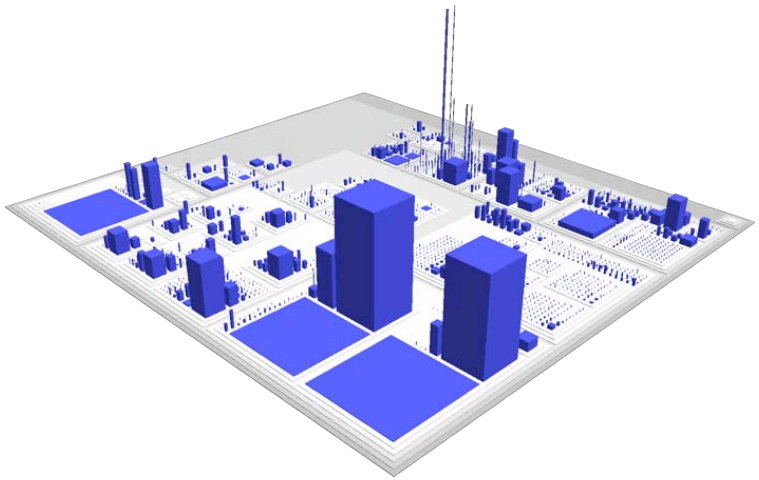
visualizations for code metrics



NEAL FORD software architect / meme wrangler

ThoughtWorks

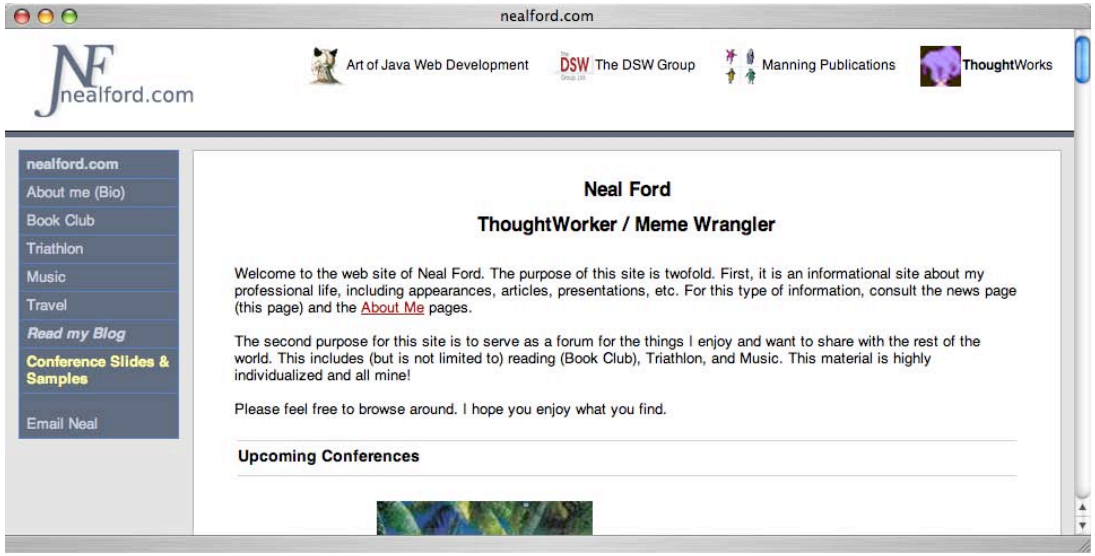
nford@thoughtworks.com
3003 Summit Boulevard, Atlanta, GA 30319
www.nealford.com
www.thoughtworks.com
blog: memeagora.blogspot.com
twitter: neal4d

NF

housekeeping

ask questions anytime

download slides from nealford.com



download samples from `github.com/nealford`

what was *that?*

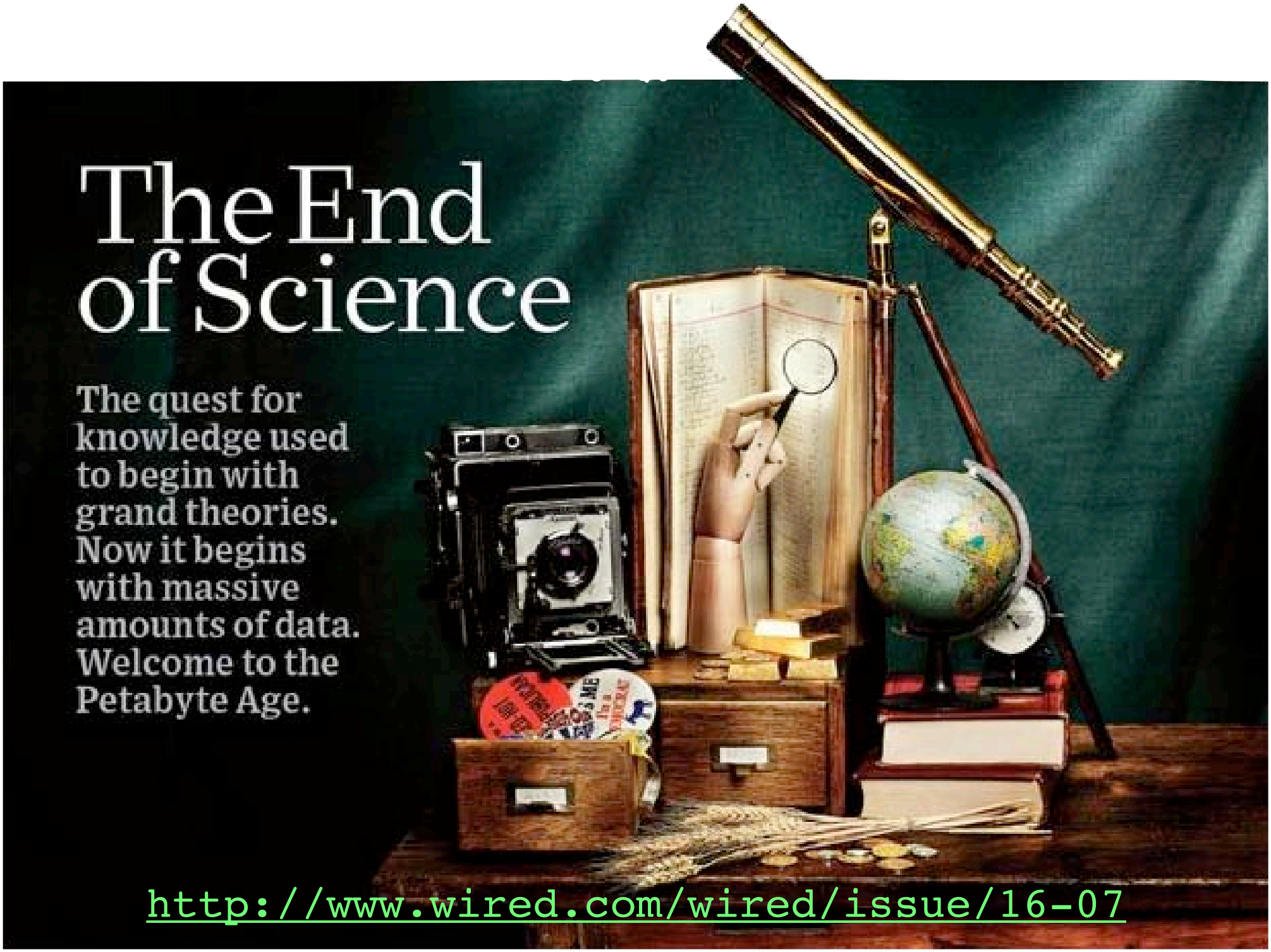
code_swarm

http://code.google.com/p/codeswarm/

point it to a subversion repository

visualization of check-ins over time

useful? cool!


The End of Science
The quest for knowledge used to begin with grand theories. Now it begins with massive amounts of data. Welcome to the Petabyte Age.
http://www.wired.com/wired/issue/16-07

1 TERABYTE

A $200 HARD DRIVE THAT HOLDS 260,000 SONGS.

20 TERABYTE

PHOTOS UPLOADED TO FACEBOOK EACH MONTH

120 TERABYTE

ALL THE DATA AND IMAGES COLLECTED BY THE HUBBLE SPACE TELESCOPE.

330 TERABYTE

DATA THAT THE LARGE HADRON COLLIDER WILL PRODUCE EACH WEEK.

460 TERABYTE

ALL THE DIGITAL WEATHER DATA COMPILED BY THE NATIONAL CLIMATIC DATA CENTER.

530 TERABYTE

ALL THE VIDEOS ON YOUTUBE.

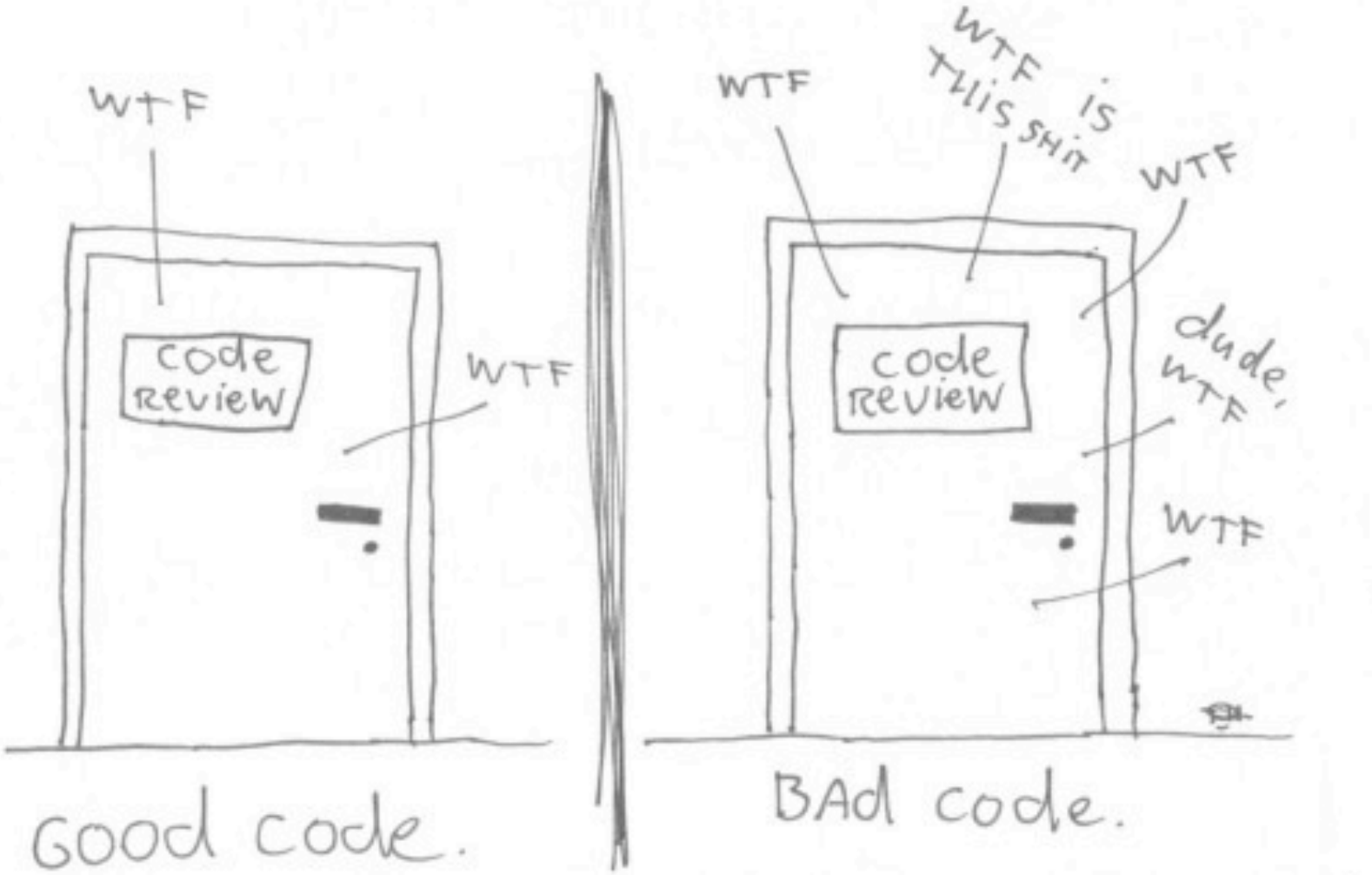
600 TERABYTE

ANCESTRY.COM'S GENEALOGY DATABASE (INCLUDES ALL U.S. CENSUS RECORDS 1790-2000).

1 PETABYTE

DATA PROCESSED BY GOOGLE'S SERVERS EVERY 72 MINUTES.

The ONLY VALID MEASUREMENT OF CODE QUALITY: WTFs/MINUTE




external perspective
is the software valuable to its users?

internal perspective

how appropriate is the design?

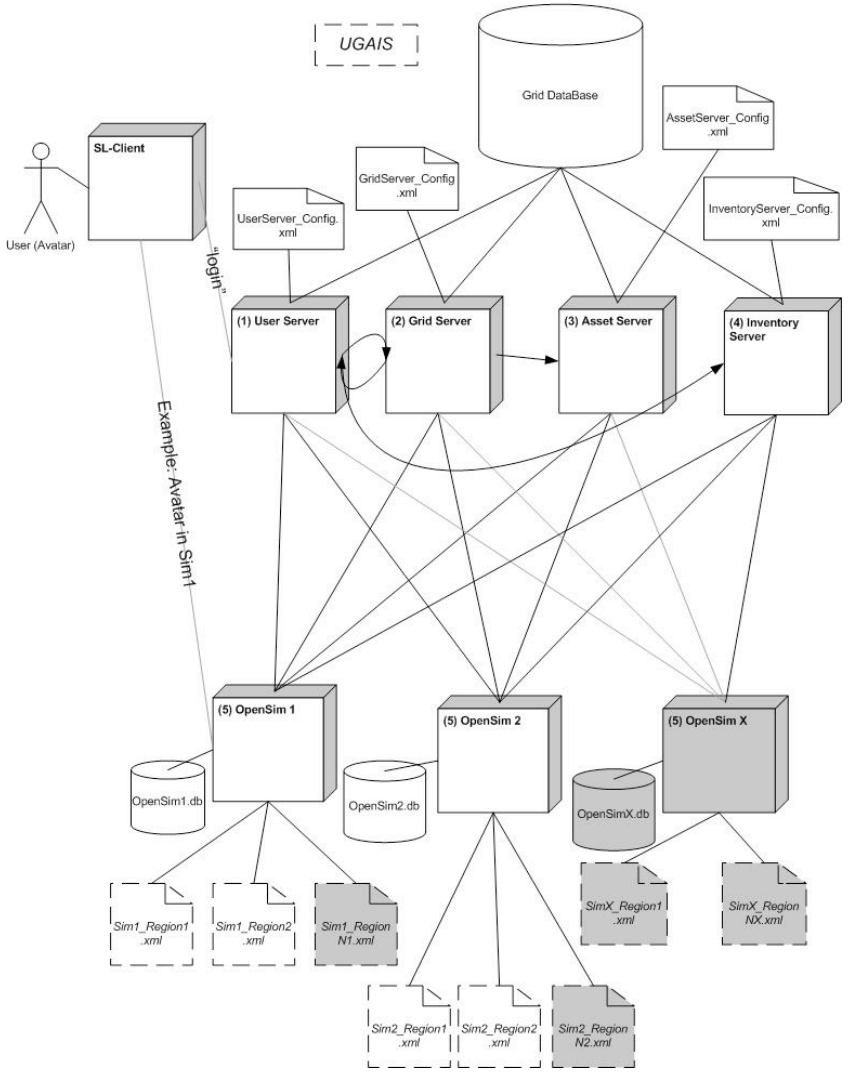
how amenable is emergent design?

how easy is it to understand & extend?

how maintainable is it?

is it salvageable?

30,000 feet

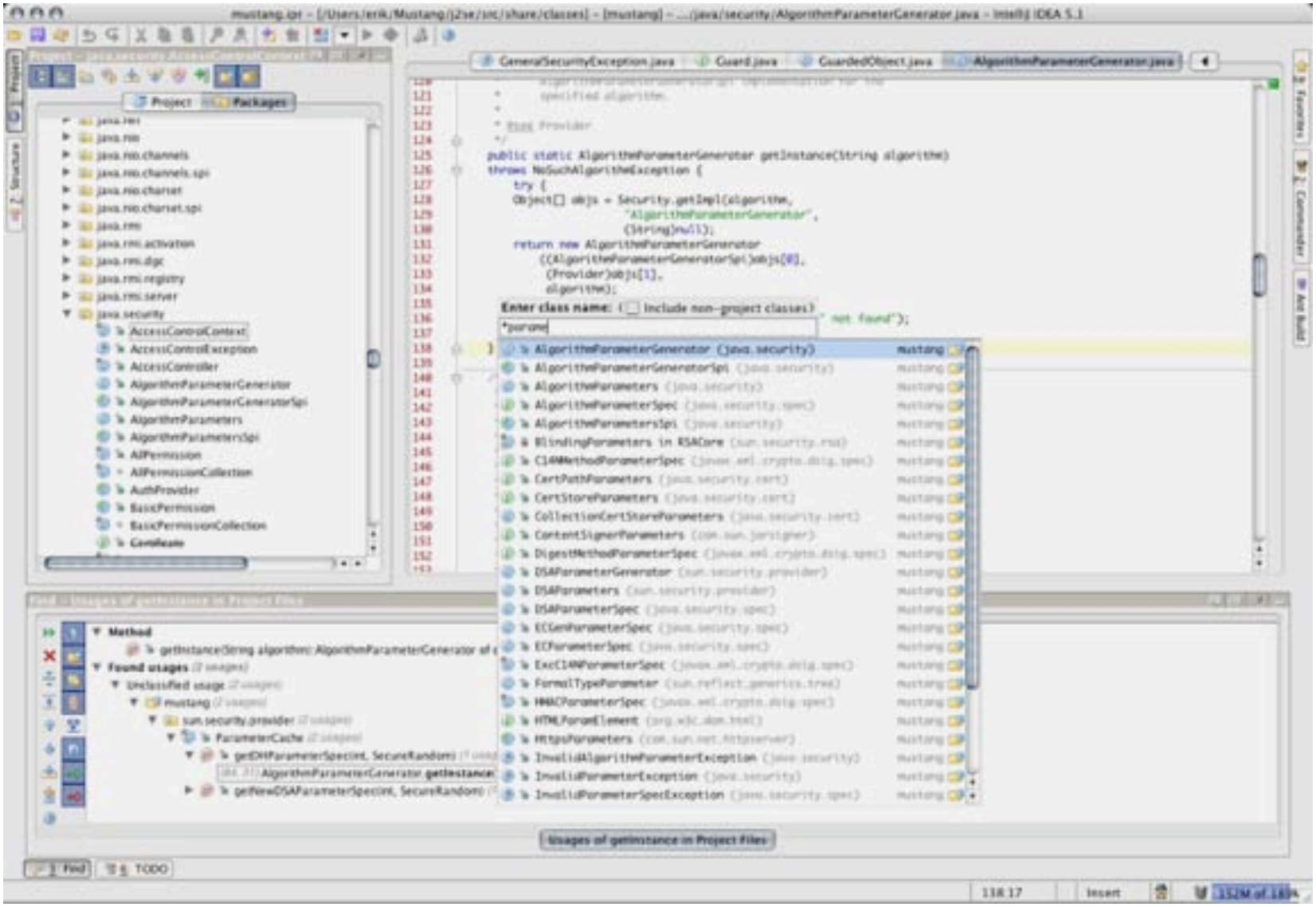


http://opensimulator.org/wiki/Grid_Architecture_Diagram

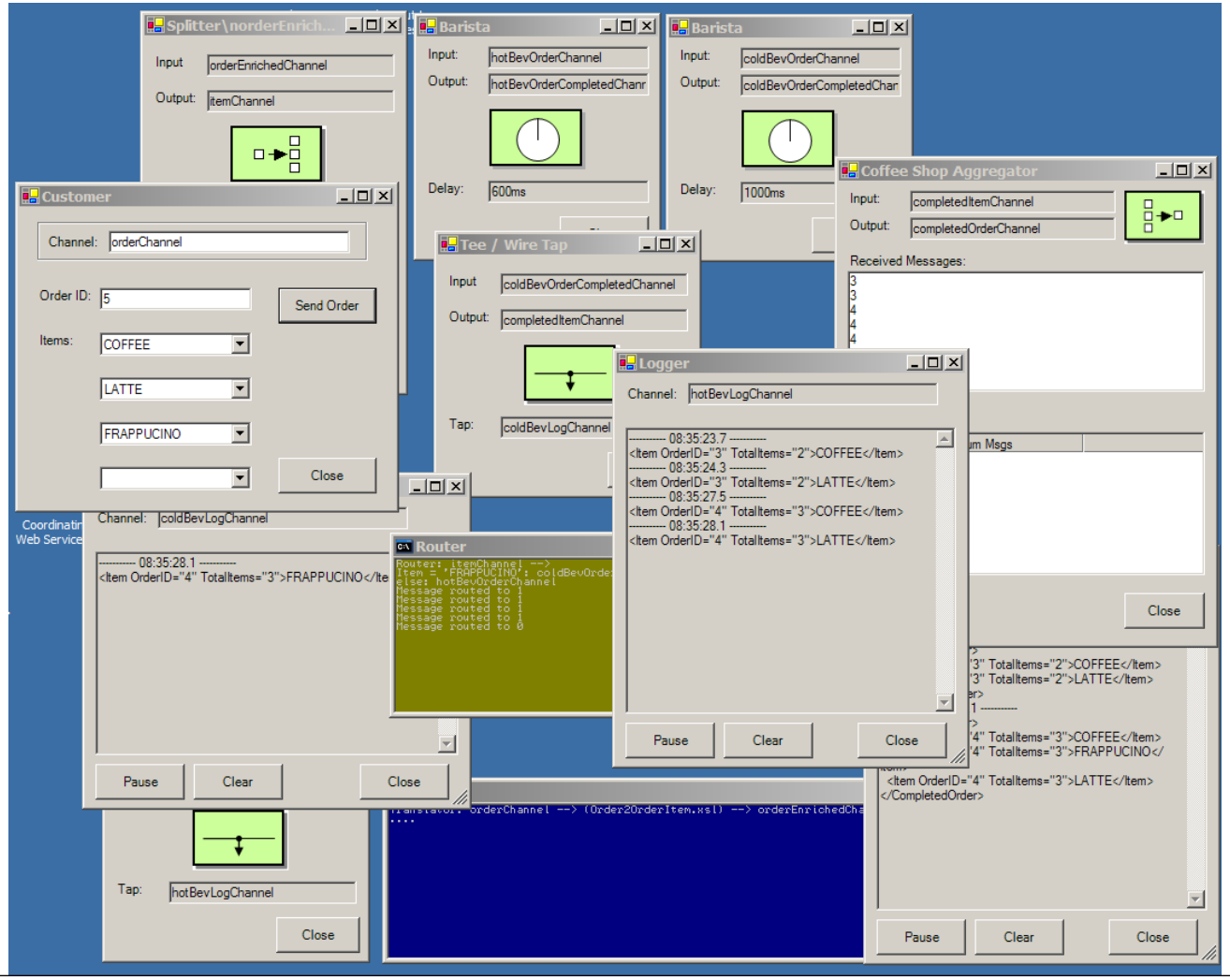
ground level

```
public void mergePluginOutput(BuildDetail build, Map paramete
    Iterator iterator = lines().iterator();
    while (iterator.hasNext()) {
        try {
            assemblePlugin(build, parameters, (String) iterat
        } catch (Exception e) {
            logger.error(e);
            continue;
        }
    }
}

void assemblePlugin(BuildDetail build, Map parameters, String
    String className = line.trim();
    if (className.startsWith("#") || StringUtils.isEmpty(clas
        return;
    }
    Class clazz = Class.forName(className);
    Widget digesterService = (Widget) clazz.newInstance();
    mergeParameters(build, parameters);
    build.addPluginOutput(digesterService.getDisplayName(), c
            .getOutput(parameters));
}

private void mergeParameters(BuildDetail build, Map parameter
    parameters.put(Widget.PARAM_CC_ROOT, configuration.getCCH
```

where are the defects?



which way do the messages flow?



where do the pictures come from?

models created upfront convey a vision but usually don't reflect reality

generating a complete model for large systems is nearly impossible

systems evolve locally, often uncontrolled

the best picture very much depends on the question you are trying to answer

need tools to create ad-hoc models more easily

1. select a meta-model

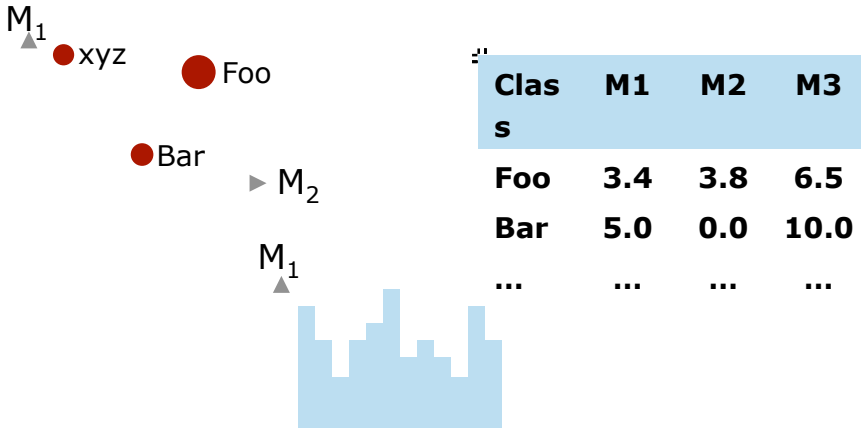
a model that describes a model

example: meta-model for a class diagram

- a class is a box with name, methods, fields,...
- available connectors: association, inheritance, aggregation…
- rules: no circles in inheritance, etc.

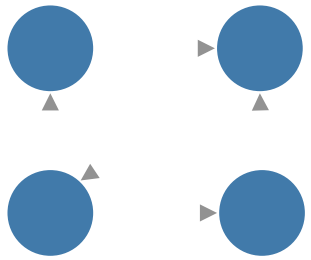
common meta-models

Metrics (Quantitative)

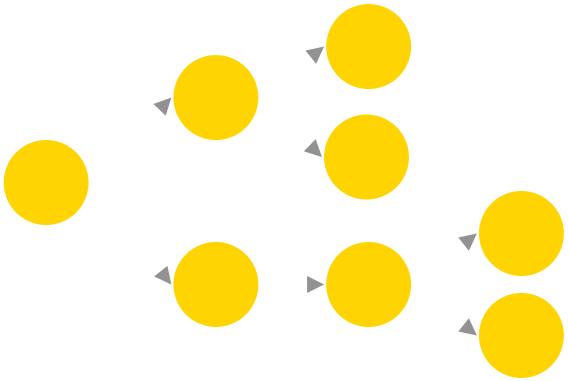


Class	M1	M2	M3
Foo	3.4	3.8	6.5
Bar	5.0	0.0	10.0
...	...	...	...

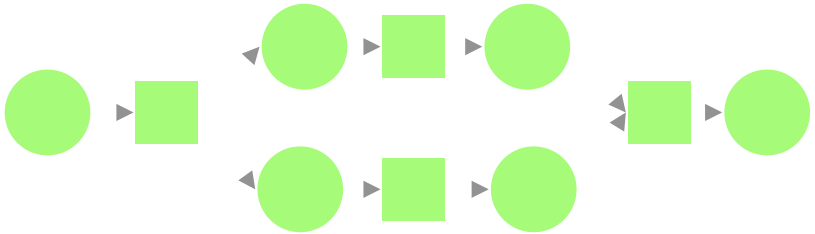
Directed Graph



Tree



Process Model (e.g. Petri Net)



2. inspection / instrumentation

static analysis

- source code
- byte code

dynamic analysis

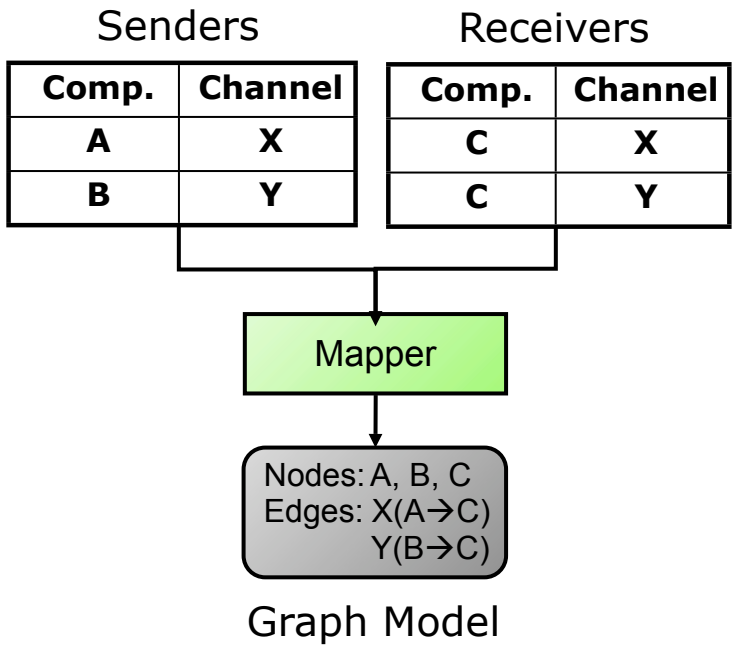
- profiling, listen to messages, log files, network sniffer, etc.

3. mapping to the model

example: messaging system

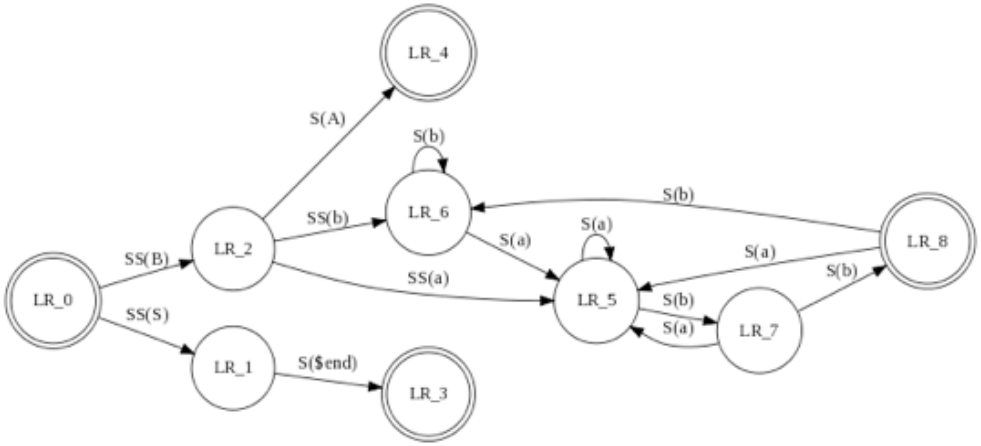
capture send/receive actions

map onto directed graph



4. visualization &...

Graphviz



...validation

don't simply observe

verify & alert

enforce rules or best practices

- detect cycles
- islands on a dependency graph

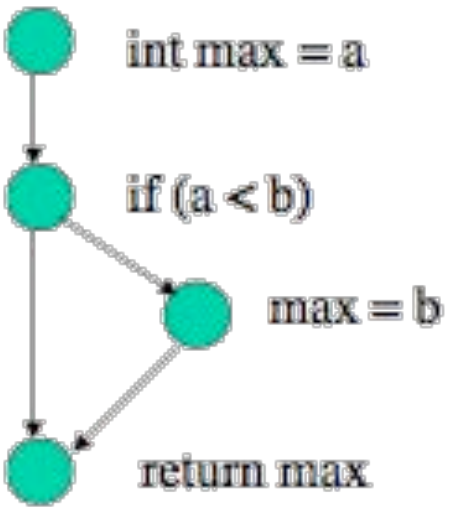

metrics

cyclomatic complexity

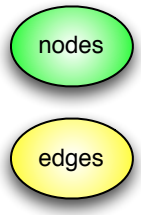
measures complexity of a function

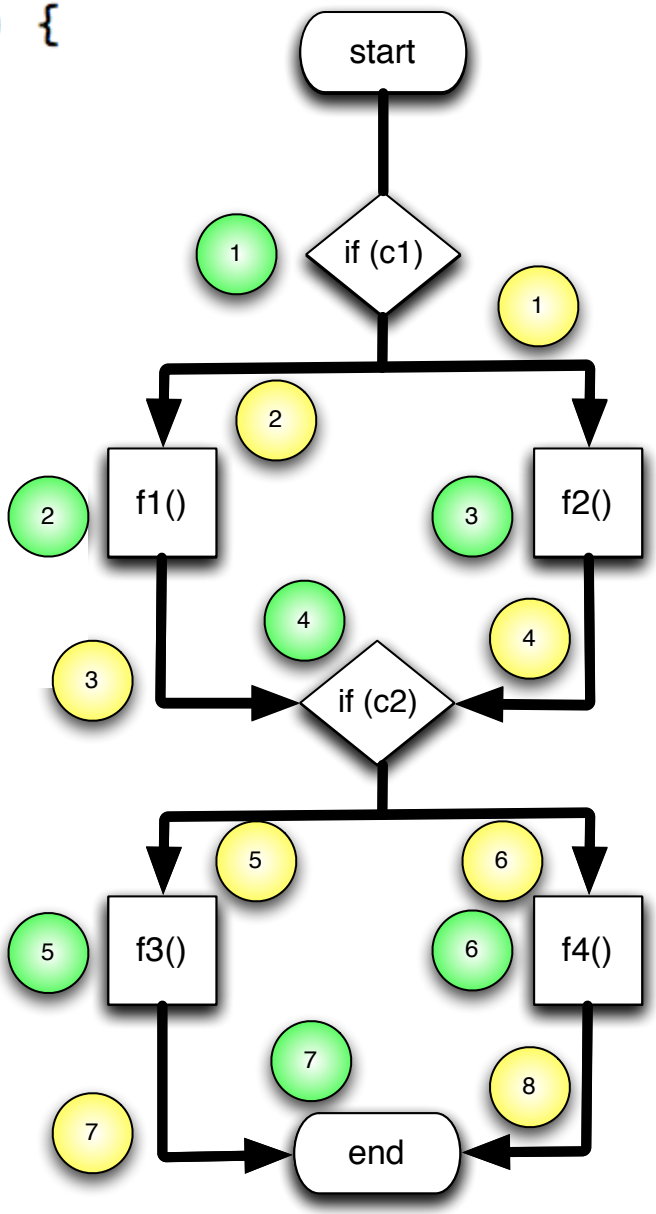
```
V(G)= e - n + 2
V(G) = cyclomatic complexity of G
e= # edges
n= # of nodes
```

```
int max (int a, int b) {
    int max = a;
    if (a < b) {
        max = b;
    }
    return max;
}
```



```
public void doIt() {
    if (c1) {
        f1();
    } else {
        f2();
    }
    if (c2) {
        f3();
    } else {
        f4();
    }
}
```





chidamber & kemerer object-oriented metrics

shyam r chidamber
chris f kemerer

easy but not terribly useful

very useful

easy (but trivial)

dit	depth of inheritance tree	# levels of inheritance
noc	number of children	# immediate descendants
npm	number of public methods	# public methods in class

very useful

wmc	weighted methods/ class	∑ of cyclomatic complexity
rfc	response for class	# of methods executed due to method call
lcom	lack of cohesion	∑ of sets of methods not shared via sharing fields
cbo/ ce	efferent couplings	∑ of other classes this class uses (outgoing calls)
ca	afferent couplings	∑ of how many other classes use this class (incoming calls)


visualizations
ERROR

source monitor

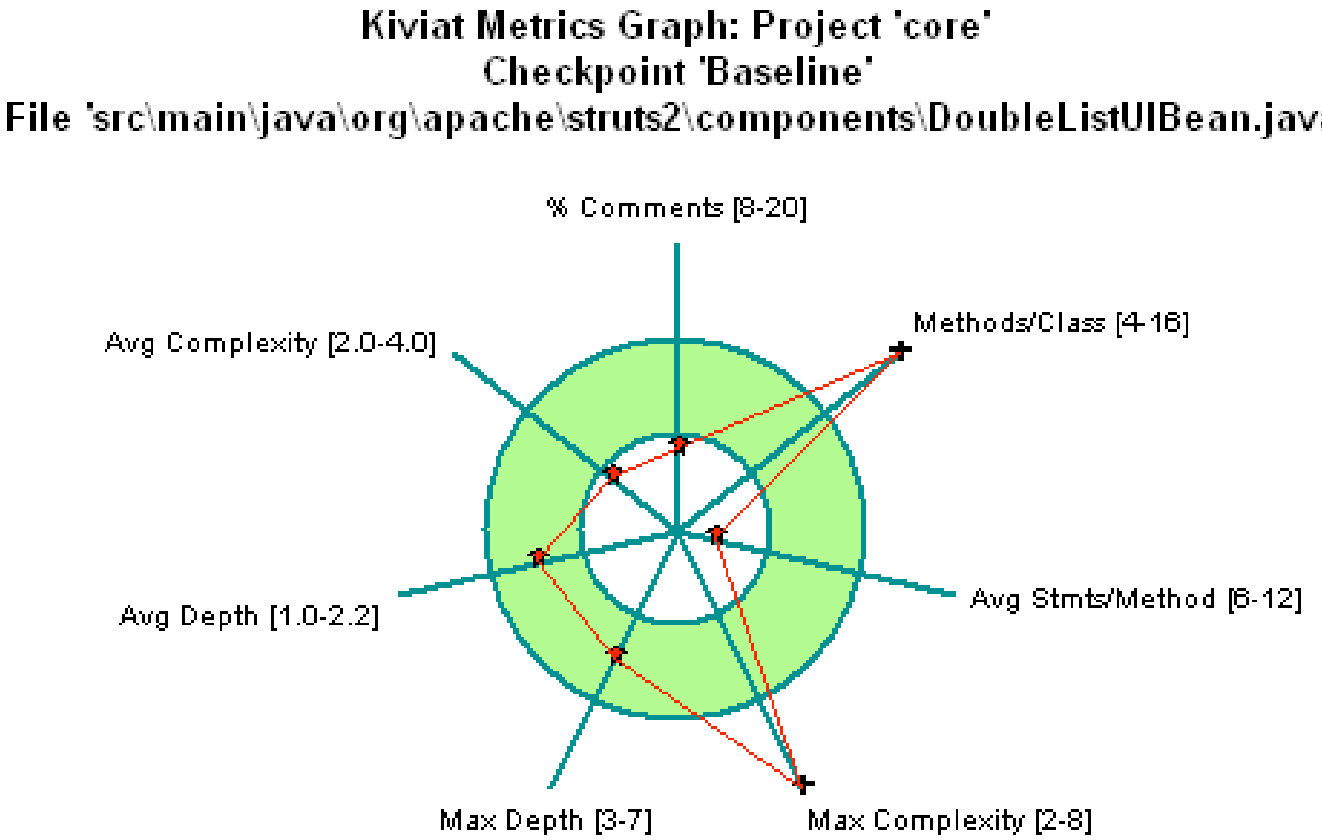
freeware tool for gathering metrics

metrics:

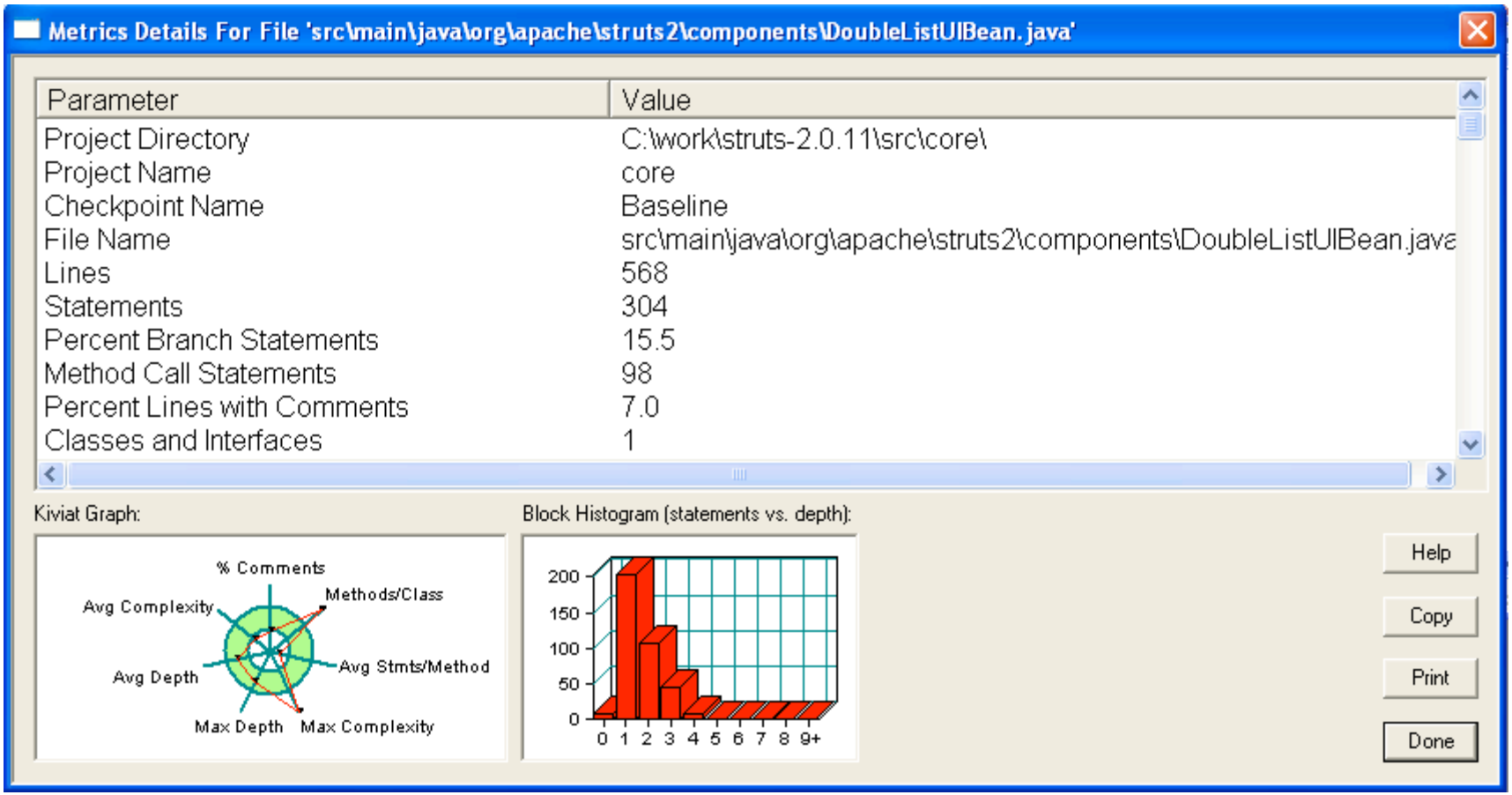
lines, statements, % branches, calls, % comments, classes, methods/class, avg stmts/ method, max complexity, max depth, average depth, average complexity

graphical user interface, windows only!

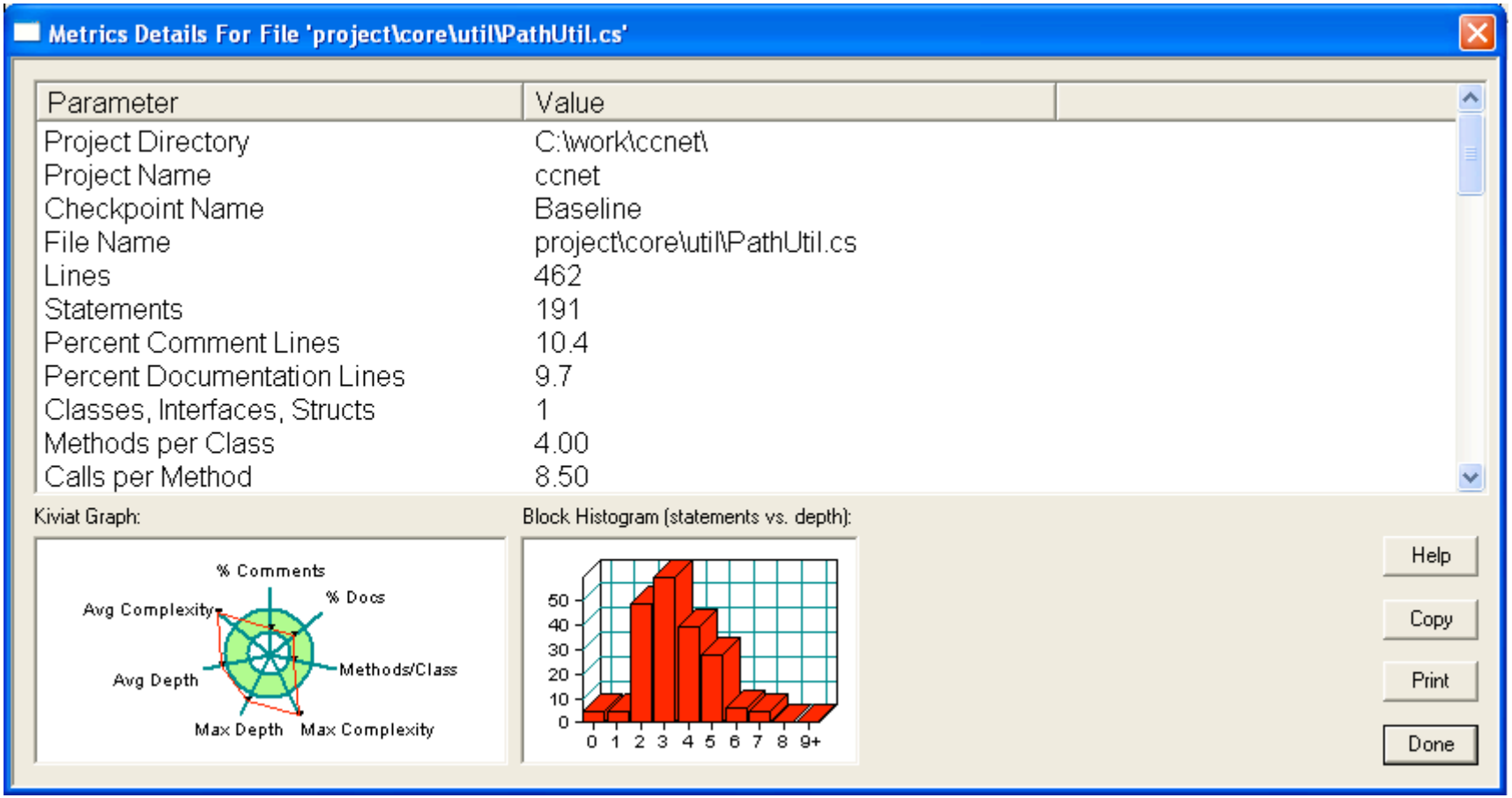
source monitor: kiviat graphs



source monitor: class summary



source monitor w/ c#



looking for...

classes that violate several kiviat graph ranges

really odd shapes

"A project dedicated to making code metrics so widely understood, valuable, and simple that their use becomes ubiquitous, thus raising the quality of software across the industry."

panopticode parts

code coverage with emma

- 1-line change to switch to cobertura

checkstyle

- 1-line switch for custom rule sets

jdepend

javancss

volatility

code duplication using simian

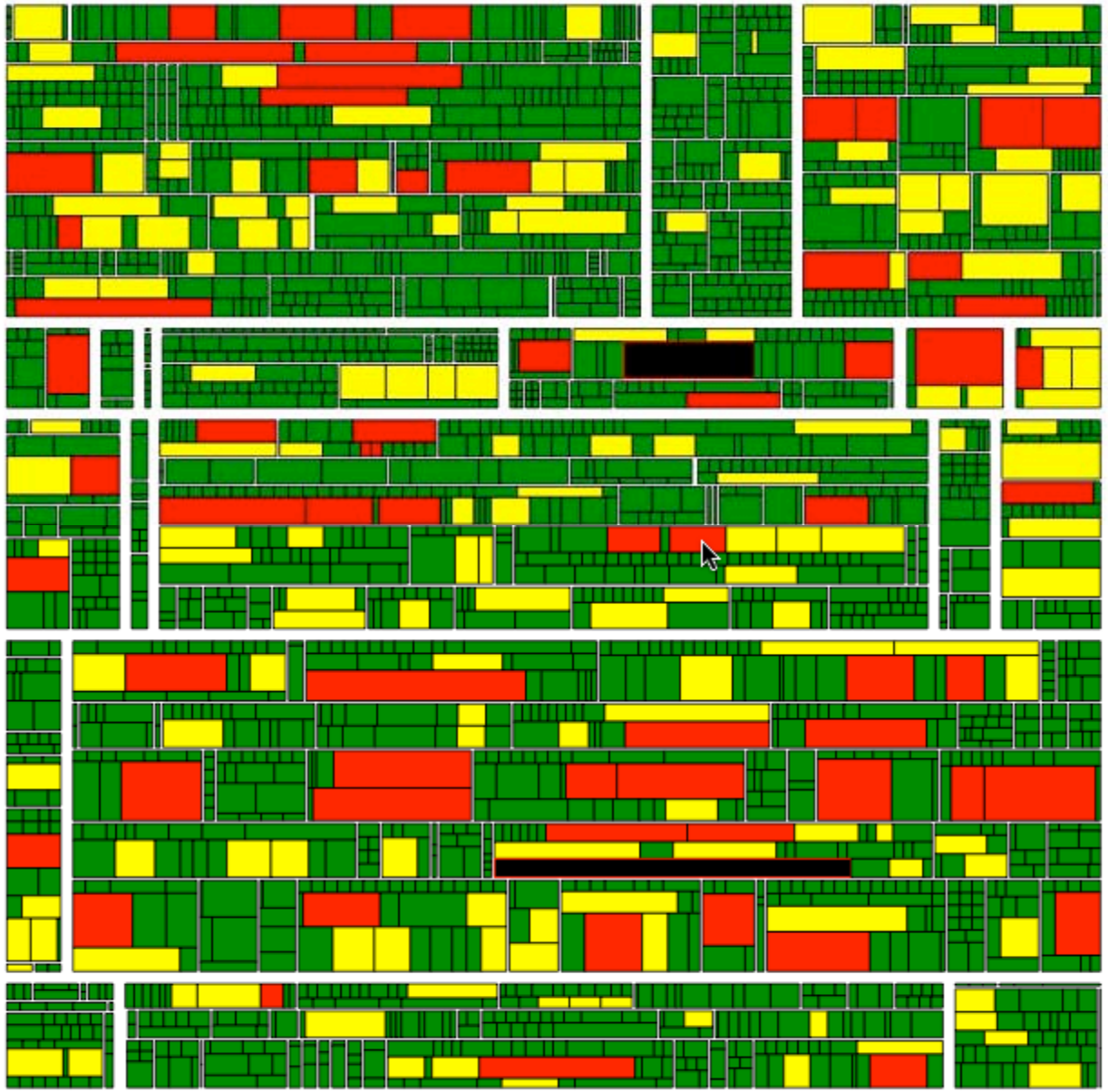
aggregator & reports

treemaps

interactive-complexity-treemap.svg

interactive-complexity-treemap.svg

CruiseControl Complexity



Details

(Click on a rectangle to view details)

Project: CruiseControl

Package: net.sourceforge.cruisecontrol.publishers

File: EmailPublisher.java

Class: EmailPublisher

- NCSS: 345
- Method Coverage: 72.0% (36.0/50.0)
- Block Coverage: 67.4% (819.0/1215.0)
- Line Coverage: 68.2% (187.6/275.0)

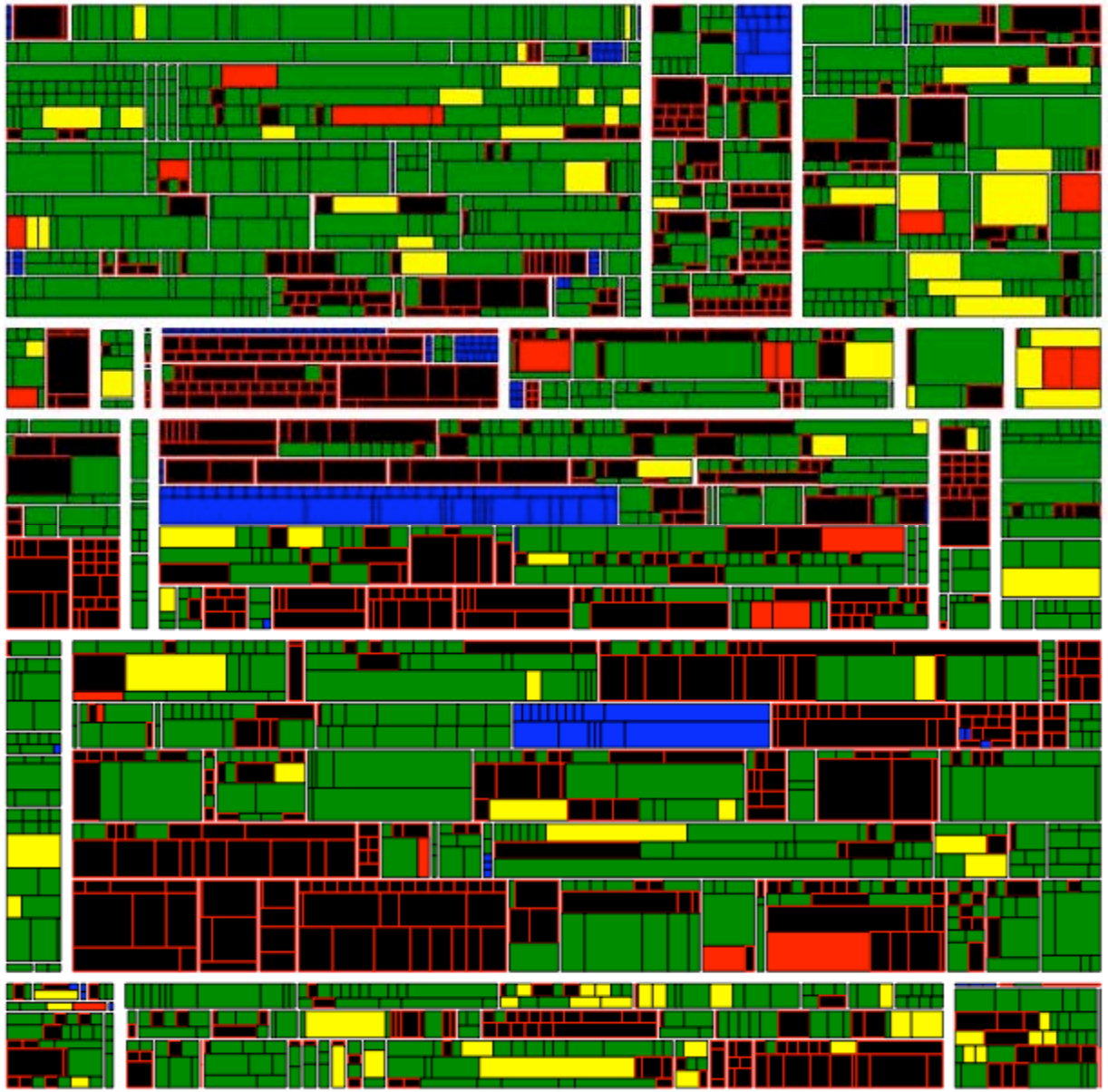
Method: createUserSet(XMLLogHelper)

- NCSS: 19
- CCN: 11
- Block Coverage: 100.0% (122.0/122.0)
- Line Coverage: 100.0% (18.0/18.0)

CCN 1-5 | CCN 6-9 | CCN 10-24 | CCN 25+ | N/A

interactive-coverage-treemap.svg

CruiseControl Code Coverage



Details

(Click on a rectangle to view details)

Project:

Package:

File:

Class:

- NCSS:
- Method Coverage:
- Block Coverage:
- Line Coverage:

Method:

- NCSS:
- CCN:
- Block Coverage:
- Line Coverage:

Coverage >= 75% | Coverage >= 50% | Coverage > 0% | Coverage = 0% | N/A

looking for...

20,000 foot view along a single dimension

simple view of one dimension

information radiators

size & complexity pyramid

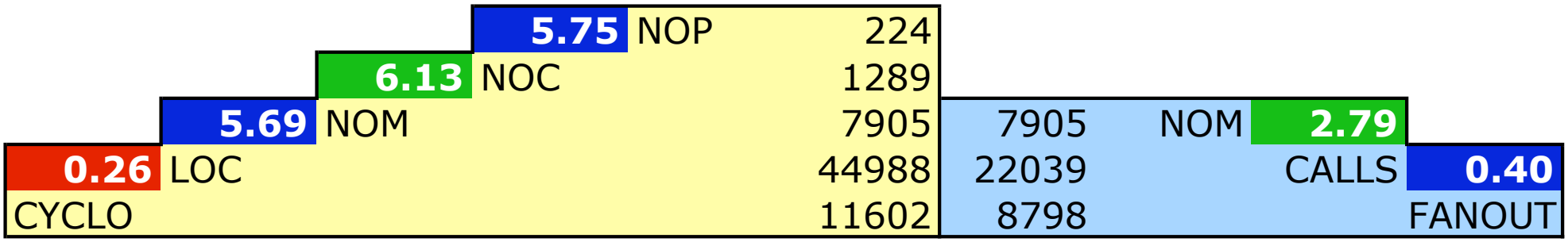
developed at Universities of Berne and Lugano

shows key metrics and their relationships

allows comparison to “industry standards”

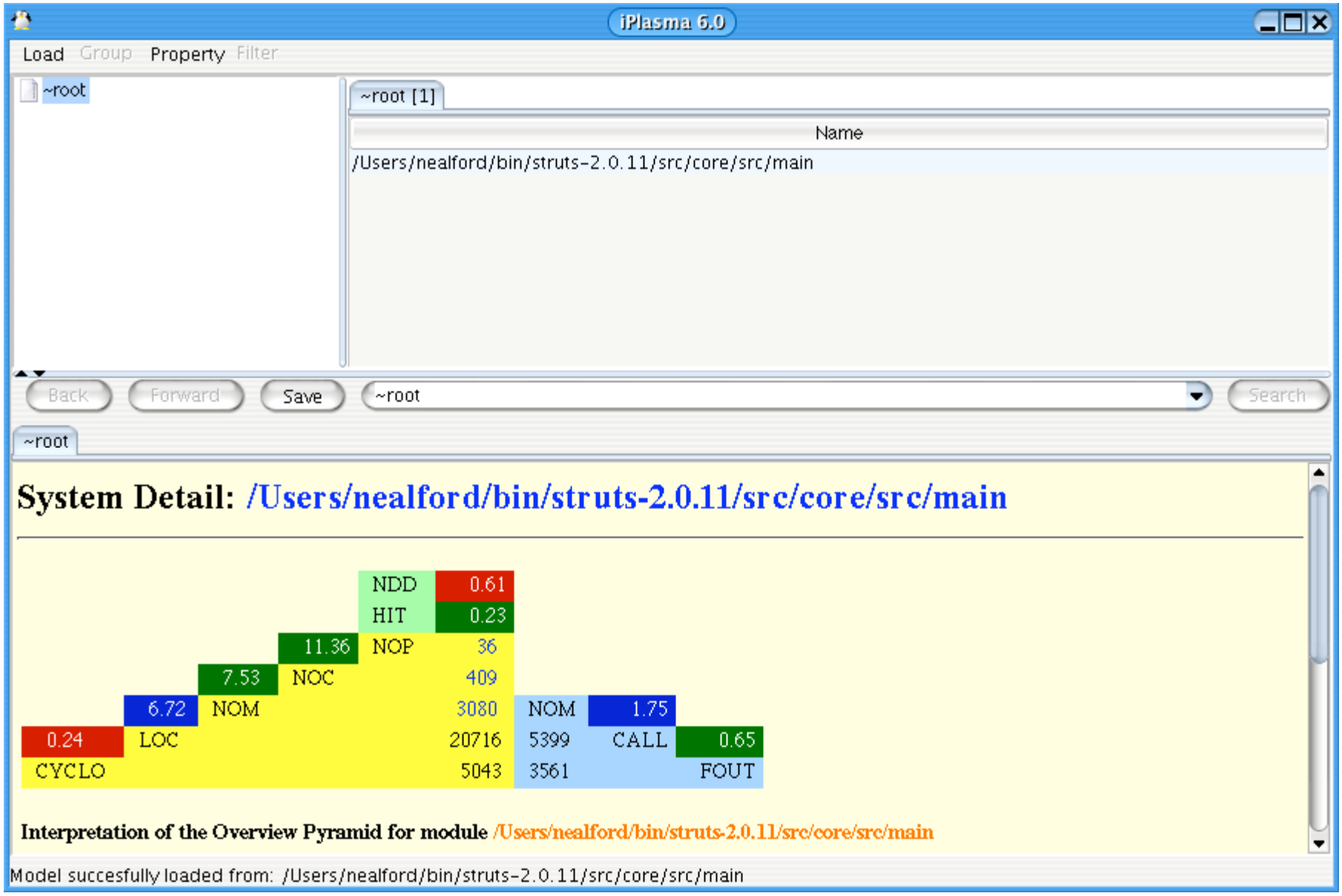
created by iPlasma tool from source code

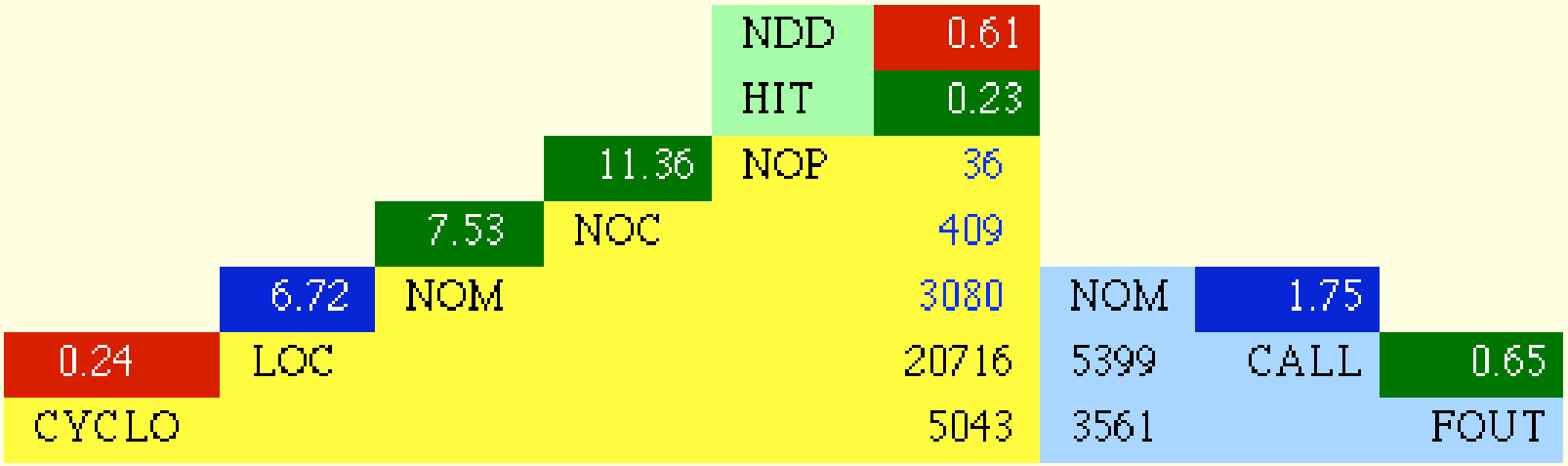
pyramid



	Low	Medium	High
CYCLO / Line	0.16	0.20	0.24
LOC / method	7	10	13
NOM / class	4	7	10
NOC / package	6	17	26
CALLS / method	2.01	2.62	3.20
FANOUT / call	0.56	0.62	0.68

iPlasma + Struts





Interpretation of the Overview Pyramid for module /Users/nealford/bin/struts-2.0.11/src/core/src/main

Class Hierarchies tend to be of **average height** and **wide**
(i.e. inheritance trees tend to have base-classes with many directly derived sub-classes)

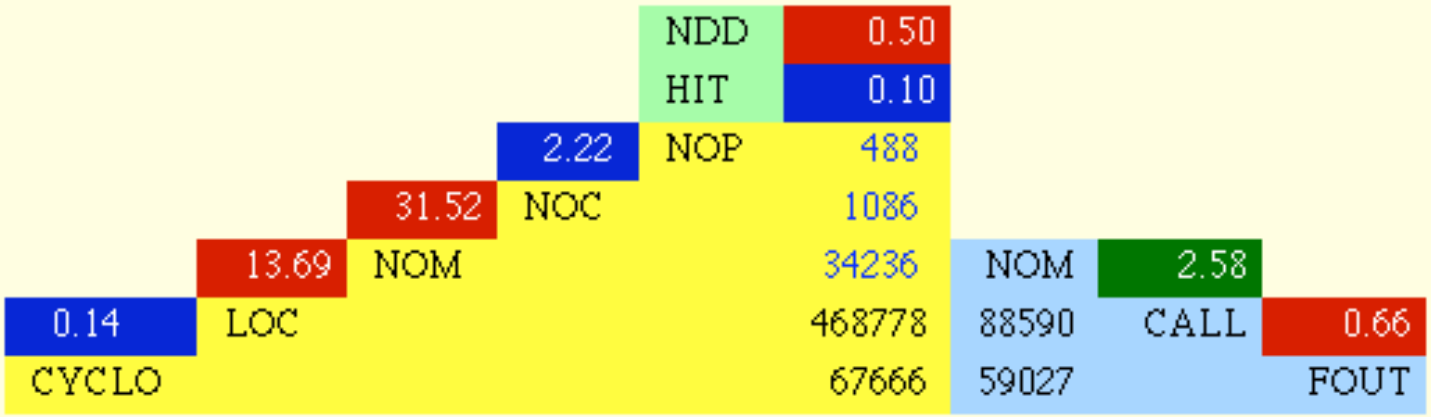
Classes tend to:

- contain an **average** number of methods;
- be organized in **average-sized packages** ;

Methods tend to:

- tend to be rather **short** yet having a rather **complex logic** (i.e. many conditional branches);
- tend to call **few methods** (low coupling intensity) from a **several other classes** ;

vuze



Interpretation of the Overview Pyramid for module
/Users/nealford/Downloads/Applications/Vuze_4.2.0.2_source.zip Folder

Class Hierarchies tend to be **shallow** and **wide**
(i.e. inheritance trees tend to have only few depth-level(s) and base-classes with many directly derived sub-classes)

Classes tend to:

- be rather **large** (i.e. they define many methods);
- be organized in rather **fine-grained packages** (i.e. few classes per package);

Methods tend to:

- tend to be rather **long** yet having a rather **simple logic** (i.e. few conditional branches);
- tend to call an **several methods** from **many other classes** (high coupling dispersion);

looking for...

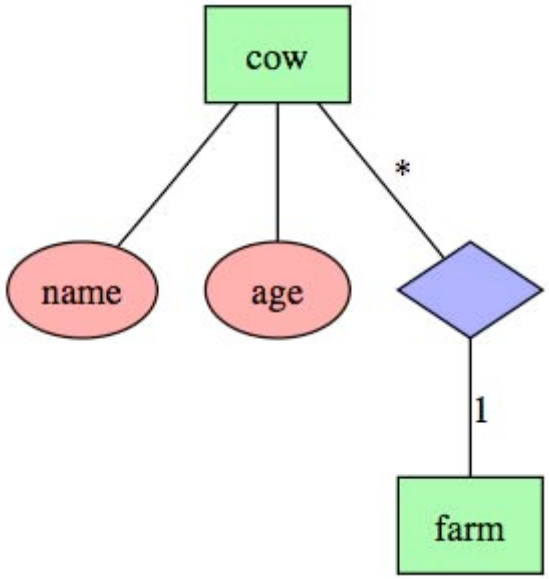
adherence to industry standards

low number of lines / method
(see composed method pattern)

low cyclomatic complexity / line

GraphViz

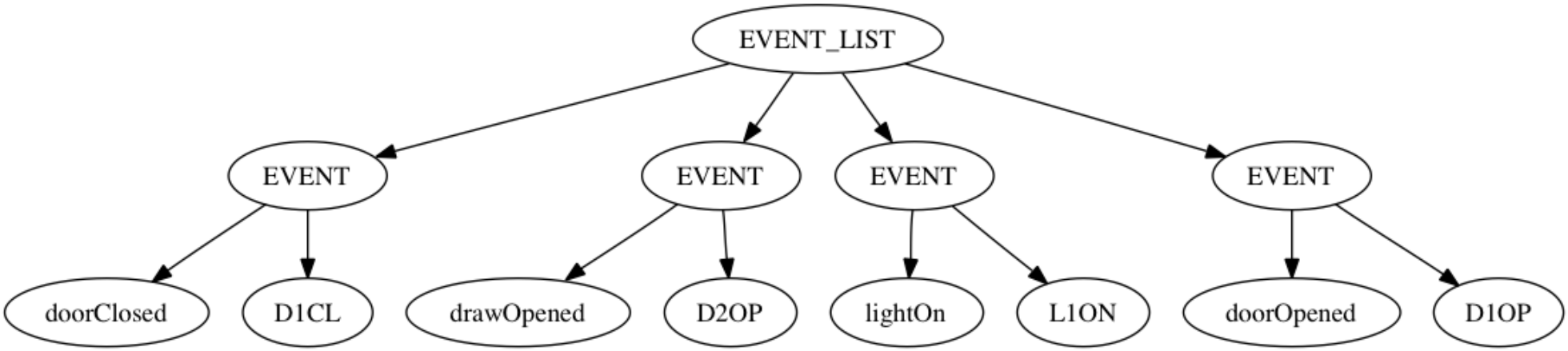
```
graph ER {
  node [shape=box style=filled fillcolor="#00ff005f"];
    farm;
    cow;
  node [shape=ellipse style=filled fillcolor="#ff00005f"];
    {node [label="name"] cow_name;}
    {node [label="age"] cow_age;}
  node [shape=diamond style=filled fillcolor="#0000ff5f"];
    {node [label=""]
      cow_farm;}

  cow -- cow_name;
  cow -- cow_age;

  cow -- cow_farm [label="*"];
  cow_farm -- farm [label="1"];
}
```



event list dot file

```
digraph simple {
ordering=out
e1 [label = "EVENT"]
e2 [label = "EVENT"]
e3 [label = "EVENT"]
e4 [label = "EVENT"]
eventList [label = "EVENT_LIST"]
eventList -> e1
eventList -> e2
eventList -> e3
eventList -> e4
c1 [label = "D1CL"]
c2 [label = "D2OP"]
c3 [label = "L1ON"]
c4 [label = "D1OP"]
e1 -> doorClosed
e1 -> c1
e2 -> drawOpened
e2 -> c2
e3 -> lightOn
e3 -> c3
e4 -> doorOpened
e4 -> c4
}
```

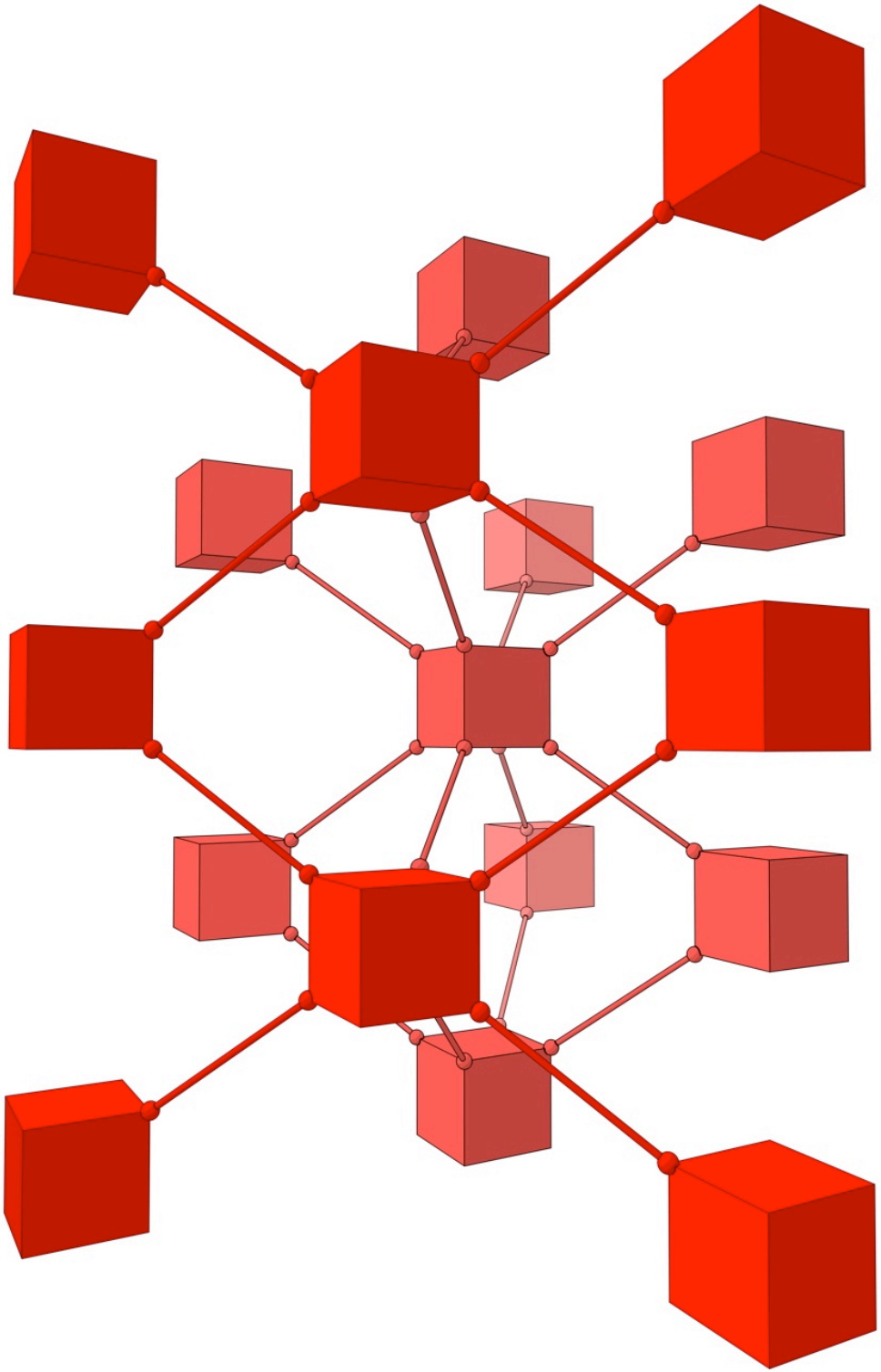
output


EVENT_LIST
EVENT
EVENT
EVENT
EVENT
doorClosed
D1CL
drawOpened
D2OP
lightOn
L1ON
doorOpened
D1OP

generating dot files

```
public void toDot(StringBuilder result) {
  String dotLabel = String.format("{%s", name);
  if (!commands.isEmpty()) {
    dotLabel += "|";
    for(Command c : commands) dotLabel += String.format("%s\\n", c.getName());
  }
  dotLabel += "}";
  result.append(String.format("%s [shape = Mrecord fontsize = 12 label = \"%s\"]\n", name, dotLabel));
  for(Map.Entry<Event,State> e : transitions.entrySet()) {
    result.append(String.format("%s -> %s [ label = \"%s\" fontsize = 10 arrowhead = open];\n",
        name, e.getValue().name, e.getKey().getName()));
  }
}
```

untangling jars



jar analyzer

Kirk Knoernschild
www.kirkk.com

xml output


```
- <JarAnalyzer>
  - <Jars>
    - <Jar name="antlr.jar">
      - <Summary>
        - <Statistics>
            <ClassCount>210</ClassCount>
            <AbstractClassCount>48</AbstractClassCount>
            <PackageCount>10</PackageCount>
            <Level>1</Level>
          </Statistics>
        - <Metrics>
            <Abstractness>0.23</Abstractness>
            <Efferent>0</Efferent>
            <Afferent>1</Afferent>
            <Instability>0.00</Instability>
            <Distance>0.77</Distance>
          </Metrics>
        - <Packages>
            <Package>antlr</Package>
            <Package>antlr.build</Package>
            <Package>antlr.collections</Package>
            <Package>antlr.debug</Package>
            <Package>antlr.preprocessor</Package>
            <Package>antlr.actions.cpp</Package>
            <Package>antlr.actions.csharp</Package>
            <Package>antlr.actions.java</Package>
            <Package>antlr.collections.impl</Package>
            <Package>antlr.debug.misc</Package>
          </Packages>
          <OutgoingDependencies> </OutgoingDependencies>
        - <IncomingDependencies>
            <Jar>struts.jar</Jar>
          </IncomingDependencies>
          <Cycles> </Cycles>
          <UnresolvedDependencies> </UnresolvedDependencies>
        </Summary>
      </Jar>
    - <Jar name="commons-beanutils.jar">
      - <Summary>
        - <Statistics>
            <ClassCount>66</ClassCount>
            <AbstractClassCount>7</AbstractClassCount>
            <PackageCount>4</PackageCount>
            <Level>2</Level>
          </Statistics>
        - <Metrics>
            <Abstractness>0.11</Abstractness>
```

transformed

JarAnalyzer Analysis

Run with JarAnalyzer on

Summary

[summary] [jars] [cycles] [explanations]

Jar Name	Total Classes	Abstract Classes	Packages	Level	Abstractness	Efferent	Afferent	Instability	Distance
antlr.jar	210	48	10	1	0.23	0	1	0.00	0.77
commons-beanutils.jar	66	7	4	2	0.11	2	3	0.40	0.49
commons-collections.jar	187	15	3	1	0.08	0	4	0.00	0.92
commons-digester.jar	55	9	3	3	0.16	3	2	0.60	0.24
commons-fileupload.jar	16	4	1	1	0.25	0	1	0.00	0.75
commons-logging.jar	18	2	2	1	0.11	0	4	0.00	0.89
commons-validator.jar	30	1	2	4	0.03	5	1	0.83	0.14
jakarta-oro.jar	62	13	6	1	0.21	0	1	0.00	0.79
struts.jar	289	33	25	5	0.11	7	0	1.00	0.11

Jars

[summary] [jars] [cycles] [explanations]

antlr.jar

Level: 1 Afferent Couplings: 1 Efferent Couplings: 0 Abstractness: 0.23 Instability: 0.00 Distance: 0.77

Uses Jars	Used by Jars	Cycles With
None	struts.jar	*None*

Packages within jar	Unresolved Packages
antlr antlr.build antlr.collections antlr.debug antlr.preprocessor antlr.actions.cpp antlr.actions.csharp antlr.actions.java antlr.collections.impl antlr.debug.misc	*None*

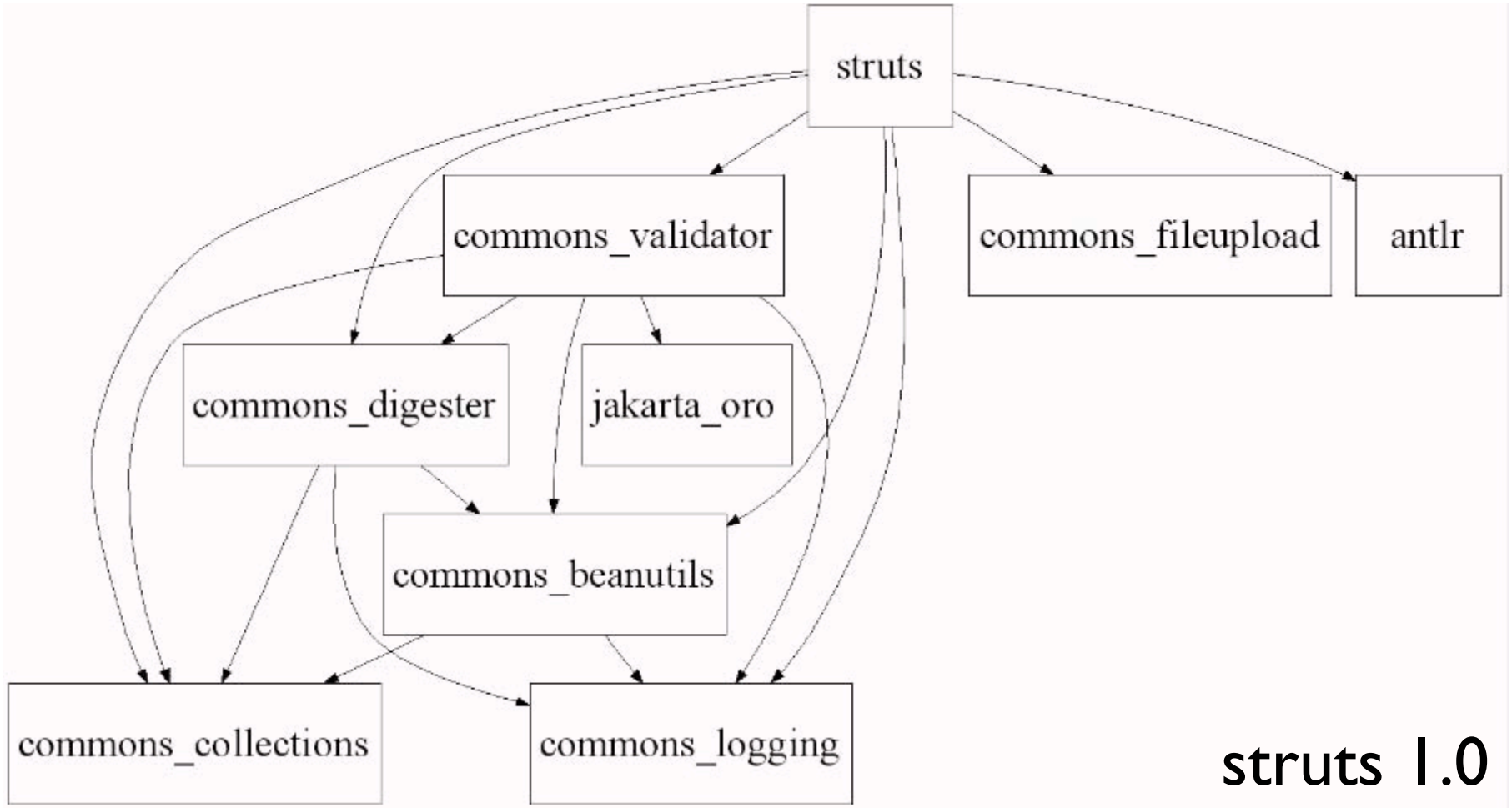
commons-beanutils.jar

Level: 2 Afferent Couplings: 3 Efferent Couplings: 2 Abstractness: 0.11 Instability: 0.40 Distance: 0.49

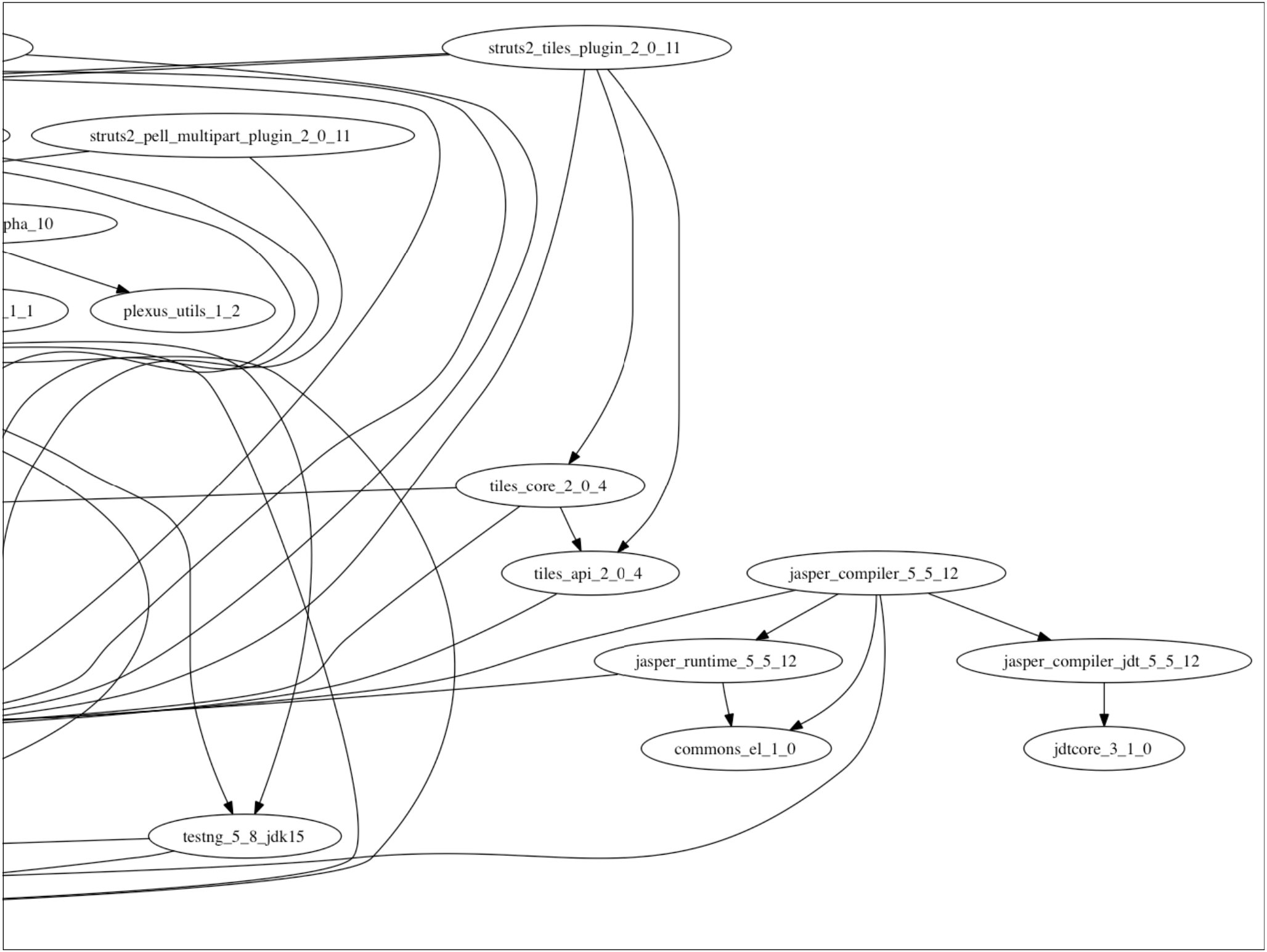
Uses Jars	Used by Jars	Cycles With
commons-collections.jar commons-logging.jar	commons-digester.jar commons-validator.jar struts.jar	*None*

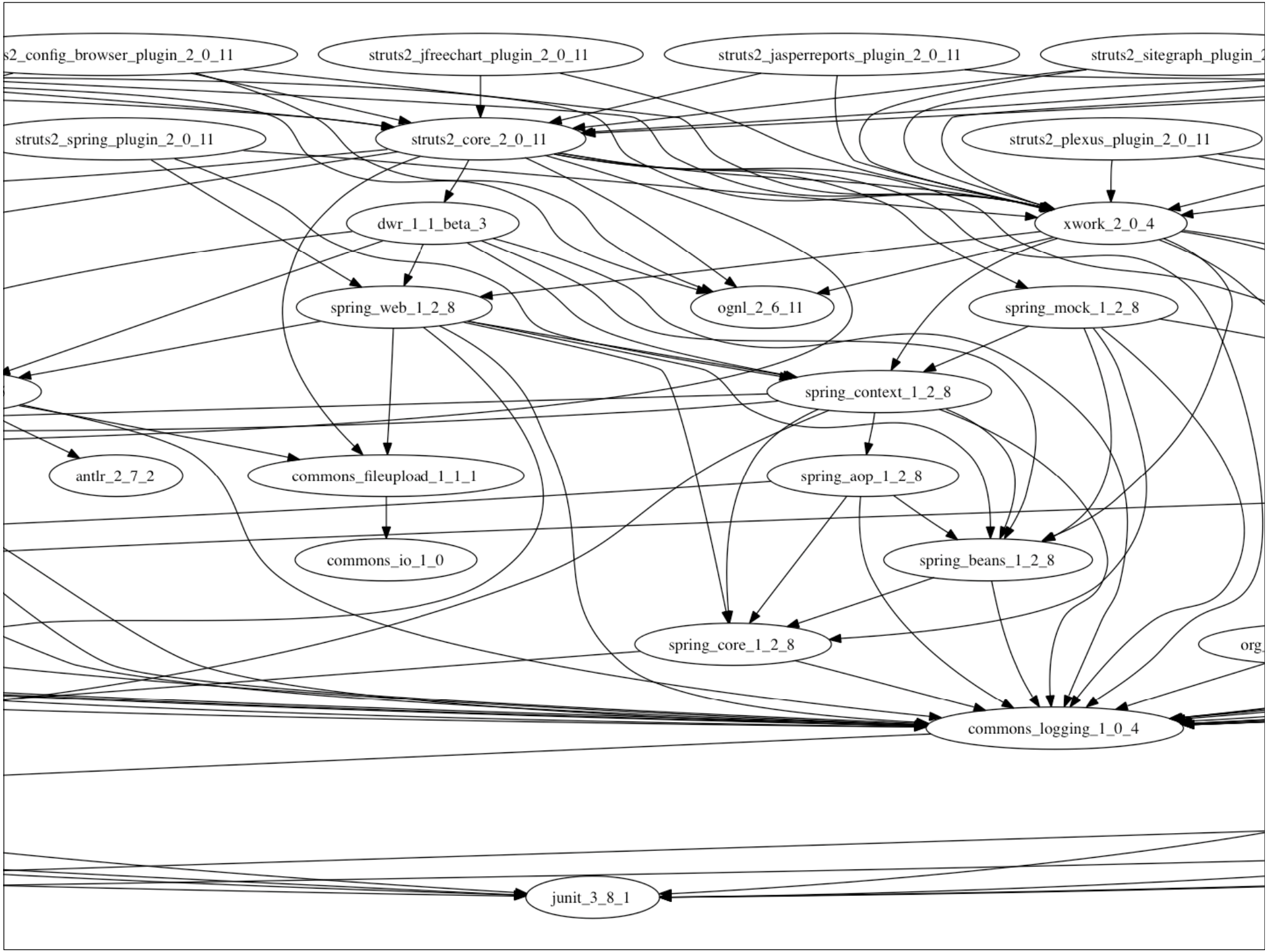
Packages within jar	Unresolved Packages
org.apache.commons.beanutils.converters org.apache.commons.beanutils org.apache.commons.beanutils.locale.converters org.apache.commons.beanutils.locale	*None*

graphical



struts 1.0


struts2_tiles_plugin_2_0_11
struts2_pell_multipart_plugin_2_0_11
pha_10
plexus_utils_1_2
tiles_core_2_0_4
tiles_api_2_0_4
jasper_compiler_5_5_12
jasper_runtime_5_5_12
jasper_compiler_jdt_5_5_12
commons_el_1_0
jdtcore_3_1_0
testng_5_8_jdk15


s2_config_browser_plugin_2_0_11
struts2_jfreechart_plugin_2_0_11
struts2_jasperreports_plugin_2_0_11
struts2_sitegraph_plugin_2
struts2_spring_plugin_2_0_11
struts2_core_2_0_11
struts2_plexus_plugin_2_0_11
dwr_1_1_beta_3
xwork_2_0_4
spring_web_1_2_8
ognl_2_6_11
spring_mock_1_2_8
spring_context_1_2_8
antlr_2_7_2
commons_fileupload_1_1_1
spring_aop_1_2_8
commons_io_1_0
spring_beans_1_2_8
spring_core_1_2_8
org_
commons_logging_1_0_4
junit_3_8_1

looking for...

not that!

small number of one-way dependencies

no “rats’ nests”

no cycles


Vizant
ant task to create a GraphViz
DOT file from an ant build file
http://vizant.sourceforge.net/

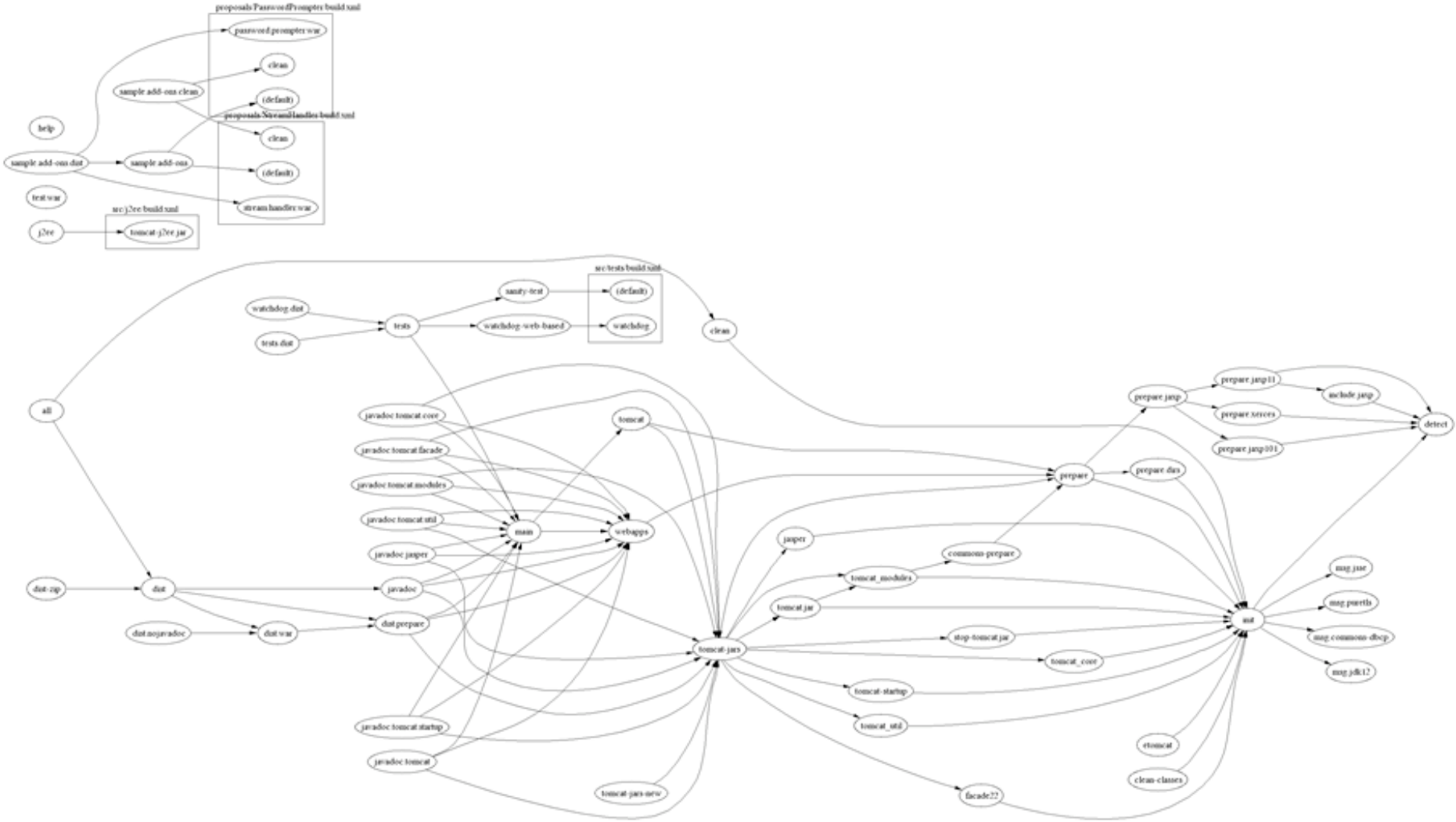
ant 1.5


allclean
clean
dist
install_dist
install
dist_javadocs
javadocs
javadoc_check
main
bootstrap
dist-lite
jars
install-lite
distribution
main_distribution
build
prepare
antractor-tests
compile-tests
run-single-test
run-which
check_for_optional_packages
src-dist
dump-info
dump-sys-properties
xml-check
test
run-tests
probe-offline

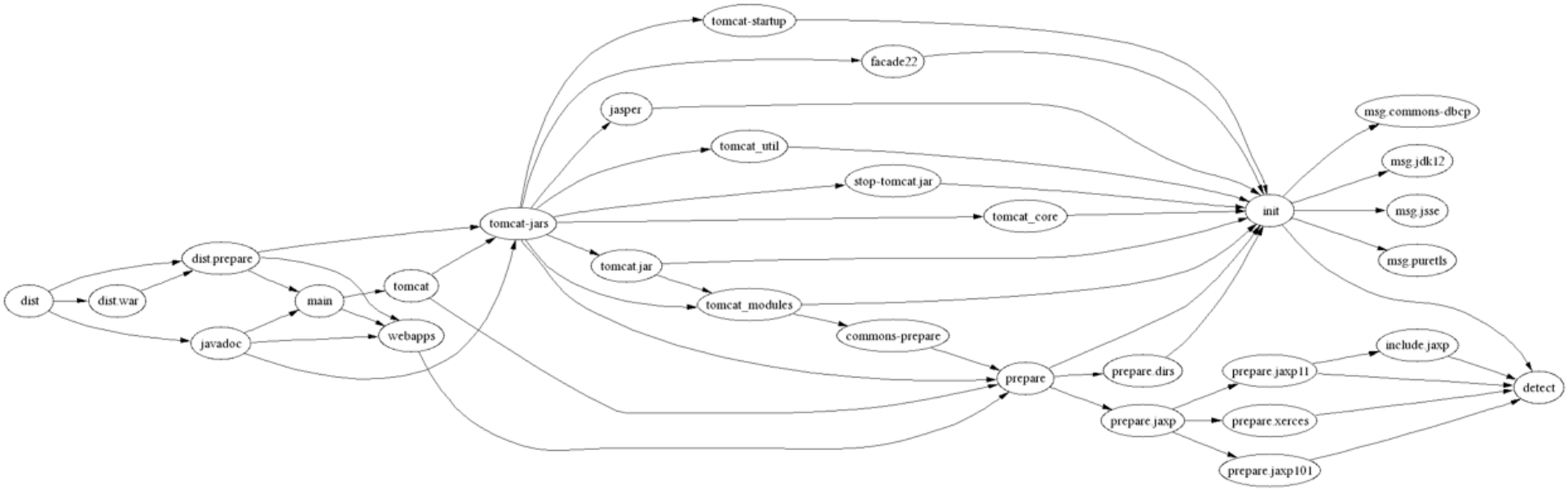
log4j


javamail
javamailCheck
jms
jmsCheck
build javamail
build jms
jmdi
jmdiCheck
build jmx
jmx
jmxCheck
perjar
build
chainsaw
log4j jar
build examples
build core
jar
init
build tmd
clean
dist
javadoc
usage
checkstyle
jmp
jmpCheck

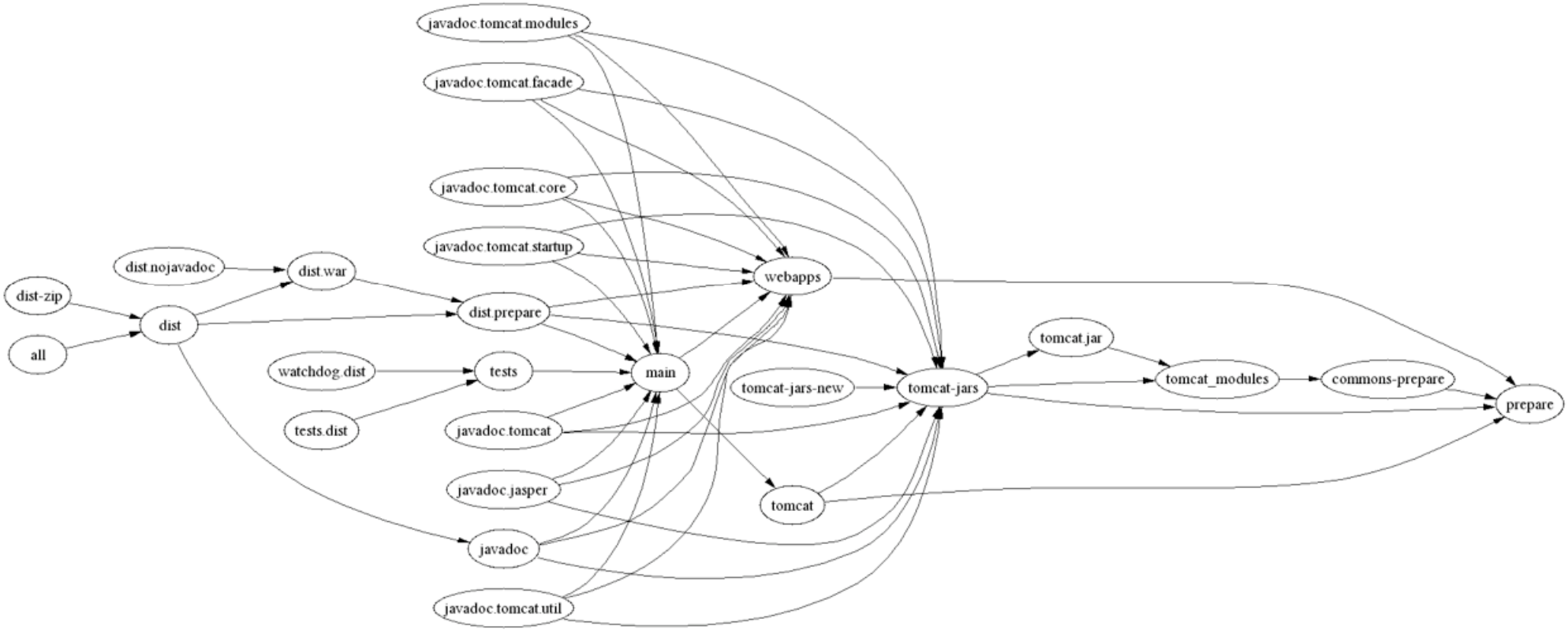
tomcat 3.3.1


proposals/PasswordPrompter/build.xml
password.prompter.war
clean
sample.add-ons.clean
(default)
proposals/NewandImadlies/build.xml
help
clean
sample.add-ons.dist
sample.add-ons
(default)
test.war
stream.handler.war
src/j2ee/build.xml
j2ee
tomcat-j2ee.jar
src/tests/build.xml
sanity-test
(default)
watchdog.dist
tests
watchdog-web-based
watchdog
tests.dist
clean
all
javadoc.tomcat.core
tomcat
javadoc.tomcat.facade
prepare.jasp
prepare.jasp11
include.jasp
prepare.xercesx
detect
prepare.jasp101
javadoc.tomcat.modules
prepare
prepare.dirs
javadoc.tomcat.util
main
webapps
jasper
javadoc.jasper
common-prepare
tomcat_modules
dist.zip
dist
javadoc
tomcat.jar
msg.jasr
msg.pserlb
dist.nojavadoc
dist.war
dist.prepare
init
stop-tomcat.jar
msg.common-dbcp
tomcat-jars
tomcat_core
msg.jdk12
tomcat-startup
javadoc.tomcat.startup
tomcat_util
etomcat
javadoc.tomcat
clean-classes
tomcat-jars-new
facade22

from="dist"


tomcat-startup
facade22
jasper
tomcat_util
stop-tomcat.jar
tomcat_core
tomcat-jars
tomcat.jar
tomcat_modules
commons-prepare
prepare
prepare.dirs
prepare.jaxp
prepare.jaxp11
prepare.xerces
prepare.jaxp101
include.jaxp
detect
init
msg.commons-dbcp
msg.jdk12
msg.jsse
msg.puretls
dist
dist.war
dist.prepare
javadoc
main
tomcat
webapps

to="prepare"


javadoc.tomcat.modules
javadoc.tomcat.facade
javadoc.tomcat.core
javadoc.tomcat.startup
dist.nojavadoc
dist.war
dist-zip
dist
dist.prepare
webapps
all
watchdog.dist
tests
main
tomcat-jars-new
tomcat-jars
tomcat.jar
tomcat_modules
commons-prepare
prepare
tests.dist
javadoc.tomcat
javadoc.jasper
tomcat
javadoc
javadoc.tomcat.util

look for...

hot spots

more even distribution

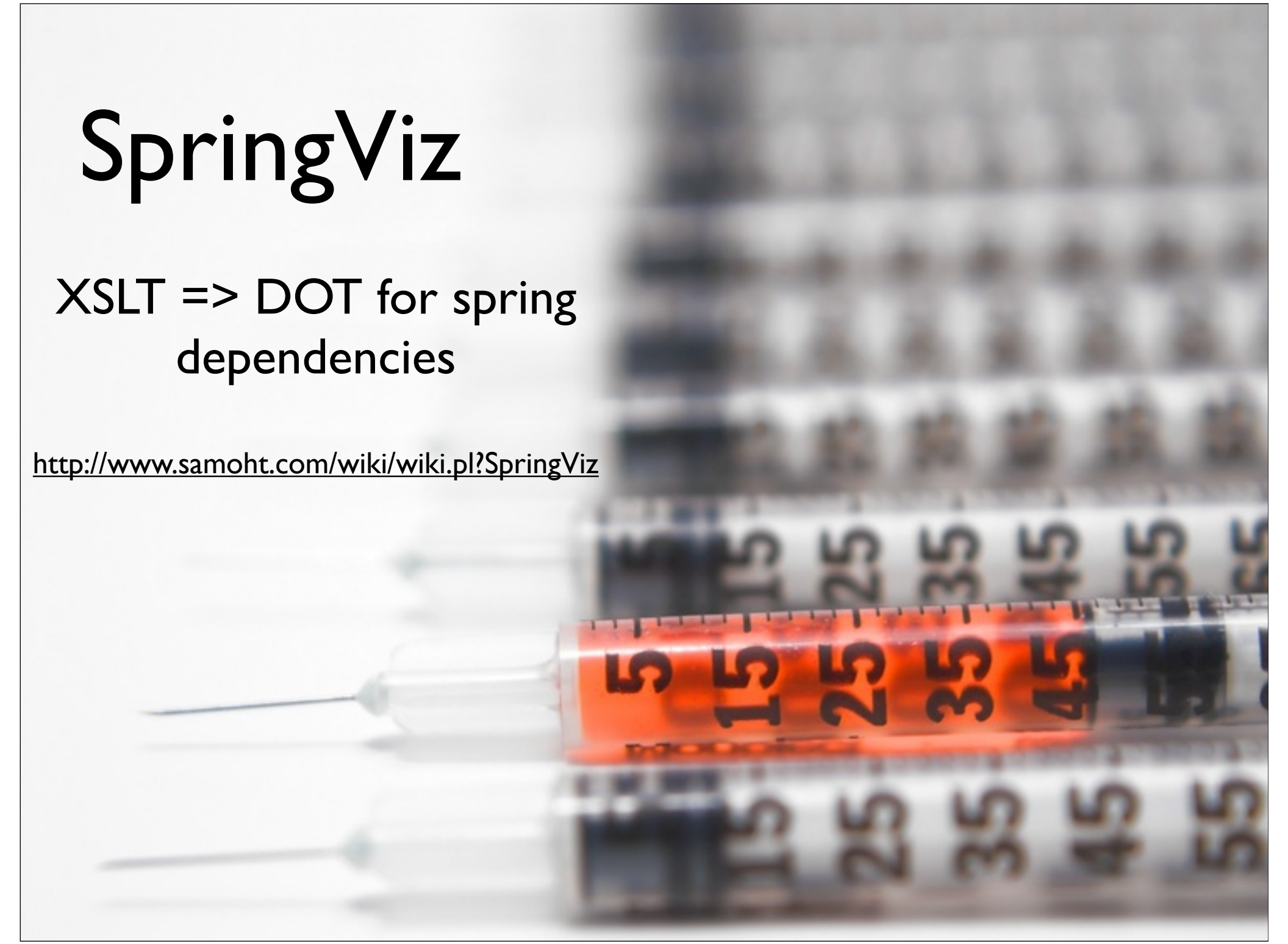
networks around common dependent elements

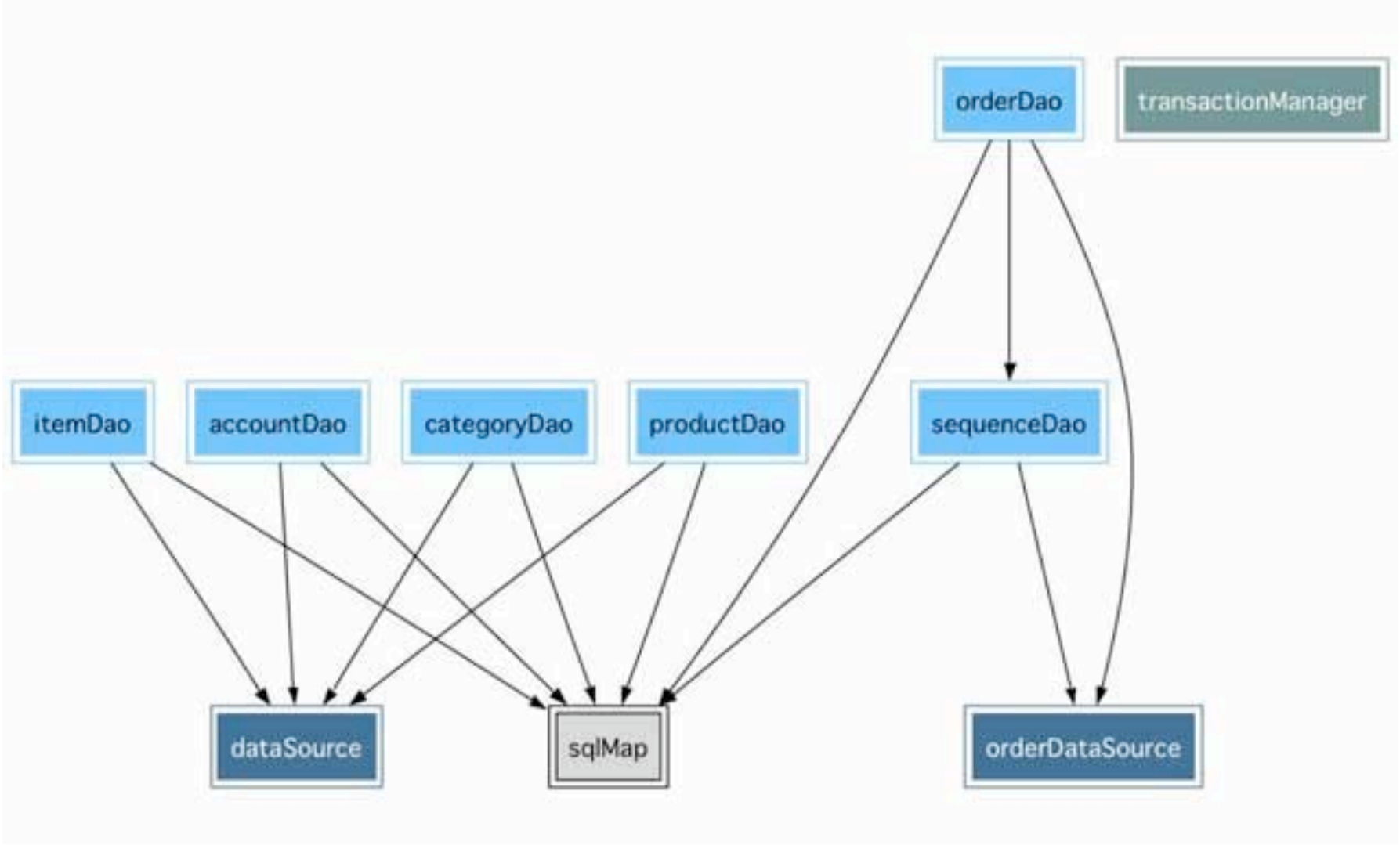
think about extracting
via macrodef

SpringViz

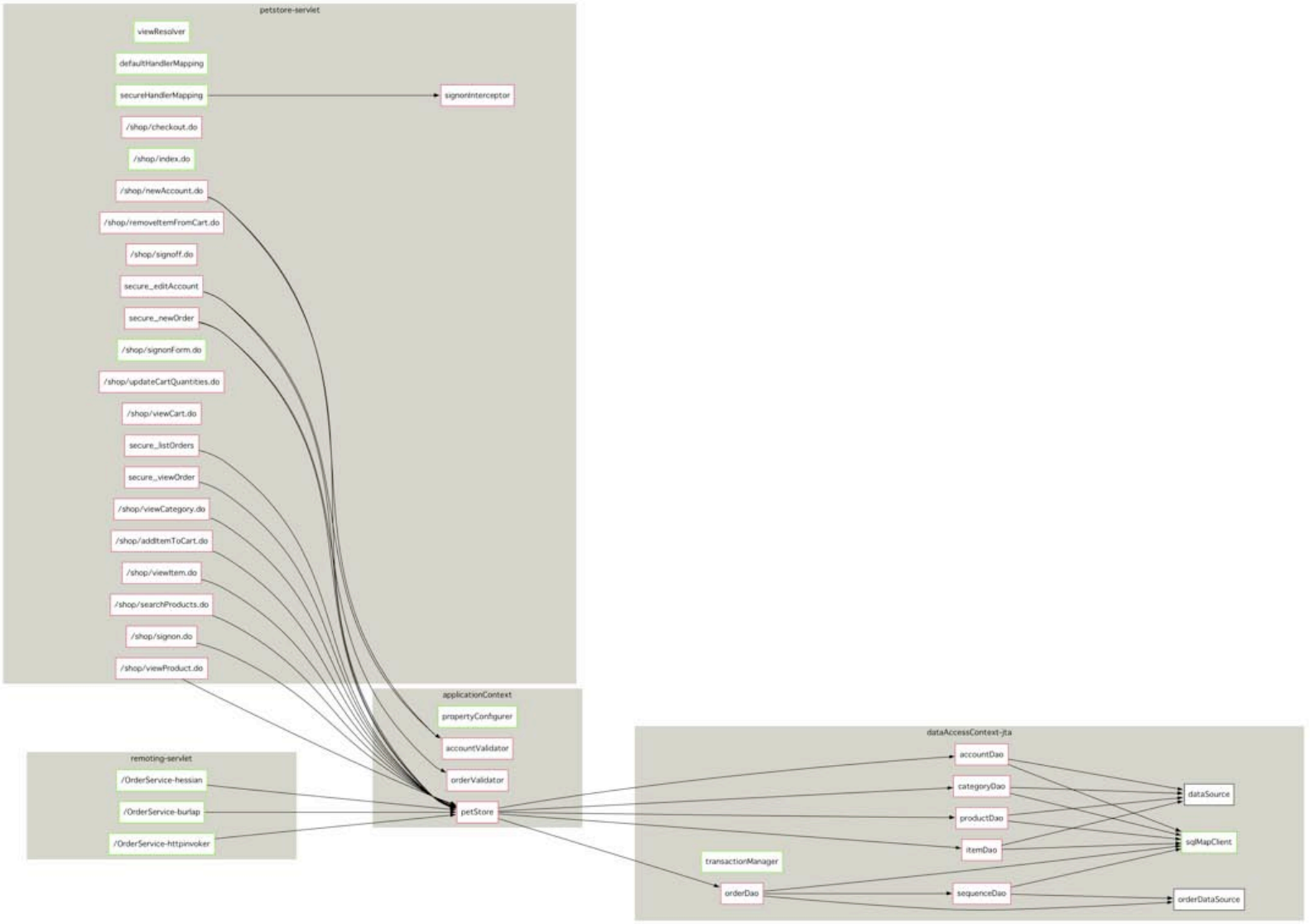
XSLT => DOT for spring dependencies

http://www.samoht.com/wiki/wiki.pl?SpringViz




orderDao
transactionManager
itemDao
accountDao
categoryDao
productDao
sequenceDao
dataSource
sqlMap
orderDataSource

SpringViz


petstore-servlet
viewResolver
defaultHandlerMapping
secureHandlerMapping
signonInterceptor
/shop/checkout.do
/shop/index.do
/shop/newAccount.do
/shop/removeItemFromCart.do
/shop/signoff.do
secure_editAccount
secure_newOrder
/shop/signonForm.do
/shop/updateCartQuantities.do
/shop/viewCart.do
secure_listOrders
secure_viewOrder
/shop/viewCategory.do
/shop/addItemToCart.do
/shop/viewItem.do
/shop/searchProducts.do
/shop/signon.do
/shop/viewProduct.do
applicationContext
propertyConfigurer
accountValidator
orderValidator
petStore
remoting-servlet
/OrderService-hessian
/OrderService-burlap
/OrderService-httpinvoker
dataAccessContext-jta
accountDao
categoryDao
productDao
itemDao
transactionManager
orderDao
sequenceDao
dataSource
sqlMapClient
orderDataSource

look for...

regularity

symmetry

overloaded dependencies

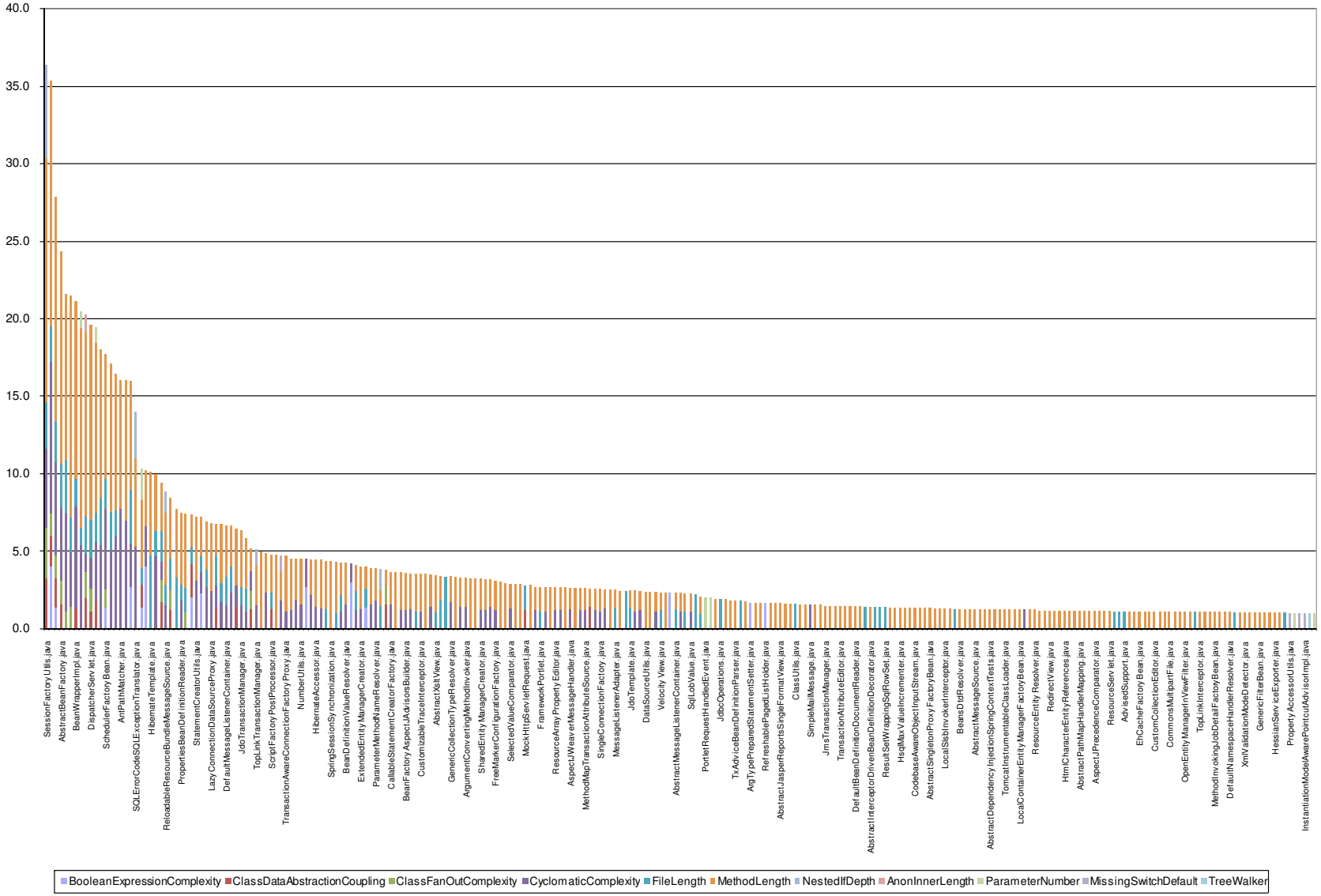
isolated pockets

toxicity chart

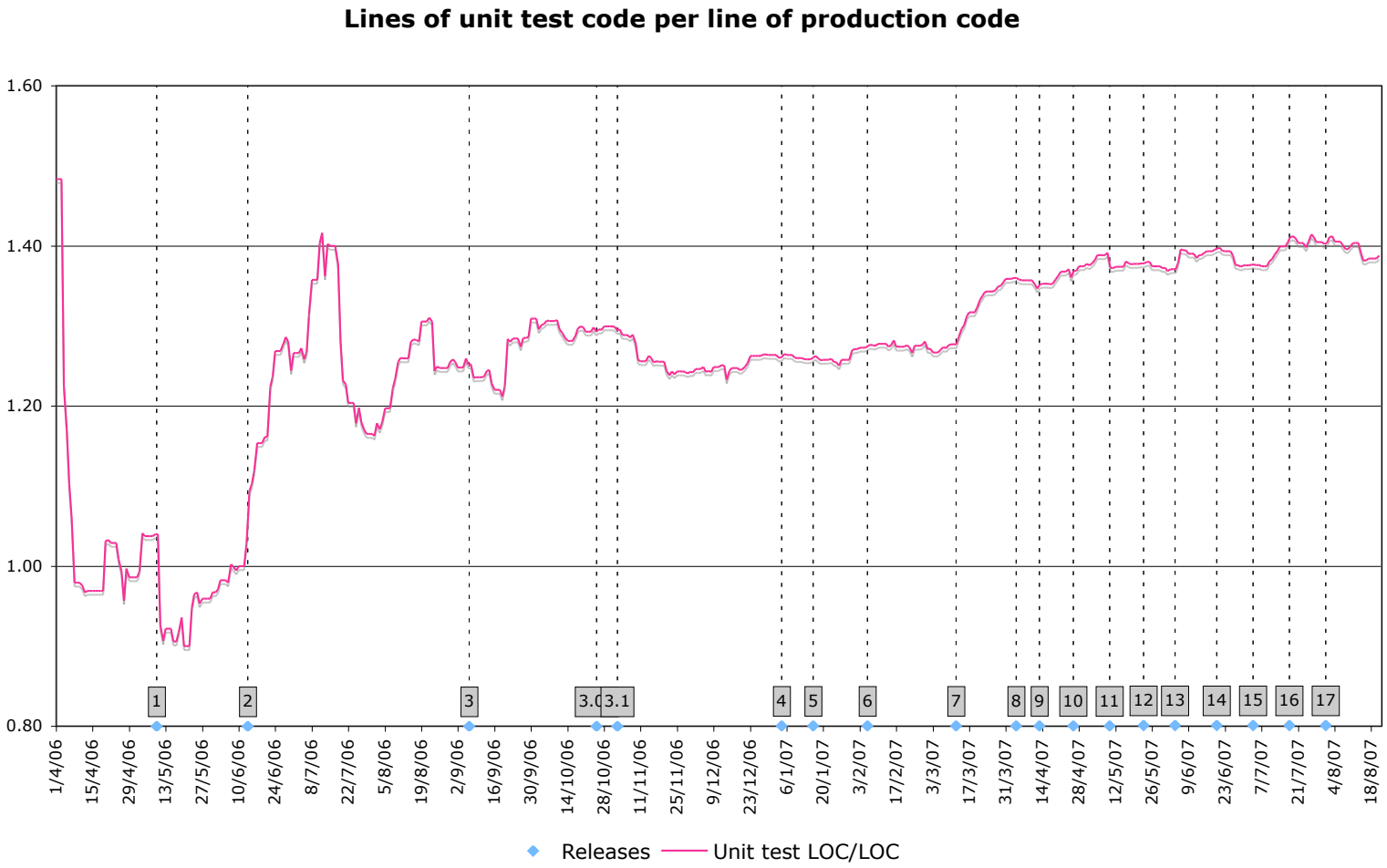
provides easy to compare overview of quality

created with checkstyle + excel

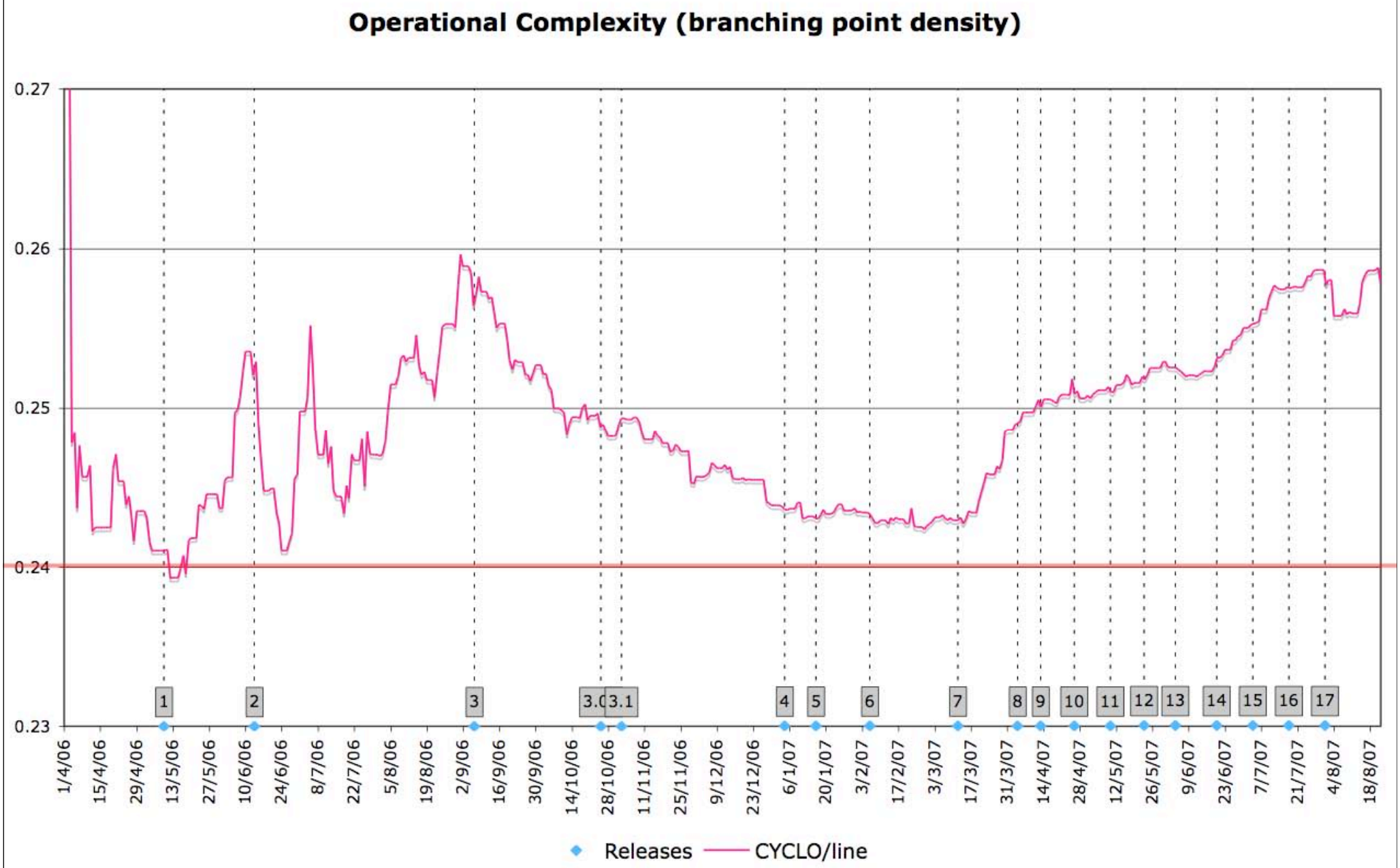
toxicity chart



test to code ratio



created using unix tools + excel


Operational Complexity (branching point density)
0.27
0.26
0.25
0.24
0.23
1
2
3
3.0
3.1
4
5
6
7
8
9
10
11
12
13
14
15
16
17
1/4/06
15/4/06
29/4/06
13/5/06
27/5/06
10/6/06
24/6/06
8/7/06
22/7/06
5/8/06
19/8/06
2/9/06
16/9/06
30/9/06
14/10/06
28/10/06
11/11/06
25/11/06
9/12/06
23/12/06
6/1/07
20/1/07
3/2/07
17/2/07
3/3/07
17/3/07
31/3/07
14/4/07
28/4/07
12/5/07
26/5/07
9/6/07
23/6/07
7/7/07
21/7/07
4/8/07
18/8/07
Releases
CYCLO/line

look for...

notifications along your key dimension

toxicity: high-spikes

test-to-code ratio: higher is better

complexity / loc: trends

deltas more interesting than raw numbers

"Unveiling the beauty of statistics for a fact based world view."

time-based statistical view of chart data

founded in Stockholm by Ola Rosling, Anna Rosling Rönnlund and Hans Rosling

now realized in the google spreadsheet motion gadget

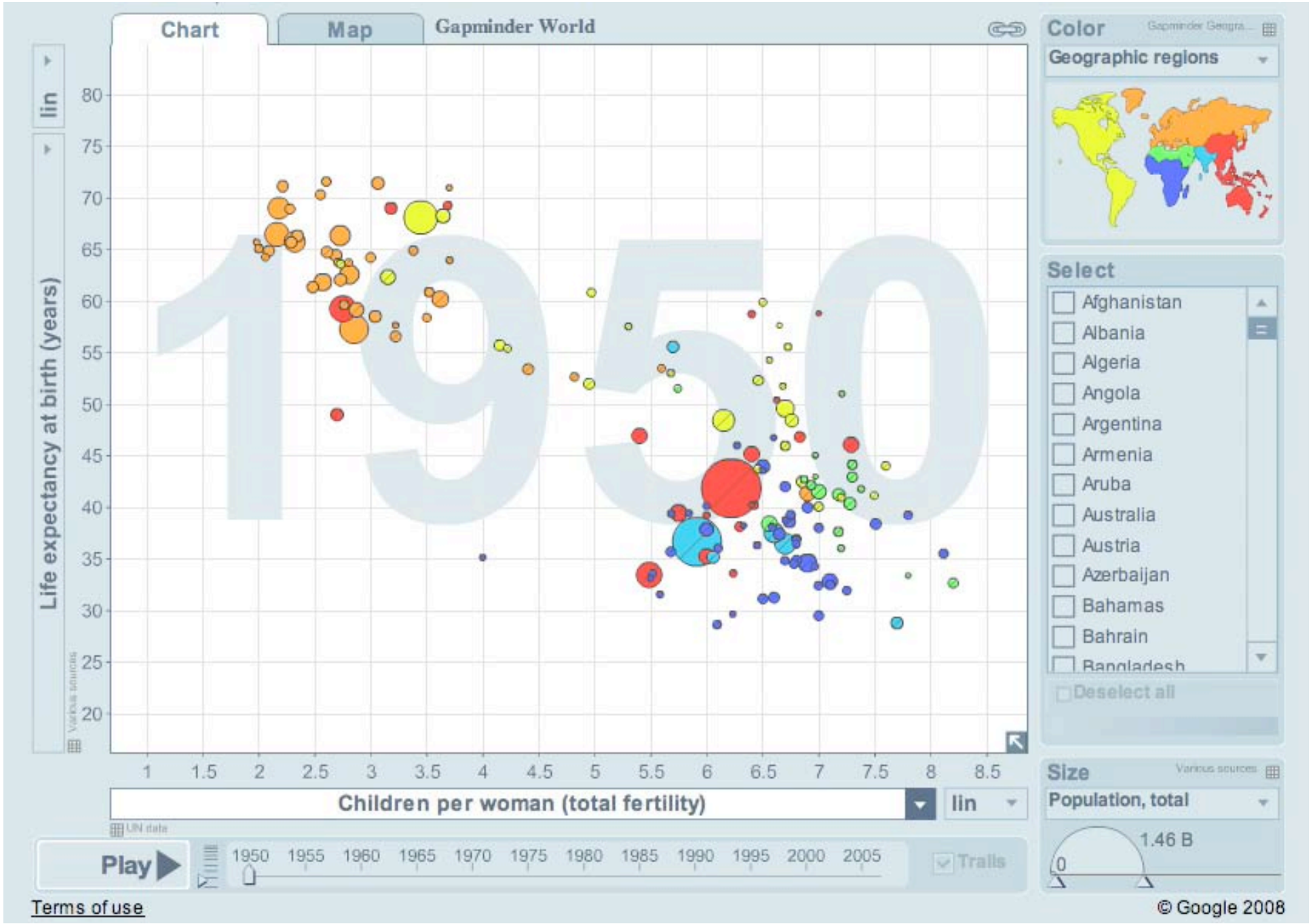


Chart
Map
Gapminder World
lin
Life expectancy at birth (years)
80
75
70
65
60
55
50
45
40
35
30
25
20
1950
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Children per woman (total fertility)
lin
UN data
Play
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005
Trails
Color
Gapminder Geogra...
Geographic regions
Select
Afghanistan
Albania
Algeria
Angola
Argentina
Armenia
Aruba
Australia
Austria
Azerbaijan
Bahamas
Bahrain
Bangladesh
Deselect all
Size
Various sources
Population, total
1.46 B
0
Terms of use
© Google 2008

the data

	Version		loc/cc	LOC	CC
1					
2	v1	1999	6.02941176470588	12915	2142
3	v2	2000	6.17486583184258	13807	2236
4	v3	2001	6.17706949977866	13954	2259
5	v4	2002	6.16593886462882	14120	2290
6	v5	2003	6.29637618636756	14595	2318
7	v6	2004	6.22636327971754	15871	2549
8	v7	2005	6.22466281310212	16153	2595
9	v8	2006	6.20398773006135	16180	2608
10	v9	2007	6.17825921702775	16255	2631
11	v10	2008	6.21148725751236	16330	2629

motion chart gadget

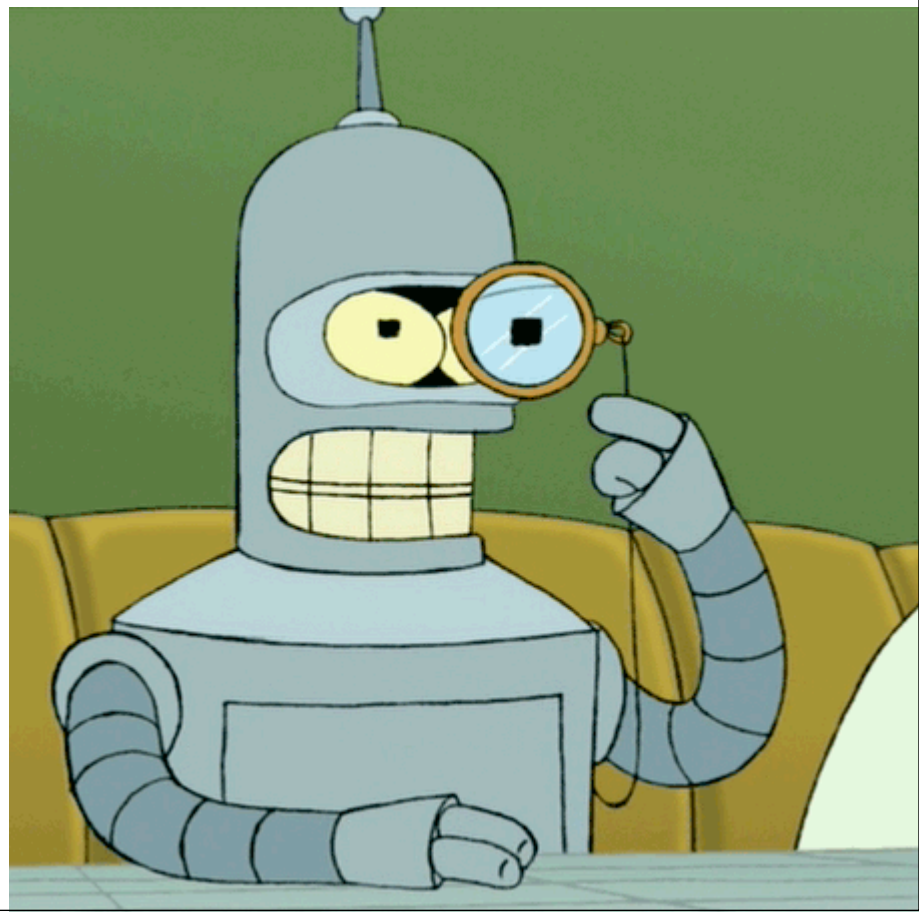
look for...

time-based trends

odd outliers along dimensions

symmetry

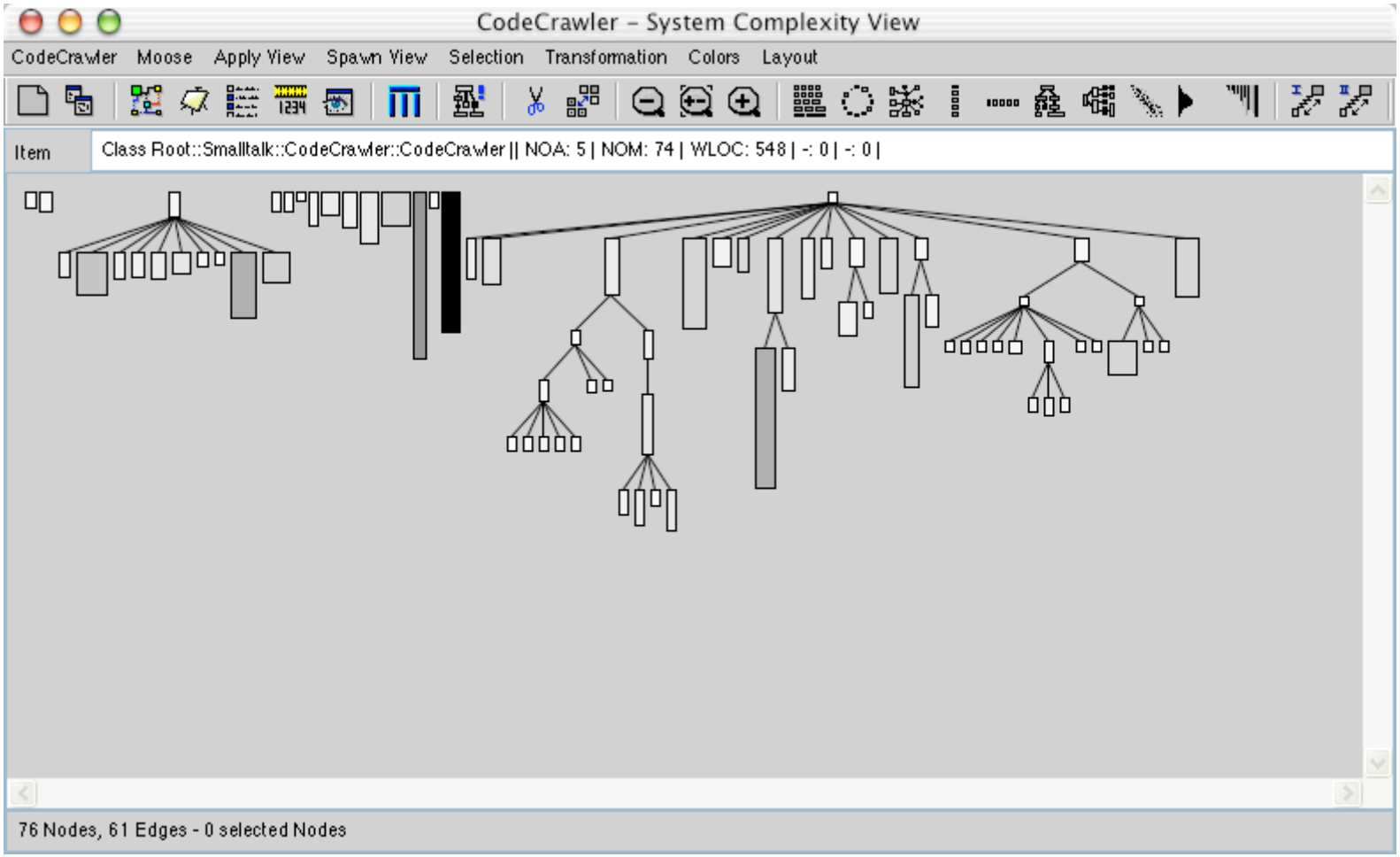
fluidity



CodeCrawler

www.inf.unisi.ch/faculty/lanza/codecrawler.html

CodeCrawler



CodeCrawler

academic graphical metrics tool

language independent

written in VisualAge Smalltalk

based on the Moose platform

quirky but powerful

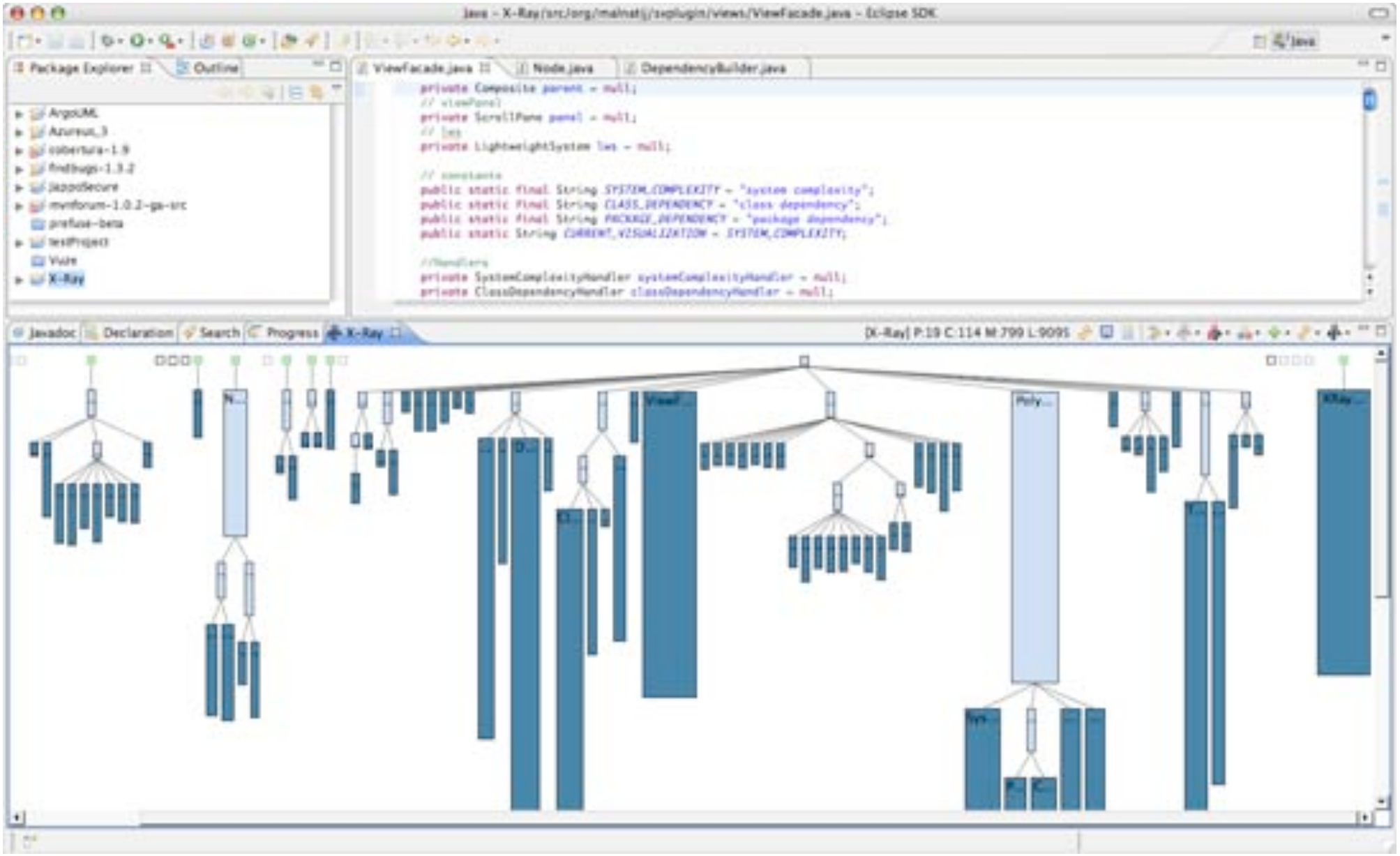
x-ray

graduate student project written by Jacopo Malnati (http://atelier.inf.unisi.ch/~malnatij/xray.php)

open-source software visualization plug-in for eclipse

provides system complexity view, class & package dependency view

model of the underlying Java project can be triggered and used by other plug-ins



x-ray visualizing itself through via system complexity view

using x-ray

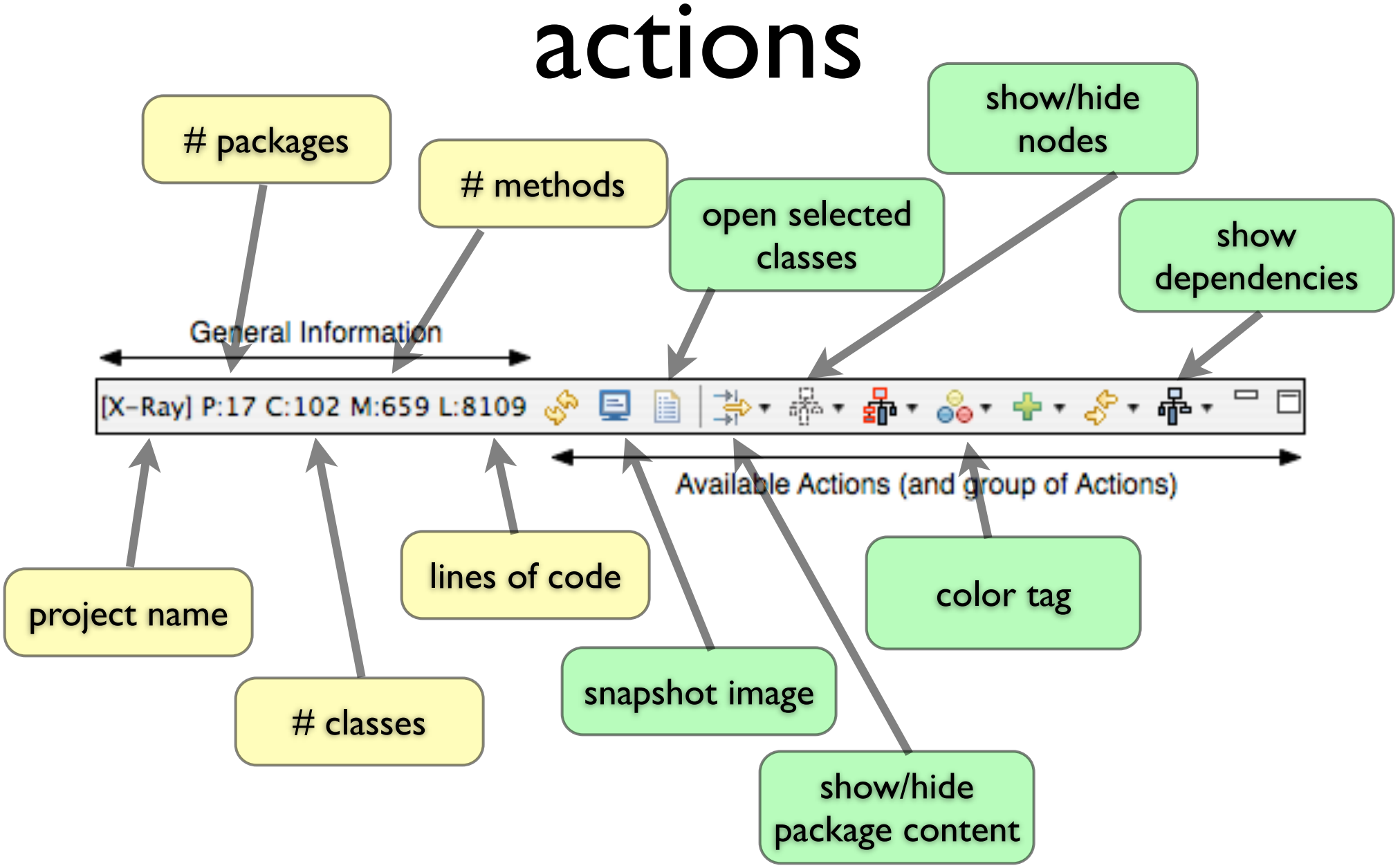
install the plug-in

choose the Analyze Current Project action
from the package explorer

x-ray creates *textual information* and *actions*

visualizations characterized by entities
positioned according to layouts and criterions

actions


packages
methods
show/hide nodes
open selected classes
show dependencies
General Information
[X-Ray] P:17 C:102 M:659 L:8109
Available Actions (and group of Actions)
project name
classes
lines of code
snapshot image
show/hide package content
color tag

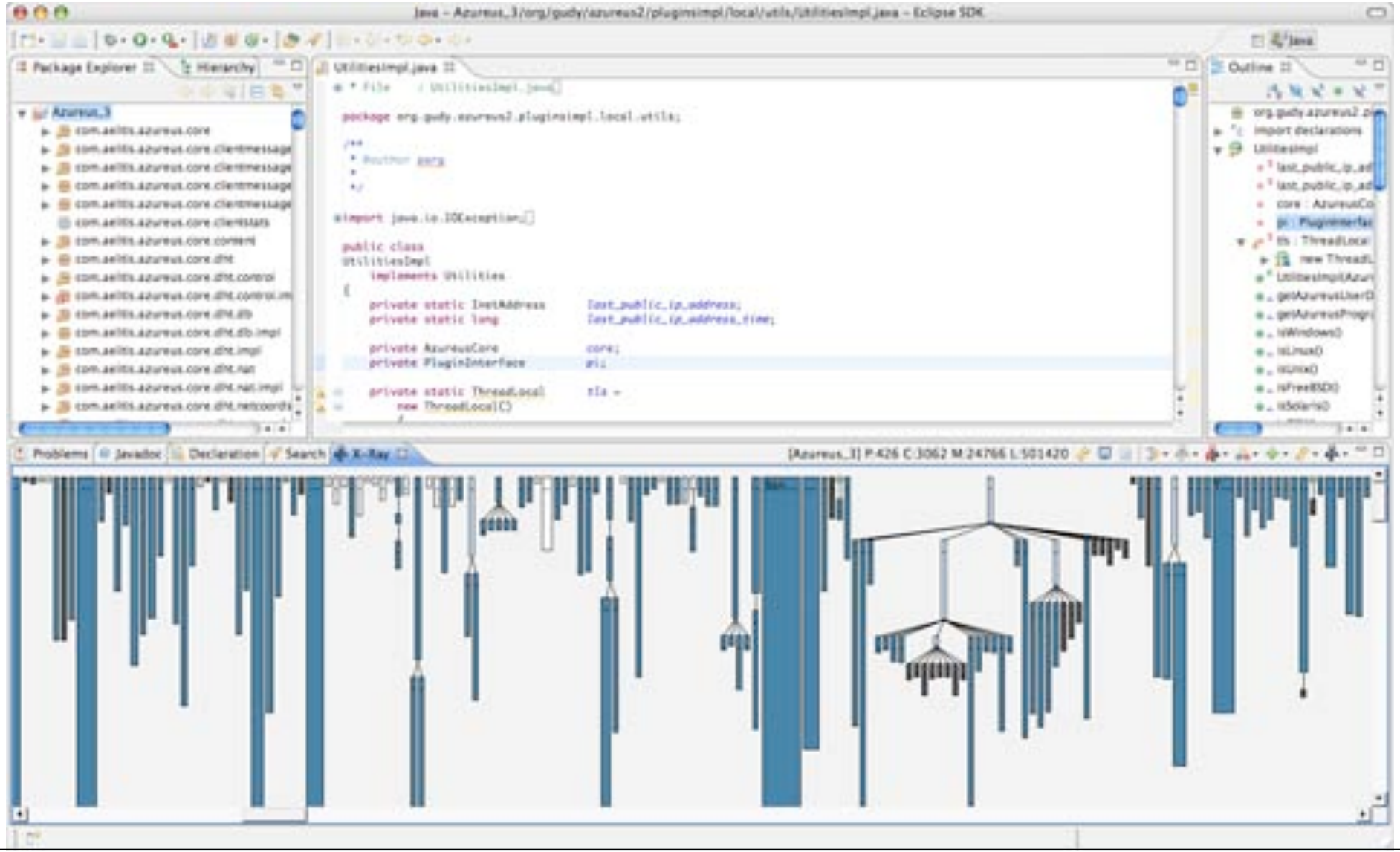
polymetric views

system complexity view

class dependency view

package dependency view

system complexity view



system complexity view

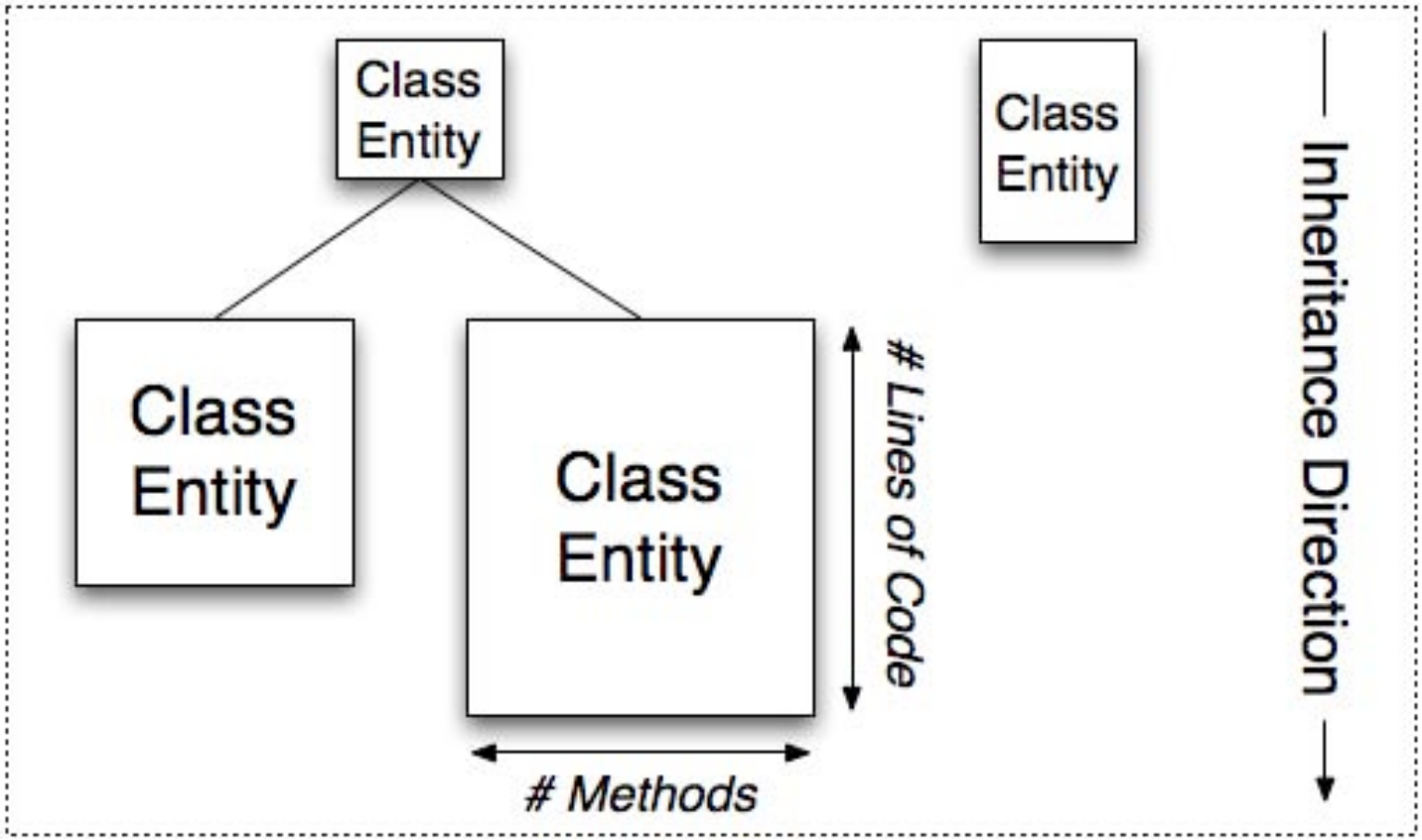
tries to illustrate disharmonies in the design and implementation of a system.

identify big nodes (compared to the others)

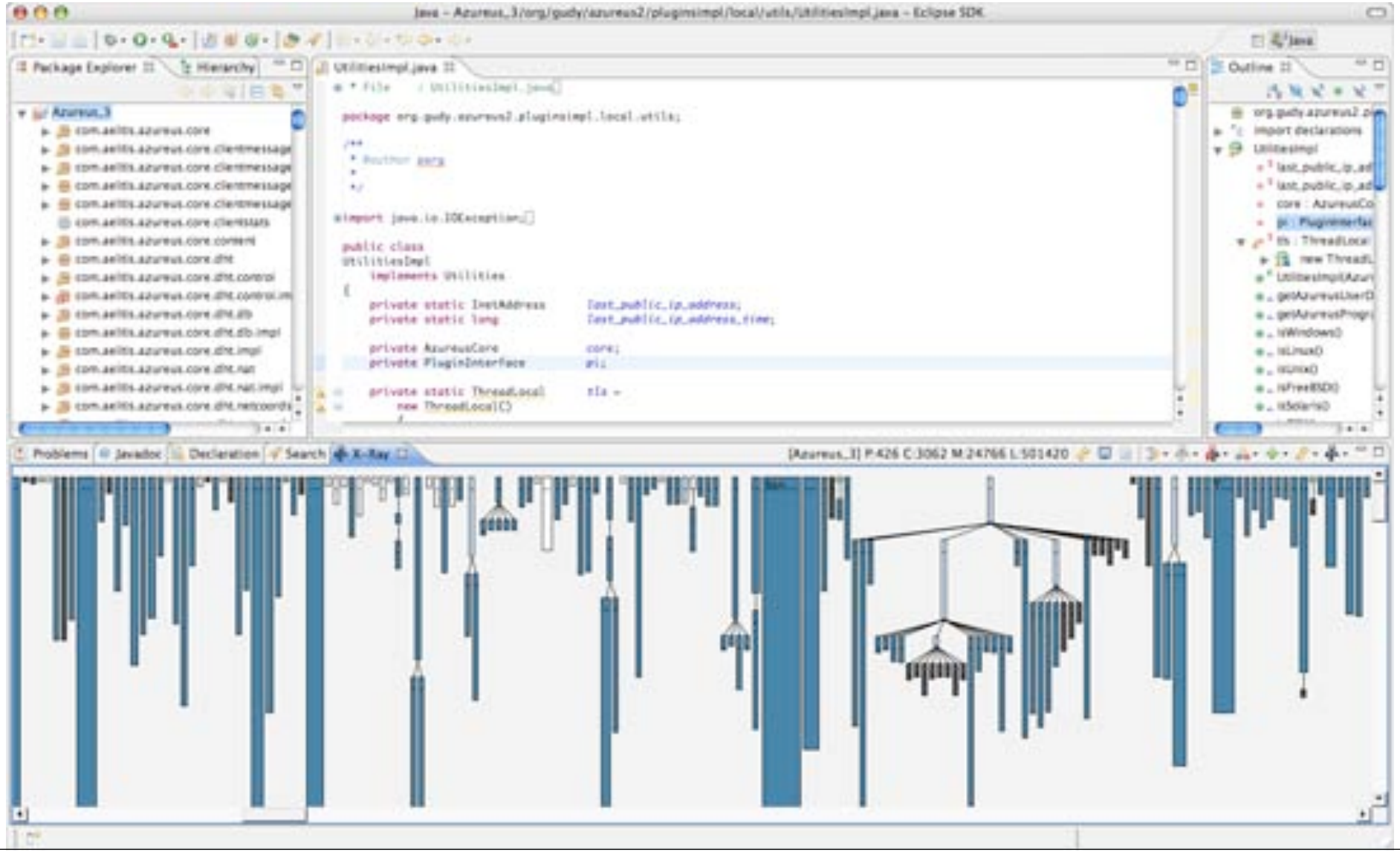
anomalies of shape (provided by the inheritance tree)

view provides several different dimensions of metrics

positional metrics



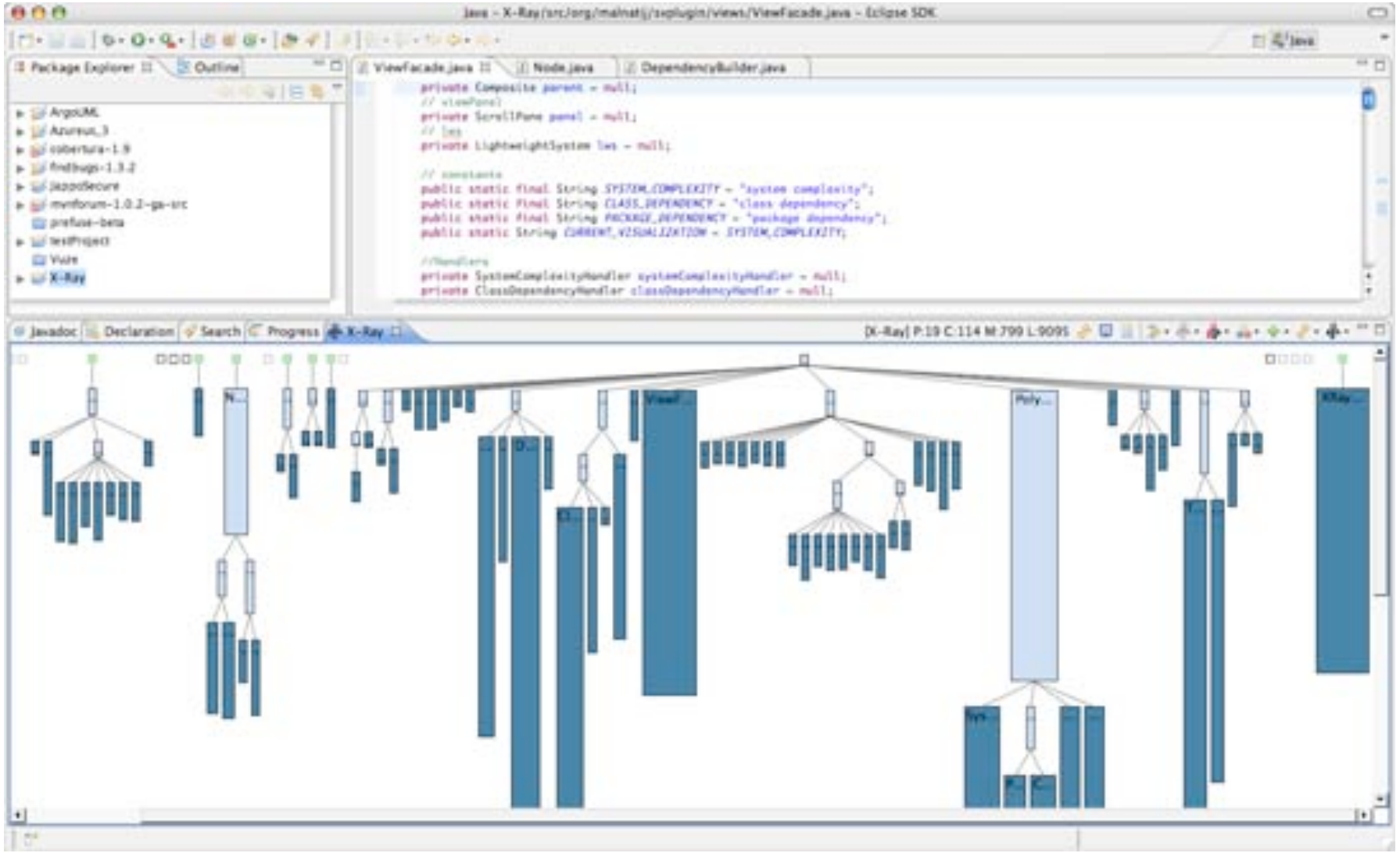
system complexity view

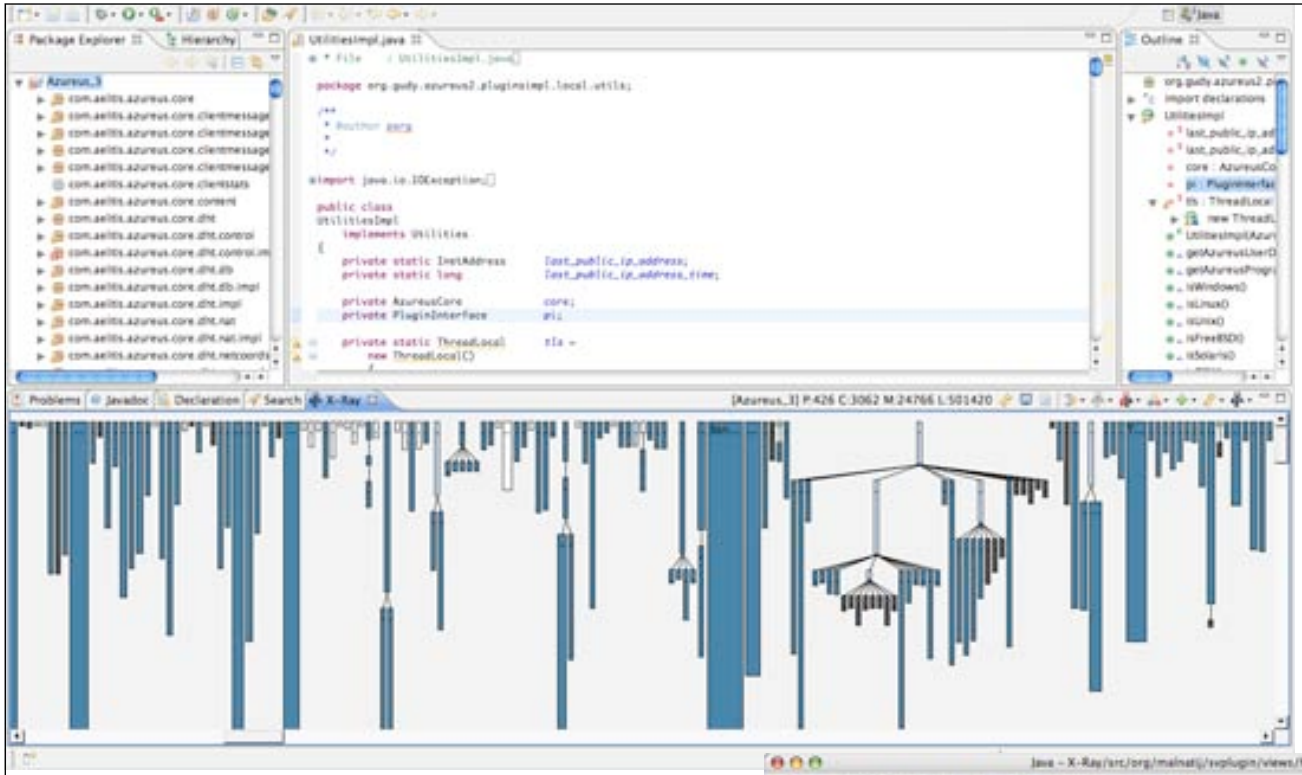


color metrics

- **Dark Blue** implies a concrete class.
- **Light Blue** implies an abstract class.
- **White** implies an interface.
- **Green** implies an external class. By external class we mean a class that is external to the project, while some internal classes are inheriting from it.
- **Light Gray** implies an abstract inner class.
- **Dark Gray** implies a concrete inner class.

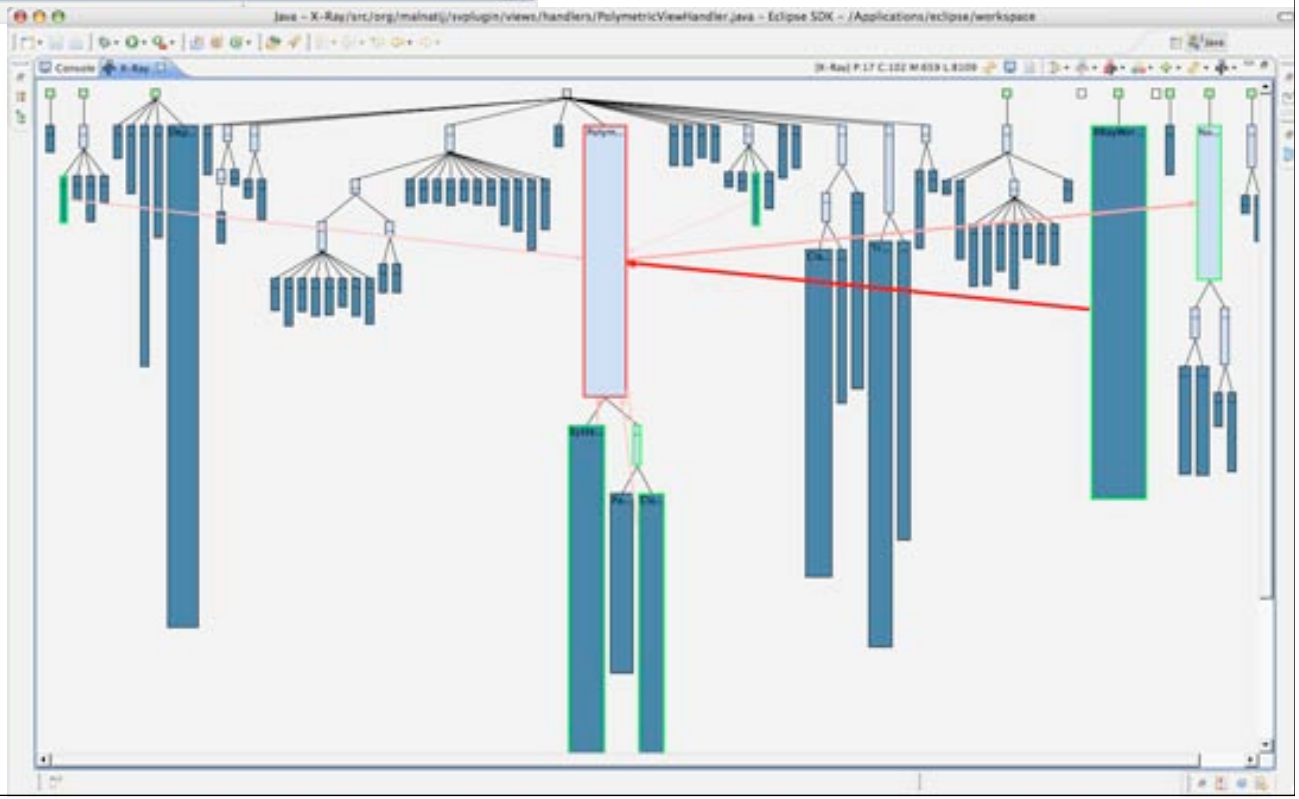
system complexity view



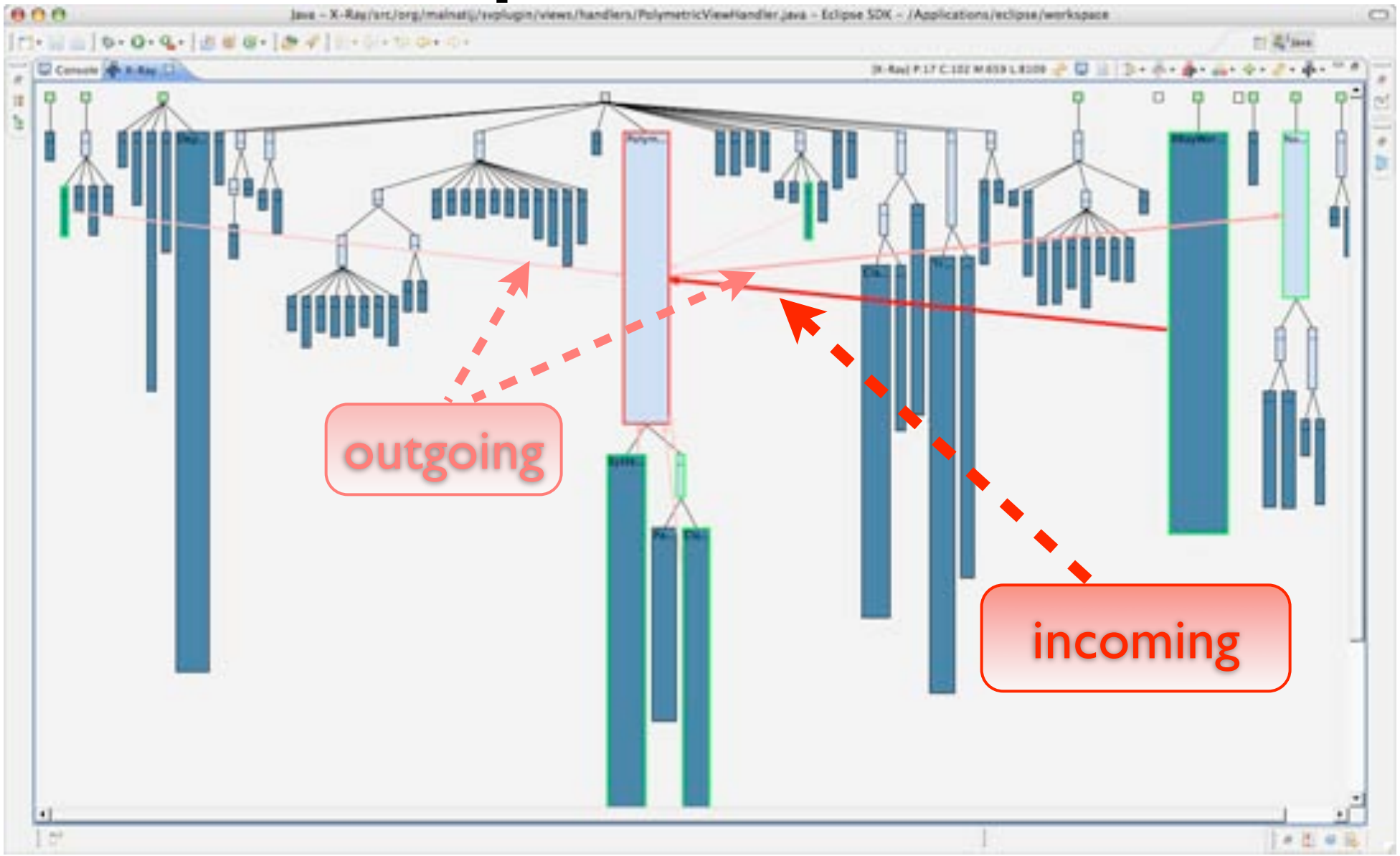


Azureus 3.0 (more than 500,000 lines of code)

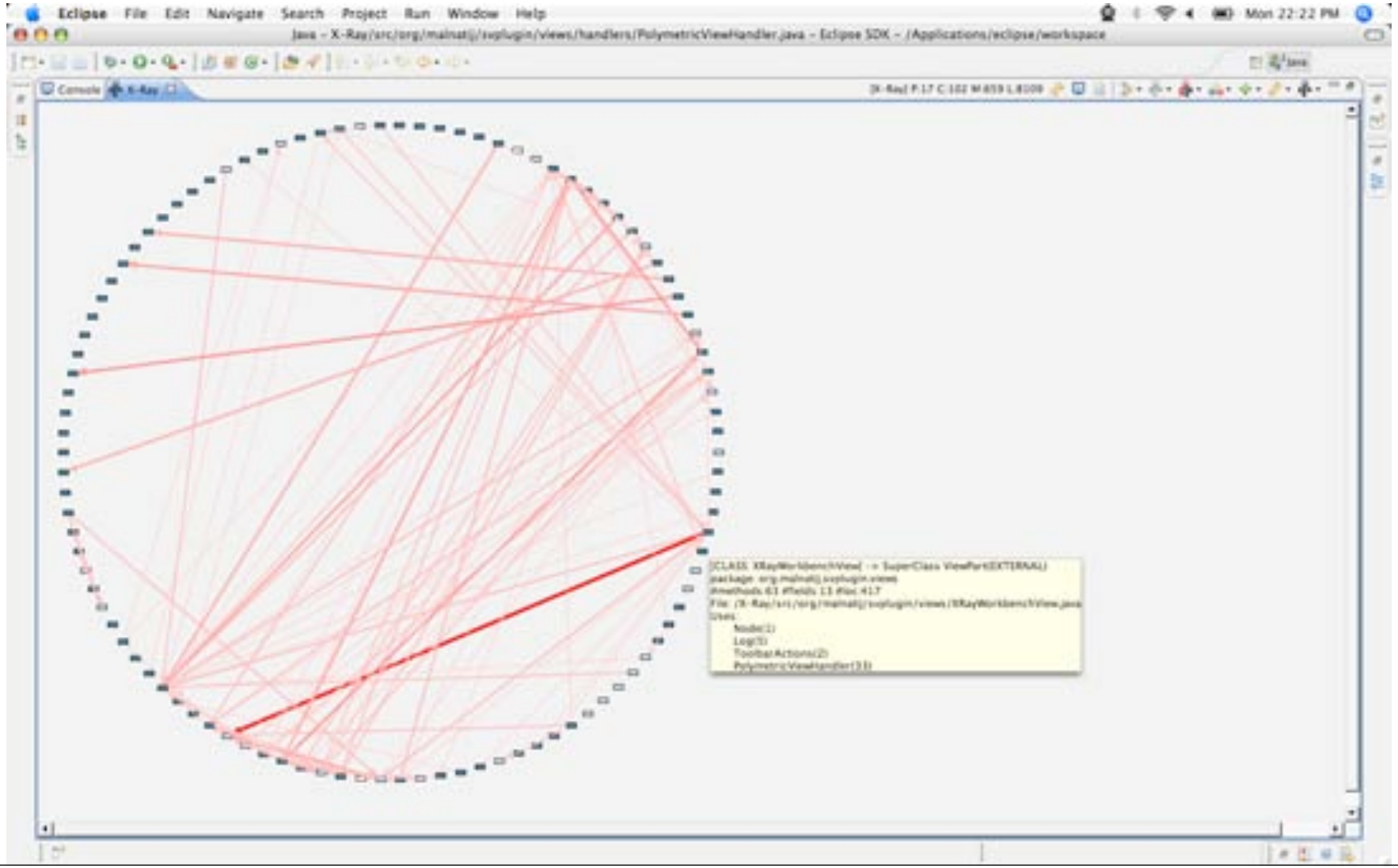
x-ray itself



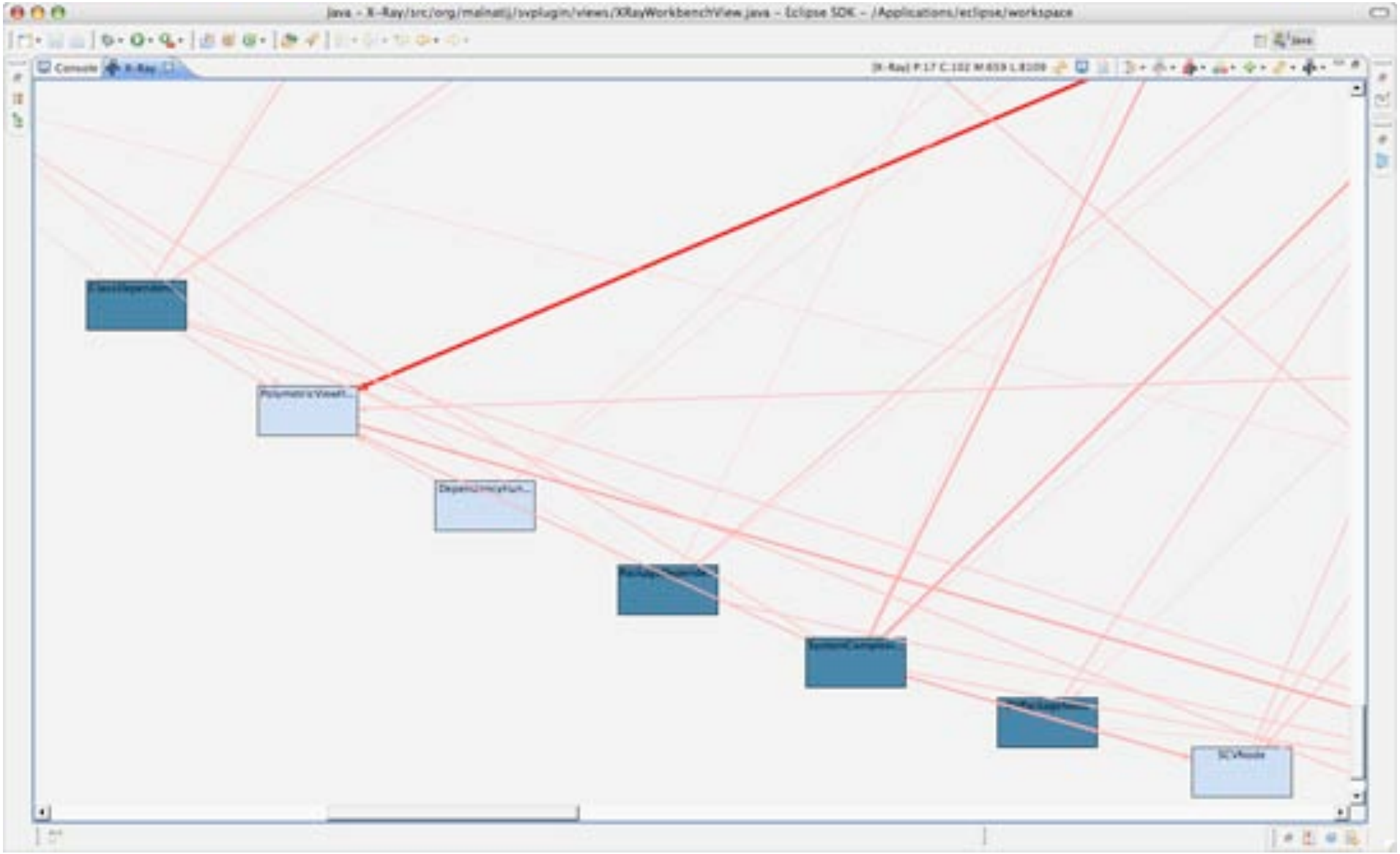
dependencies



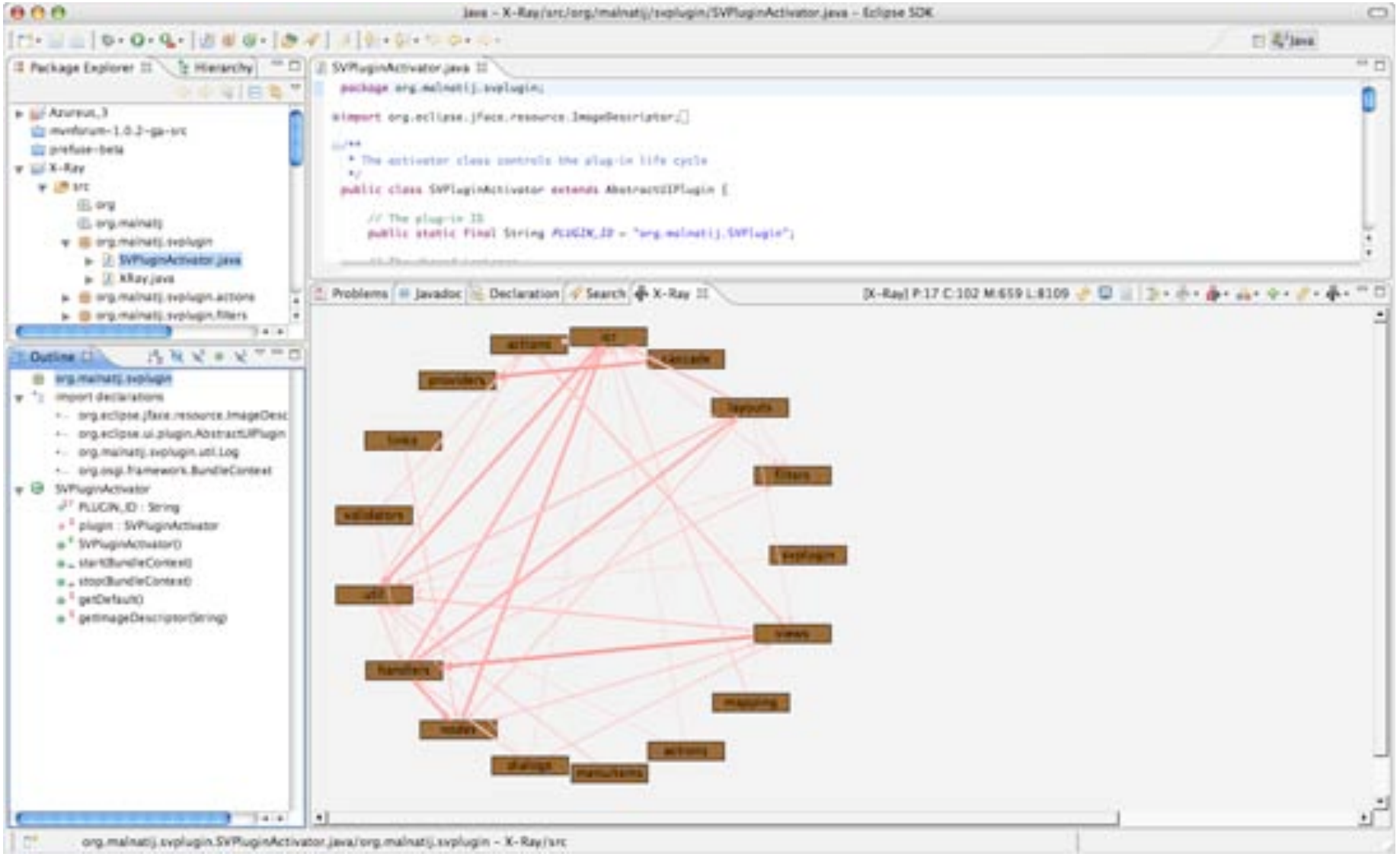
class & package dependency views



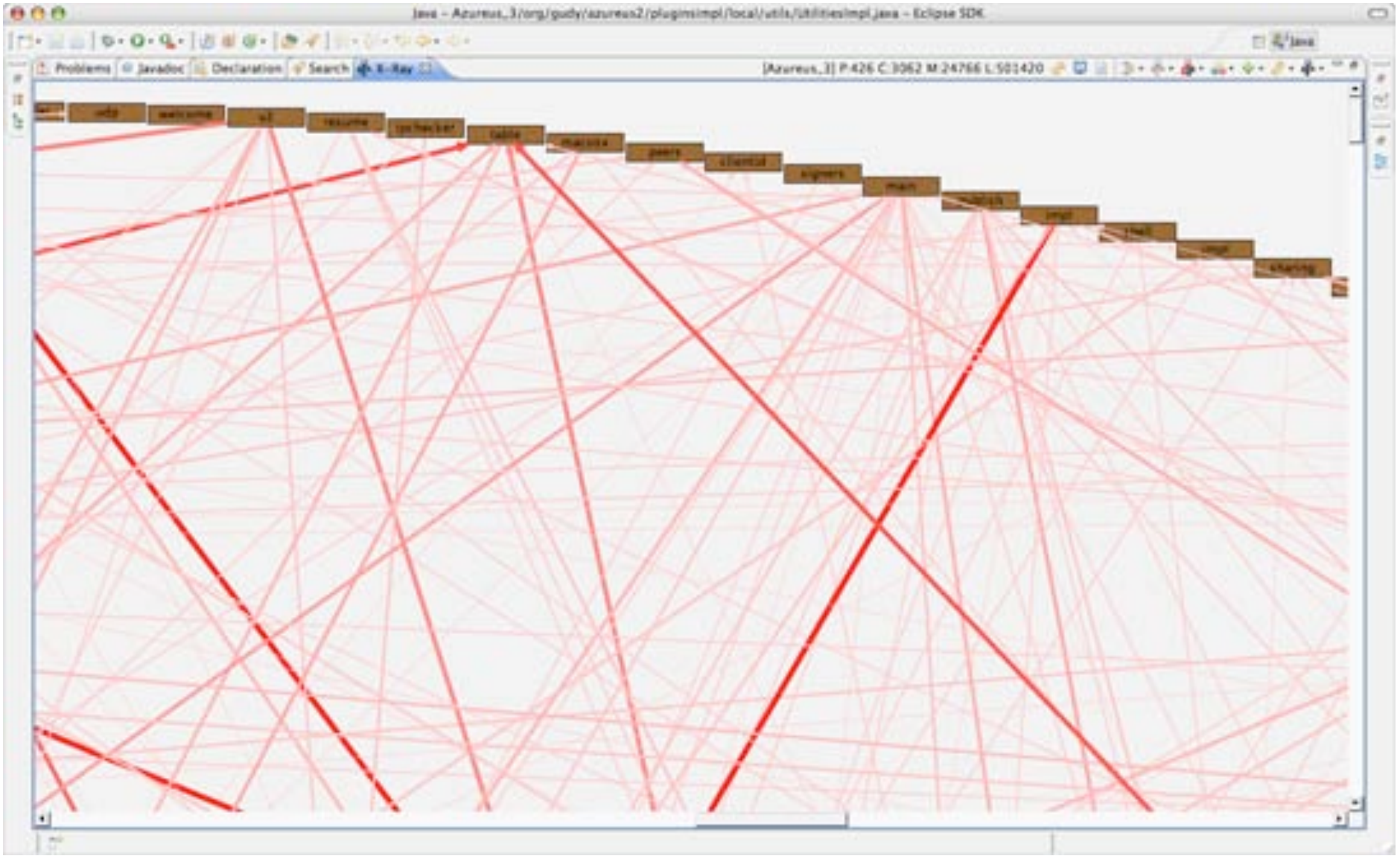
class dependency view



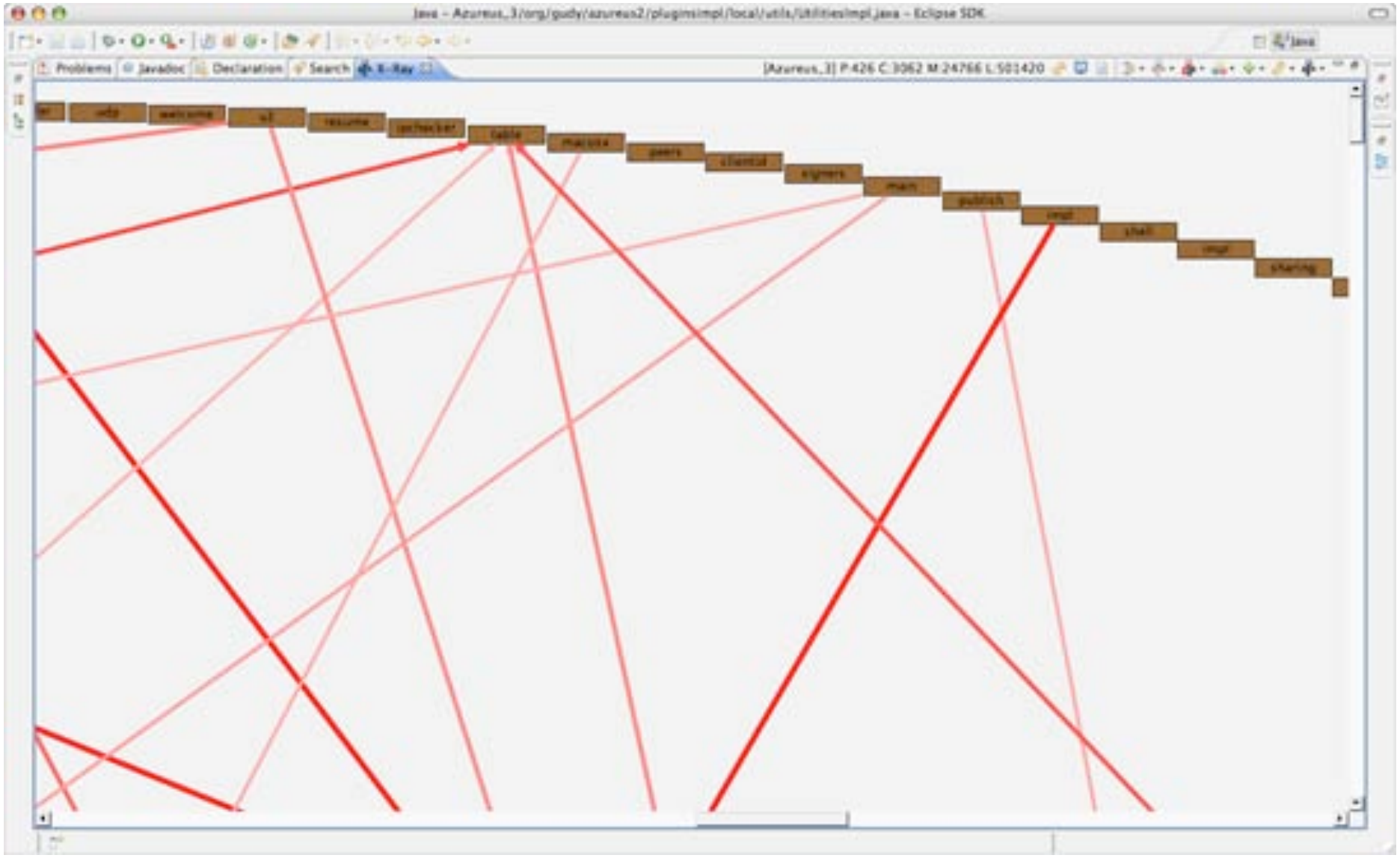
package dependency



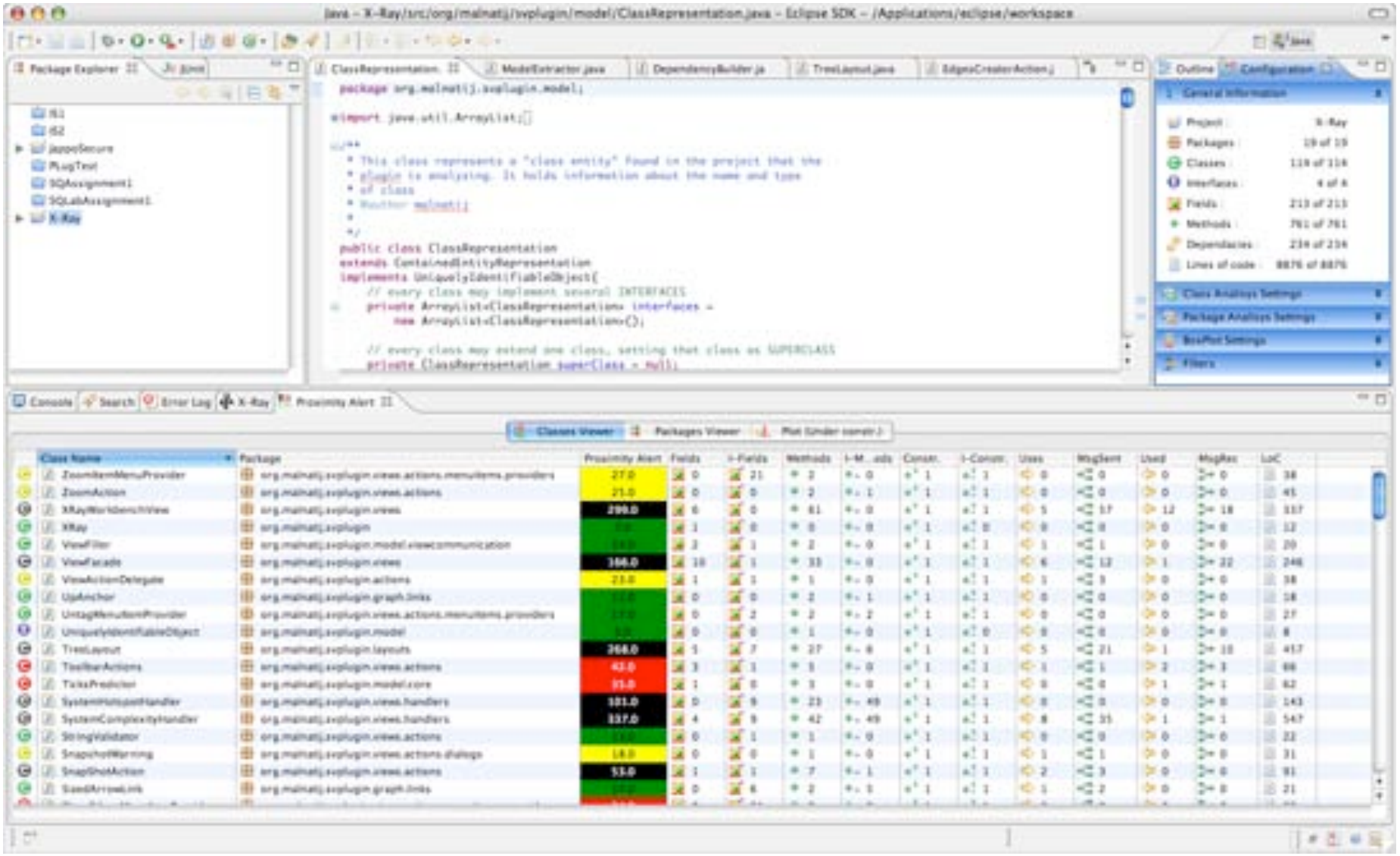
Azureus packages



filtering (< 30 weight)



proximity alert



look for...

towers (=> lots of code, lots of methods)

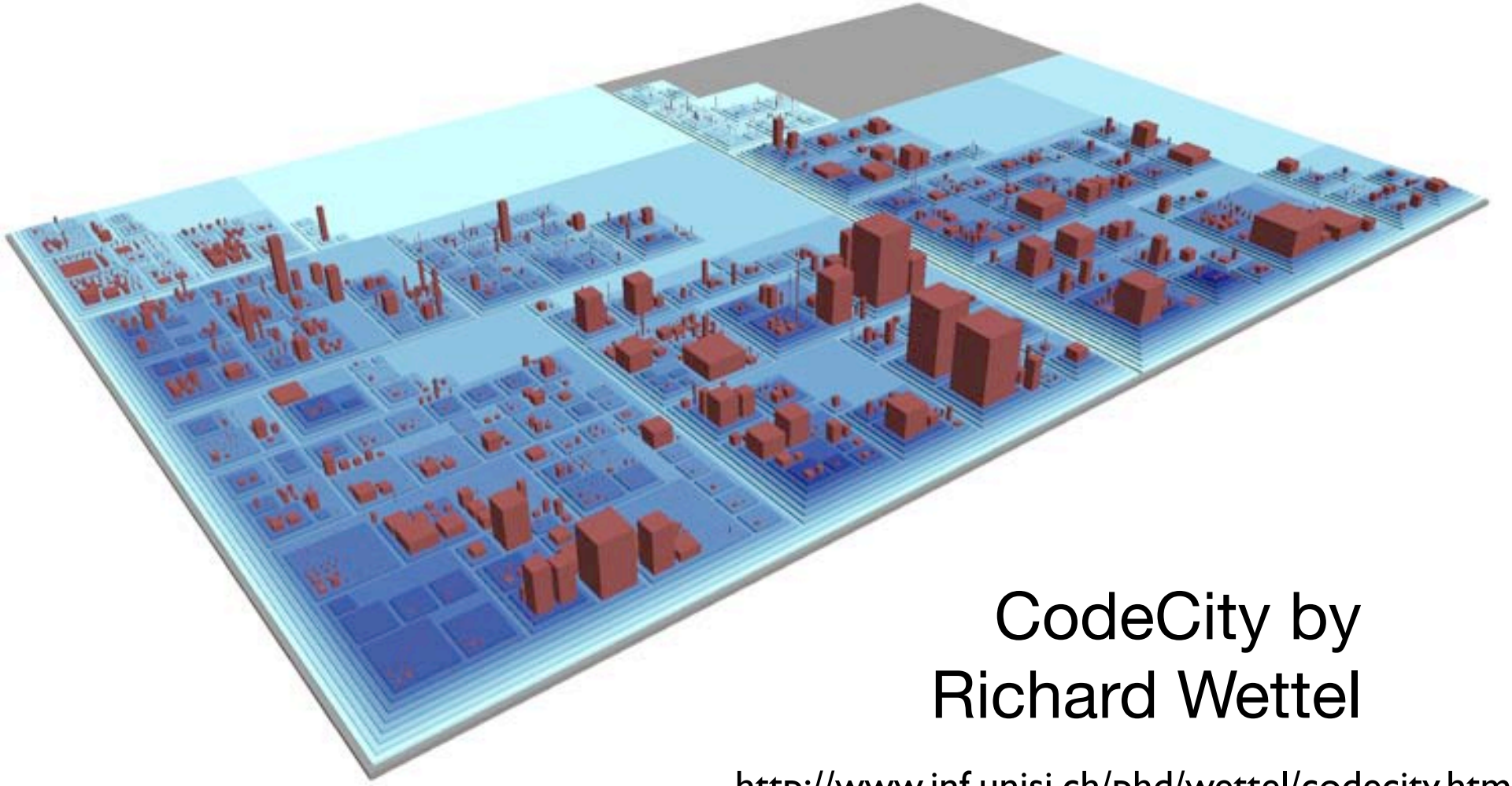
tangled dependencies

exuberant responsibility

natural partitions

balance

10,000 ft view (literally)



CodeCity by
Richard Wettel

http://www.inf.unisi.ch/phd/wettel/codecity.html

CodeCity

integrated environment for software analysis

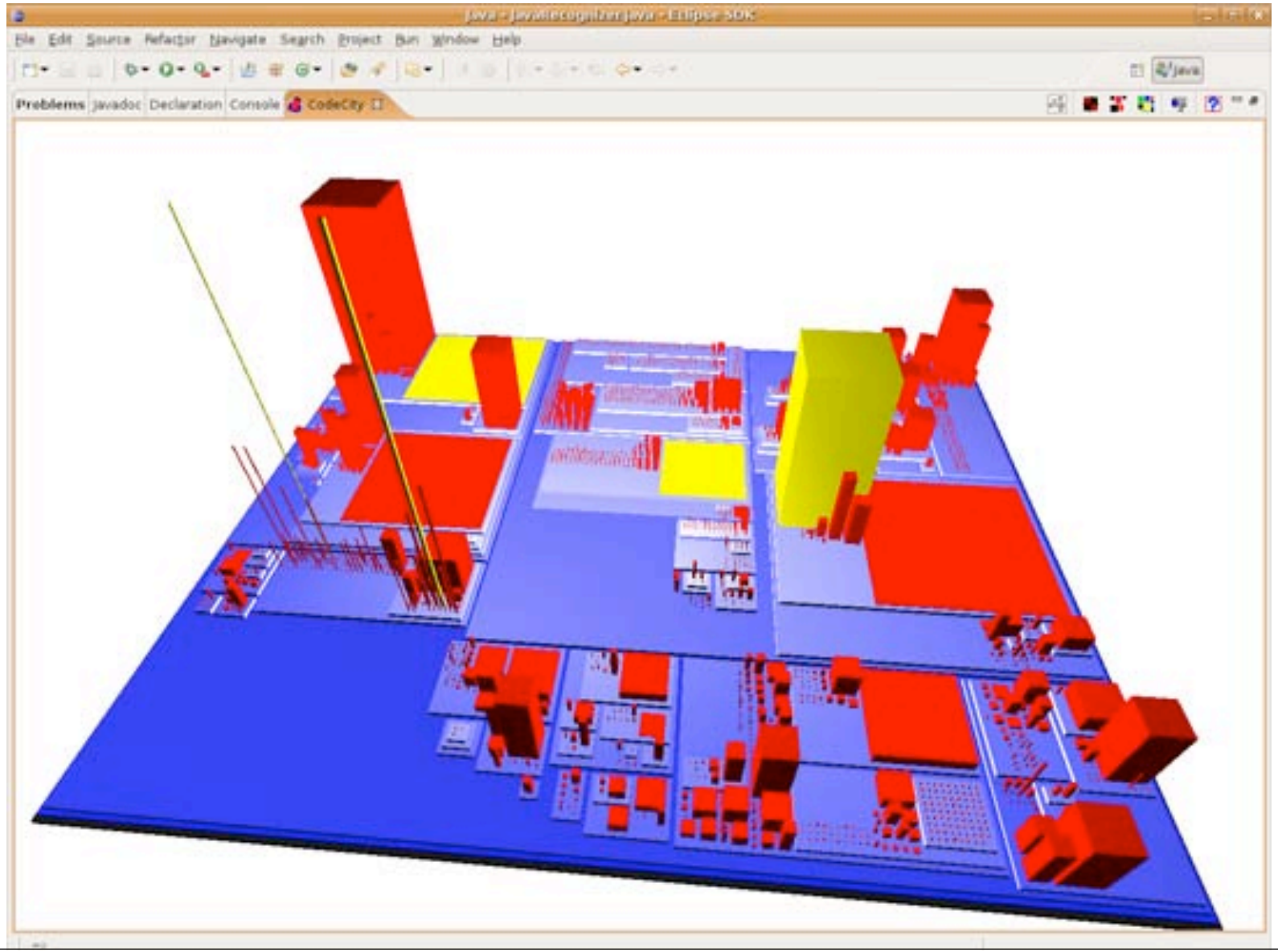
software systems are visualized as interactive, navigable 3D cities

written in VisualWorks Smalltalk, atop the Moose platform

classes => buildings

packages => districts

citylyzer


File Edit Source Refactor Navigate Search Project Run Window Help
Problems Javadoc Declaration Console CodeCity

Citylyzer

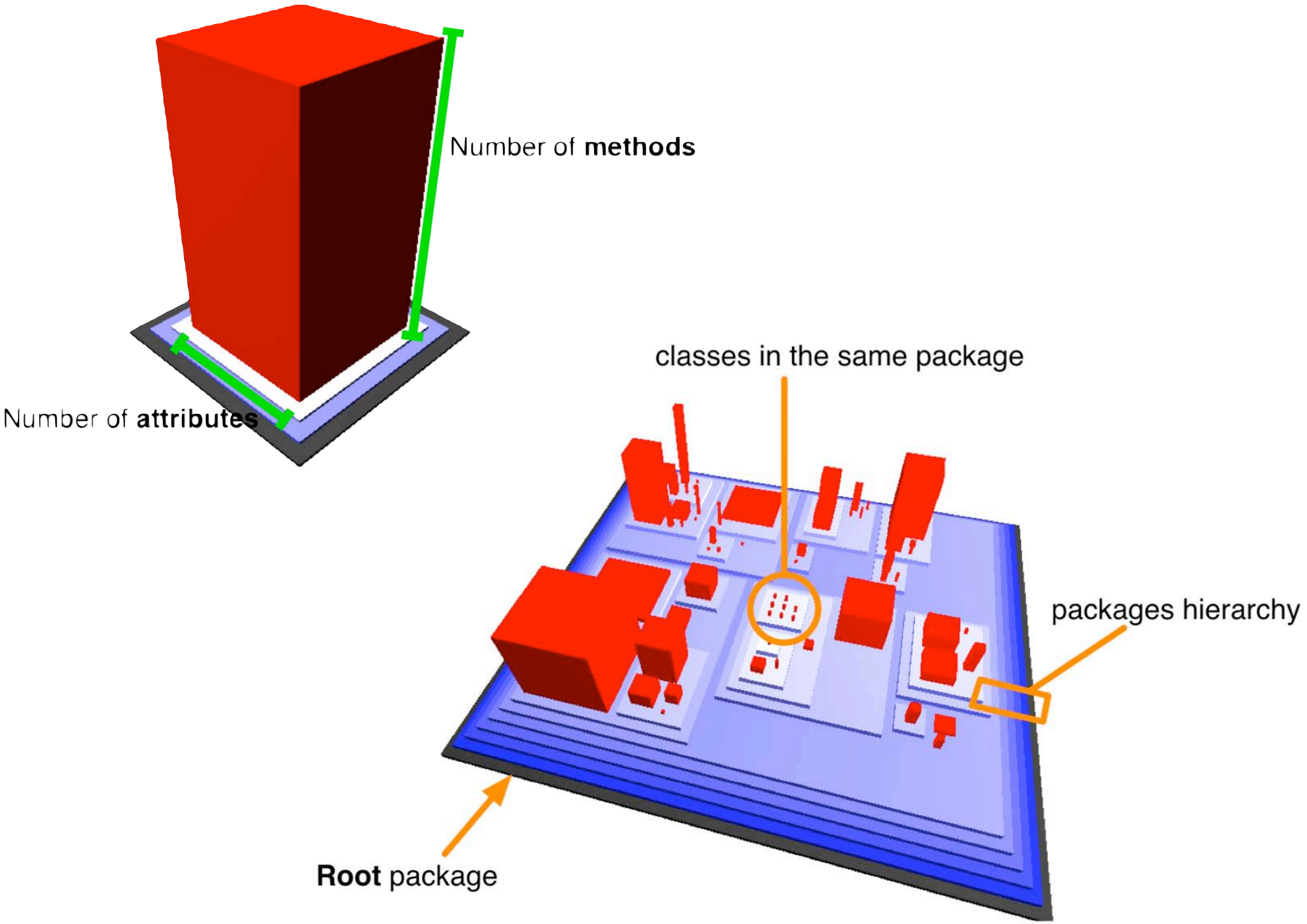
written atop x-ray

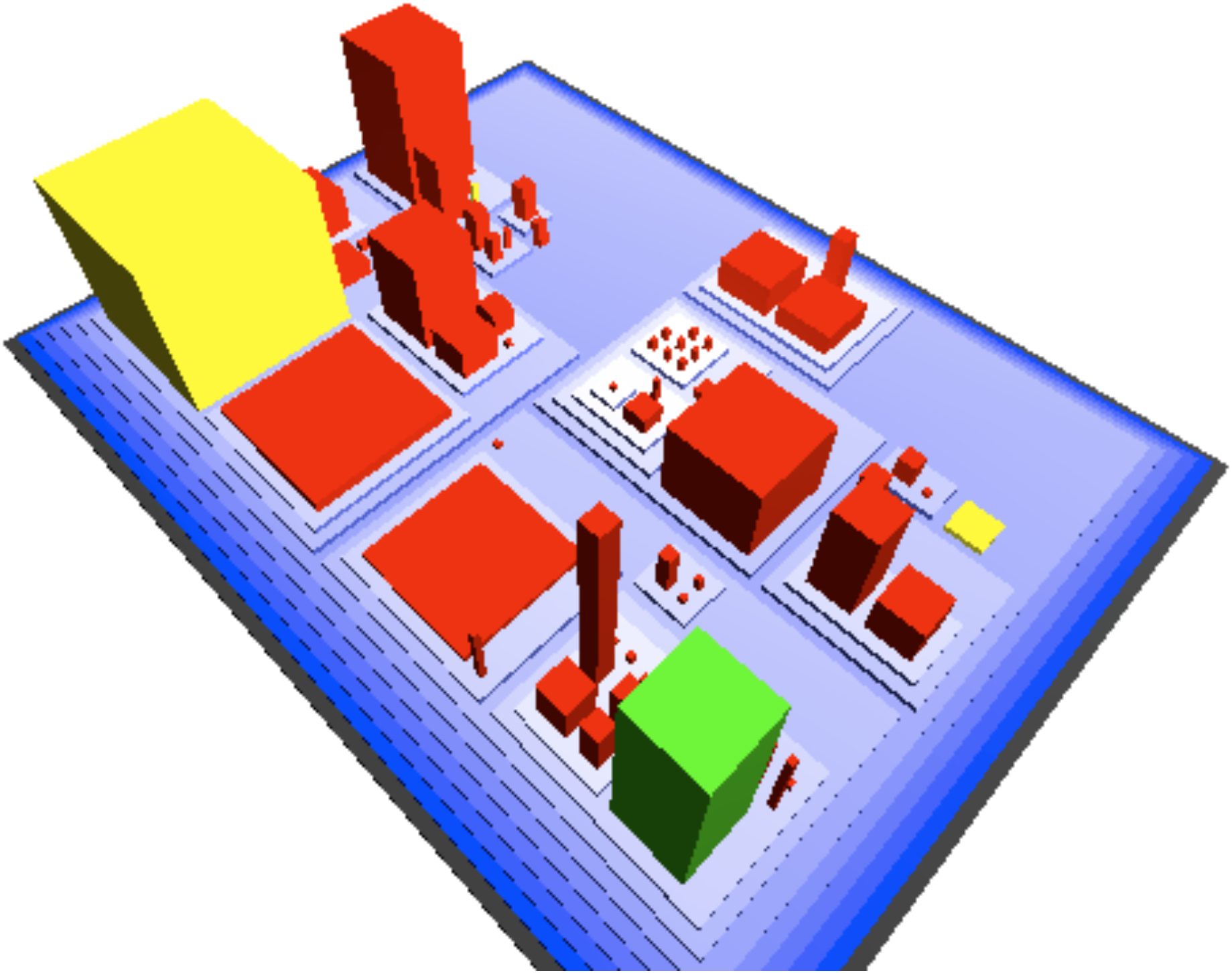
inspired by CodeCity

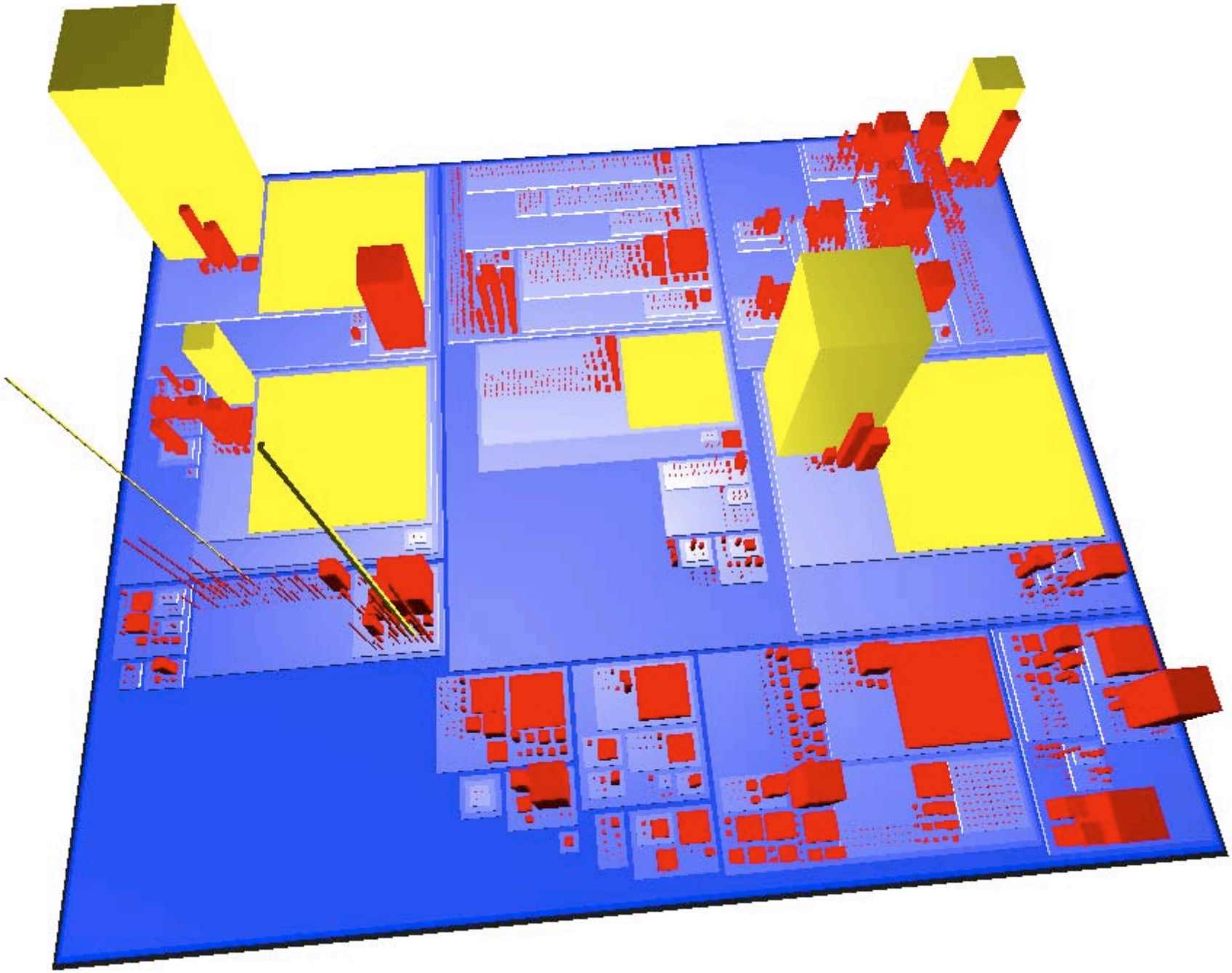
building height => number of methods

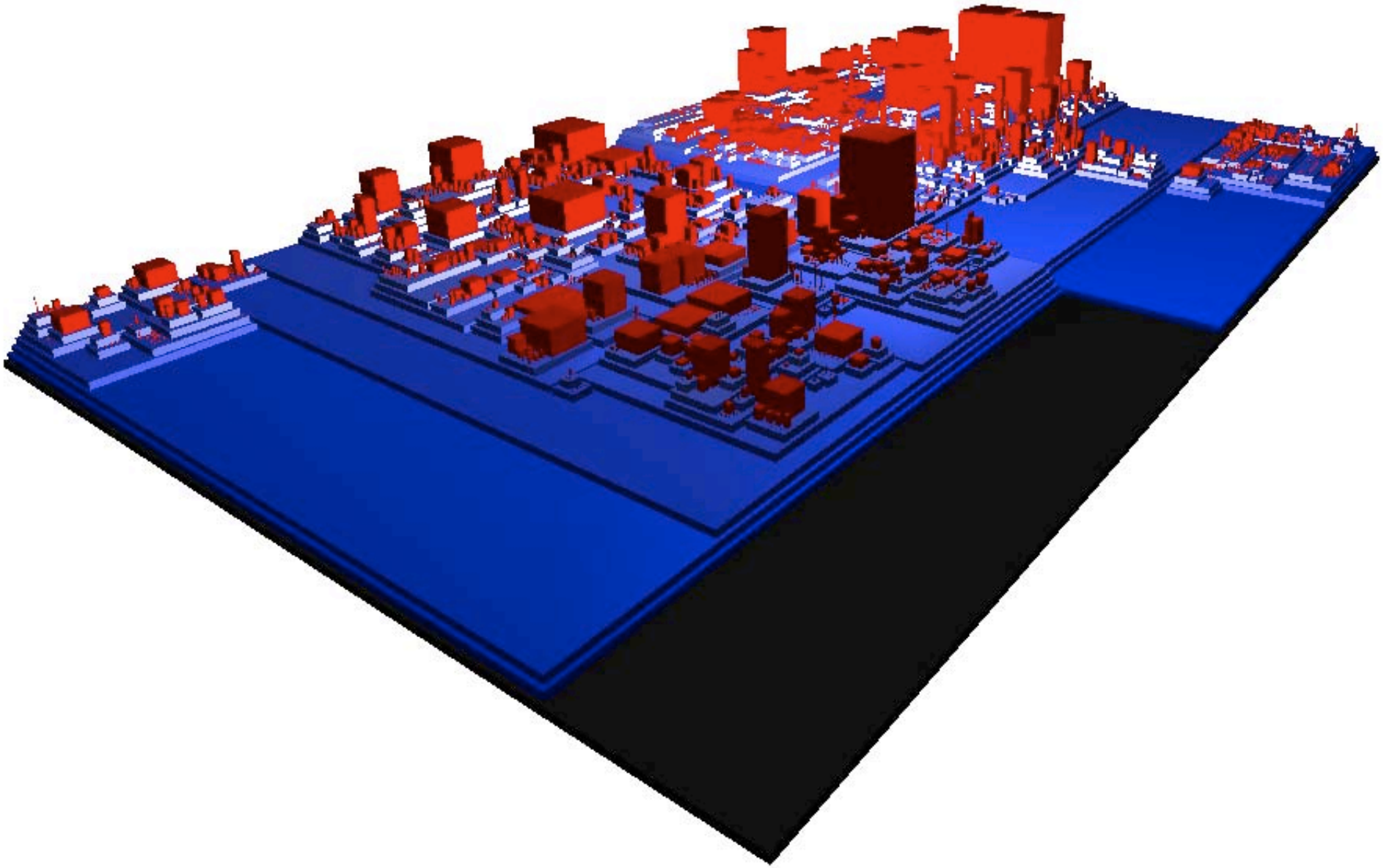
width/length => number of attributes

packages => districts


Number of **methods**
Number of **attributes**
classes in the same package
packages hierarchy
Root package







look for...

"real" cityscape

buildings that wouldn't exist in the real world

overly crowded neighborhoods

abandoned parts of town

would you live there?

summary

intermediate altitude

information radiators

single dimensions

compelling evidence

cool!

? ' s

please fill out the session evaluations
samples at `github.com/nealford`

NEAL FORD software architect / meme wrangler

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