



An Examination of the Run- time Performance of GUI Creation Frameworks

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Presentation Outline

- Introduction: importance of graphical user interfaces (GUIs)
- What is a GUI?
- Event handling latency and GUI manipulation event difficulty
- Overview of GUI creation frameworks: Swing and Thinlet
- Experimental design and justification
- Empirical results:
 - Event handling latency
 - CPU and memory consumption
- Related and future work
- Conclusion

Introduction

- Source code for GUIs: Past- 48%, Current- 60%
- GUI creation frameworks: correctness and performance
- Analysis of Java programs
 - ➔ Statically, at source code and bytecode levels
 - ➔ Dynamically, at bytecode level and on specific virtual machine(s)
- Our focus: performance of GUI creation frameworks for specific applications and Java virtual machines
- GUI toolkit showdown: Thinlet vs. Swing
- User-perceived performance for a case study application

GUI Fundamentals

- A GUI is simply a set of widgets
- The state of the GUI is the state of all the widgets
- Our model ignores widget layout constraints
- Event handling latency: $L(E) = L_A(E) + L_G(E)$
- Difficulty of GUI manipulation event: $D(E) = D_A(E) + D_G(E)$
 - Formulation of $D_A(E)$ requires analysis of algorithms in the underlying application and JVM
 - Formulation of $D_G(E)$ requires understanding of the GUI widgets that are updated and added to the GUI

Comparing Swing and Thinlet

- **Swing:**
 - Extension of AWT
 - Approximately 50 components
 - **Advantages:**
 - Lightweight – more efficient use of resources
 - Written in Java – cross-platform and very consistent look and feel
 - **Disadvantages:**
 - Inherent abstraction level
 - Excessive object creation
- **Thinlet:**
 - Created by Robert Bajzat
 - Currently 22 components
 - **Advantages:**
 - Application Separation: GUI in XML and underlying code in Java
 - Relatively simple GUI development
 - **Disadvantages:**
 - Limited number of components
 - Limited threading model



Visual Database Querying Tool

- Ideal candidate application - enables the variation of GUI manipulation event handling difficulty
- Difficulty was varied by changing table sizes to 25, 250, and 2500 tuples
- User can select tables, attributes, and comparison operators
- Query results displayed in the form of a table
- One version of the tool was developed with Swing and another with Thinlet
- Each tool uses the same Java Database Connectivity (JDBC) driver to connect to a PostgreSQL database



Experiments

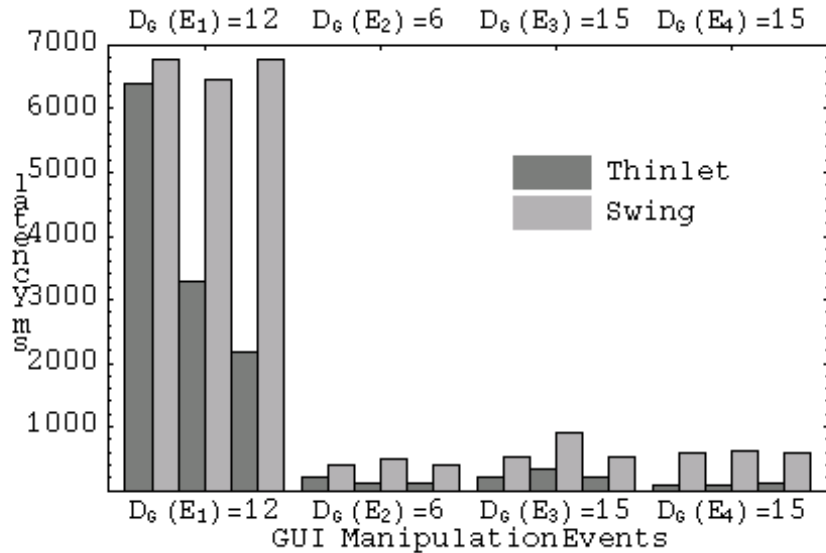
- Systems Used
 - Pentium III, 533 Mhz with 128 MB RAM
 - Debian/GNU Linux – JVM 1.4.1
 - Ms Windows NT – JVM 1.4.0
 - UltraSPARC-5 Sun4u, 366 Mhz with 128 MB RAM
 - Solaris 8 – JVM 1.4.1
- Five Distinct Experiments
 - Initial startup
 - Opening of Screens (Selection of tables, attributes, relational operators)
 - Viewing of final query results with 3 different table sizes

Latency Results: Overview

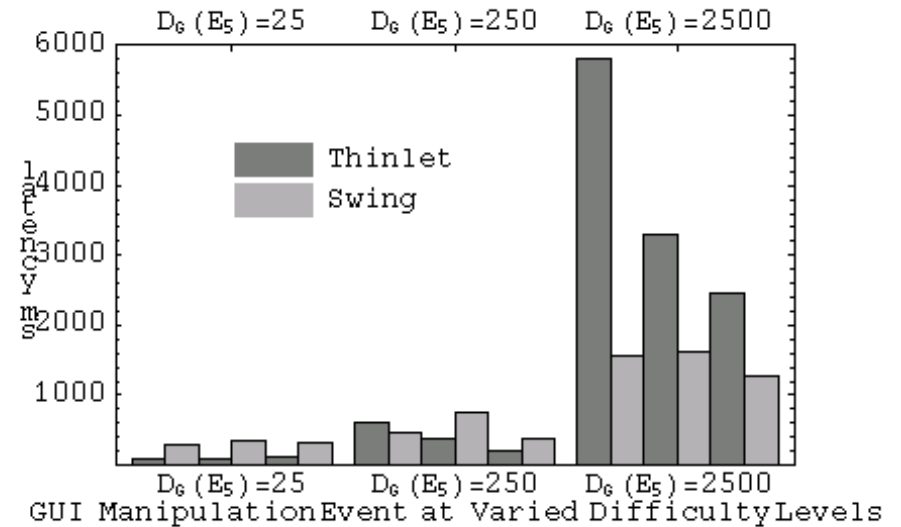
- Measured average event handling latency for single addition to textarea
- First four experiments measure event handling latency when table size is not a factor
- Fifth experiment varied the table sizes:
 - Thinlet outperforms Swing for smaller number of updates/adds
 - Swing outperforms Thinlet for larger number of updates/adds

Latency Time (ms)		
OS	Thinlet	Swing
Solaris	4	6.33
Linux	3.16	3.66
Windows	3.33	3.33

Latency Results: Graphs



(a)

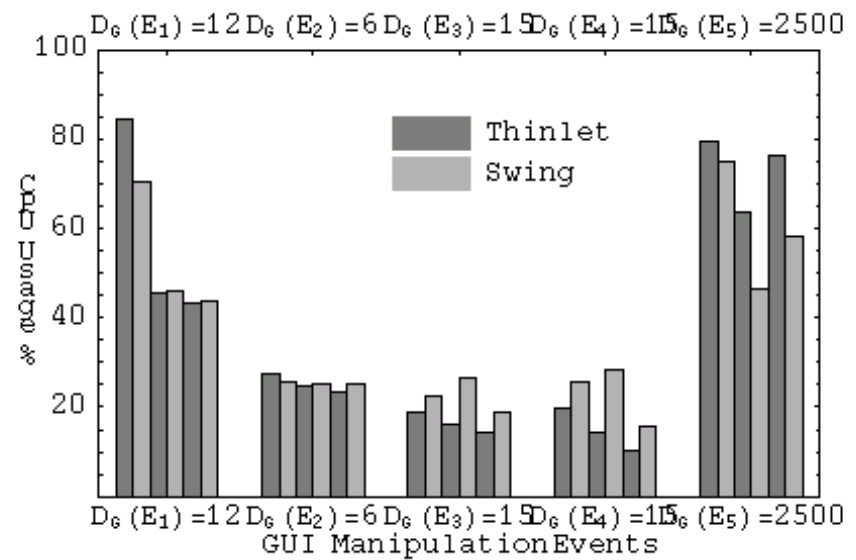


(b)

CPU and Memory Results

- Swing uses less CPU when rendering large amounts of data
- Memory usage consistent throughout applications with more use at startup and querying final results
- Memory usage for single addition to textarea

Memory Used (ms)		
OS	Thinlet	Swing
Solaris	392	992
Linux	312	748
Windows	334.66	846.66



Related and Future Work

- Related research:
 - Memon et al.: testing and analysis of programs with GUIs
 - Endo et al.: interactive system performance analysis
 - Horgan et al: Java - centric performance analysis
- Future research:
 - The impact of different JVM modes (HotSpot client, HotSpot server, interpreted) on user- perceived performance
 - Memory usage patterns for applications that use Swing and Thinlet
 - New case study applications
 - New Java GUI creation frameworks: Eclipse SWT, SWIXML
 - General methodology for GUI toolkit performance analysis

Conclusion

- Thicket is better for less difficult GUI manipulation events
 - Easier to implement due to XML interface
 - Currently, only 22 widgets
 - Threading model needs to be improved
- Swing is better for more difficult GUI manipulation events
 - Harder to implement
 - Approximately 50 widgets in toolkit
- GUI toolkit choice depends of application being created for which to choose
- Our goal: to provide GUI- driven application developers with heuristics for choosing the appropriate GUI creation framework



Resources

- Java GUI Creation Framework Performance Research:
 - <http://cs.allegheeny.edu/~gkapfham/research/jgp/>
- Java Performance Tuning (J. Shirazi):
 - <http://www.javaperformancetuning.com>
- Performance Documentation for Java HotSpot VM:
 - <http://java.sun.com/docs/hotspot/>
- Performance Documentation for Java Platform:
 - <http://java.sun.com/docs/performance/>
- S. Wilson and J. Kesselman. *Java Platform Performance: Strategies and Tactics*, Addison- Wesley, 2003.