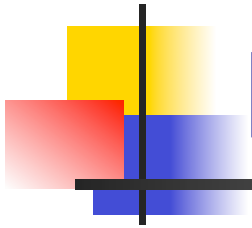
A Pedagogic Programming Environment for Java that Scales to Production Programming

Charles S. Reis

Master's Thesis Defense

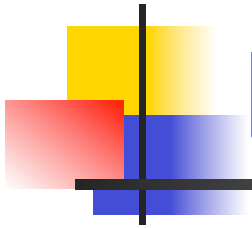
Rice University

April 16, 2003



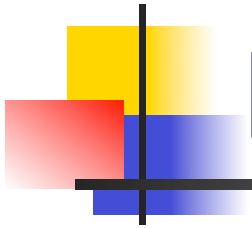
Pedagogic IDEs

- Useful tools in courses
  - Simple, easy to learn
  - Guiding philosophy for features
  -
- Usually limited to intro level
  - Lack of powerful features
  - Restrictive interfaces (eg. UML)



Professional IDEs

- Many advanced features
- Large, Cumbersome
  - Significant overhead
  - Complex user interfaces
  - Not designed for students
  -
- Avoided by many professionals!

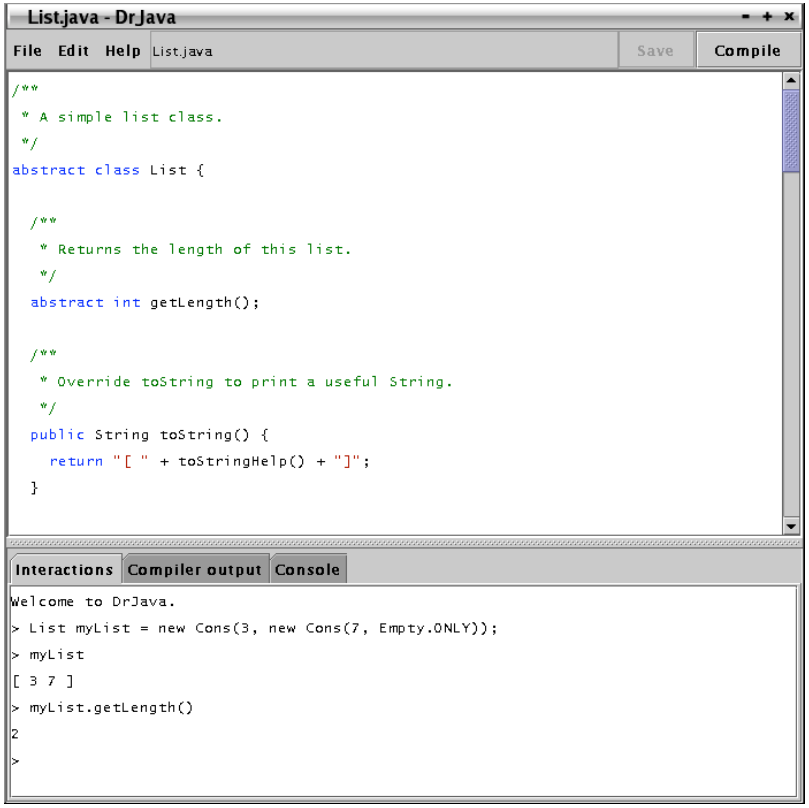


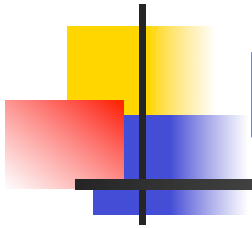
Motivation

- Can pedagogic IDEs be useful at the level of production development?

DrJava

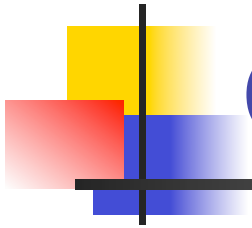
- Pedagogic IDE for intro level
  - Simple, intuitive
  - Interactive (REPL)
  - Focus on source language





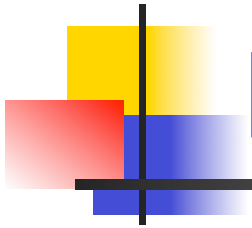
DrJava Development

- Created by students at Rice
  - Object oriented, design patterns
  - Extreme Programming (XP)
  - Open Source
  -
- Customers worldwide



Goal

- Extend DrJava to support production programming
  - Small set of new features
  - Ease transition to professional IDEs
  - Teach production programming with DrJava

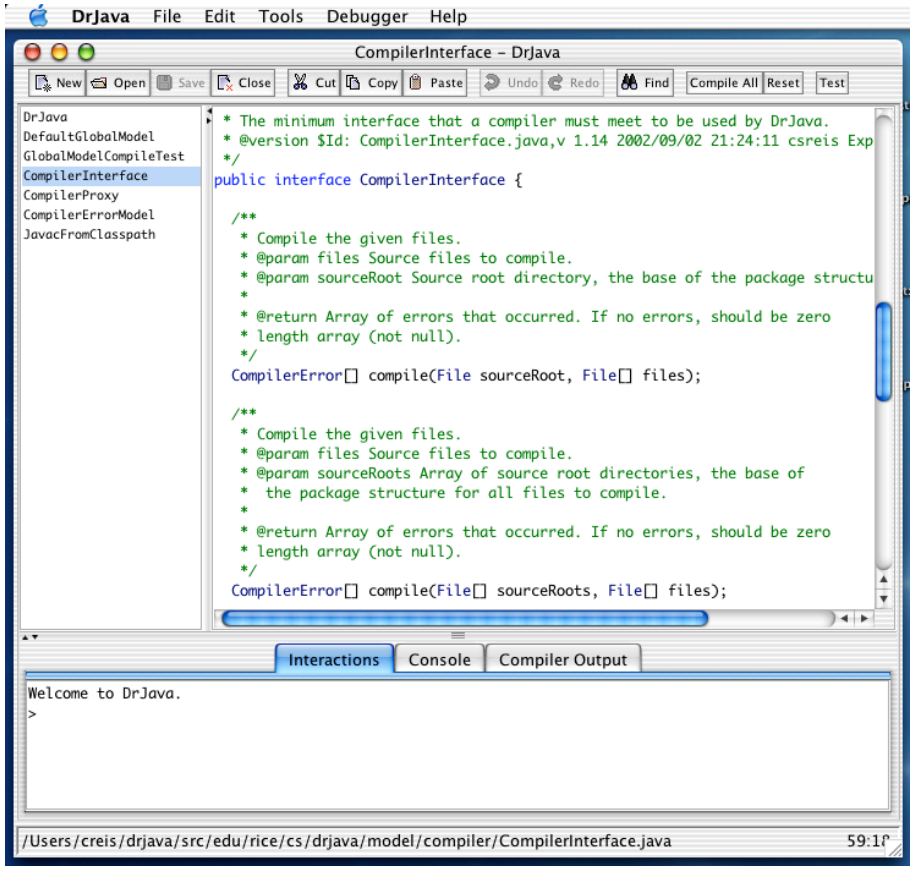


Necessary Features

- REPL still useful
- Easy access to multiple files
- Traditional debugger
  - Suspend execution, query values
- Test-driven development
  - Integrated support for unit tests

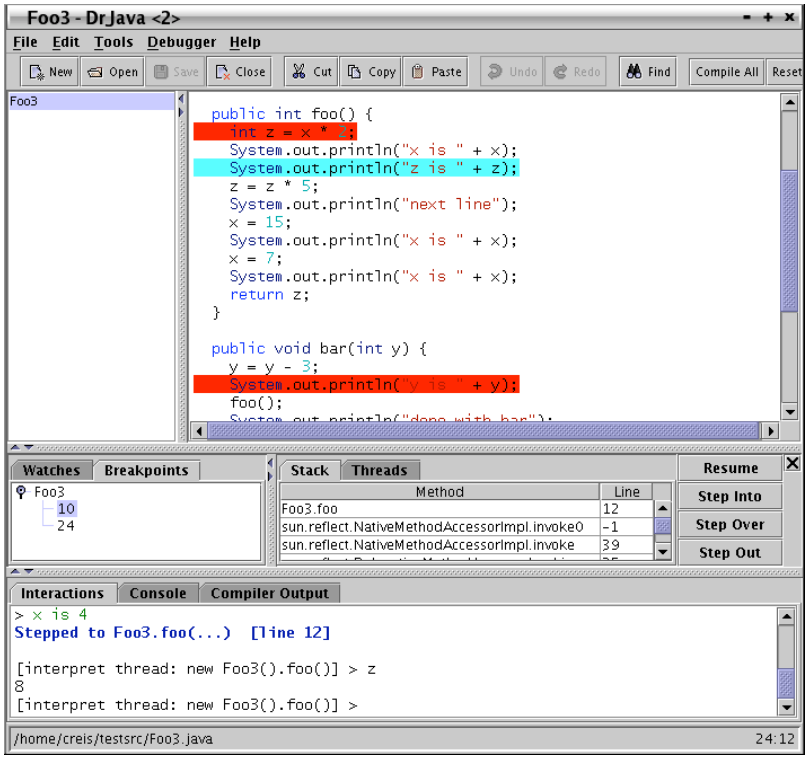
Editing Multiple Files

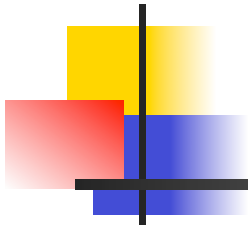
- Java projects span many files
  - Need convenient access to many classes at once
  -
- Add document selector



Interactive Debugger

- Traditional features
  - Breakpoints
  - Stepping
  - Query values
  -
- Integrated with Interactions Pane (REPL)



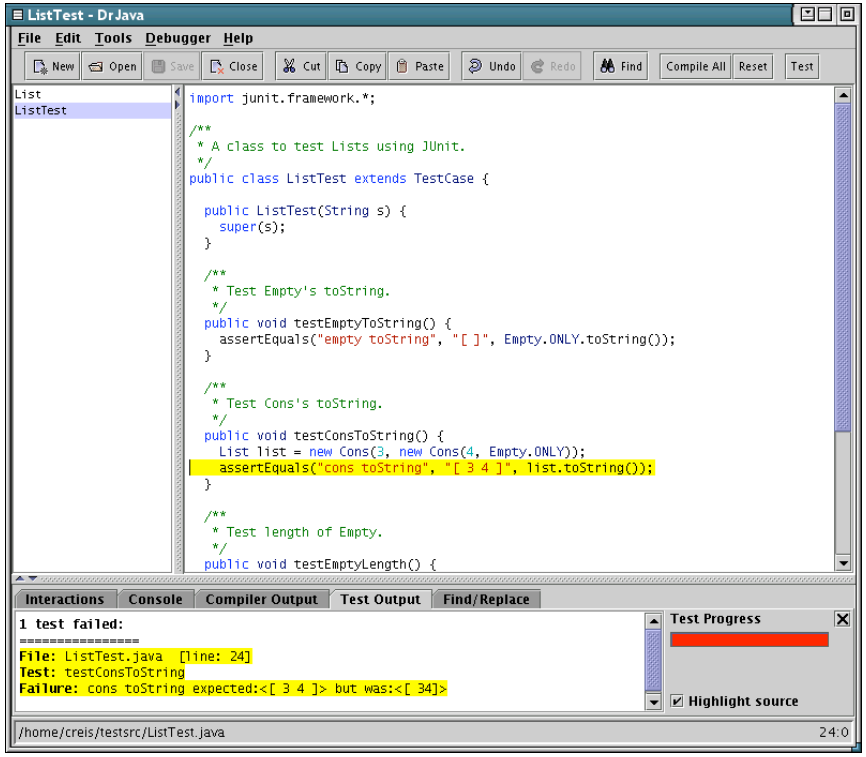


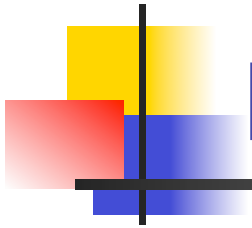
Debugger + REPL

- Flexible Points of Entry
  - Not just `main` method
  - Easily repeat experiments
  -
- Interact with state in Java
  - Query, modify values
  - Call methods, etc

Unit Testing Support

- Key to incremental development
- Quality Safeguard
-
- Easy to write, run
  - JUnit framework
  - “Test” button
  - Visual feedback



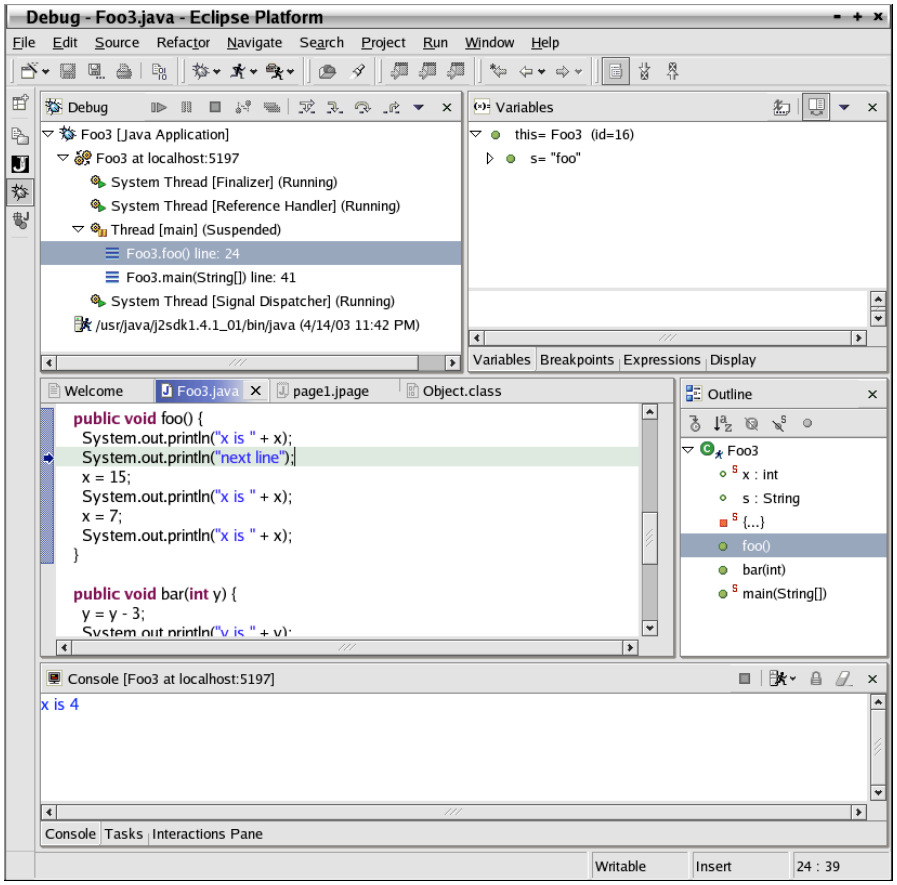


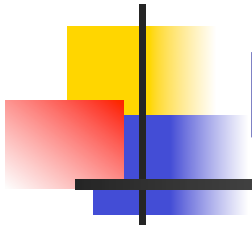
Leveraging Professional IDEs

- Occasionally useful
  - Powerful refactoring tools
- Desire an easier transition from pedagogic IDEs

IBM's Eclipse

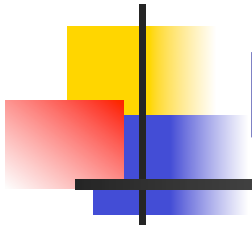
- Widely used, open source IDE
- Everything is a "plug-in"
- Many advanced features
- Active ties with academia





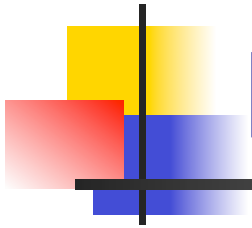
DrJava Plug-in for Eclipse

- Innovation Grant from IBM
- Ease transition to Eclipse
  - Simplify user interface
  - Provide Interactions Pane (REPL)
  - Debugger + REPL
  -
- REPL also useful for professional developers



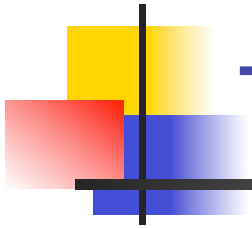
Plug-in Development

- Code Re-use
  - All logic directly from DrJava
  - Single point of control for bug fixes, feature improvements
- Refactoring DrJava
  - More modular design
  - Safe and easy: unit tests!



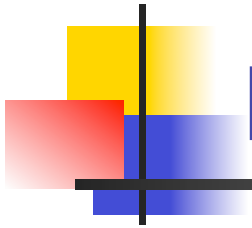
DrJava's Scalability

- DrJava team uses DrJava
  - Effective tool for its own development
  -
- Scales to Production Programming



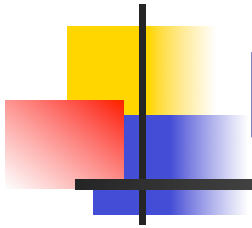
Teach Production Programming

- Use DrJava to teach production programming skills
  - Common, familiar environment
  - Select DrJava as course project!



Extend DrJava in a Course

- Students can:
  - Learn effective practices (XP)
  - Join an existing product team
  - Maintain a product
  - Support customers



Extreme Programming

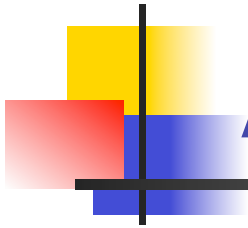
- Expose students to effective development practices
  - Ubiquitous unit testing
  - Pair programming
  - On-site customer
  - Incremental releases

Classroom Challenges

- Time constraints
- Scarce resources
-
- How to:
  - Quickly transfer knowledge?
  - Adapt Extreme Programming?
  - Manage development?

XP: Knowledge Transfer

- Pair Programming
  - With experienced TAs
  - With other students
  -
- Unit Tests
  - Executable documentation

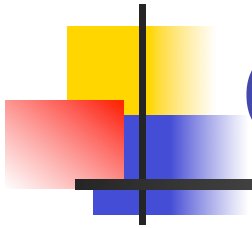


Adapting XP for Classroom

- Pair Programming
  - Lab time, students select own pairs
- On-site Customers
  - Students themselves (using DrJava)
- No fixed deadlines
  - Require 10 logged hours per week

Managing Development

- TA's as Project Managers
- `SourceForge.net`
  - Free open source project hosting
  - Professional quality management
    - Bug reports
    - Feature requests
    - Task management

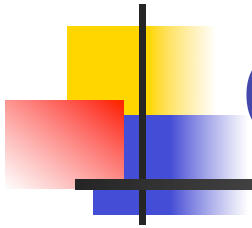


Case Study: COMP 312

- Early unit test assignment
- Bug fixes
- Large features in small tasks
  - 2002: JUnit support, debugger, configurability
  - 2003: Interactive debugger, Javadoc, interactions pre-processor

Results

- DrJava effective for production programming
  - Used in its own development
- Eclipse plug-in eases transition
- Excellent results from 312
  - Many core features implemented
  - Students exposed to process



Conclusion

- Pedagogic IDEs can scale to production development
  - DrJava’s simplicity preserved
  - Effective for large projects
  - Useful for teaching production programming skills