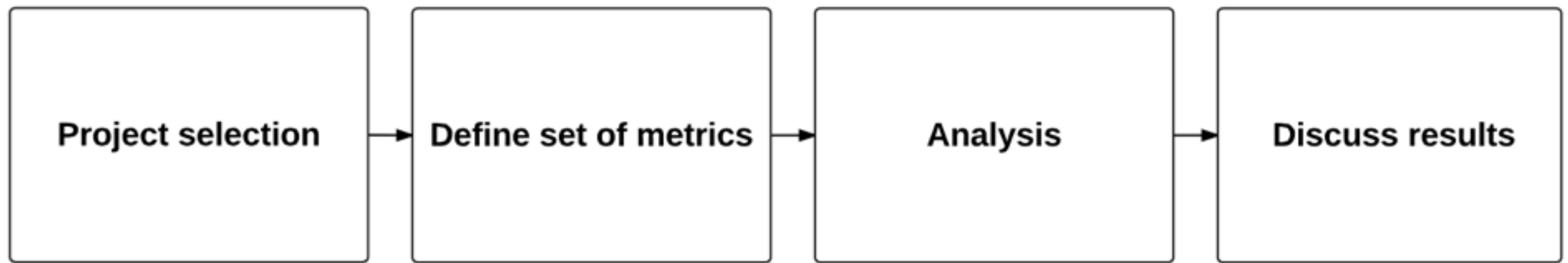


An Empirical Study on Evolution of Open Source JavaScript Projects

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Goal

- Study evolution of JavaScript projects
 - LOC, directory structure, functions, complexity, etc.
- Community Contribution
 - Number of Developers, number of reported issues and the time issues take to fix.
- Study of code smells related to JavaScript
 - With different groups of severity (Critical, Major, Minor, etc).



- 15 open source JavaScript projects
- Total 57 years of evolution
- 1065 releases
- 63473 commits
- 67787 submitted issues on Github issue tracker



Projects

| Project Name | First Release | Last Release | #Releases | #Commits |
|---------------|---------------|--------------|-------------------|---------------------|
| Coffee Script | 2010 | 2015 | 31 | 3967 |
| Less.js | 2010 | 2015 | 38 | 2428 |
| NPM | 2010 | 2015 | <u>298</u> | 5509 |
| Mongoose | 2010 | 2015 | 197 | 4789 |
| Underscore | 2010 | 2015 | 30 | 1985 |
| Node-mysql | 2010 | 2015 | 38 | 914 |
| Q | 2010 | 2014 | 48 | 3359 |
| Request | 2011 | 2015 | 32 | 1644 |
| Ember.js | 2011 | 2015 | 87 | 9150 |
| Source-map | 2011 | 2015 | 29 | <u>396</u> |
| Bootstrap | 2011 | 2015 | 27 | 11195 |
| Mocha | 2011 | 2015 | 80 | 1702 |
| Brackets | 2011 | 2015 | 60 | <u>15871</u> |
| Bower | 2012 | 2015 | 65 | 1813 |
| Grunt | 2013 | 2014 | <u>5</u> | 1309 |

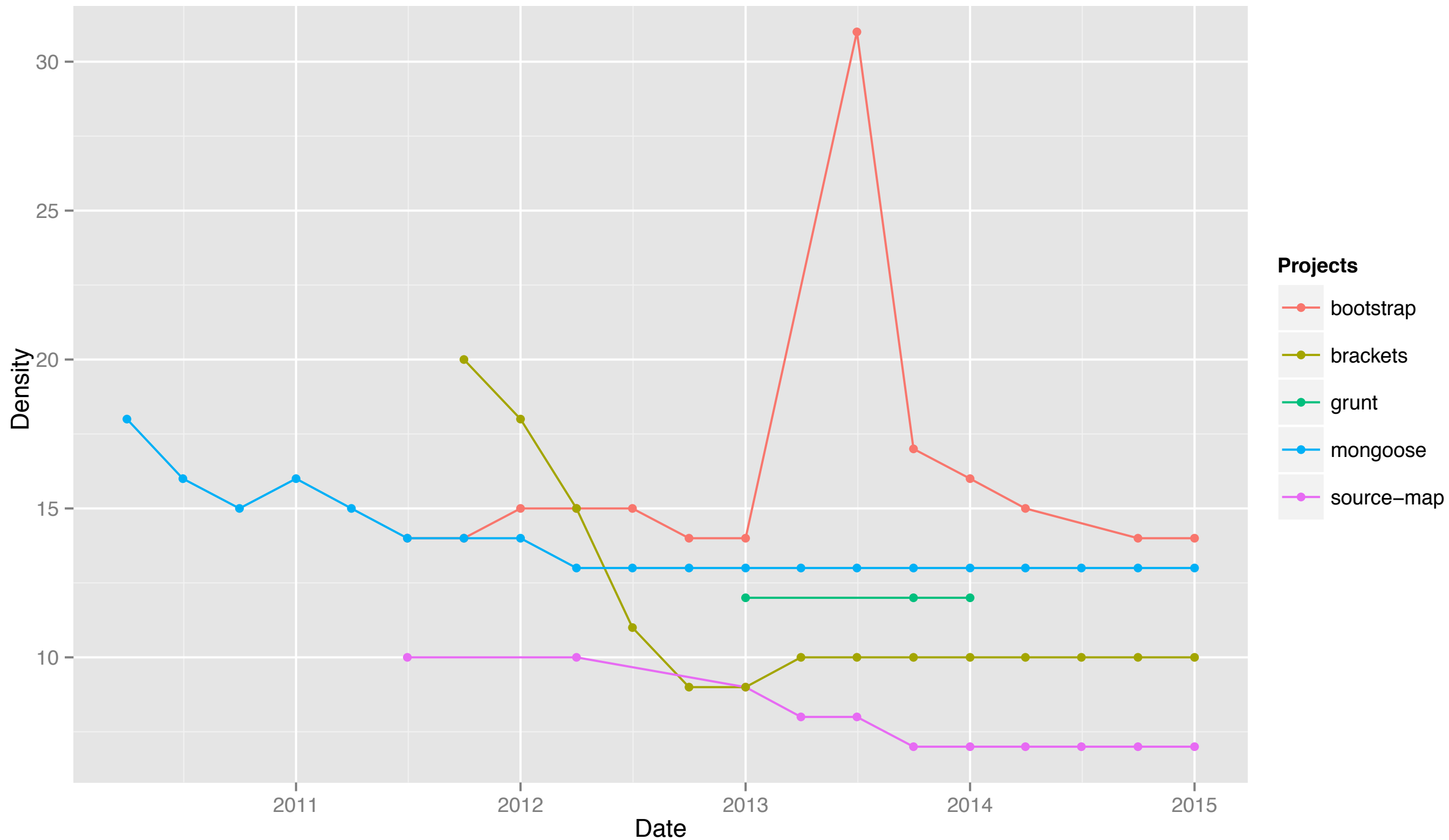
Metrics that we gather to study evolution

- **Lines of code:** The number of uncommented lines of code
- **Complexity:** McCabe complexity
- **Comment Lines:** Number of lines containing either comment or commented-out code.
- **Duplicated Lines(%):** Density of duplication = $\text{Duplicated lines} / \text{Lines} * 100$
- **Number of Directories**
- **Number of Files**
- **Code Smells:** Number of code smells with severity of blocker, critical, major and minor

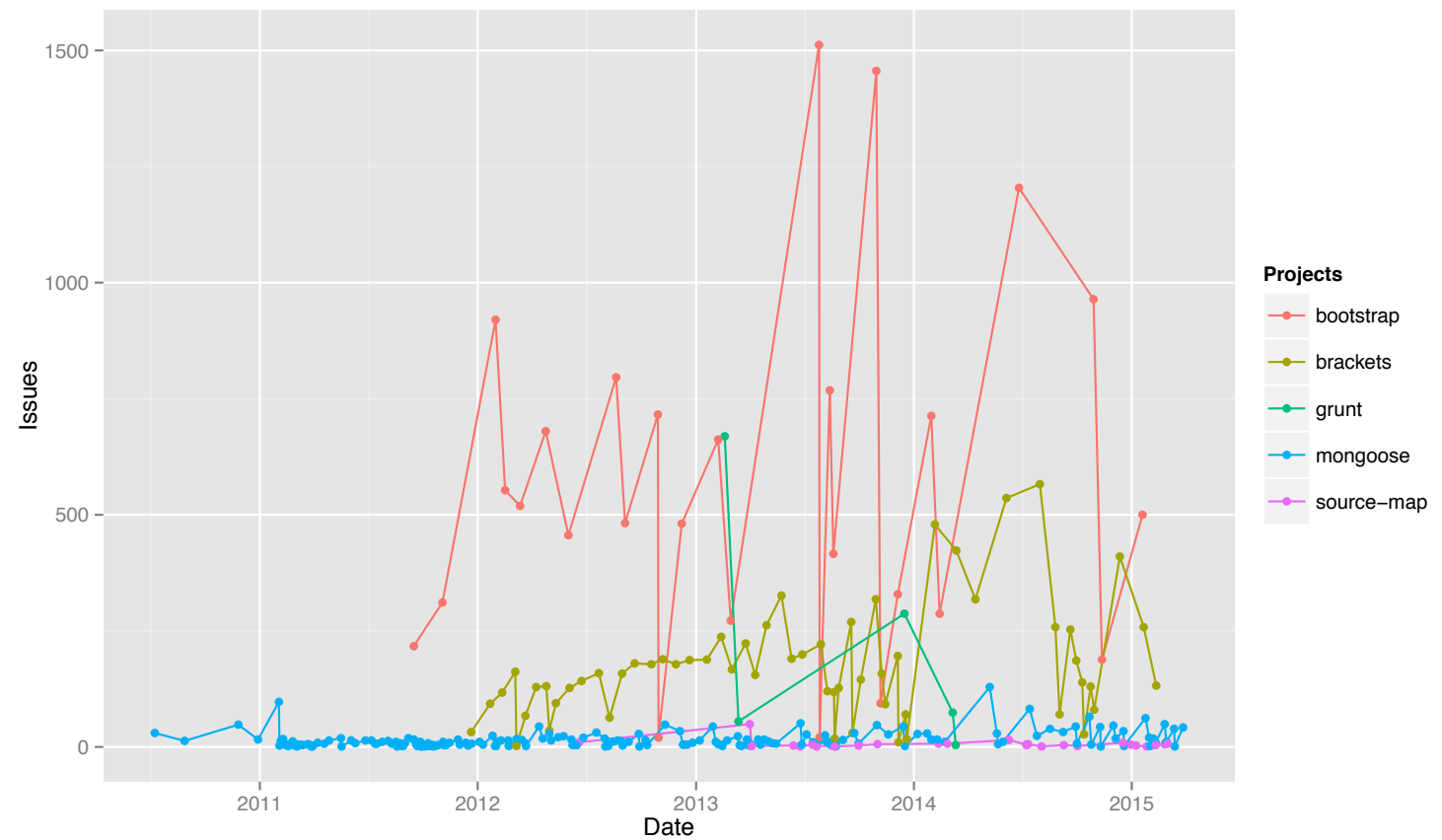
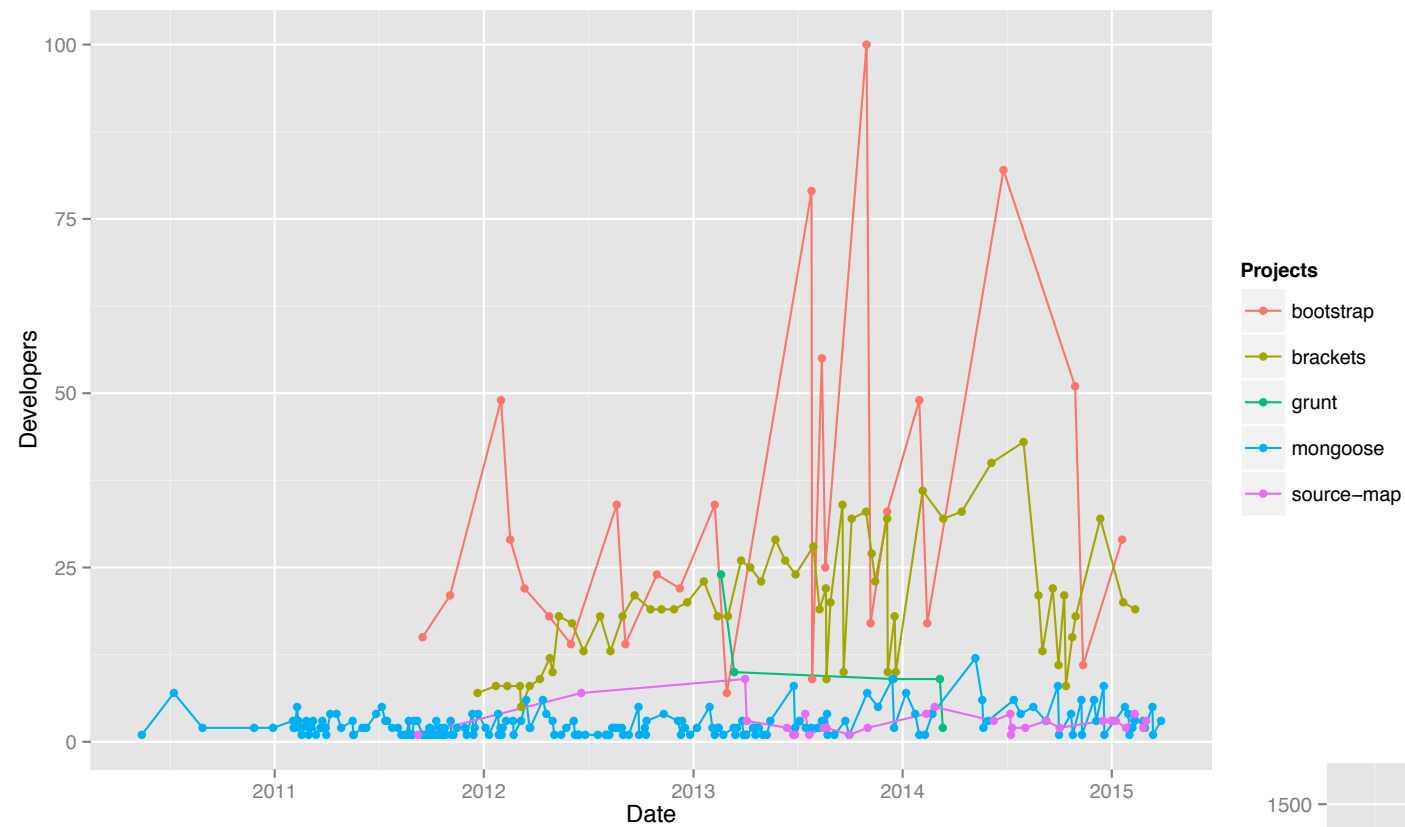
Differences in first and last release

- Most growth in terms of LOC belongs to Brackets with total 260,520 lines added from first release in compare to last release.
- The general trend for comment lines is increasing, however CoffeeScript shows decreasing from first release with 836 lines to 124 lines in last release.
- Brackets starts with 14 directories and in the last release it contains 179 directories.
 - We observe that source organization grows as the size of project grows. It means the more code added to the project, the more directories and sub directories needed to organize them.
- Based our result, we found that the number of statements, functions and cyclomatic complexity increase as the lines of code increase.

Function Density

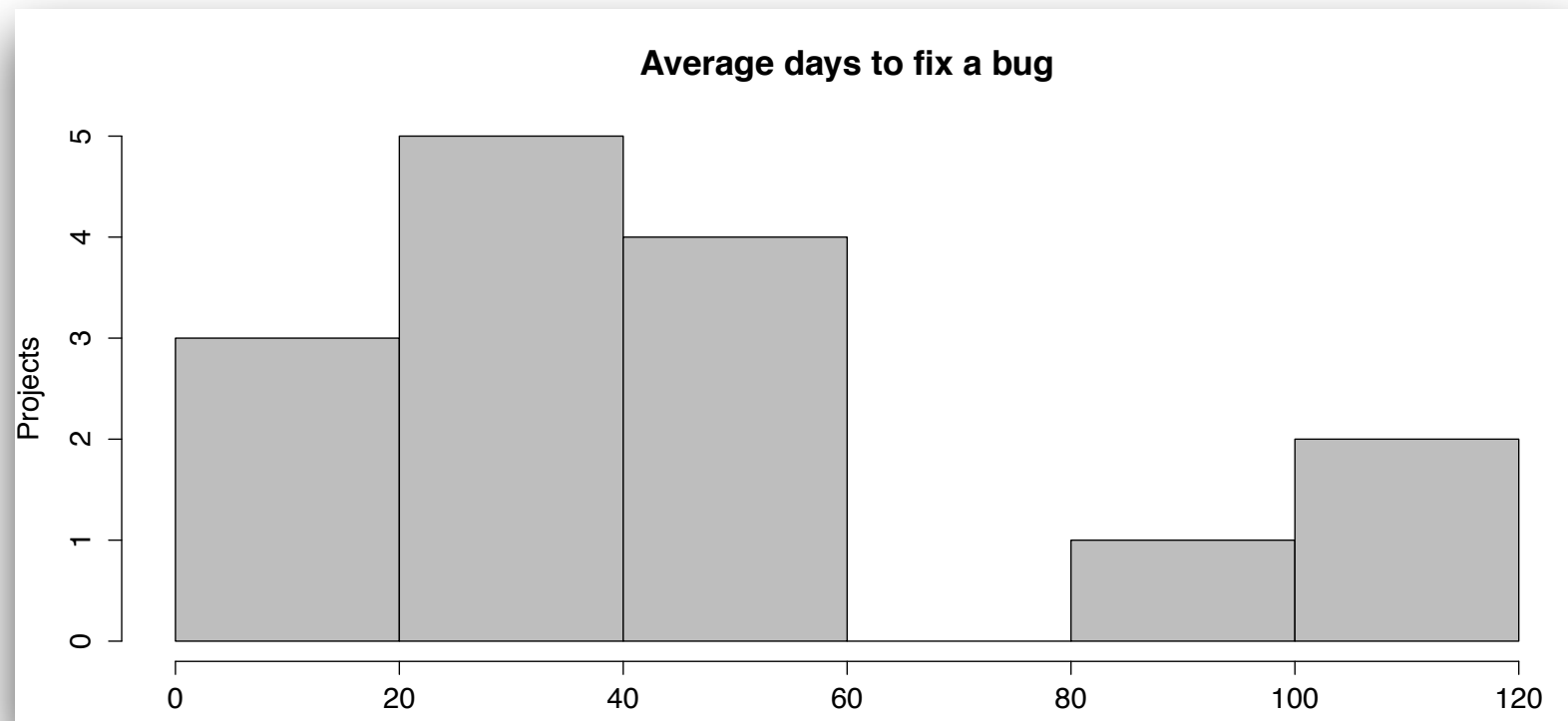


of Developers vs # of Issues



Average days to fix a bug

| Project Name | Days |
|---------------|------|
| Coffee Script | 46 |
| Less.js | 113 |
| NPM | 58 |
| Mongoose | 44 |
| Underscore | 14 |
| Node-mysql | 47 |
| Q | 30 |
| Request | 105 |
| Ember.js | 22 |
| Source-map | 17 |
| Bootstrap | 11 |
| Mocha | 83 |
| Brackets | 26 |
| Bower | 30 |
| Grunt | 28 |



Code Smells in JavaScript

Critical

continue should not be used:

continue is an unstructured control flow statement. It makes code less testable, less readable and less maintainable. Structured control flow statements such as **if should be used instead**.

Major

switch statements should end with a **default** clause

The requirement for a final default clause is defensive programming. The clause should either take appropriate action or contain a suitable comment as to why no action is taken.

Minor

Statements should be on separate lines:

For better readability, do not put more than one statement on a single line.

Projects

| Project Name | Major Bad Smells | | Minor Bad Smells | |
|----------------------|------------------|--------------|------------------|--------------|
| | First Release | Last Release | First Release | Last Release |
| Coffee Script | 1692 | 3528 | 31 | 48 |
| Less.js | 336 | 4285 | 24 | 317 |
| NPM | 1300 | 12535 | 10 | 49 |
| Mongoose | 316 | 4773 | 4 | 161 |
| Underscore | 465 | 1000 | 10 | 19 |
| Node-mysql | 230 | 479 | 10 | 72 |
| Q | 15 | 319 | 1 | 41 |
| Request | 115 | 3798 | 2 | 20 |
| Ember.js | 8469 | 1489 | 586 | 343 |
| Source-map | 91 | 2686 | 5 | 7 |
| Bootstrap | 523 | 4777 | 7 | 49 |
| Mocha | 233 | 1675 | 2 | 76 |
| Brackets | 1167 | 40985 | 35 | 5248 |
| Bower | 169 | 226 | 1 | 44 |
| Grunt | 137 | 155 | 11 | 10 |

Questions?