# Nullable Method Detection

Don’t Repeat The Mistakes Others Have Already Fixed

Manuel Leuenberger

Master thesis

13.12.2016

# Problem

```
Terms terms = fields.terms(field);
TermsEnum termsEnum = terms.iterator();
```

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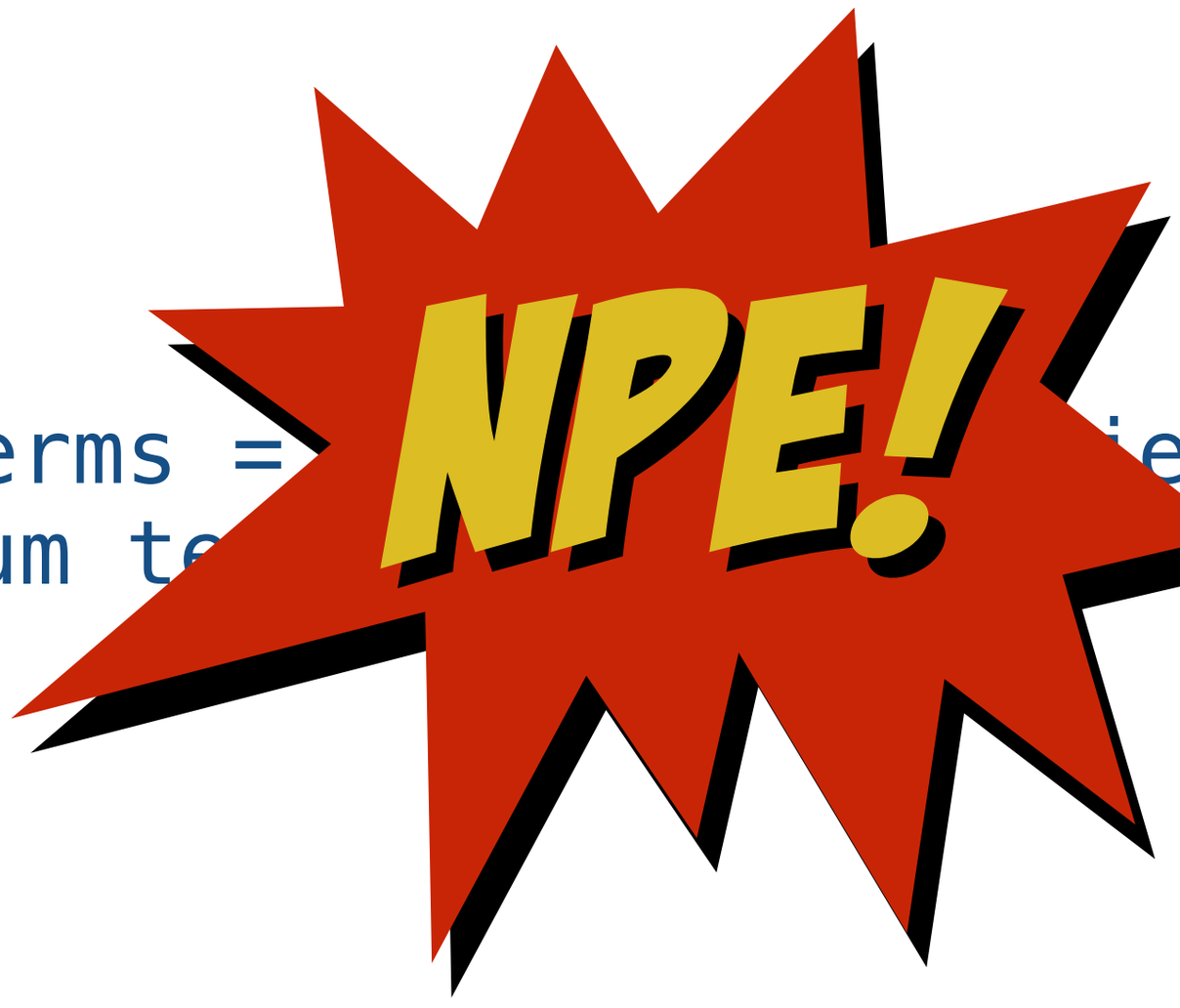


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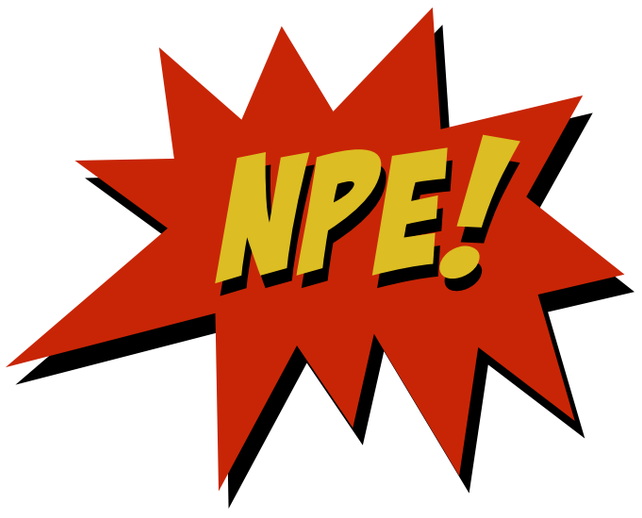
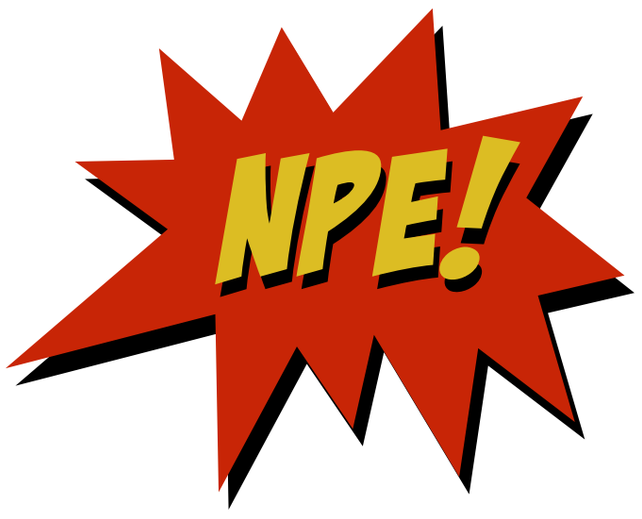
# Related Work



# Related Work

null check is most frequent bug-fix pattern



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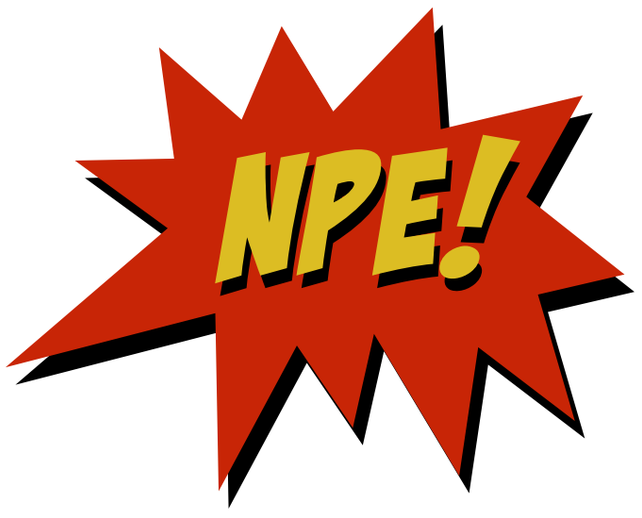

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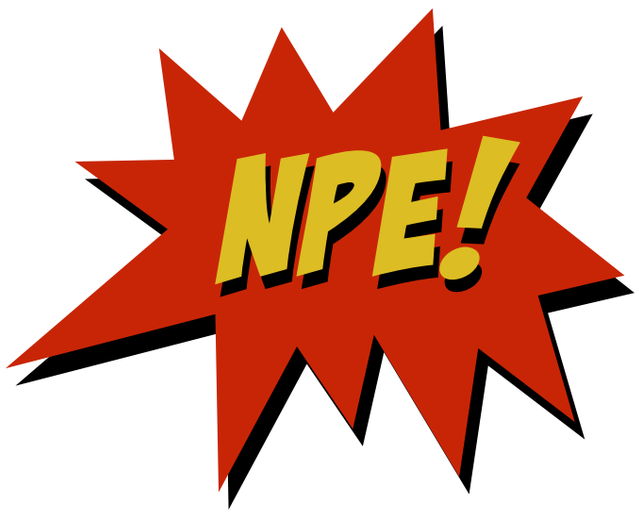

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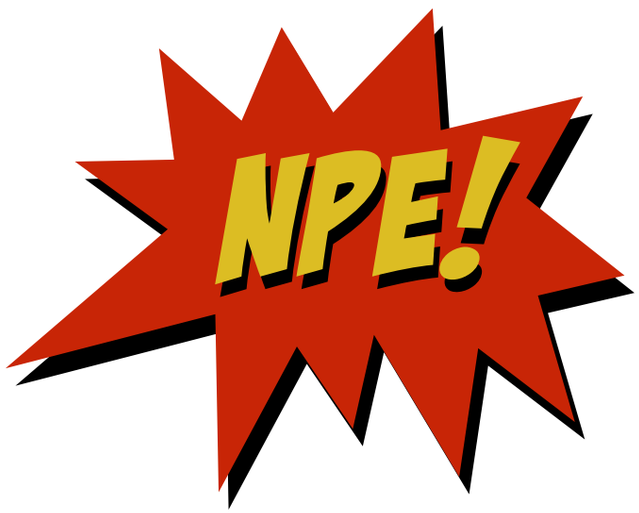
false-positives due to infeasible paths



# Idea

**Don’t Repeat The Mistakes Others Have Already Fixed**

empirical evidence instead of verification

# Goal

```
Terms terms = fields.terms(field);
TermsEnum termsEnum = terms.iterator();
```

# Goal

**77% (535/699) checked for null**

```
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```

# Method UUID

- lookup requires method UUID
- method contracts may evolve
- (class, method) not universally unique

→ (**Maven artifact**, class, method) is unique

```
    groupId: org.apache.lucene
 artifactId: lucene-core
    version: 6.2.0
      class: o.a.l.i.Fields
     method: o.a.l.i.Terms terms(j.l.String)
```

# Nullable Method Detection

*nullable method* := “callers check return value for null”

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```
org.apache.lucene.index.Fields
org.apache.lucene.index.Terms terms(java.lang.String)
```

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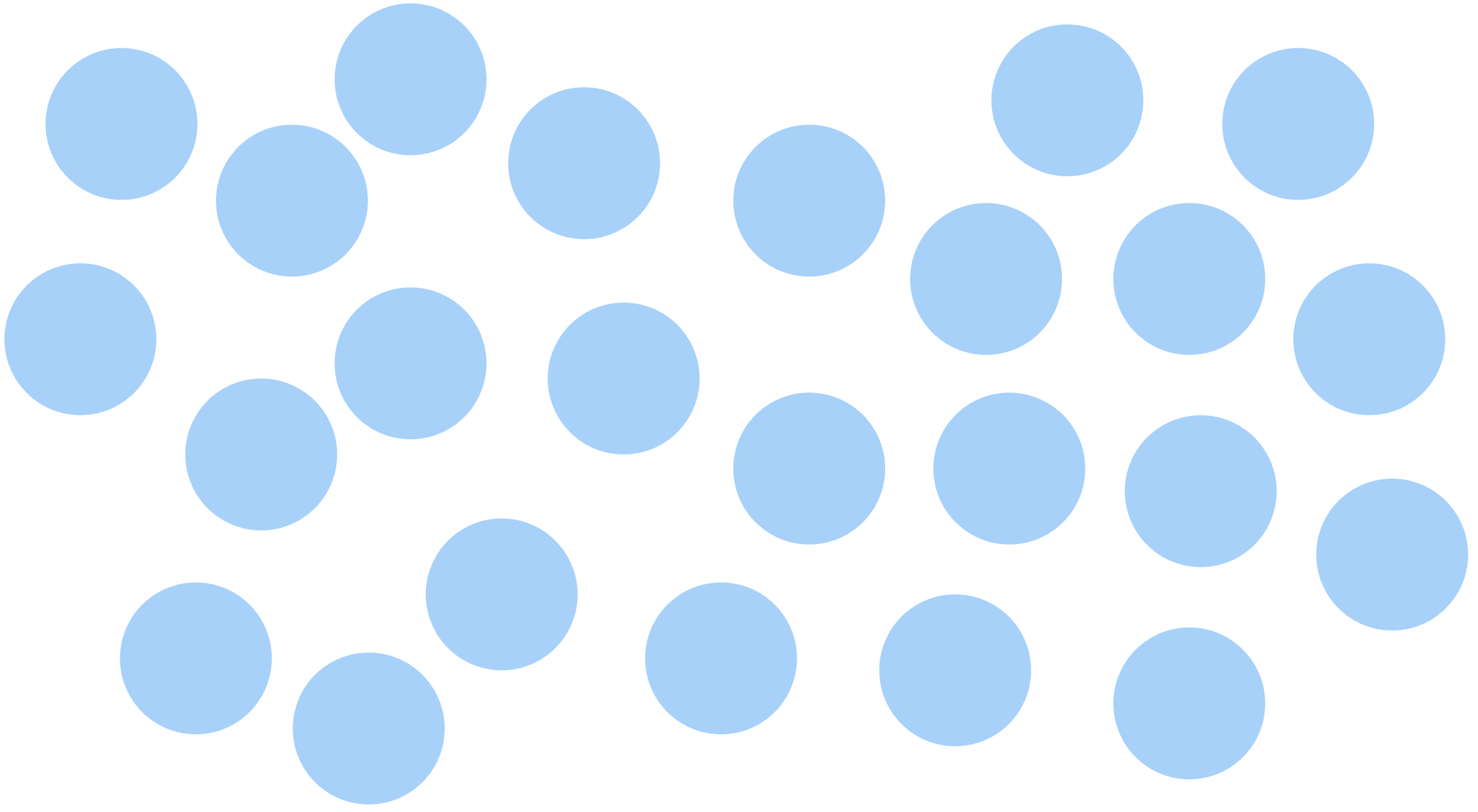
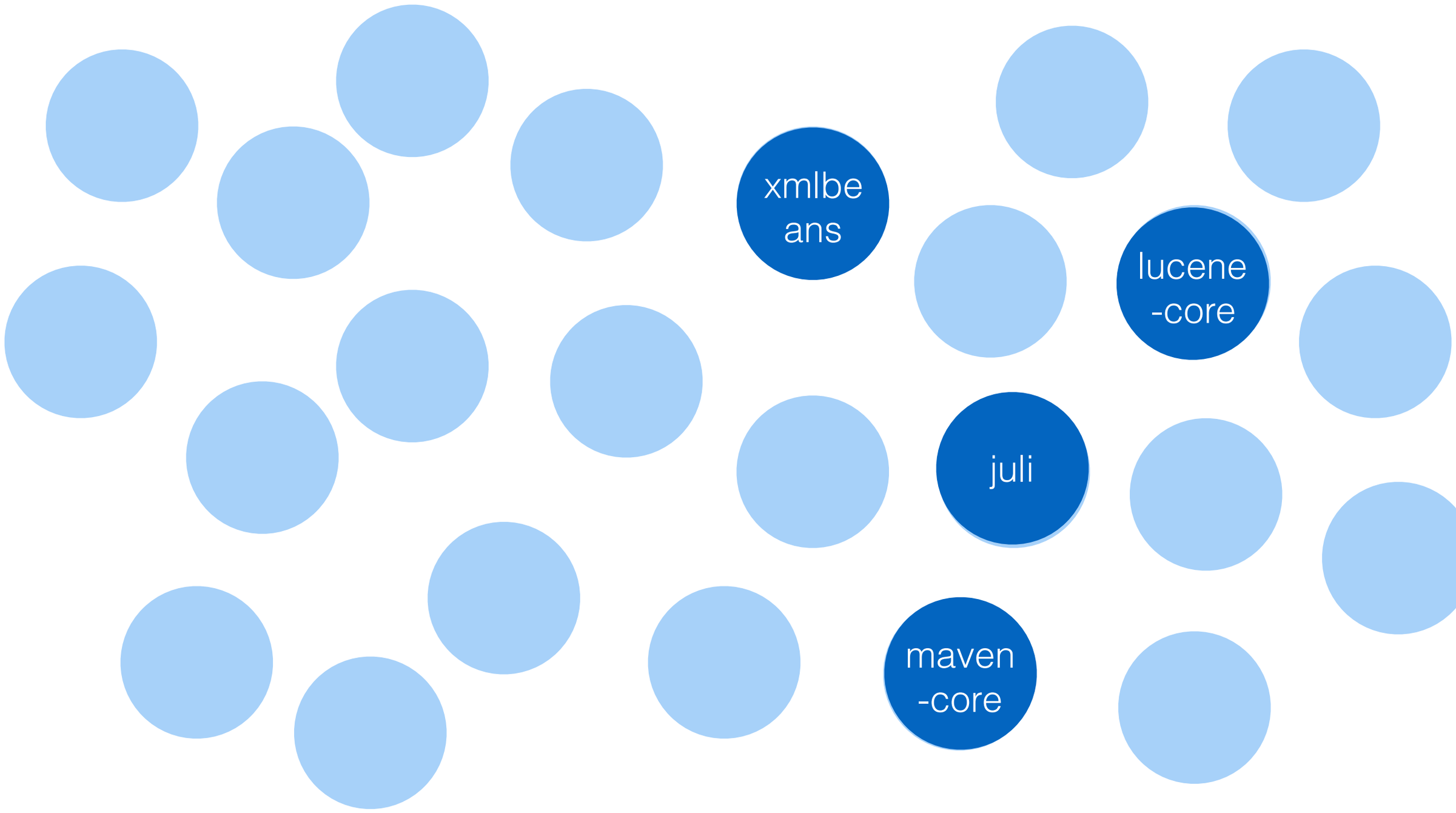
# Usage of **Apache** Artifacts



# Usage of **Apache** Artifacts



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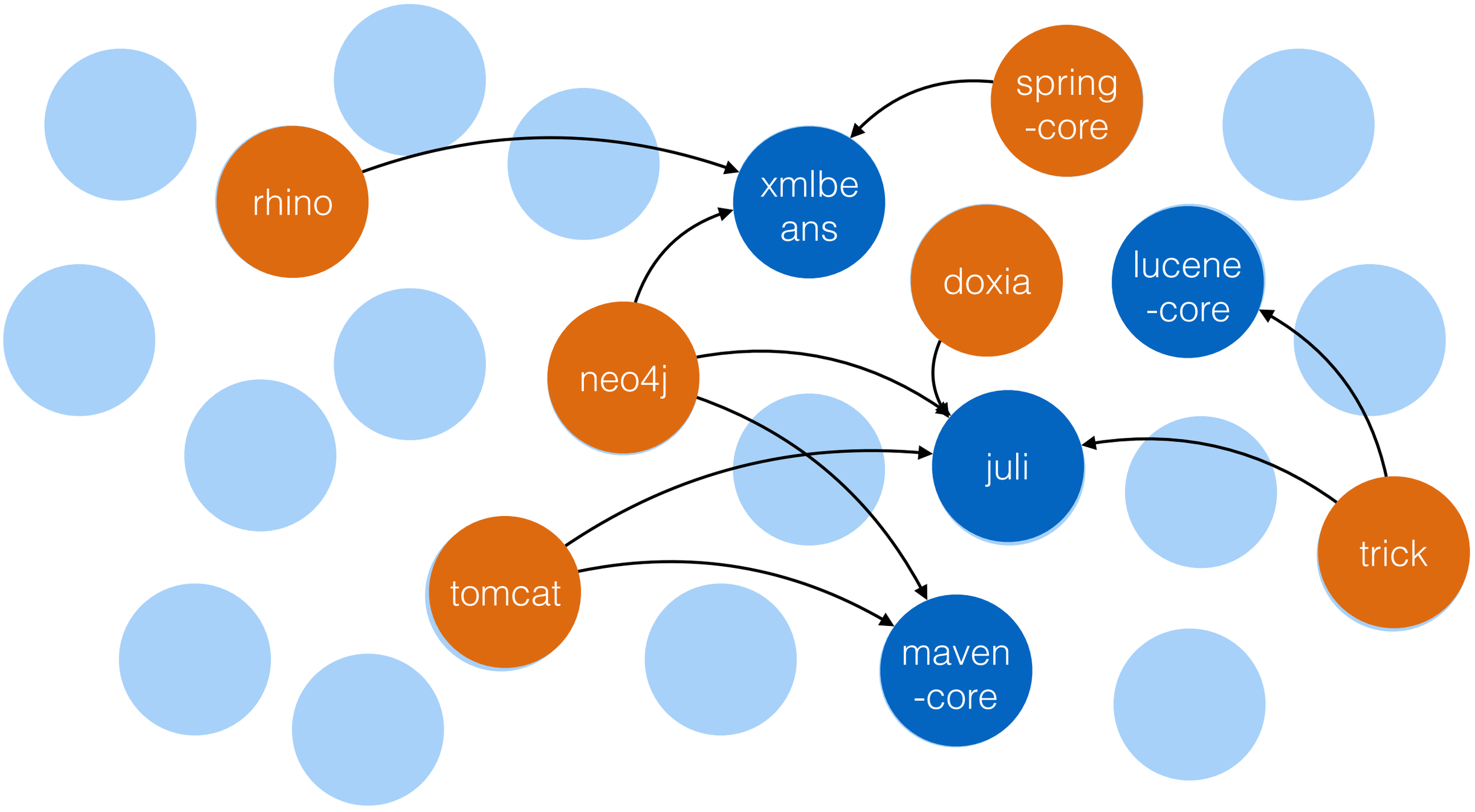
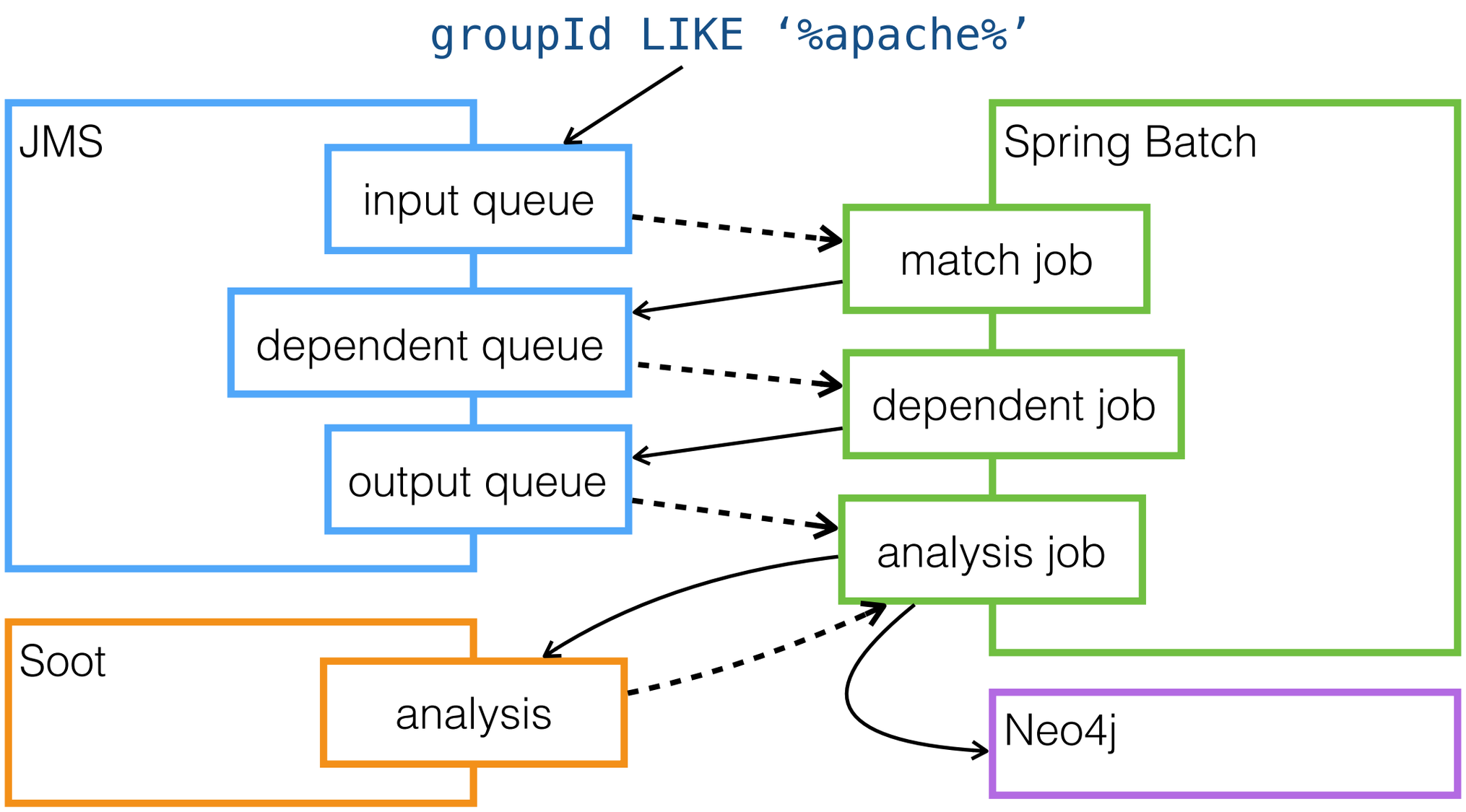
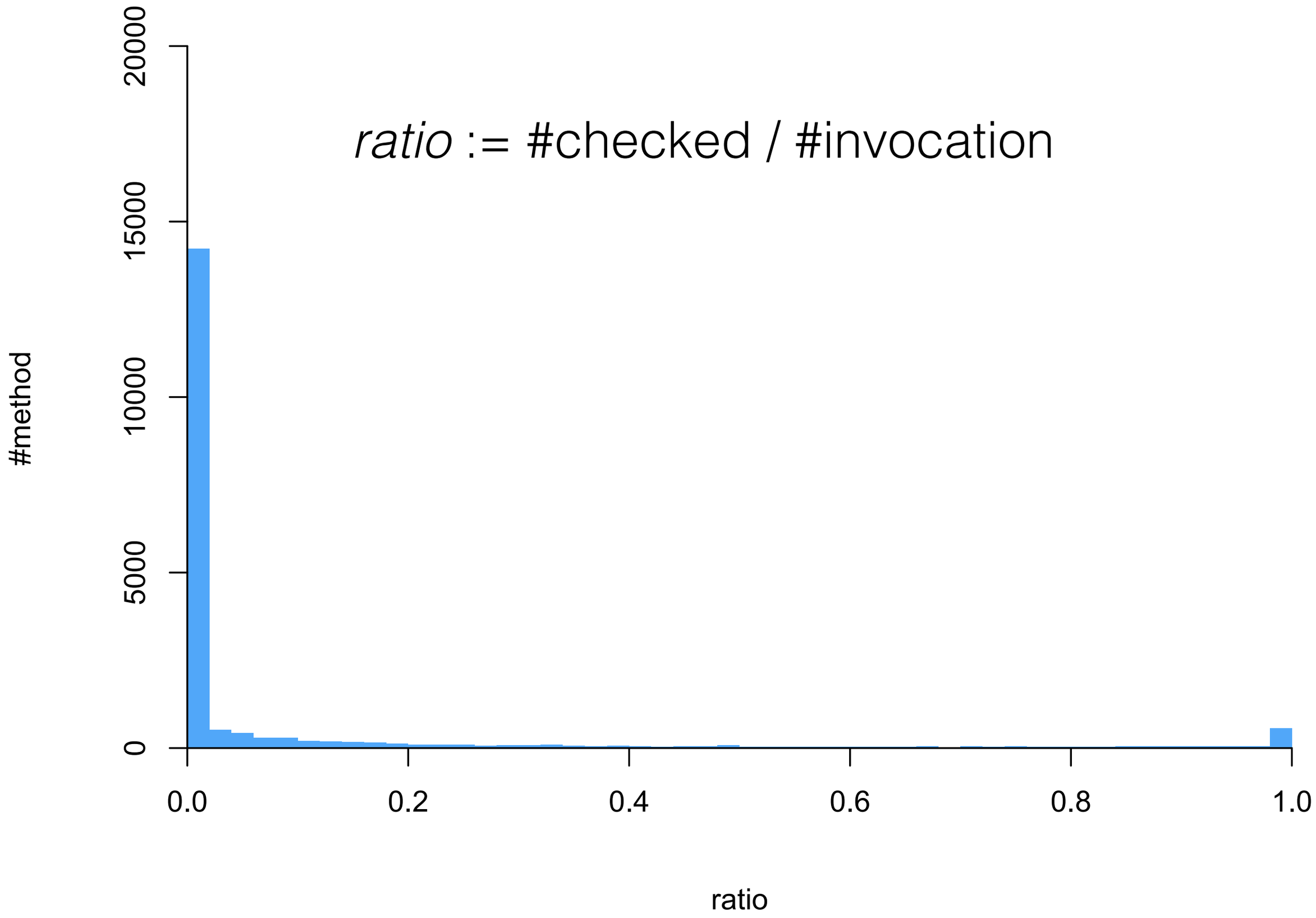


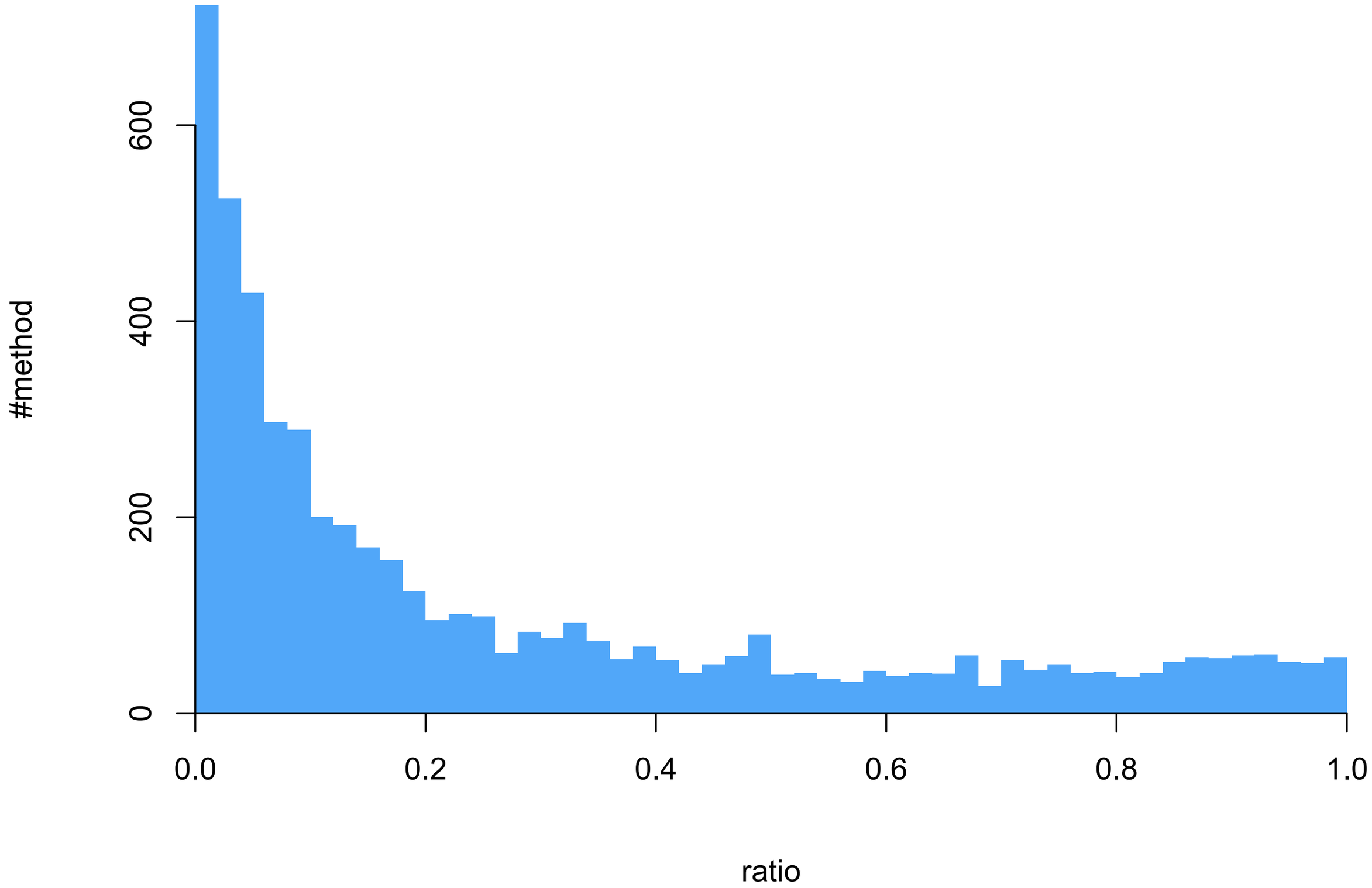
# Architecture



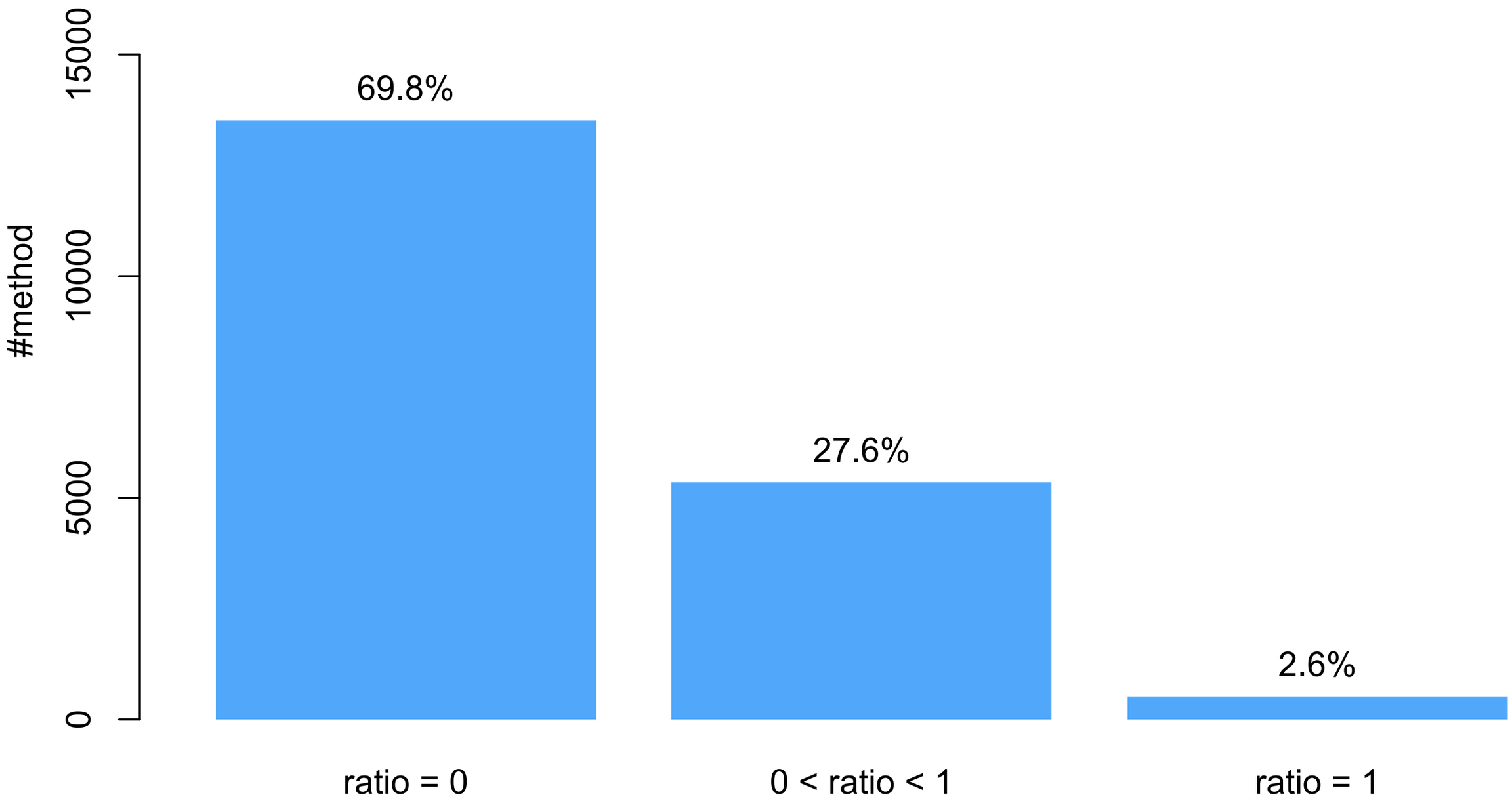
# Results

- analyzed
  - ~45’000 artifacts
  - ~5’000’000 classes
  - ~37’000’000 methods
- found
  - ~150’000’000 invocations
  - ~10’000’000 null checks


nullable method distribution, #method = 19363, #invocation >= 100
ratio := #checked / #invocation
#method
0
5000
10000
15000
20000
0.0
0.2
0.4
0.6
0.8
1.0
ratio


nullable method distribution, #method = 5342, #invocation >= 100, 0 < ratio < 1
#method
0
200
400
600
0.0
0.2
0.4
0.6
0.8
1.0
ratio

# nullable method distribution, #method = 19363, #invocation >= 100



# Limitations

- only ~20’000 methods with >100 invocations
- analysis only detects single expression checked for null in if statements

```
// not detected
Objects.notNull(value)
if (value instanceof  String) {
if (value1 > 0 && value2 != null) {
```

# Conclusion

- Focussed API usage analysis
  - build thousands of class-paths per hour
  - analyze hundreds of artifacts per hour
- 70% of methods are never checked
- 27% of methods are sometimes checked
- 3% of methods are always checked

→ **only invocations of 27% of methods need further analysis**

# Future Work

- IDE plugin that looks up invocations on nullability
- analyze whole Maven repositories
- intra-procedural: detect bugs
- inter-procedural: prune call-graphs with knowledge about nullable methods

# Lessons Learned

- analyzing binaries with Soot is easy, and you get precise types for free
- JMS works well as stream buffers
- Neo4j scales, writing with kernel is nice, querying with cypher is ok, query planner is not always clever, transactions have isolation issues
- Spring is still not a close friend
- still love Java 8 streams
- crunching numbers and plotting with R is surprisingly easy

# References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