Modeling and Validating Interaction Aspects in UML

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Aspects at Use-Case Level

- Why?
  - Separate cross-cutting requirements
  - Avoid tangled requirements documentation
  - Facilitate requirements change
  - *Support clear thinking process*
- *Clear thinking process*
  - Represent aspects/non-aspects separately
  - Weave aspects/non-aspects
  - Execute aspects/non-aspects for validation

Represent Aspects/Non-Aspects

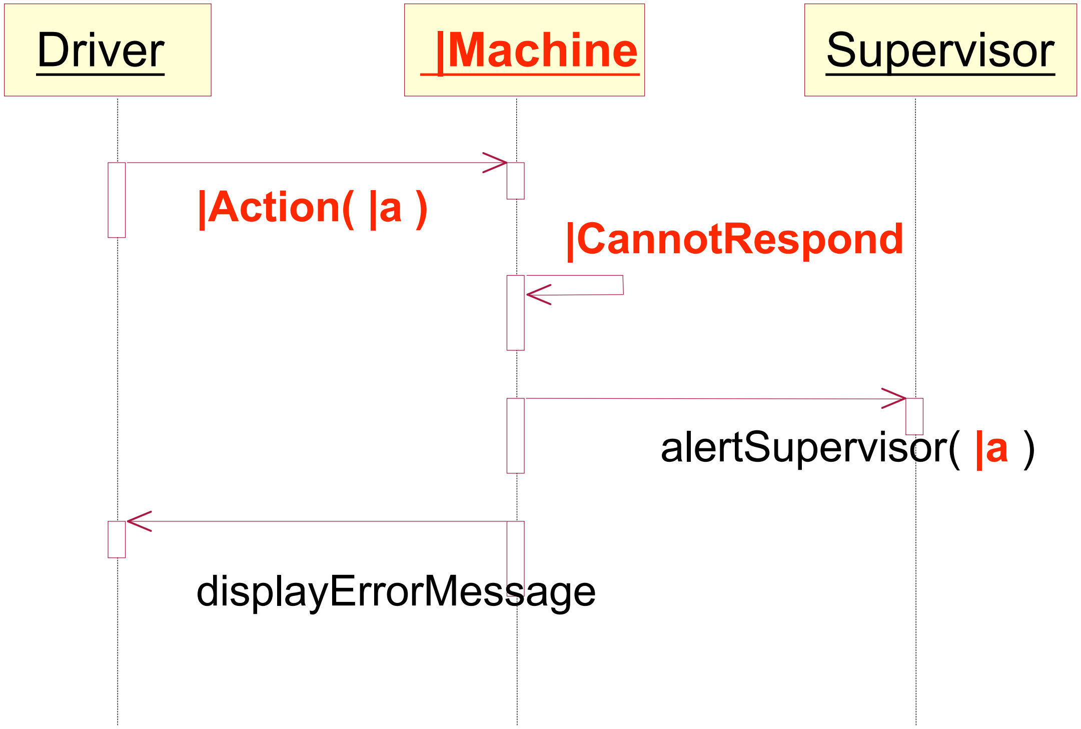
- Focus on interactions (UML Sequence Diagrams)
  - Non-aspects are just sequence diagrams
- Aspects are *Interaction Pattern Specifications* (Kim et al.)
- Weaving is specialized composition
- Execution is translation to state machines (Whittle & Schumann algorithm)

Interaction Pattern Specifications

- Specialization of the UML metamodel
  - each element is a *role* (a UML metaclass with additional properties)
- Instantiate by assigning UML model elements to each role
- Conformance: the assigned model elements satisfy the properties of that role

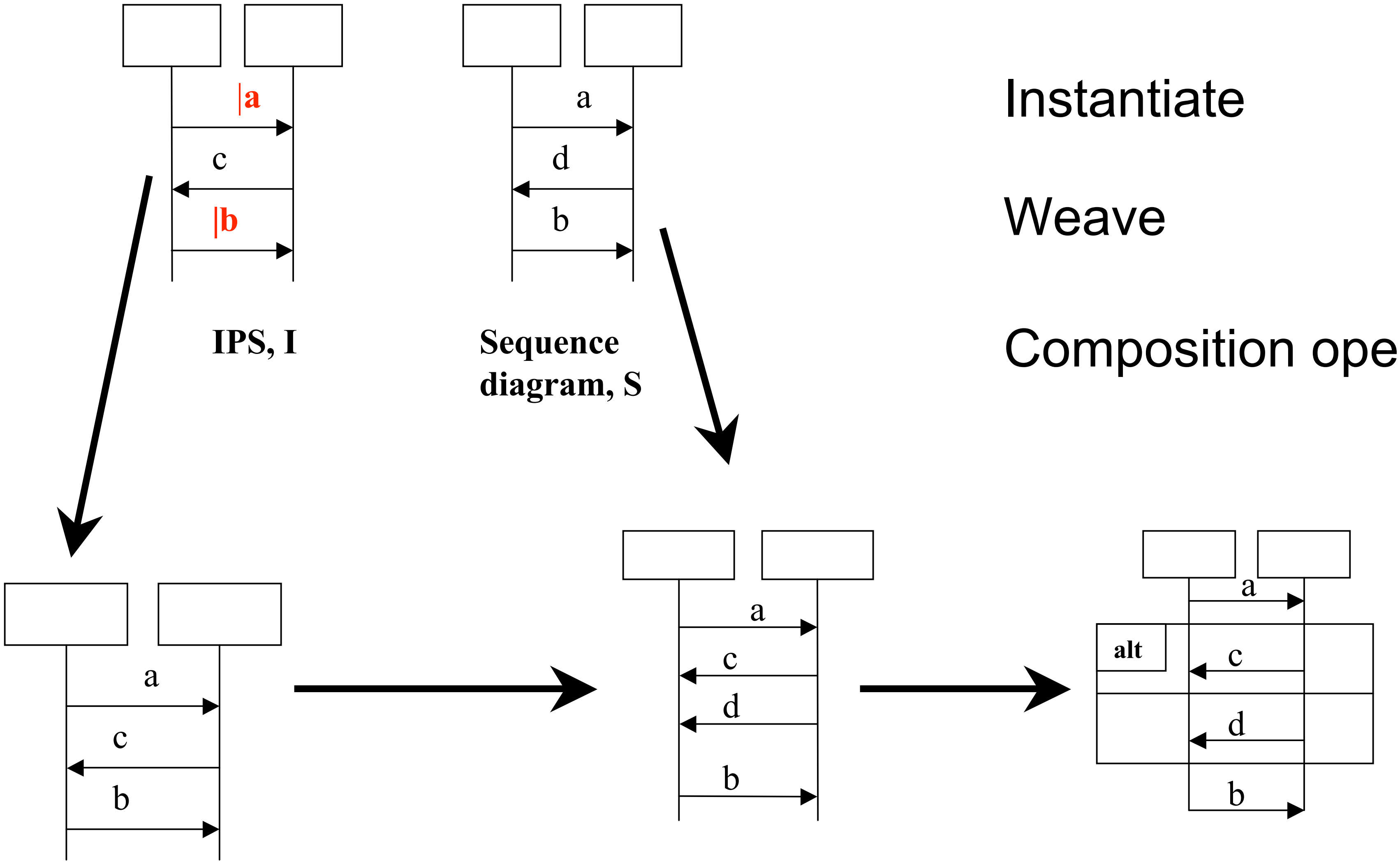
Example IPS

Car parking system: driver gets a ticket from entry machine after pressing a button. Driver parks. On leaving, driver inserts ticket into exit machine and pays.



roles in red

Weaving

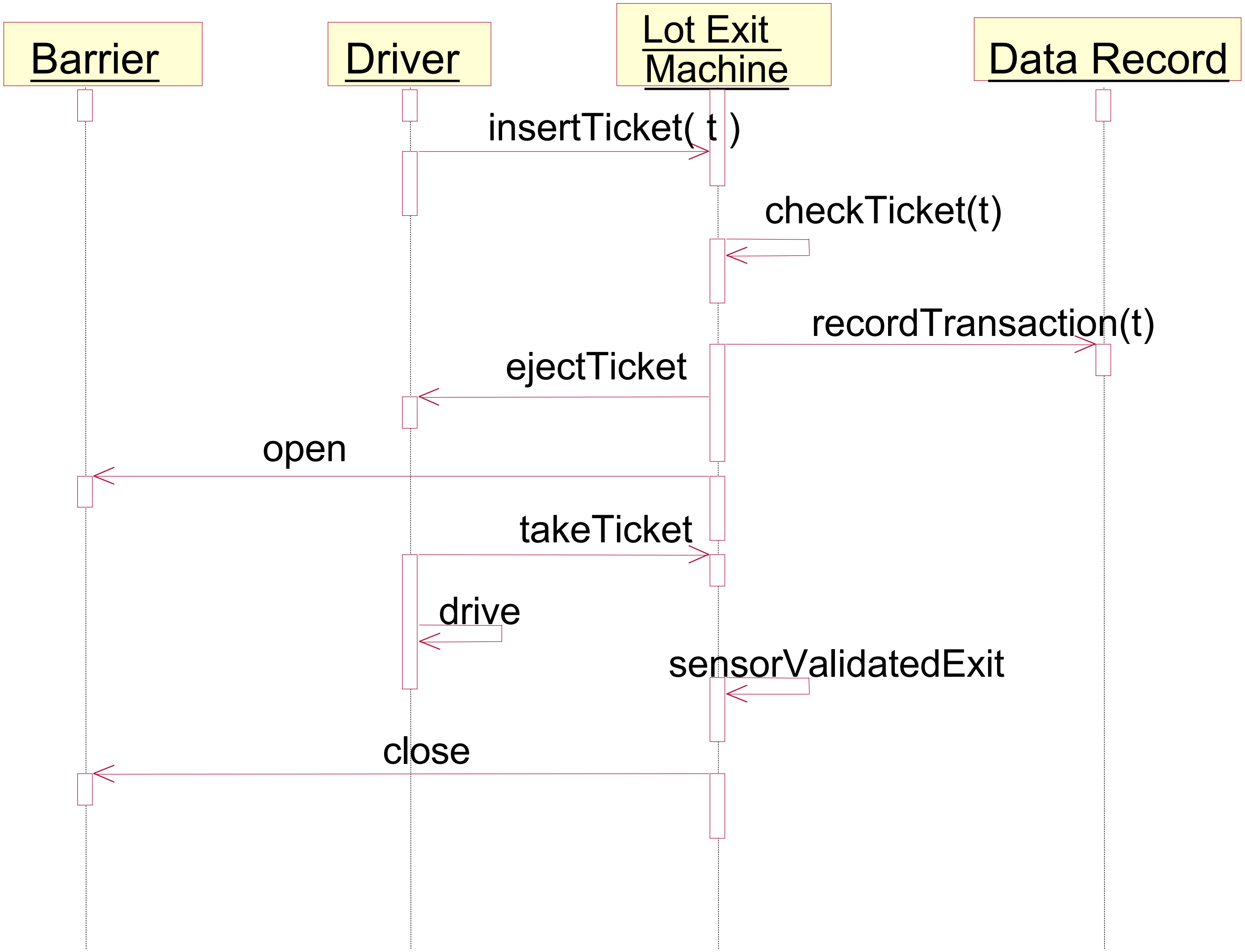


Instantiate

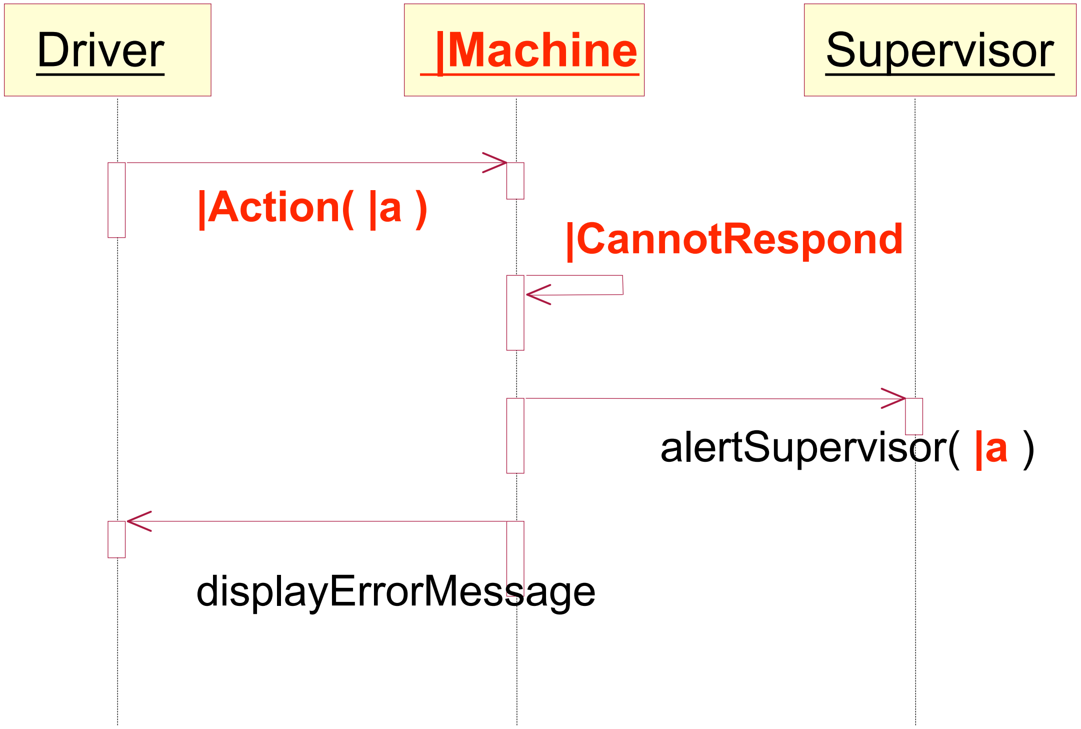
Weave

Composition operator

Car parking example

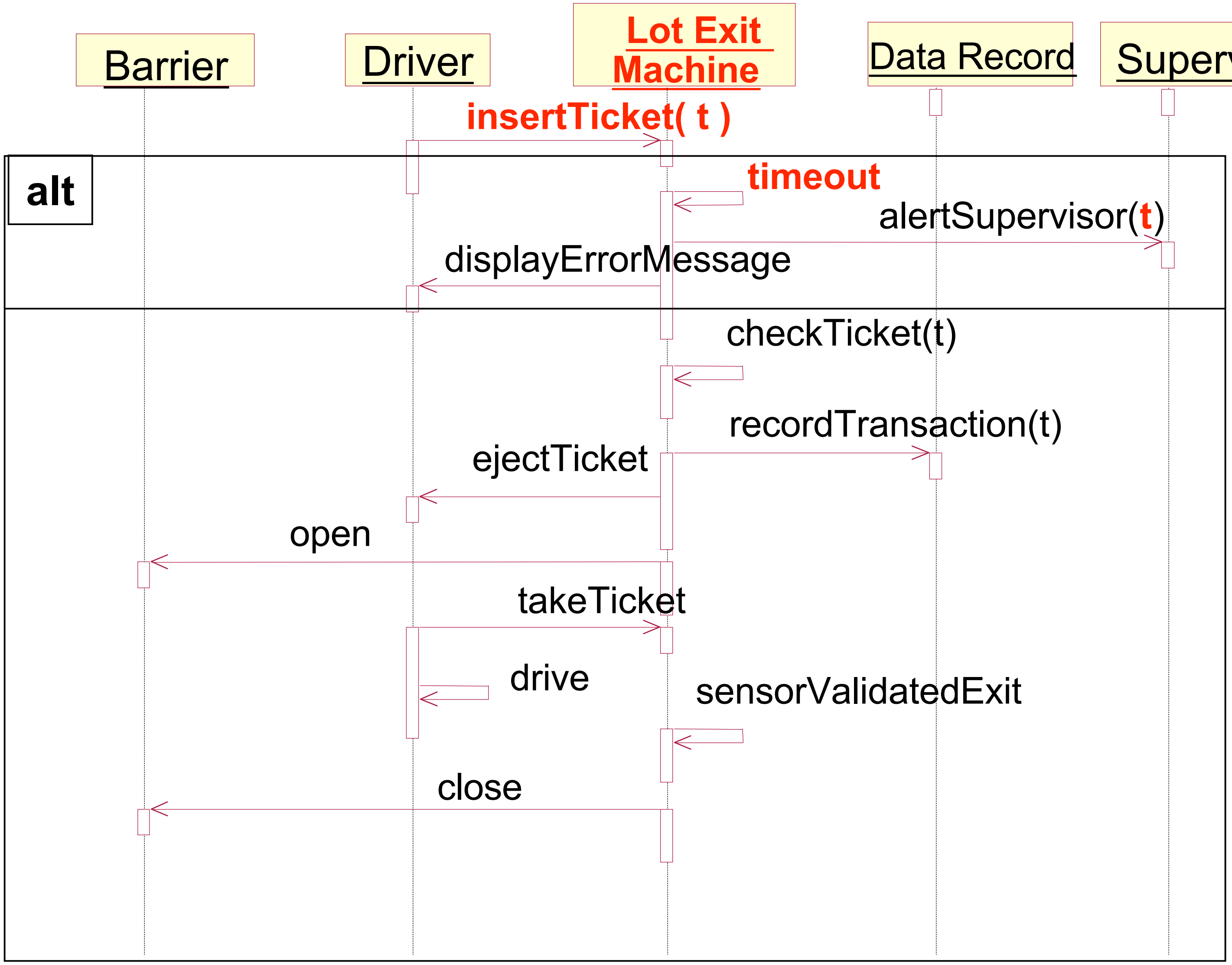


Instantiation



|Machine binds to Lot Exit Machine
|Action binds to insertTicket
|a binds to t
|CannotRespond binds to timeout

Composed Interaction



red = former roles

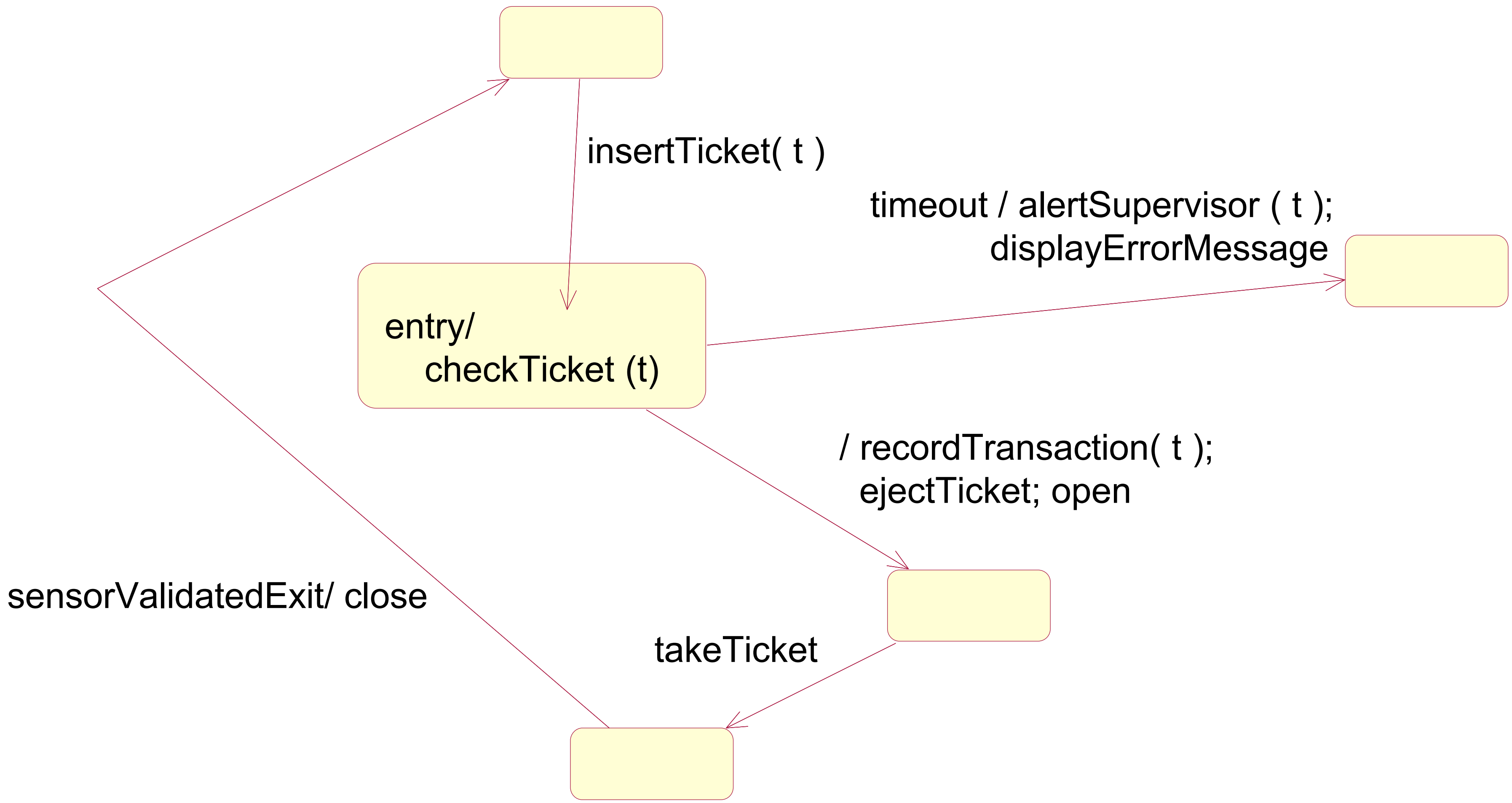
Composition Operators

- **OR**: alternative interactions with choice point to decide
- **AND**: interactions occur concurrently
- **IN**: insert one interaction inside the other
- Others: further work…

Validation of Composed Interactions

- Use Whittle & Schumann algorithm to transform composed interactions into a set of (executable) state machines
- Whittle & Schumann:
  - State machine generated for each participant involved in the interaction
  - For each participant:
    - Incoming message becomes a trigger in the state machine
    - Outgoing message becomes an action in the state machine
    - Interactions can be joined using “state labels”

Example: state machine generated



insertTicket(t)

timeout / alertSupervisor (t); displayErrorMessage

entry/ checkTicket (t)

/ recordTransaction(t); ejectTicket; open

sensorValidatedExit/ close

takeTicket

Summary

- Representation/Instantiation/Weaving of aspectual/non-aspectual interactions (UML sequence diagrams)
- Translation to set of state machines for validation purposes
- Future work: how to feedback results of validation to augment or correct the interaction models