Measure and improve code quality

Using automation

About myself

Vlad Korolev

- Been doing software development for 20+ years
- Have seen (and wrote) code of varying quality
- Personally experienced many problems discussed in this talk

What is Code Quality?

What is Quality?

David Garvin

Five Dimensions of Quality

1. Transcendental
2. Product
3. User
4. Manufacturing
5. Value

Transcendental

Plato

A characteristic of an object that could not be described. But could be learned when one is exposed to a succession of high quality objects.

Transcendental

Aristotle

Quality is not an act, but a habit.

Transcendental

Robert Pirsig

I think there is such a thing as Quality, but that as soon as you try to define it, something goes haywire. You can't do it.

Transcendental

Pirsig

No way to explain, but everybody knows it through repeated exposure to low / high quality product

Product: Precise measurement of known variable

Ice Cream

More butterfat $\rightarrow$ higher quiality

Product: Precise measurement of known variable

Persian rugs

More knots per square inch $\rightarrow$ higher quiality

User

More desirable products are of higher quality.

User

Better selling products are of higher quality.

Manufacturing

Conformance to well defined standard.

Manufacturing

Lower variance $\rightarrow$ higher quality.

Value : Monetary

More expensive products are of higher quality.

Value : Monetary

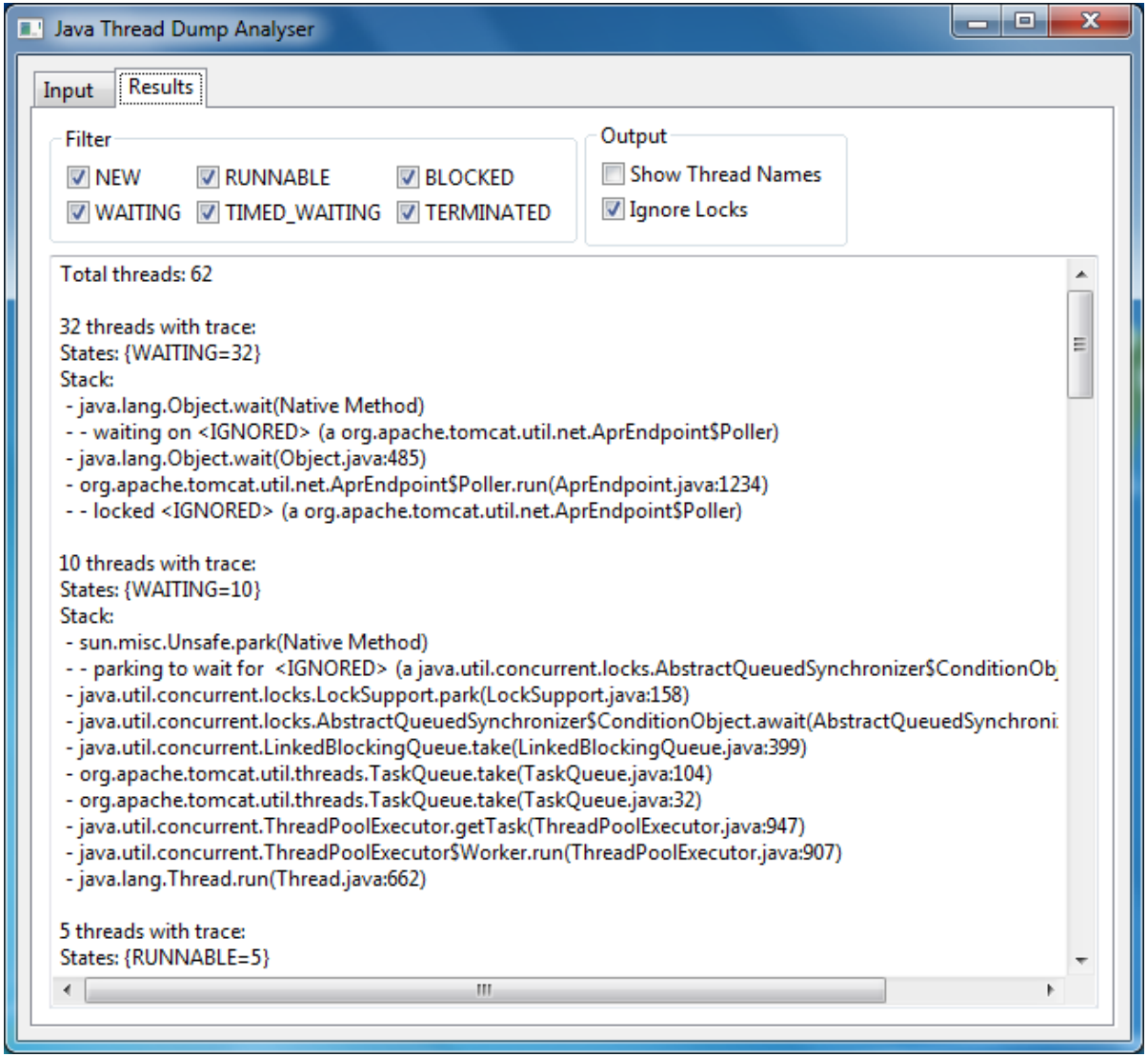
Ferrari is of higher quality than Pinto.

What is Code Quality?

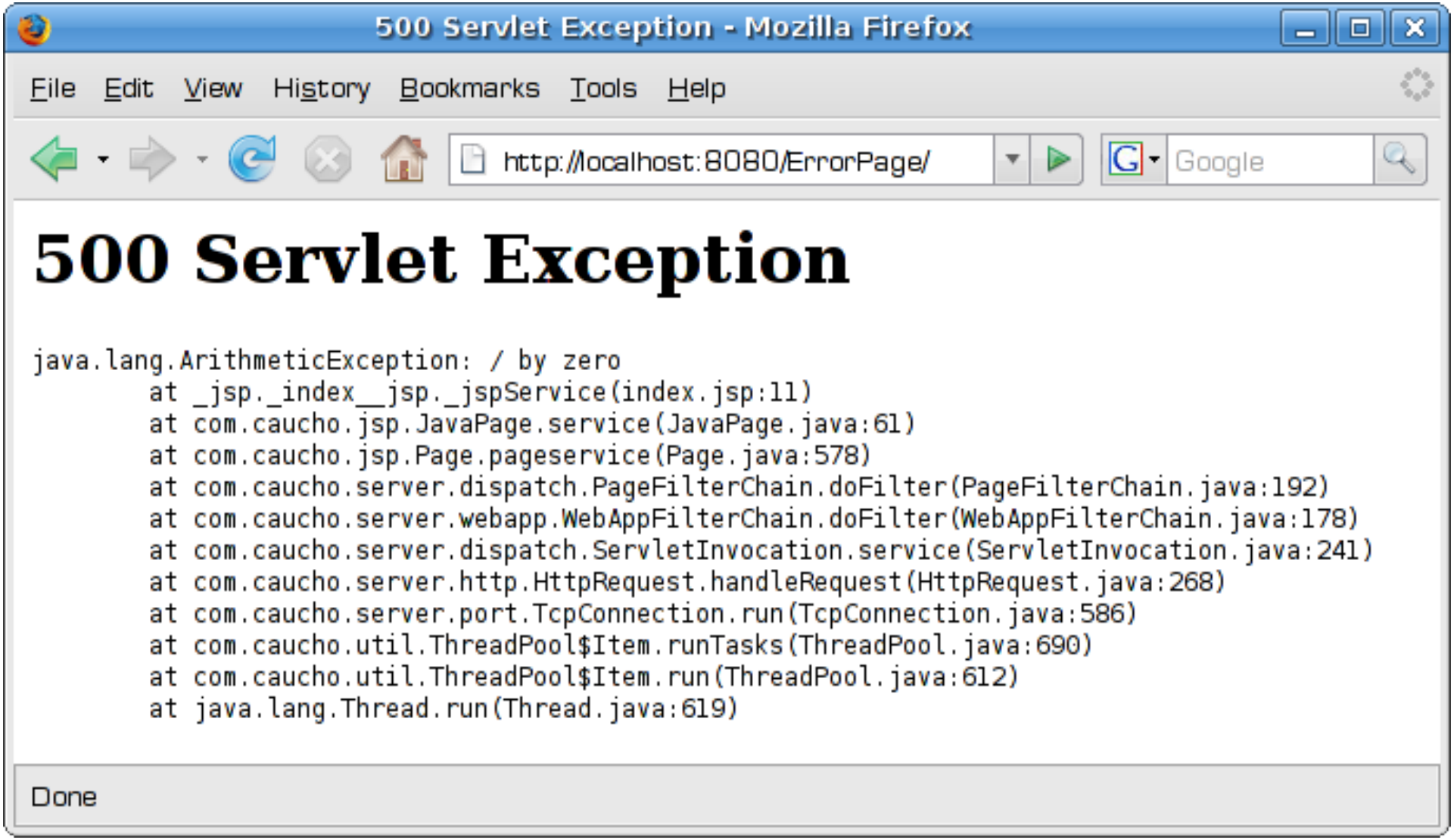
Code Quality

- External
- Internal

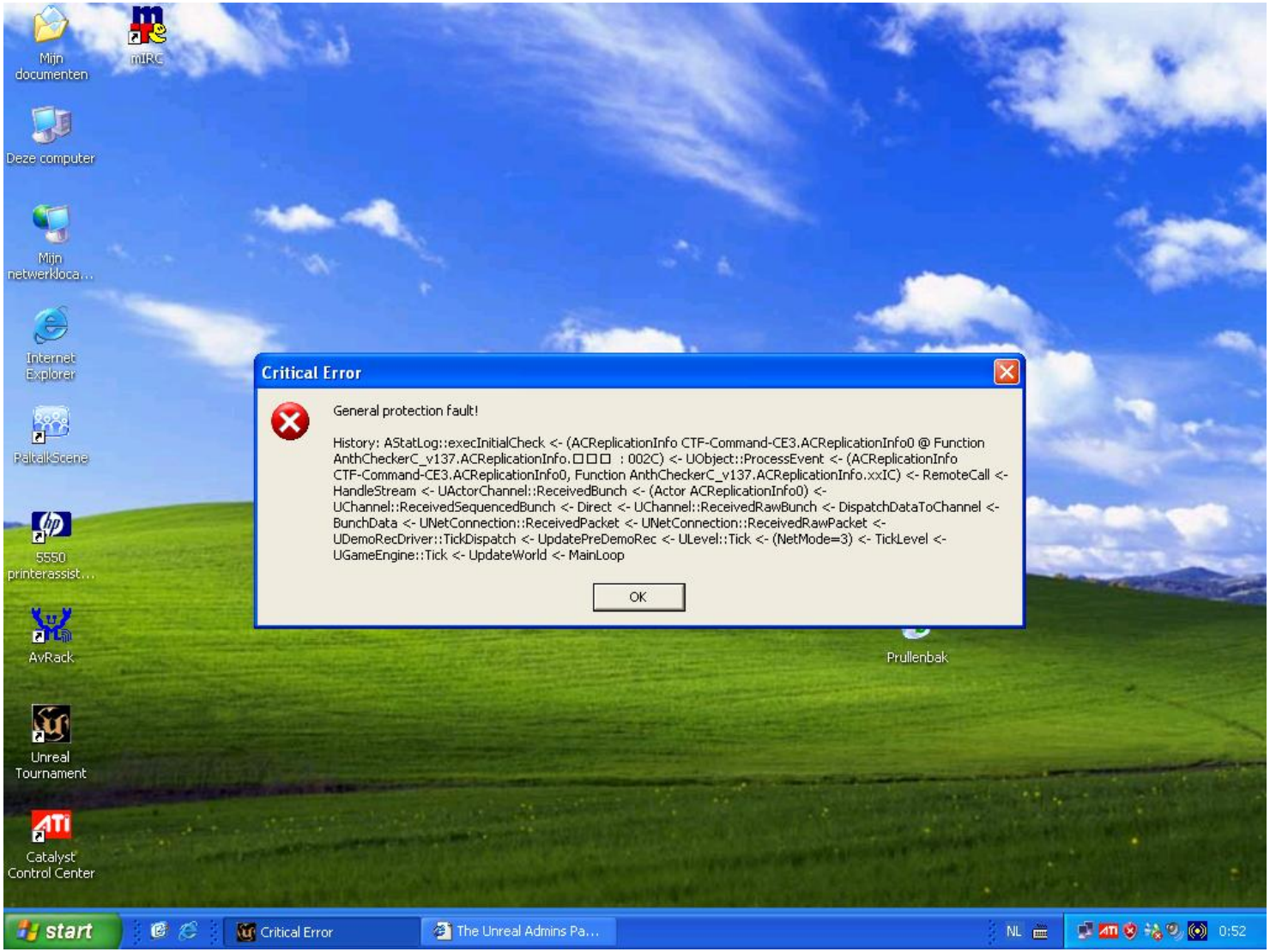
External Code Quality



External Code Quality



External Code Quality



External Code Quality

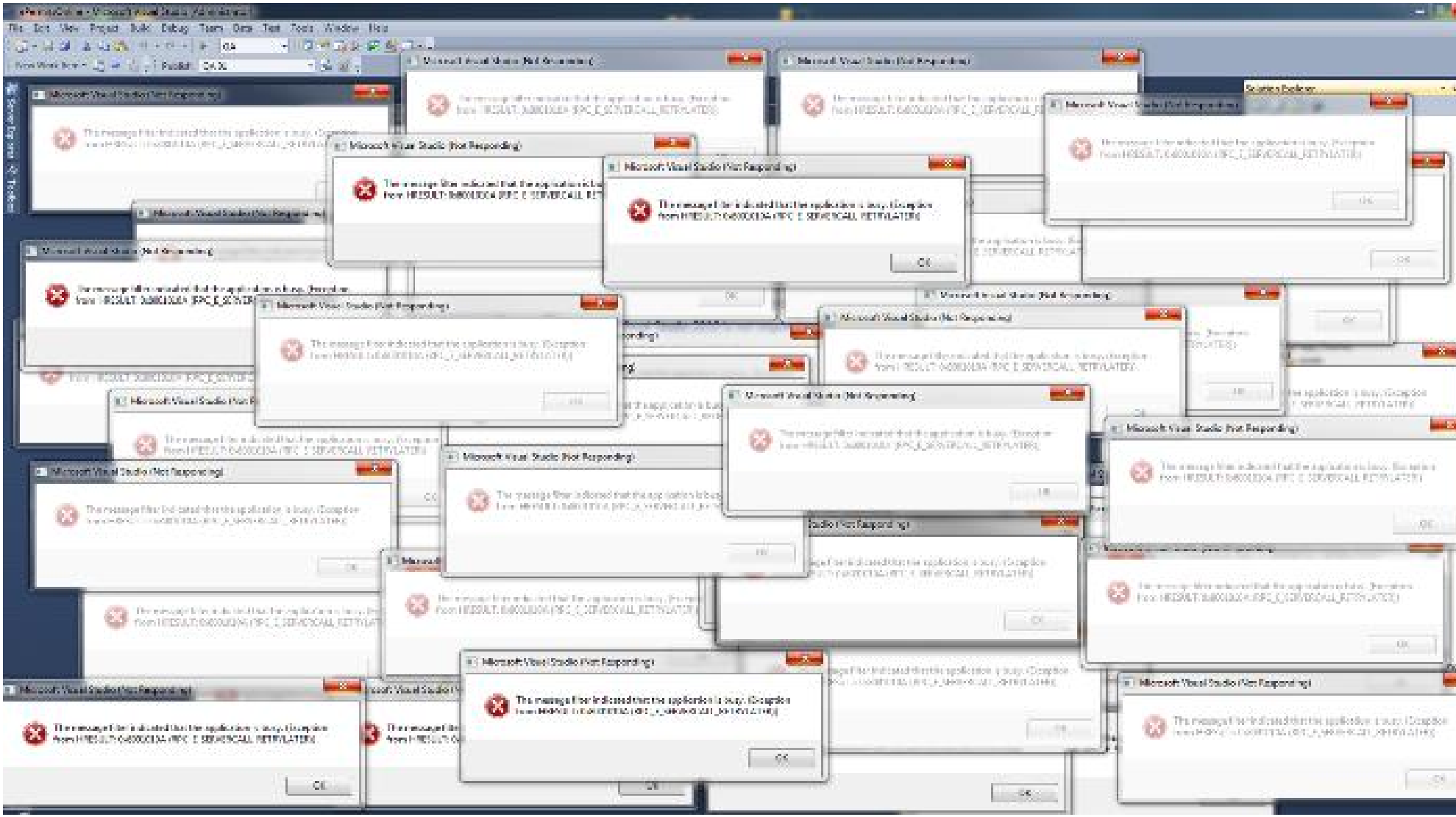
External Code Quality

```
hub.c: new USB device 00:1d.7-6.2, assigned address 5
input: USB HID v1.10 Keyboard [Weltrend Bar Code Reader] on usb1:5.0
Unable to handle kernel NULL pointer dereference at virtual address 00000048
 printing eip:
f977dee6
*pde = 00000000
Oops: 0000
CPU:    0
EIP:    0010:[<f977dee6>]    Tainted: P
EFLAGS: 00210207
eax: 00000000   ebx: f75e3400   ecx: f50ae300   edx: 00000000
esi: 00010011   edi: f47fdc50   ebp: f50ae300   esp: c0341eb0
ds: 0018   es: 0018   ss: 0018
Process swapper (pid: 0, stackpage=c0341000)
Stack: f50a1300 f75e3400 f977d281 f75e3400 f50ae300 350a1300 00088141 f50ae34
       0177f666 00000000 00000001 00000001 f50ae34c f50a1060 00000000 0000000
       f50ae300 00000437 f977f64a f75e3400 f50ae300 c0341fa0 00000008 f50a021
Call Trace:    [<f977d281>] [<f977f64a>] [<f977ff89>] [<f977733a>] [<c01087f5
  [<c01089f9>] [<c01052c0>] [<c010aea8>] [<c01052c0>] [<c01052e3>] [<c0105372
  [<c0105000>]

Code: 8b 42 48 39 c8 75 f7 8b 01 89 02 8b 41 48 89 42 48 8b 83 00
 <0>Kernel panic: Aiee, killing interrupt handler!
In interrupt handler - not syncing
 <0>Rebooting in 30 seconds..
```

External Code Quality

External Code Quality



External Code Quality

- Ad hoc tests

External Code Quality

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- QA Tests

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- Regression tests

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External Code Quality

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- QA Tests
- Regression tests
- User reports
- Your boss comes up to you saying :
  1. All systems are down
  2. The system is crediting wrong accounts
  3. The system is delivering messages to the wrong users

Internal Code Quality

When you're a carpenter making a beautiful chest of drawers, you're not going to use a piece of plywood on the back, even though it faces the wall and nobody will ever see it. Youll know its there, so youre going to use a beautiful piece of wood on the back. For you to sleep well at night, the aesthetic, the quality, has to be carried all the way through.

Steve Jobs

Internal Code Quality

- How do we measure it?

Internal Code Quality

- How do we measure it?
- What's our equivalent of plywood?

7 Axes of Code Quality

- Bad Patterns [Bugs]

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- Bad Style [Coding Rules]
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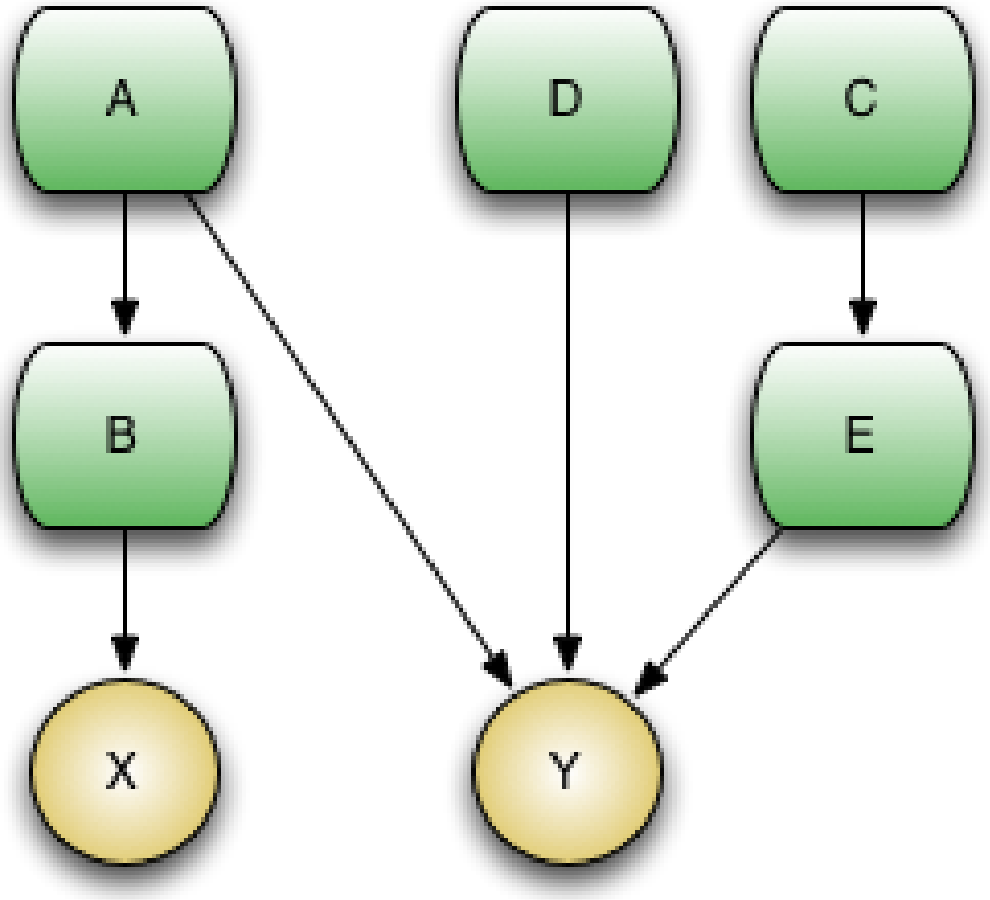
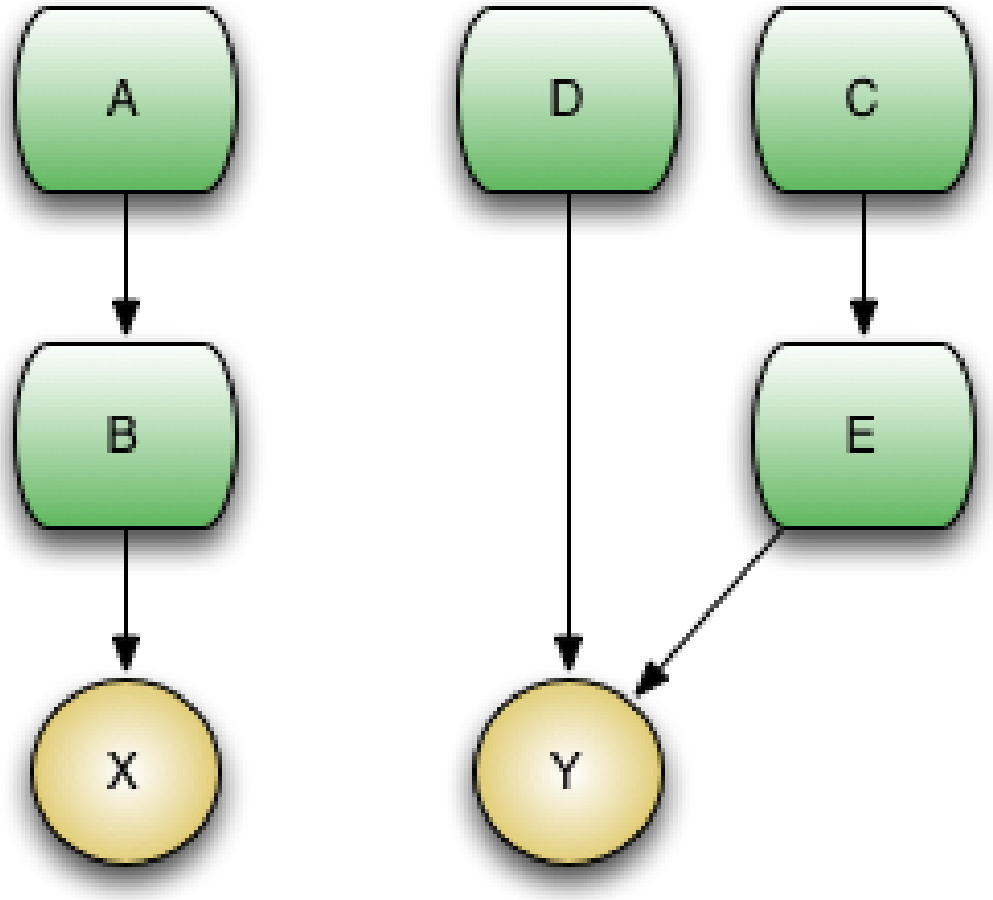
- Comments
- Architecture
  - Lack of Cohesion of Methods
  - Cicular dependencies
- Complexity
  - God classes
  - God methods

Lack of Cohesion of Methods [LCOM4]



Lack of Cohesion of Methods [LCOM4]



Code Complexity

Response for Class

What is RFC?

RFC stands for Response For Class. RFC measures the complexity of the class in terms of method calls.

For each class, it counts:

- +1 for each method
- +1 for each call of a distinct method (note that getters and setters are not considered as methods)

Example:

```
1   public class ClassA
2   {
3     private ClassB classB = new ClassB();         // call (constructor of class B) => +1
4     public void doSomething(){                    // method declaration => +1
5       System.out.println ( "doSomething");        // call (System.out.println) => +1
6     }
7     public void doSomethingBasedOnClassB(){       // method declaration => +1
8       System.out.println (classB.toString());     // call (System.out.println) => 0 because already counted on line 5 + cal
9     }
10  }
11
12  // default constructor of ClassA => +1
13  // RFC = 6
```

Cyclomatic Complexity

- Keywords that increment complexity:

`if, for, while, case, catch, throw, return (that is not the last statement of a method), conditionals, else`

- Keywords that don't increment complexity:

`default, finally`

```
public void process(Car myCar){           // +1
    if(myCar.isNotMine()){                // +1
        return;                           // +1
    }
    car.paint("red");
    car.changeWheel();
    while(car.hasGazol() && car.getDriver().isNotStressed()){   // +2
        car.drive();
    }
    return;
}
```

Sonar

What is Sonar?

- Web based tool.

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What is Sonar?

- Web based tool.
- Collects collects metrics from multiple projects
- Repository of rules
- Ticketing system for quality improvement
- Dashboards / Reports

Why should I use sonar ?

Tester: Pinpoint the weak spots

- Overly complex code
- No coverage

Why should I use sonar ?

Developer: Education

- Thread Safety
- Resource management
- Language subtleties

Why should I use sonar ?

Developer: Maintainability

- Readability
- Complexity
- Missing or incorrect documentation

Why should I use sonar ?

Developer: Adherence to standards

- Naming convention
- Formatting
- Use of bad methods *System.out.println*
- Coding rule compliance
- Boilerplate code

Why should I use sonar ?

Architect: Is design being degraded?

- Circular dependencies
- Lack of cohesion
- Over complex classes and methods

Why should I use sonar ?

Big Boss

Why should I use sonar ?

Big Boss : Metrics

Platforms

- Java

Platforms

- Java
- .NET

Platforms

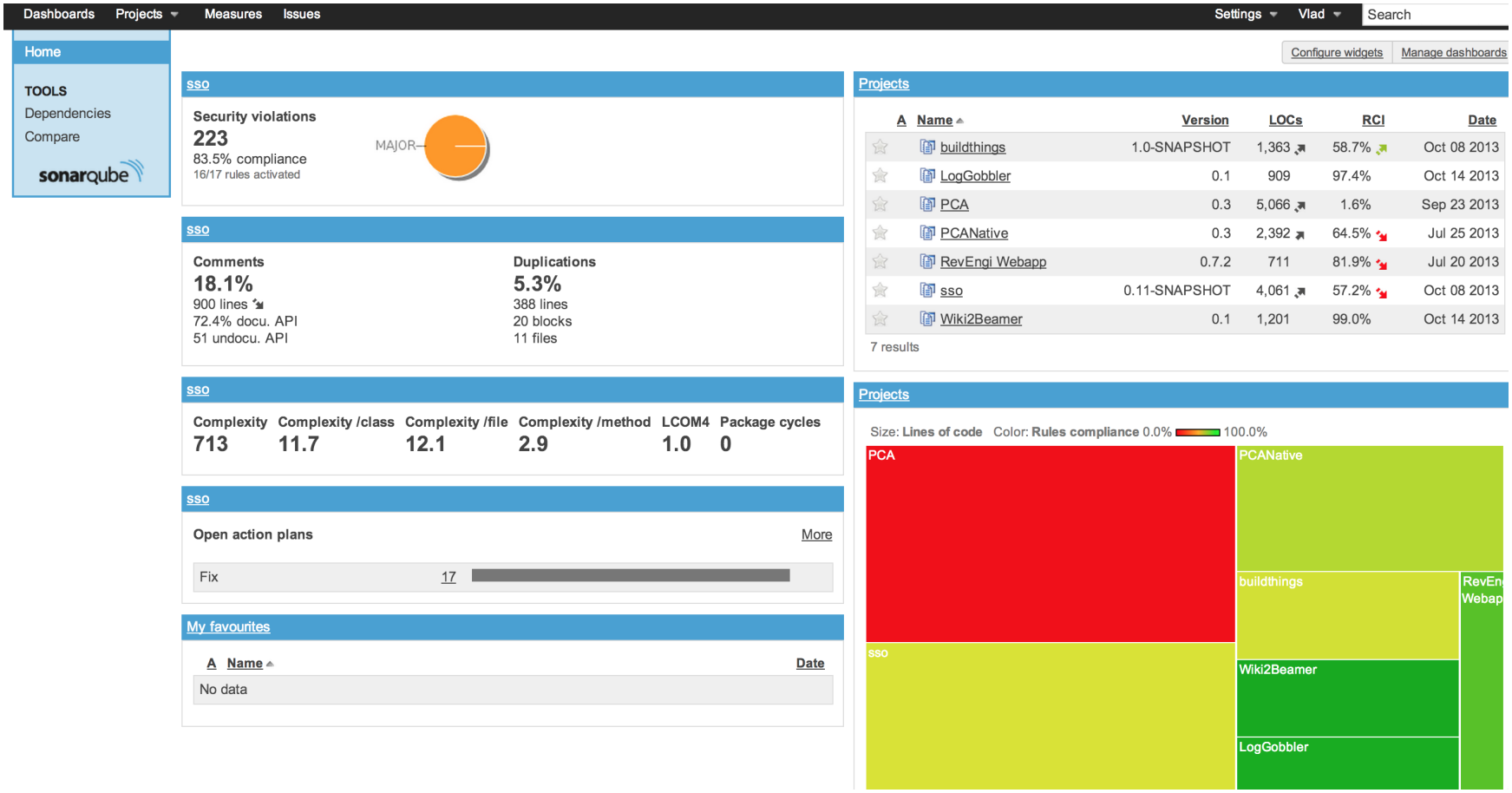
- Java
- .NET
- C++

Platforms

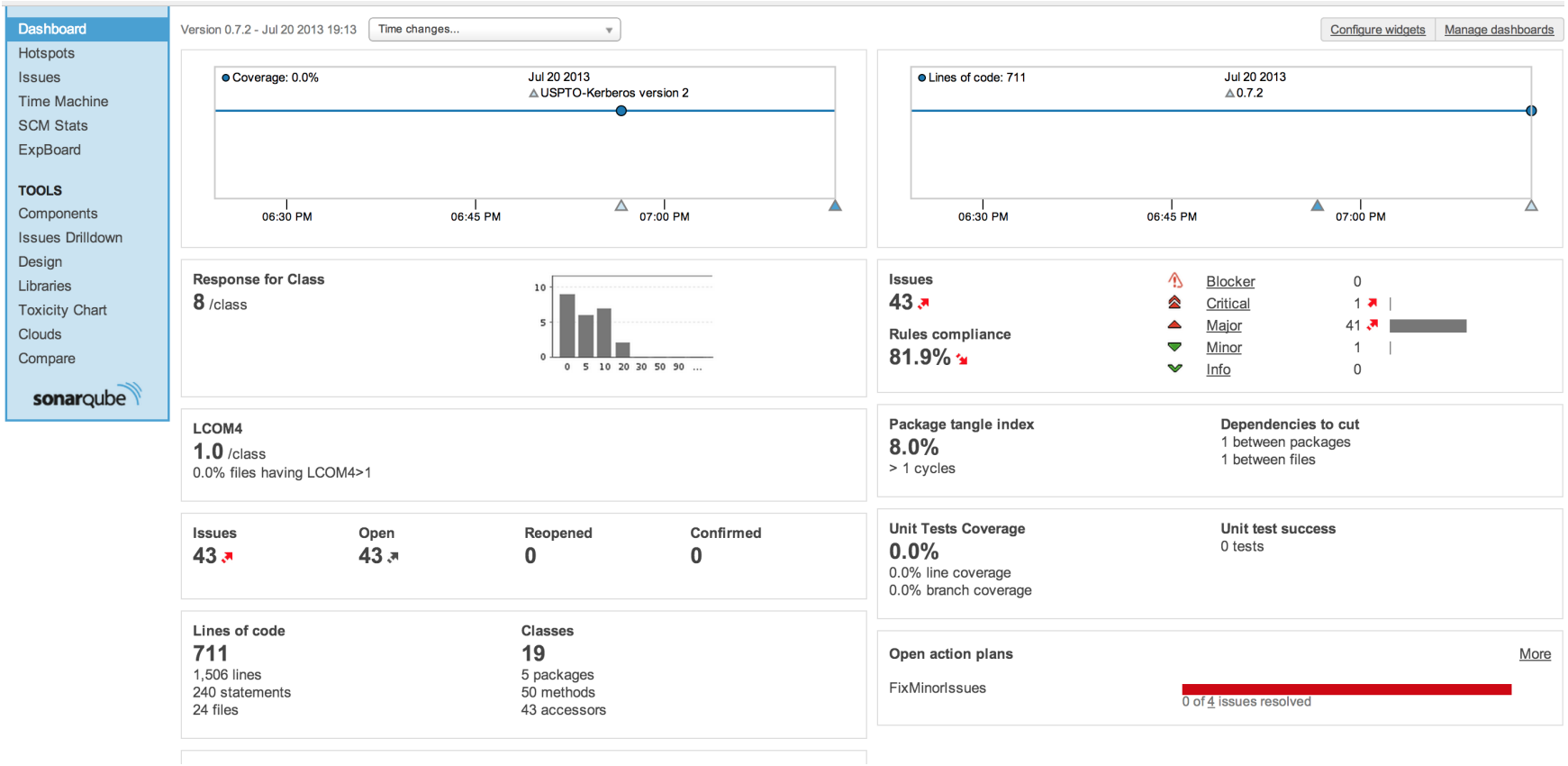
- Java
- .NET
- C++
- Python

Demo

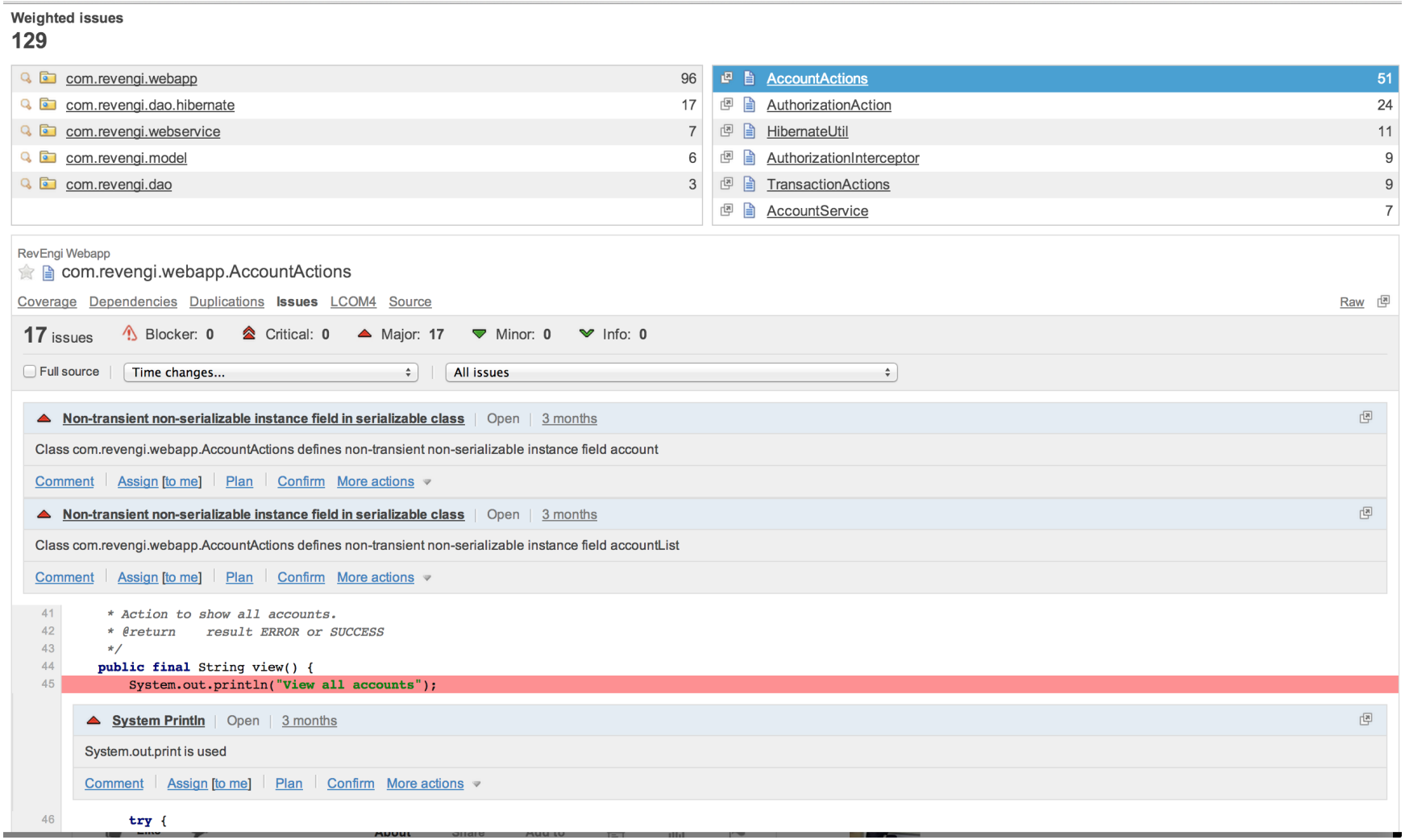
Main Dashboard



Project Drill-Down



Project Issues Drill-Down



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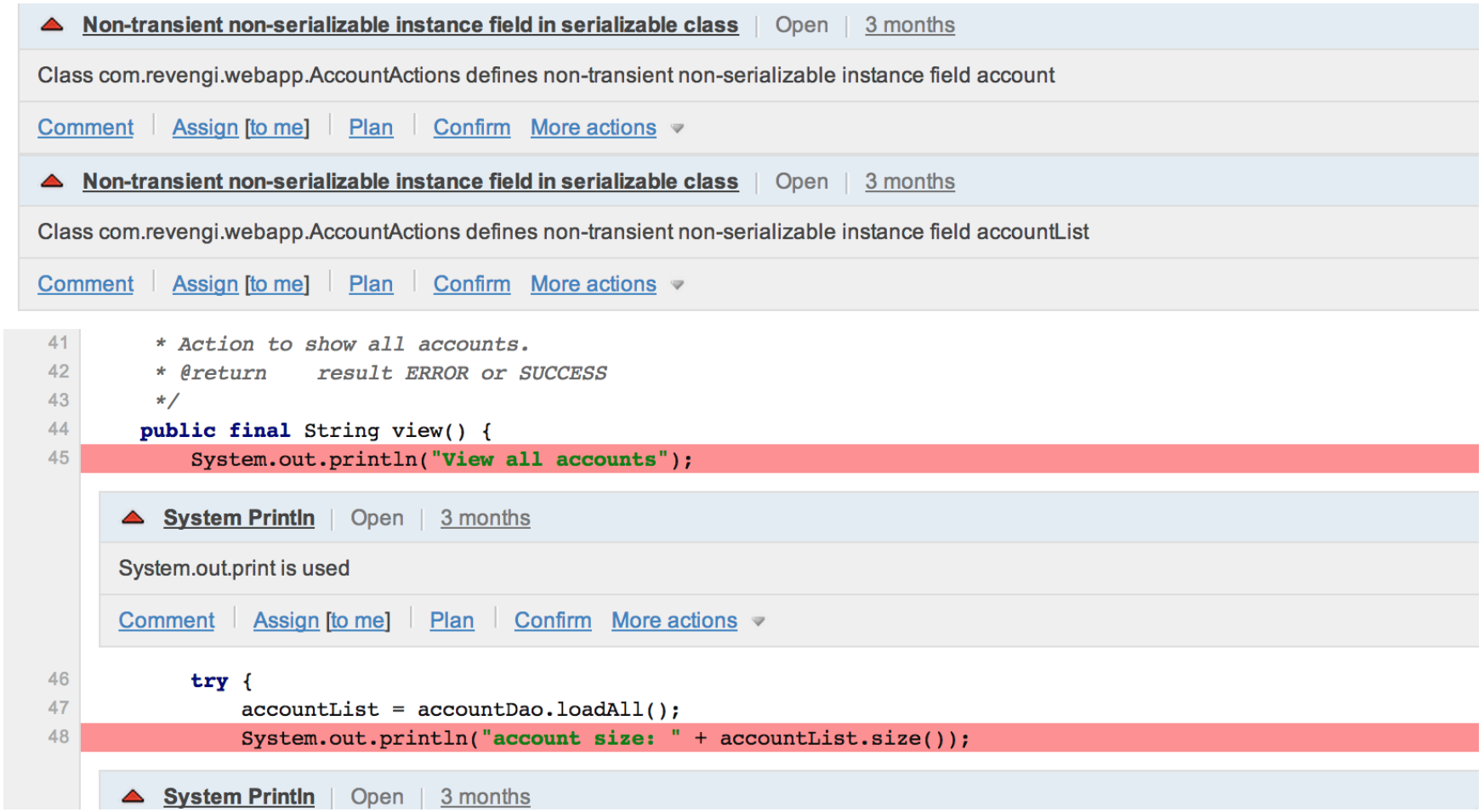
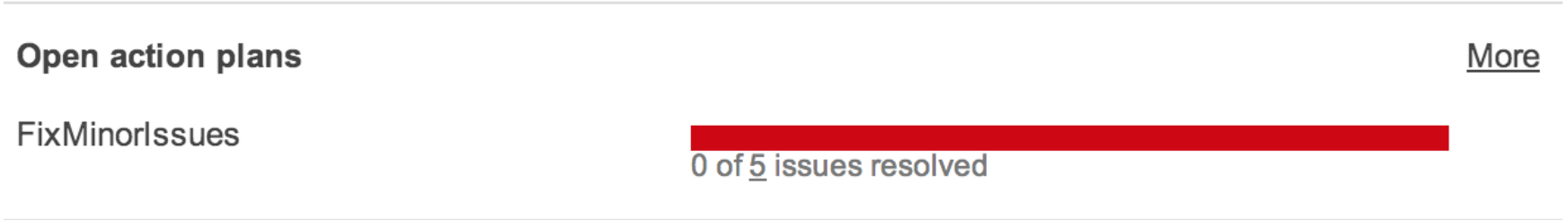


Issue Tracking



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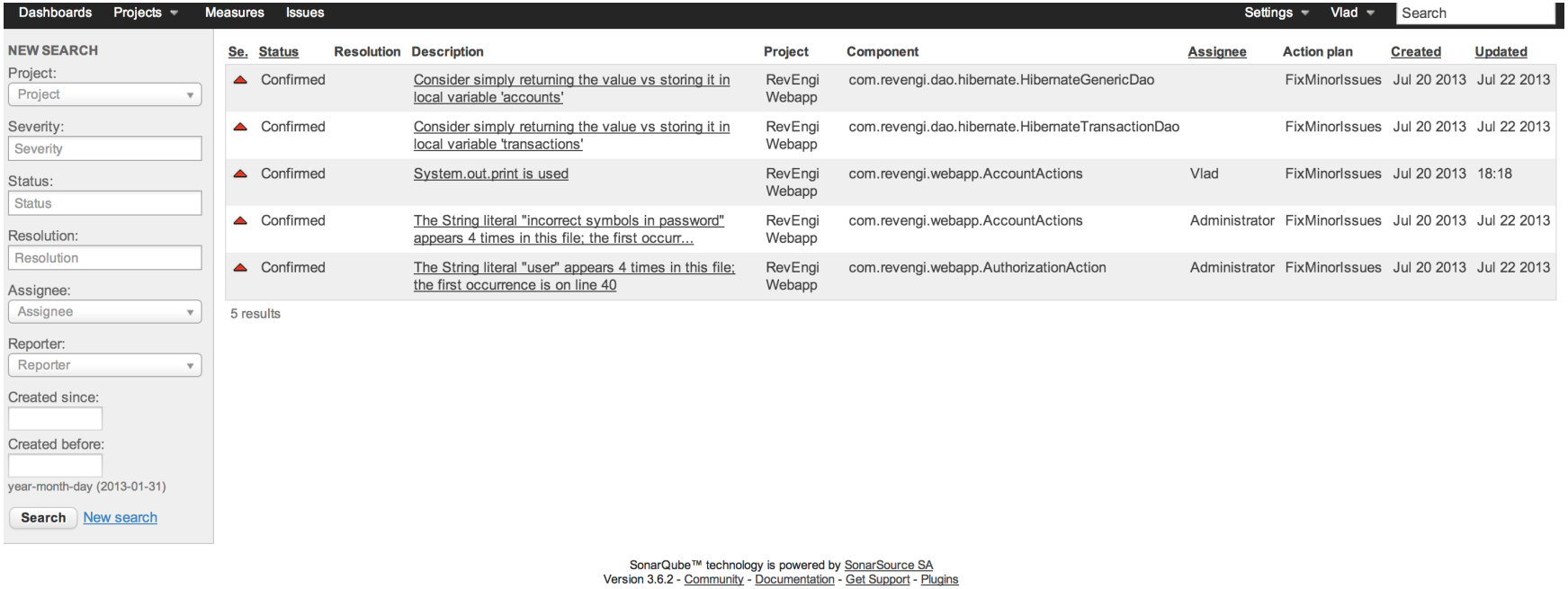

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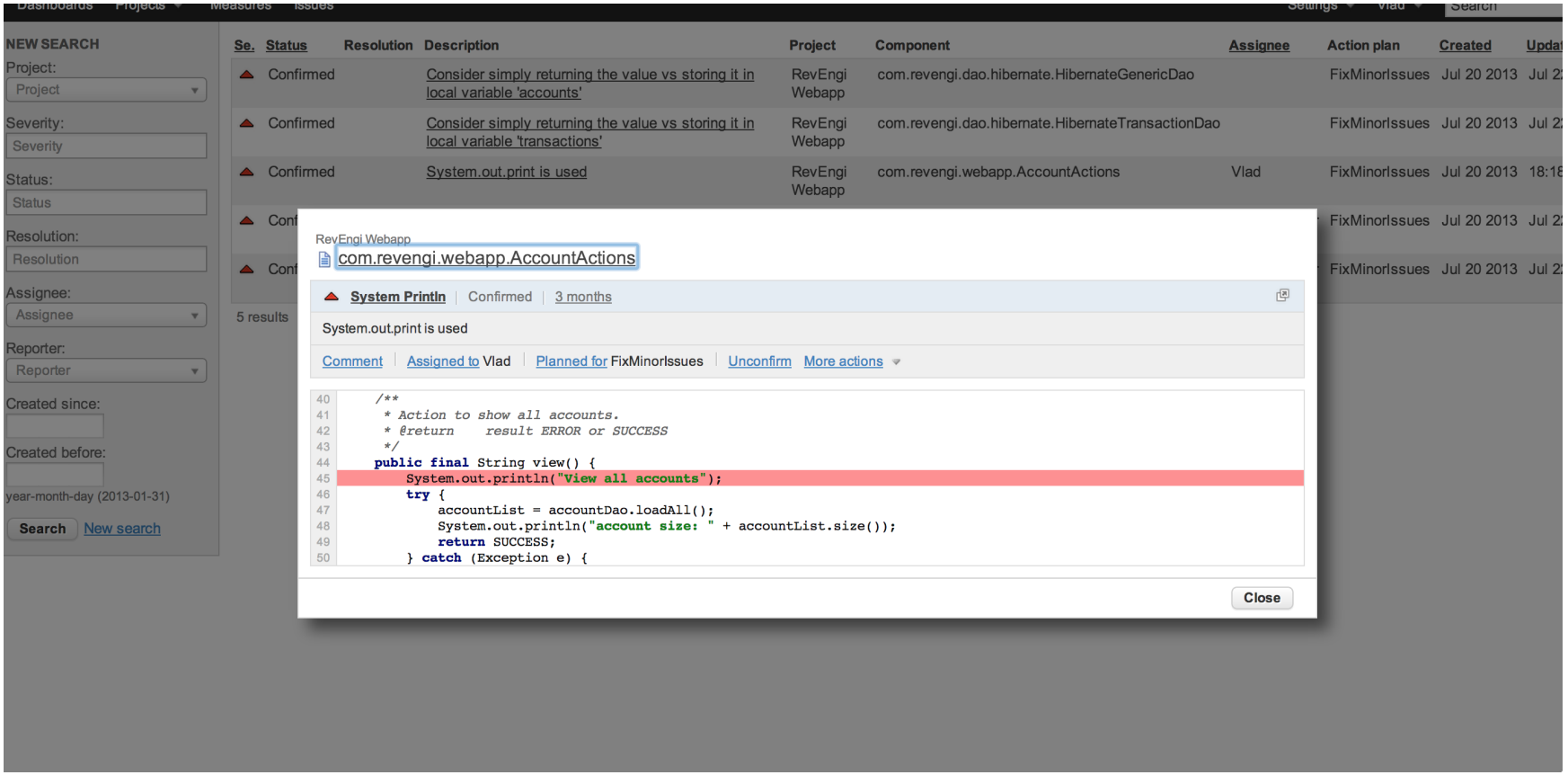


Cut and Paste

PCANative

CMSInterface.cpp

Duplications Issues Source

22.8% Lines: **1,745** Duplicated lines: **398** Duplicated blocks: **16**

Blocks	Nb Lines	From line	File	Details
2	30	213	CMSInterface.cpp	CMSInterface.cpp
	26	637	CMSInterface.cpp	

```
637     (*NOTIFIER)("Connecting to CMS");
638
639     (*NOTIFIER)("In the connection method");
640
641     LogFile << "Opening service connections to " << host << _T(" port ") << adminPort.c_str();
642     if(adminPort.compareIgnoreCase(myidPort)!=0)
```

Expand

Blocks	Nb Lines	From line	File	Details
2	41	260	CMSInterface.cpp	CMSInterface.cpp
	41	667	CMSInterface.cpp	

```
260     try
261     {
262         (*NOTIFIER)("Beginning the SyncMGR call");
263         if(syncMgr==NULL || !syncMgr->isSessionOpen())
264         {
265             (*NOTIFIER)("Made it in to  SyncMGR call");
```

Expand

Blocks	Nb Lines	From line	File	Details
2	29	502	CMSInterface.cpp	CMSInterface.cpp
	31	720	CMSInterface.cpp	

```
502     if(syncMgr!=NULL)
503     {
504         try
505         {
506             if(syncMgr->isSessionOpen())
507             {
```

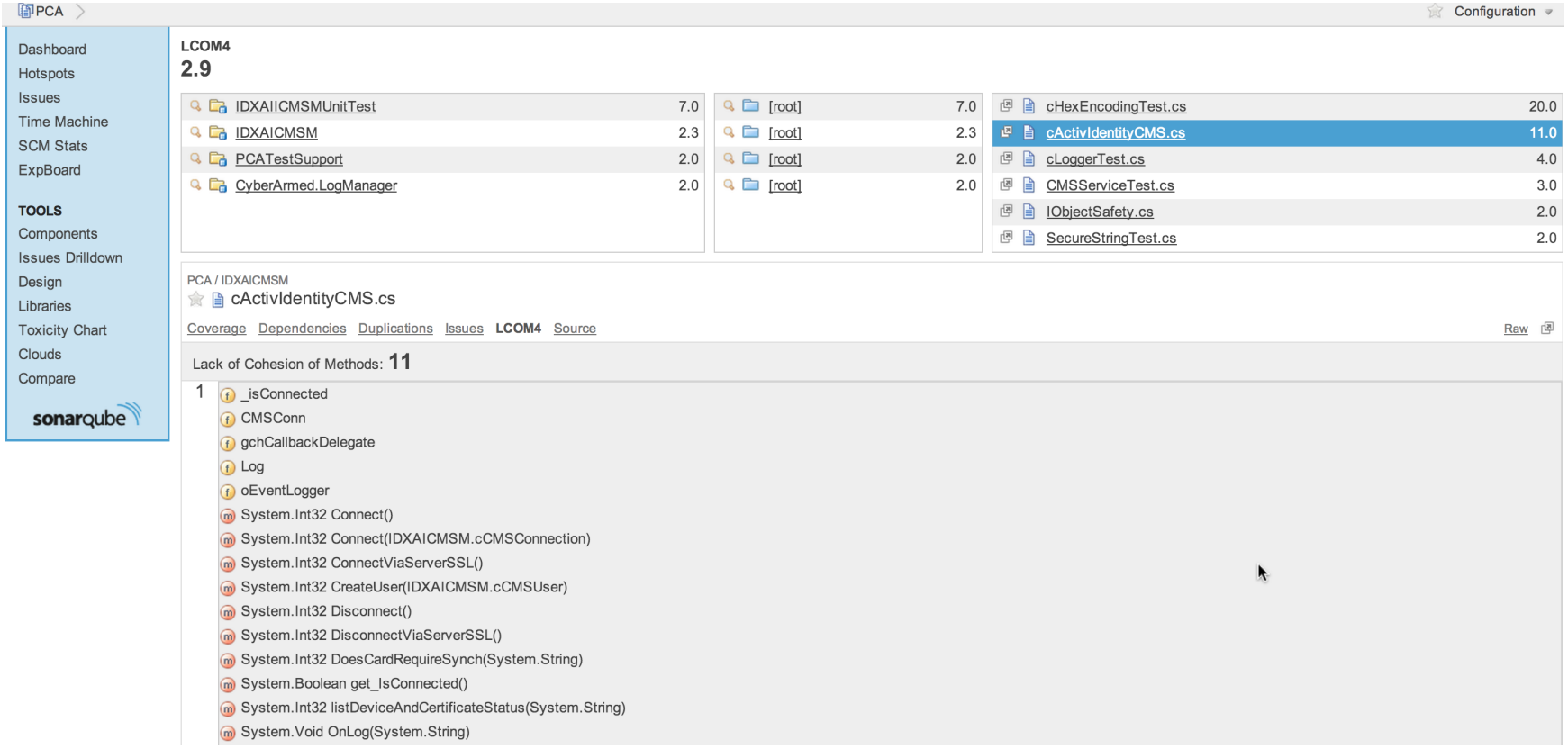
Expand

Blocks	Nb Lines	From line	File	Details
2	32	1009	CMSInterface.cpp	CMSInterface.cpp
	32	16	attic.cpp	

```
1009     CriteriaVector criterias;
1010     criterias.push_back(Criteria(CRITERIA_ID_USERID, CRITERIA_COMPARISON_EQUAL, user));
1011     (*NOTIFIER)("Search for user.");
1012     UserIdVector* userIds = userMgr->findUserIds(&criterias, 1);
1013
1014
```

Expand

Lack of Cohesion



Lack of Cohesion

System.Int32 DisconnectViaServerSSL()
System.Int32 DoesCardRequireSynch(System.String)
System.Boolean get_IsConnected()
System.Int32 listDeviceAndCertificateStatus(System.String)
System.Void OnLog(System.String)
System.String RetreiveFingerprintDataFromCms(System.String)
System.String RetrieveEmailAddressFromCms(System.String)
System.String RetrieveFullNameFromCms(System.String)
System.String RetrievePhotoFromCms(System.String)
System.String ReturnCardIdentificationNumber(System.String)
System.Void set_IsConnected(System.Boolean)

2 System.String ReturnVersionNumber()

3 System.Int32 SychronizeCard(IDXAICMSM.cCMSUser, System.Boolean)

4 System.Int32 UpdateCard(IDXAICMSM.cCMSUser)

5 System.Int32 ActivateCard(IDXAICMSM.cCMSUser)

6 System.String CheckCardStatus(System.String)

7 IDXAICMSM.cActivIdentityCMS/ReturnManagedStruct ReturnDetailedDeviceInformation(System.String)

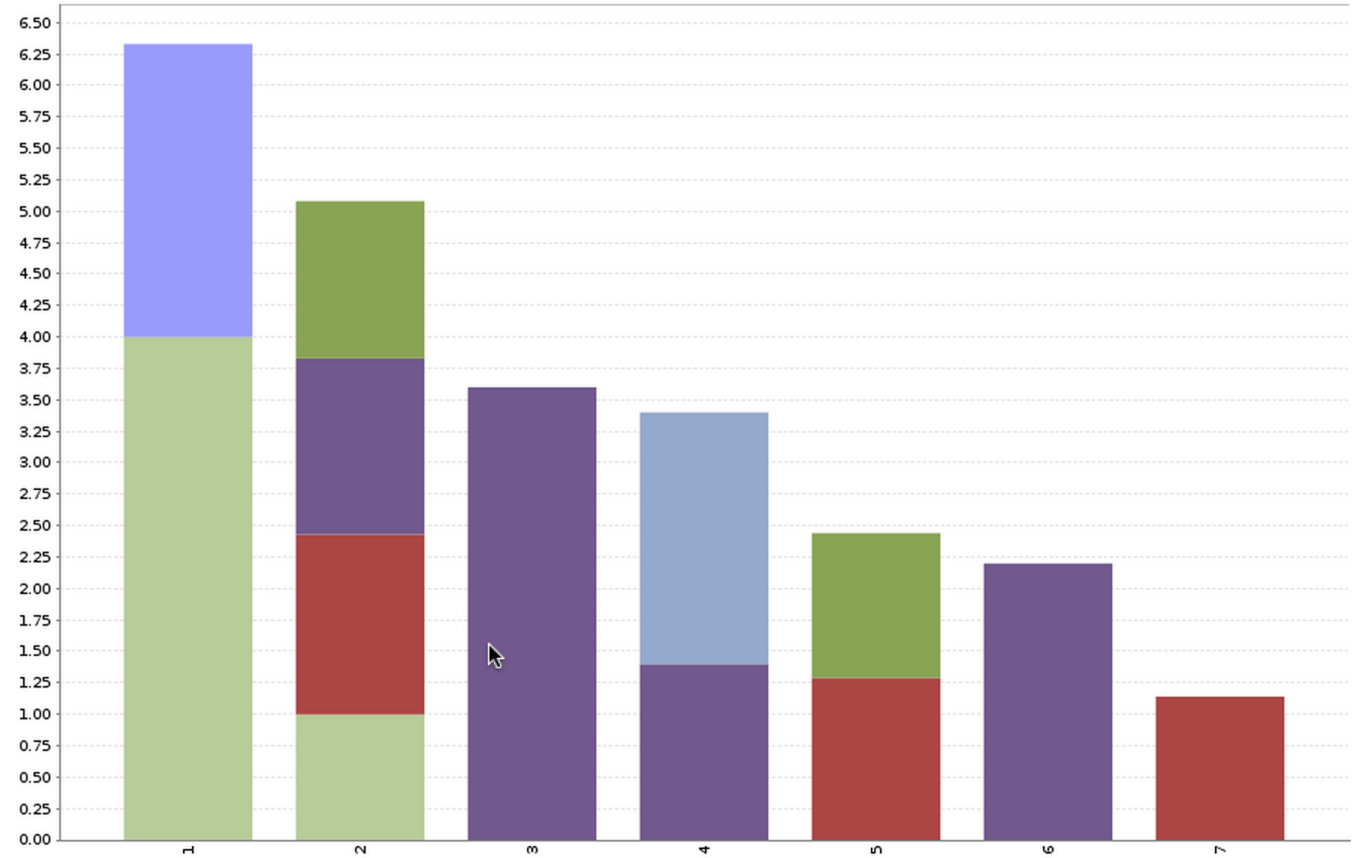
8 System.Void listCertStatus(System.String)

9 System.Void ResetUser(System.String, System.String, System.String)

10 System.Void BindCard(System.String, System.String, System.String)

11 System.Void RequestReplacementReqeust(System.String, System.String, System.String)

Project Health



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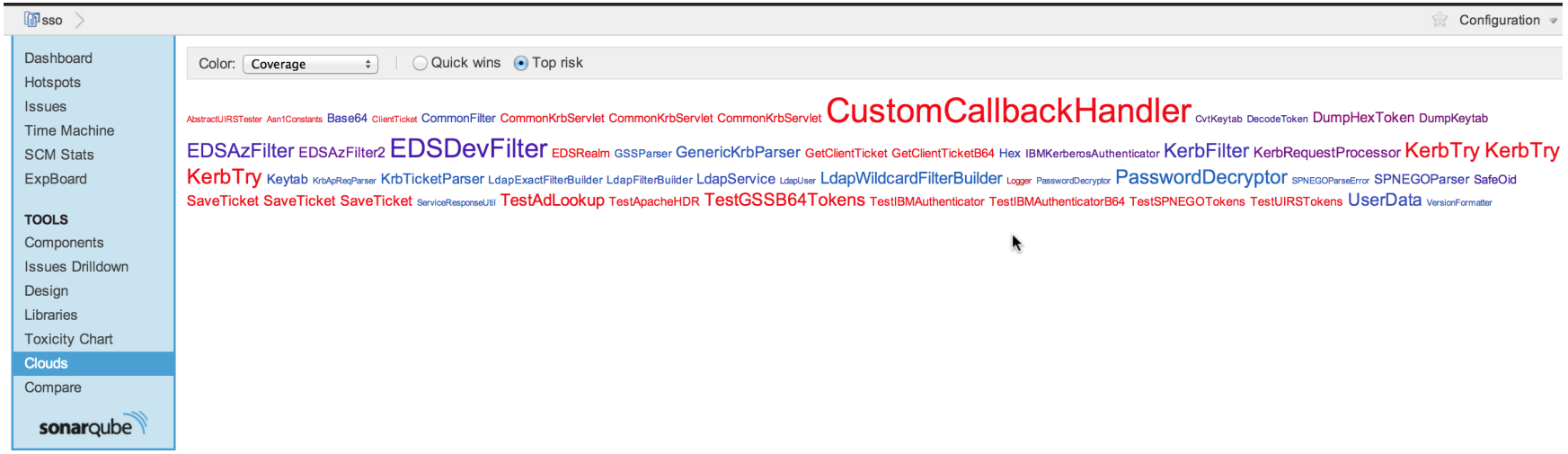

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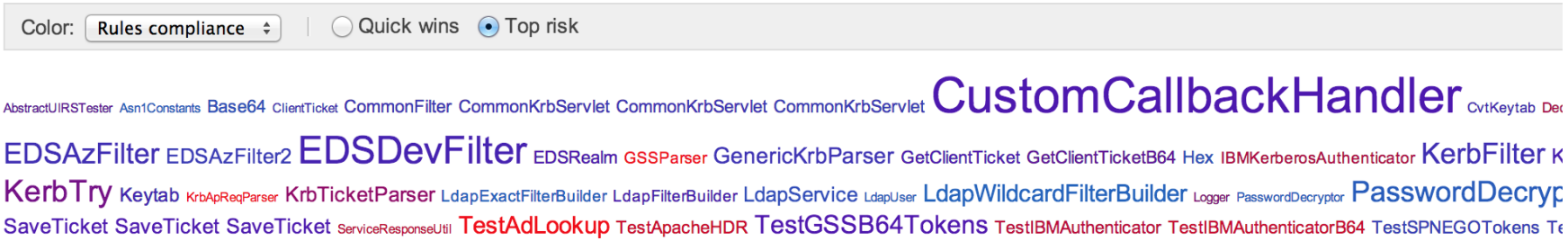

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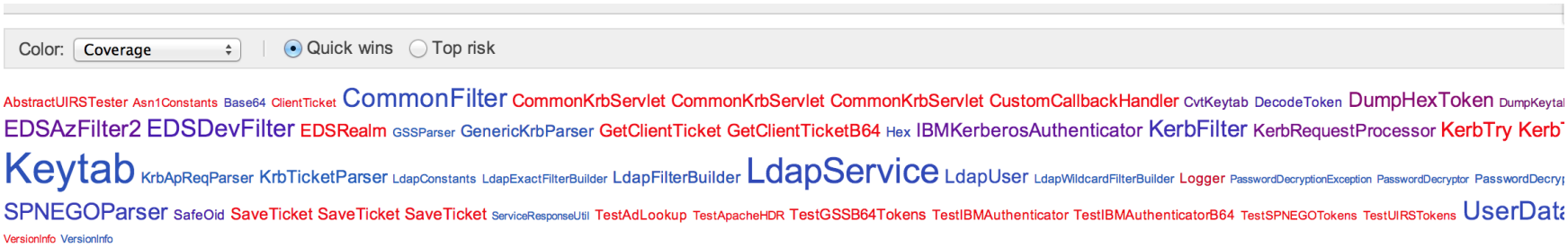
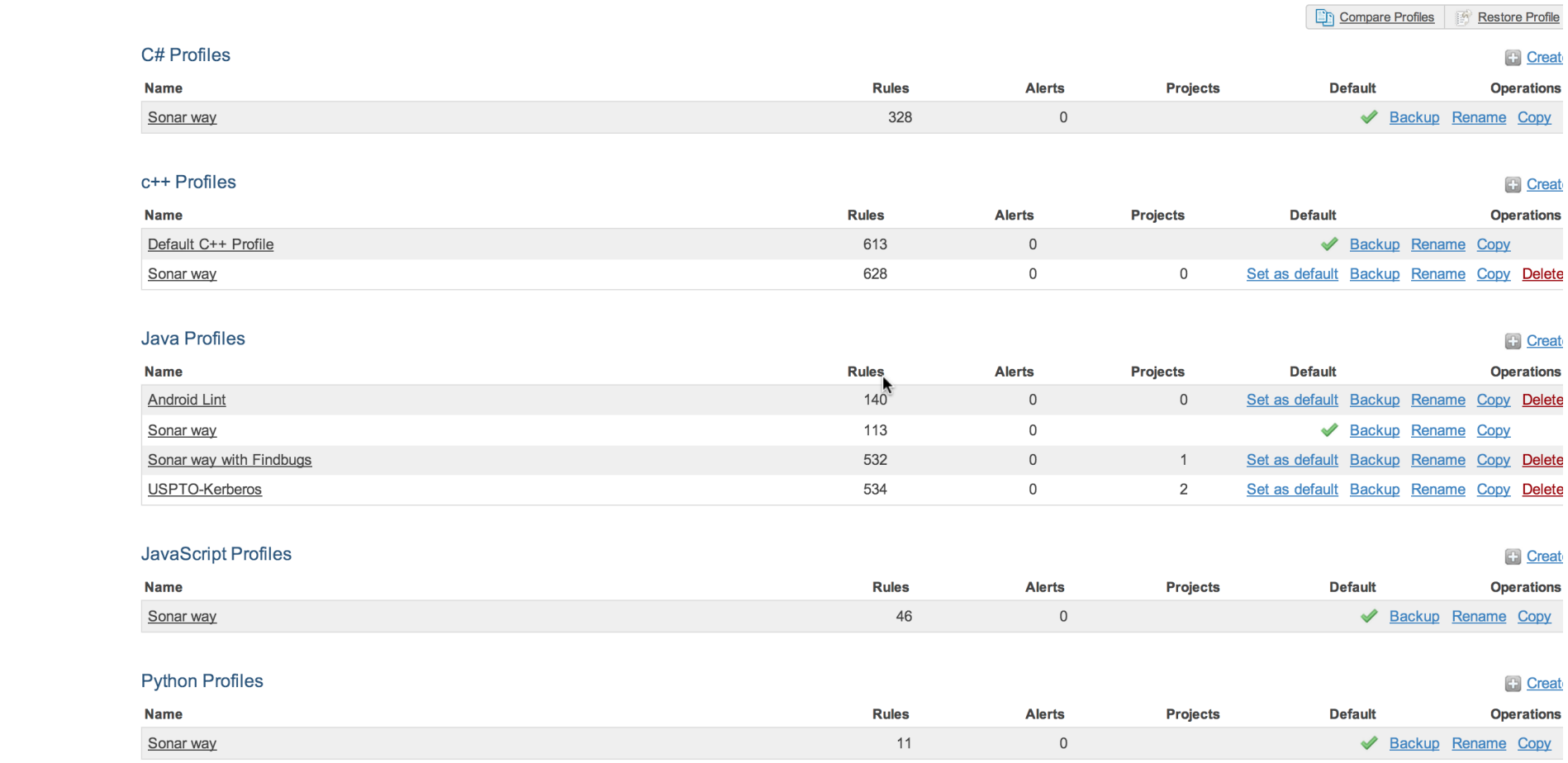


Quality Profiles



Quality Profiles

☑	Critical	Security - Array is stored directly
☑	Major	Signature Declare Throws Exception
☑	Major	Simplify Boolean Expression
☑	Major	Simplify Boolean Return
☑	Major	Simplify Conditional
☑	Minor	Singular Field
☑	Major	Statements should be on separate lines
☑	Major	Static Variable Name
☑	Major	String Buffer Instantiation With Char
☑	Major	String Instantiation
☑	Major	String Literal Equality
☑	Major	String To String
☑	Major	System Println

Questions ???

End