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

Raula G. Kula, Osaka University, Japan

Daniel M. German, University of Victoria, Canada

Takashi Ishio, Osaka University, Japan

Ali Ouni, University of UAE, UAE

Katsuro Inoue, Osaka University, Japan
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

- Peak LU
- Current Usage
- Peak Age
- Current Age
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 (i.e., 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.
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?