



SOFTWARE (R)EVOLUTION

A CRYSTAL BALL TO PRIORITIZE TECHNICAL DEBT

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Questioning Technical Debt

“Like a financial debt, the **technical debt incurs interest payments, which come in the form of the extra effort that we have to do in future development”**

<https://martinfowler.com/bliki/TechnicalDebt.html>

Interest Rate Is A Function Of Time

```
1 void display()
2 {
3     for(i=1;i<7;i++)
4     {
5         switch (i)
6         {
7             case 1:
8
9                 setPicture("< string 2 > ");
10
11                 break;
12             case 2:
13
14                 setPicture("< string 2 > ");
15
16                 break;
17
18             case 3:
19
20                 setPicture("< string 3 > ");
21
22                 break;
23
24             case 4:
25
26                 setPicture("< string4 > ");
27
28                 break;
29
30             case 5:
31
32                 setPicture("< string5 > ");
33                 break;
34             case 6:
35
36                 setPicture("< string 6> ");
37
38                 break;
39         }
40     }
41 }
```


All Technical Debt Isn't Equal



Most Technical Debt Isn't Technical

There's A Strong Link Between Technical Debt And The Organisation

Wish List: Information to Prioritize Technical Debt

Where's the Highest Interest Rate?

A diagram illustrating a transition from a complex, tangled architecture to a simpler, more organized one. It features two boxes containing network-like diagrams of interconnected nodes and lines. An arrow points from the left box to the right box, indicating a process of simplification or refactoring.

Does the Architecture Support the way our System Evolves?

A diagram illustrating a transition from a complex architecture to a simpler one, with a database icon. It features three boxes containing network-like diagrams of interconnected nodes and lines. Arrows point from the first box to the second, and from the second to the third. To the right of the third box is a blue cylindrical icon representing a database.

Any Productivity Bottlenecks for Inter-Team Coordination?

A diagram showing a transition from a complex architecture to a database icon. It features a box containing a network-like diagram of interconnected nodes and lines. An arrow points from this box to a blue cylindrical icon representing a database.

Collective Intelligence

Uncover Evolutionary Patterns In A System

Frequencies

Time

Social information

```
commit b7c90c4a6784acd5bae68b97e1f4a99ad3ace4d5
Author: N. Taylor Mullen <nimullen@microsoft.com>
Date: Mon Mar 28 16:59:48 2016 -0700

    React to aspnet/Razor#719.

2 2 test/Microsoft.AspNetCore.Mvc.Razor.Host.Test/TestFiles/Output/Runtime/ModelExpressionTagHelper.cs
8 8 test/Microsoft.AspNetCore.Mvc.Razor.Test/RazorPageTest.cs
2 2 test/Microsoft.AspNetCore.Mvc.TagHelpers.Test/RenderAtEndOfFormTagHelperTest.cs

commit 529fa67c2ba23198b87c5734275a8fe8dbb7c690
Author: Pranav K <prkrishn@hotmail.com>
Date: Mon Mar 21 15:23:23 2016 -0700

    Adding tests for PrefixContainer

    Fixes #4045

4 4 src/Microsoft.AspNetCore.Mvc.Core/Internal/PrefixContainer.cs
1 1 src/Microsoft.AspNetCore.Mvc.Core/ModelBinding/DictionaryModelBinder.cs
151 9 test/Microsoft.AspNetCore.Mvc.Core.Test/Internal/PrefixContainerTest.cs

commit f9d24a8521fbdc82234544068d4a832ca8f3a53a
Author: Kévin Chalet <kevinchalet@gmail.com>
Date: Wed Mar 9 21:12:23 2016 +0100

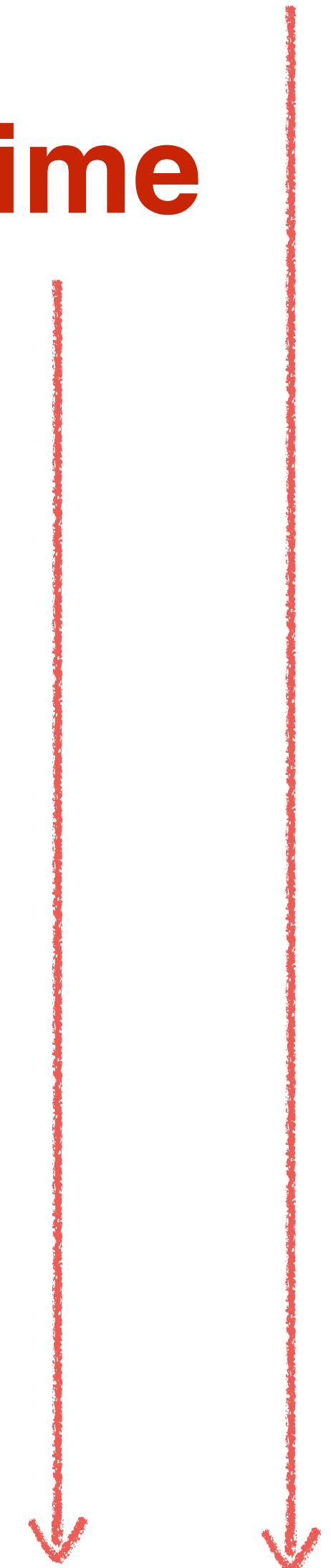
    Introduce SignInResult/SignOutResult and ControllerBase.SignIn/SignOut

3 3 src/Microsoft.AspNetCore.Mvc.Core/ChallengeResult.cs
49 46 src/Microsoft.AspNetCore.Mvc.Core/ControllerBase.cs
2 2 src/Microsoft.AspNetCore.Mvc.Core/ForbidResult.cs
26 3 src/Microsoft.AspNetCore.Mvc.Core/Internal/MvcCoreLoggerExtensions.cs
16 0 src/Microsoft.AspNetCore.Mvc.Core/Properties/Resources.Designer.cs
3 0 src/Microsoft.AspNetCore.Mvc.Core/Resources.resx
95 0 src/Microsoft.AspNetCore.Mvc.Core/SignInResult.cs
117 0 src/Microsoft.AspNetCore.Mvc.Core/SignOutResult.cs
7 7 test/Microsoft.AspNetCore.Mvc.Core.Test/ForbidResultTest.cs
86 0 test/Microsoft.AspNetCore.Mvc.Core.Test/SignInResultTest.cs
87 0 test/Microsoft.AspNetCore.Mvc.Core.Test/SignOutResultTest.cs

commit 49e0a958c52572af32853426a54ecf79d55046de
Author: Sebastien Ros <sebastienros@gmail.com>
Date: Mon Mar 28 09:59:50 2016 -0700

    Fixing race in unit test

3 0 test/Microsoft.AspNetCore.Mvc.TagHelpers.Test/DistributedCacheTagHelperTest.cs
```

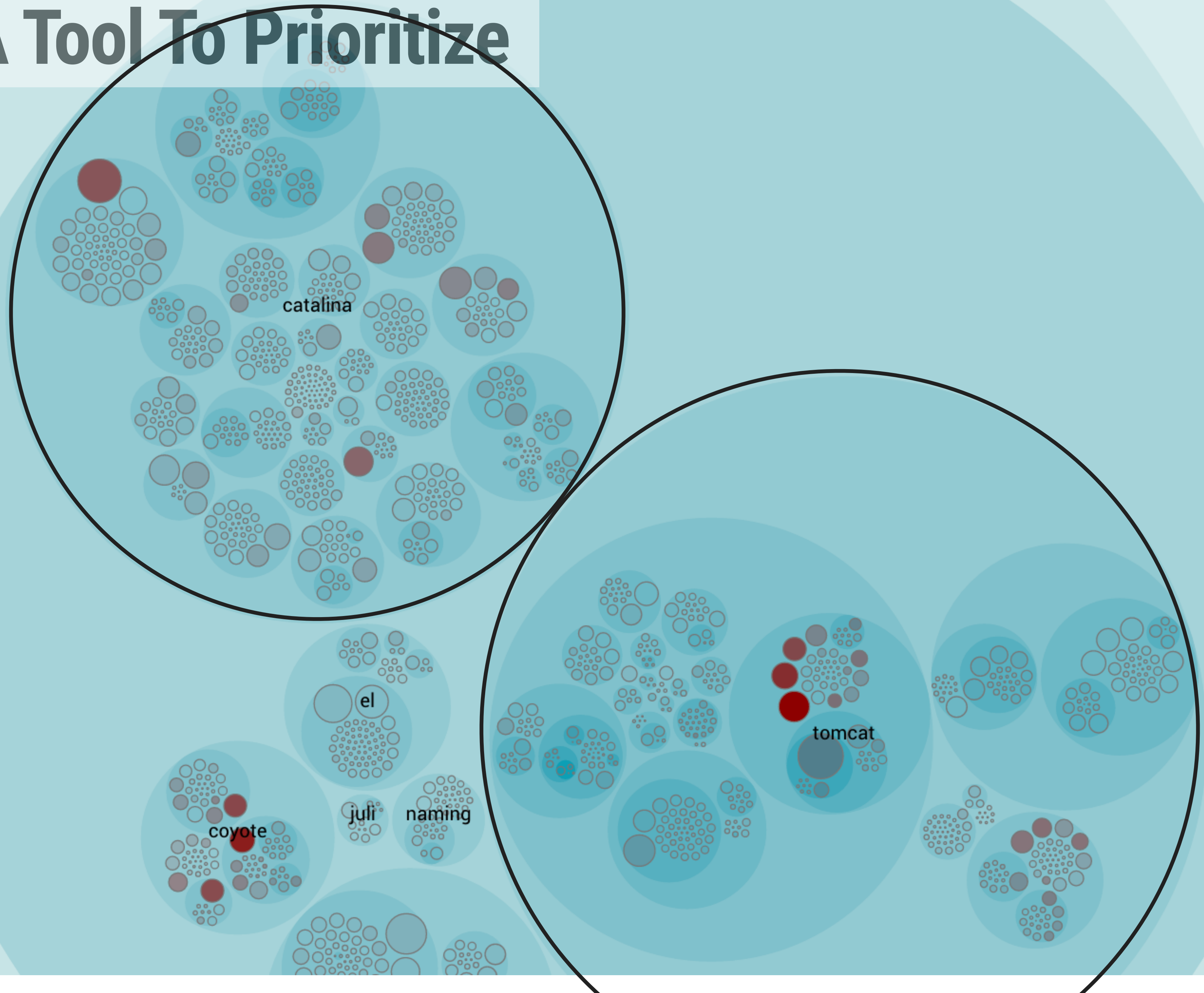


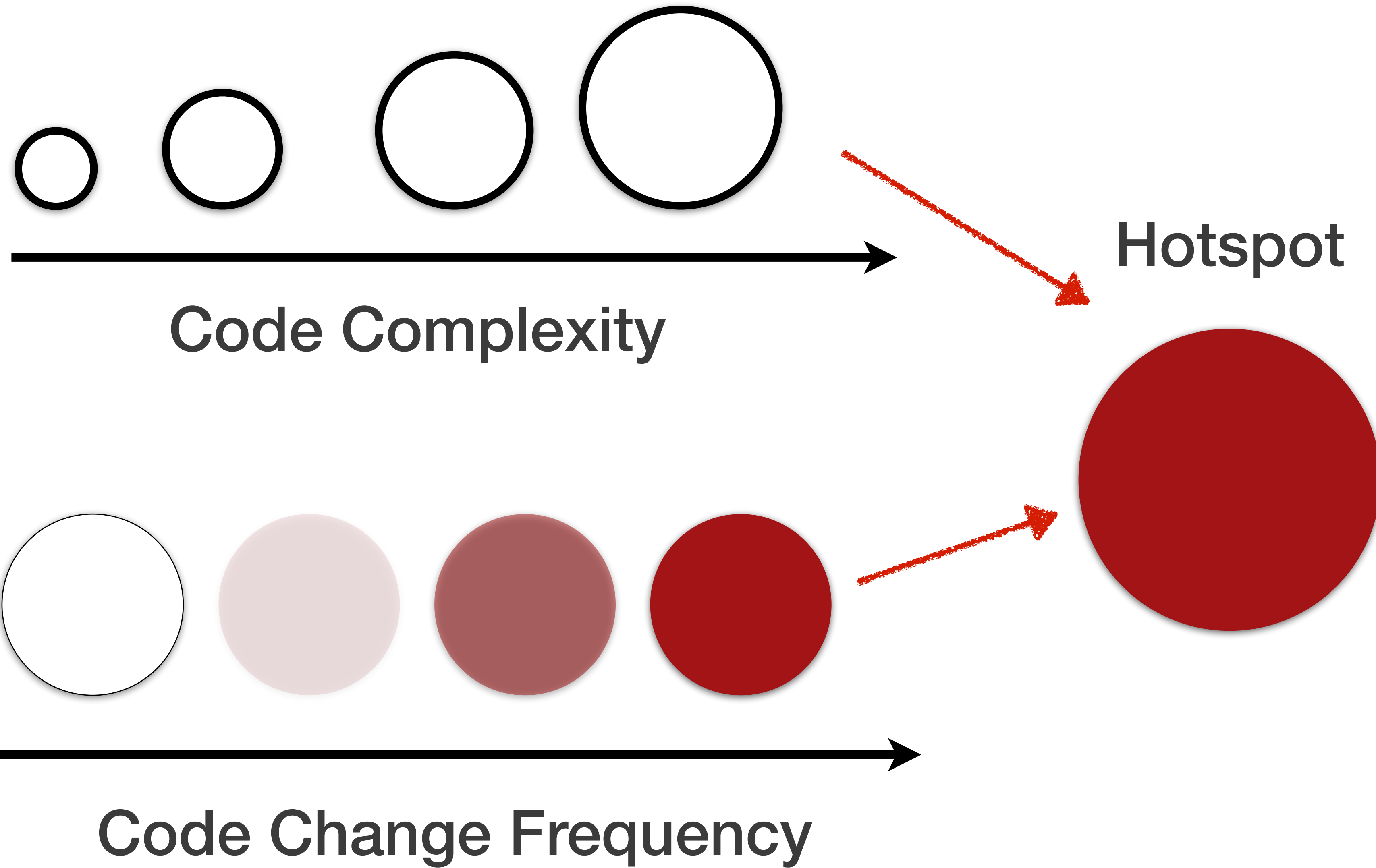
Hotspots

Where's The Highest Interest Rate?

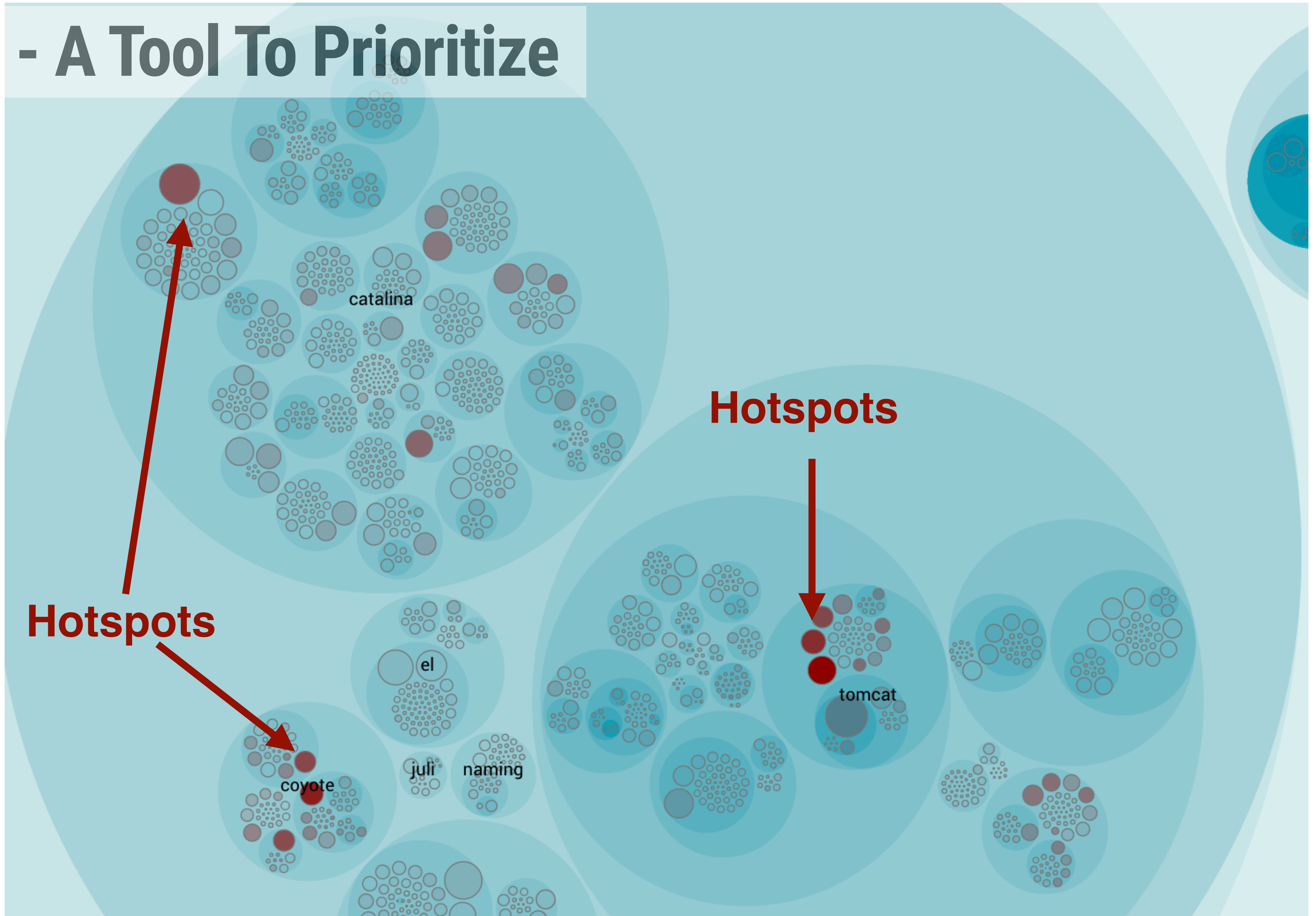
```
export function init() {
  const fileSummaryContainer = $('#evolutionSummaryContainer');
  const evolutionContainer = $('#evolutionContainer');
  const table = $('<table>');
  table.addClass('table table-striped');
  const tr = $('<tr>');
  tr.append($('<td>'));
  table.append(tr);
  tableSorter.sort(table, {});
  evolutionContainer.append(table);
  xhr.csv(options.fileSummaryUrl, parseFileSummaryRow)
    .then(data => {
      var fileTable = tabulator.tabulate(fileSummaryContainer.get(0), data, ['lan
      fileTable
        .attr('id', 'summarytable')
        .classed('file-content', true)
        .selectAll('thead th')
        .text(function(column) {
          return column.charAt(0).toUpperCase() + column.substr(1);
        });
      sort($(fileTable.node()), {});
    });
}
```


Hotspots - A Tool To Prioritize





Hotspots - A Tool To Prioritize



Hotspots

Hotspots

catalina

tomcat

coyote

el

juli

naming


```
MAKE COMPARISONS WITH  
defn crontab-without-timezone  
[]  
(f/formatter "m H d M e")) ; for  
(def ^:private crontab-time-formatter (f/with  
(defn- adjust-weekday->crontab-day  
"Cron tab says Sundays are '0' but Joda wants it to be '7'.  
Let's adjust the Joda format to cron tab format here."  
[time-parts]  
(let [correct-adj (take 4 time-parts)]  
    (conj correct (if (possible-adjustment-needed "7") "0" possible-adjustment-needed))))  
(defn- time->plan-form  
"Takes a date-time object and converts it to  
a crontab format in order to simplify comparisons."  
[date-time  
 (->> date-time  
   (f/unparse (formatter))  
   as-parts-of-plan  
   adjust-weekday->crontab-day))  
(defn- part-matches?  
[[plan-part time-part]]  
(or (= plan-part "*")  
     (= plan-part time-part)))  
(defn plan-matches-time?  
"Returns true if the given date-time matches the plan.  
plan: a cron tab entry with its five elements.  
time: a DateTime instance to match against."  
[time-part time? plan date-time (fn [] crontab-time-formatter)])  
(defn- time-matches-time-formatter  
[time-part time? plan date-time (fn [] crontab-time-formatter)]  
(= time-part (time? time-formatter plan)))
```

All Code is Equal

...but some Code is more equal than others*

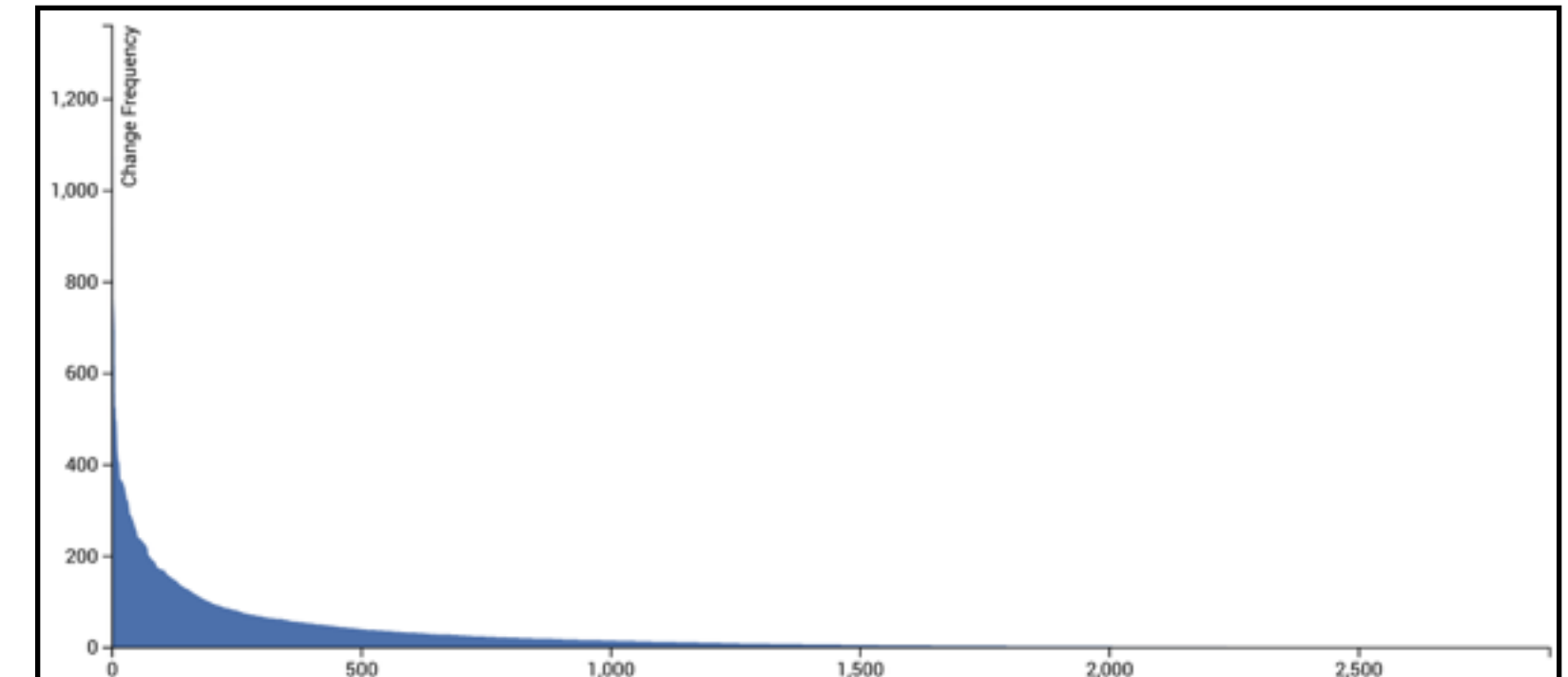
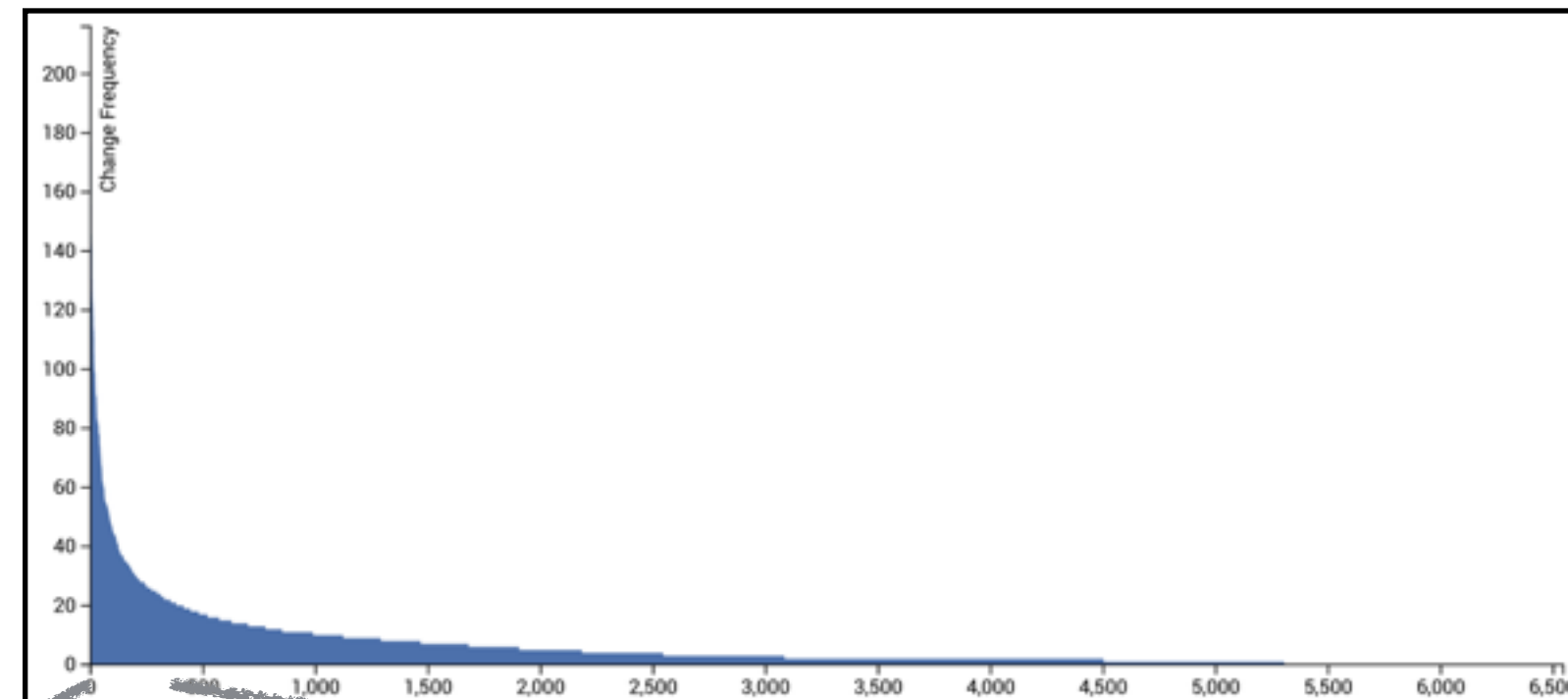
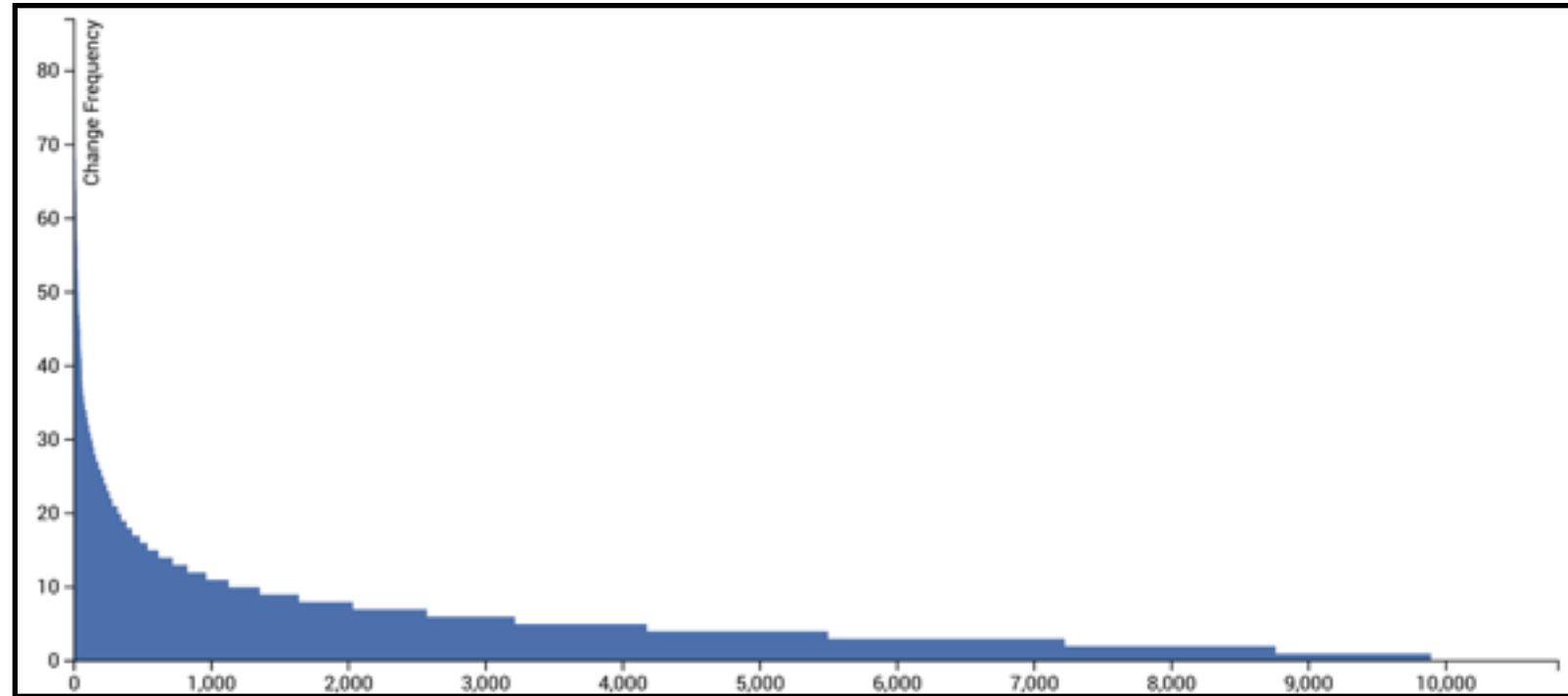
* Sorry, George Orwell

Why Hotspots Work

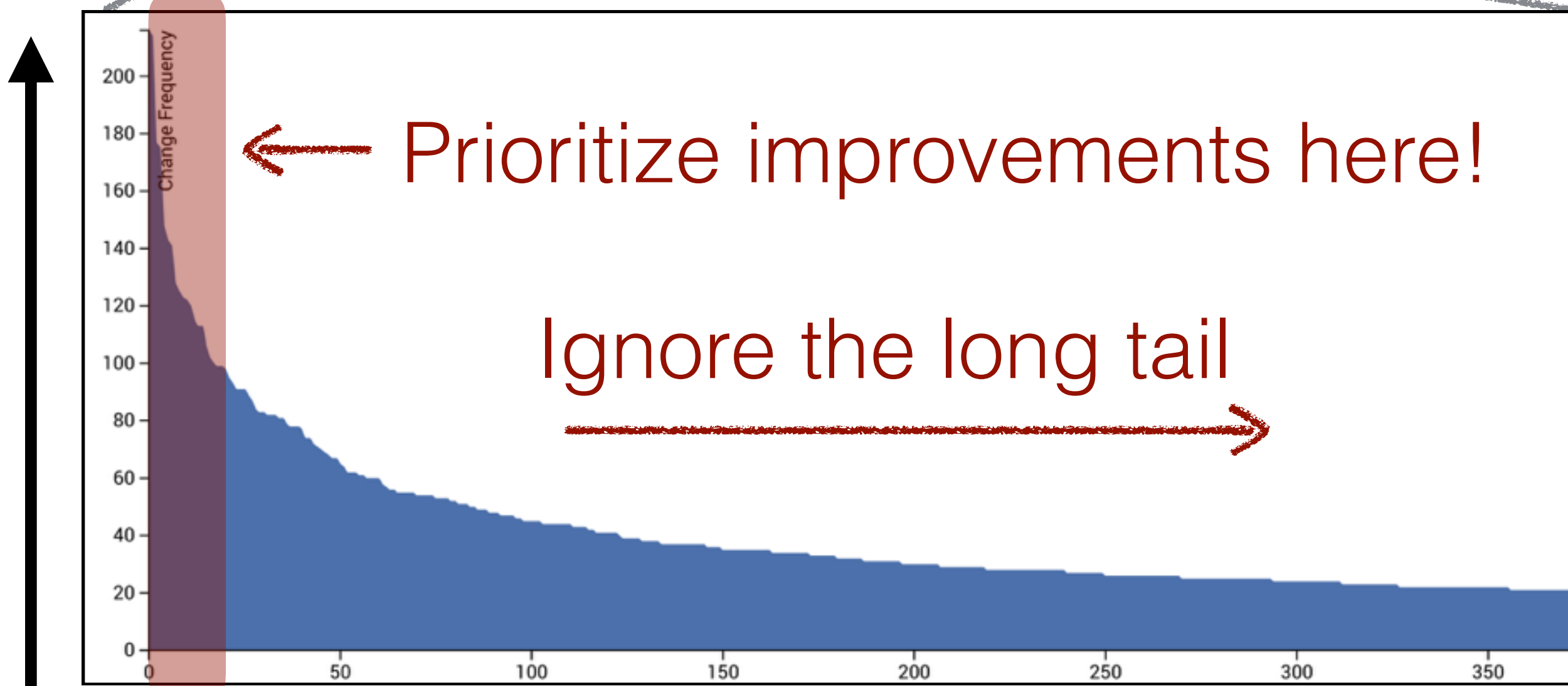
1 Year in Roslyn (C#, VB)

6 Years of Erlang

12 Years of Ruby on Rails



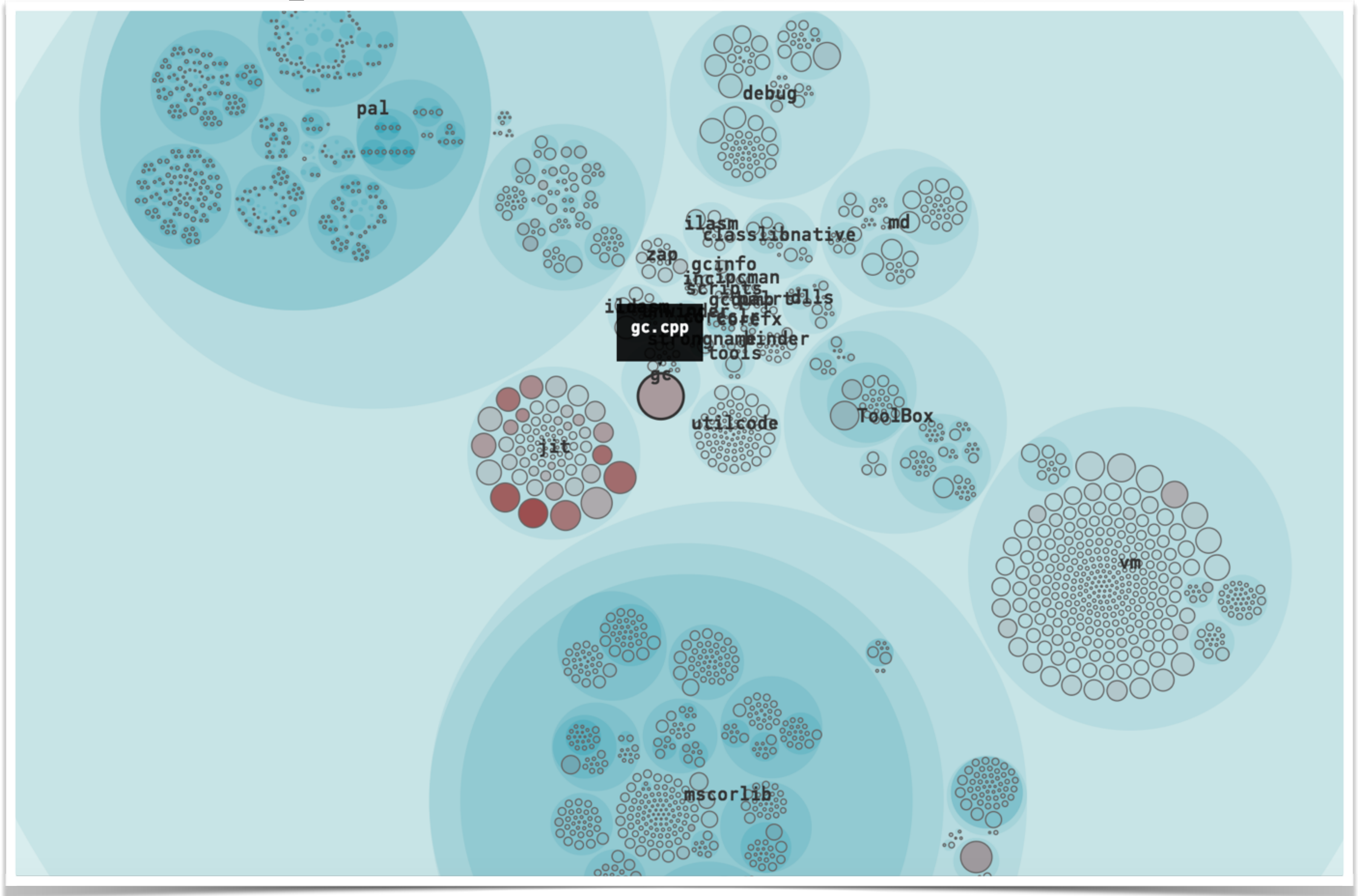
Change Frequency



Each file in the system

Hotspots

Case Study:



gc.cpp

dotnet / coreclr

Watch 989

Star 6,935

Fork 1,673

Code

Issues 916

Pull requests 81

Projects 1

Wiki

Pulse

Graphs

Branch: master

coreclr / src / gc / gc.cpp

Find file

Copy path

 **adamtornhill** Correct preprocessor conditional termination in case BACKGROUND_GC is...

f93e169 21 hours ago

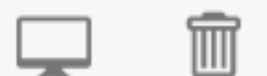
21 contributors



1.2 MB

Download

History



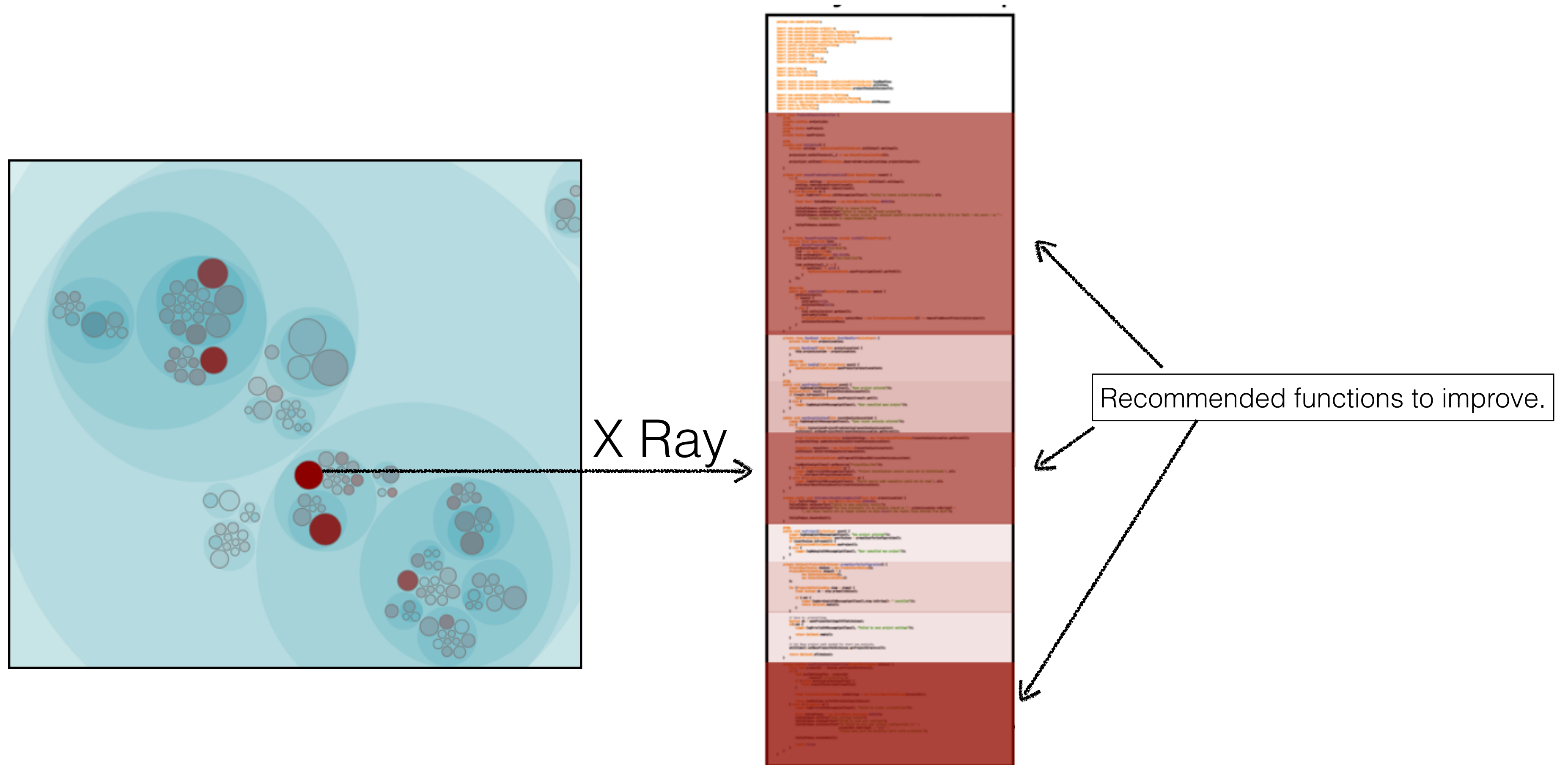
[View Raw](#)

(Sorry about that, but we can't show files that are this big right now.)















Hotspots X-Ray

File Level Hotspots

Function Level Hotspots

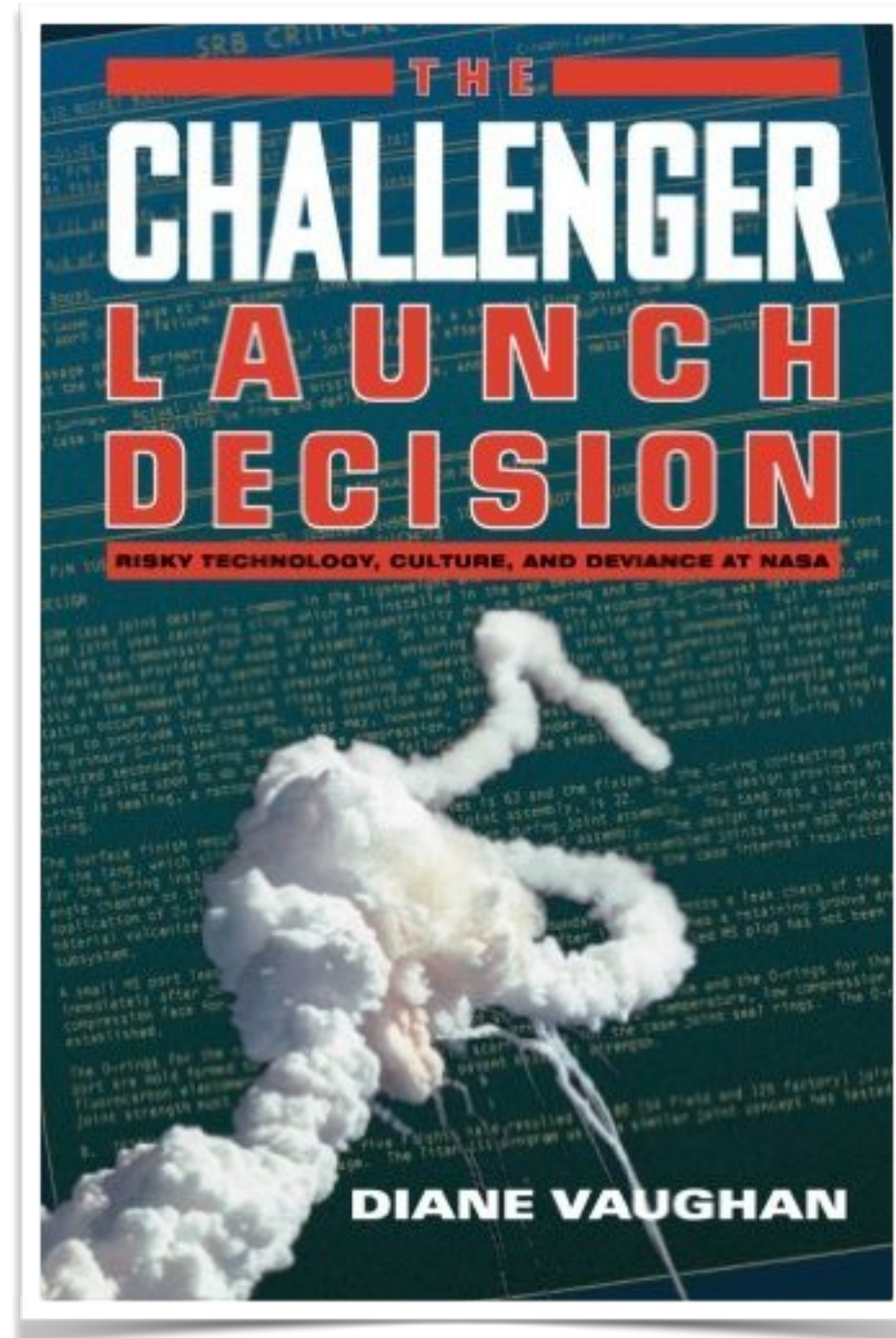


Function-Level

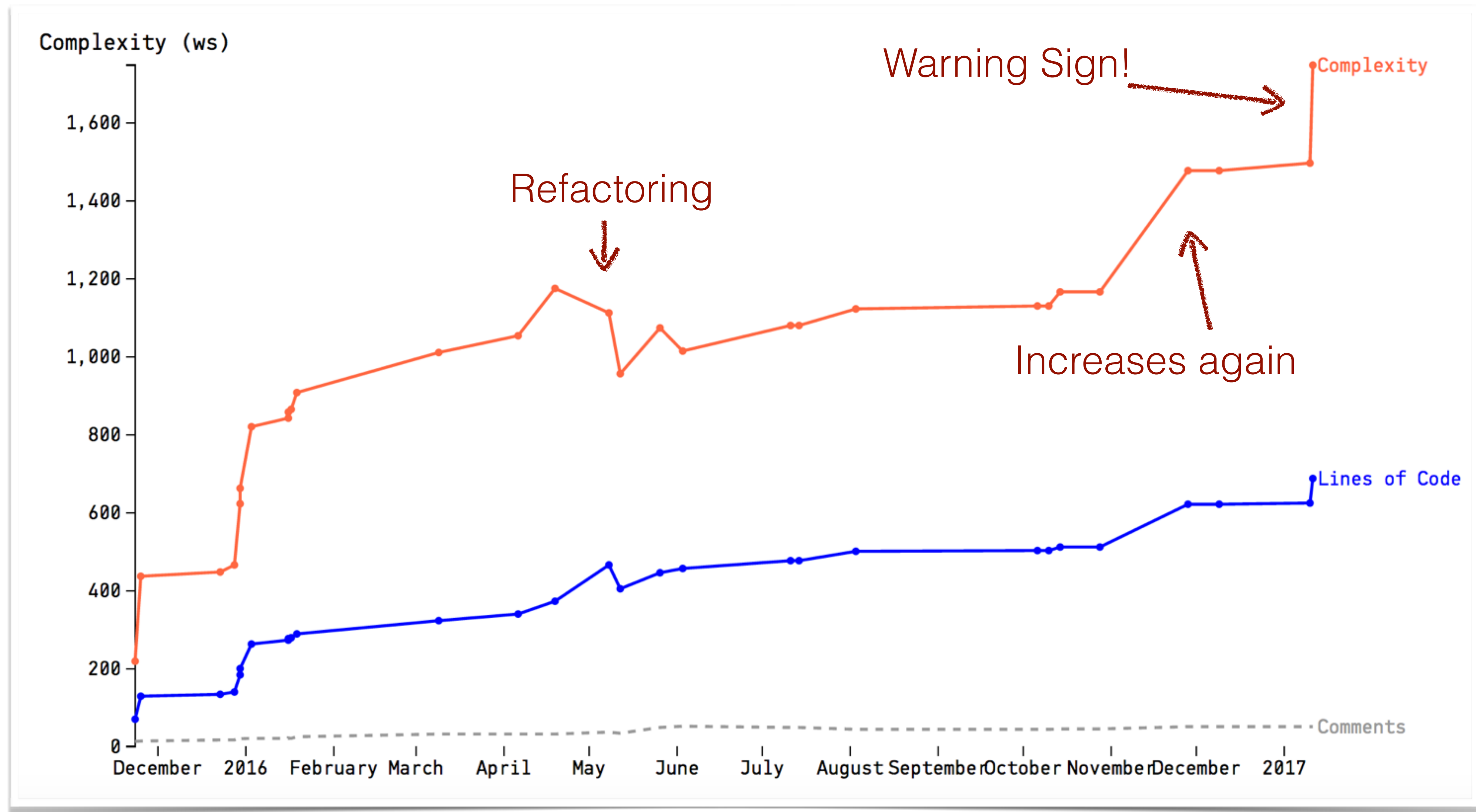
Function	Change Frequency	Lines of Code		
gc_heap::grow_brick_card_tables	23	332		
gc_heap::garbage_collect	19	424		
gc_heap::gc1	18	512		
gc_heap::plan_phase	17	1,507		
GCHeap::Initialize	16	121		
gc_heap::initialize_gc	15	197		
gc_heap::generation_to_condemn	14	539		

[Read More:](#)

Normalization of Deviance



Supervise your Complexity Trends



Hotspots Summary



Hotspots find the code with the highest interest rate.

Hotspots work because all code isn't equal.

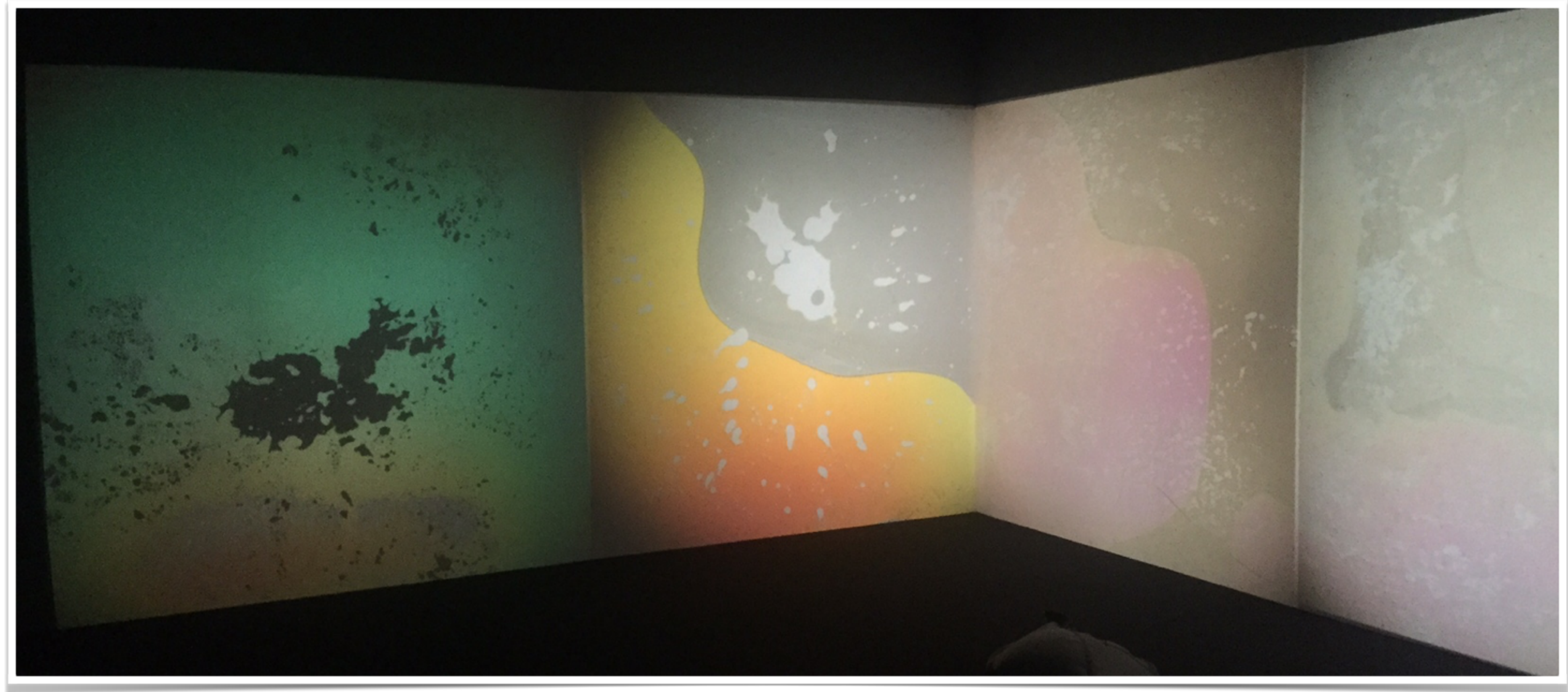
Supervise the Complexity Trend of your Hotspots.

Evaluate Your Architectural Patterns

Does the Architecture Support the way our System Evolves?

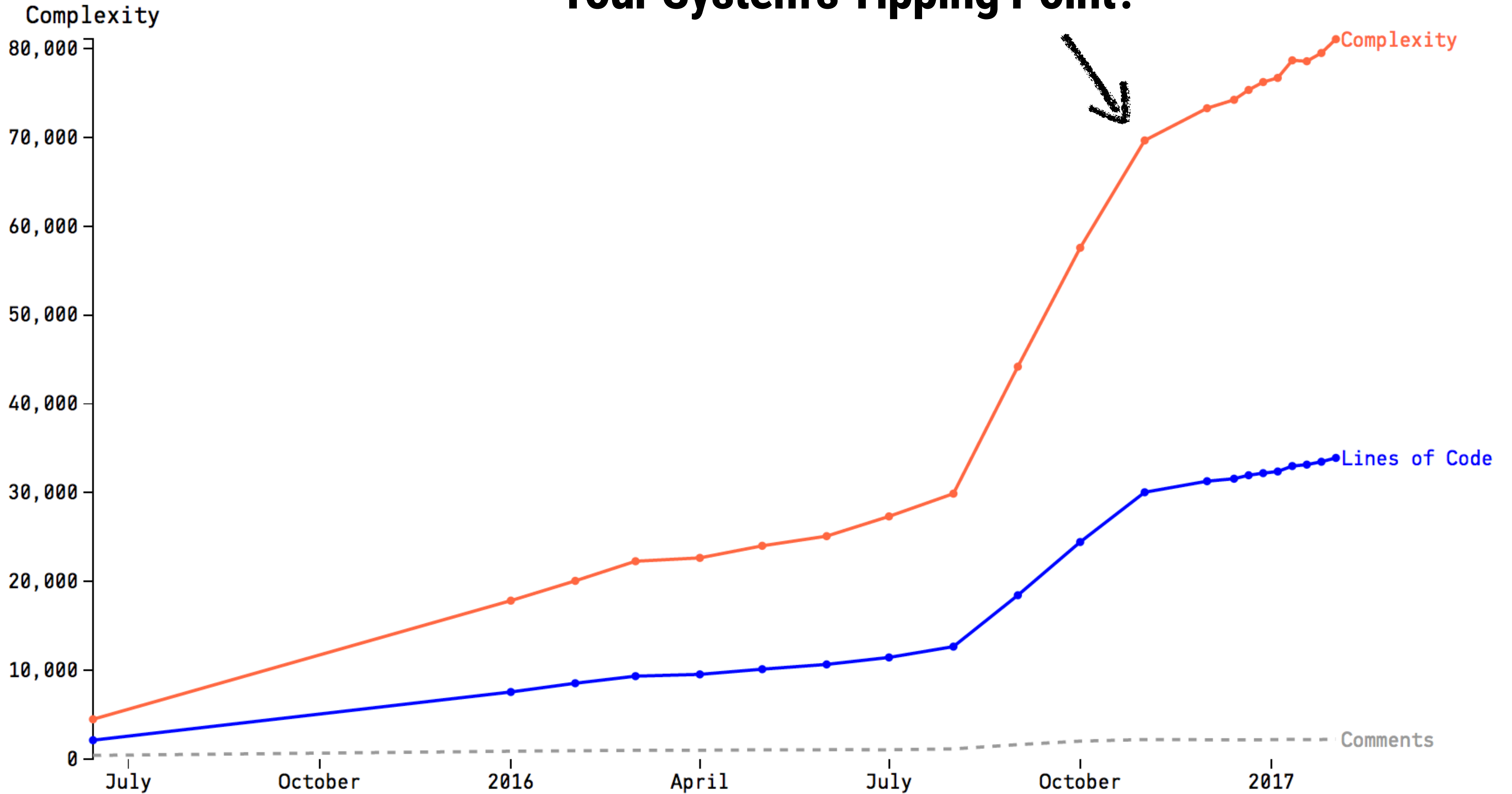
```
export function init() {
  const fileSummaryContainer = $('#evolutionContainer');
  const evolutionContainer = $('#evolutionContainer');
  const table = $('#table');
  table.addClass('table-striped');
  $.getJSON('data', (i, row) => {
    const tr = $('#tr');
    tr.append(`${row.value}`);
    table.append(tr);
  });
  tableSorter.sort(table, {});
  evolutionContainer.append(table);
  xhr.csv(options.fileSummaryUrl, parseFileSummaryRow)
    .then(data => {
      var fileTable = tabulator.tabulate(fileSummaryContainer.get(0), data, ['language']);
      fileTable
        .attr('id', 'summarytable')
        .classed('file-content', true)
        .selectAll('thead th')
        .text(function(column) {
          return column.charAt(0).toUpperCase() + column.substr(1);
        });
      sort($(fileTable.node()), {});
    });
}
```


Code is Auto-Destructive Art

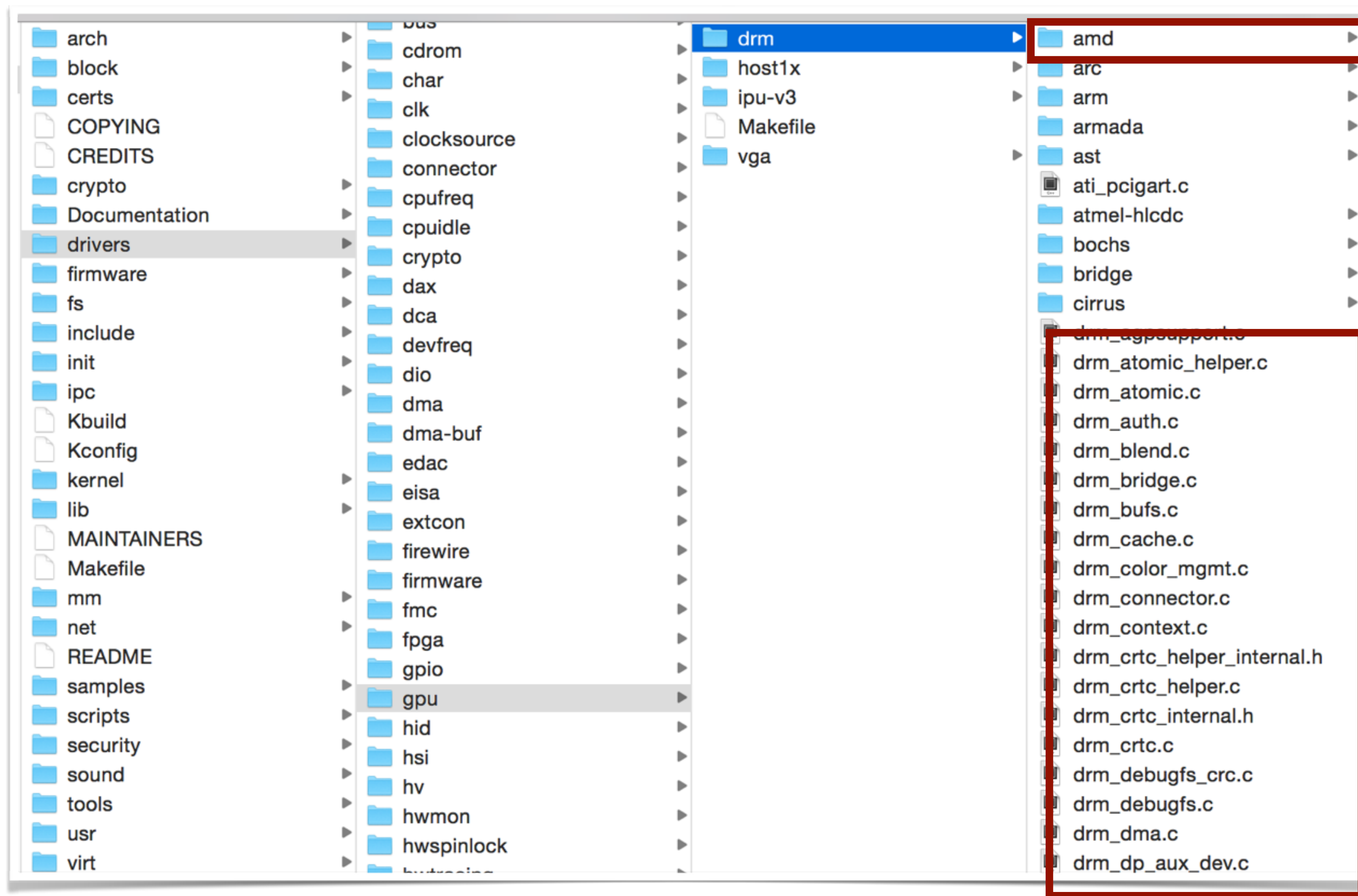


System Complexity Growth

Your System's Tipping Point?



Specify Your Logical Components

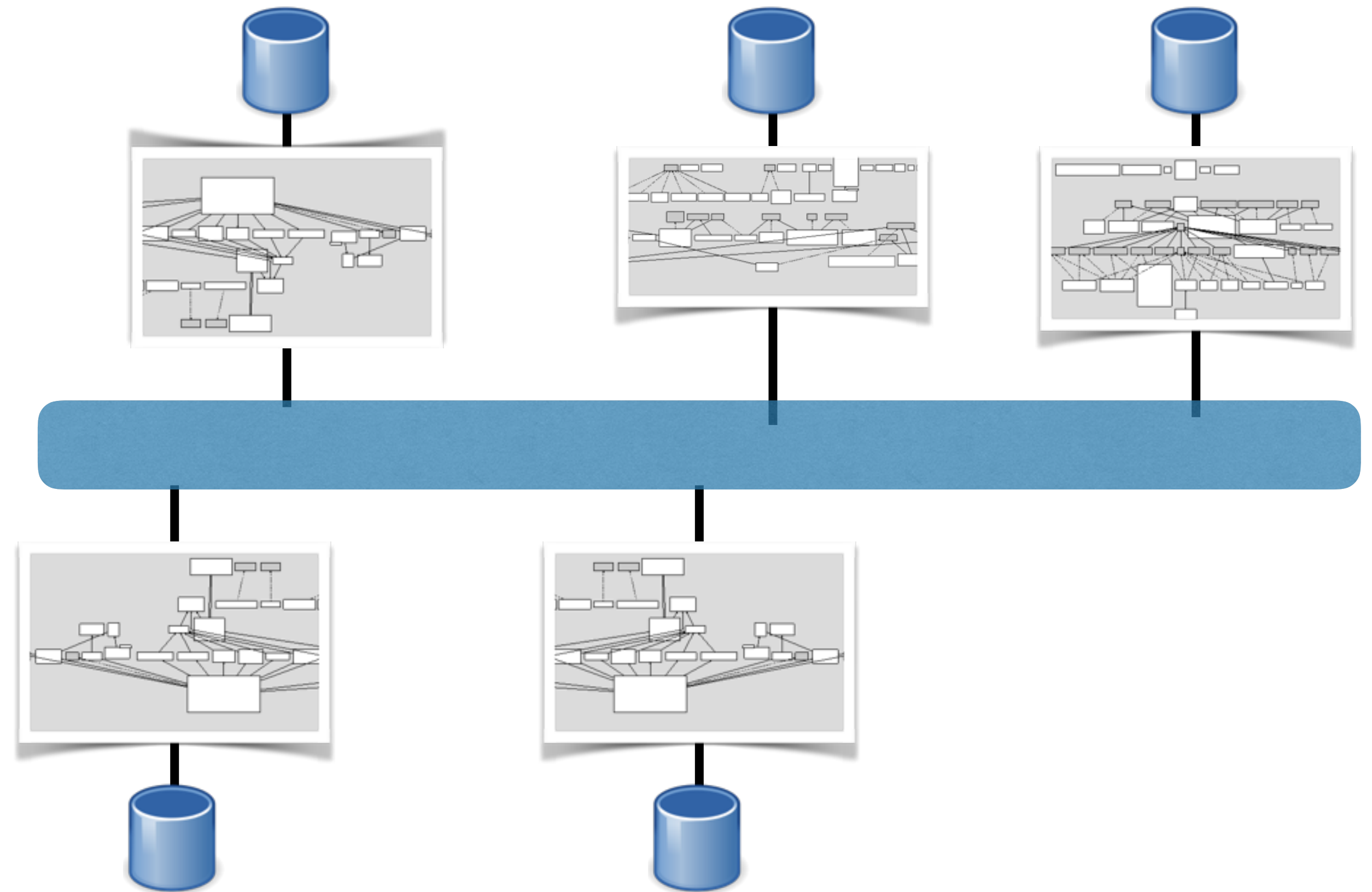
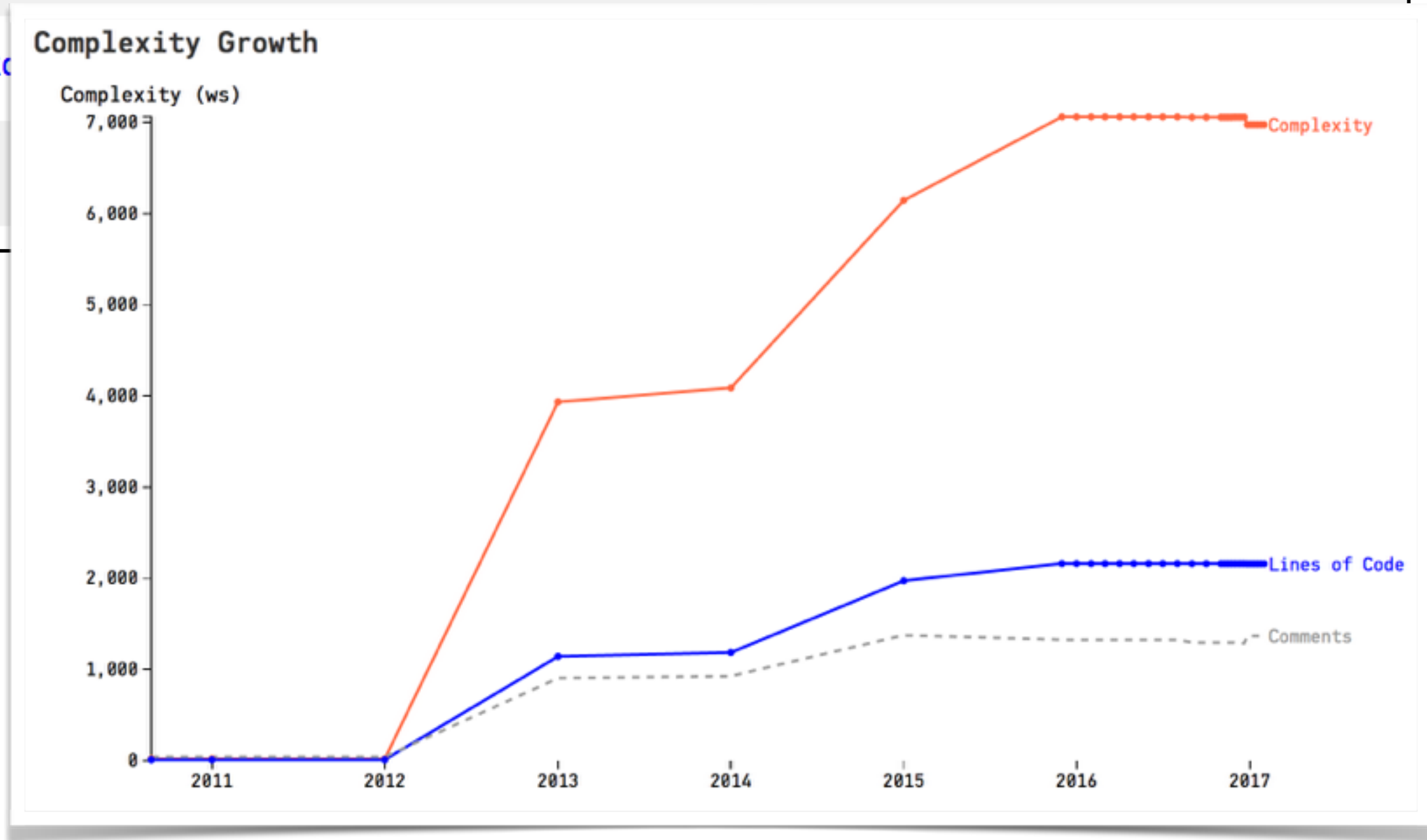


DRM/AMD
...

DRM Shared

Identify **Hotspots** on a **(Micro)Service Level**

Component	Change Frequency	Lines of Code
Recommendations	271	5,114
Diagnostics	269	3,440
Integration Tests	227	8,150
Login	183	8,655
Export	168	4,355



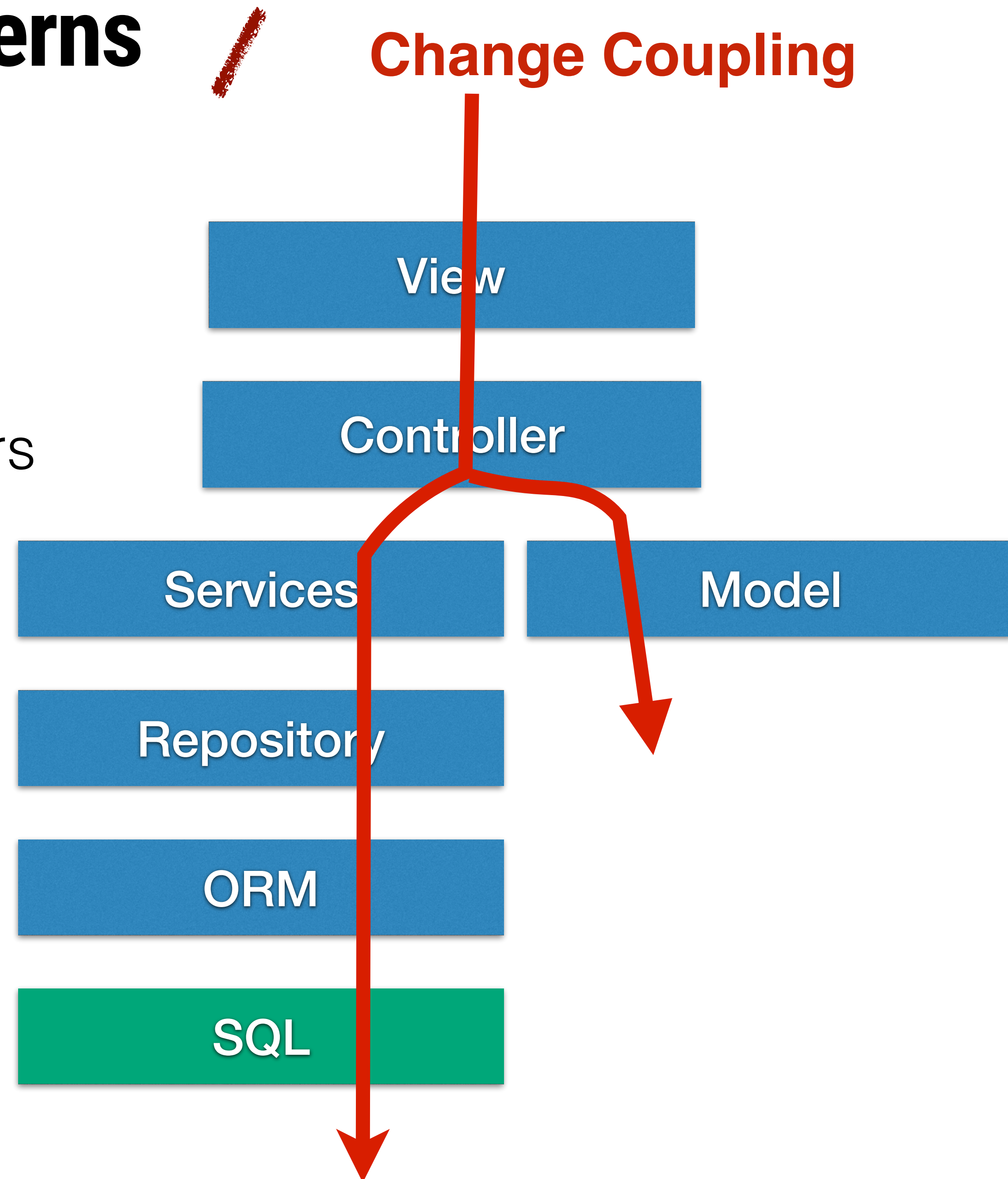
Temporal Coupling



Layers: A Separation of Concerns

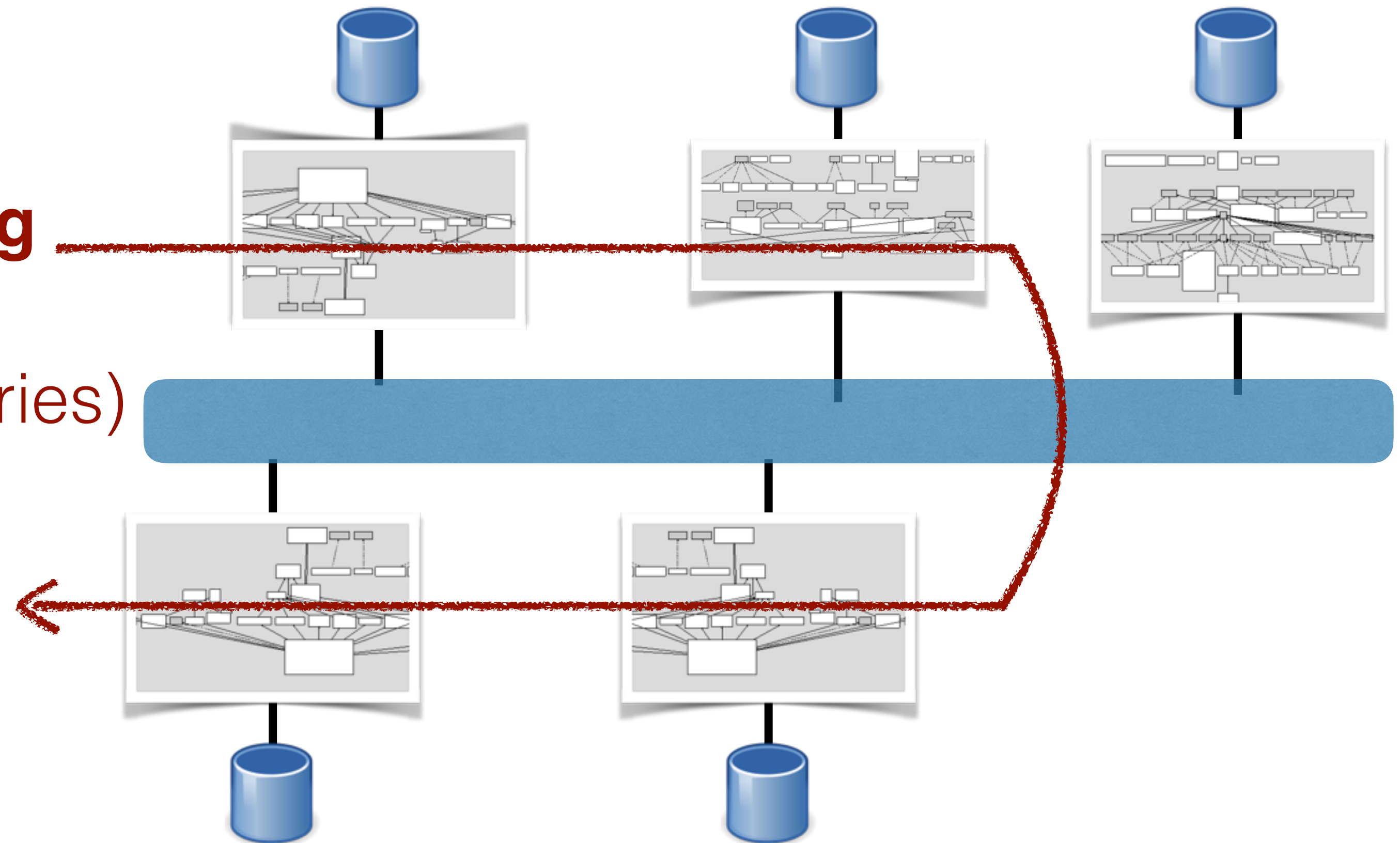
General Observation:

30-70 % of all commits touch multiple layers



Supervise The Change Coupling Between Services

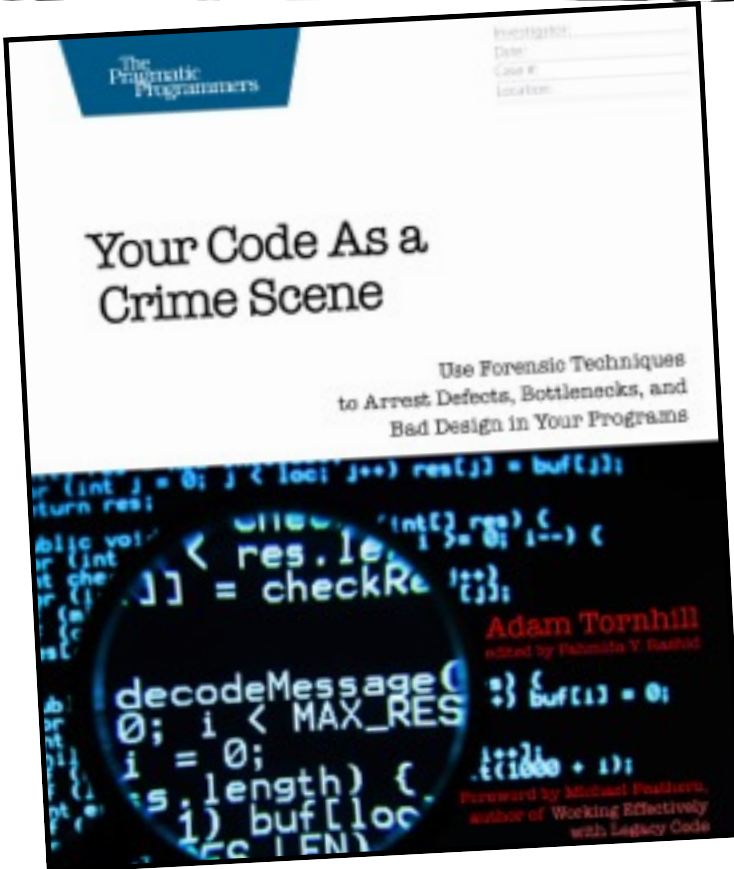
Temporal Coupling
(potentially across repository boundaries)



The Microservices Shotgun Surgery Pattern



Tools



Code Maat: open source, text-only (GPL)

<https://github.com/adamtornhill/code-maat>

CodeScene: free for open source (commercial)

<https://codescene.io/>



Evolution Radar

<http://reveal.inf.usi.ch/web/dambros/tools/evoradar.php>



Moose Platform: open source platform

<http://www.moosetechnology.org/>

Architecture Summary



Identify your Architectural Hotspots.

Know your System's Tipping Point.

Use Temporal Coupling to Evaluate your Architecture.

Meet The Social Side of Your Code

Any Productivity Bottlenecks for inter-team coordination?

```
export function init() {
  const fileSummaryContainer = $('#evolutionContainer');
  const evolutionContainer = $('#evolutionContainer');
  const options = {
    evolutionContainer: evolutionContainer,
    fileSummaryContainer: fileSummaryContainer,
  };
  xhr.csv(options);
}

const table = $('#table');
const tbody = table.find('tbody');
const tableSorter = new TableSorter(table);

$.each(data, (i, row) => {
  const tr = $('#tr');
  tr.append($(' <td> |'));
  tr.append($(' <td> |'));
  table.append(tr);
});

tableSorter.sort(table, {});
evolutionContainer.append(table);

xhr.csv(options, fileSummaryUrl, parseFileSummaryRow)
  .then(data => {
    var fileTable = tabulator.tabulate(fileSummaryContainer.get(0), data, ['lan

    fileTable
      .attr('id', 'summarytable')
      .classed('file-content', true)
      .selectAll('thead th')
      .text(function(column) {
        return column.charAt(0).toUpperCase() + column.substr(1);
      });
    sort($(fileTable.node()), {});
  });
}
```


Process Loss

Individual Contributions

Team Work

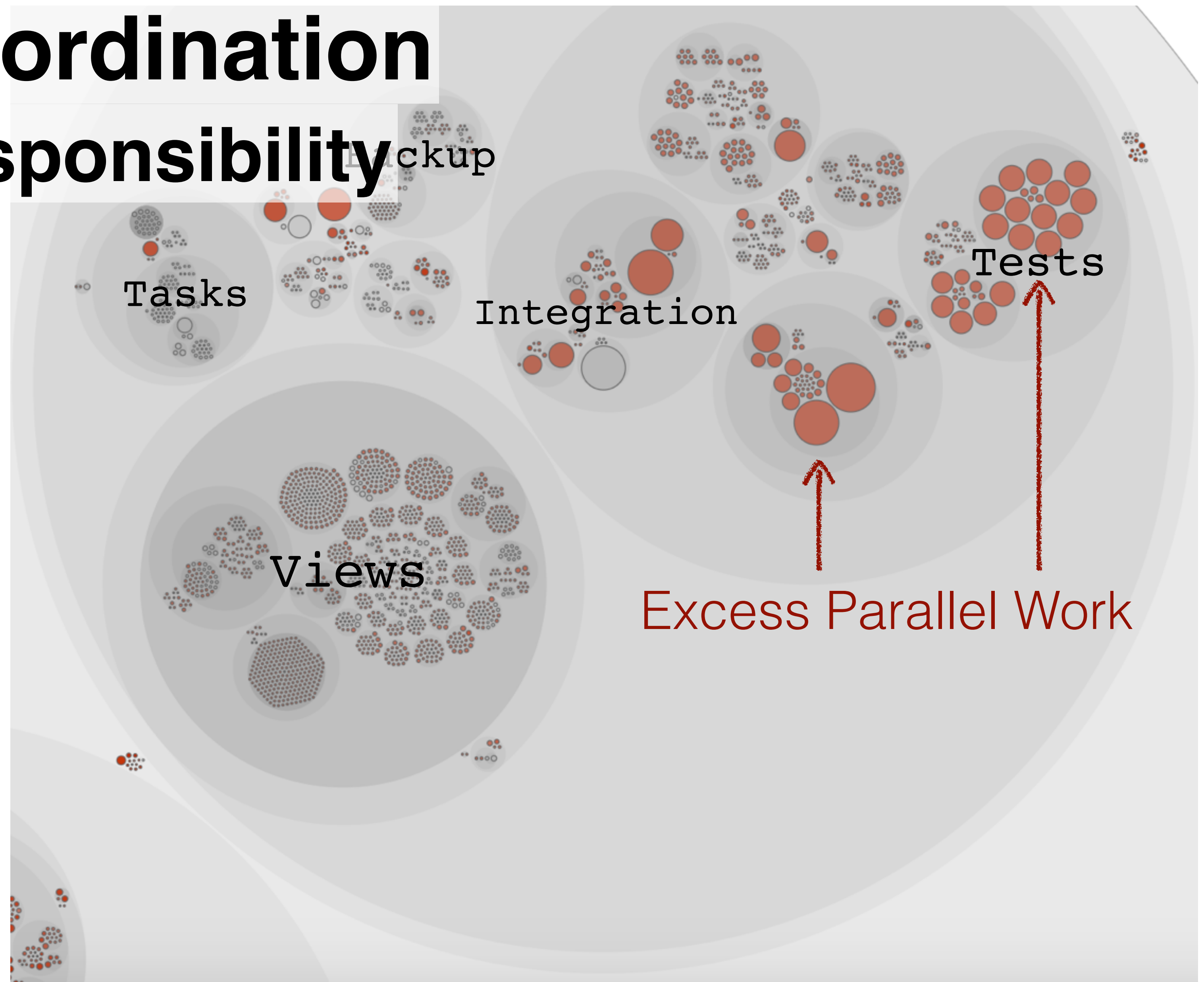
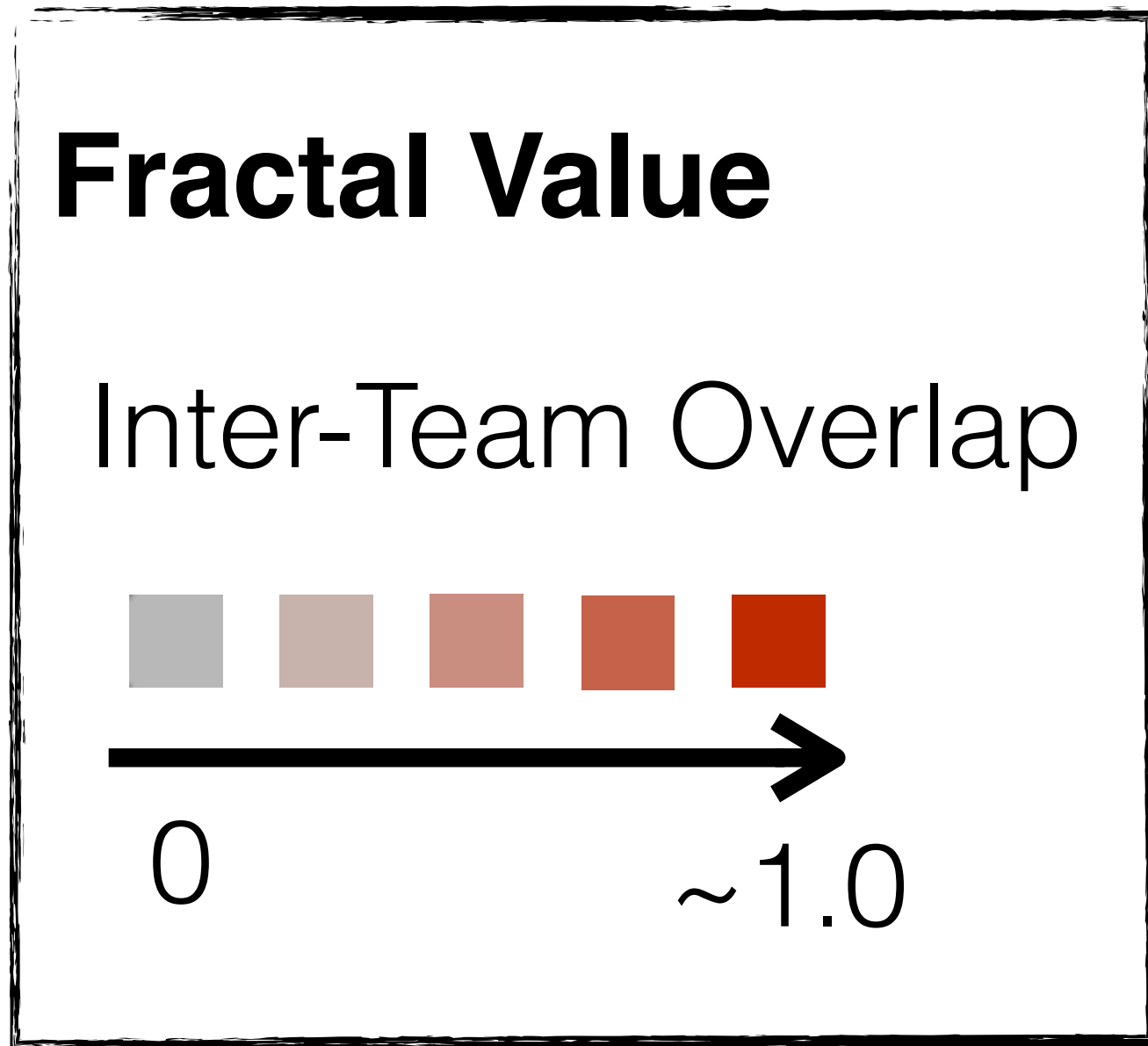


Diffusion of Responsibility



Measure Team Coordination

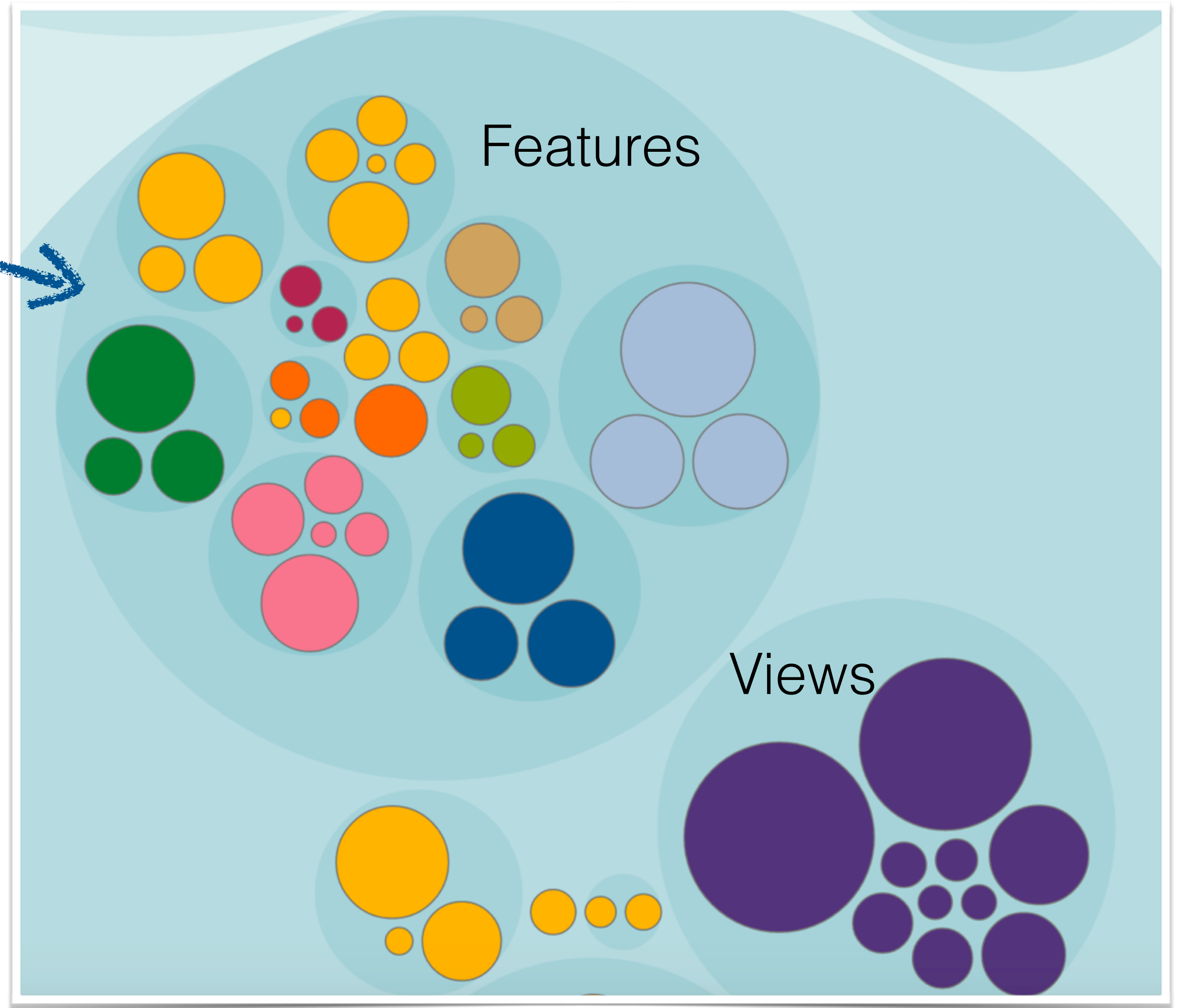
The Diffusion of Responsibility



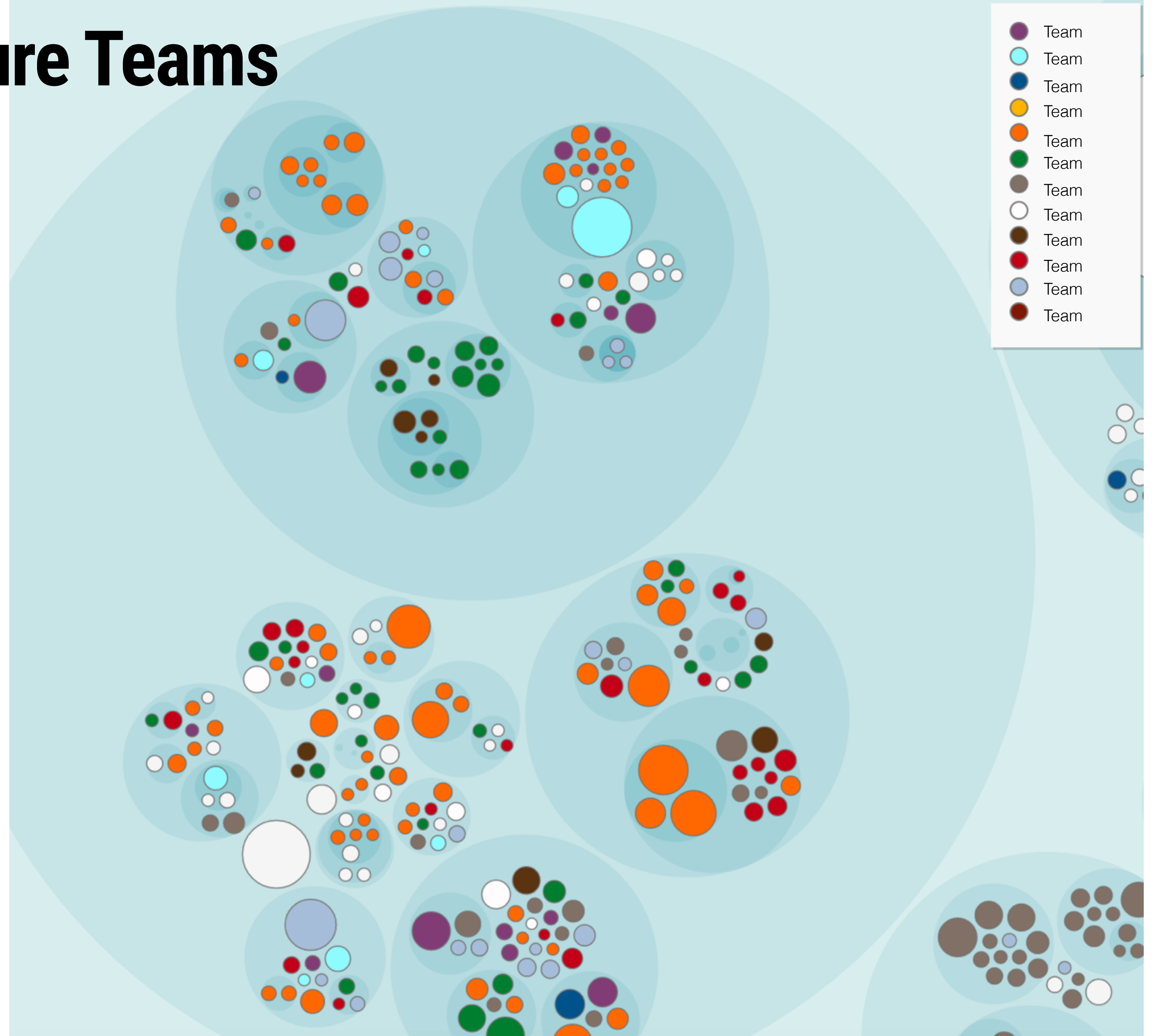
Measuring Conway's Law

Architectural Pattern: Package by Feature

- Backup Team
- Calculations Team
- Ads Team
- Recommendations Team
- Export Team
- Front-End Team



The Perils of Feature Teams



Align Your Architecture and your Organisation

Make Decisions **Influenced By Data**



CodeScene: The Analyses as a Service

<https://codescene.io/>

Read The Book: Your Code As A Crime Scene

<https://pragprog.com/book/atcrime/your-code-as-a-crime-scene>

Time - The Hidden Dimension of Software Design

<http://www.empear.com/blog/software-revolution-part3/>

The Day I Parsed A Monster

<http://www.empear.com/blog/parse-a-monster/>

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