

## Motivation

**Problem 1: High maintenance cost**  
Soft. Maintenance = "iceberg" of soft. cost.  
Poor documented specs → High maint. costs.

**Problem 2: Issues with software reliability**  
Incorrect software wastes billions of dollars.  
Formal specs to verify against often unavailable.

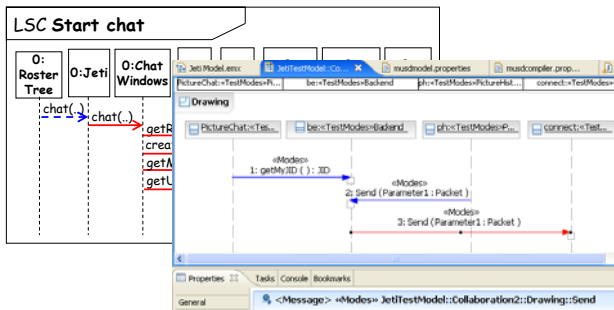
**One Solution: Software Specification Mining**  
Discovery of software specs from execution traces, code and other soft. artifacts

## Software Specifications

- Description of how a software system **should** behave.
- Comes in various forms and formalisms.
- Capture **different aspects** of software design and implementation decisions.
- Various **forms** of specifications:
  - Sequence Diagrams (formal & informal)
  - Temporal Rules and Constraints (formal)
  - Finite State Machines (formal)
  - Frequent Usage Patterns (informal)

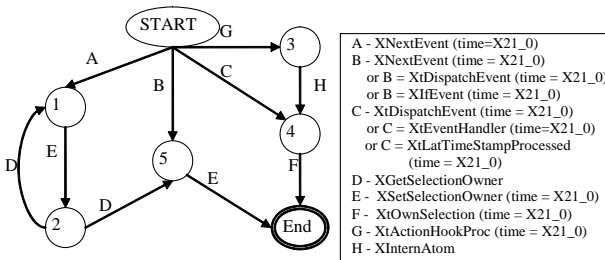
## Research Directions

### Jeti - Instant Messaging Application



Sequence Diagrams

Automata



A - XNextEvent (time=X21\_0)  
B - XNextEvent (time = X21\_0) or B = XiDispatchEvent (time = X21\_0) or B = XiEvent (time = X21\_0)  
C - XiDispatchEvent (time = X21\_0) or C = XiEventHandler (time=X21\_0) or C = XiLatTimeStampProcessed (time = X21\_0)  
D - XGetSelectionOwner  
E - XSetSelectionOwner (time = X21\_0)  
F - XiOwnSelection (time = X21\_0)  
G - XiActionHookProc (time = X21\_0)  
H - XInternAtom

Learner	k-len = 1			k-len = 3		
	Recall	Precs.	PS	Recall	Precs.	PS
k-tails	1.000	0.000	N/A	0.998	0.313	N/A
sk-strings	1.000	0.654	0.692	0.998	0.883	0.758
<b>SMaTIC</b>	<b>1.000</b>	<b>0.820</b>	<b>0.910</b>	<b>0.998</b>	<b>0.987</b>	<b>0.956</b>

X11 Windowing System - Xlib, XToolkit

### Resource Allocation:

"Whenever a resource is allocated, eventually it needs to be released"

**Windows WDK CancelSpinLock Rule:**  
"A device driver needs to call *IoAcquireCancelSpinLock* before calling *IoReleaseCancelSpinLock* and it needs to call *IoReleaseCancelSpinLock* before any subsequent calls to *IoAcquireCancelSpinLock*."

Temporal Rules or Ordering Constraints

Frequent Patterns

Connection Set Up	TxManager Set Up	Transaction Set Up	Transaction Commit	Transaction Disposal
TransactionManagerLocator.getInstance TransactionManagerLocator.locate TransactionManagerLocator.tryJNDI TransactionManagerLocator.usePrivateAPI	TxManager.begin XidFactory.newXid XidFactory.getNextId XidImpl.getTrulyGlobalId	TransactionImpl.associateCurrentThread TransactionImpl.getLocalId XidImpl.getLocalId LocalId.hashCode TransactionImpl.equals TransactionImpl.getLocalIdValue XidImpl.getLocalIdValue TransactionImpl.getLocalIdValue XidImpl.getLocalIdValue	TxManager.commit TransactionImpl.commit TransactionImpl.beforePrepare TransactionImpl.checkIntegrity TransactionImpl.checkBeforeStatus TransactionImpl.endResources TransactionImpl.completeTransaction TransactionImpl.cancelTimeout TransactionImpl.doAfterCompletion TransactionImpl.instanceDone	TxManager.releaseTransactionImpl TransactionImpl.getLocalId XidImpl.getLocalId LocalId.hashCode LocalId.equals

JBoss Application Server - Transaction

## Current/Future Work

- Extended Case Studies
- Extended Applications of Techniques in :
  - Security and Intrusion Detection
  - Program Verification, Testing, Debugging
  - Program Comprehension, Re-Engineering
- Visualization of Mined Specifications
- Analysis and Reasoning on Mined Specs

## References

- D. Lo, S. Maoz. Mining Scenario-based Triggers and Effects. ASE'08.
- D. Lo, S-C. Khoo, and C. Liu. Mining Temporal Rules for Software Maintenance. JSME'08.
- D.Lo, S-C. Khoo. SMaTIC: Towards Building an Accurate, Robust and Scalable Spec. Miner. FSE'06.
- D. Lo, S-C. Khoo and C. Liu. Eff. Mining of Iterative Patterns for Soft. Spec. Discovery. KDD'07.