InsectJ: A Generic Instrumentation Framework for Collecting Dynamic Information within Eclipse

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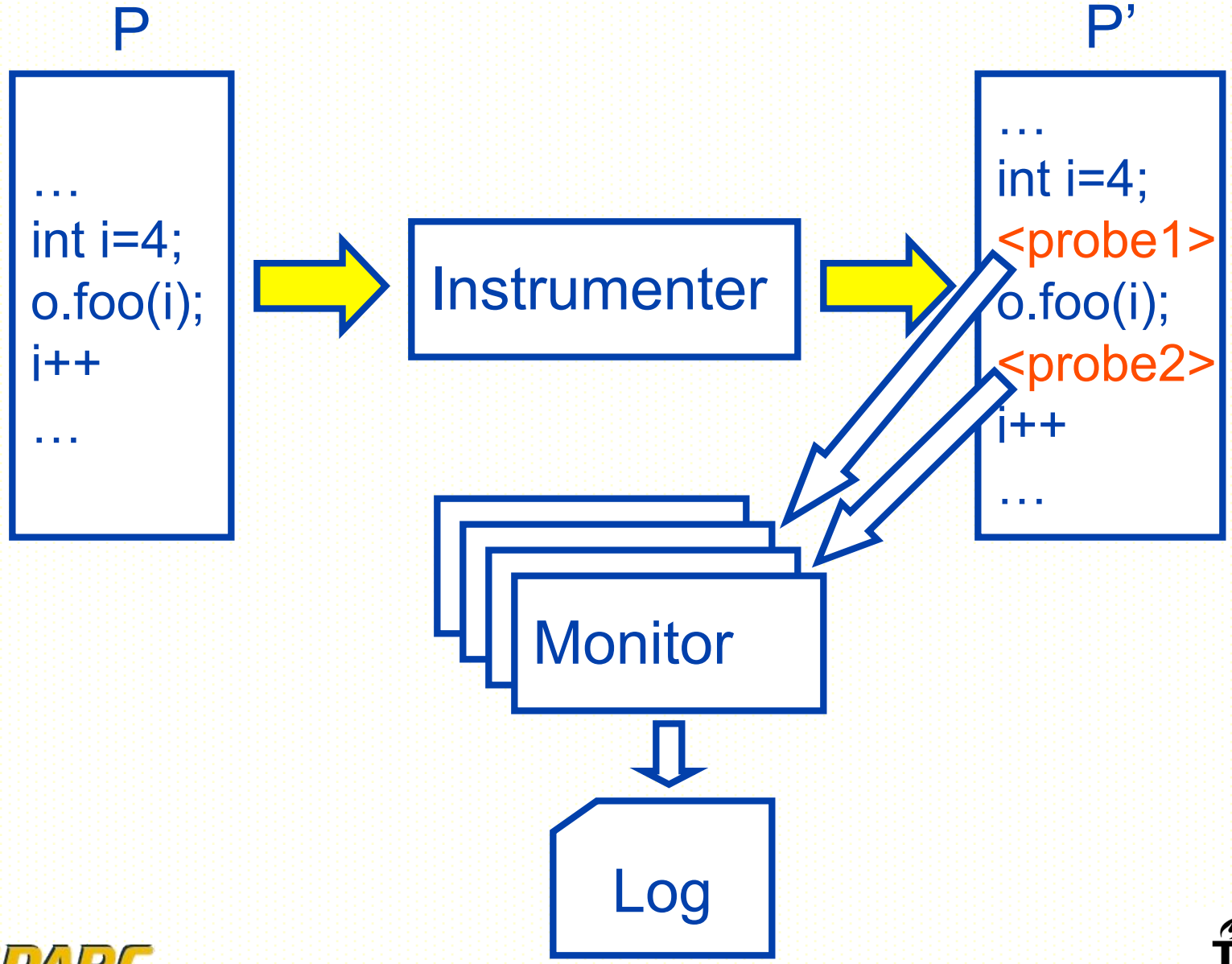
Delft University of Technology

Instrumentation Overview



Motivation

Increasing interest in programs' dynamic behavior

Instrumentation commonly used for supporting dynamic analyses

- Coverage
- Program tracing
- Profiling
- Runtime checking
- Mixed static and dynamic analyses
- …

Many issues to address

Key Instrumentation Challenges

Overhead

=> Number of probes

=> Cost of probes

Complexity

=> User unfriendliness

=> Low level details

Non-customizability

=> Ad-hoc solutions

=> Difficult to modify and adapt

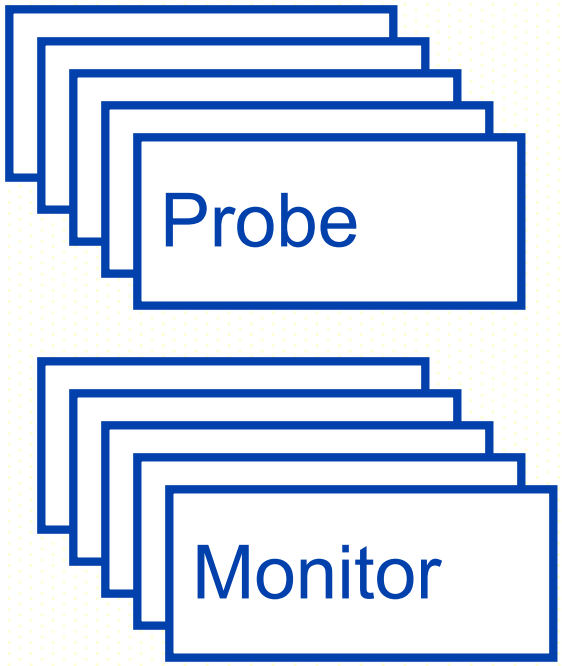
What is InsECT-J?

INStrumentation, **E**xecution, and **C**ollection **T**ool for **J**ava

Flexible, efficient bytecode instrumentation tool for collecting dynamic information

- GUI-based instrumentation (static and on the fly)
- GUI-based monitor creation
- Support for collection of new kinds of data

GUI-based Instrumentation



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```
void foo {
…
}
void bar {
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}
```
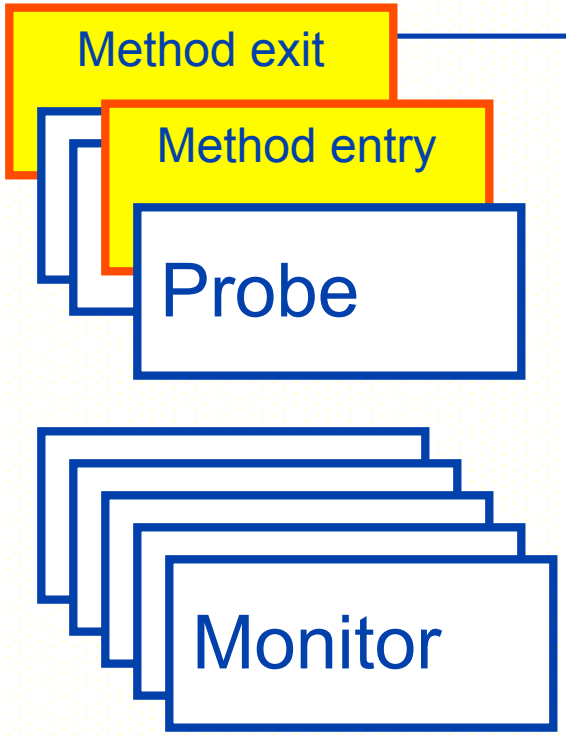

GUI-based Instrumentation



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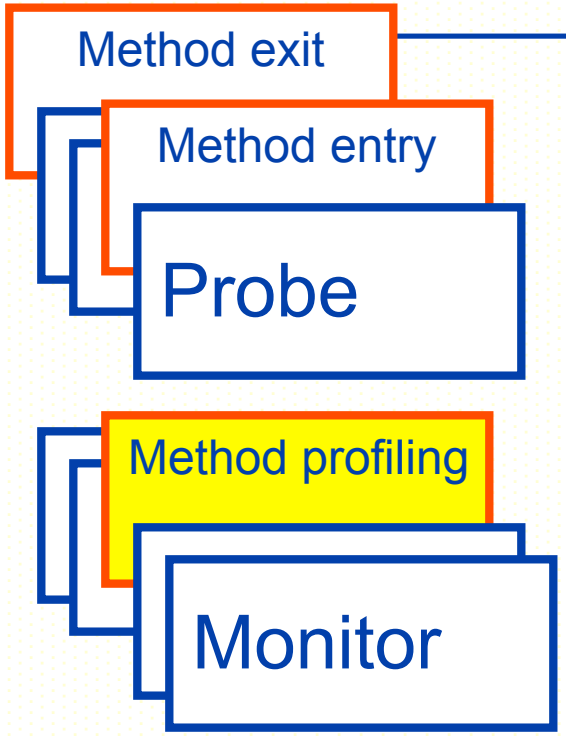

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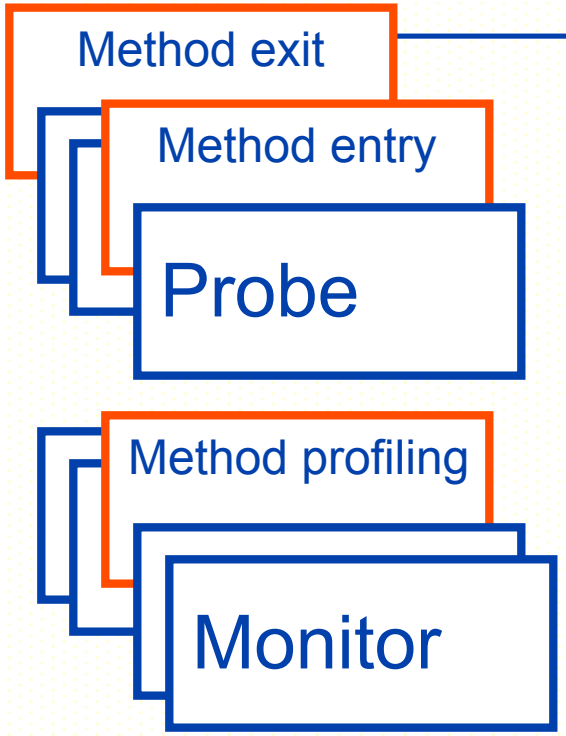
GUI-based Instrumentation



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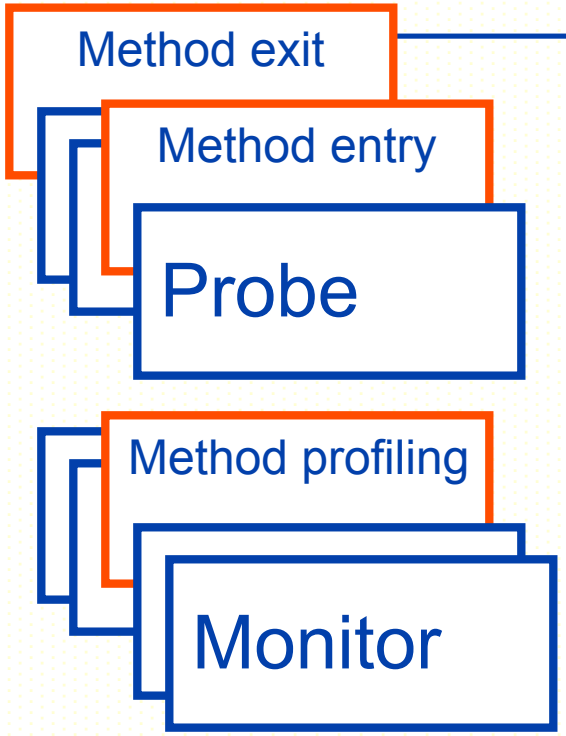
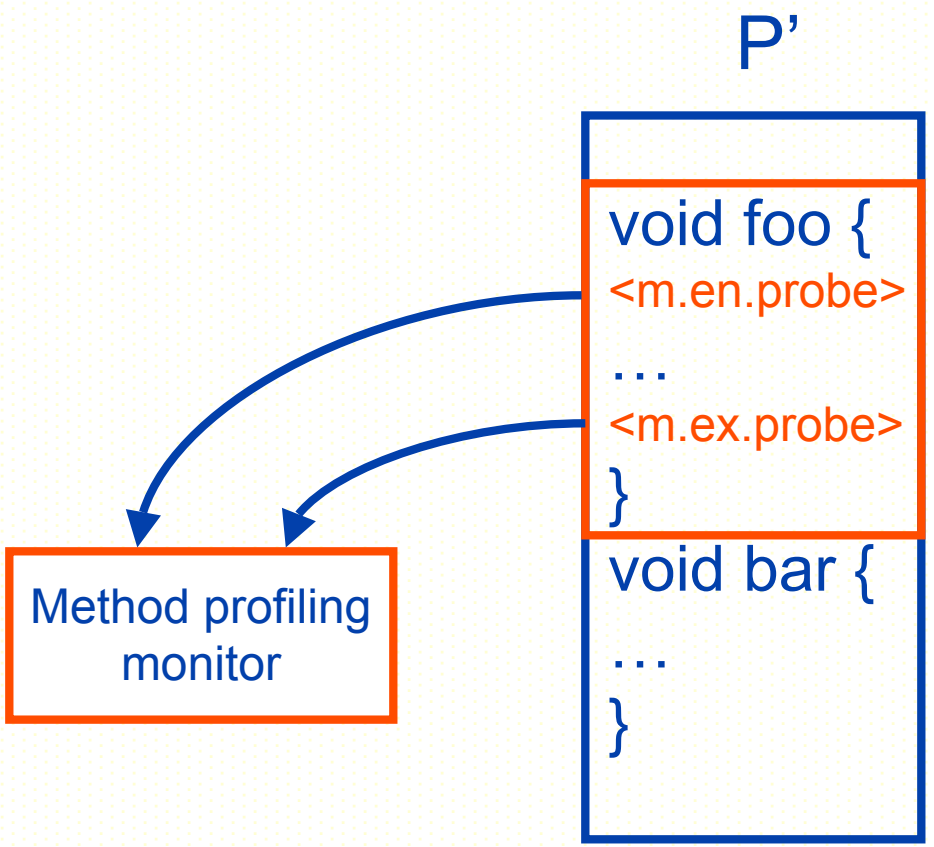
GUI-based Instrumentation

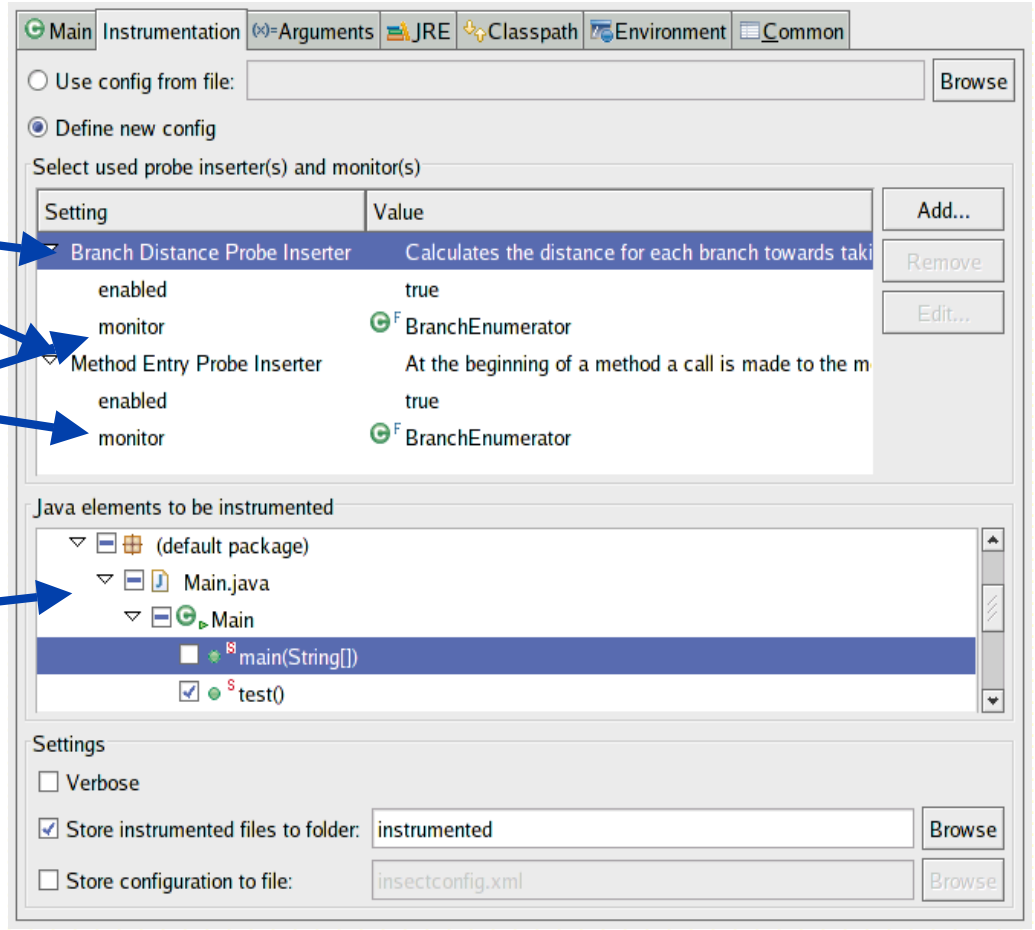




GUI-based Instrumentation

Let users select

1. Which information to collect
2. How to process the information
3. Which parts of the program to instrument



GUI-based Instrumentation

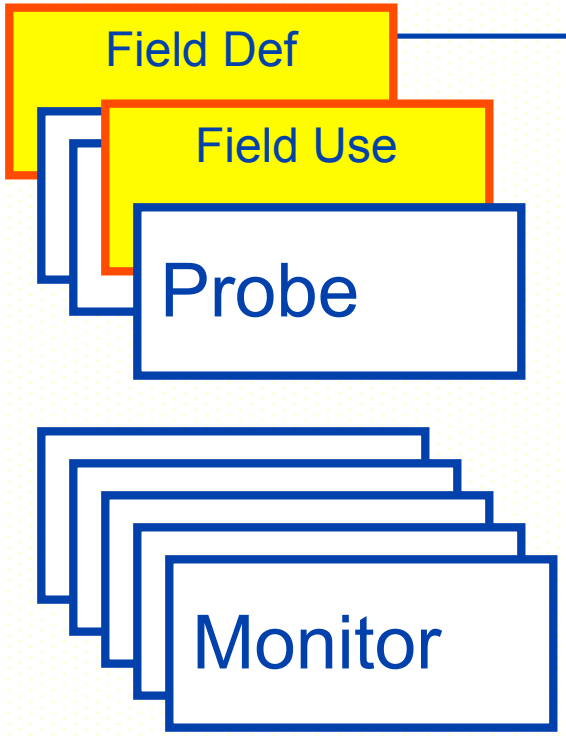
Extensible probe library

- Basic block
- Branch
- Cast
- Call
- Return
- Field read/write
- Method entry/exit
- Throw
- Catch
- Acyclic paths (WIP)
- …

Extensible monitor library

- Block coverage
- Block profiling
- Branch coverage
- Branch profiling
- Method profiling
- Cast monitoring (down-casting)
- DefUse tracing
- Throw/catch coverage
- …

GUI-based Monitor Creation



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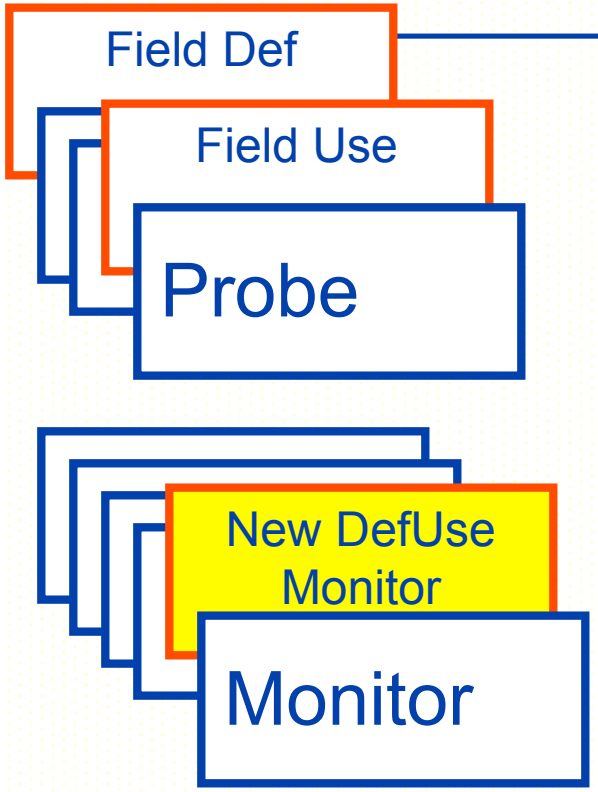
GUI-based Monitor Creation



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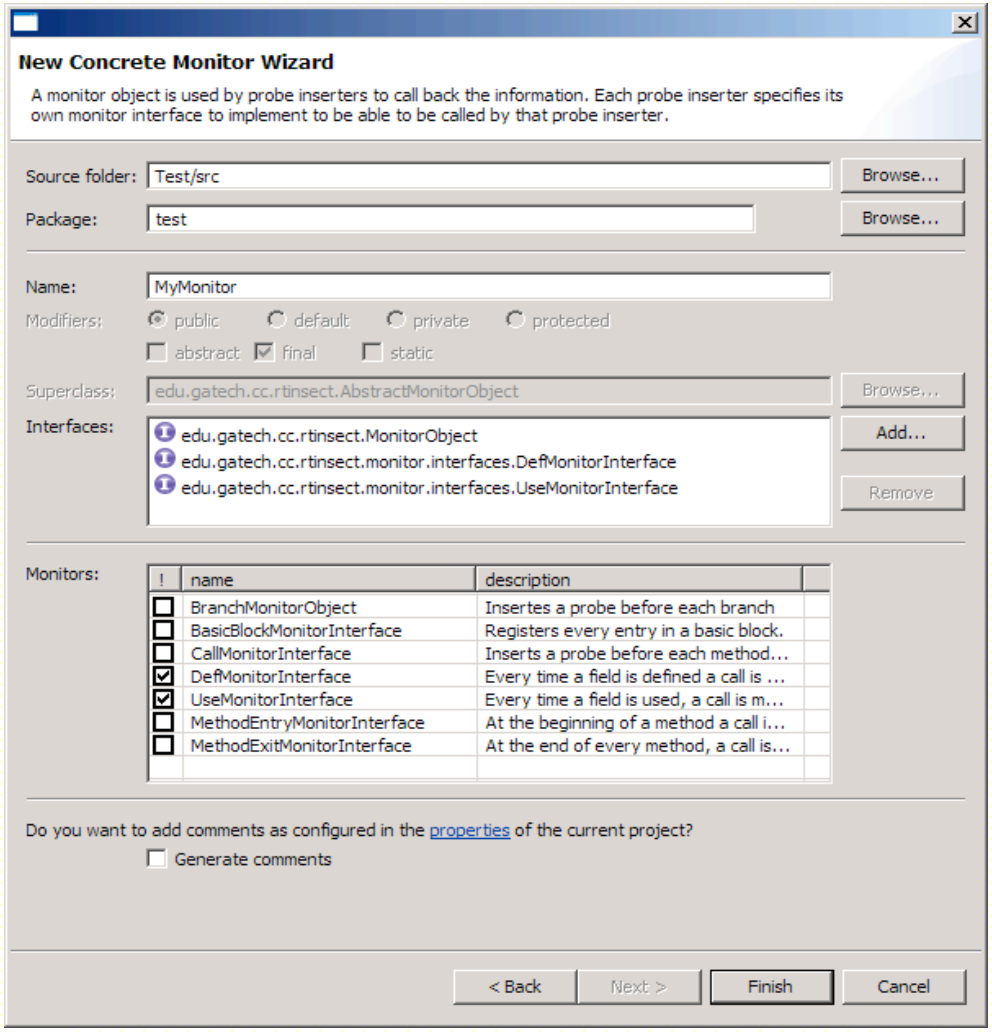
GUI-based Monitor Creation

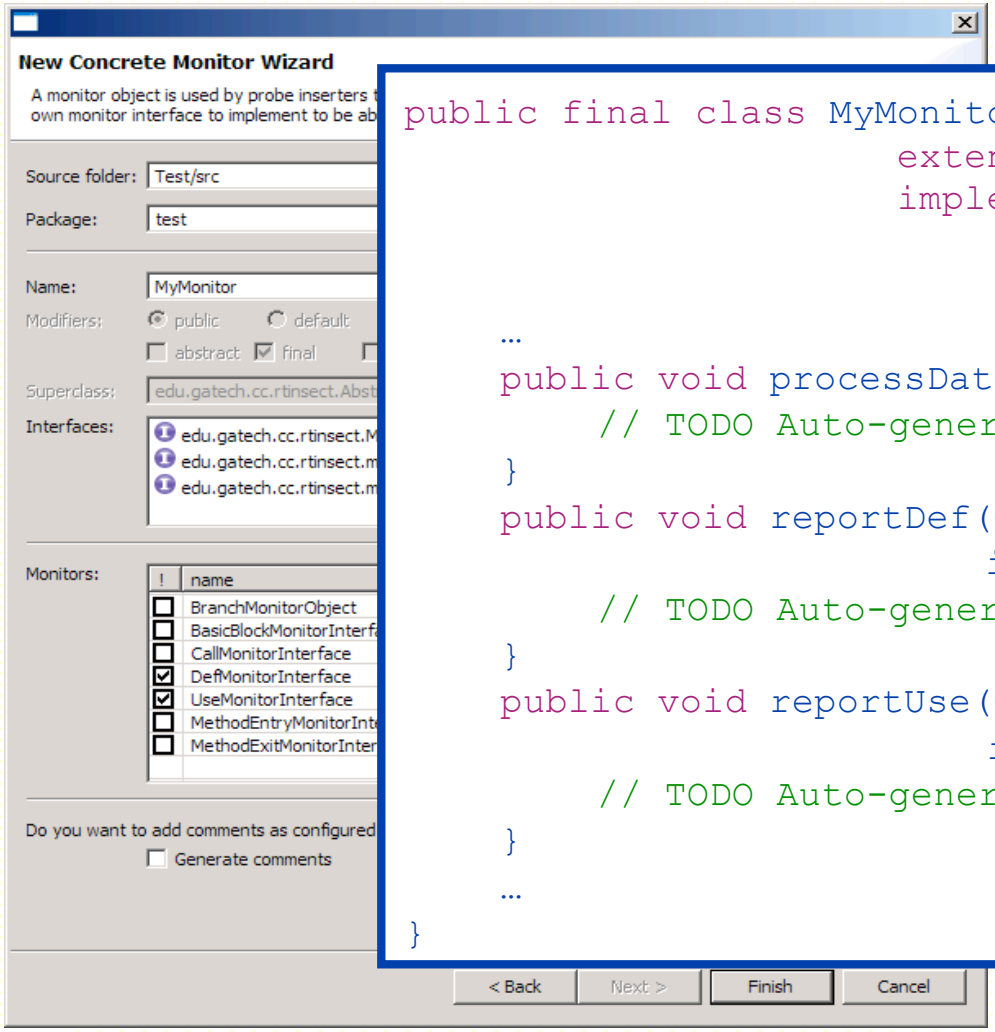
Automated monitor stub creation through a wizard



- Monitors implement interfaces for the corresponding probe(s)
- Monitor wizard creates monitor stub classes

GUI-based Monitor Creation

Automated monitor stub creation through a wizard

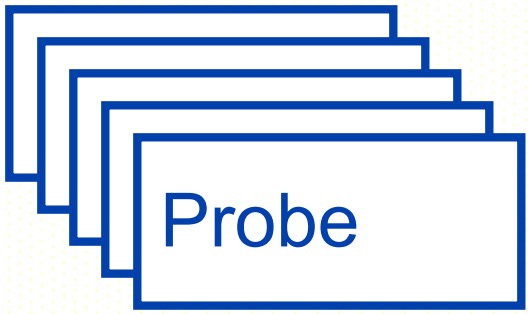


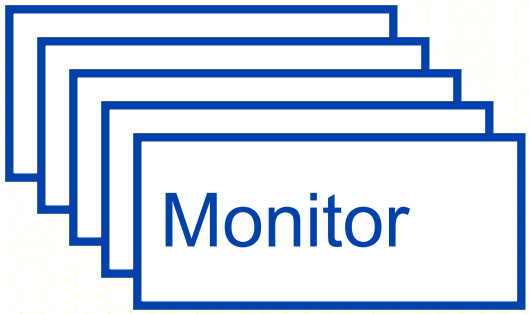
- Monitors implement

```
public final class MyMonitor
                    extends AbstractMonitorObject
                    implements MonitorObject,
                               DefMonitorInterface
                               UseMonitorInterface {

    …
    public void processData() {
        // TODO Auto-generated method stub
    }
    public void reportDef(Object newValue, Object oldValue,
                          int srcLine, int probeId) {
        // TODO Auto-generated method stub
    }
    public void reportUse(Object value, int srcLine,
                          int probeId) {
        // TODO Auto-generated method stub
    }
    …
}
```

Support for Collection of New Kinds of Data





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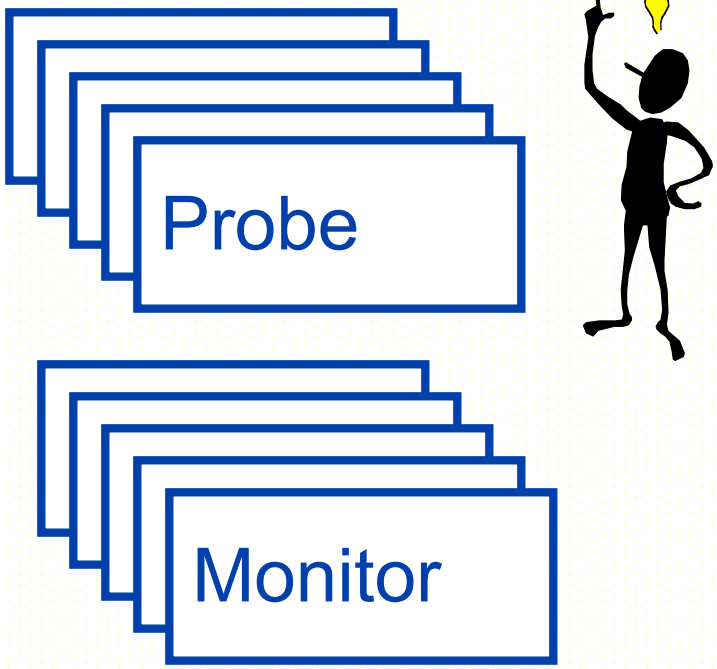

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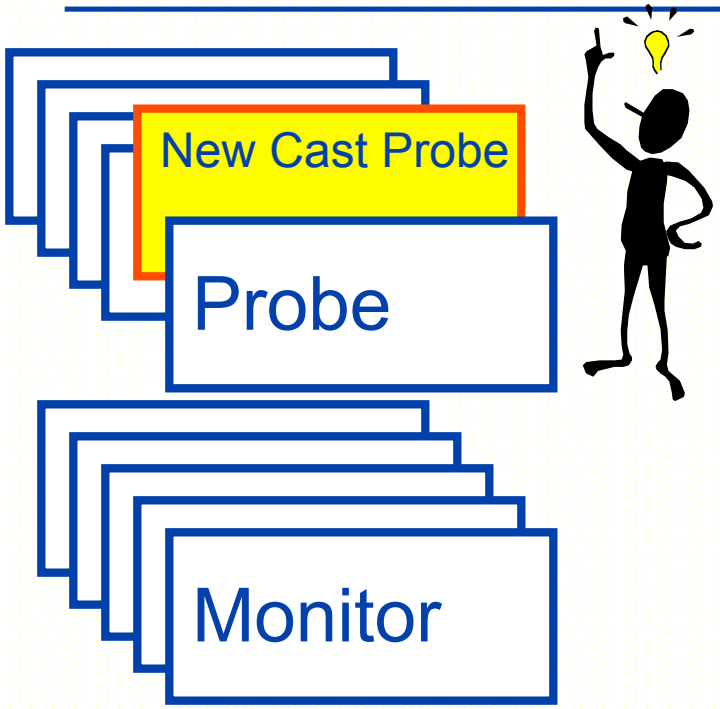

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Support for Collection of New Kinds of Data

- Allow for easier creation of new types of instrumentation
  - Create extension to Probe plug-in
  - Define monitor interface
  - Implement probe inserter that (1) collects information of interest and (2) calls monitor
- Provide higher-level abstractions for common operations
- Simple instrumentations require only a few lines of code
  (e.g., cast probe is 6 lines of code)

InsectJ Architecture

InsectJ implemented as a set of plug-ins

- Core plugin:
  - Instruments based on a configuration file
  - Provides common functionality for monitors and probe inserters
- Probe inserter plug-ins:
  - Collect different kinds of dynamic data
- Monitor Classes:
  - Predefined
  - User-defined

How Did Eclipse Help (or Did not)

The good:

- Powerful java parser
- Extensible
- Extensive, high-quality documentation
- Developer friendly
- Deployment/technology transfer

The bad:

- Complicated API
- Hard to reuse some high-level elements (JDT-UI)
- Error prone plug-in build process

Future Work

- Instrumentation at lower granularity
  - Statements
  - Context
  - …
- Addition of new probes (e.g., local defs and uses, assignments)
- Use of analysis to optimize (e.g., points-to analysis)
- Tighter integration with Eclipse
  - Visualization
  - Navigation
  - Information report

For More Information

- InsectJ's web site

  http://www.cc.gatech.edu/~orso/software/insectj
- See demo and poster tonight
- Send us email {orso|zeikerd}@cc.gatech.edu