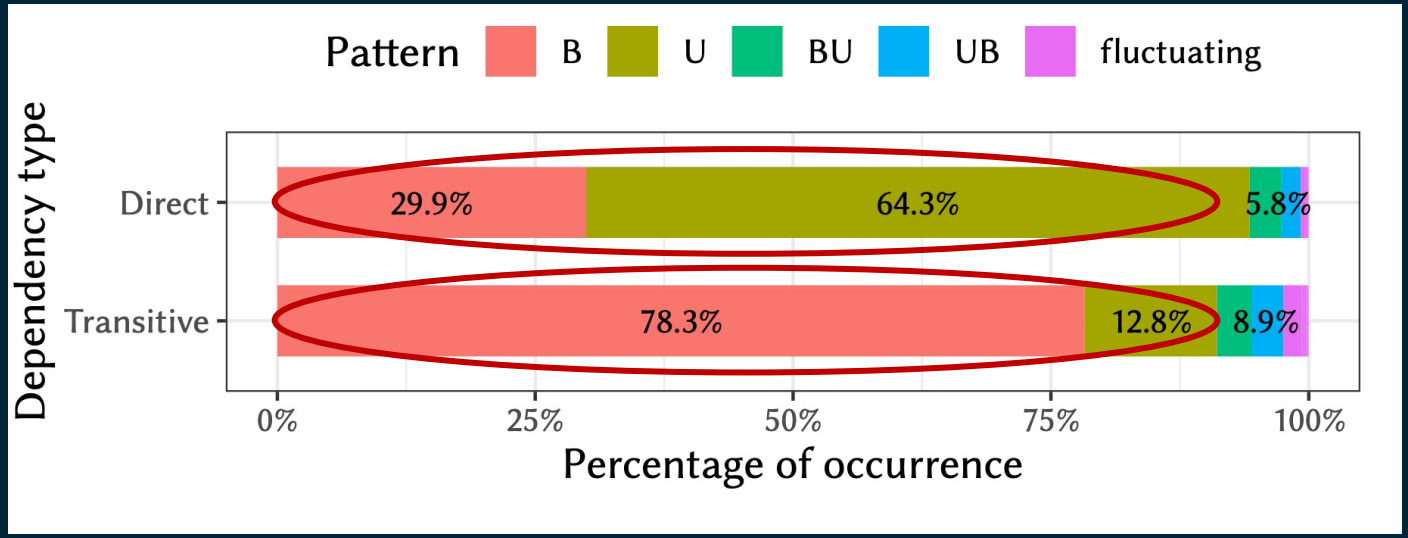


Research Question #2

89.2% of bloated direct, and 93.3% of the transitive bloated dependencies remain bloated in all subsequent versions of the studied projects.

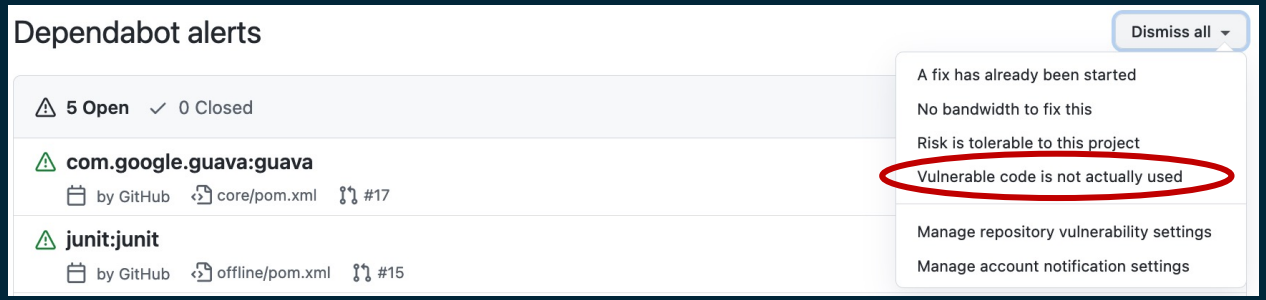
Research Question #3

RQ3: Do developers maintain dependencies that are bloated?

```
118  118        <dependency>
119  119           <groupId>commons-io</groupId>
120  120           <artifactId>commons-io</artifactId>
121       -        <version>2.6</version>
     121  +        <version>2.7</version>
122  122        </dependency>
```

Research Question #3

RQ3: Do developers maintain dependencies that are bloated?



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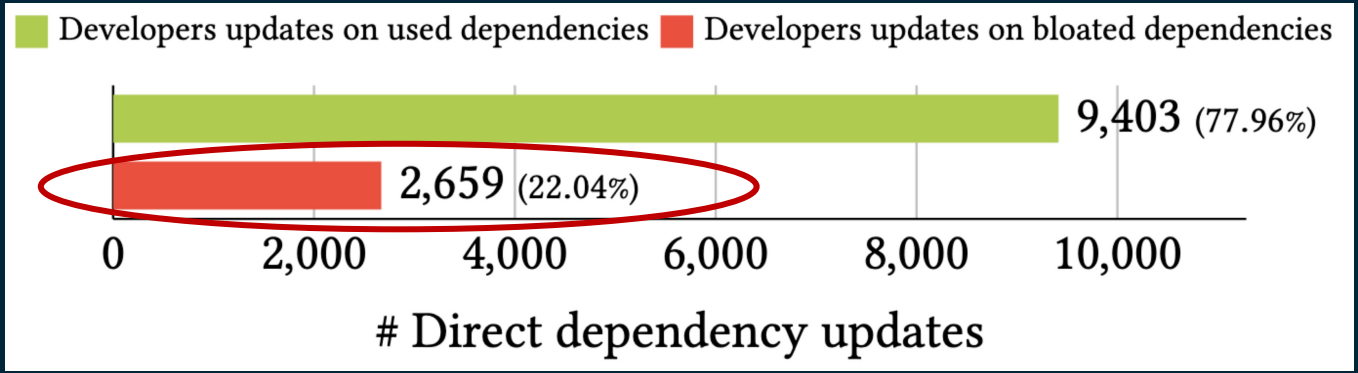

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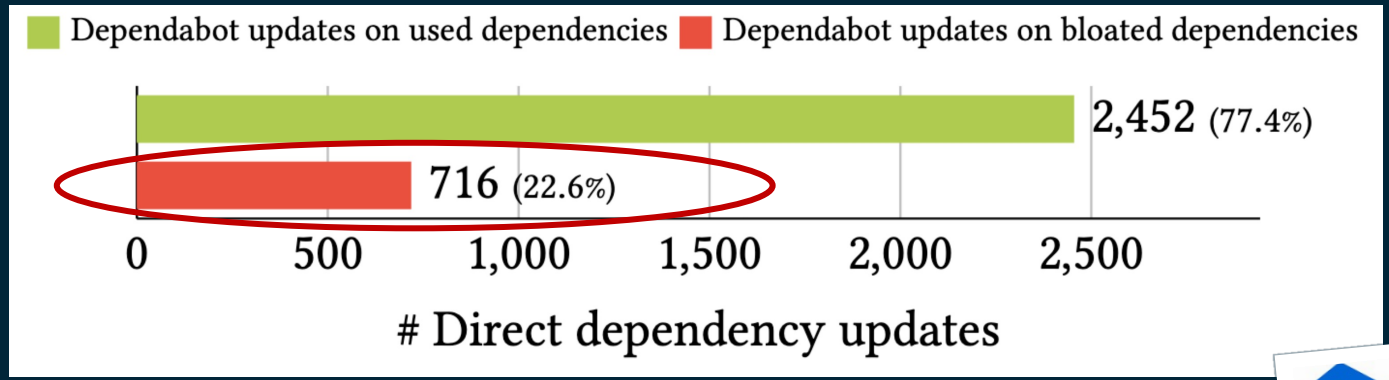
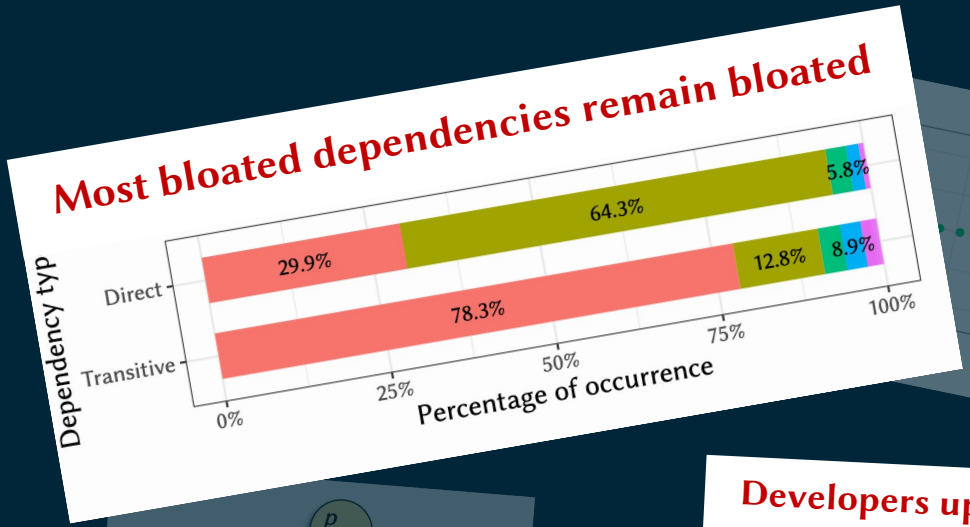
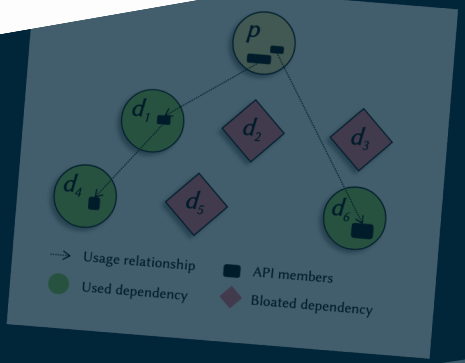


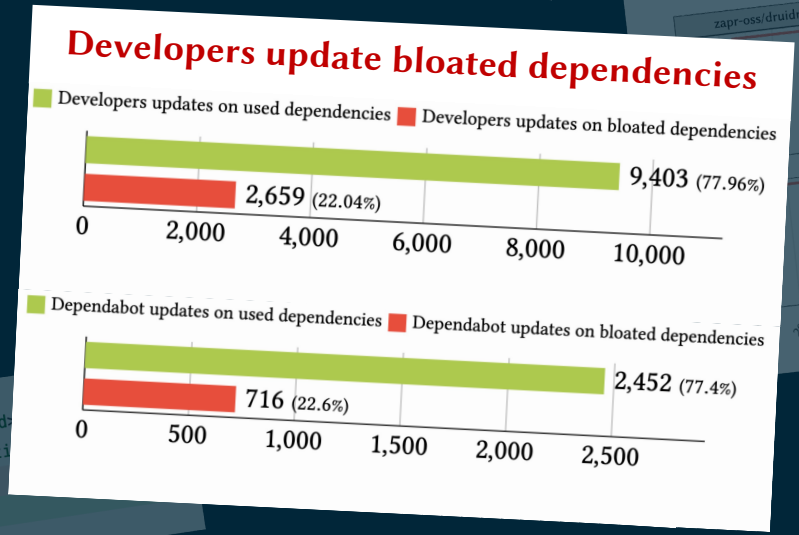
Dependabot

Research Question #3

22% of dependency updates performed by developers and bots are made on bloated dependencies.


Most bloated dependencies remain bloated
Dependency typ
Direct
Transitive
29.9%
64.3%
5.8%
78.3%
12.8%
8.9%
0%
25%
50%
75%
100%
Percentage of occurrence


p
d_1
d_2
d_3
d_4
d_5
d_6
Usage relationship
Used dependency
API members
Bloated dependency


Developers update bloated dependencies
Developers updates on used dependencies
Developers updates on bloated dependencies
9,403 (77.96%)
2,659 (22.04%)
0
2,000
4,000
6,000
8,000
10,000
Dependabot updates on used dependencies
Dependabot updates on bloated dependencies
2,452 (77.4%)
716 (22.6%)
0
500
1,000
1,500
2,000
2,500


118 118 <dependency>
119 119 <groupId>commons-io</groupId>
120 120 <artifactId>commons-io</arti
121 - <version>2.6</version>
121 + <version>2.7</version>
</dependency>


Trend
inc
dec
stable
zapr-oss/druidry
sonian/elasticsearch-jetty
percy/percy-java
Date