Continuous Performance – Monitoring Performance with Automated Tests

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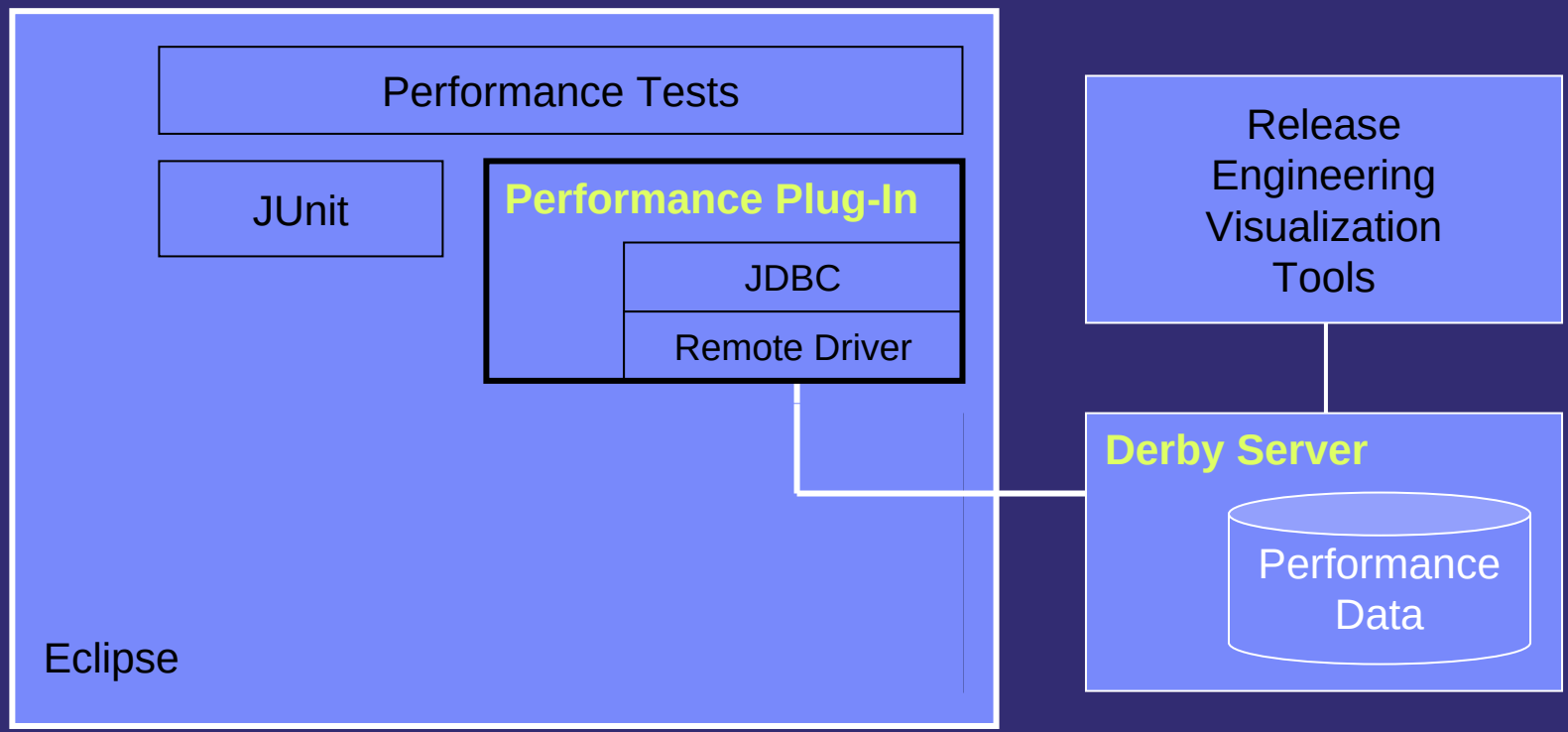
Motivation

- Performance comes always late in release cycle
  - Last minute performance “scrunches”
  - Trading performance against stability, memory footprint, etc.
- Eclipse 3.1 goal:
  Continuous performance monitoring right from the beginning of the release cycle
  - Small and simple infrastructure
  - “Red/green indicator”
  - Historical data: “When did we get slower?”
  - Build upon what developers know: JUnit
- New plug-in: org.eclipse.test.performance

Overview

- Architecture
- How to write performance tests?
- Running tests and collecting data
- Presenting performance results
- Interpreting performance results
- Pitfalls

Architecture Overview



Prepare for writing a performance test

- Check out from dev.eclipse.org:/home/eclipse
  - org.eclipse.test.performance
  - org.eclipse.test.performance.win32 (on Windows)
- Get org.junit plug-in (e.g. from Eclipse install)
- Add org.eclipse.test.performance and org.junit to your test plug-in's dependencies

Writing a performance test

```
public void testMyOperation() {
        Performance perf= Performance.getDefault();
        String ID= perf.getDefaultScenarioId(this);
        PerformanceMeter meter= perf.createPerformanceMeter(ID);
        try {
                for (int i= 0; i < 10; i++) {
                        meter.start();
                        // code to measure
                        meter.stop();
                }
                meter.commit();
                perf.assertPerformance(meter);
        } finally {
                meter.dispose();
        }
}
```

Asserts that collected data is within [-100%, +10%] range of reference data in the performance database.

Writing a PerformanceTestCase

- Convenience class **PerformanceTestCase**

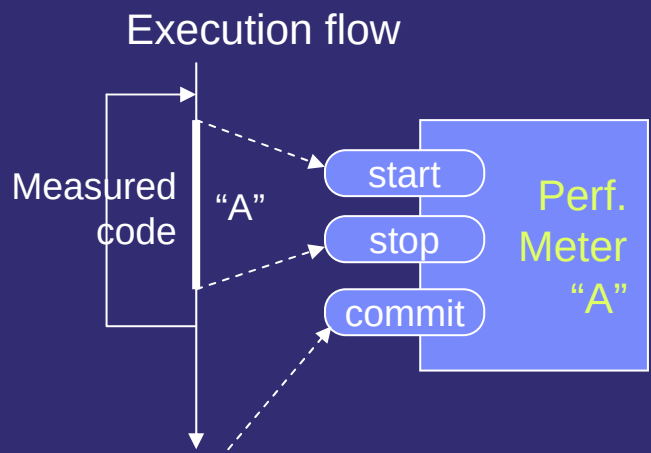
```
public class MyPerformanceTestCase extends PeformanceTestCase {

        public void testMyOperation() {
                for (int i= 0; i < 10; i++) {
                        startMeasuring();
                        // code to measure
                        stopMeasuring();
                }
                commitMeasurements();
                assertPerformance();
        }
}
```


Performance Meters

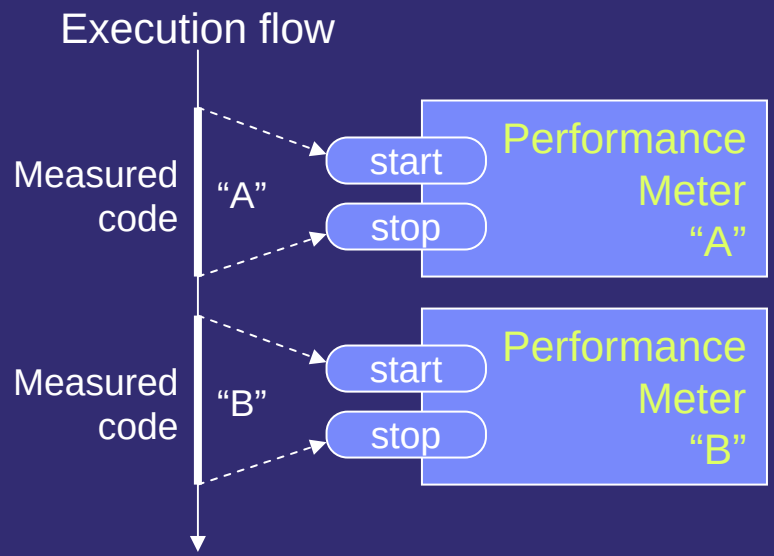
- A Performance Meter
  - Monitors performance counters across a single piece of code
    - Piece of code identified by “scenario name”
  - Performance counters are called “dimensions”
  - Default dimensions provided by OS:
    - Elapsed time, kernel/user time
    - Memory consumption, VM characteristics
    - I/O (bytes read, written)
  - Multiple calls to `start()`/`stop()` are averaged
  - `commit()` prints collected data:

```
Scenario 'A' (average over 10 samples):
        CPU Time: 6 ms
        Used Java Heap: 2K
        Kernel time: 1 ms
```

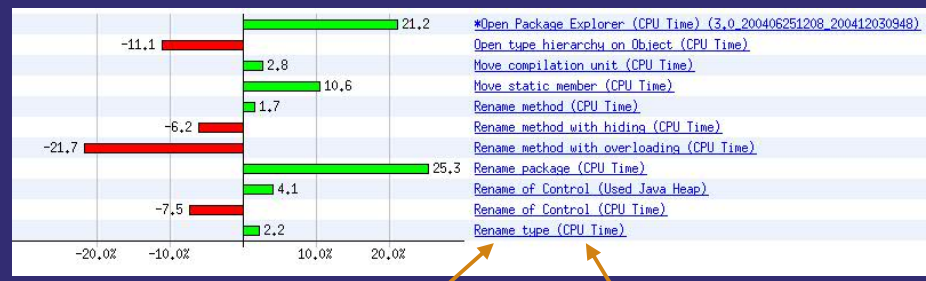


Performance Meters (contd.)

- Don’t reuse PerformanceMeters for more than one piece of code
  - Create a new instance!
  - Distinguish via scenario name
  - Call `commit()` on all meters outside measured code, after last call to `stop()`



Performance Summaries



- Tag PerformanceMeter for global summary:

```
// ...
PerformanceMeter meter= perf.createPerformanceMeter(ID);
perf.tagAsGlobalSummary(meter, “A Short Name”, Dimension.CPU_TIME);
//...
```

- Tag PerformanceMeter for component summary:

```
// ...
PerformanceMeter meter= perf.createPerformanceMeter(ID);
perf.tagAsSummary(meter, “A Short Name”, Dimension.CPU_TIME);
//...
```


Running Performance Tests

- As part of Eclipse Automated Testing Framework on each build
  - Add to Ant target "`performance`" to `test.xml`:

```
<!-- performance test target -->
<target name="performance">
  …
  <ant target="ui-test" antfile="${library-file}" dir="${eclipse-home}">
    <property name="data-dir" value="${workspace-dir}"/>
    <property name="plugin-name" value="${test-plugin-name}"/>
    <property name="classname" value="${test-case}"/>
  </ant>
  …
</target>
```

  - Performance data is written to database on `PerformanceMeter#commit()`
- Locally
  - Create Launch Configuration
  - Specify -Xms256M -Xmx256M to avoid memory pressure during measurements
  - Performance data is written to console on `PerformanceMeter#commit()`

Collecting data in database

- Get Derby (aka Cloudscape) database from http://incubator.apache.org/derby/
- Create “Derby” library project (for details see: Performance How-To document)

- Configure performance plug-in by setting three system properties:
  - Database location:

    -Declipse.perf.dbloc=<location of server>
  - Store tagged data as “Variations”

    -Declipse.perf.config=<key1>=<value1>;<key2>=<value2>;...;<key*n*>=<value*n*>
  - Assert performance against reference data

    -Declipse.perf.assertAgainst=<key1>=<value1>;<key2>=<value2>;...;<key*n*>=<value*n*>

- Example:
  - Store reference data for 3.0 build in DB

    -Declipse.perf.config=platform=win32;build=N20040625;jvm=sun
  - Store new data and compare it against reference data

    -Declipse.perf.config=platform=win32;build=N20050303;jvm=sun
    -Declipse.perf.assertAgainst=build=N20040625

Three variations: platform, build, jvm

Regenerating Reference Data

Performance results are compared against reference data from **previous** releases.

- Problem: reference data not available for newly written tests
- Solution
  - Regenerate reference data on a weekly basis (or if new performance tests have been added)
- Requires
  - Branch for performance tests against previous releases
  - New tests must be ported back to reference branch
  - Only port if
    - performance test and its results are comparable across releases
    - measured functionality existed previously

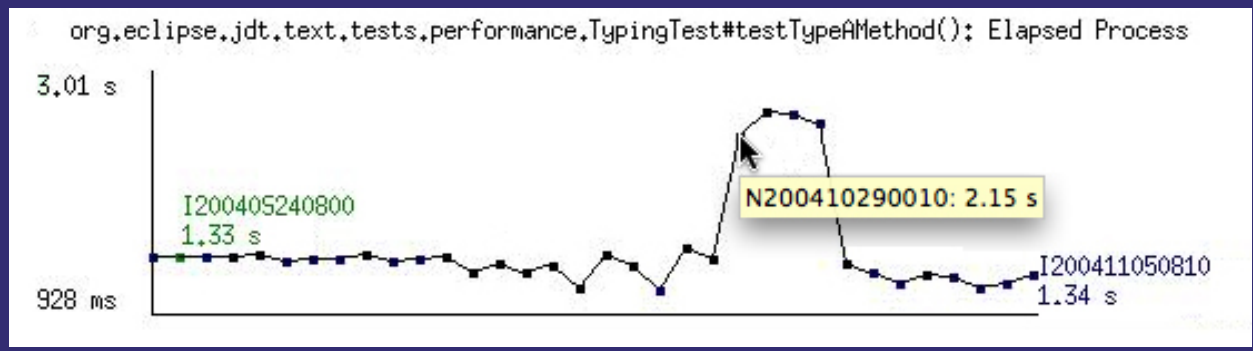
Viewing Results Locally

- Graphic tools/scripts available in Release Engineering project org.eclipse.releng.basebuilder
  - `org.eclipse.performance.test.ui.Main` generates fingerprints, data tables and line graphs
- Performance plug-in provides simple “View” class for listing data as a table (`org.eclipse.test.internal.performance.db.View`)
- You need to specify:
  - Database location
  - Performance Scenario ID pattern (e.g. “%EditorTest%”)
  - Variation patterns (e.g. “platform=win32” and “build=I%”)
  - Tag for x-axis (e.g. “build”)

```
Scenario: org.eclipse.jdt.text.tests.performance.RevertJavaEditorTest#testRevertJavaEditor()
Builds:            I200409240800    I200409281200  I200410050800  I200410190941  I200410260800
CPU Time:        1.02 s [284 ms]  1.05 s [327 ms]        971 ms           1 s         481 ms
Elapsed Process: 1.02 s [286 ms]  1.07 s [345 ms]        981 ms        1.01 s         481 ms
Kernel time:       41 ms [27 ms]    48 ms [40 ms]         46 ms         28 ms          22 ms
Page Faults:           145 [125]        148 [125]           176           191           143
System Time:     1.02 s [285 ms]  1.06 s [345 ms]        981 ms        1.01 s         477 ms
```


Interpreting Results

- Observe performance results regularly
  - Example: typing performance in Java Editor



- Performance results don't pinpoint the problem
  - But they help to find problems early
  - This makes it easier to correlate a performance problem with other changes that are the likely cause

- Increased performance test coverage and performance tests on all application layers allow to further narrow down the origin of regressions

Advanced Usage

- Combine PerformanceMeter with full fledged profiler
  - Use profiler API to start/stop profiling
  - Reproduces the exact same scenario while collecting profiling data
  - Beware of distortions:
    the profiling method typically has an impact on the results

- Create your own PerformanceMeter
  - Example:
    count number of calls to specific paint method via JDI

Pitfalls

- Don’t make tests too short
  - On some platforms timer resolution is a few milliseconds (10ms on Win32)
  - Run them in a loop to bring normal run time in the range of 1s (beware of better JIT optimization)
- Be aware of startup costs (JIT, cache, etc.)
  - If interested in startup time
    - run test only once in JVM session (“Session Tests”)
    - use multiple JVM sessions to make average more stable (if collected data uses same tag, it is automatically aggregated)
  - If not interested in startup time
    - don’t collect data for first runs, use warm-up runs
- Keep things comparable
  - Compare with respective default preferences vs. compare with same preferences

Conclusion

- The Eclipse performance plug-in is not the “silver bullet” to performance problems
  - You still need a lot of creativity to find the real cause of a performance problem
- However, continuous performance testing makes it easier to pinpoint the cause because
  - you can spot a performance problem as soon as it occurs
  - it becomes easier to understand what code changes had occurred at the same time

Acknowledgments

- Performance infrastructure started by Text team
- IBM contributed part of implementation
- All other “guinea pigs” within OTI Labs

References

- Performance Tests How-To: http://dev.eclipse.org/viewcvs/index.cgi/~checkout~/org.eclipse.test.performance/doc/Performance Tests HowTo.html
- Performance tests for further illustration can be found, for example, in the `org.eclipse.jdt.text.tests` and other `*.tests` plug-ins