



A Qualitative Comparison of Three Aspect Mining Techniques

M. Ceccato, M. Marin, [K. Mens](#),
L. Moonen, T. Tourwé, P. Tonella

Aspect mining

- Identification of crosscutting concerns in existing software systems
- Starting point for system exploration
- Support program comprehension, software maintenance and evolution
 - e.g. migrating to an AOP solution

Goal: high degree of automation

Comparison and combination of mining techniques

- Understand what “assumptions” (about crosscutting concerns) the techniques rely on
- Evaluate strengths and weaknesses
- Mutual filtering / completion
- Enhance automation through a multi-technique approach and tool

Three aspect mining techniques



– Identifier Analysis –



Use FCA to group classes/methods with similar names

	figure	drawing	request	remove	update	change	event	...
drawingRequestUpdate(DrawingChangeEvent e)	-	X	X	-	X	-	-	...
figureRequestRemove(FigureChangeEvent e)	X	-	X	X	-	-	-	...
figureRequestUpdate(FigureChangeEvent e)	X	-	X	-	X	-	-	...
figureRequestRemove(FigureChangeEvent e)	X	-	X	X	-	-	-	...
figureRequestUpdate(FigureChangeEvent e)	X	-	X	-	X	-	-	...
...	X

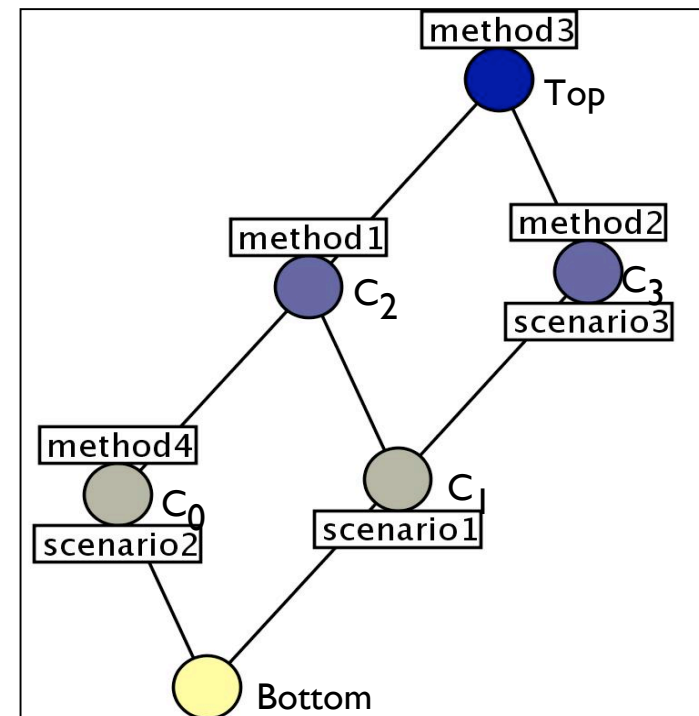
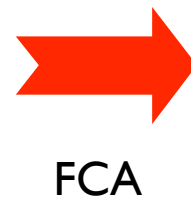
Three aspect mining techniques



– Dynamic Analysis –

Use FCA to associate methods with the most specific use case scenarios in which they are executed

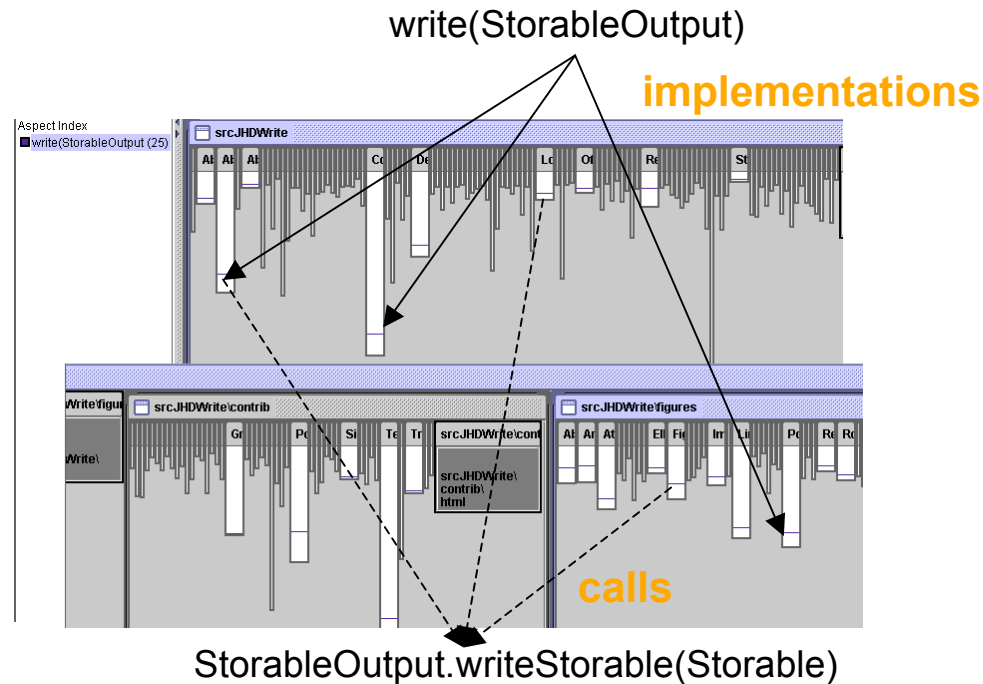
	meth ₁	meth ₂	meth ₃	meth ₄
scen ₁	x	x	x	
scen ₂	x		x	x
scen ₃		x	x	



Concept lattice with sparse labeling

Three aspect mining techniques

– Fan-in analysis –



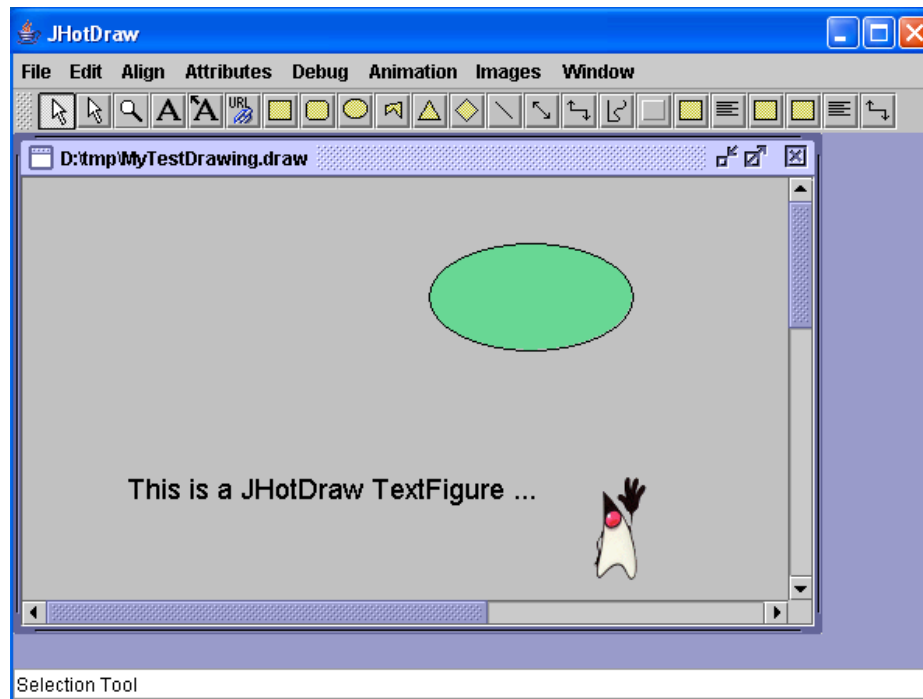
Persistence concern

Concerns

- Contract enforcement
- Consistent behavior
- Scattered implementation relying on common functionality
- Design patterns with specific structure

JHotDraw

– common benchmark for aspect mining –



- Framework for 2D graphics
- ~18,000NCLOC
- Open-source (jhotdraw.org)
- Good design – GoF patterns (Gamma et al.)

Comparison

Concern	Fan-in analysis	Identifier Analysis	Dynamic Analysis
Observer	+	+	+
Consistent Behavior / Contract Enforcement	+	-	-
Command Execution	+	+	-
Bring to front / Send to back	-	-	+
Manage Handles	-	+	+
Move Figures	+ (discarded)	+	+

Conclusions drawn from the results

- Limitations
 - **Dynamic** analysis: misses functionalities exercised by *all* traces
 - **Fan-in**: only crosscutting with large extent
 - **Identifier** analysis: relies on naming conventions
- Combination (orthogonal properties) – enhance automation and improve individual results

Combination of techniques

- **Increased coverage**
 - the union of discovered results (fan-in + dynamic)
- **Improved completeness** for the discovered aspect “seeds”
 - more elements relevant to the aspect (+ identifier)
- **Coarse-grained aspects**
 - grouping of identifier analysis concepts (fan-in/dynamic)
- **Filtering**
 - Discard irrelevant concepts

Resources

- Detailed results
 - **Fan-in**: swerl.tudelft.nl/amr
 - **Dynamic analysis**: star.itc.it/dynamo/jhotdraw-detailed-results.html
 - **Identifier analysis**: ask me ☺
- *JHotDraw* as benchmark and *AJHotDraw* as showcase for aspect refactoring
- Tools: *Dynamo*, *FanInTool*, *DelfSTof*
- Collaborations
 - *AIRCo/AIRPort*