UNIVERSITY
OF OSLO

State Machines with automatic code generation to JavaFrame

Version 050923 Revision 1

INF 5150

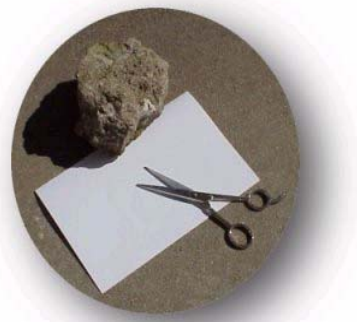
Our goals

- A good way of thinking for
  - modelers
  - programmers
- such that their programs will become:
  - rapidly made according to specification
  - have high quality
  - be efficient
  - maintainable by competent persons
  - be adaptive to a changing environment of requirements and third party software
- This should apply to large and small programs

Finite State Machines

- Finite
  - a finite number of states
  - [here] a *small* number of *named* states
- State
  - a stable situation where the process awaits stimuli
  - a state in a state machine represents the history of the execution
- Machine
  - that only a stimulus (signal, message) triggers behavior
  - the behavior consists of executing transitions
  - may also have local data

The Knoble game

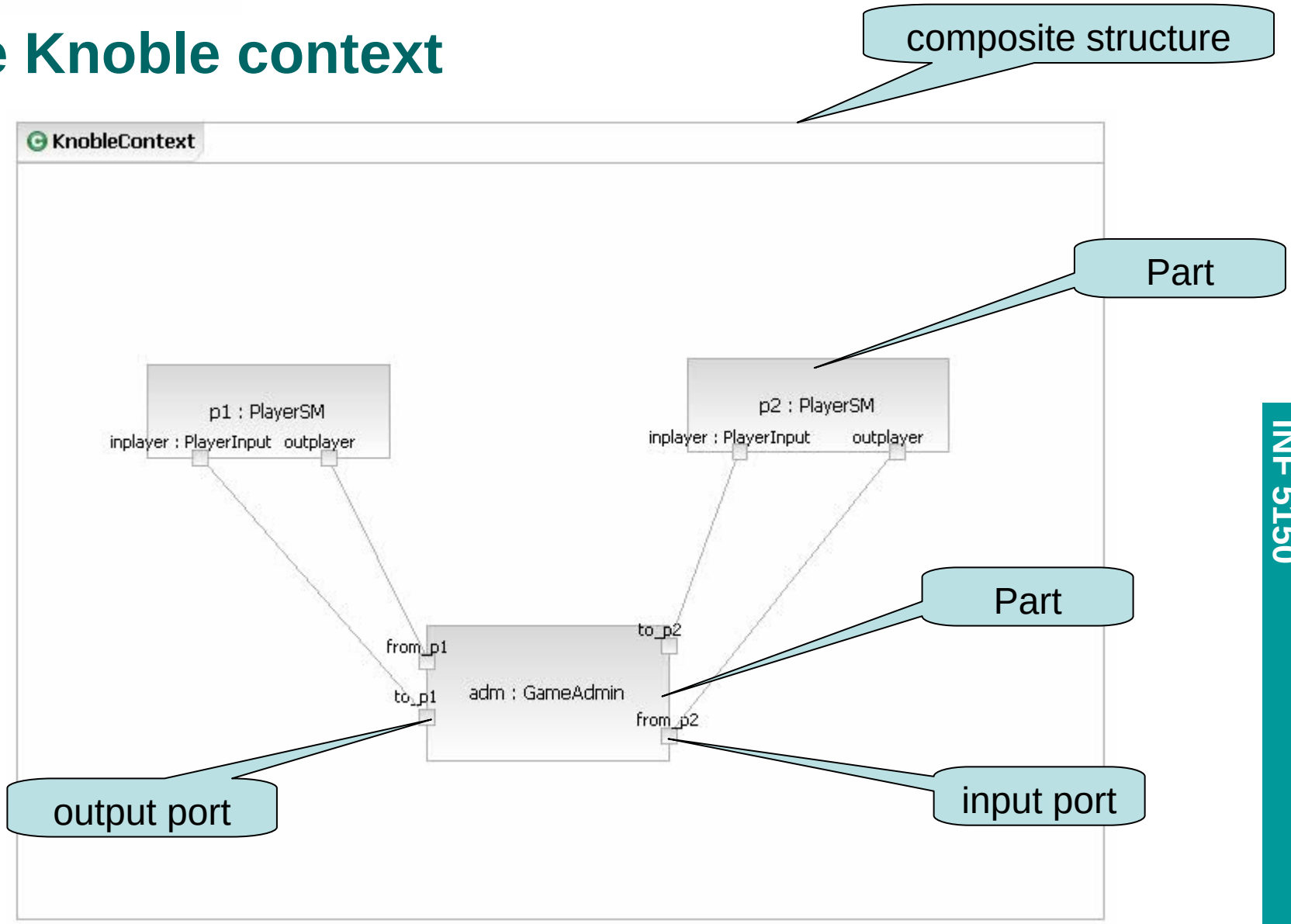


- A game administrator controls the game
- Invites the players
- The players make a draw like:

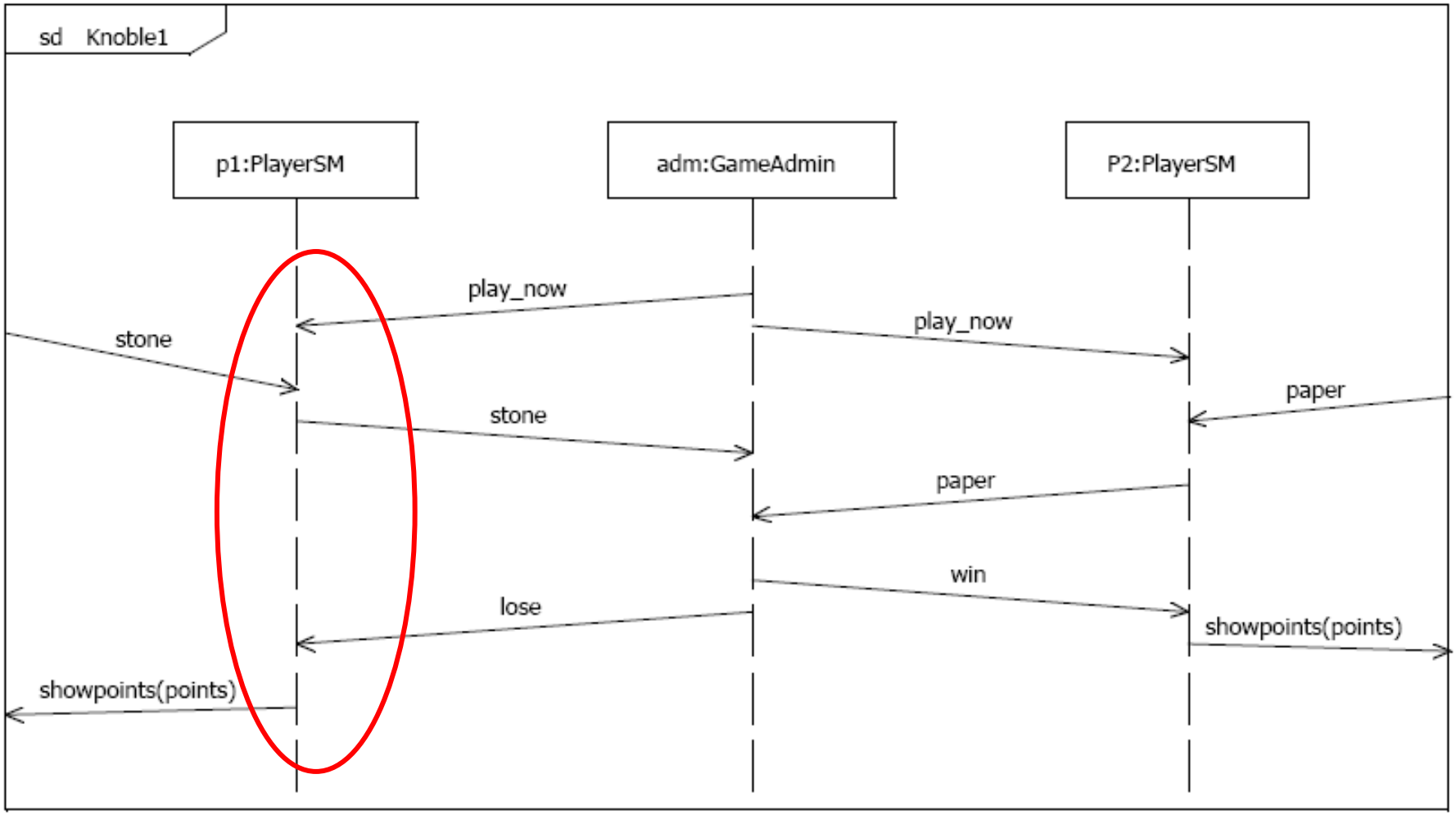


- The game administrator calculates the scores

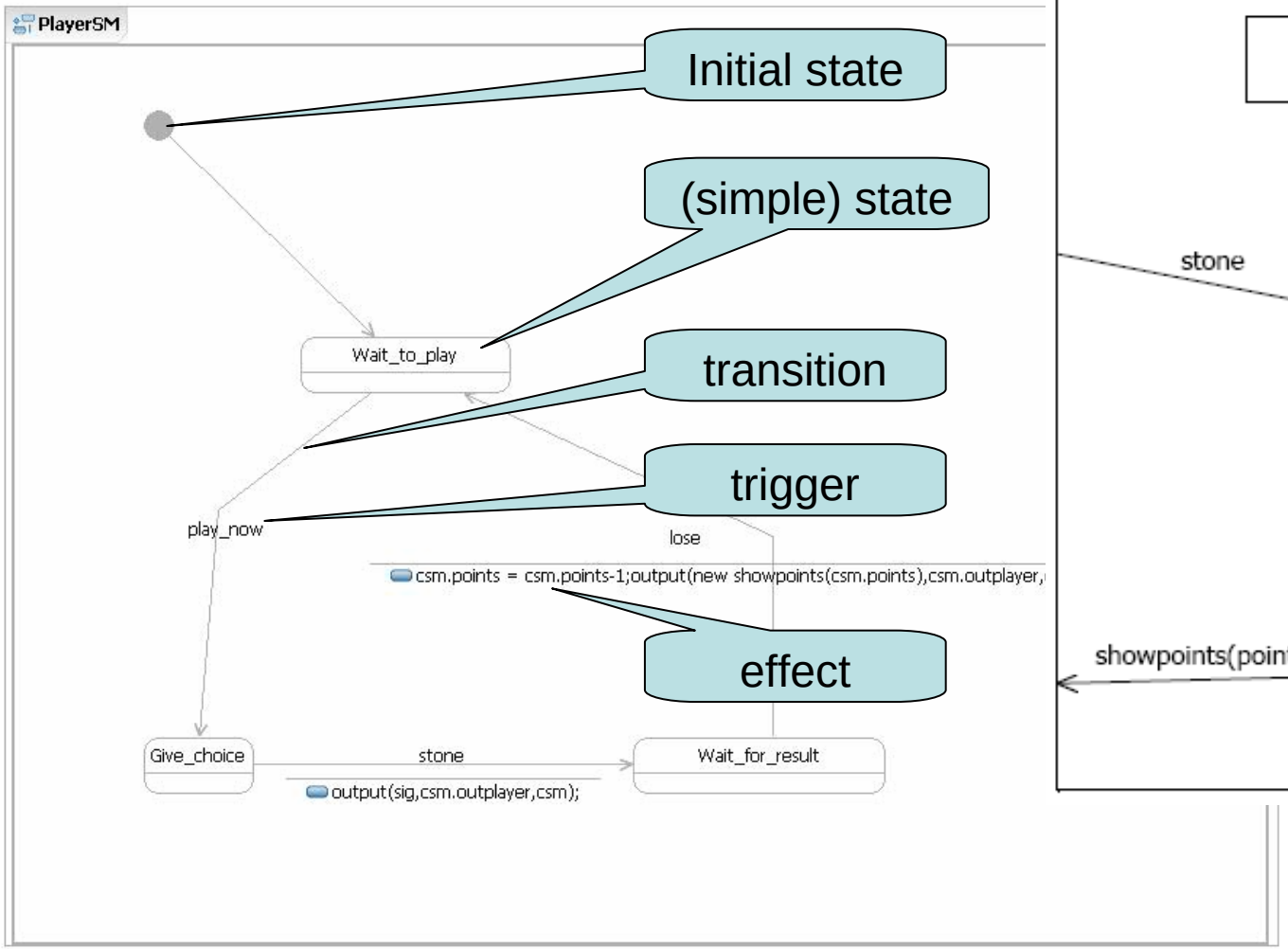
The Knoble context

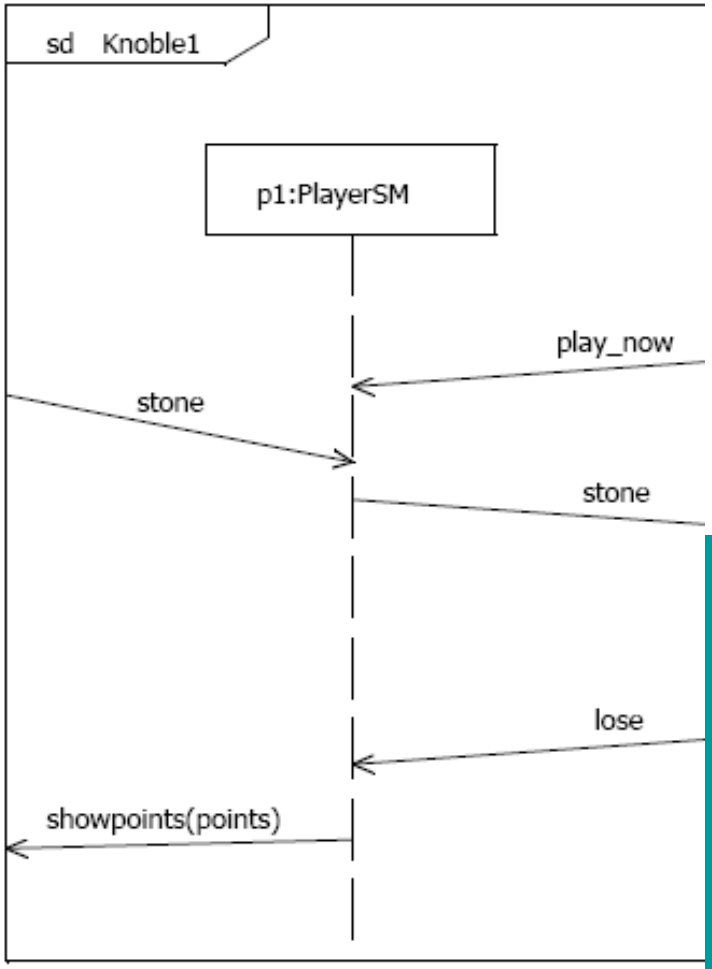


What happens?

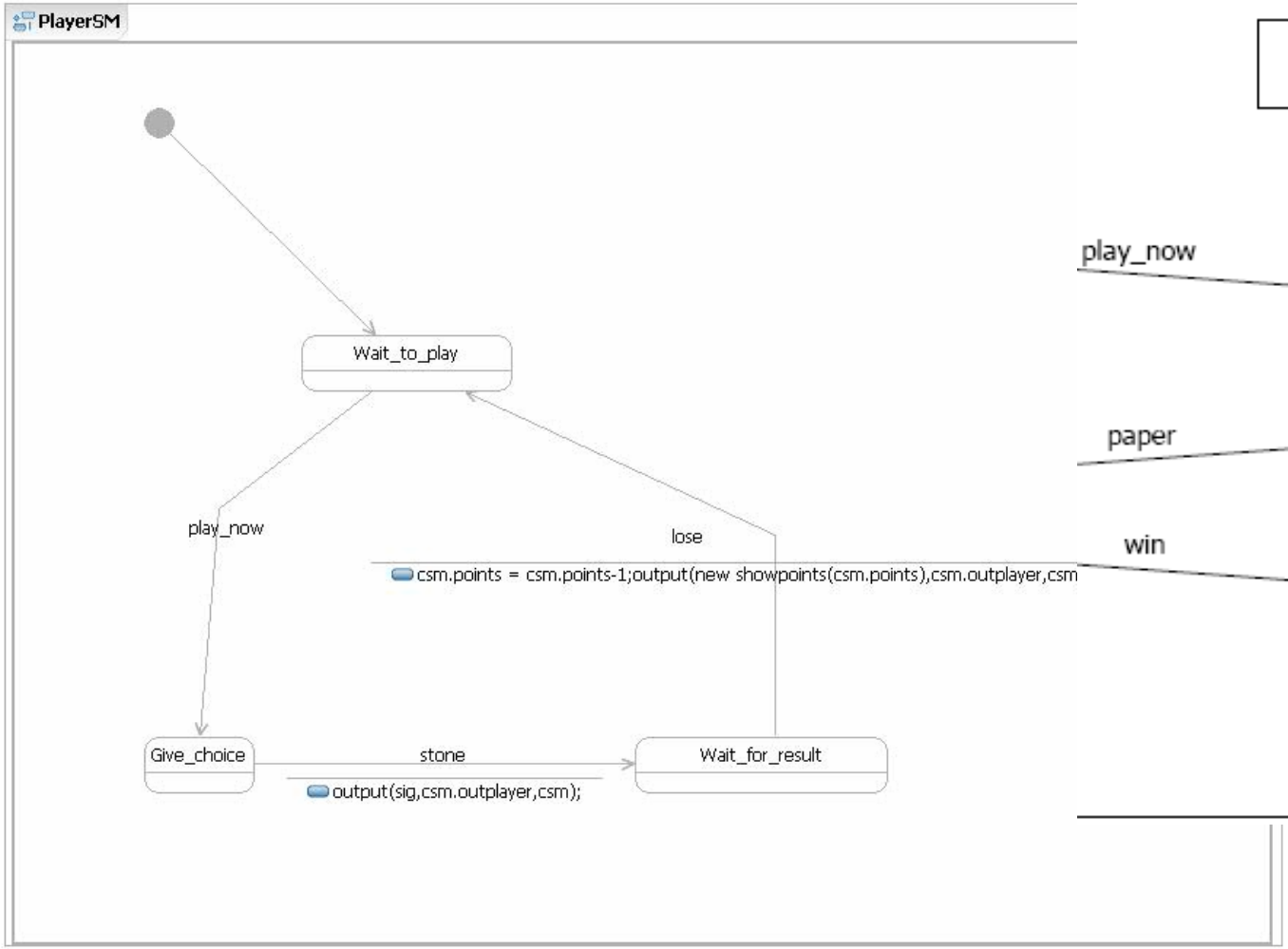


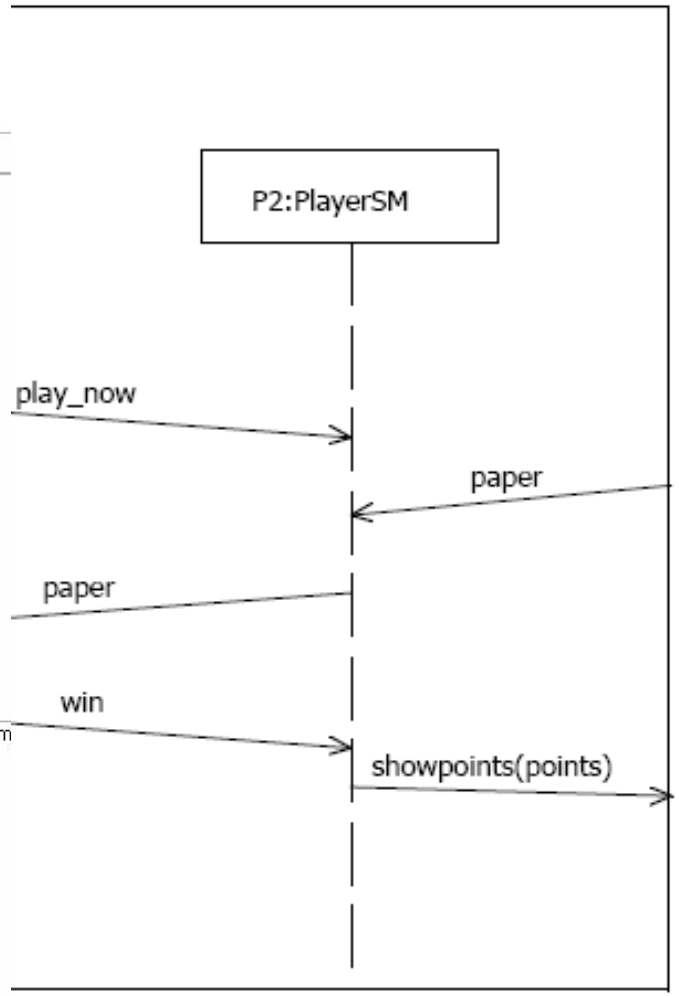
Player: first attempt



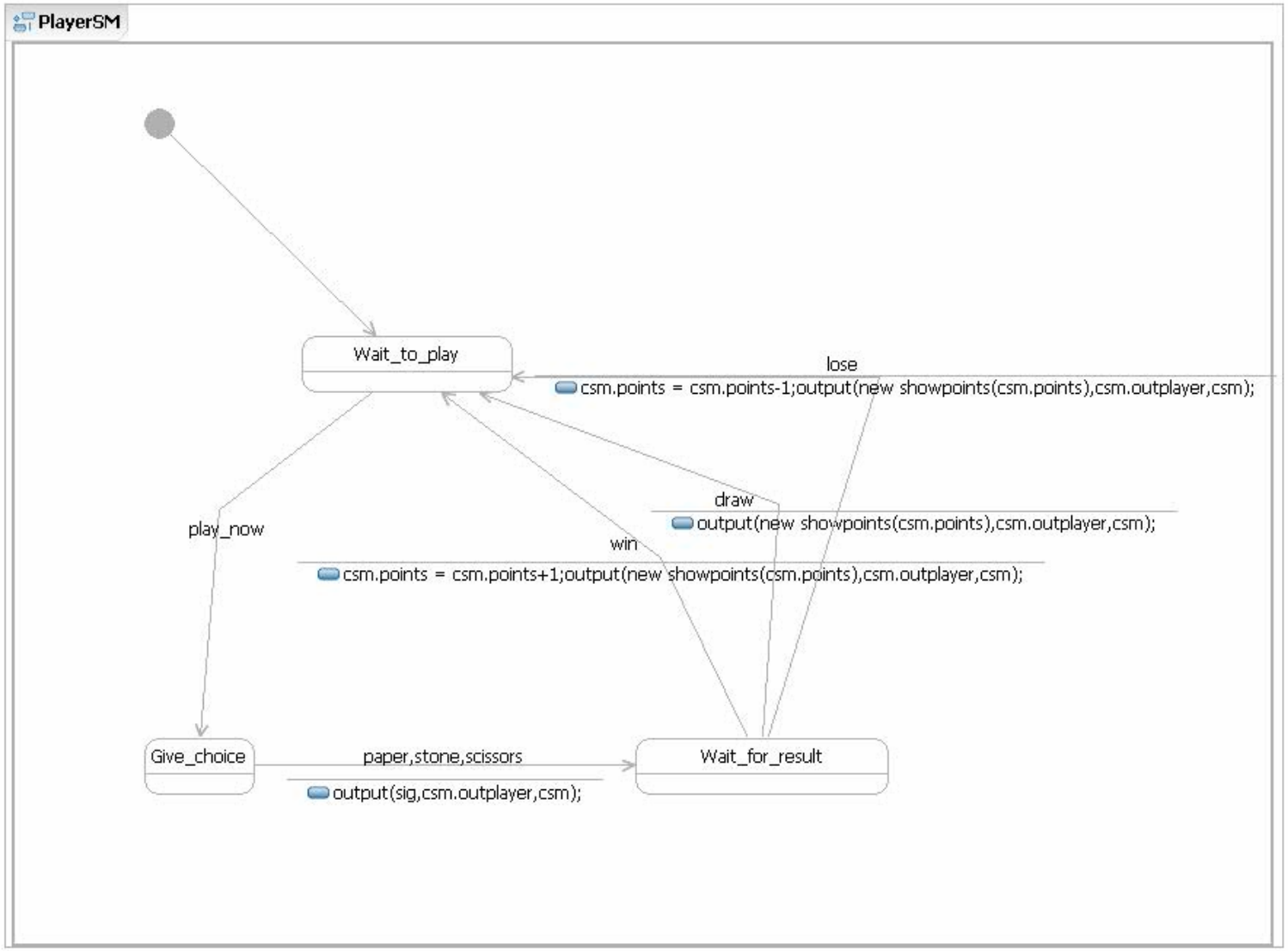


Player: why it is not sufficient

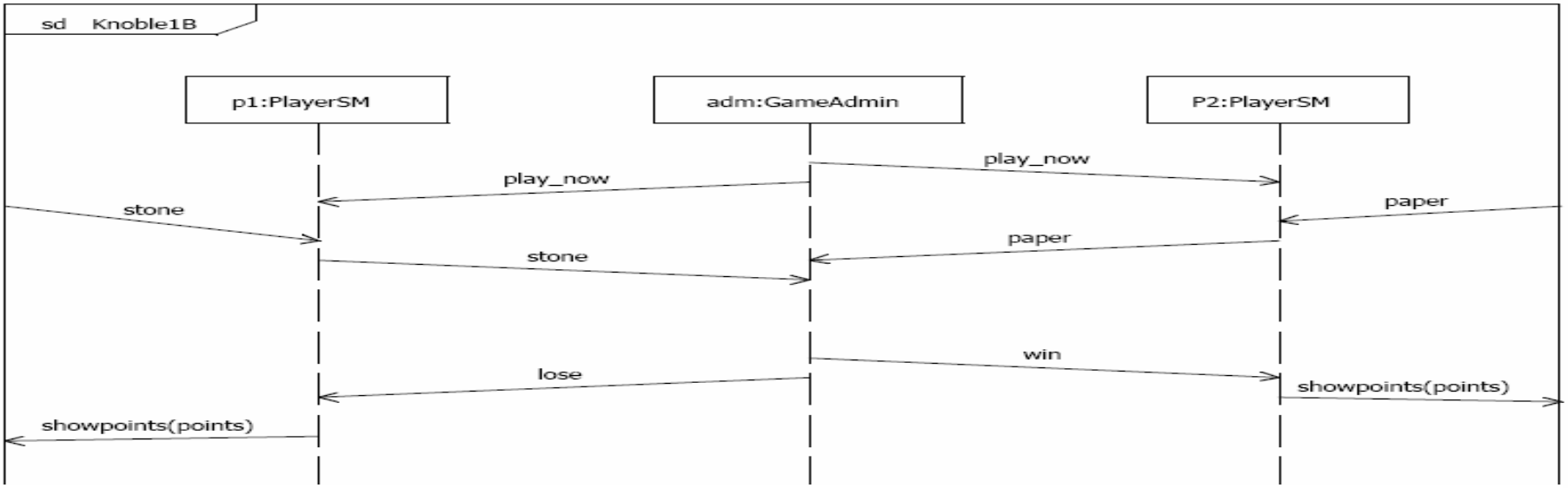


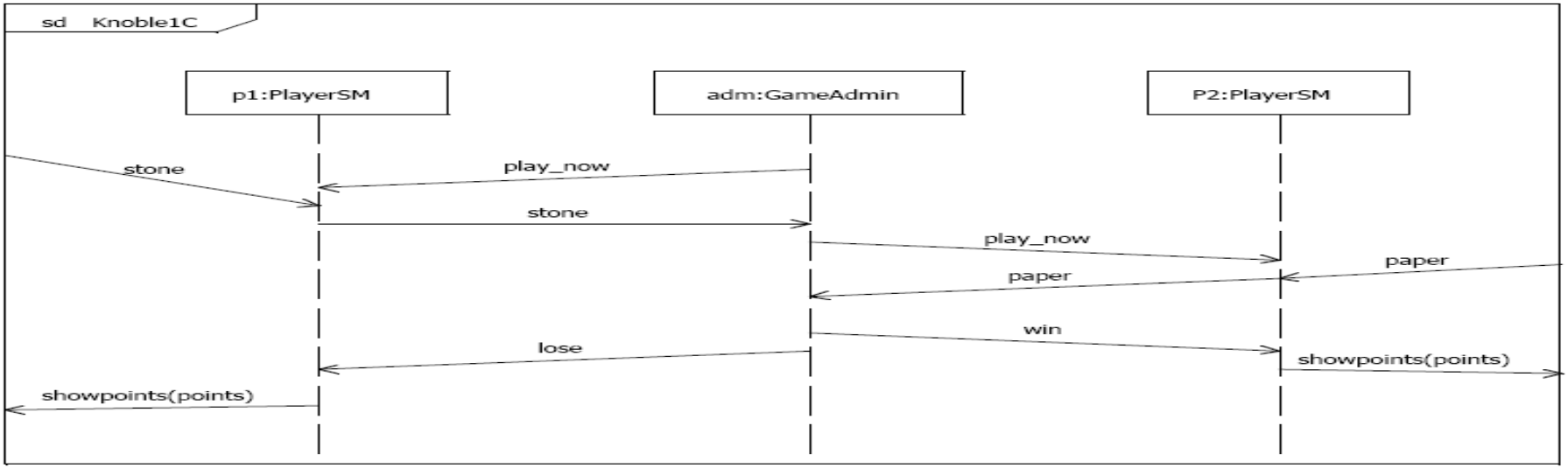


Player: second solution

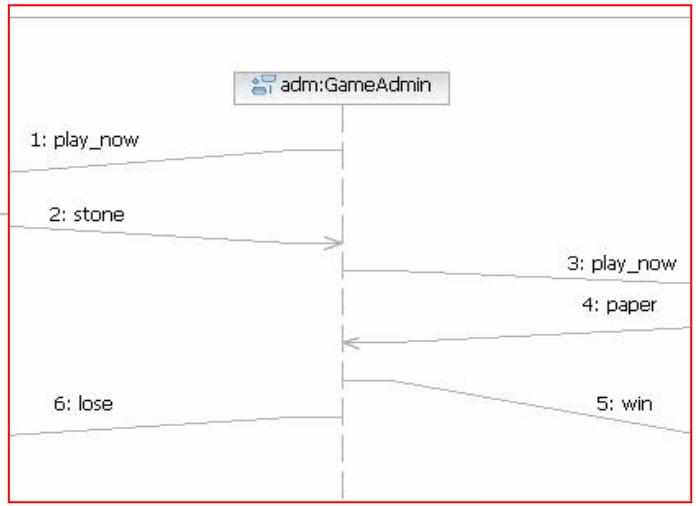


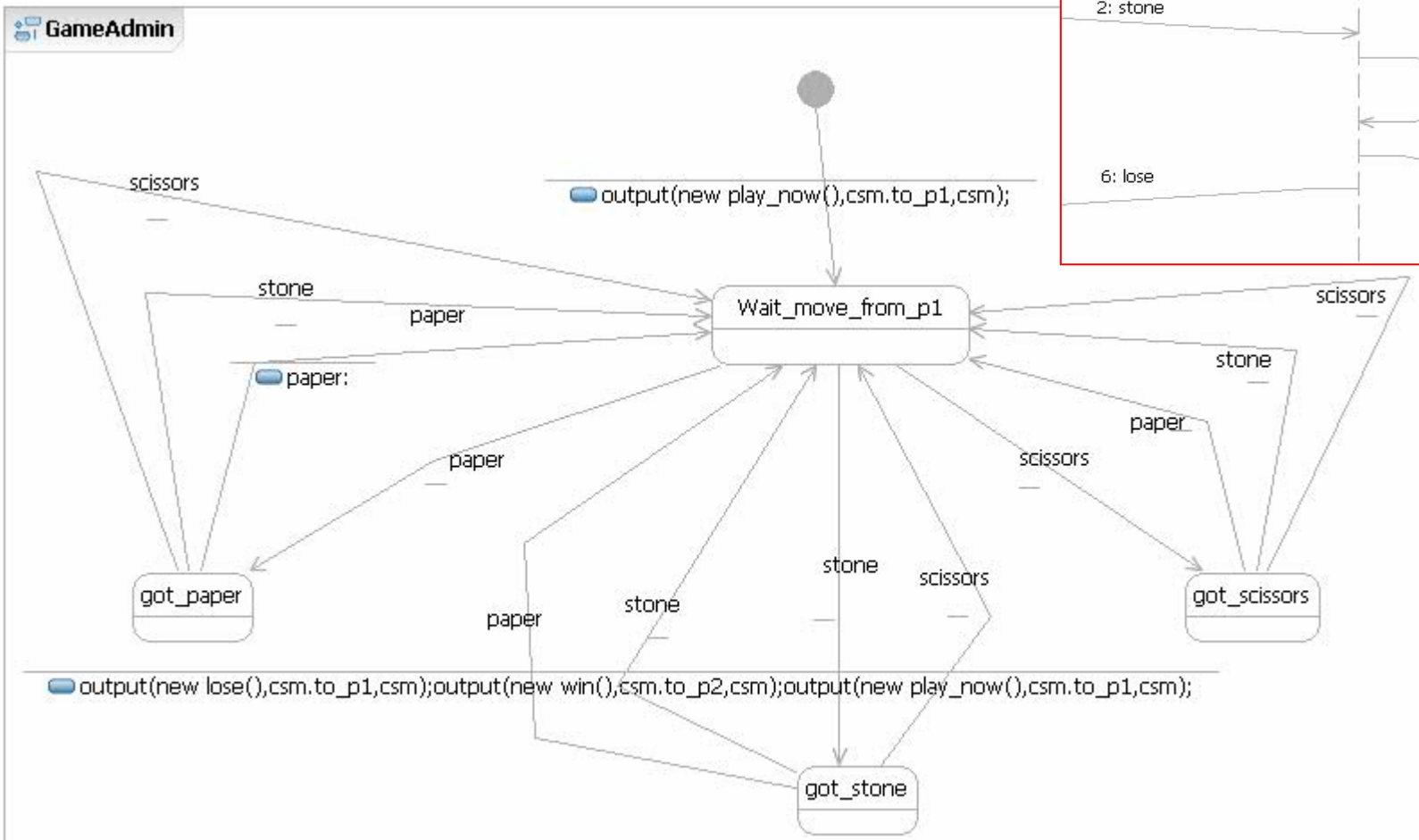
GameAdmin: are these diagrams acceptable?



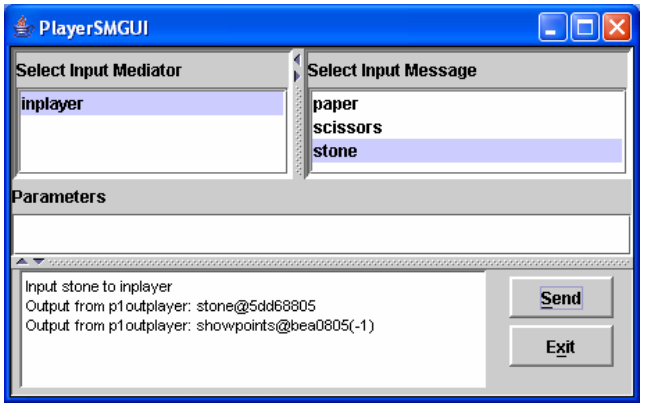


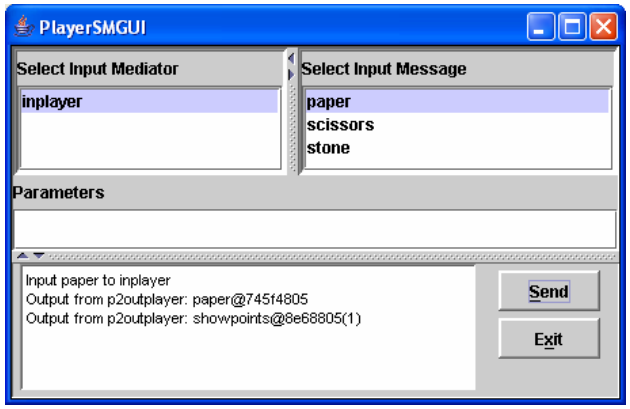
GameAdmin: first attempt





Demo Knoble2 (running JFTrace)



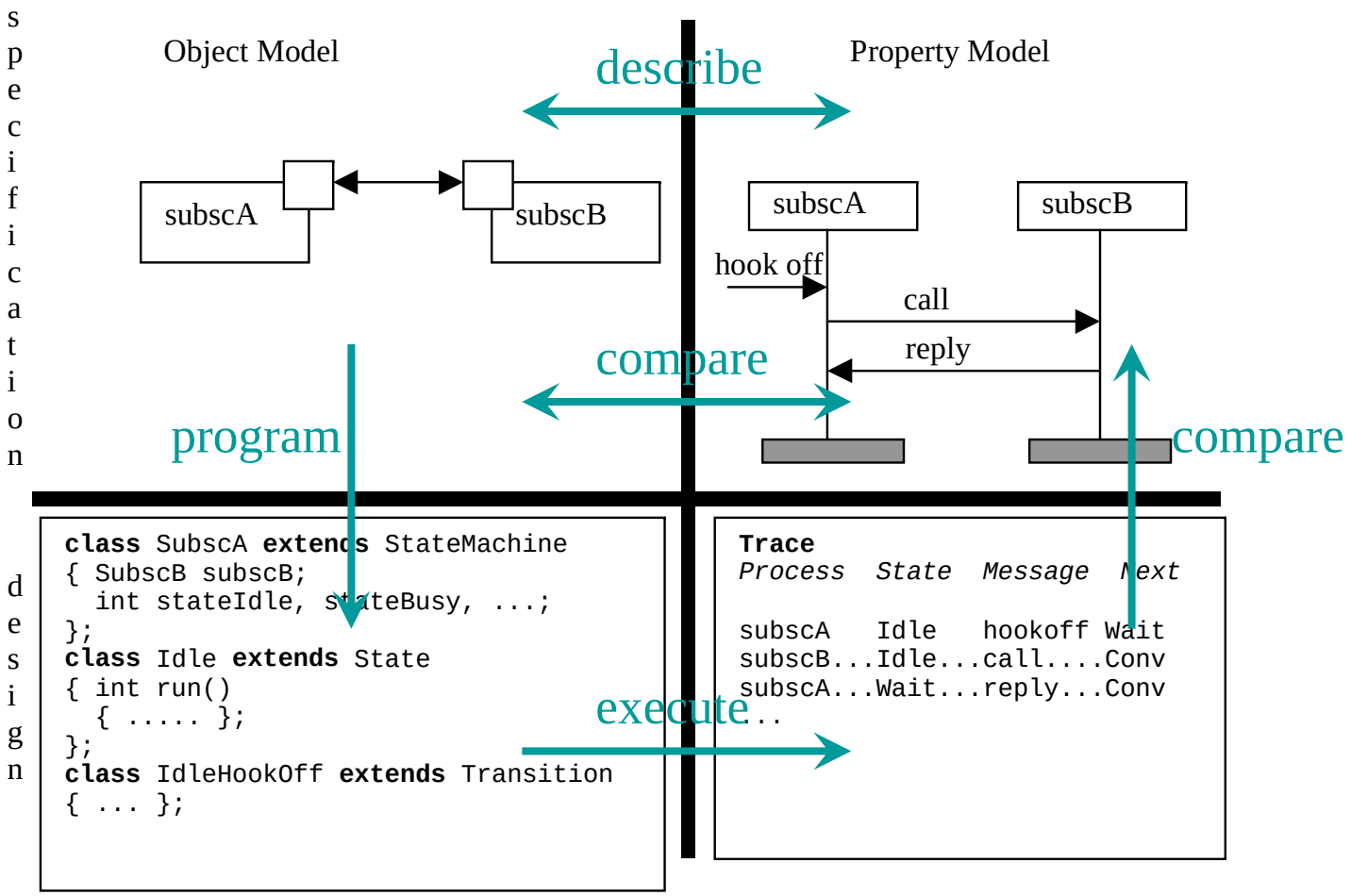


Filtered Trace from /127.0.0.1:54321 at 2005-09-22 13:53:15.269

Table View

Time	State Machine	Current State	Input	Transition Behaviour	Next State
0	New GameAdmin@aeec806				
0	New PlayerSM@35a4806				
0	New PlayerSM@60dd0806				
1052	GameAdmin@aeec806	null	StartMessage@b278806	Output play_now@20db8806	Wait_move_from_p1
1052	PlayerSM@35a4806	null	StartMessage@3700806		Wait_to_play
1052	PlayerSM@35a4806	Wait_to_play	play_now@20db8806		Give_choice
1052	PlayerSM@60dd0806	null	StartMessage@63354806		Wait_to_play
30274	PlayerSM@35a4806	Give_choice	stone@5dd68805	Output stone@5dd68805	Wait_for_result
30274	GameAdmin@aeec806	Wait_move_from_p1	stone@5dd68805	Output play_now@521f8805	got_stone
30274	PlayerSM@60dd0806	Wait_to_play	play_now@521f8805		Give_choice
38195	PlayerSM@60dd0806	Give_choice	paper@745f4805	Output paper@745f4805	Wait_for_result
38195	GameAdmin@aeec806	got_stone	paper@745f4805	Output lose@a888805 Output win@a478805 Output play_now@a168805	Wait_move_from_p1
38195	PlayerSM@35a4806	Wait_for_result	lose@a888805	Output showpoints@bea0805 (-1)	Wait_to_play
38205	PlayerSM@35a4806	Wait_to_play	play_now@a168805		Give_choice
38205	PlayerSM@60dd0806	Wait_for_result	win@a478805	Output showpoints@8e68805 (1)	Wait_to_play
38205	GameAdmin@aeec806	Wait_move_from_p1	showpoints@bea0805 (-1)		Default transition
38205	GameAdmin@aeec806	Wait_move_from_p1	showpoints@8e68805 (1)		Default transition

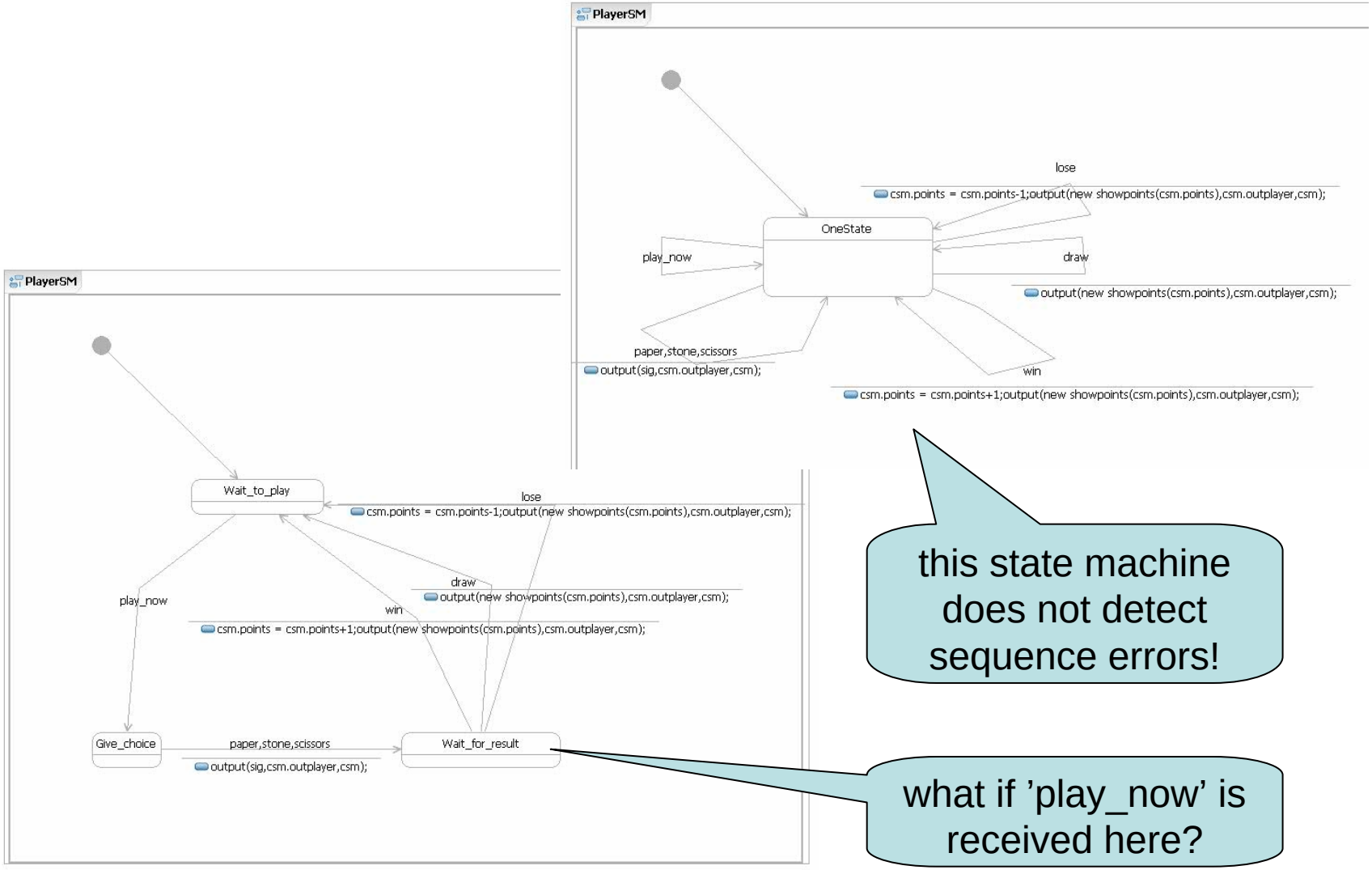
UML JavaFrame Profile Model analysis



State Machines: unassailability?

- Understandable
  - think locally, act globally
  - states represent compressed representation of execution history
- Robust
  - detect errors through discovering undefined transitions
- Maintainable
  - make additions and alterations with a minimum of ripple effects
- Analyzable
  - systems of state machines can be handled by model checkers
  - compare sequence diagrams with state machine(s)

PlayerSM: Compare these versions!



this state machine does not detect sequence errors!

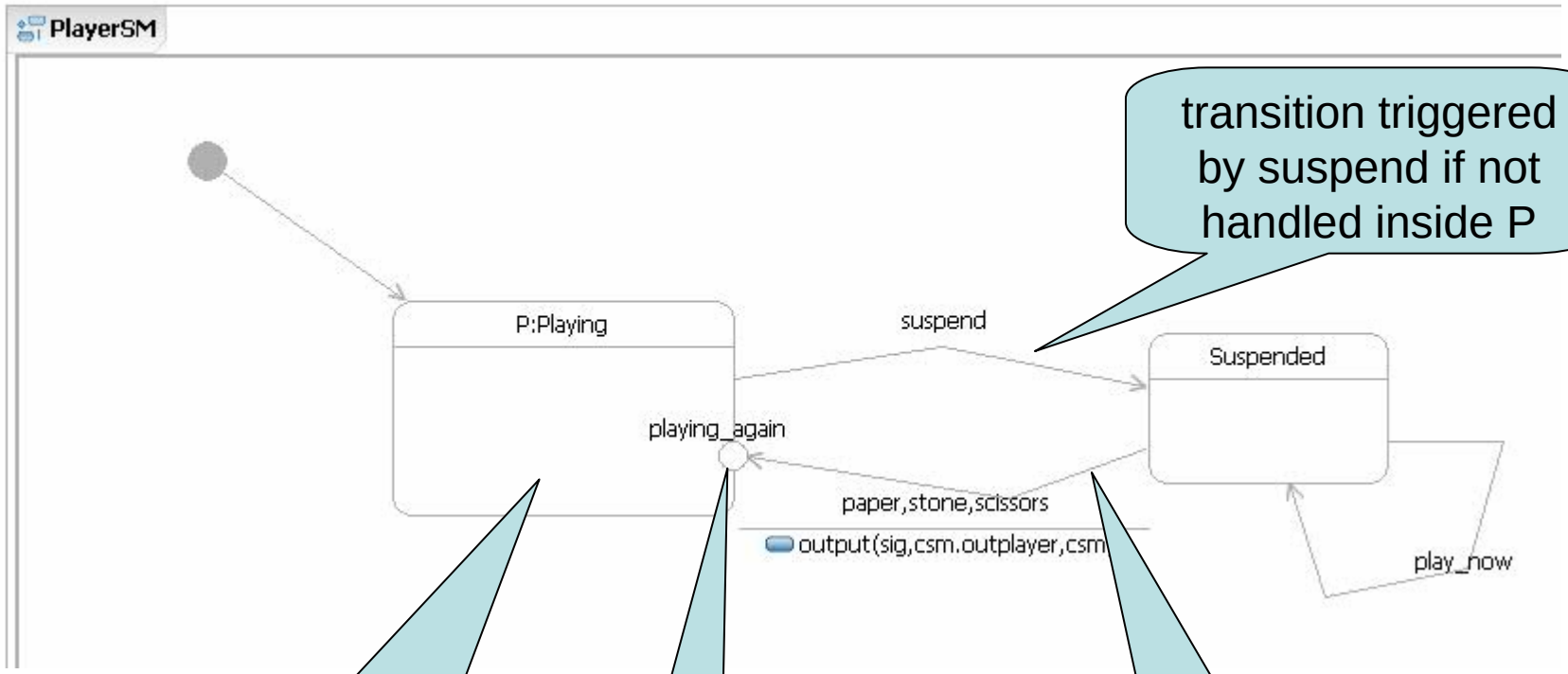
what if 'play_now' is received here?

INF 5150

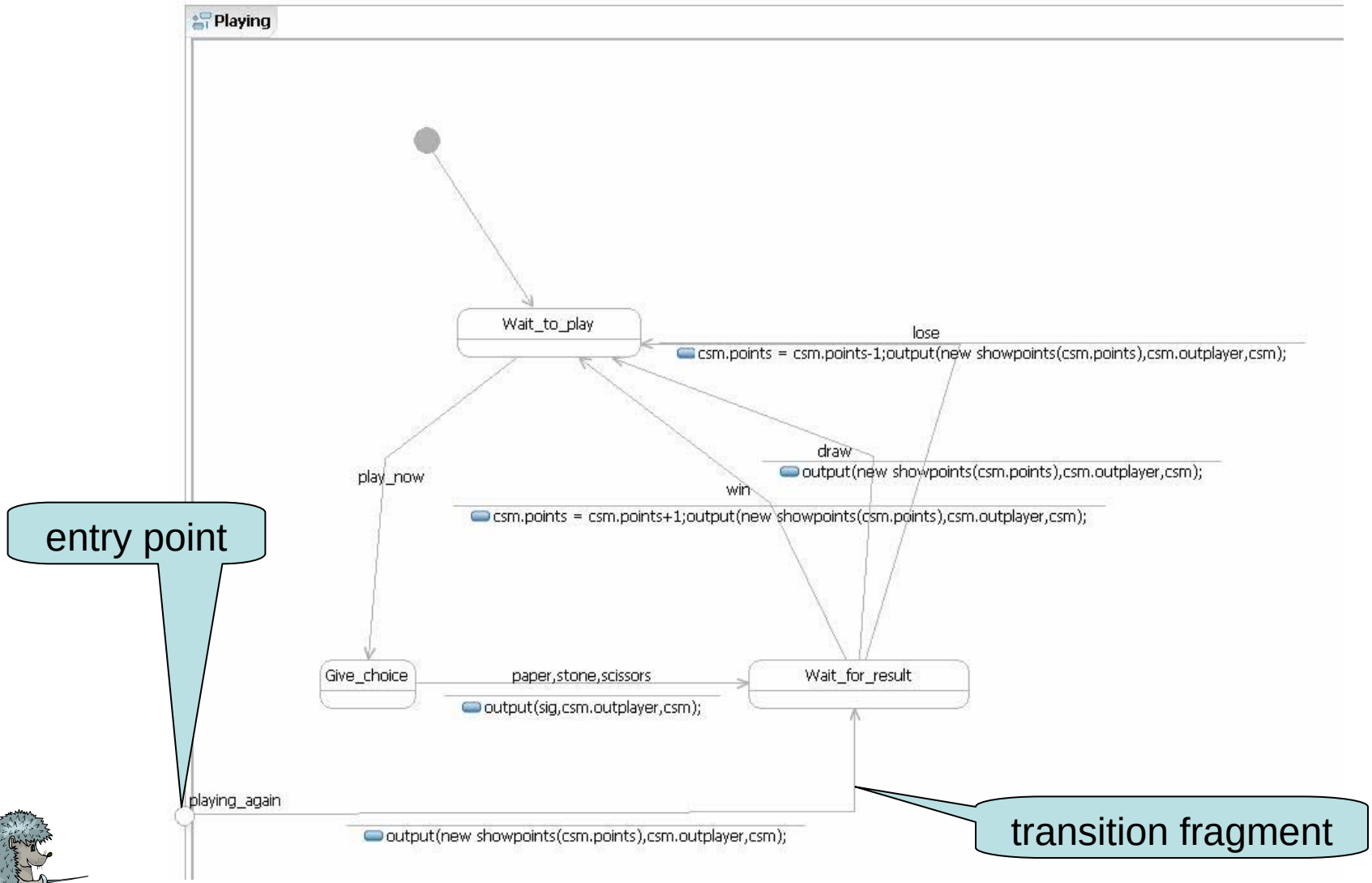
Knoble: Now we add another requirement

- Assume that the Player may at any time receive a 'suspend' message from the GUI
- This should have the effect that
  - the player will not play
  - until he/she receives a paper/stone/scissors message from GUI
    - then such a message is directly a move
- We would like to make this change
  - as compact as possible
  - without changing much of what is already made functioning

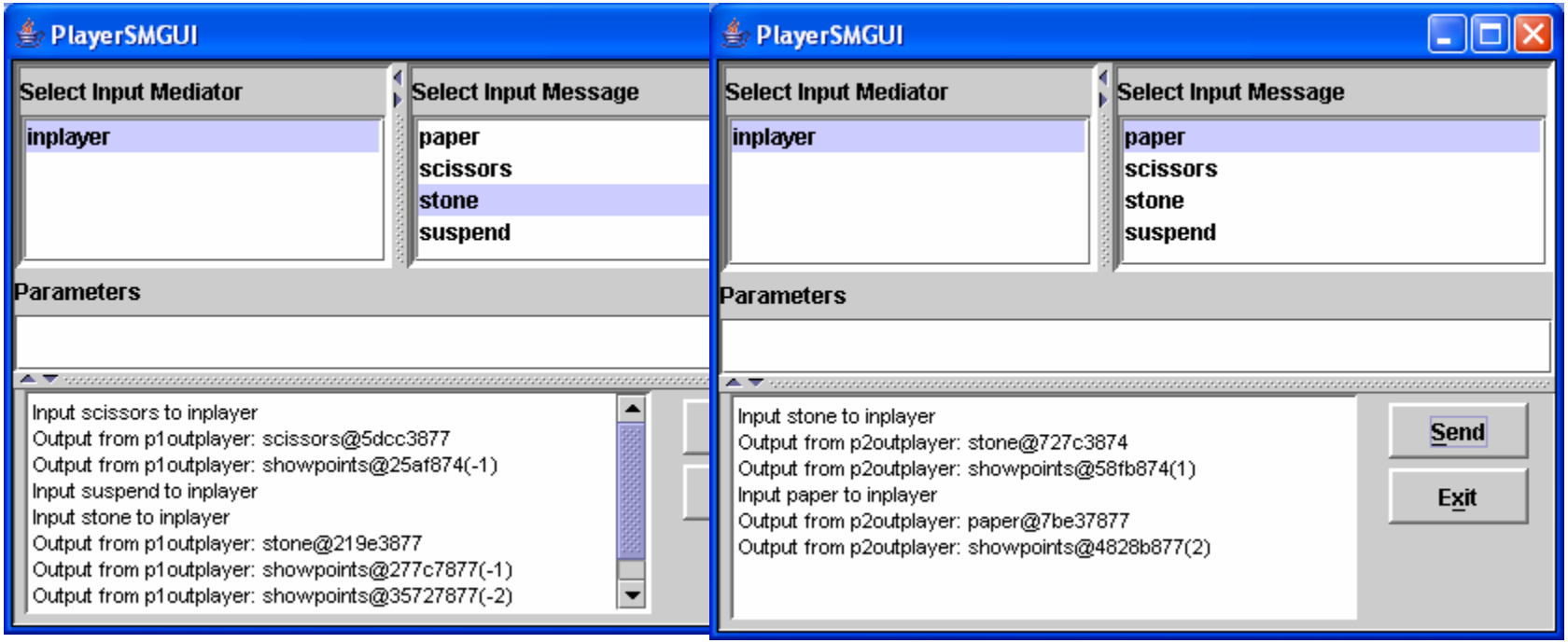
PlayerSM: Introducing Submachine states



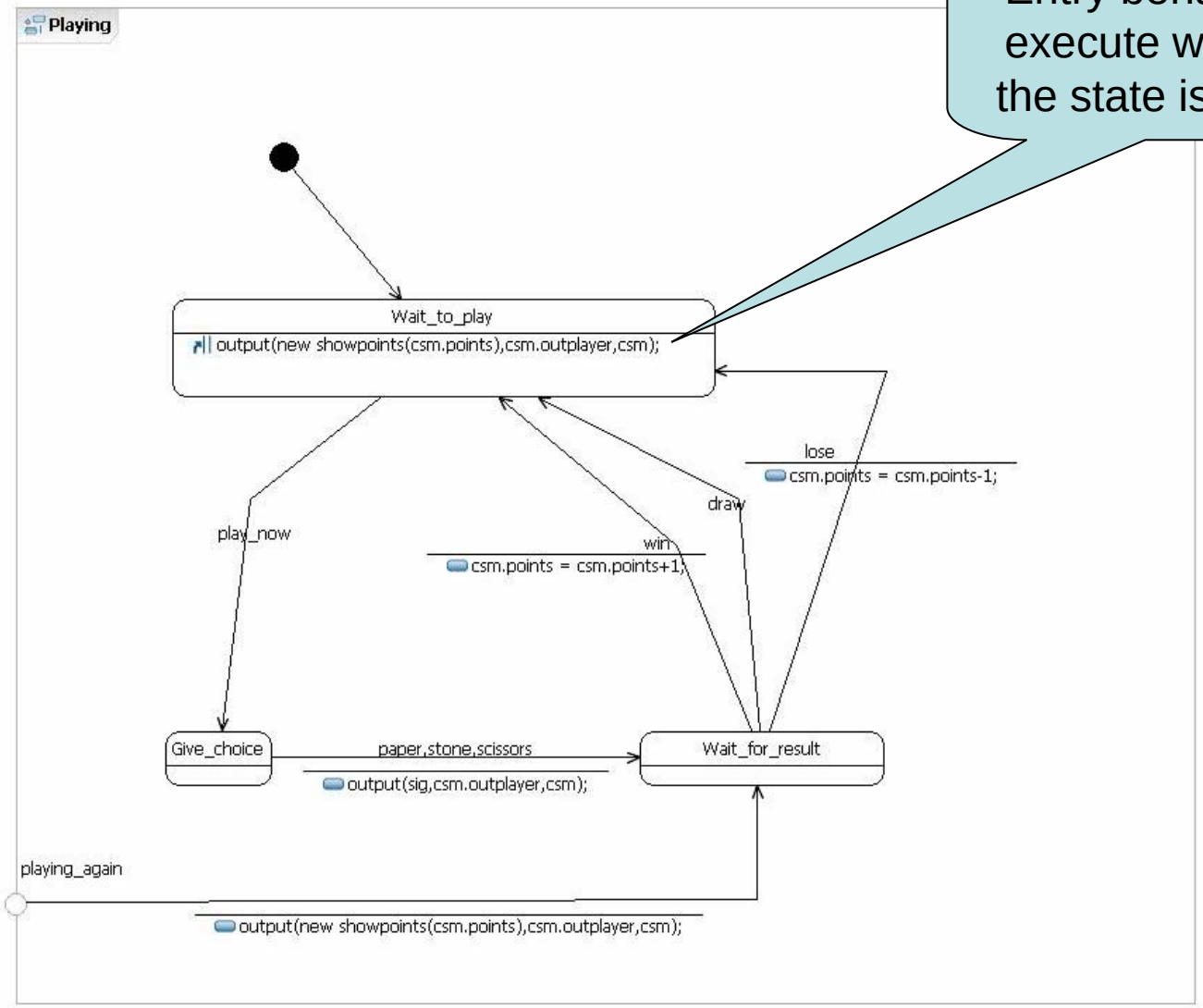
Playing: almost like the old Player with entry



Demo Knoble4 (not running JFTrace)



Entry and Exit behaviors

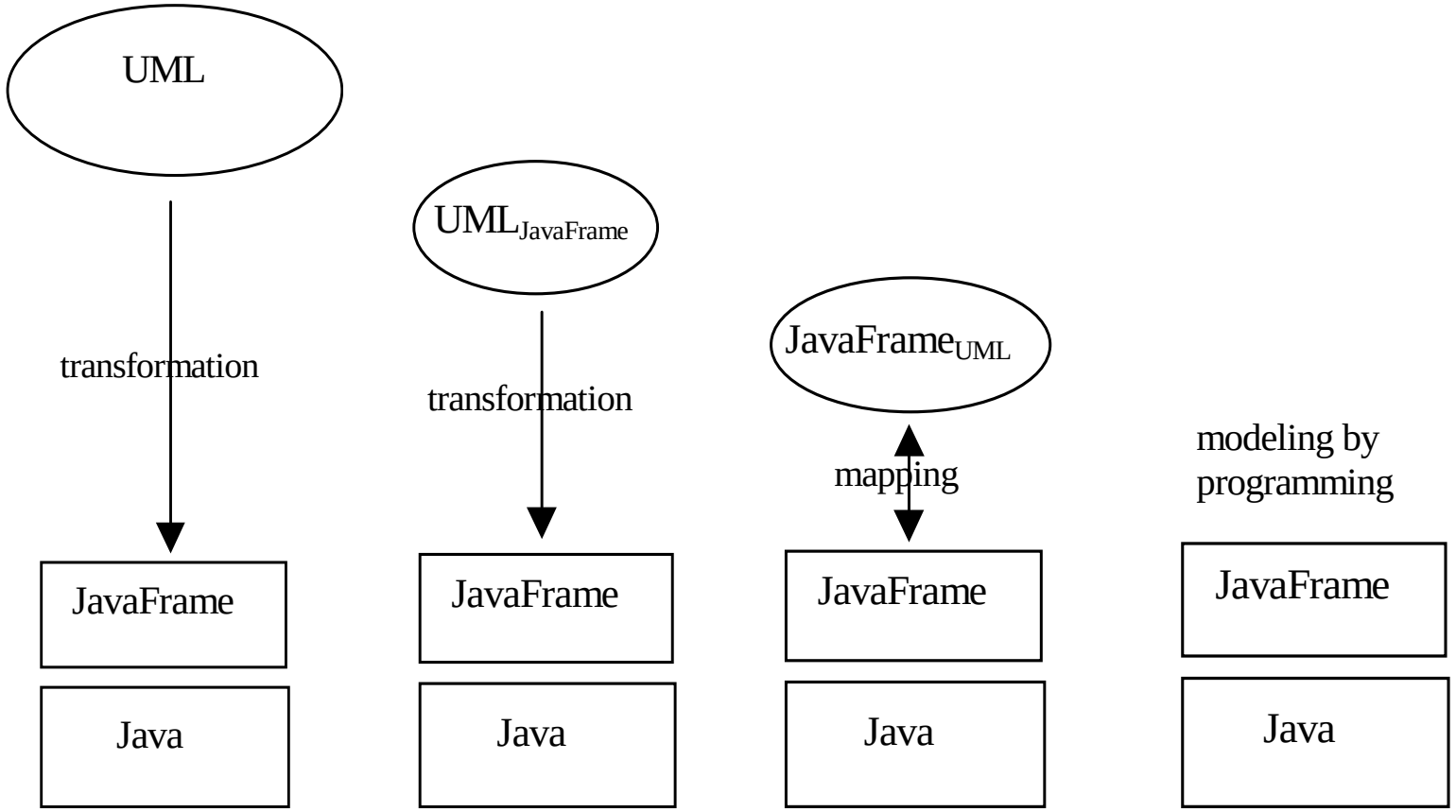


Entry behavior will execute whenever the state is entered

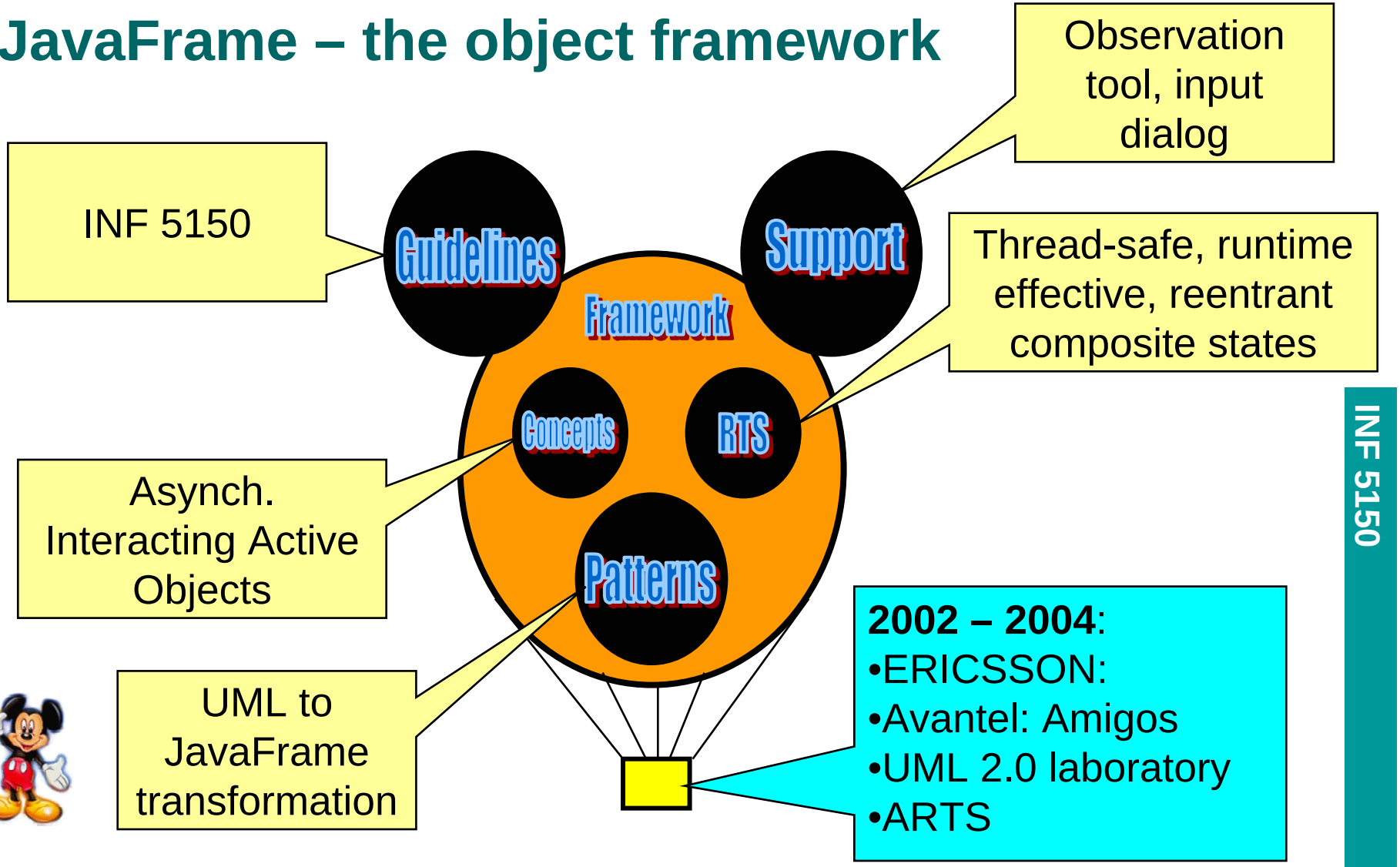
Summary State Machines

- State
  - finite number
  - simple or composite (submachine states)
- Transition
  - trigger
  - effect
- Exit and Entry Points
  - interface points within a runtime transition
- Exit and Entry Behaviors
  - behavior to be executed every time the machine exits or enters the state
- State machines may have variables (and parameters)

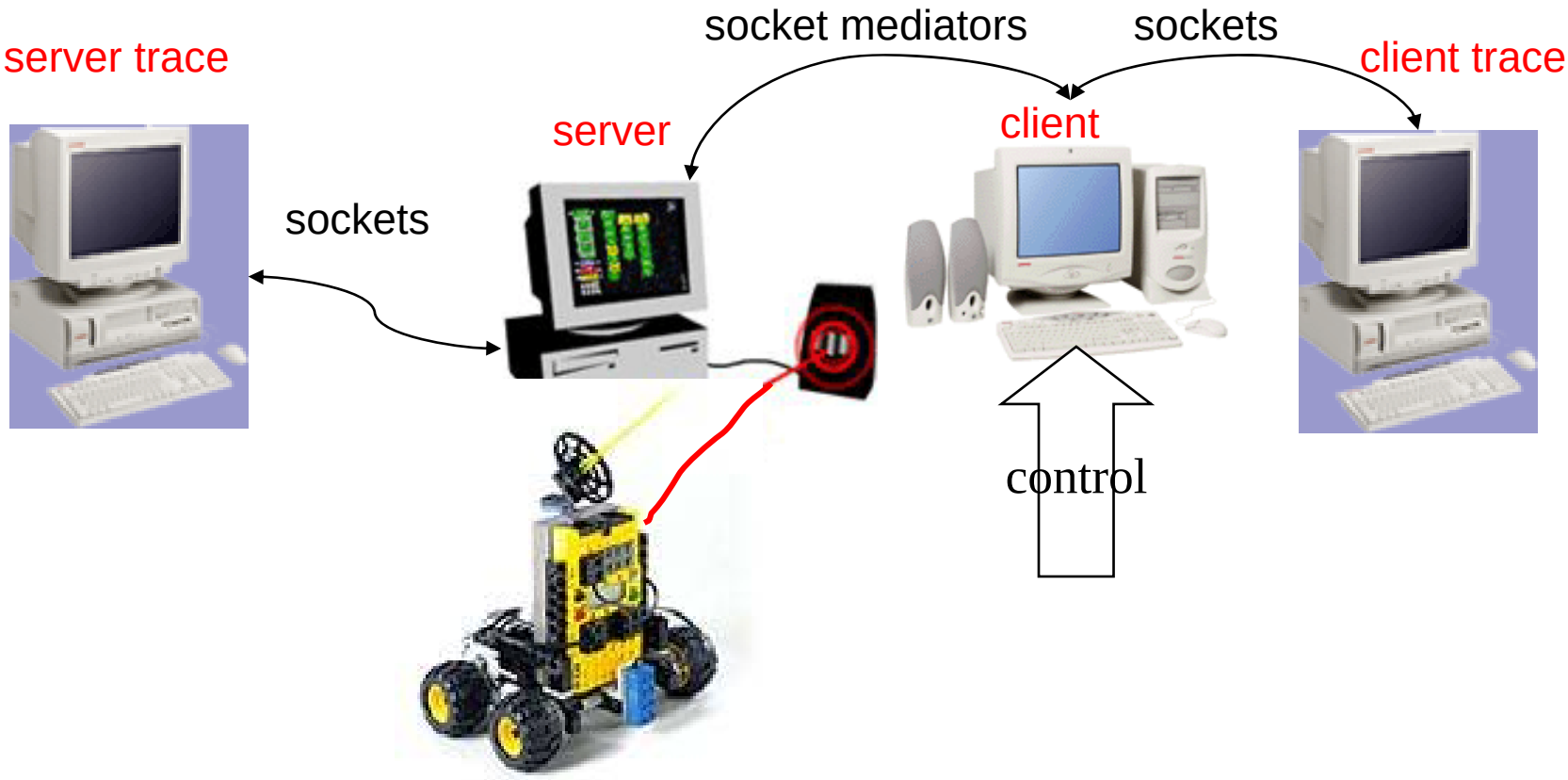
UML and Java: JavaFrame - the solution



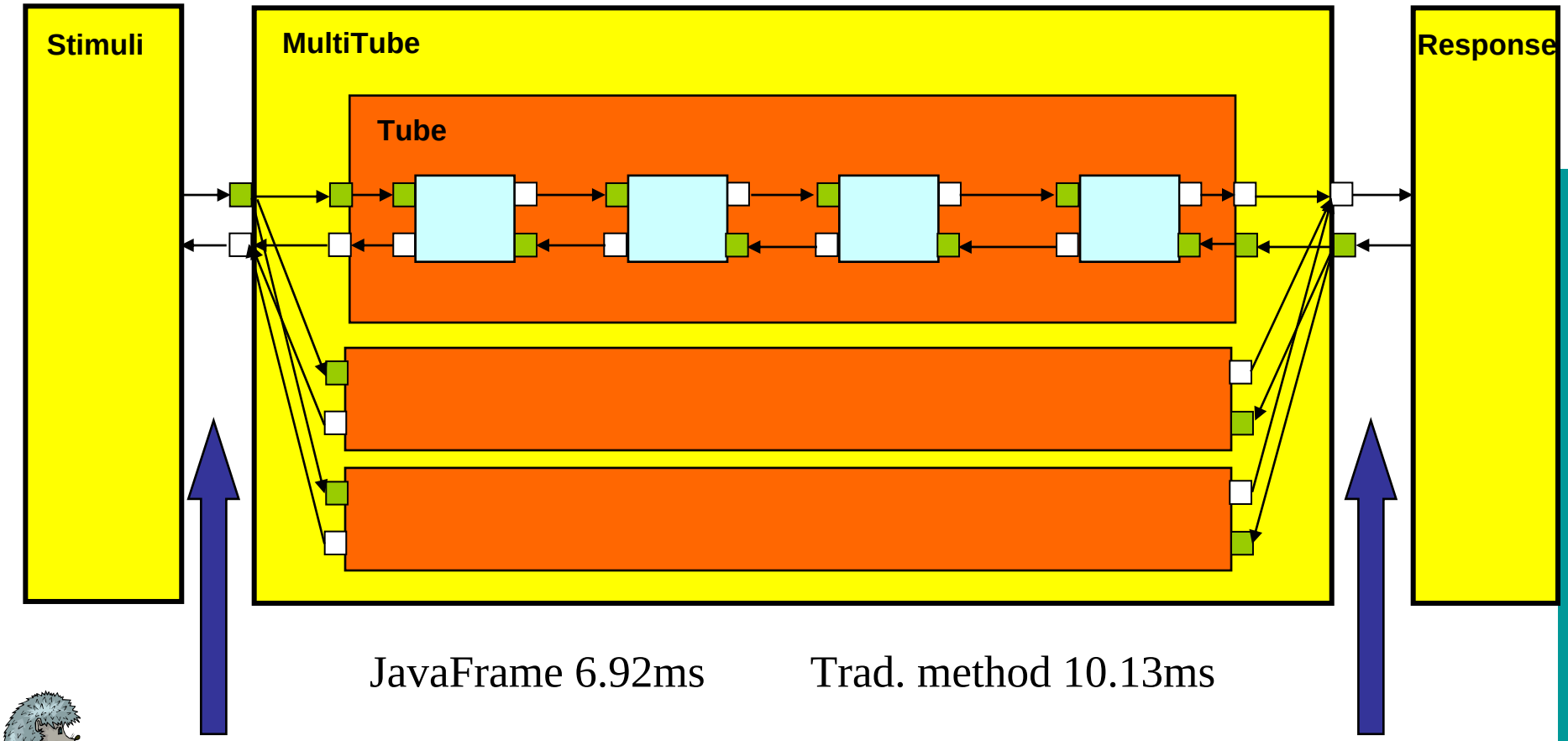
JavaFrame – the object framework



Experiences - The Lego Mindstorm experiment



Experiences - The Performance Model



JavaFrame 6.92ms Trad. method 10.13ms