SOFTWARE (R)EVOLUTION

A CRYSTAL BALL TO PRIORITIZE TECHNICAL DEBT

@AdamTornhill

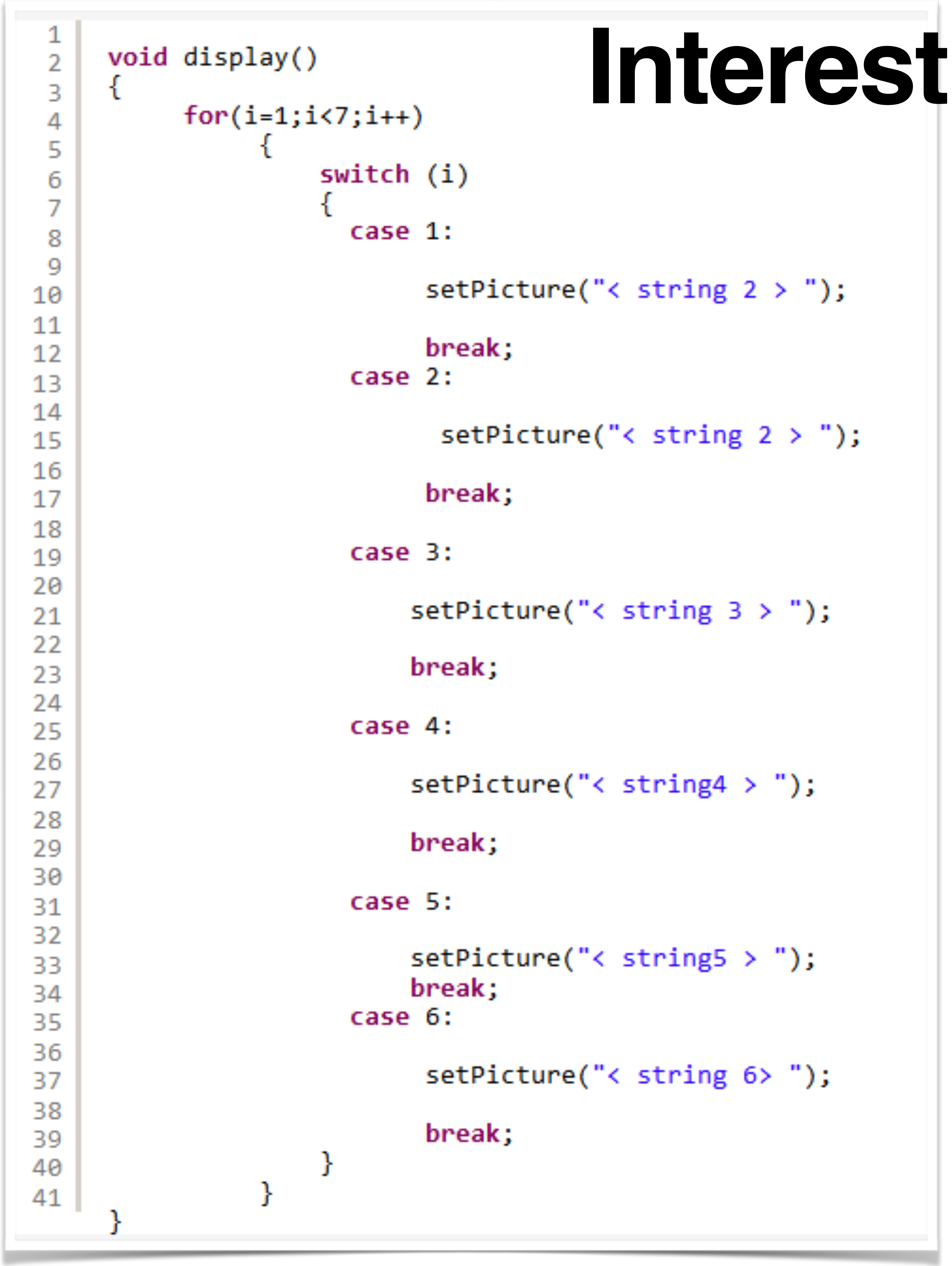
empear©

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



```

void display()
{
     for(i=1;i<7;i++)
          {
              switch (i)
              {
                case 1:

                     setPicture("< string 2 > ");

                     break;
                case 2:

                      setPicture("< string 2 > ");

                     break;

                case 3:

                    setPicture("< string 3 > ");

                    break;

                case 4:

                    setPicture("< string4 > ");

                    break;

                case 5:

                    setPicture("< string5 > ");
                    break;
                case 6:

                     setPicture("< string 6> ");

                     break;
              }
          }
}
```

http://i.imgur.com/a8Xo4Hp.png

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All Technical Debt Isn’t Equal

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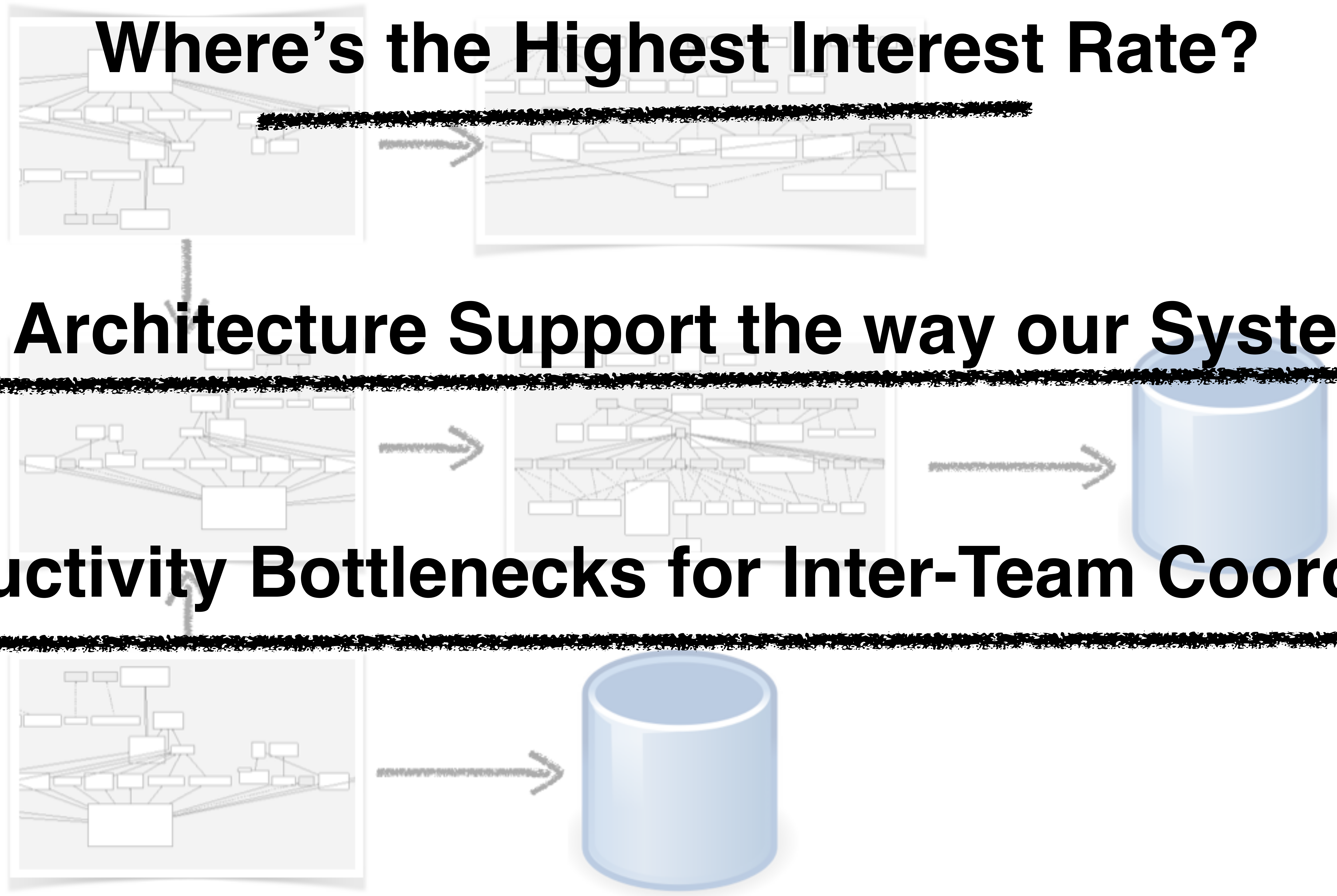
Most Technical Debt Isn’t Technical

There’s A **Strong Link** Between **Technical Debt** And The **Organisation**

Wish List: Information to **Prioritize** Technical **Debt**



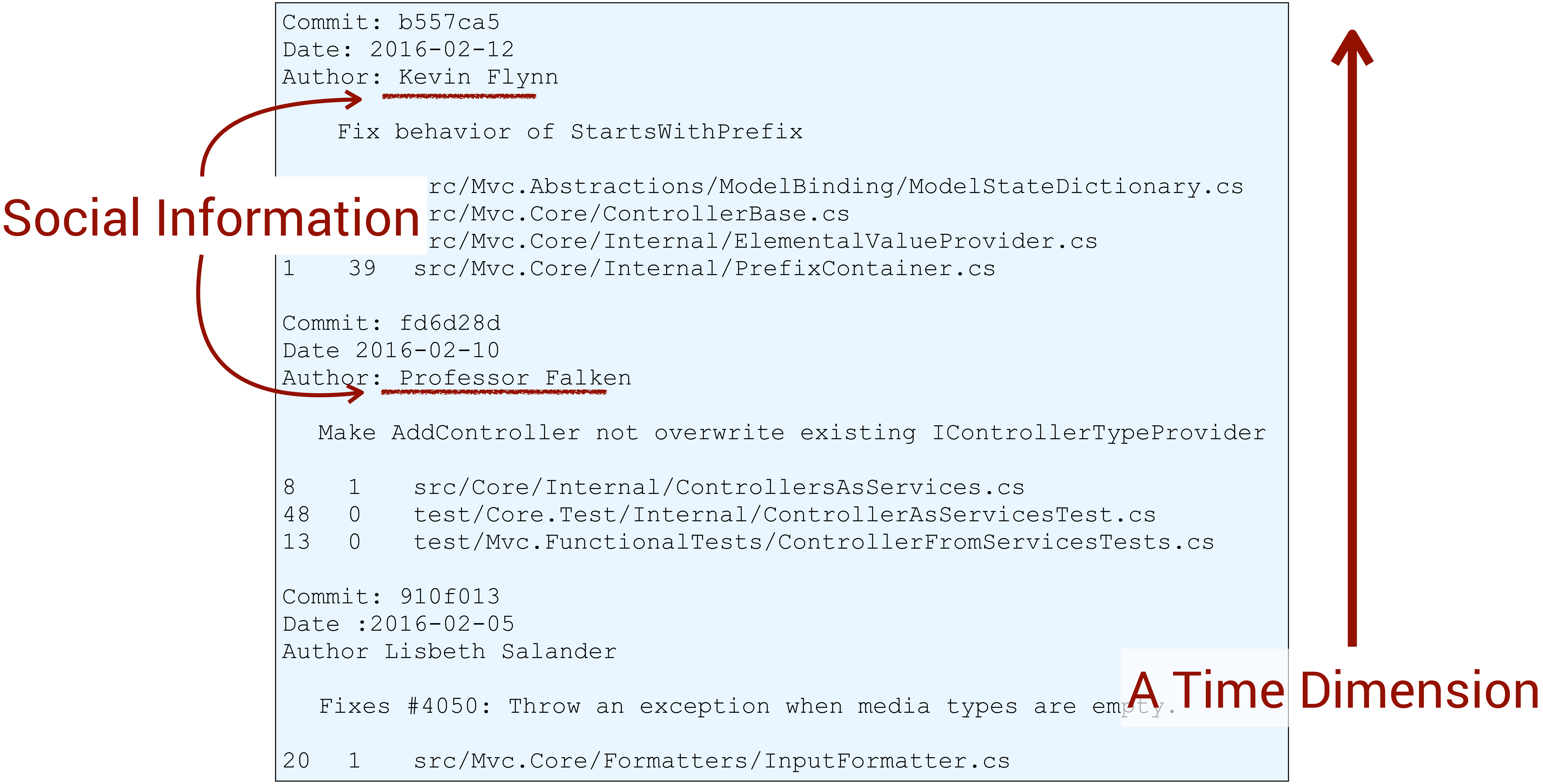
Where's the Highest Interest Rate?

Does the Architecture Support the way our System Evolves?

Any Productivity Bottlenecks for Inter-Team Coordination?

Collective Intelligence

Uncover **Evolutionary Patterns** In A System



```
Commit: b557ca5
Date: 2016-02-12
Author: Kevin Flynn

    Fix behavior of StartsWithPrefix

                rc/Mvc.Abstractions/ModelBinding/ModelStateDictionary.cs
                rc/Mvc.Core/ControllerBase.cs
                rc/Mvc.Core/Internal/ElementalValueProvider.cs
1    39   src/Mvc.Core/Internal/PrefixContainer.cs

Commit: fd6d28d
Date 2016-02-10
Author: Professor Falken

   Make AddController not overwrite existing IControllerTypeProvider

8    1    src/Core/Internal/ControllersAsServices.cs
48   0    test/Core.Test/Internal/ControllerAsServicesTest.cs
13   0    test/Mvc.FunctionalTests/ControllerFromServicesTests.cs

Commit: 910f013
Date :2016-02-05
Author Lisbeth Salander

   Fixes #4050: Throw an exception when media types are empty.

20   1    src/Mvc.Core/Formatters/InputFormatter.cs
```

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Hotspots

Where’s The Highest Interest Rate?

```
export function init(
  const fileSummaryContain
  const evolutionContainer = $('#evolu
  xhr.csv(options.evolutionUrl, parseEvolution
    .then(data => {
      const table = $('<table>')
        .addClass('table table-striped');
      $(data).each((i, row) => {
        const tr = $('<tr>')
          .append($('<td>').text(row.statistic))
          .append($('<td>').text(row.value.toLocaleString()));
        table.append(tr);
      });

      tableSorter.sort(table, {});

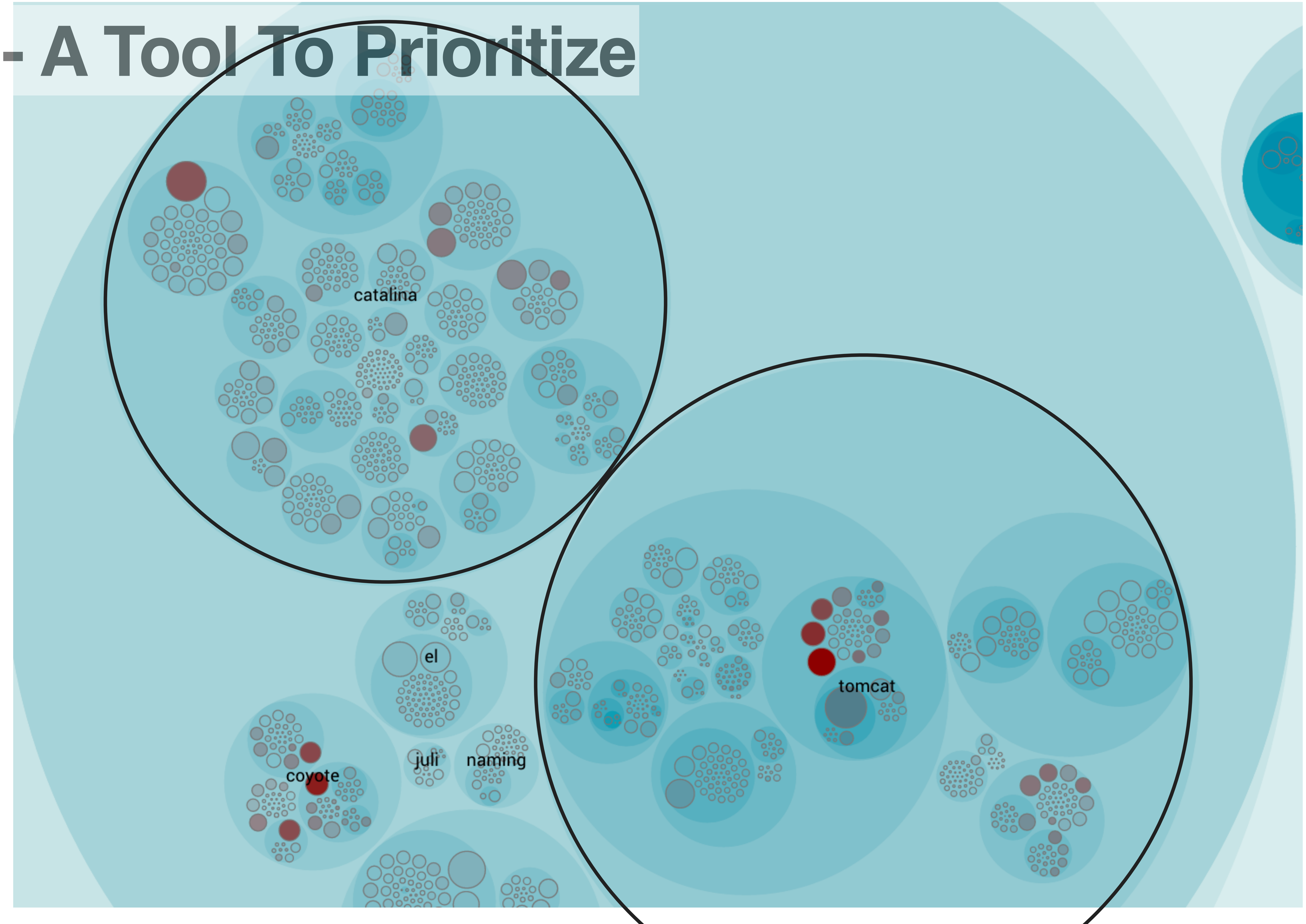
      evolutionContainer.append(table);
    });

  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);
        });

        ort($(fileTable.node()), {});
```

Hotspots - A Tool To Prioritize



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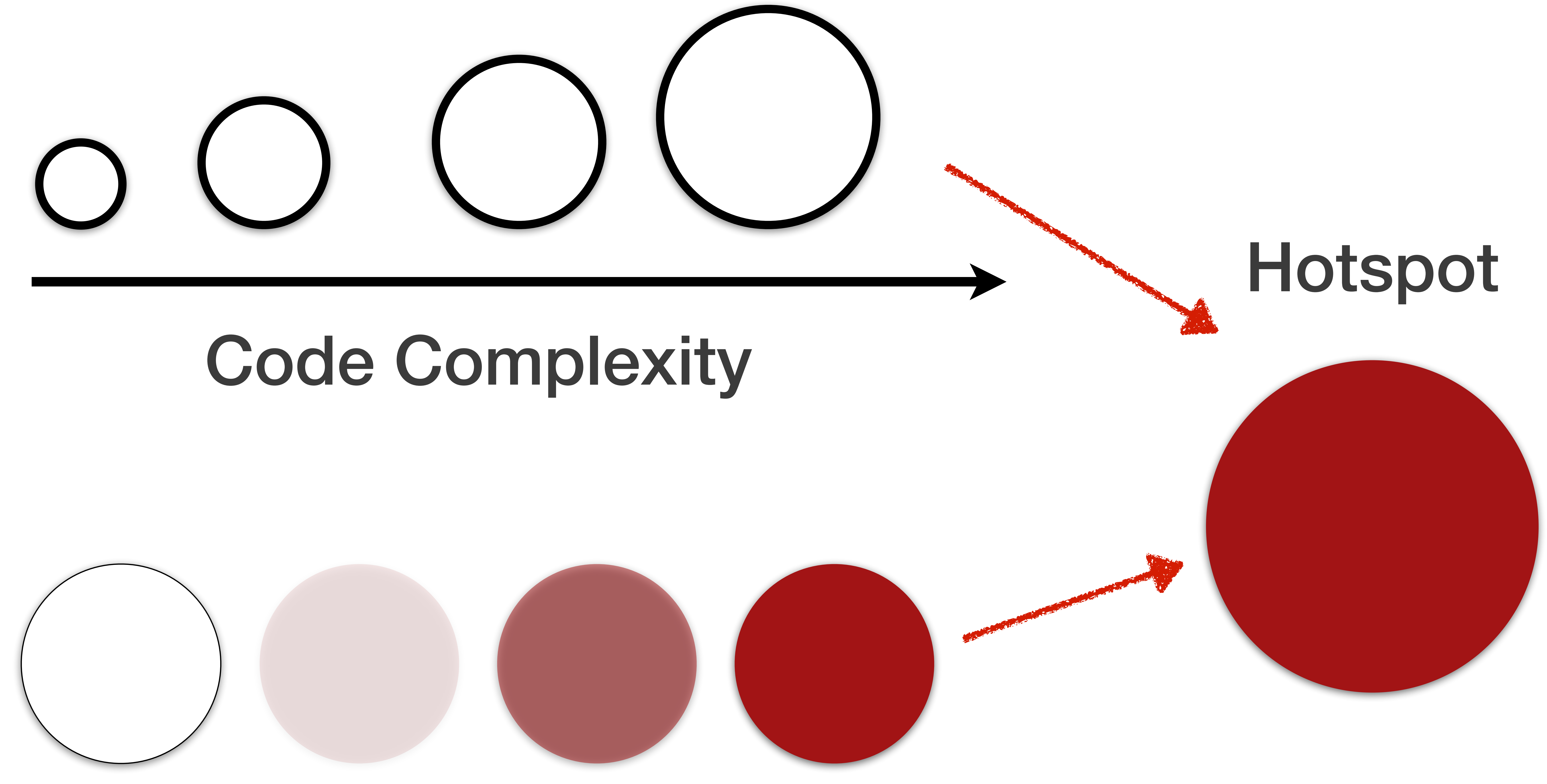

Hotspot

Code Complexity

Code Change Frequency

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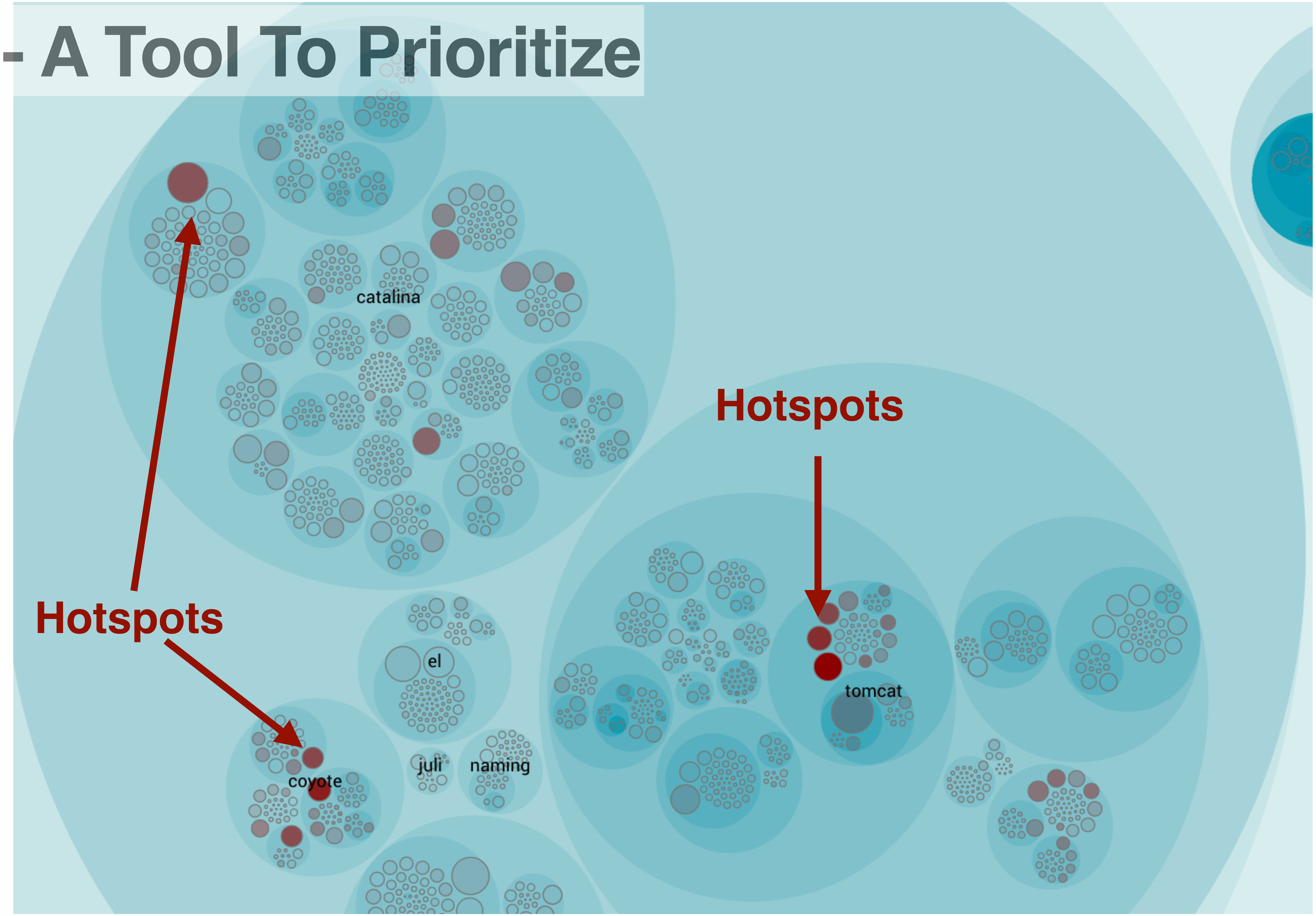
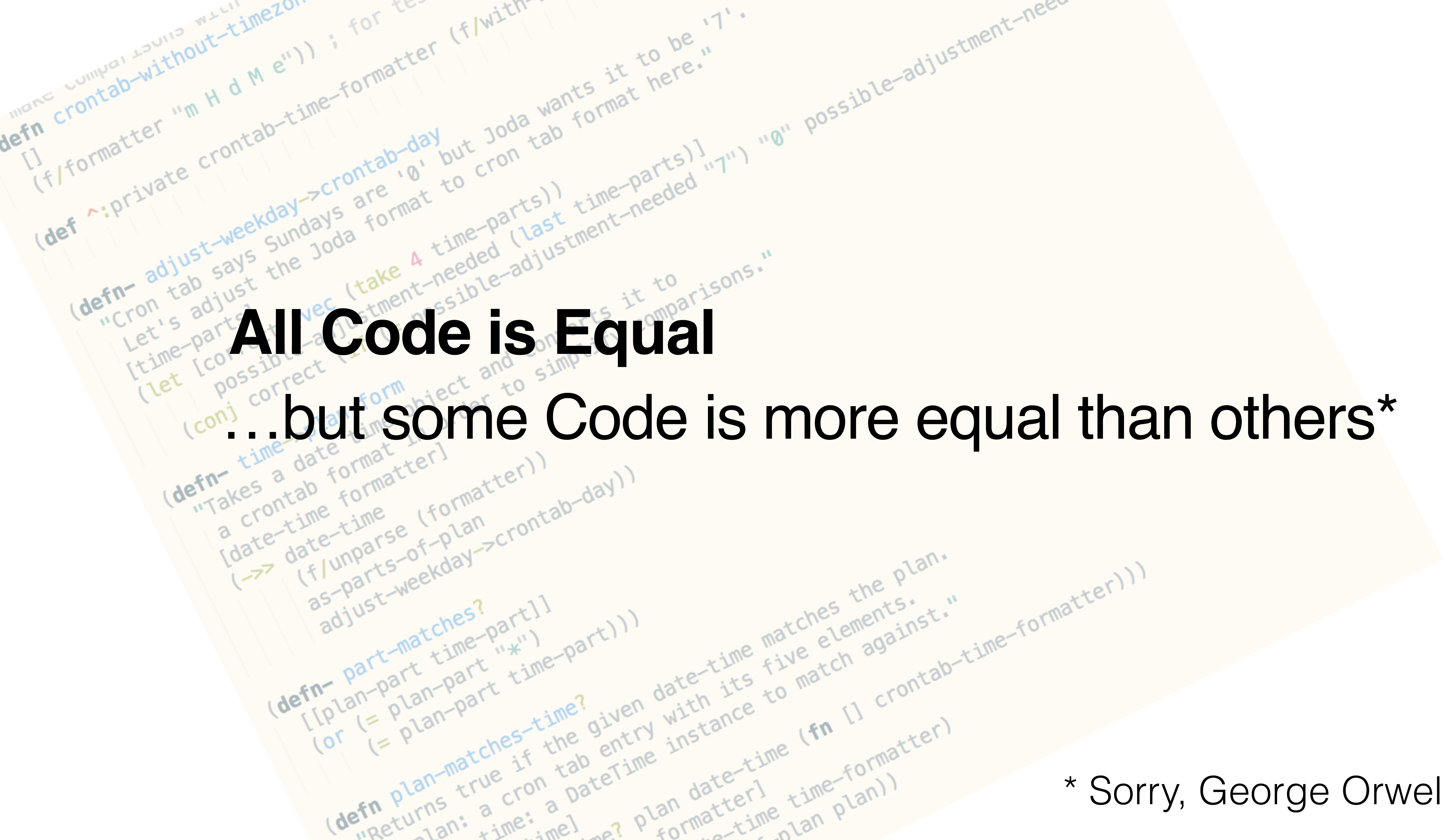
Hotspots - A Tool To Prioritize





```
make comparisons with
(defn crontab-without-timezo
  []
  (f/formatter "m H d M e")) ; for te

(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-vec (take 4 time-parts))
        possible-adjustment-needed (last time-parts)]
    (conj correct (if (= possible-adjustment-needed "7") "0" possible-adjustment-need

(defn- time->plan-form
  "Takes a date time object and converts it to
  a crontab format in order to simplify comparisons."
  [date-time formatter]
  (->> 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."
  [plan date-time]
  (plan-matches-time? plan date-time (fn [] crontab-time-formatter)))
  ([plan date-time formatter]
  (date-time time-formatter)
  plan plan))
```

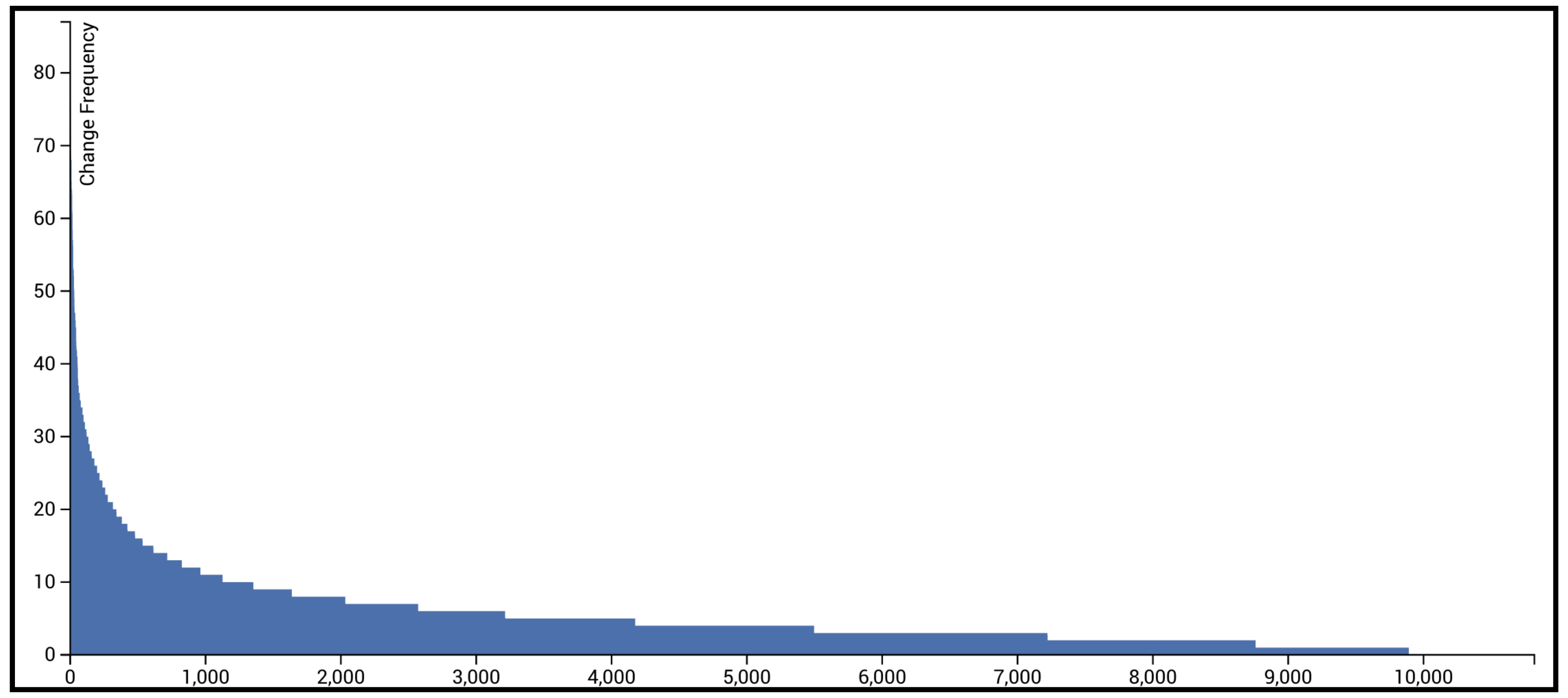
All Code is Equal

…but some Code is more equal than others*

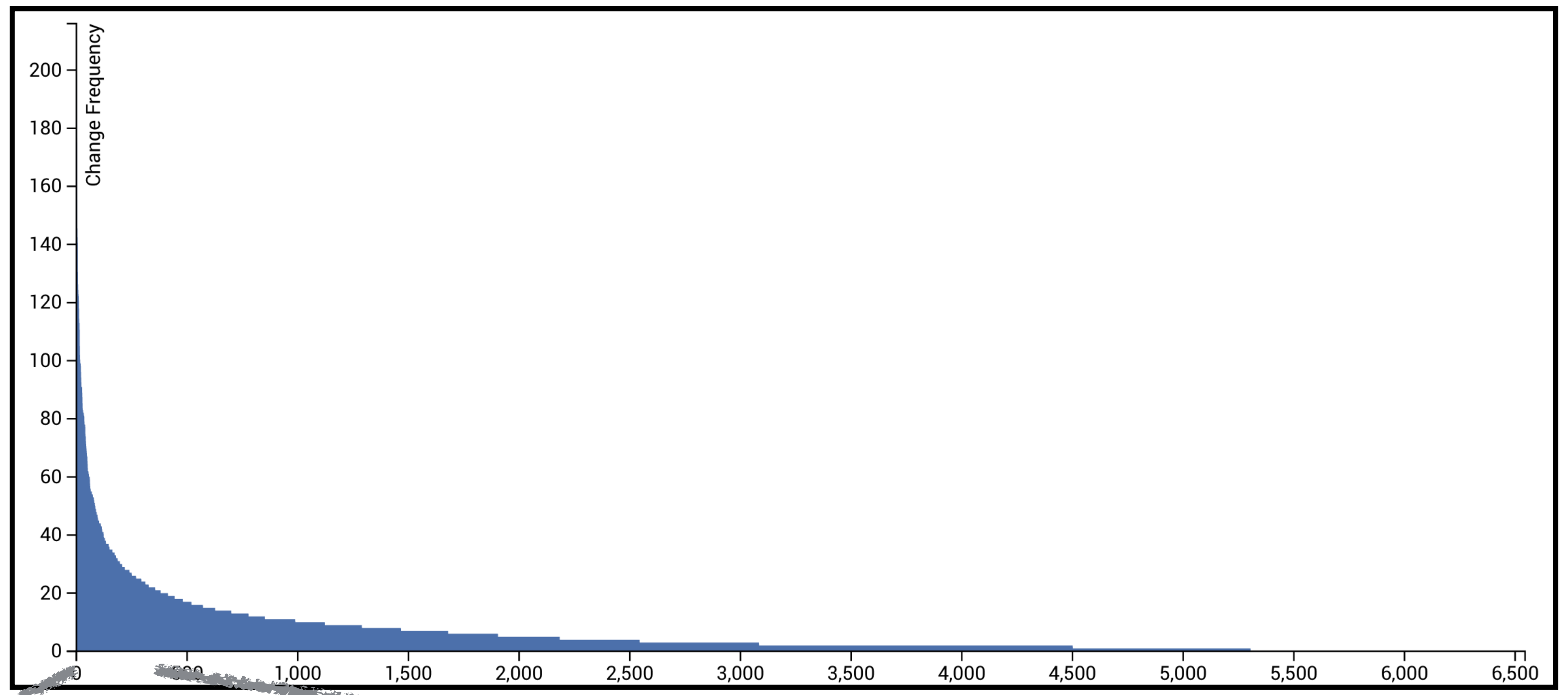
* Sorry, George Orwell

Why Hotspots Work

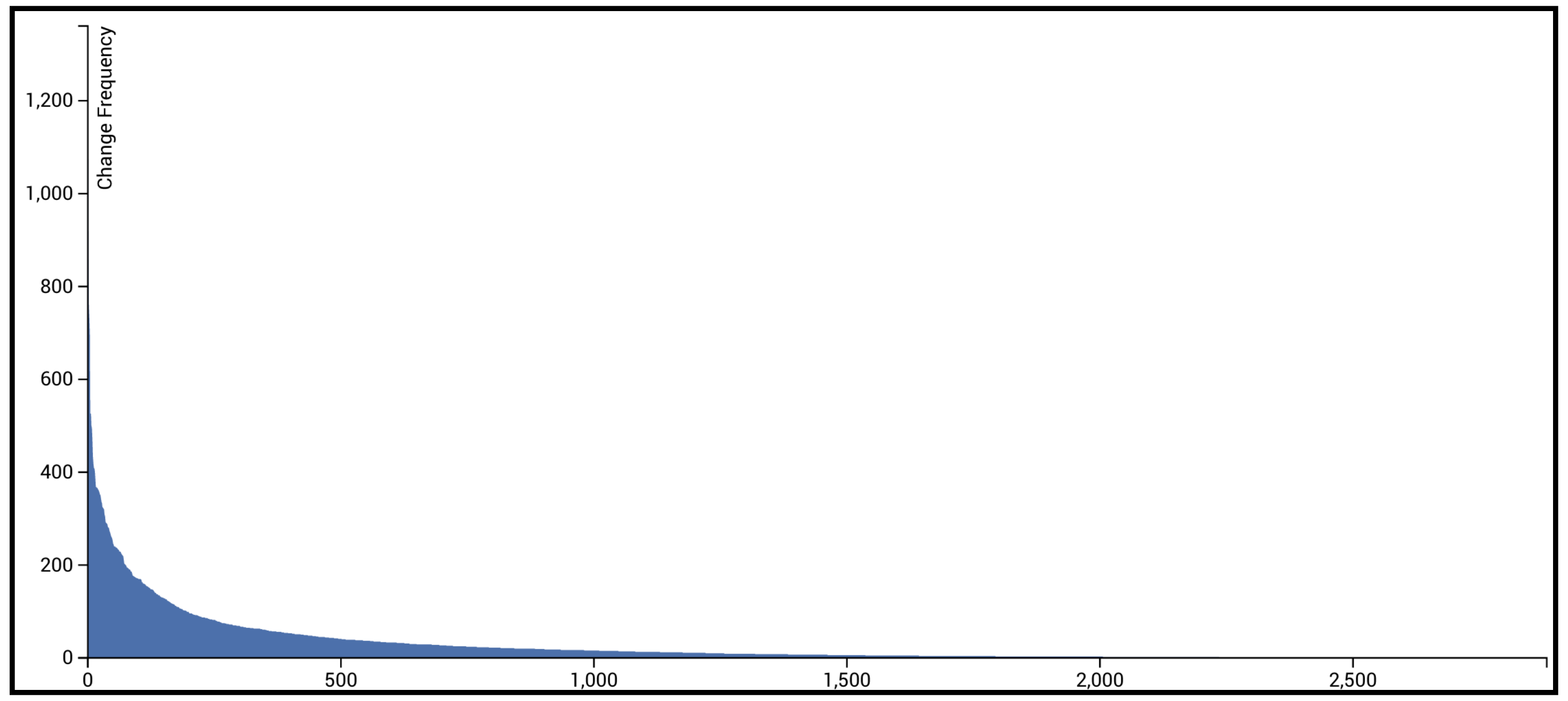
1 Year in Roslyn (C#, VB)

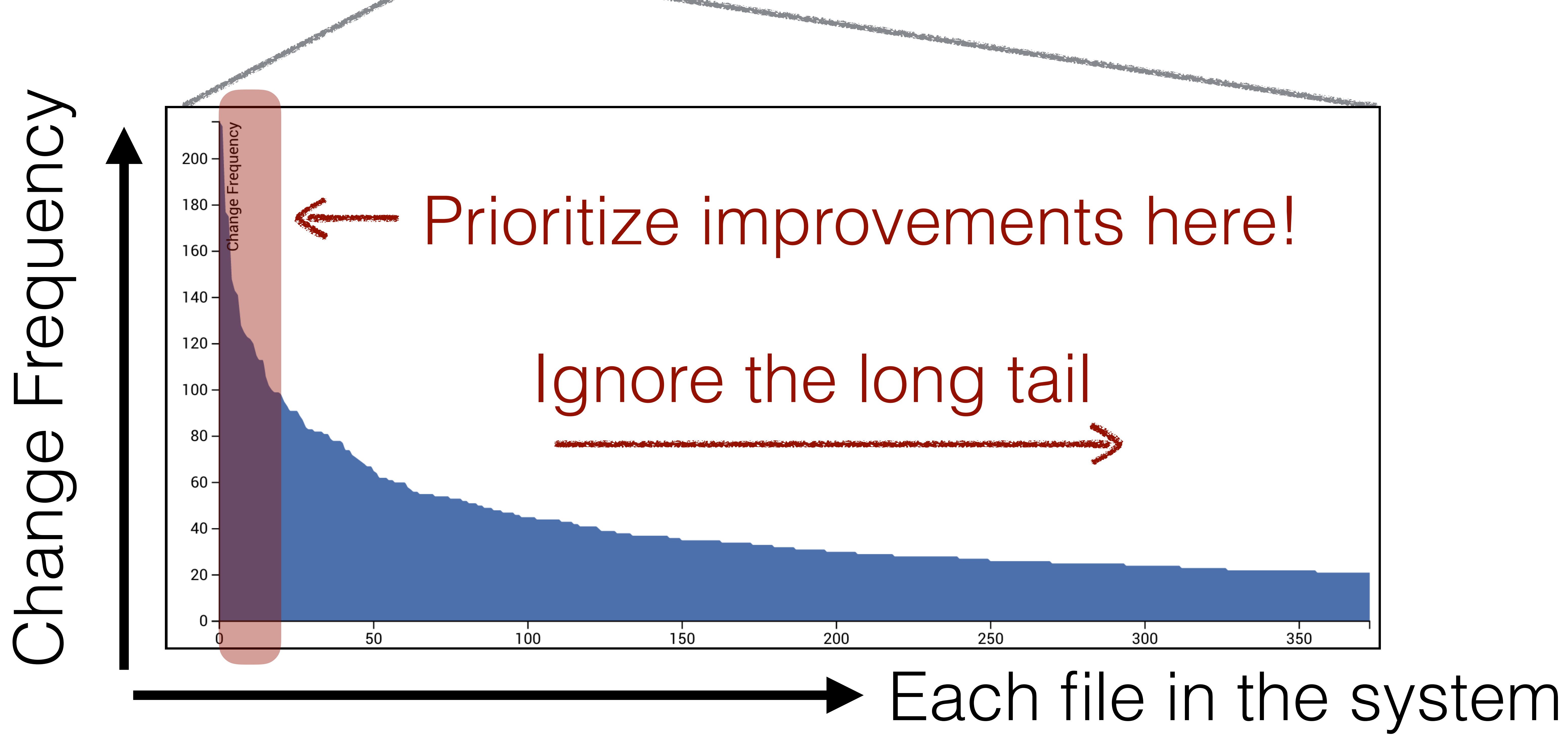


6 Years of Erlang



12 Years of Ruby on Rails





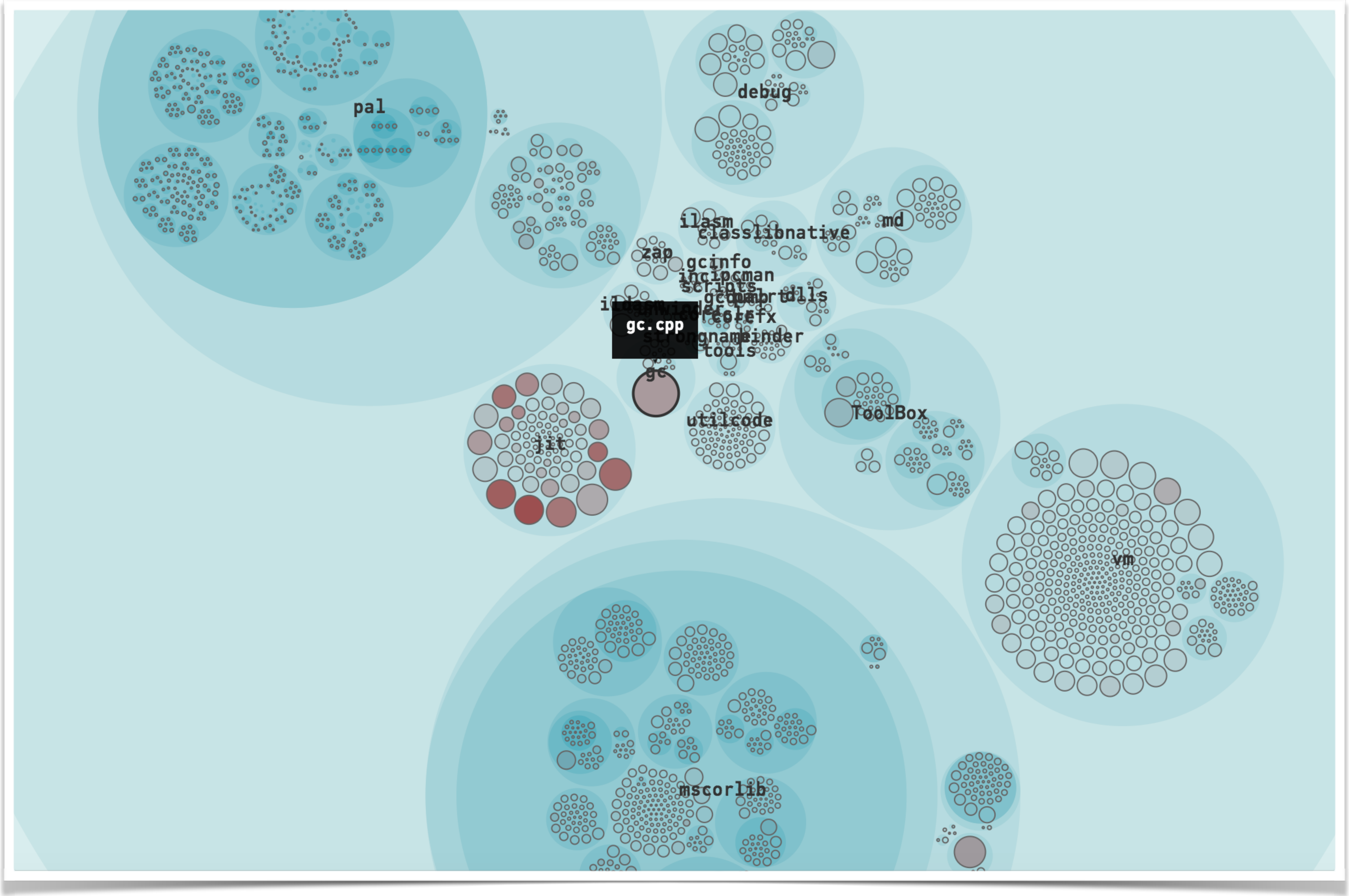
Prioritize improvements here!

Ignore the long tail

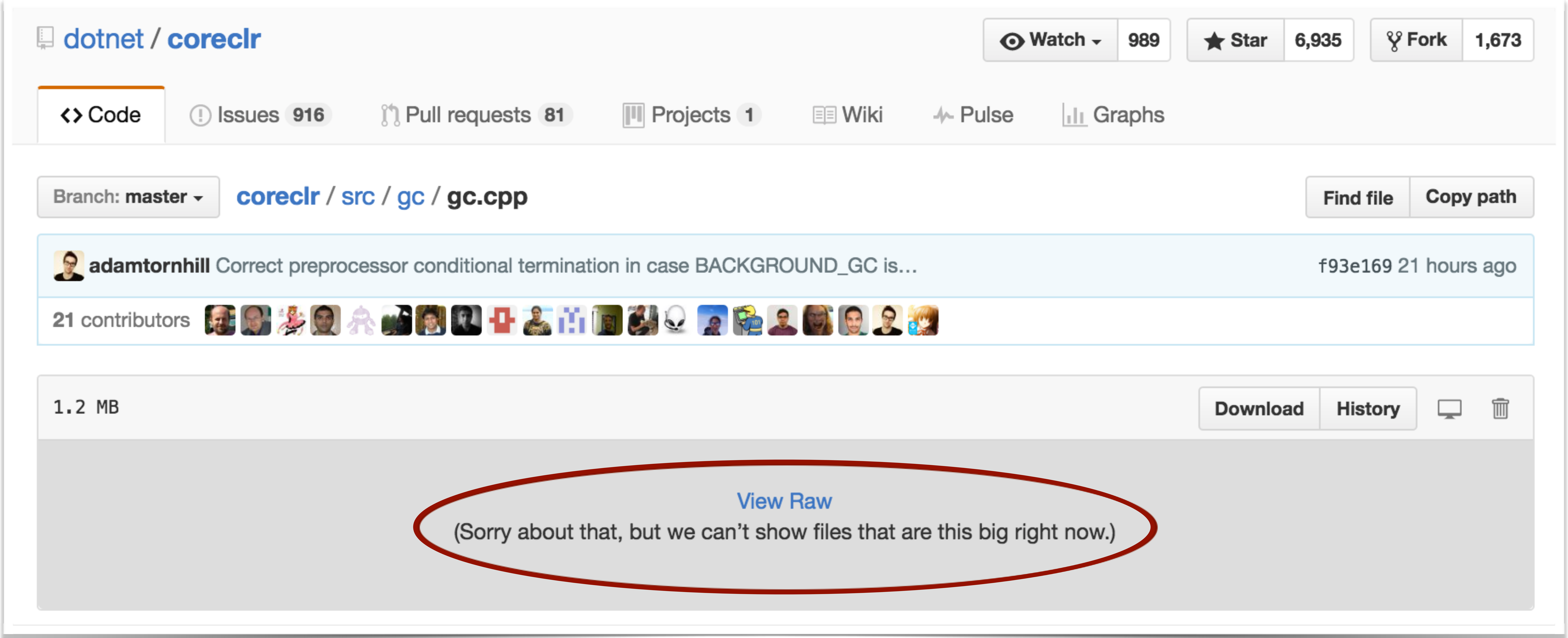
Reference: *Your Code as a Crime Scene*, ISBN:1680500384

Hotspots

Case Study:


pal
debug
md
ilasm
classlibnative
zap
gcinfo
inc
ipcman
scripts
gcdump
dlls
ildasm
unwinder
corefx
gc.cpp
strongname
binder
tools
gc
utilcode
ToolBox
jit
vm
mscorlib

gc.cpp



coreclr / src / gc / gc.cpp

adamtornhill Correct preprocessor conditional termination in case BACKGROUND_GC is… f93e169 21 hours ago

1.2 MB

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

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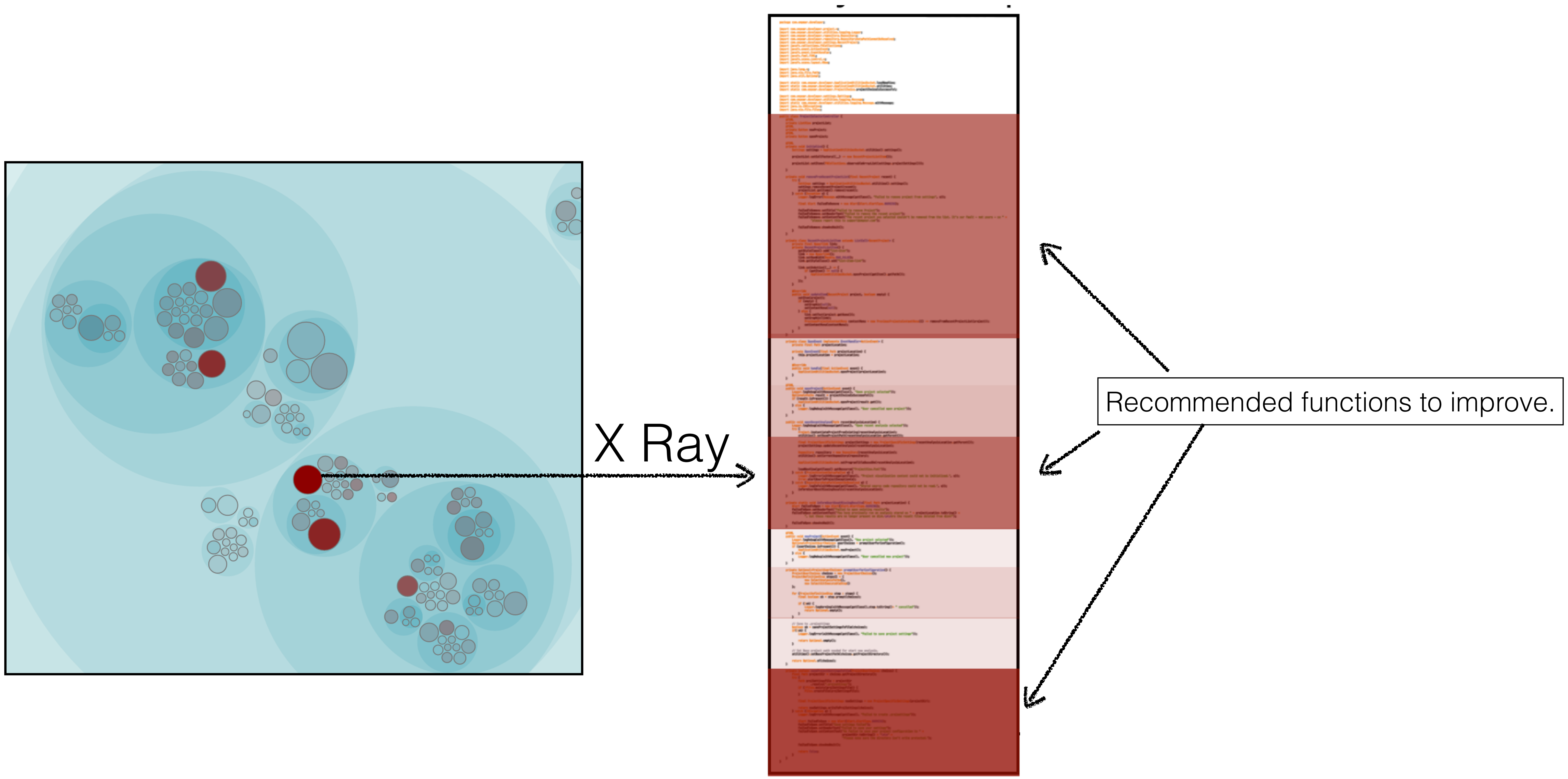
Hotspots X-Ray

File Level Hotspots

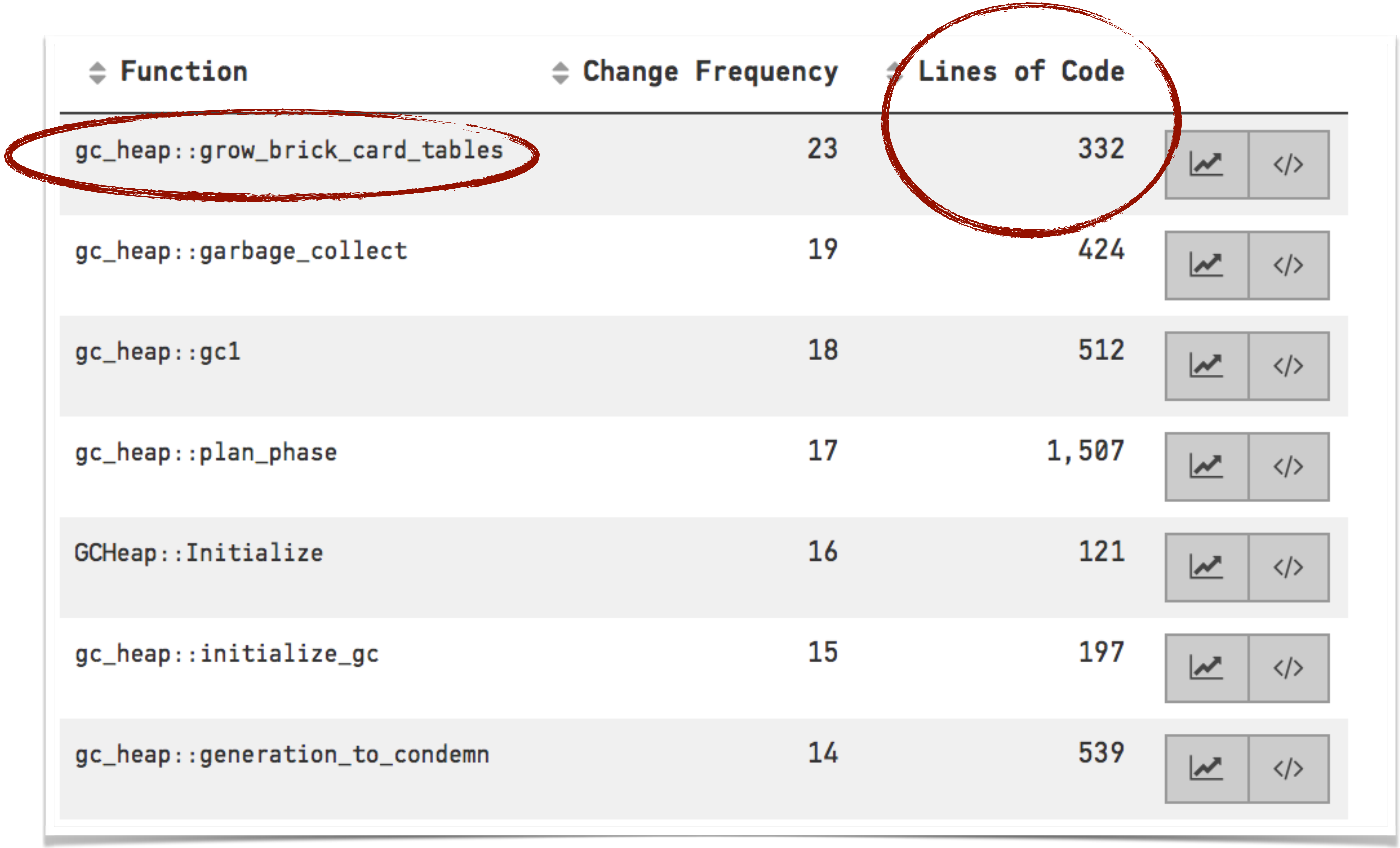
Function Level Hotspots



X Ray

Recommended functions to improve.

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:

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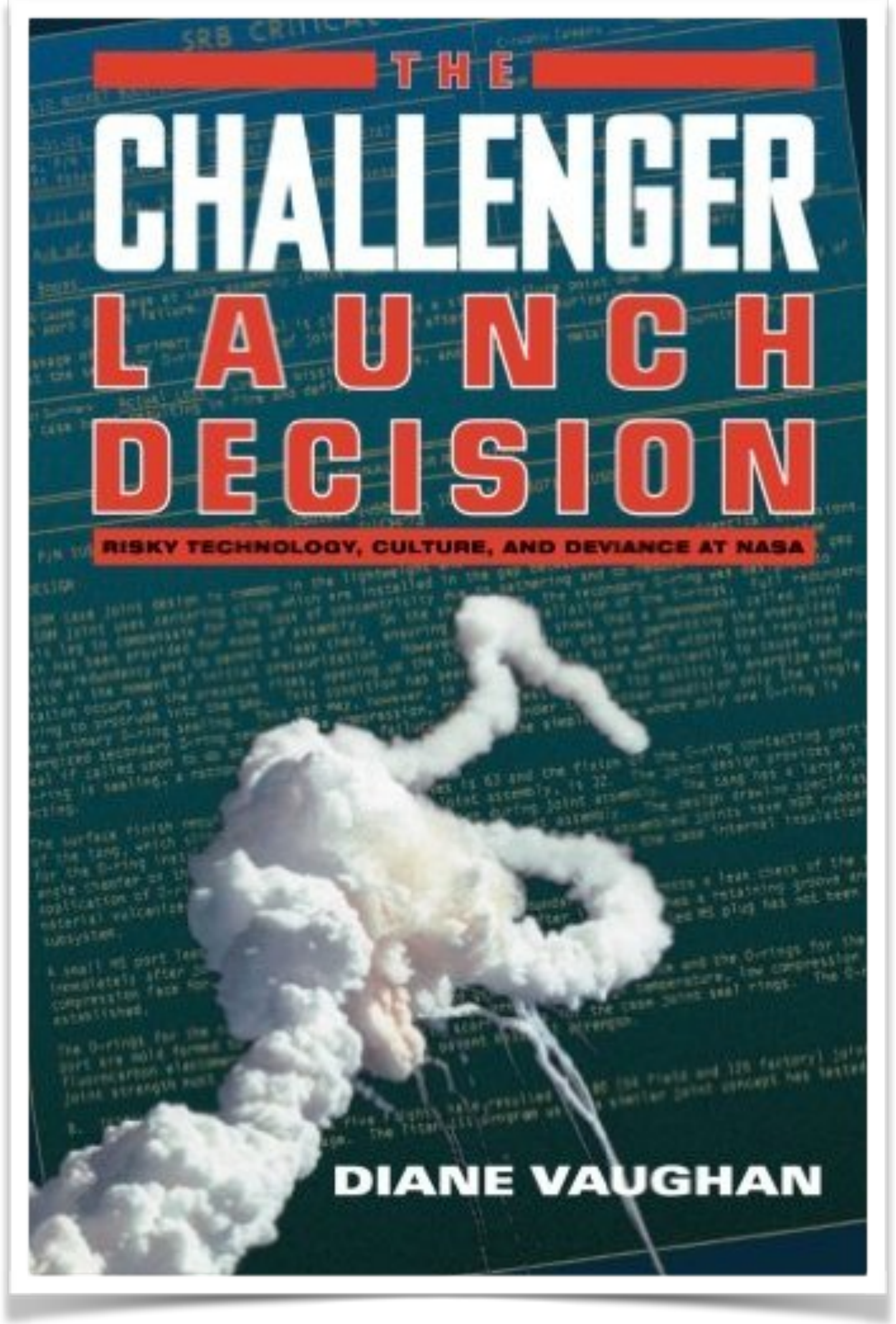
Normalization of Deviance

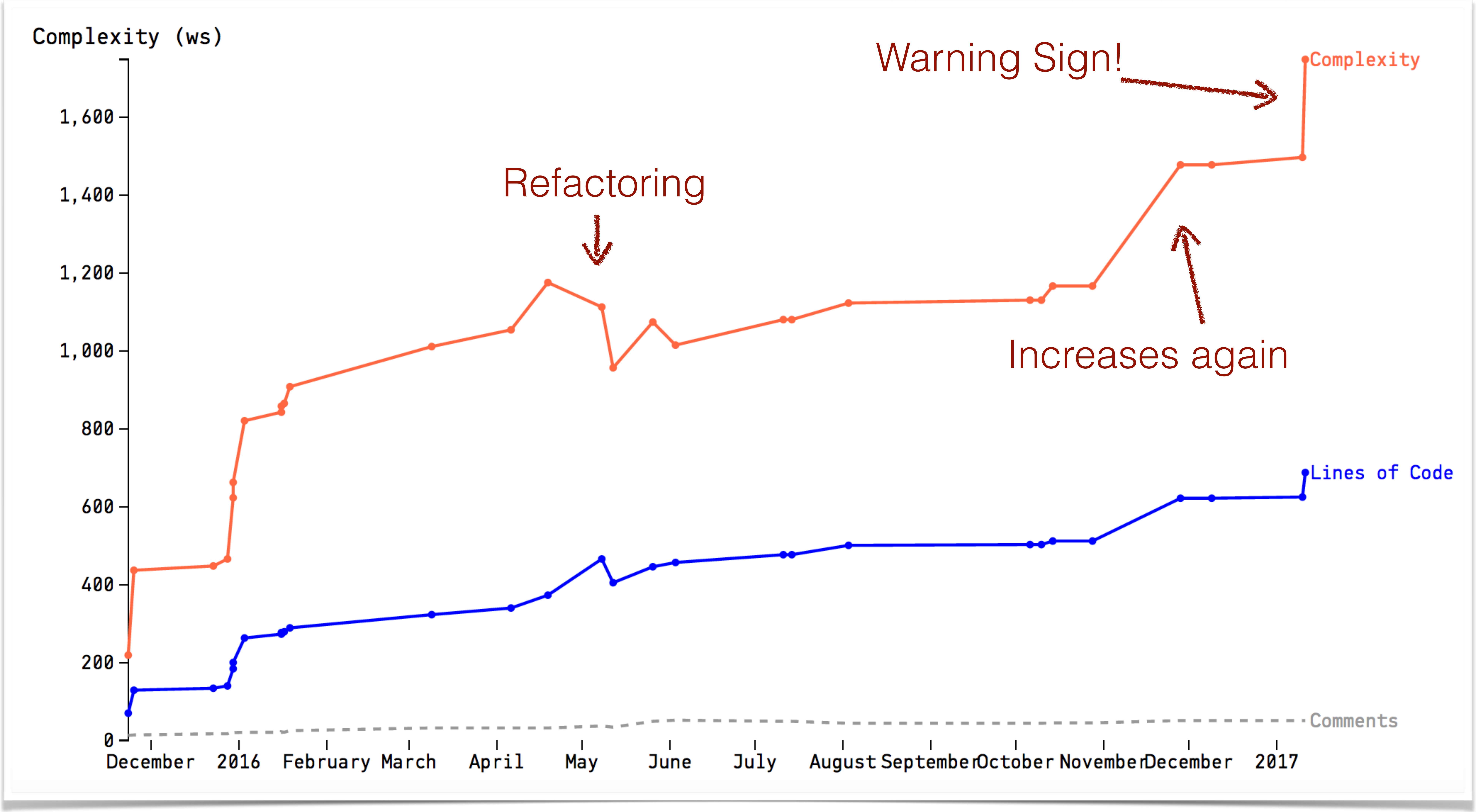


THE CHALLENGER LAUNCH DECISION

RISKY TECHNOLOGY, CULTURE, AND DEVIANCE AT NASA

DIANE VAUGHAN

Supervise your Complexity Trends



Warning Sign!

Refactoring

Increases again

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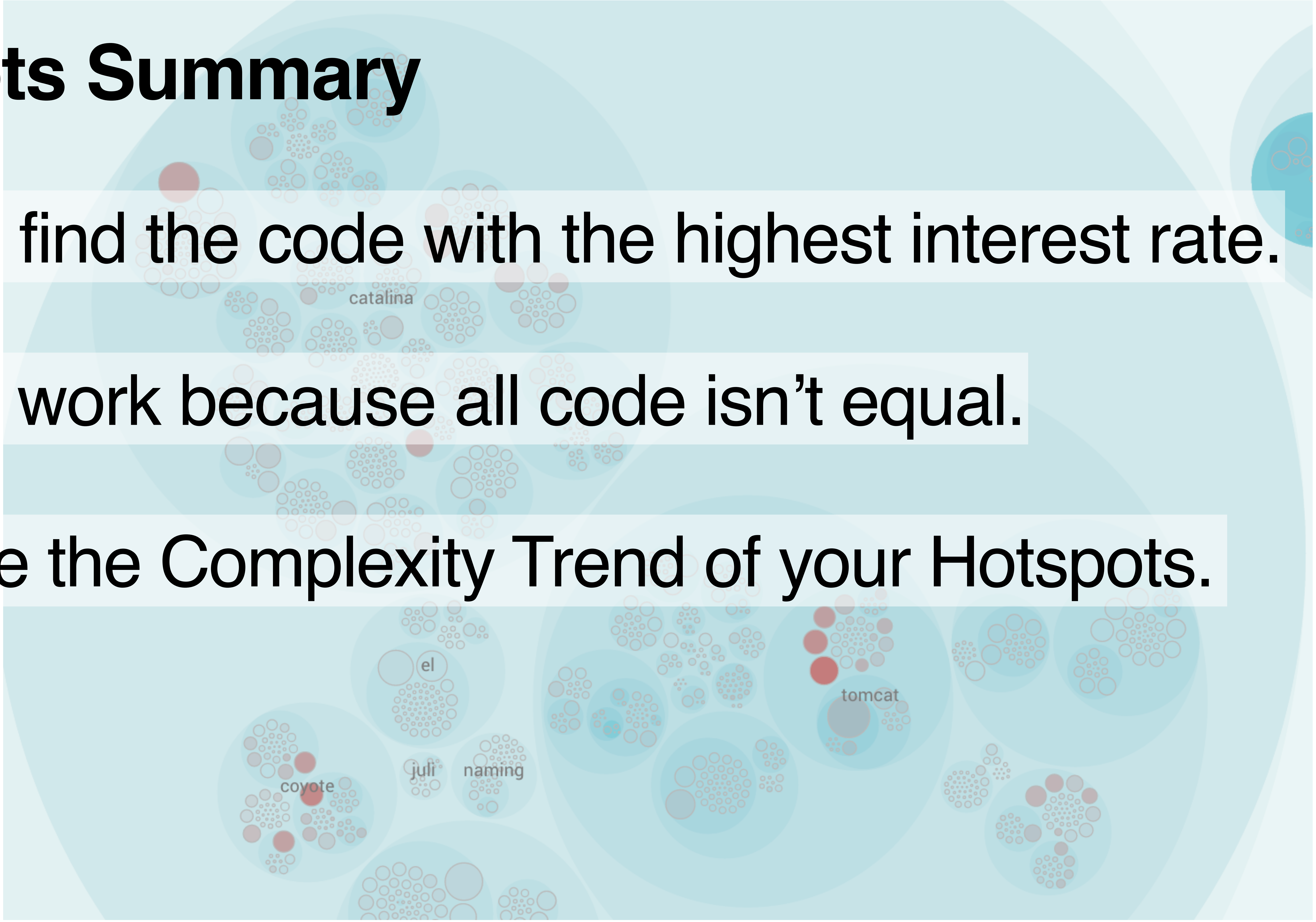
Hotspots Summary

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?

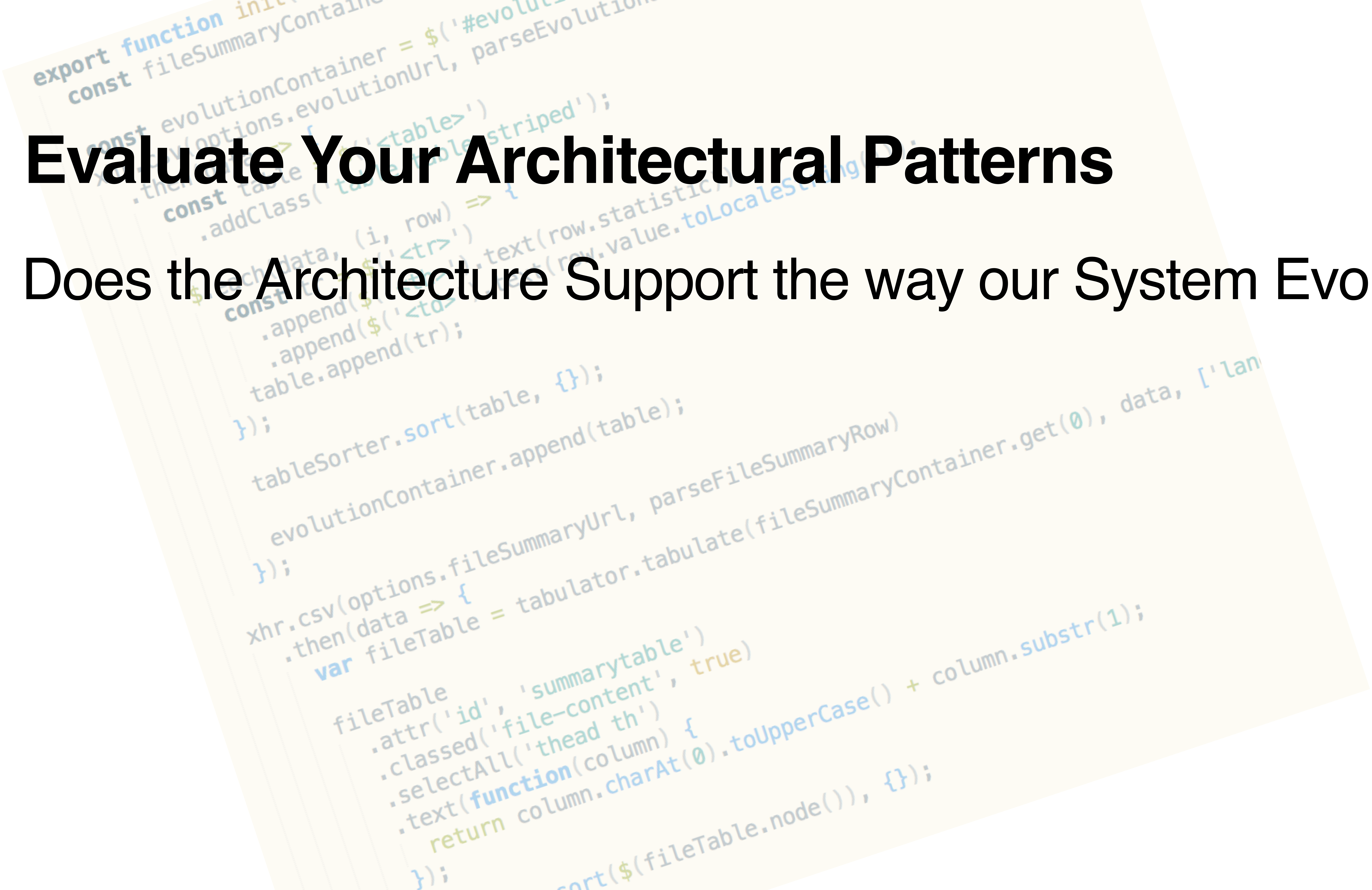


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        table.append(tr);
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      evolutionContainer.append(table);
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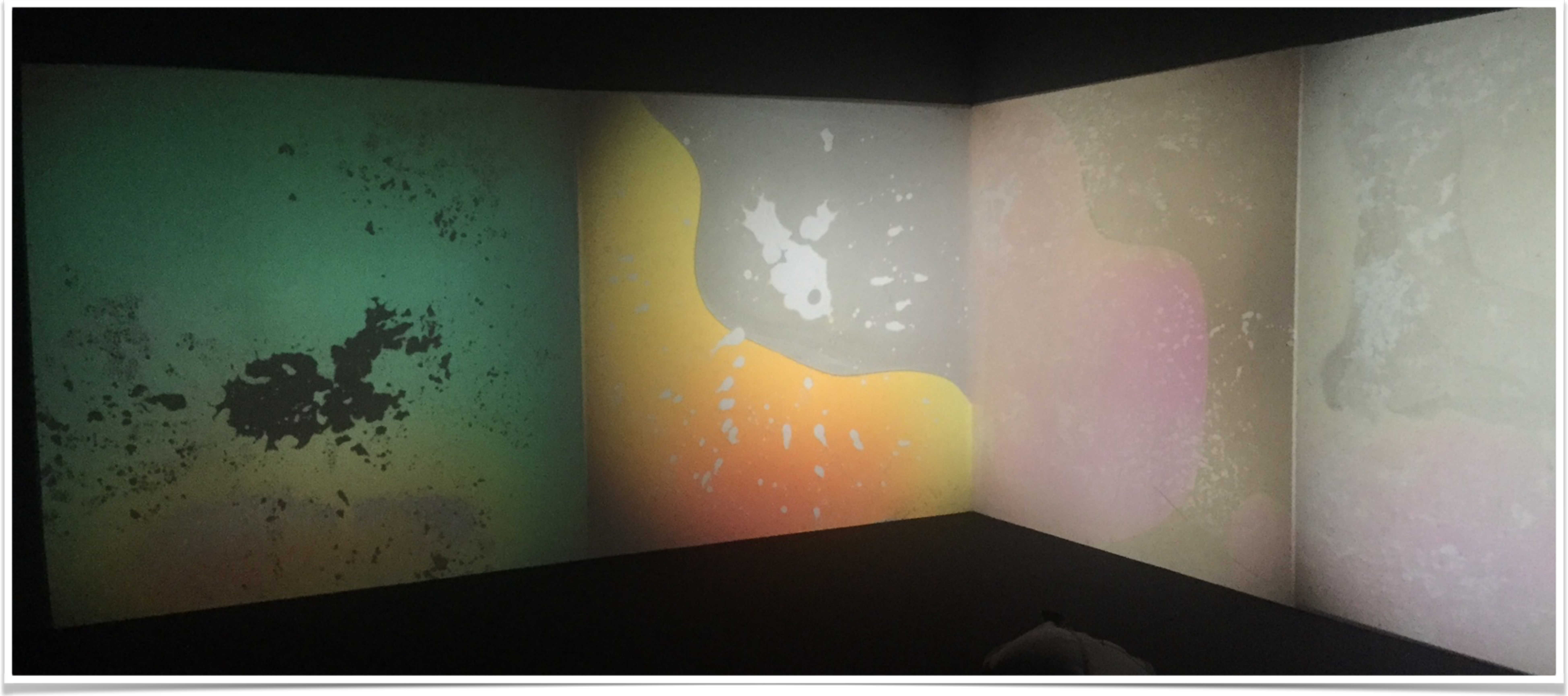
        .selectAll('thead th')
        .text(function(column) {
          return column.charAt(0).toUpperCase() + column.substr(1);
        });
      ort($(fileTable.node()), {});
```

Code is Auto-Destructive Art



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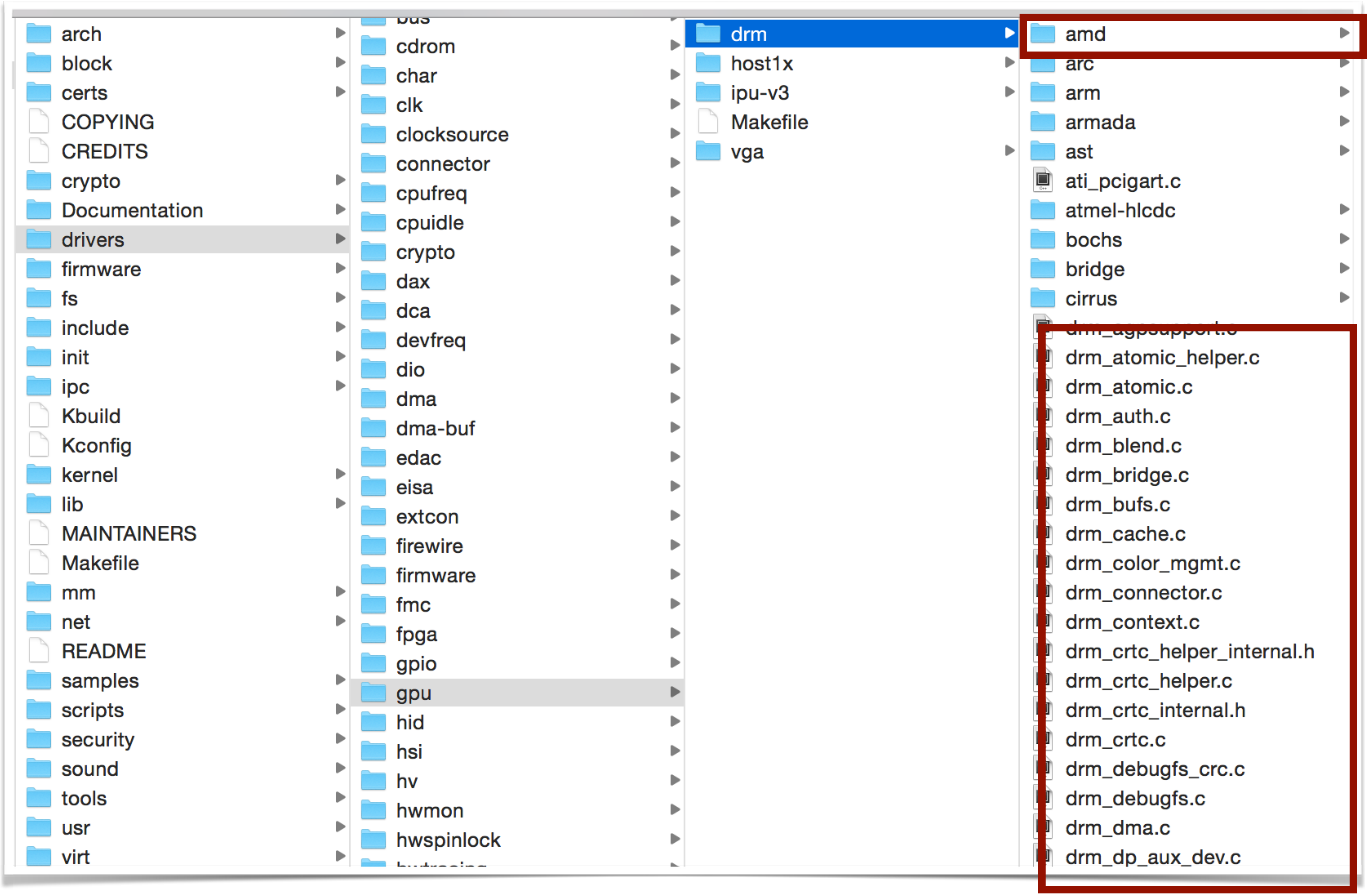
Specify Your Logical Components



arch
block
certs
COPYING
CREDITS
crypto
Documentation
drivers
firmware
fs
include
init
ipc
Kbuild
Kconfig
kernel
lib
MAINTAINERS
Makefile
mm
net
README
samples
scripts
security
sound
tools
usr
virt

bus
cdrom
char
clk
clocksource
connector
cpufreq
cpuidle
crypto
dax
dca
devfreq
dio
dma
dma-buf
edac
eisa
extcon
firewire
firmware
fmc
fpga
gpio
gpu
hid
hsi
hv
hwmon
hwspinlock
hwtracing

drm
host1x
ipu-v3
Makefile
vga

amd
arc
arm
armada
ast
ati_pcigart.c
atmel-hlcdc
bochs
bridge
cirrus
drm_agpsupport.c
drm_atomic_helper.c
drm_atomic.c
drm_auth.c
drm_blend.c
drm_bridge.c
drm_bufs.c
drm_cache.c
drm_color_mgmt.c
drm_connector.c
drm_context.c
drm_crtc_helper_internal.h
drm_crtc_helper.c
drm_crtc_internal.h
drm_crtc.c
drm_debugfs_crc.c
drm_debugfs.c
drm_dma.c
drm_dp_aux_dev.c

DRM/AMD

...

DRM Shared

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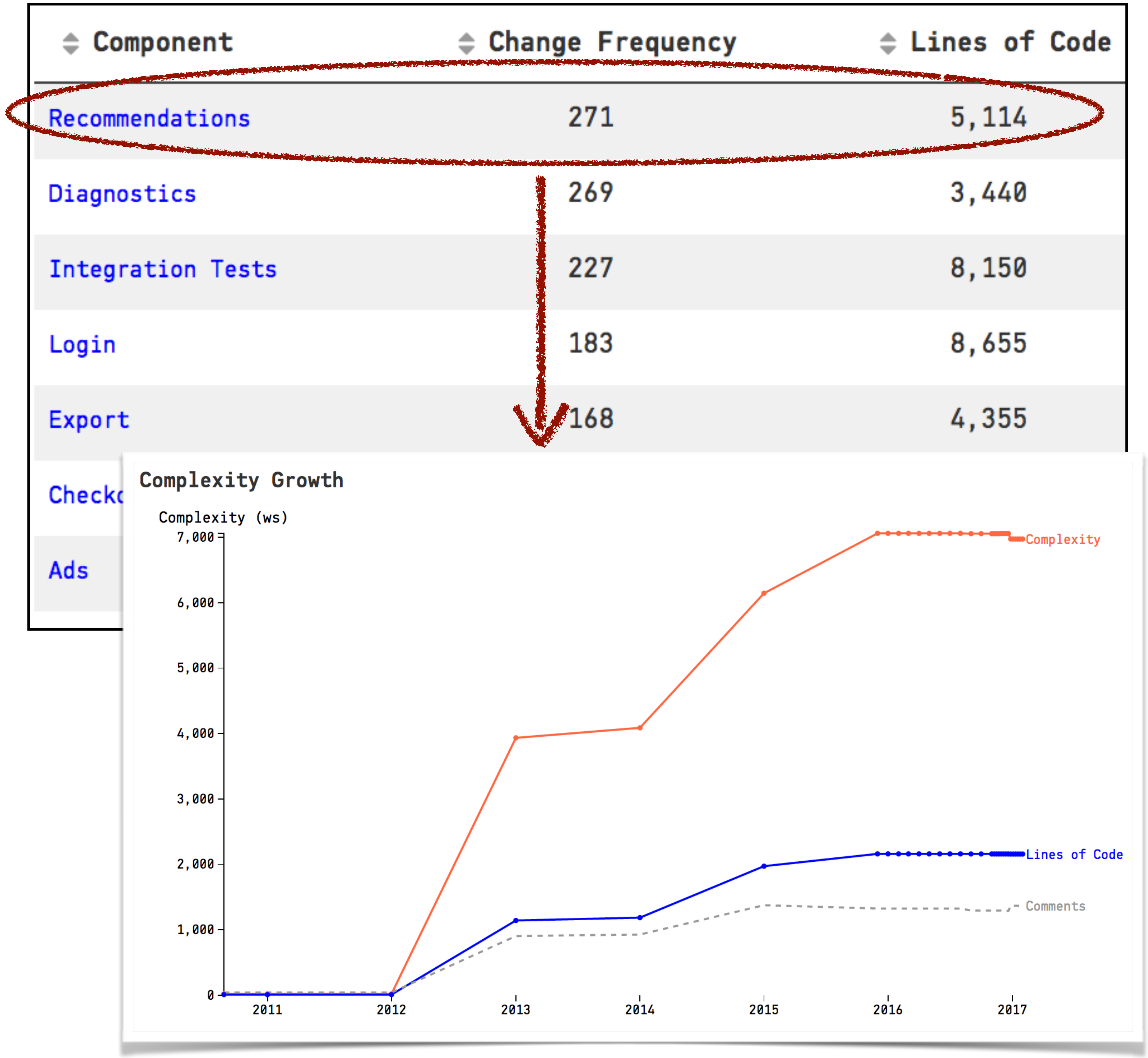
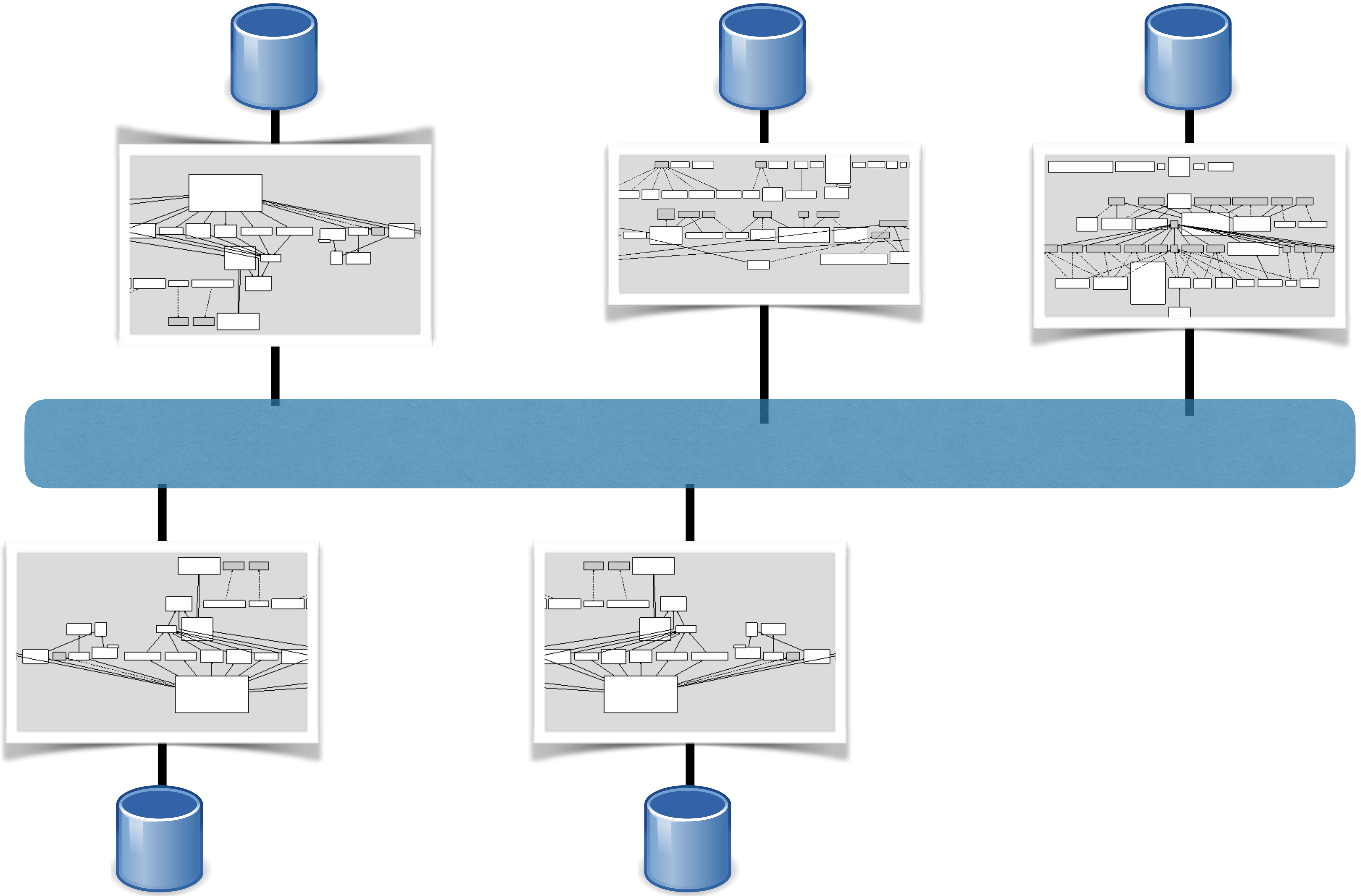
Identify **Hotspots** on a **(Micro)Service** Level



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
Checko		
Ads		

Complexity Growth



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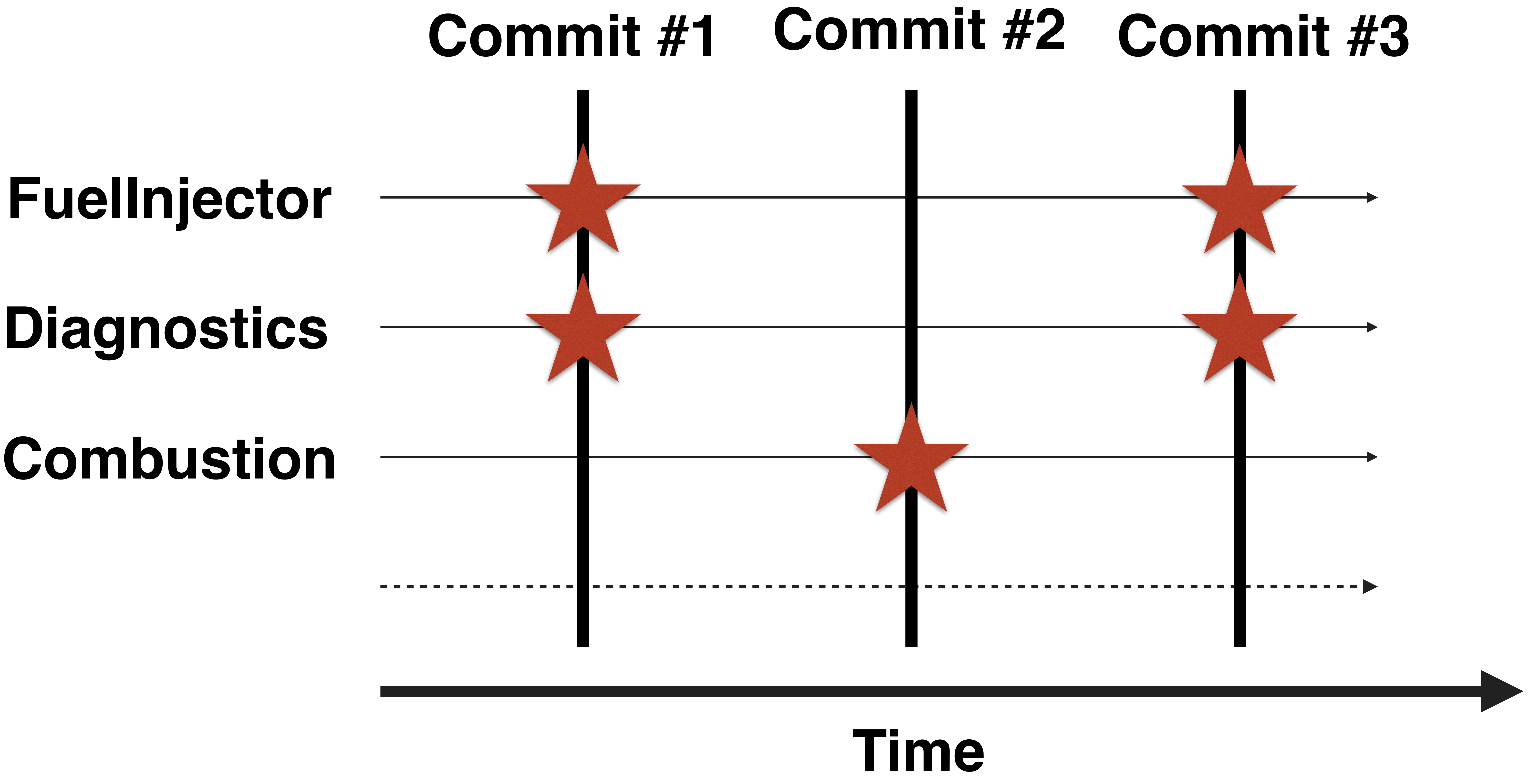
Temporal Coupling



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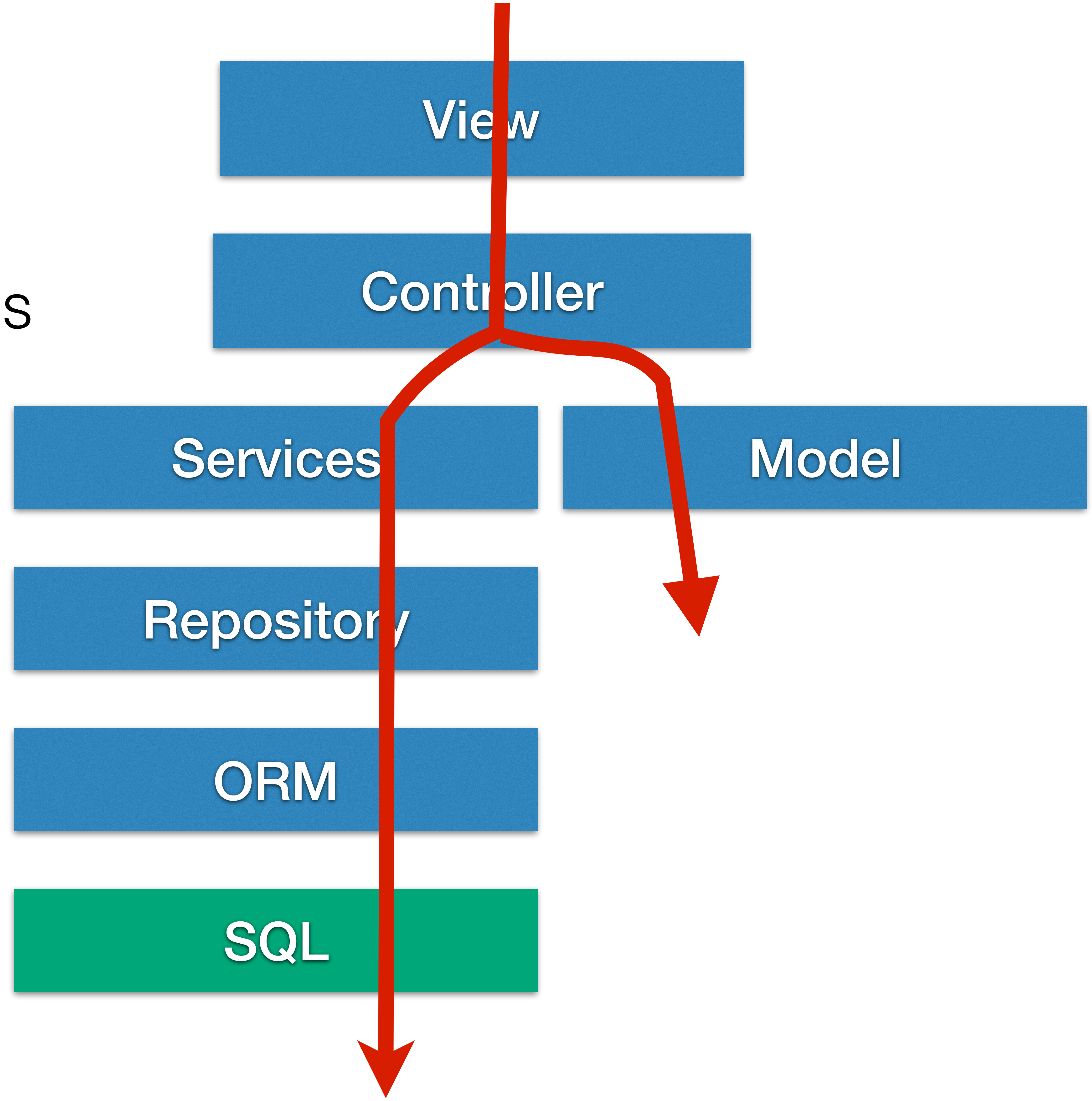
Read More: http://www.empear.com/blog/software-revolution-part3/

Layers: A Separation of Concern~~s~~

Change Coupling

General Observation:

30-70 % of all commits touch multiple layers



View

Controller

Services

Model

Repository

ORM

SQL

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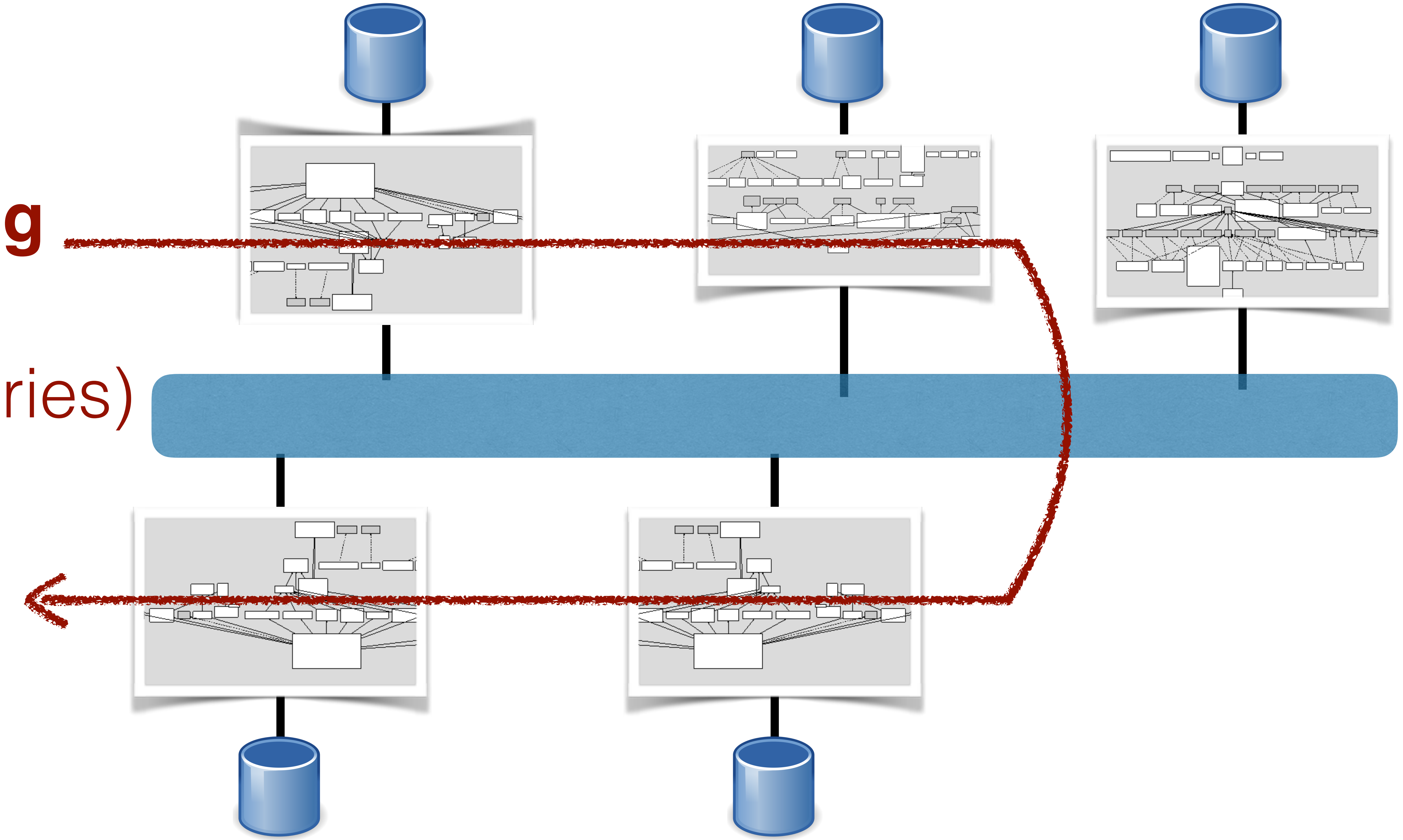
Supervise The Change Coupling Between Services



Temporal Coupling

(potentially across repository boundaries)

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The Microservices Shotgun Surgery Pattern

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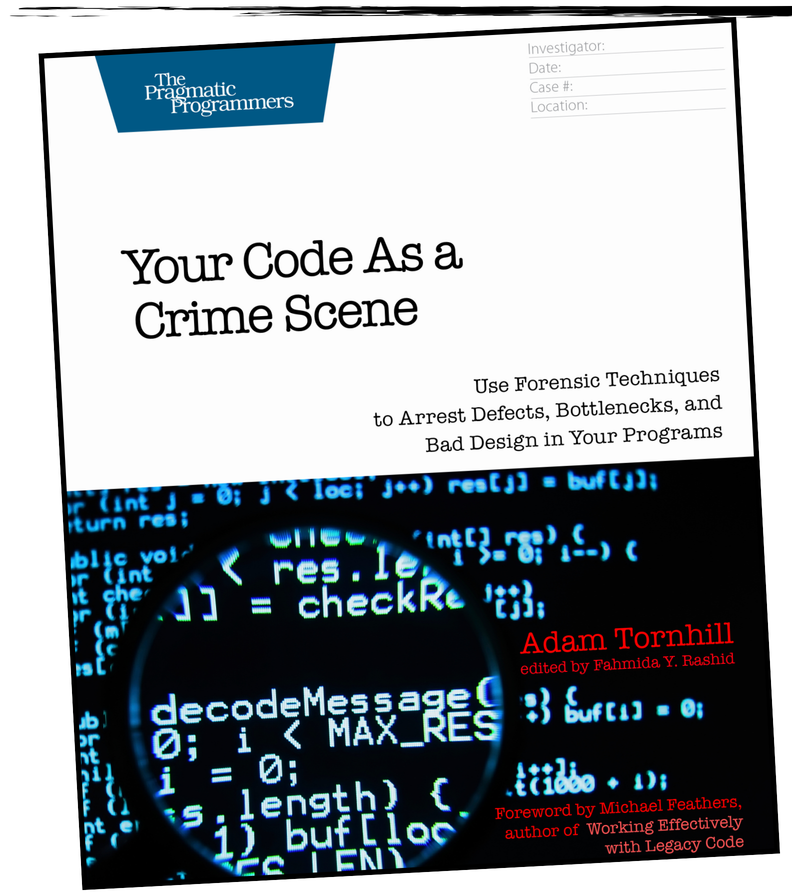
Tools



The Pragmatic Programmers

Your Code As a Crime Scene

Use Forensic Techniques to Arrest Defects, Bottlenecks, and Bad Design in Your Programs

Adam Tornhill
edited by Fahmida Y. Rashid

Foreword by Michael Feathers, author of Working Effectively with Legacy Code

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

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

CodeScene:

https://codescene.io/

CODESCENE
BY EMPEAR®

The history of your code will decide its future.

Evolution Radar

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

Moose Platform: open source platform

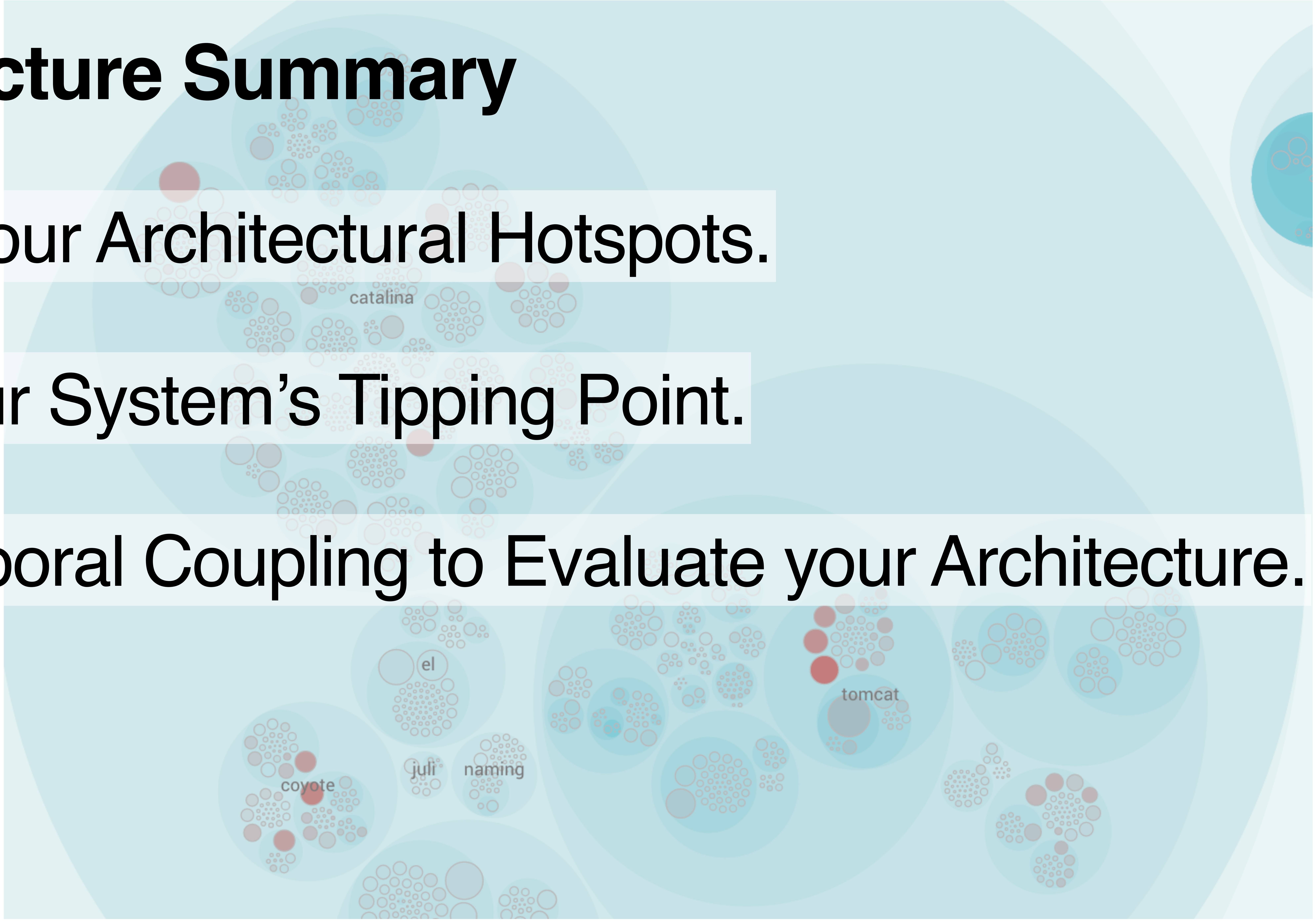
http://www.moosetechnology.org/

Architecture Summary

Identify your Architectural Hotspots.

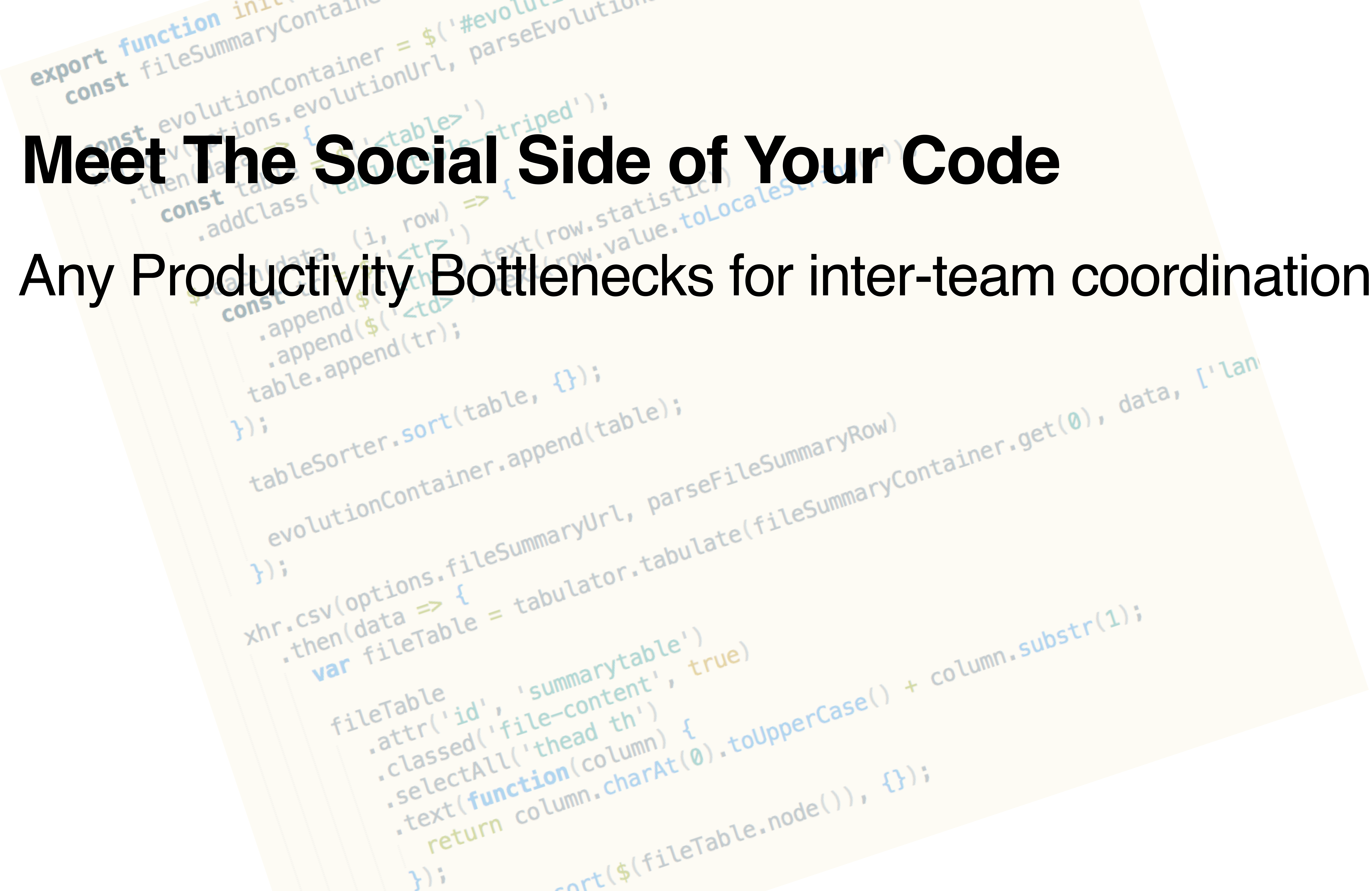
Know your System’s Tipping Point.

Use Temporal Coupling to Evaluate your Architecture.

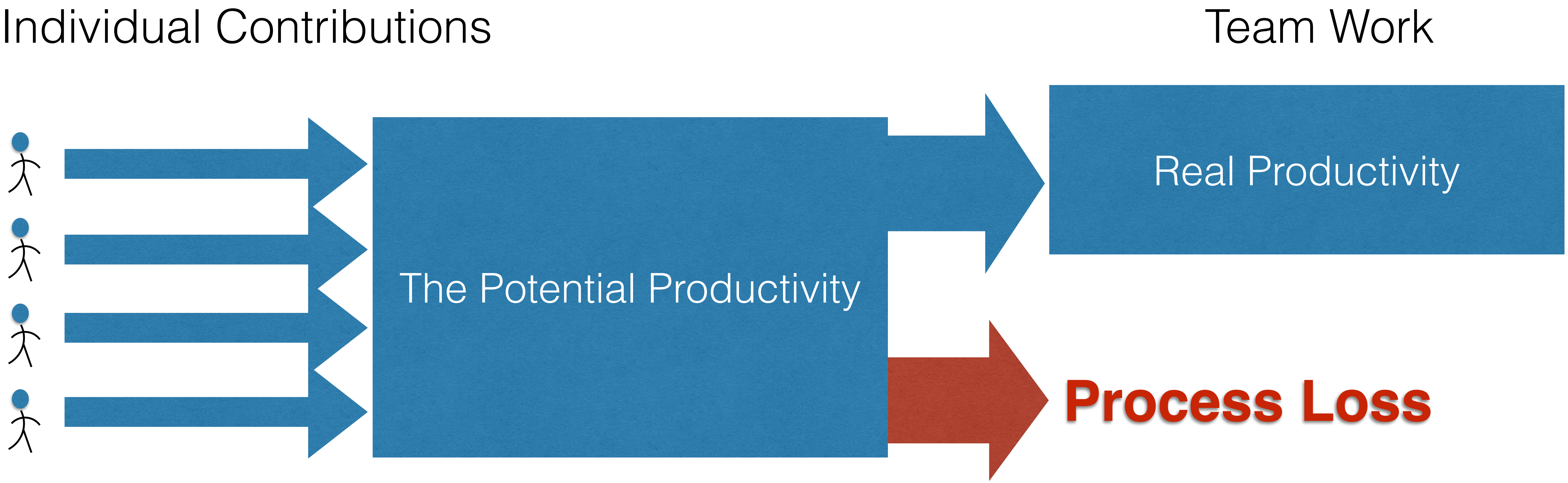


Meet The Social Side of Your Code

Any Productivity Bottlenecks for inter-team coordination?



Process Loss



Individual Contributions

Team Work

The Potential Productivity

Real Productivity

Process Loss

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Diffusion of Responsibility

Measure Team Coordination

The Diffusion of Responsibility

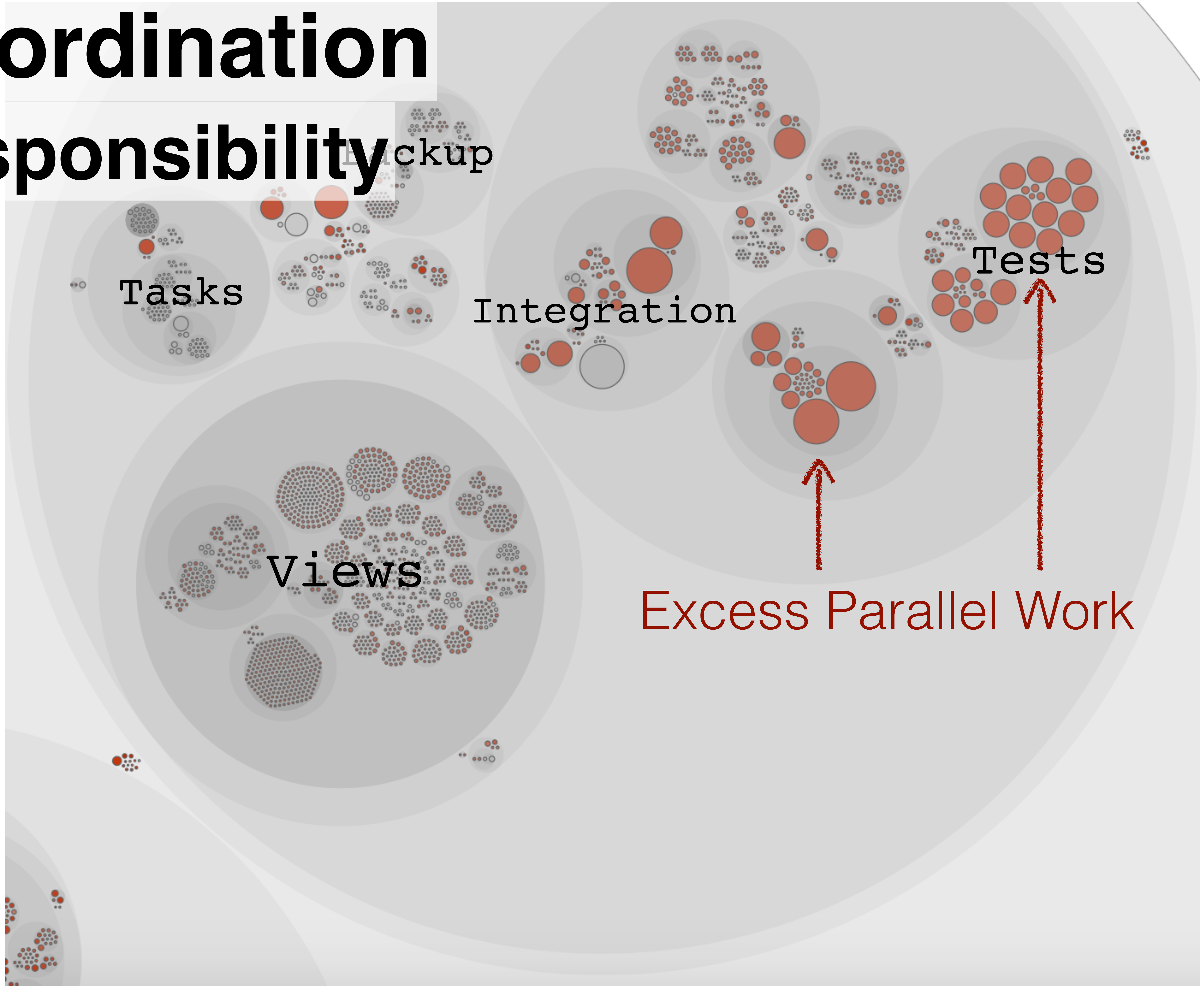
Fractal Value

Inter-Team Overlap

■ ■ ■ ■ ■

→

0 ~1.0

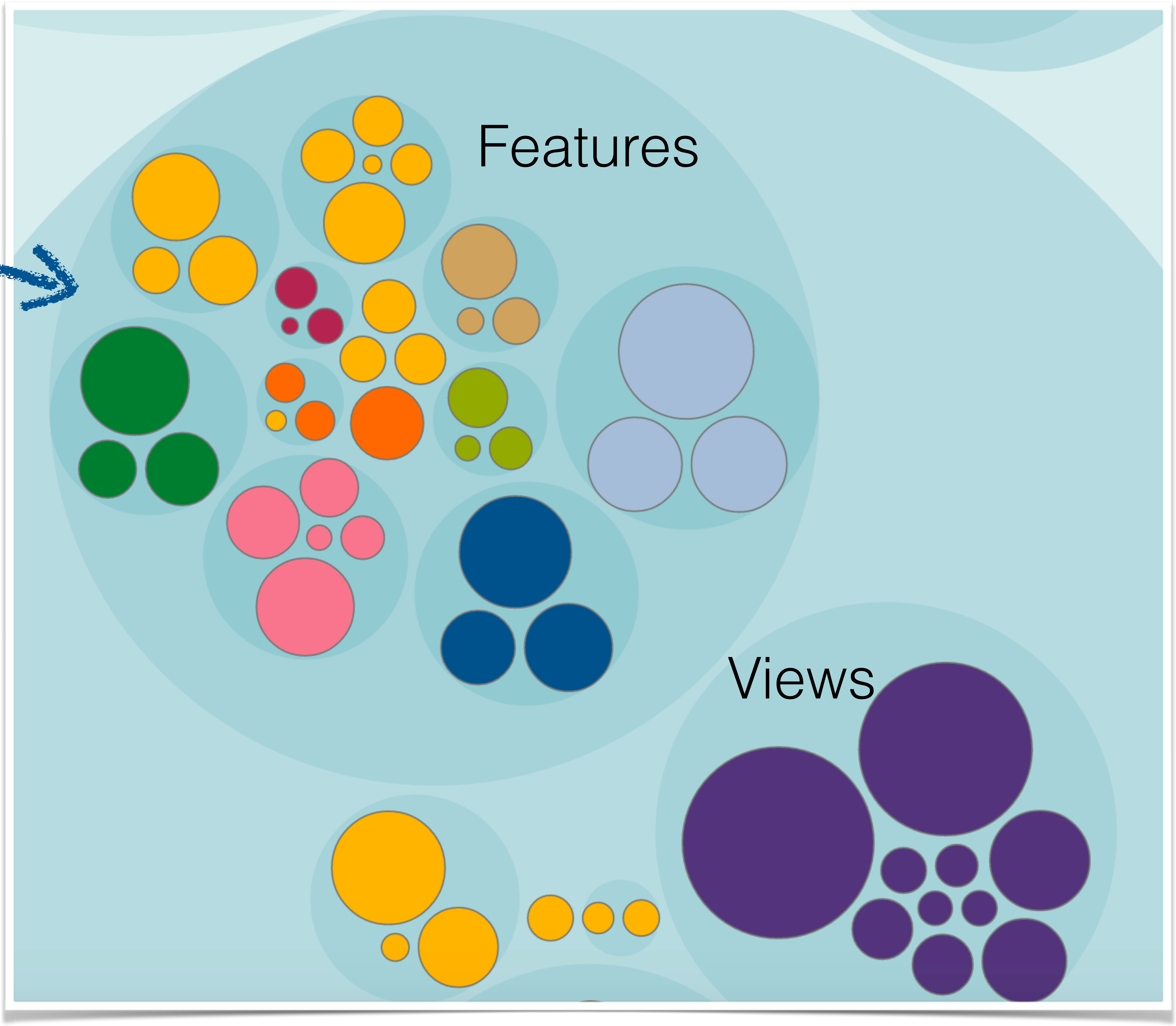


Fractal Value: M. D’Ambros, M. Lanza, and H Gall. *Fractal Figures: Visualizing Development Effort for CVS Entities.*

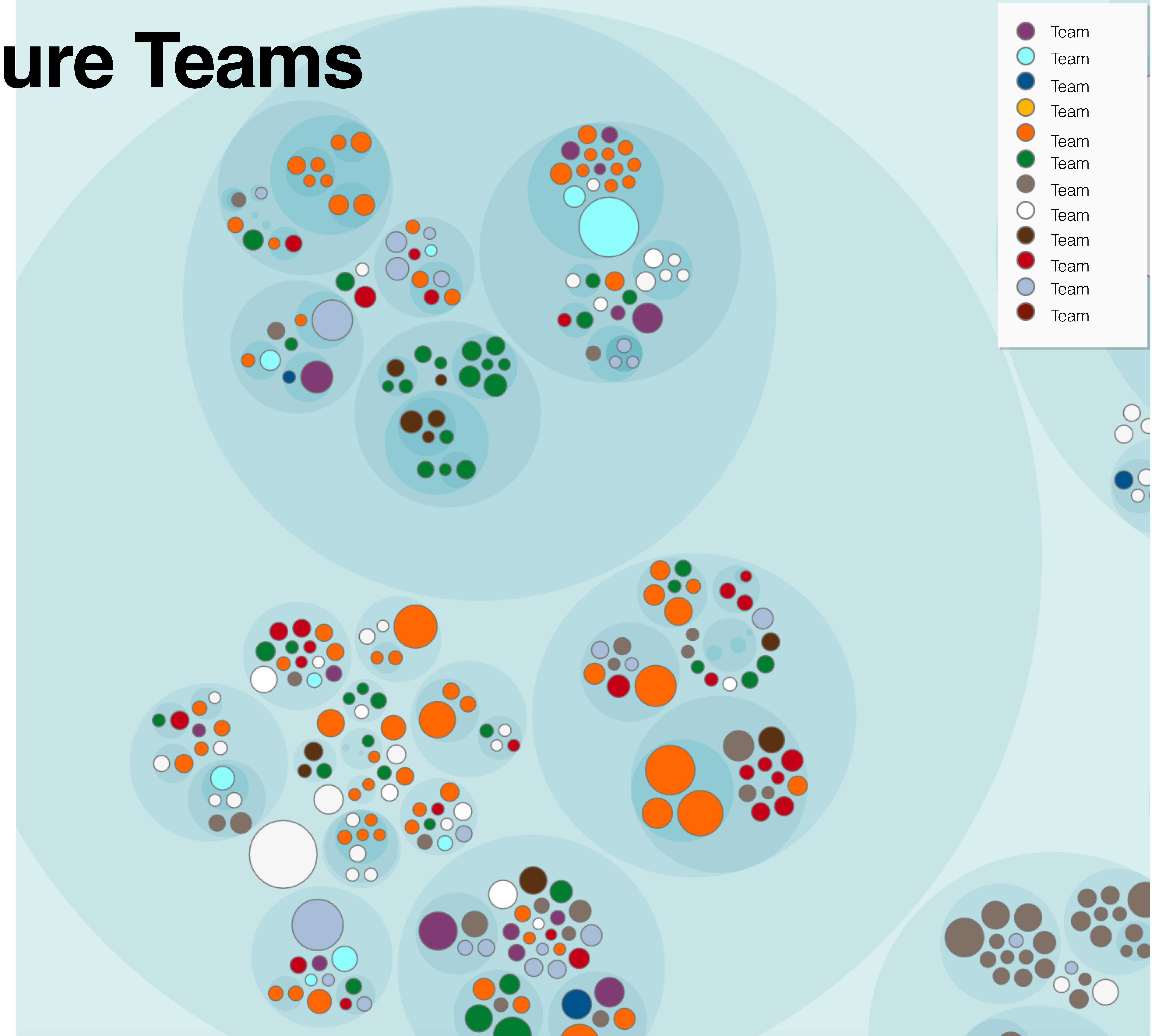
Measuring Conway's Law

Architectural Pattern: Package by Feature

- 🟨 Backup Team
- 🟩 Calculations Team
- 🟥 Ads Team
- 🟦 Recommendations Team
- 🟦 Export Team
- 🟪 Front-End Team



The Perils of Feature Teams



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Align Your Architecture and your Organisation

Make Decisions **Influenced By Data**

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Read The Books: Your Code As A Crime Scene

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

Software Design X-Rays (October 2017)

https://pragprog.com/book/atevol/software-design-x-rays

Blog on Behavioral Code Analysis

http://www.empear.com/blog/

Run the Analyses in CodeScene:

CØDESCENE

https://codescene.io/

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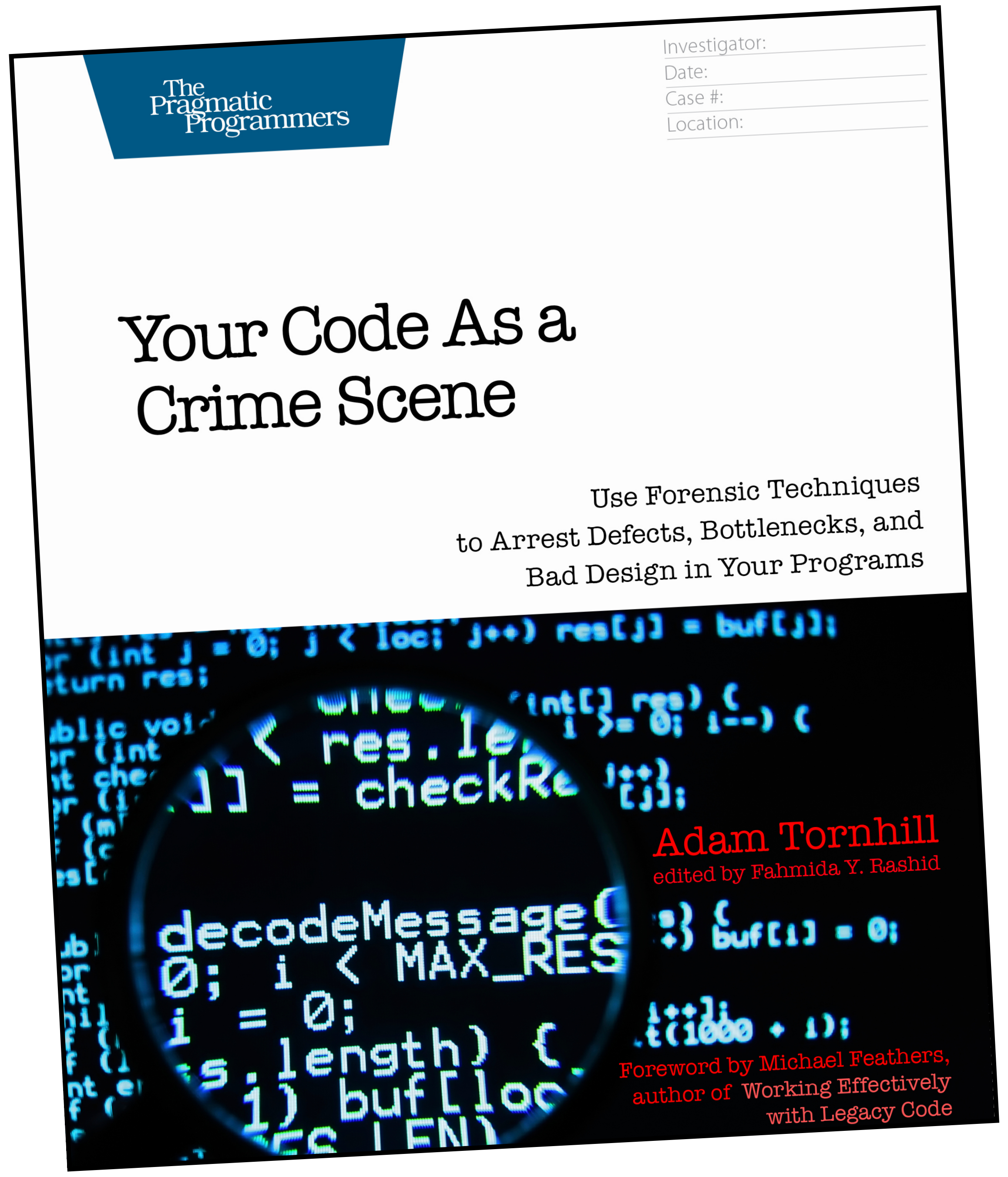
adam.tornhill@empear.com



The Pragmatic Programmers

Investigator:
Date:
Case #:
Location:

Your Code As a Crime Scene

Use Forensic Techniques to Arrest Defects, Bottlenecks, and Bad Design in Your Programs

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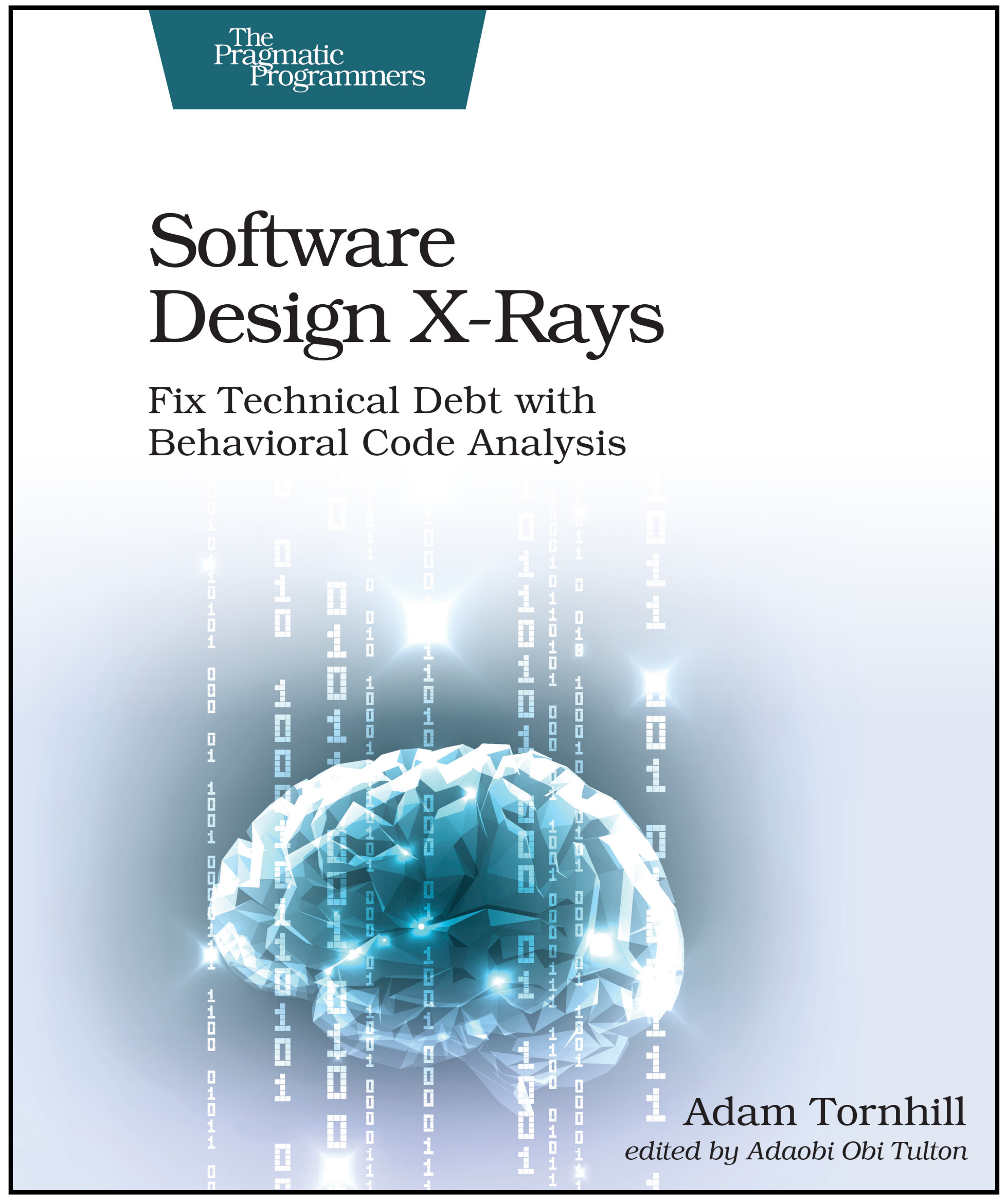
Foreword by Michael Feathers, author of Working Effectively with Legacy Code



The Pragmatic Programmers

Software Design X-Rays

Fix Technical Debt with Behavioral Code Analysis

Adam Tornhill
edited by Adaobi Obi Tulton