An Exploratory Study on Library Aging by Monitoring Client Usage in A Software Ecosystem

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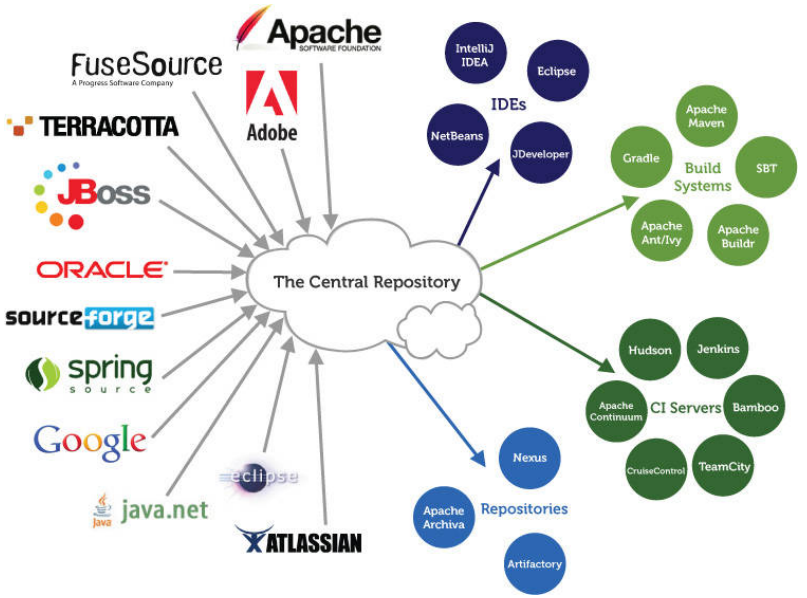
Third-party Software Reuse is commonplace...

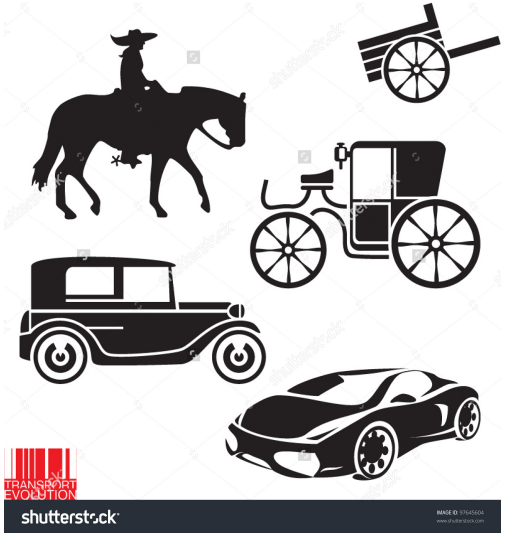
The Central Maven Ecosystem



Managing these third-parties ...

not so trivial...

- consider transistive
- consider stability



Leave to the ecosystem forces ...

Dependency Management Tools

Maven JVM libraries

NPM

Bower

PyPi...

Developers 'Struggle' with Change

> *We found that all three ecosystems (Eclipse, R/CRAN, and Node.js/npm) differ substantially in their practices and expectations toward change and that those differences can be explained largely by different community values in each ecosystem*

-- *[Bogart et al.,FSE 2016]*

Developer concerns of Software Reliability

Software Aging:

> *'as time passes, aged components are faced with a higher likelihood to fail'*

-- *[Parnas, ICSE 1994]*

Code Decay:

> *'unanimous feeling among developers of the software that code degrades through time and maintenance becomes increasingly difficult and expensive'*

-- *[Eick et al., TSE 2001]*

~~Leave~~ Aware of the ecosystem forces ...

Developer concerns of ~~Software~~ Library Aging

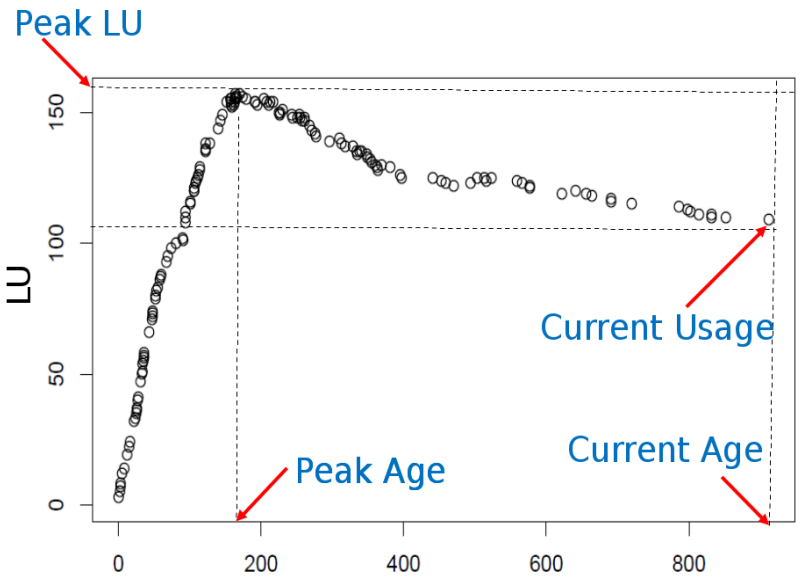
- Concept based on Monitoring Library Usage (LU) within the Ecosystem
- At a higher abstract than API.
- ~~Software~~ Library Decay

Code Rejuvenation:

> *'a mitigation of code decay, to prolong the lifespan of a software'*

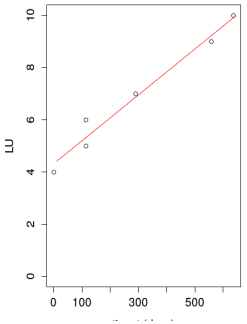
- What ecosystem changes influence the aging process? ~~Rival~~ newer versions?

Key Characteristics and LU Trends



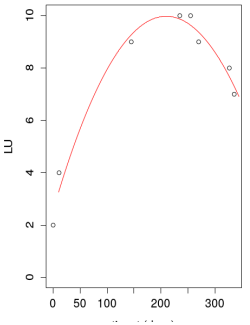
Modeling Library Aging (polynomial equations)

First-order



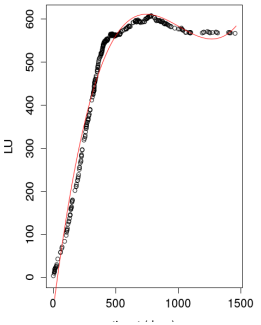
Steady Increase

Second-order



Decay

Higher-order



Decay and Rejuvenation

Empirical Study - Research Questions

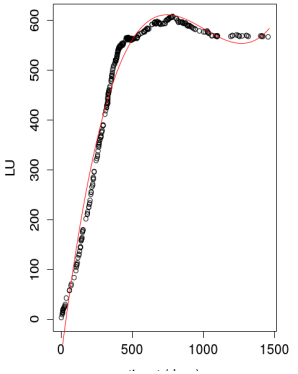
- (RQ1) Do popular libraries share common aging characteristics of their LU? If so, what are these characteristics?
- (RQ2) What is the effect of ecosystem factors such as library rivals to popular library aging characteristics?

RQ1 Research Method

Quantitative Method

- Extracted Library Usage of 4,659 GitHub Java Projects
- Changes in dependencies 852,322
- Popular Library Versions 9,197
- Perform Curve Fitting and Statistical Analysis of Key Characteristics

Results for RQ1



We found 81.7% of the popular libraries (ie., with high Peak LU and Peak Age) best fitted the higher-order model

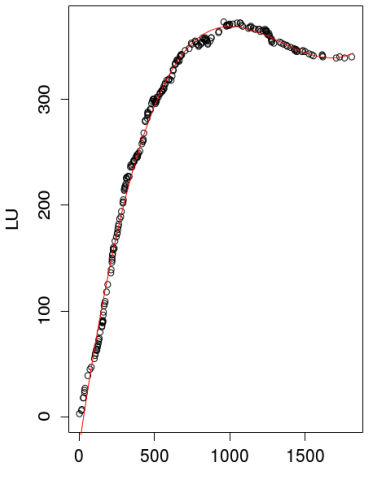
RQ2 Research Method

Qualitative Case Study

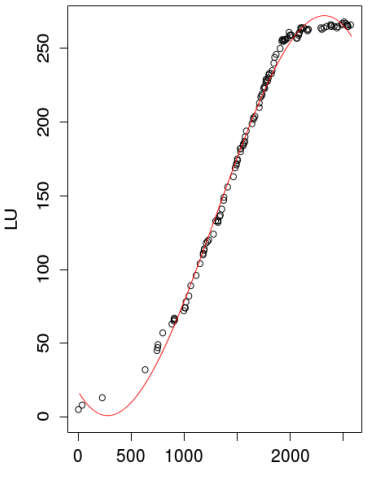
- Case Library versions
  - Junit version, 4.8.2
  - Commons-collections version, 3.2.1
- Inspect the change logs and investigate other related changes in the ecosystem.

Results for RQ2

Junit 4.8.2



Commons-collections 3.2.1



Emergence or absence of ~~rival~~ newer libraries in the ecosystem have an effect on library decay or rejuvenation, especially causing a library to reach its Peak LU.

We present Library Aging as a means to model and evaluate third-party libraries...

Become Aware of the ecosystem ...

As an ERA, many challenges for the future ...

Scalability ...

> *Developers manage multiple library dependencies...*

Find other Ecosystem Factors ...

> *other global factors such as security vulnerabilities or a change in the environment platform may affect the aging of a library*

-- *[Bavota et al., EMSE 2015]*

Variety between Ecosystems...

> *Modeling various ecosystems...*

1. Should we empower users of third-party libraries?

2. What other Ecosystem Factors should are harmful for third-party library users?