Turning Eclipse Against Itself:

Finding Errors in Eclipse Sources

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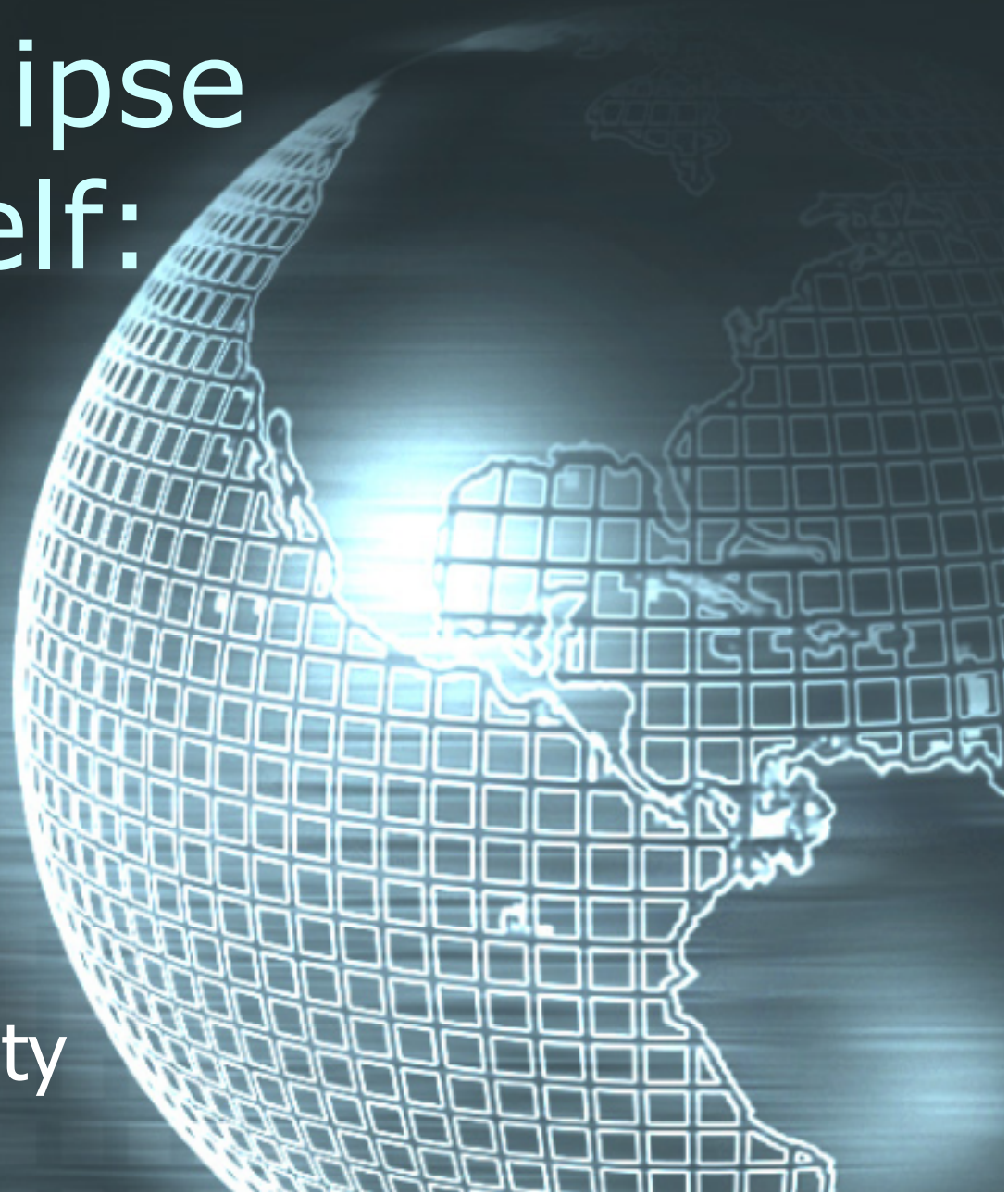
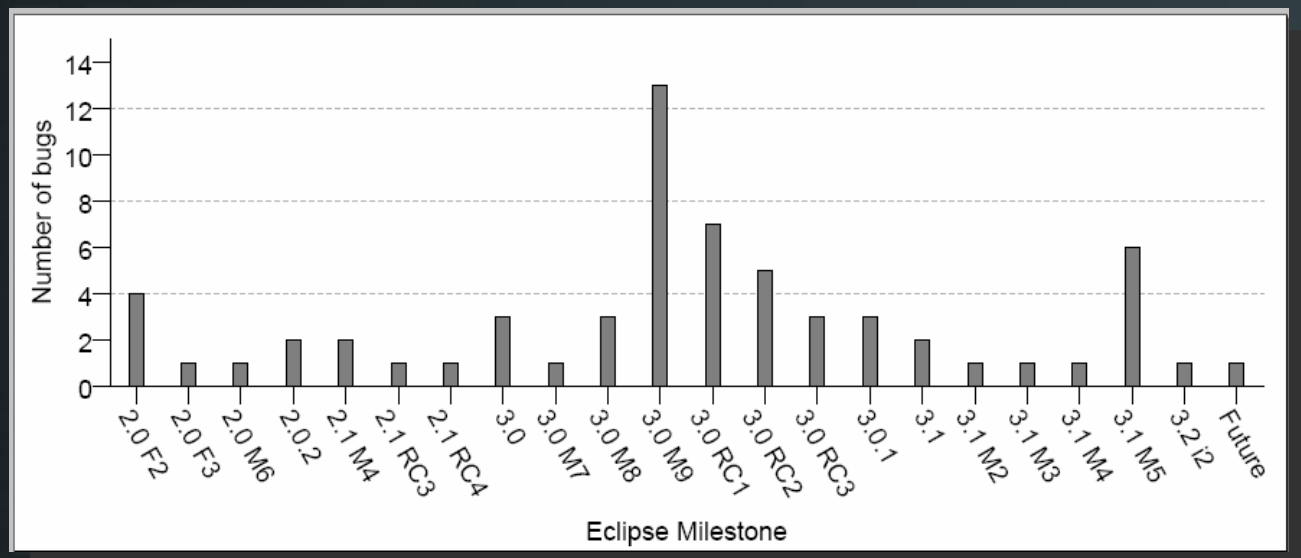


Summary

- We want to **find errors** in **Eclipse**
  - Implemented a tool called **Checklipse** (plugin)
  - Uses **lightweight static analysis**
- Looks for violations of **3 design rules**
  - One **API usage** rule
  - Two **resource management** rules
- Preliminary results are **encouraging**
  - Ran Checklipse on Eclipse sources
  - Found a total of **68** likely errors
  - Checklipse checks multiple plugins in **minutes**

Eclipse Code Base…

- Eclipse:
  - One of the biggest Java projects ever written
  - Very robust
- Still, a multitude of bugs exist
  - bugs.eclipse.org – hundreds of known errors
  - Think about *unknown* ones!
  - Certain types of errors are repeatedly introduced over and over
    - "Lapsed listener" errors discovered for different Eclipse releases



Error Patterns to the Rescue

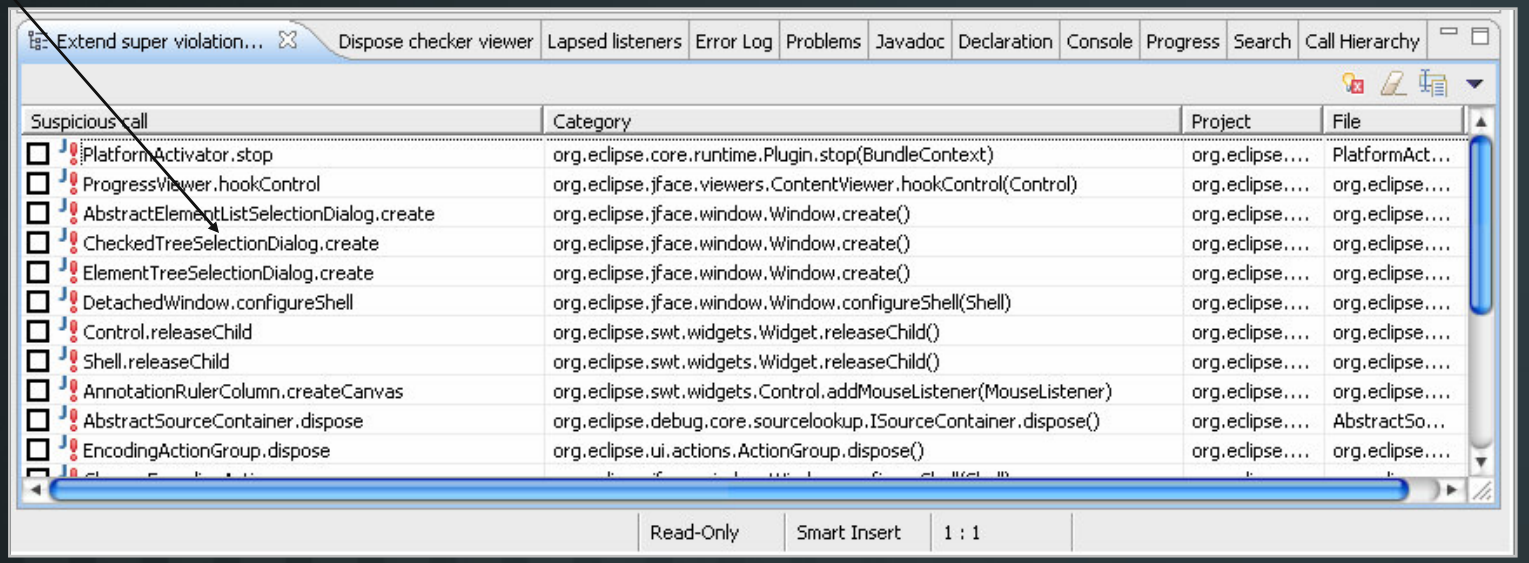
- Lots of API-specific coding patterns
  - Patterns are "specified"
    - using comments
    - not at all
  - Misuse of these patterns leads to errors
- This is great news for us!
  - Discover what the error patterns are
  - Find and report *pattern violations*
    - Can do so using *dynamic* or *static* analysis
- On to the error patterns…
  - 3 patterns evaluated
  - Many more remain – looking to expand the scope of Checklipse

Error pattern #1: Call super

- A common rule of thumb in Eclipse code
  - For many methods *m*
  - A subclass implementing method *m* must call *super.m(…)* inside method *m*

Must call `super`, but don't

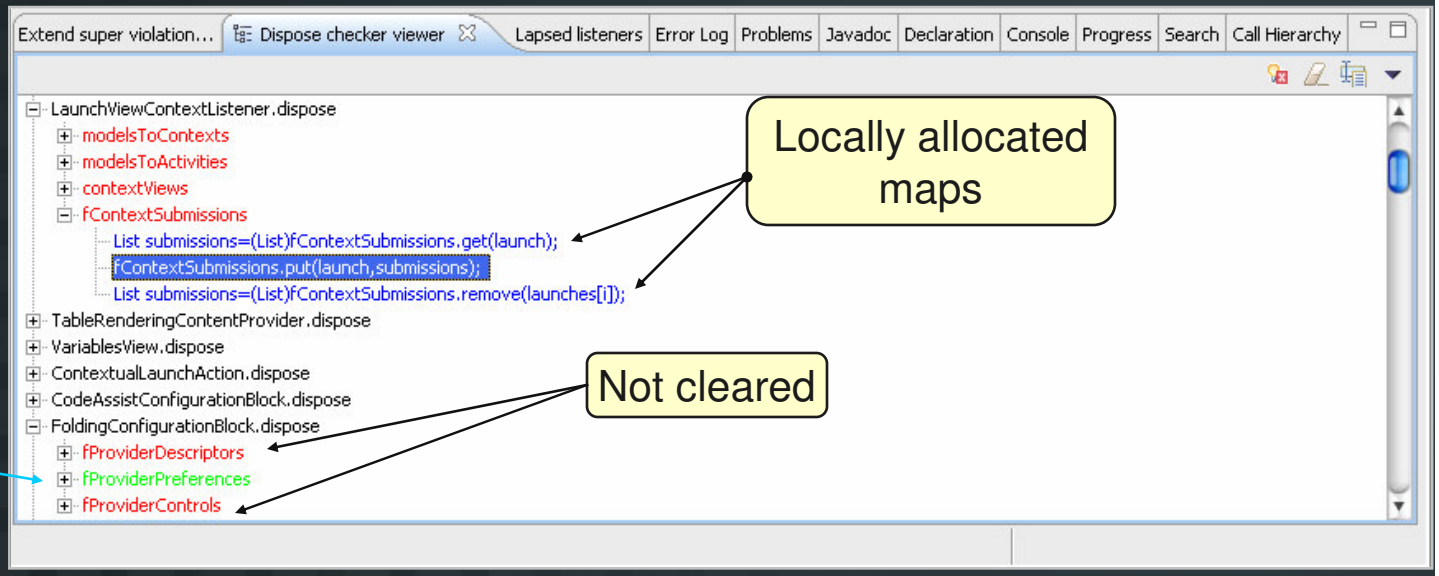
Checklipse super checker



Error pattern #2: Failing to Dispose

- OS resource leaks are common:
  - Many classes define method *dispose()*
  - SWT design rule: dispose what you create
    - Interesting special case: maps
    - Need to clear most class-allocated maps in *dispose()*
    - Failing to clear the maps, causes OS resource leaks

Checklipse dispose checker

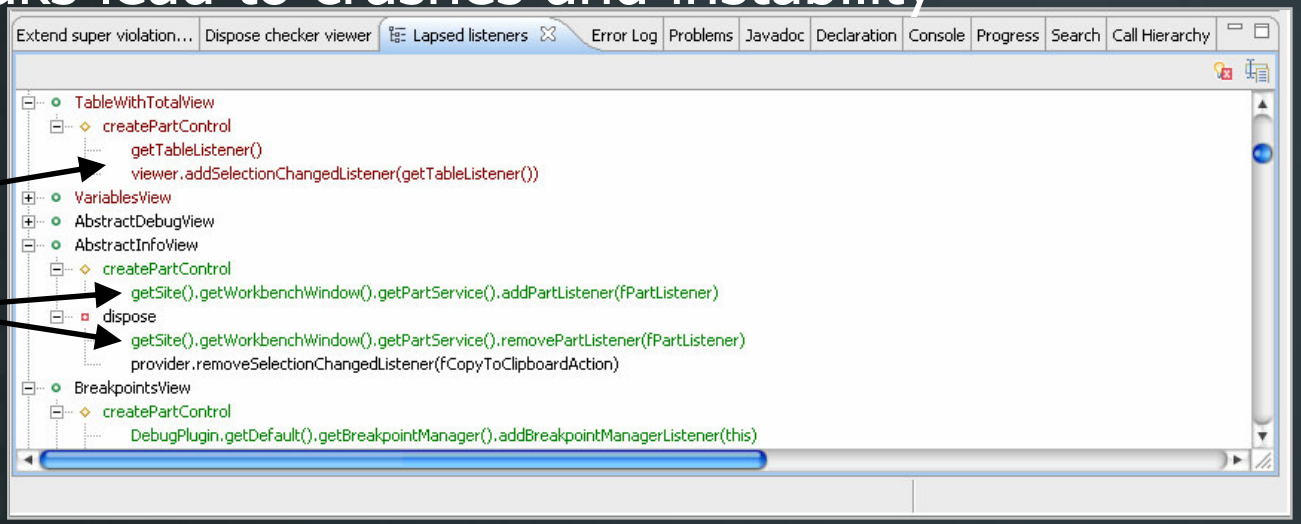


Error pattern #3: Lapsed Listeners

- Memory leaks exist in Java, despite GC!
- Common case of memory leaks:
  - Listeners are used to register handlers for events, such as mouse clicks, etc.
  - Not un-registering listeners properly leads to memory leaks
  - Memory leaks lead to crashes and instability

Not unregistered listener

unregistered listener



Checking for Pattern Violations: How?

- Runtime or dynamic approaches
  - Aspects allow run time checking of rules
  - Memory profilers and debuggers
  - Custom-made tools:
    - *sleak* by Steve Northover, the architect of SWT
    - a tool to check for memory leaks in Eclipse code
  - But: violations need to be triggered during a particular execution!
- Instead, we analyze the Java source code of the plugins
- Advantages:
  - No need to consider a particular execution
  - So, can find all potential pattern violations

Static Analysis State of the Art

- Sound and complete analysis approaches
  - Suffer from imprecision – false positives
  - Don't scale to code bases the size of Eclipse
- We use unsound lightweight static analysis
  - Runs fast – took several minutes to analyze 20 core Eclipse plugins
  - Produces false positives
    - Takes time to filter the false positives
  - May miss errors

Why Lightweight Static Checking?

- Overall goal:
  - Address whole *classes* of problems
  - Better target debugging efforts of Eclipse developers
- Make it fast and easy to audit potential errors
  - User is presented with three custom viewers
  - One for each error pattern
    - Extend super viewer
    - Dispose rule viewer
    - Lapsed listener viewer
- Can run analysis and fix the errors without ever leaving Eclipse
- So, what did we find?

We Find…

EXTEND SUPER	
methods that require super to be called	38
calls to these methods	390
filtered calls	19
potential errors (methods not calling super)	**13**
DISPOSAL RULES	
dispose methods checked	794
filtered methods	51
potential errors (leaking dispose methods)	**42**
LAPSED LISTENERS	
subclasses of ViewPart checked	81
subclasses with matched listeners	6
subclasses not using listeners	53
subclasses with mismatched listeners	22
potential errors (classes with lapsed listeners)	**13**
TOTAL ERRORS	**68**

Status

Implemented Checklipse

- Working tool
- Runs fast
- Available for download

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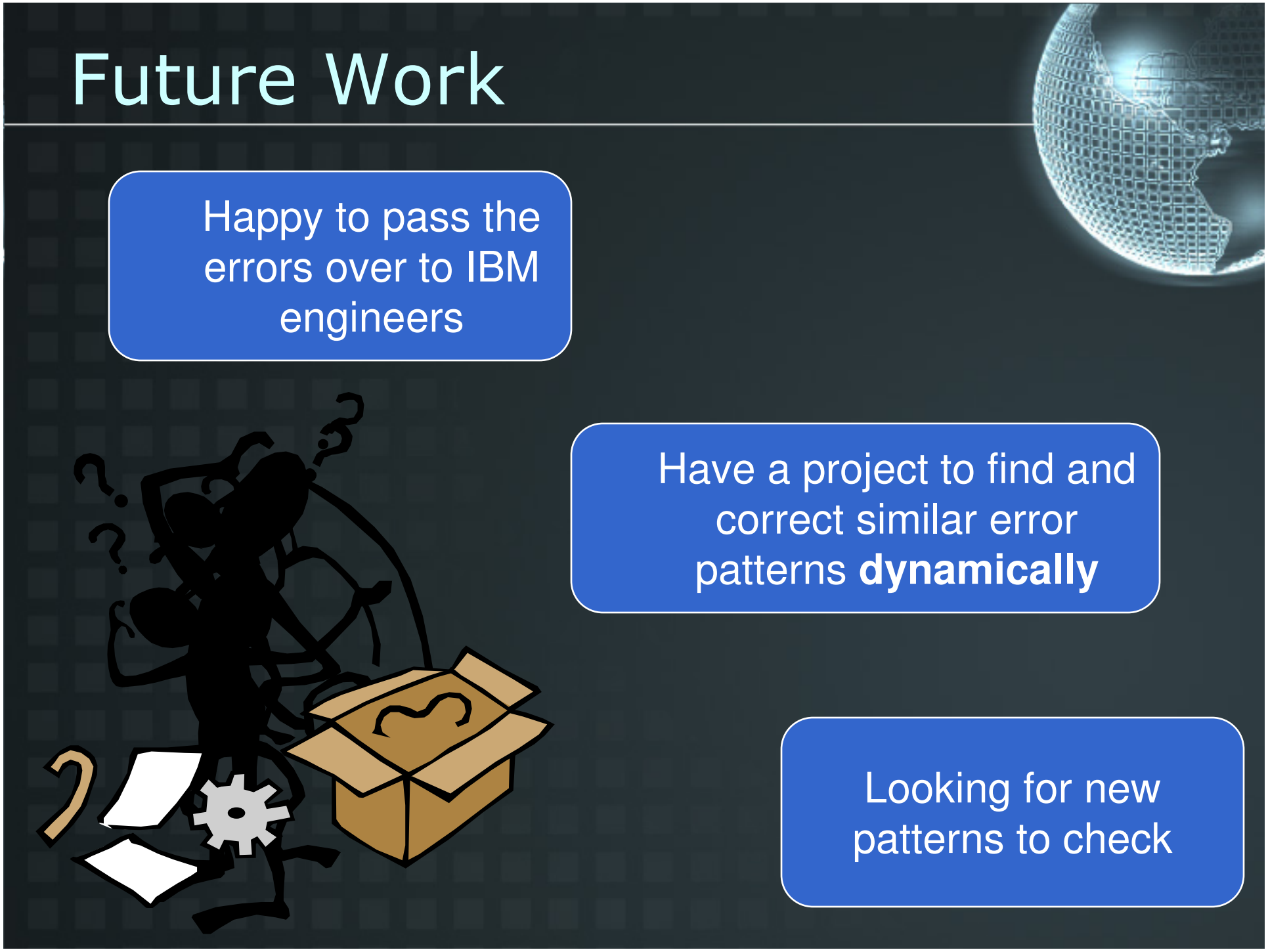
Find 68 *likely* errors

- Many are hard to evaluate
- Used our best judgement to determing what is an error
- Need a strong knowledge of APIs

Future Work



Happy to pass the errors over to IBM engineers

Have a project to find and correct similar error patterns **dynamically**

Looking for new patterns to check