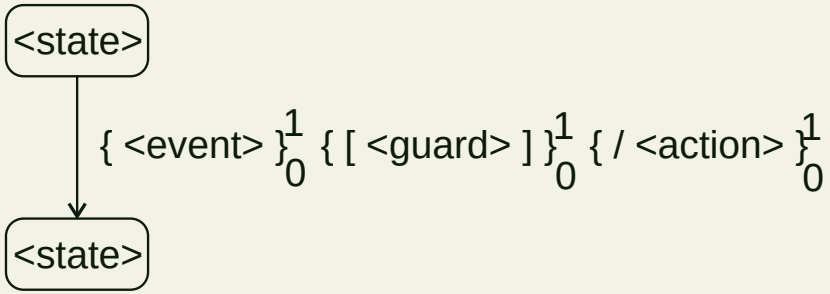
5. Statechart Diagrams

5.1 Examples for Statecharts

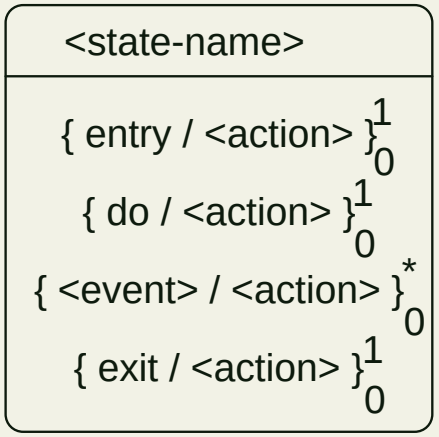
- To follow: examples from the UML notation guide
- plus other examples

Statechart Syntax – Overview

<transition> ::=



<state> ::=



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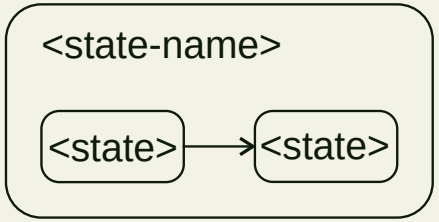
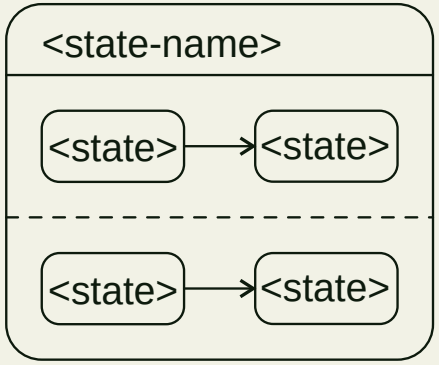
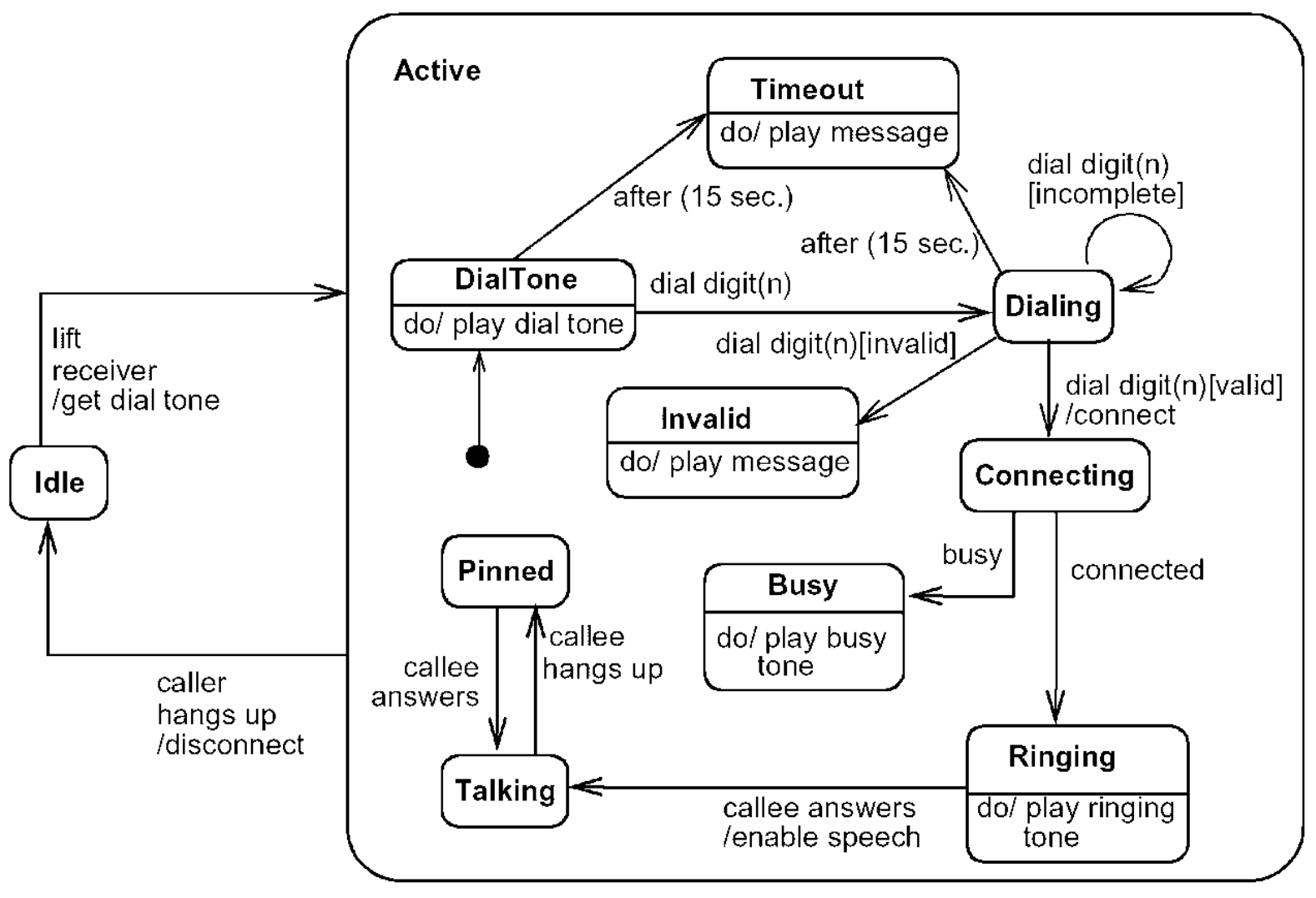


<state-with-concurrent-substates> ::=

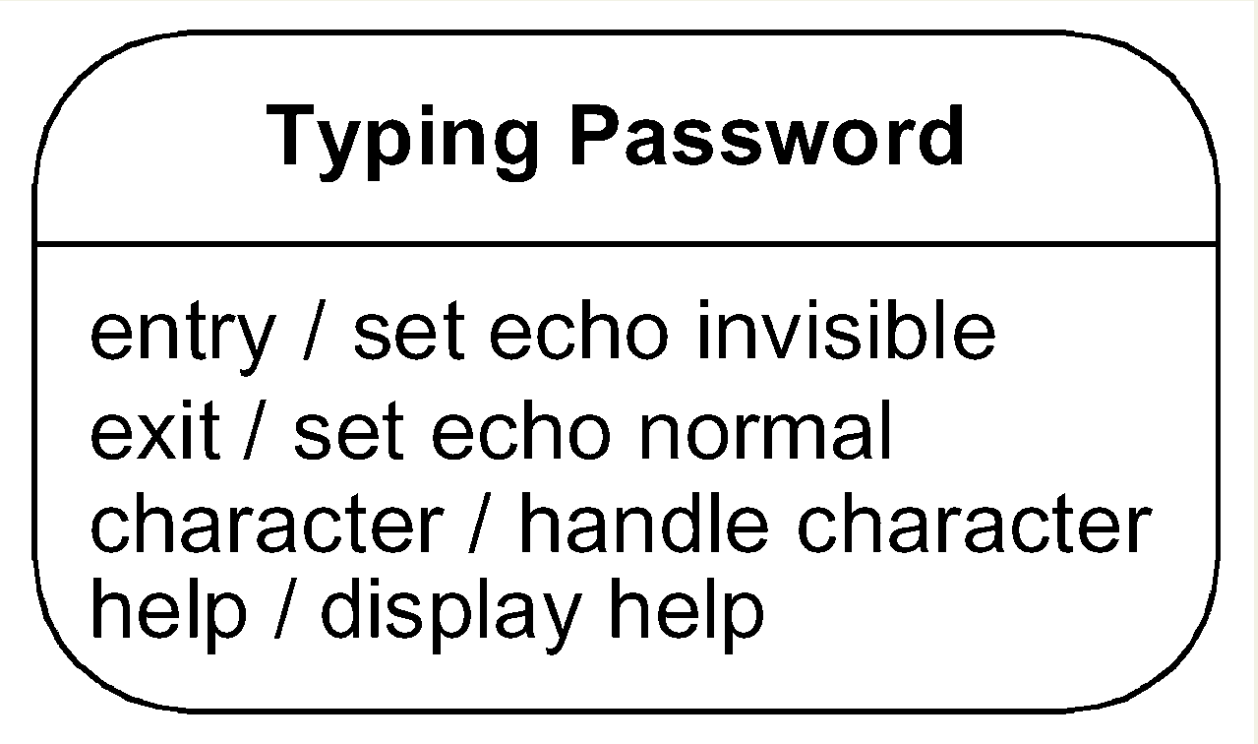


pseudo states: initial, final, synchronisation, deep history, shallow history, stub

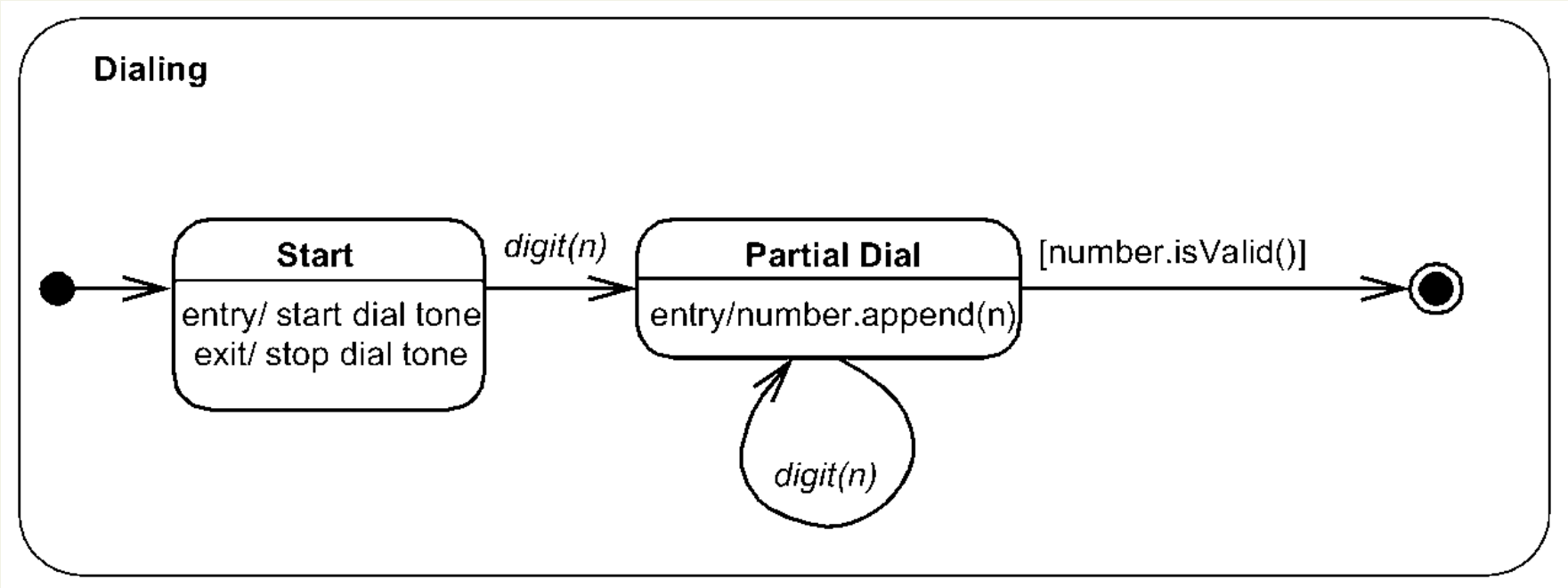
Statechart Diagram (3-71)



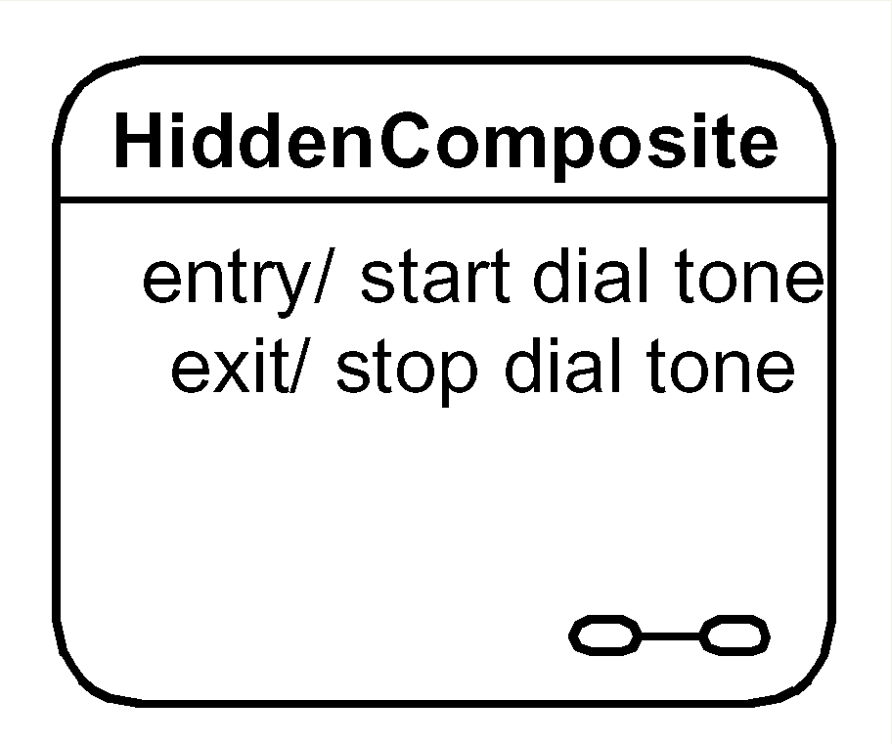
Statechart Diagram (3-72)



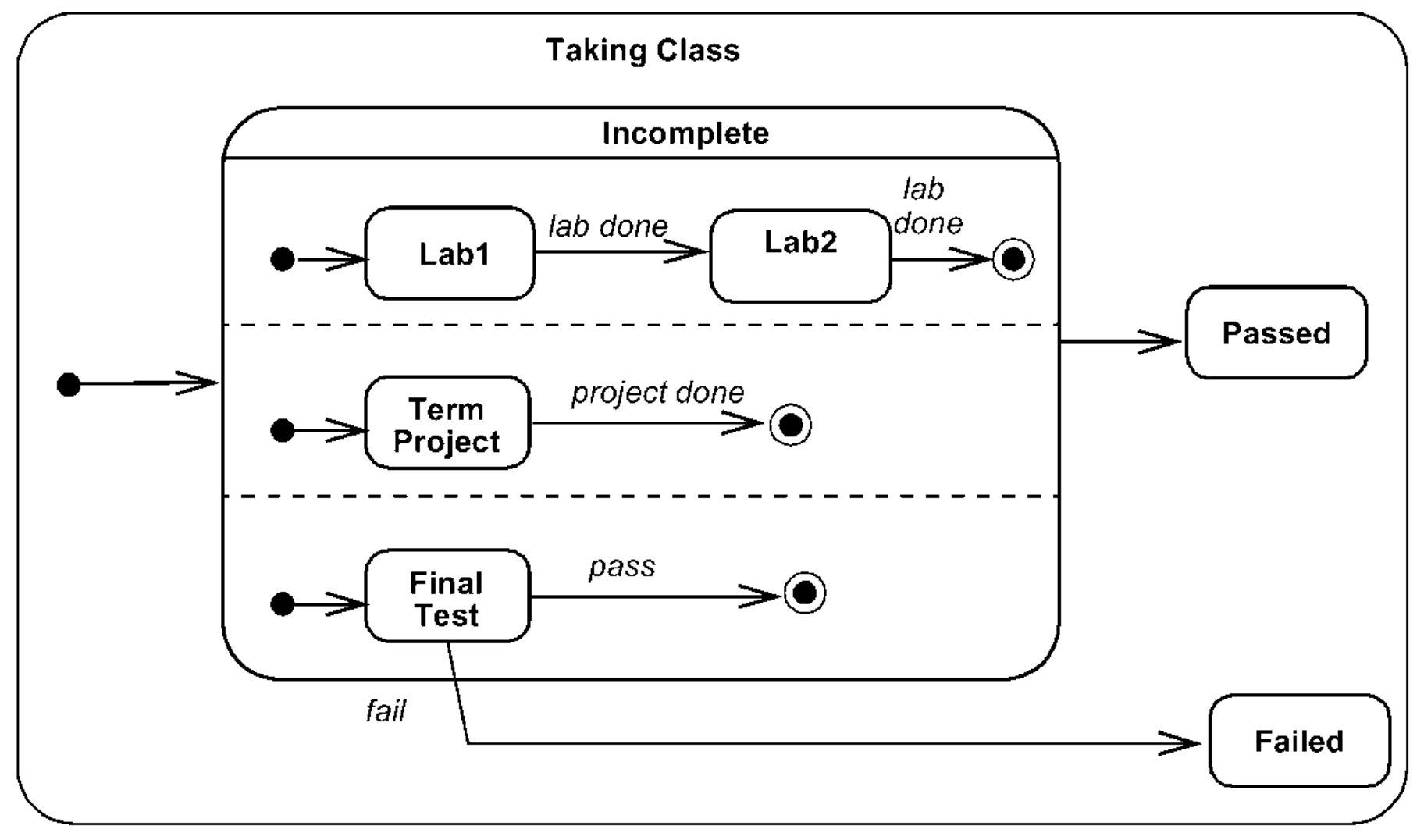
Statechart Diagram (3-73)



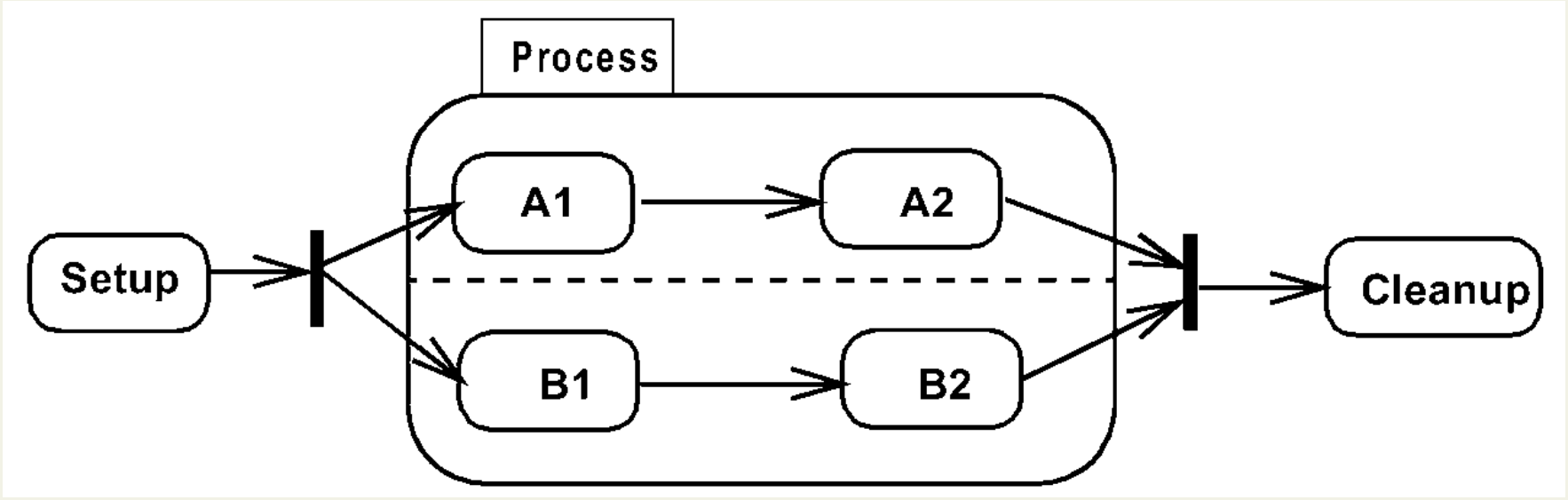
Statechart Diagram (3-74)



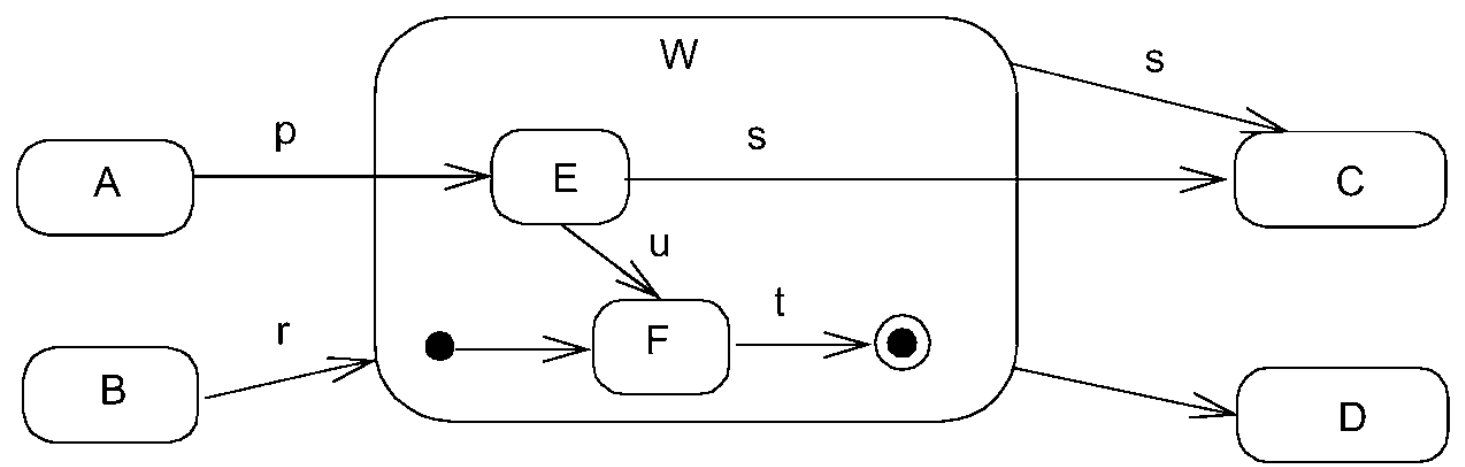
Statechart Diagram (3-75)



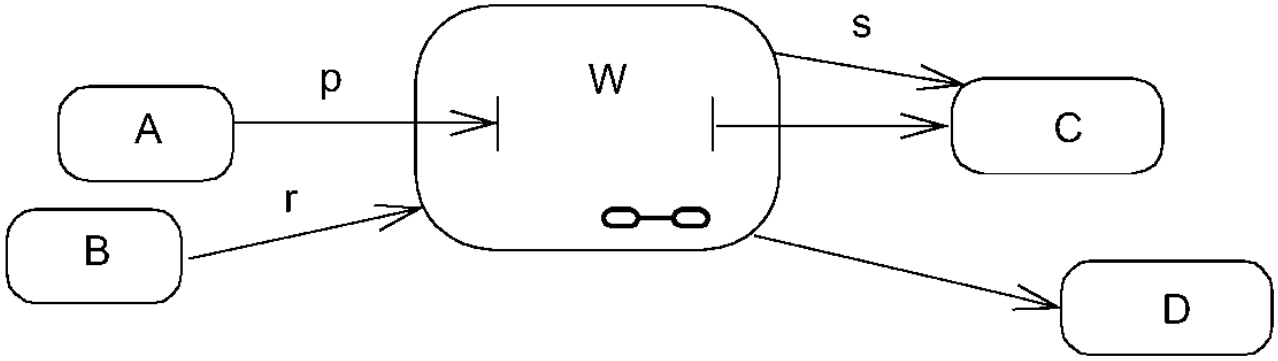
Statechart (3-77)



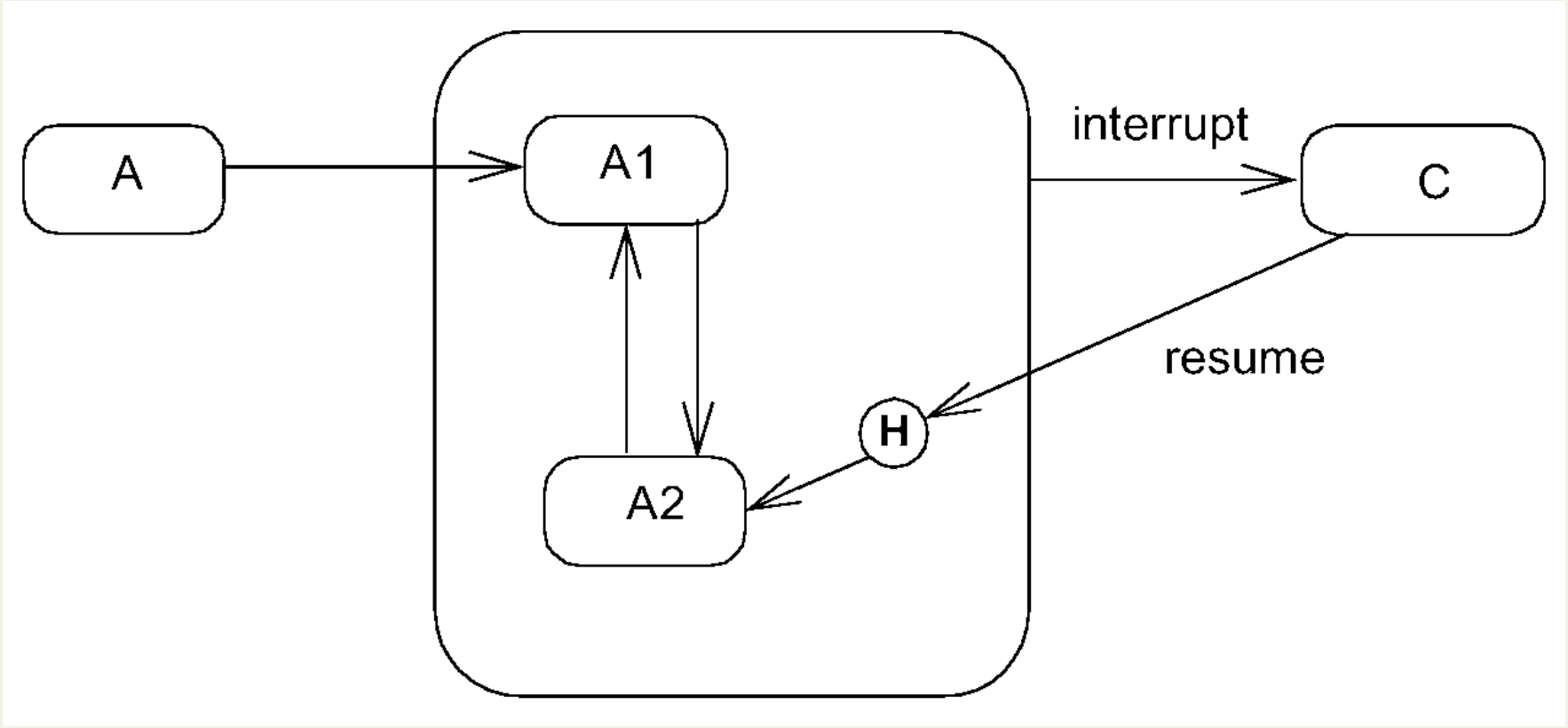
Statechart Diagram (3-78)



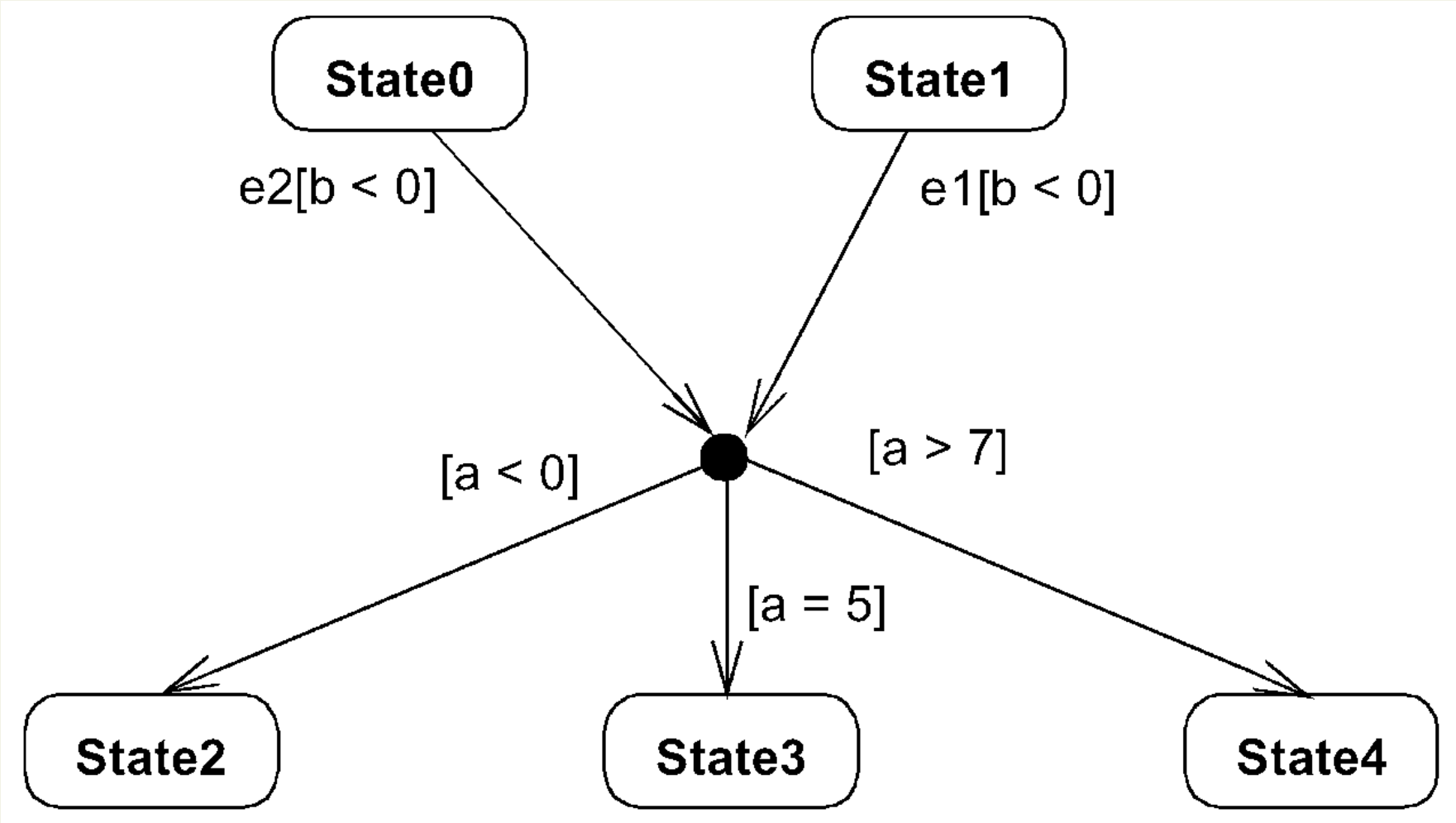
may be abstracted as



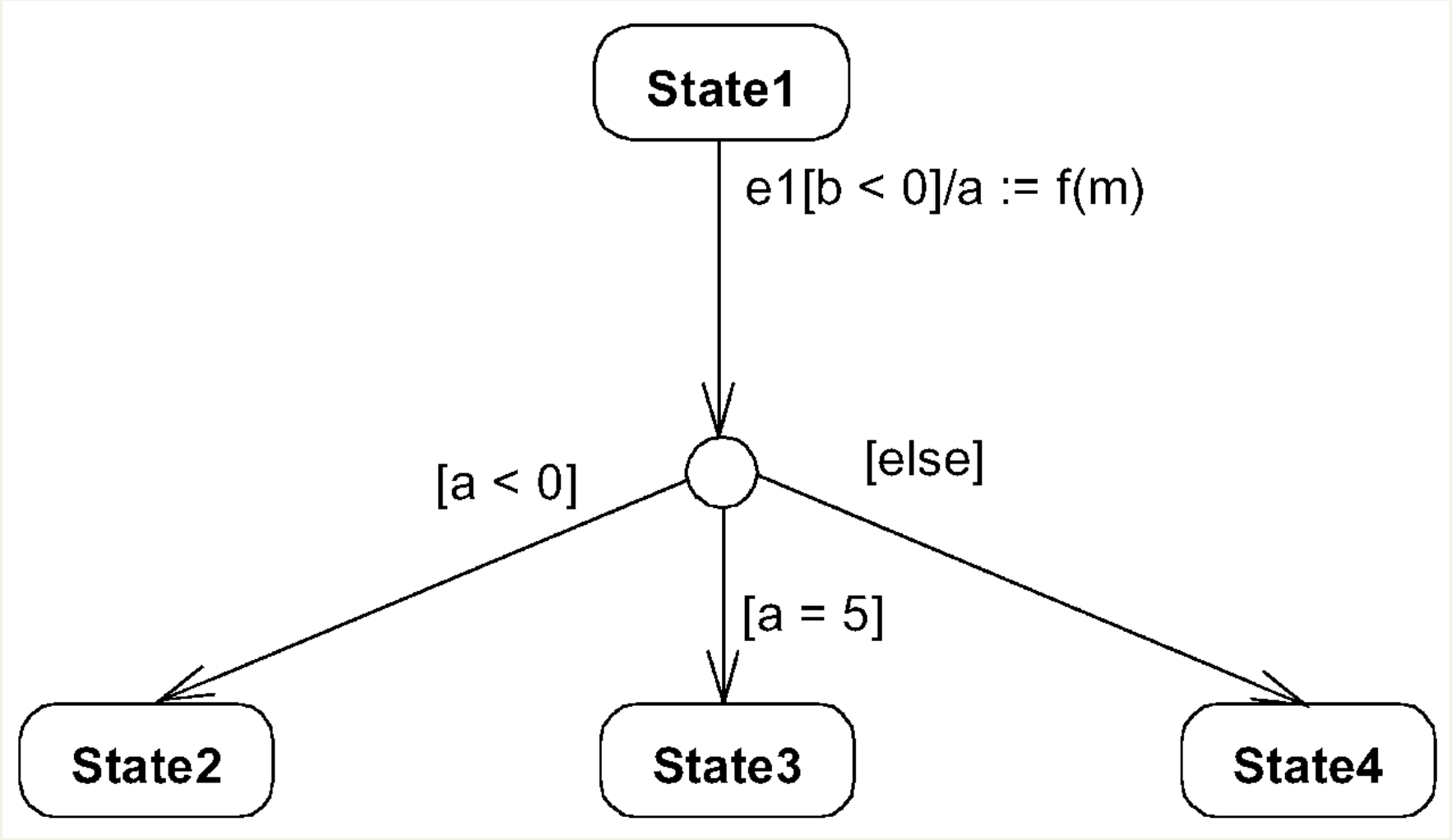
Statechart Diagram (3-79)



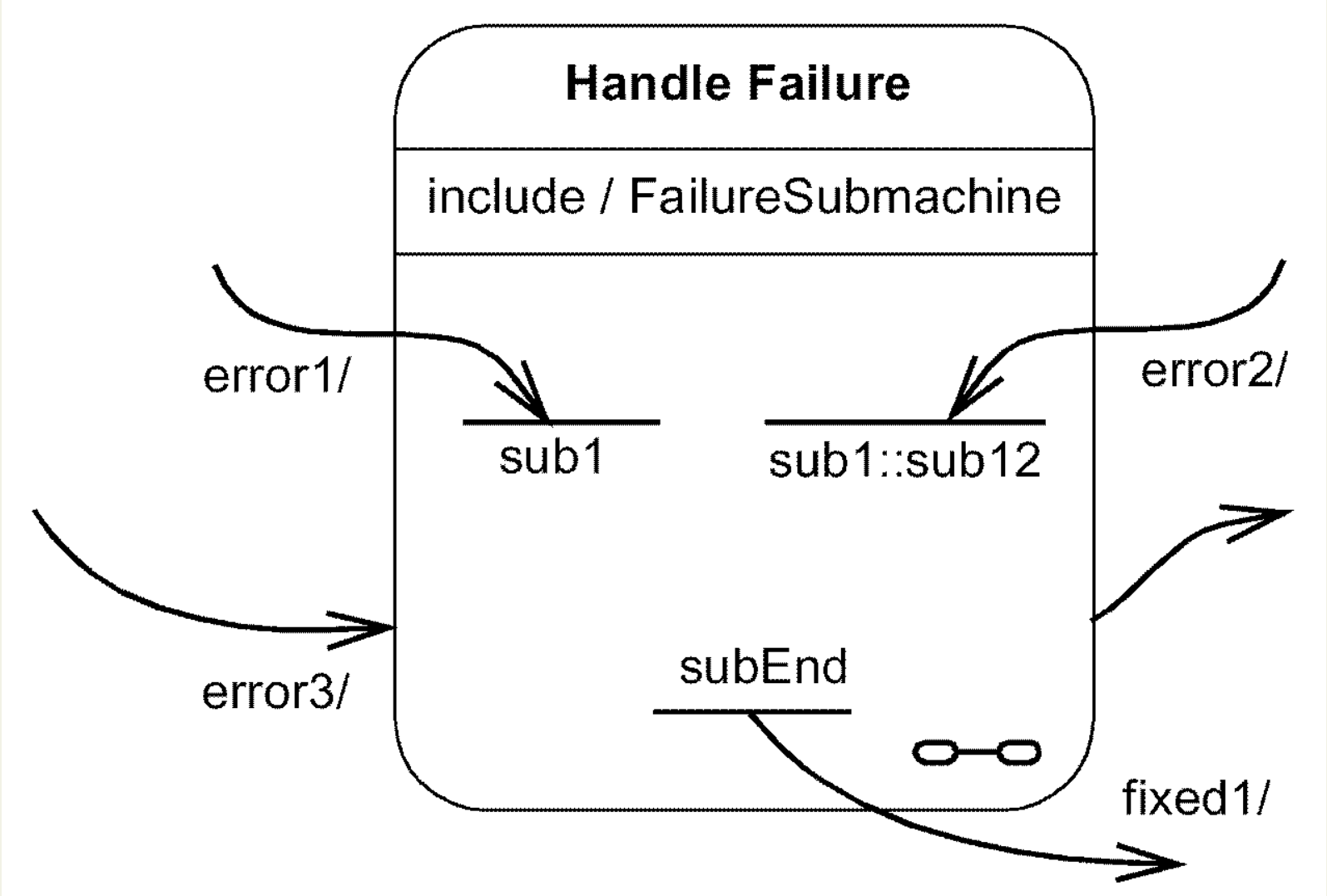
Statechart Diagram (3-80)



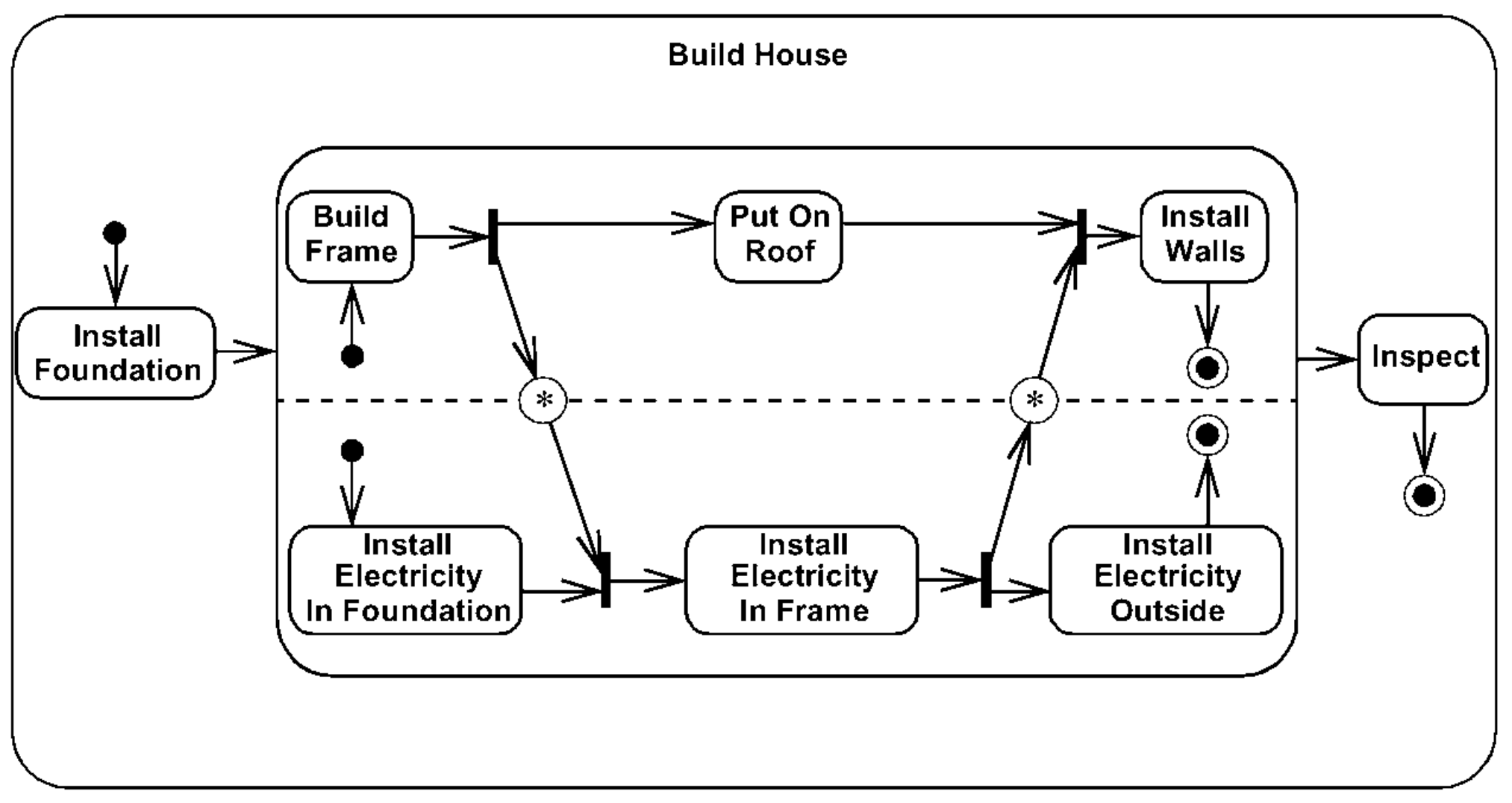
Statechart Diagram (3-81)



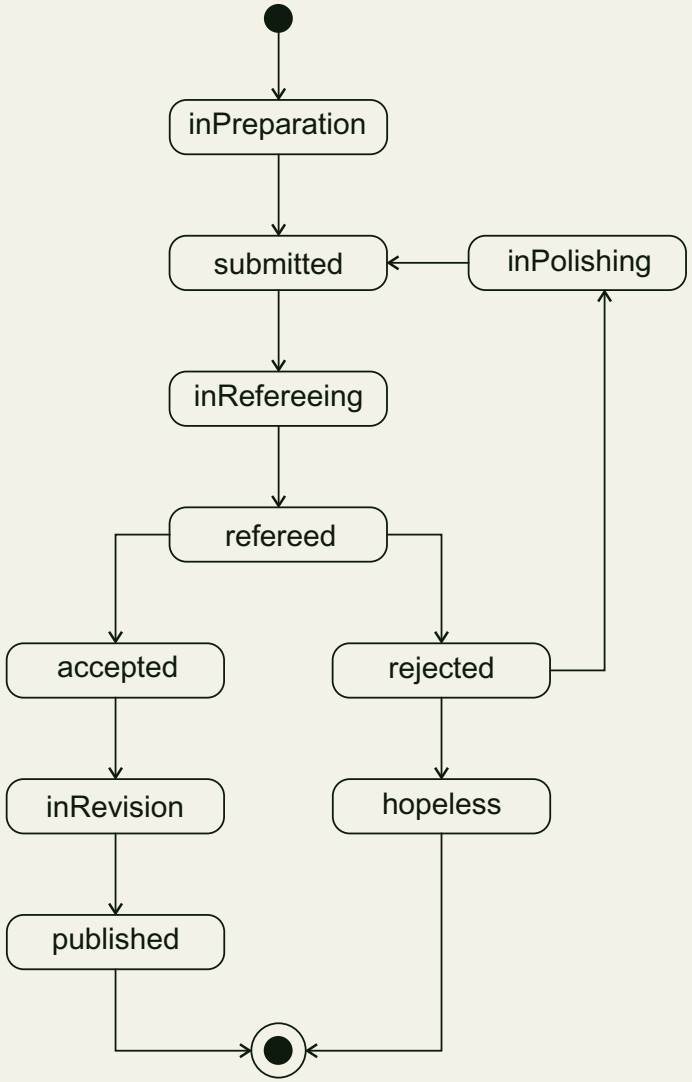
Statechart Diagram (3-82)



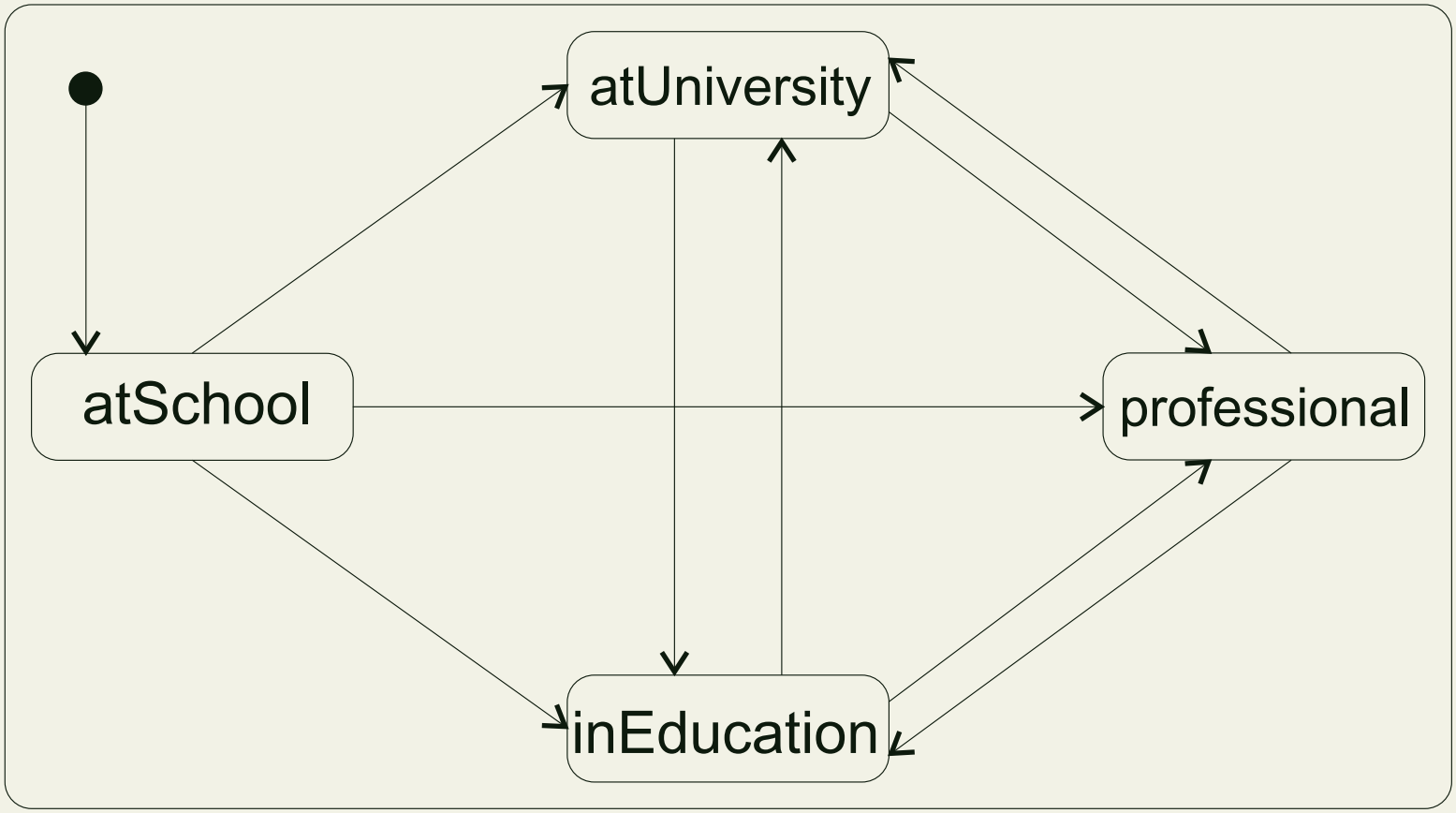
Statechart Diagram (3-83)



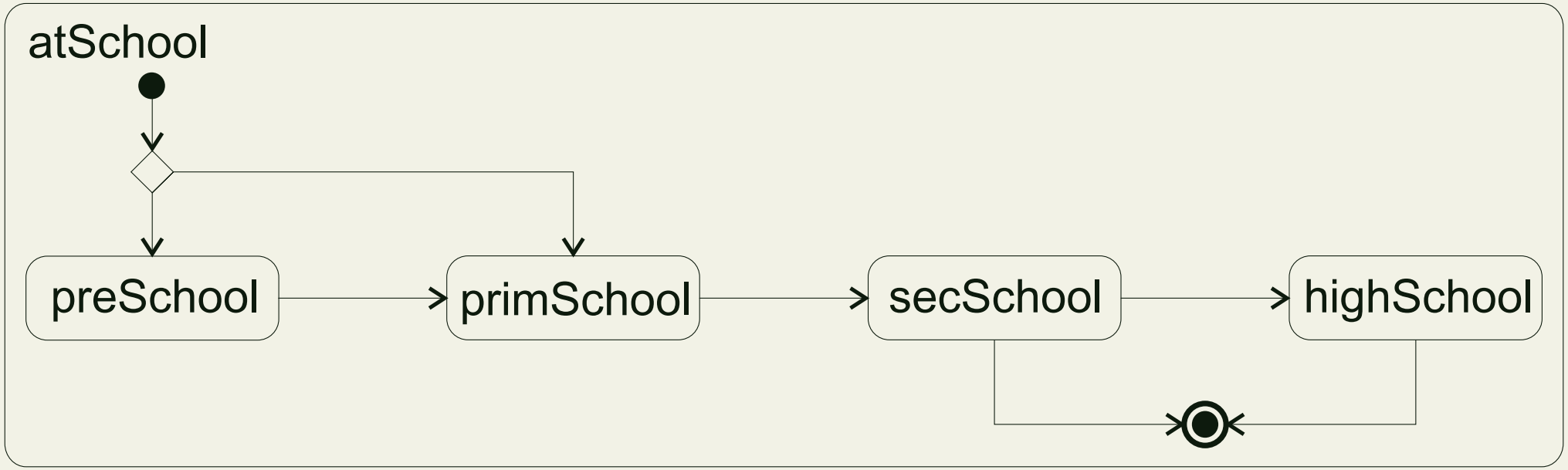
Submission Status for Scientific Paper



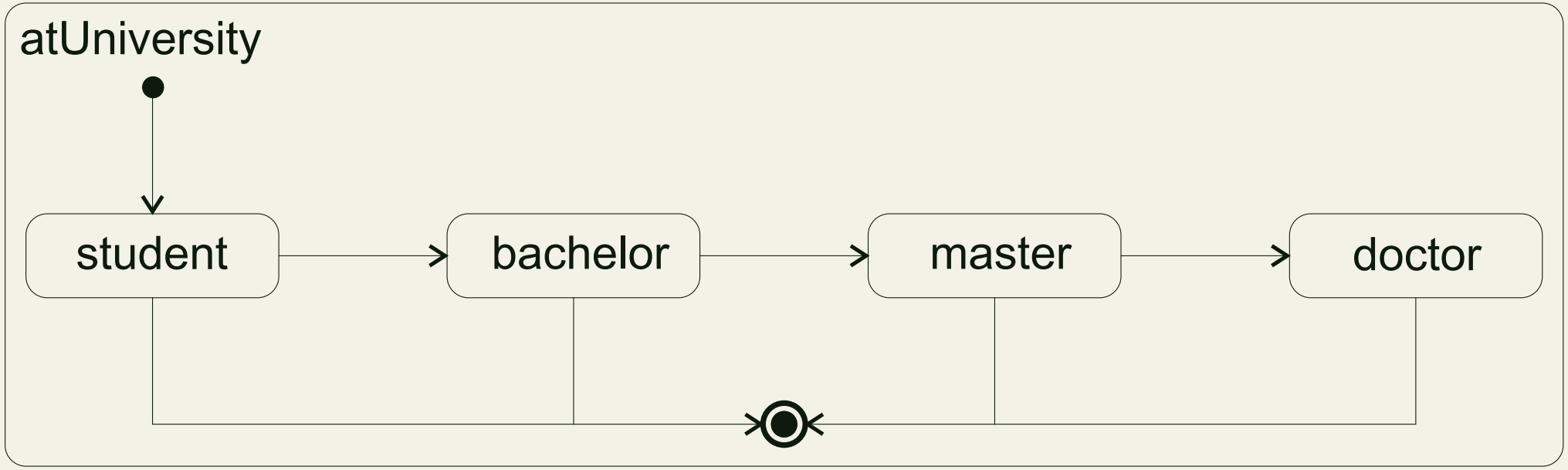
Education Status for People (1)



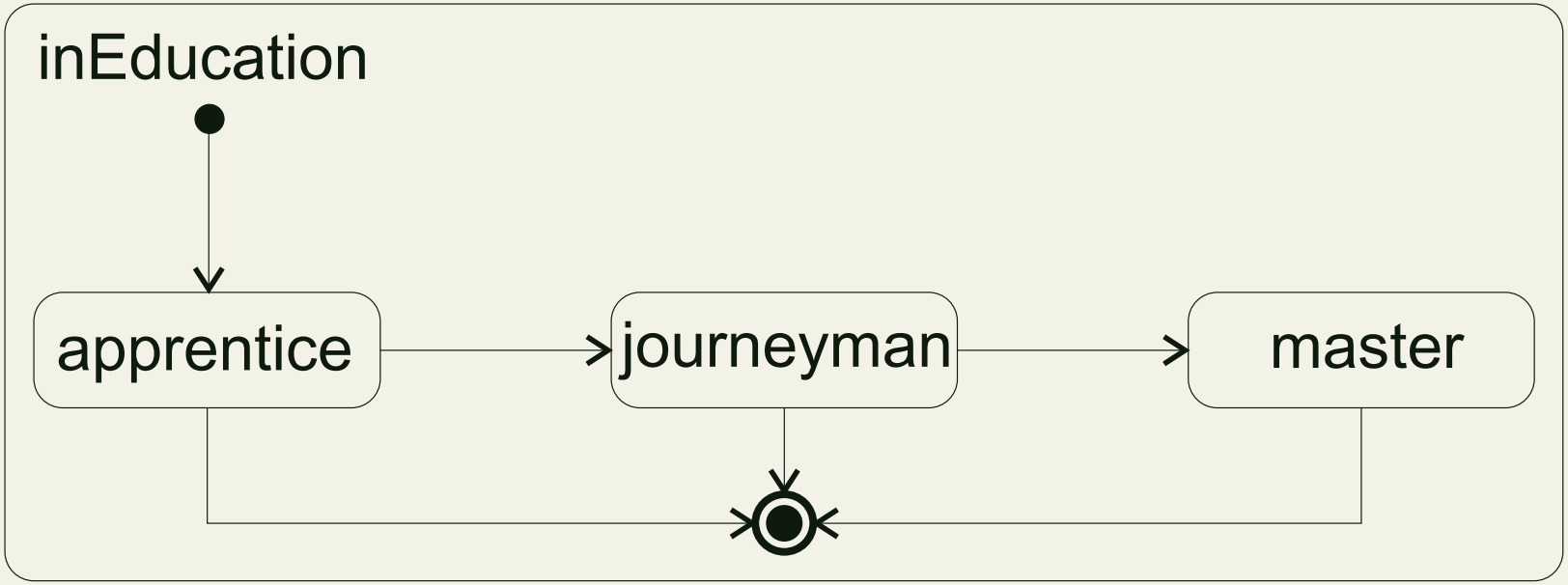
Education Status for People (2)



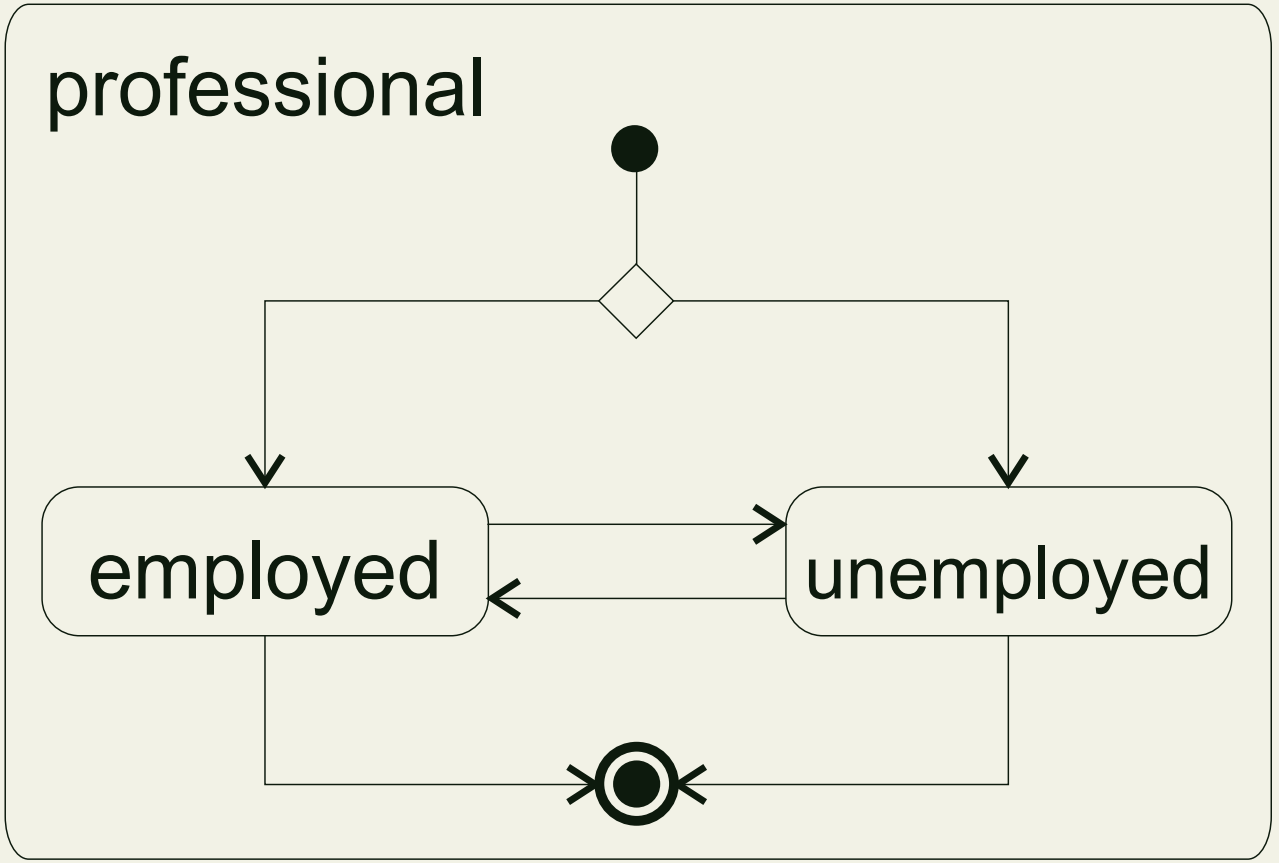
Education Status for People (3)



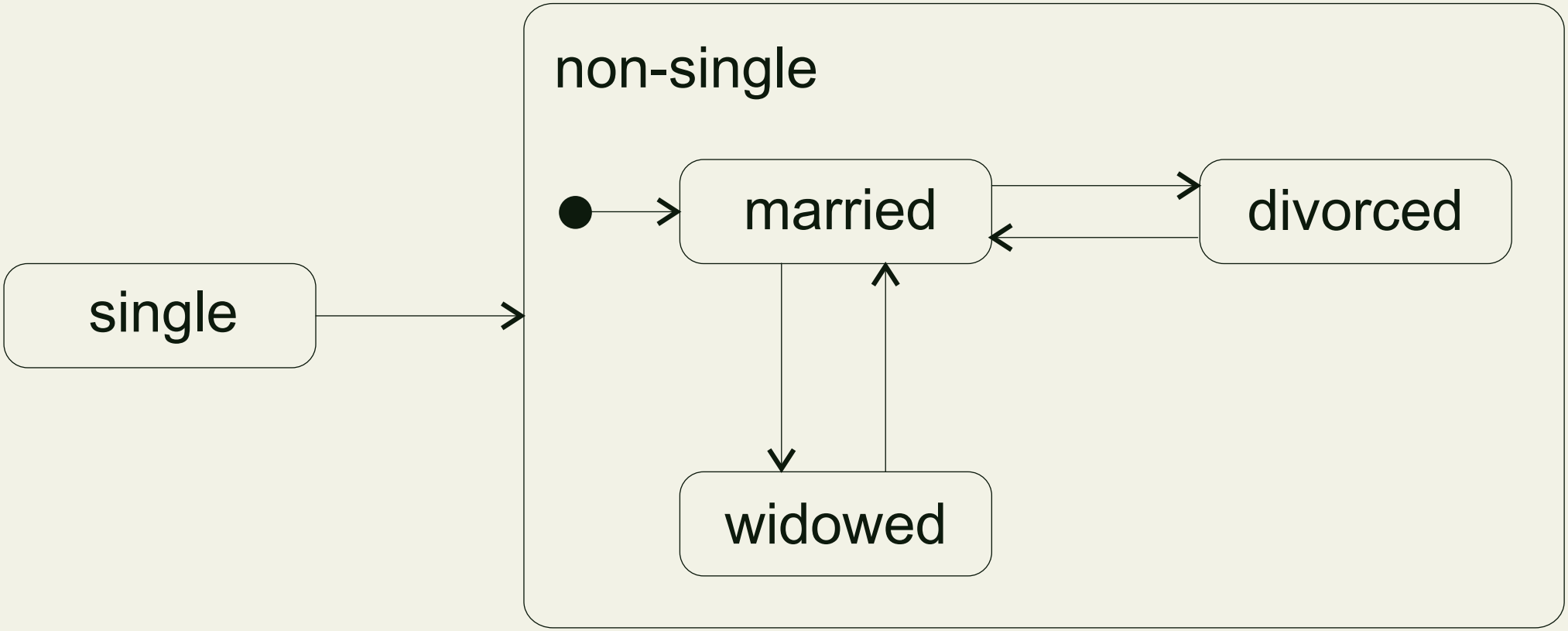
Education Status for People (4)



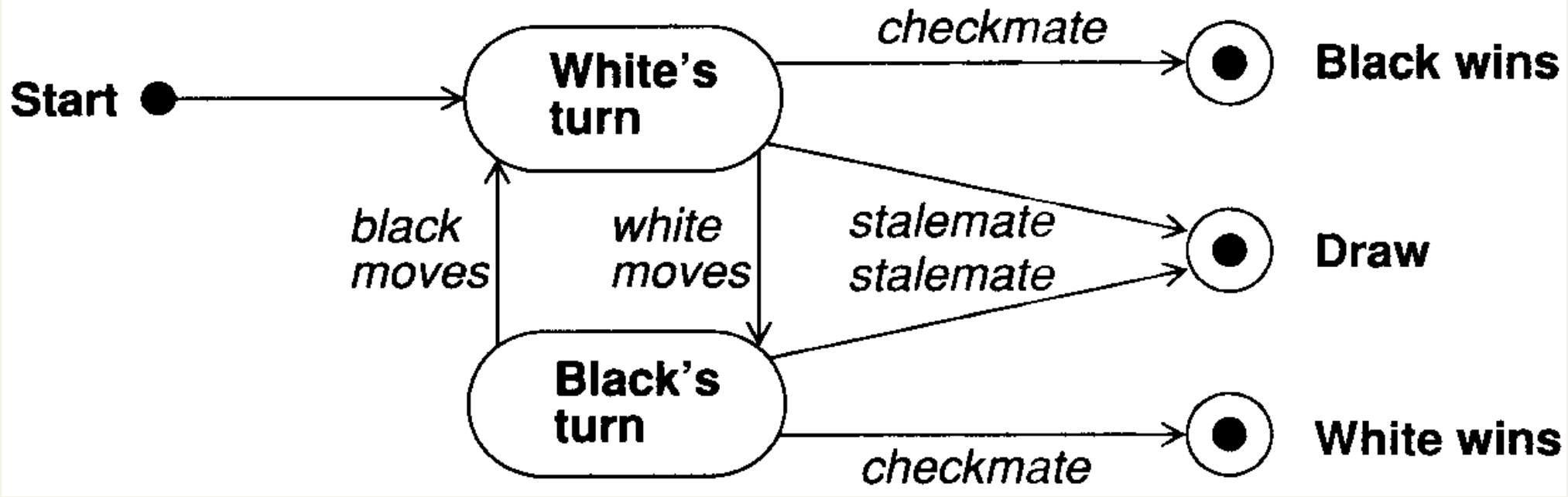
Education Status for People (5)



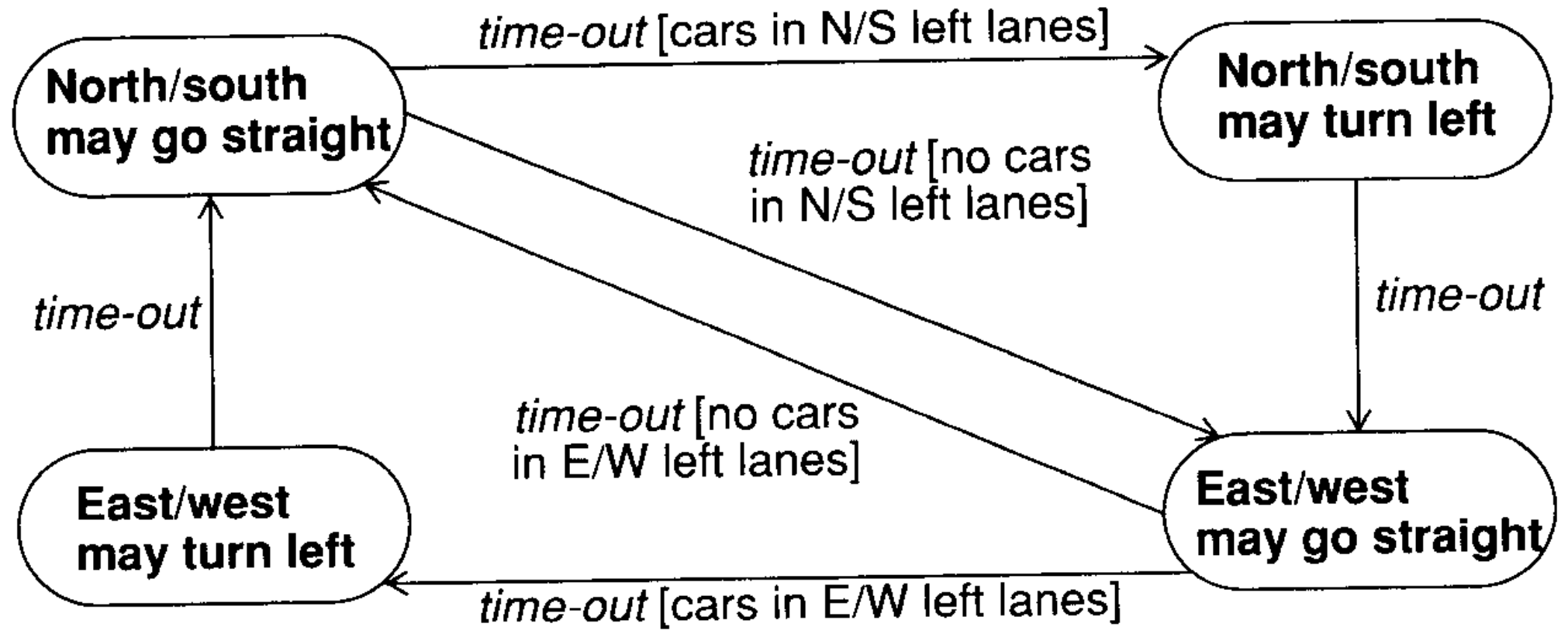
Civil Status for People



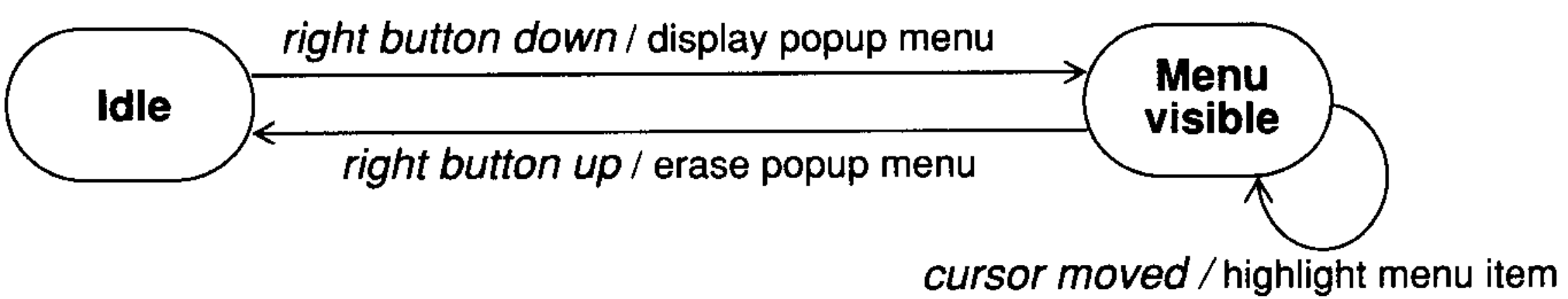
One-shot State Diagram for Chess Game



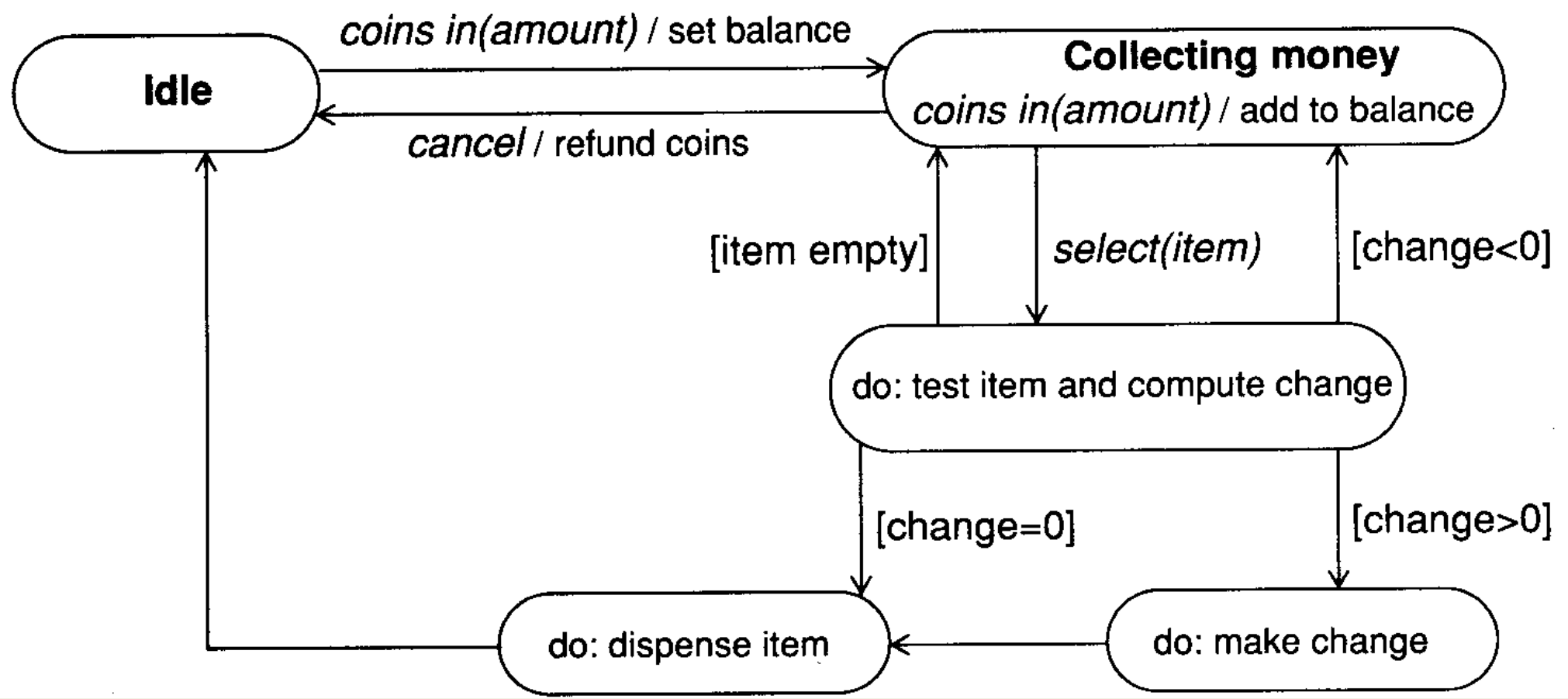
State Diagram with Guarded Transitions



Actions for Pop-up Menu

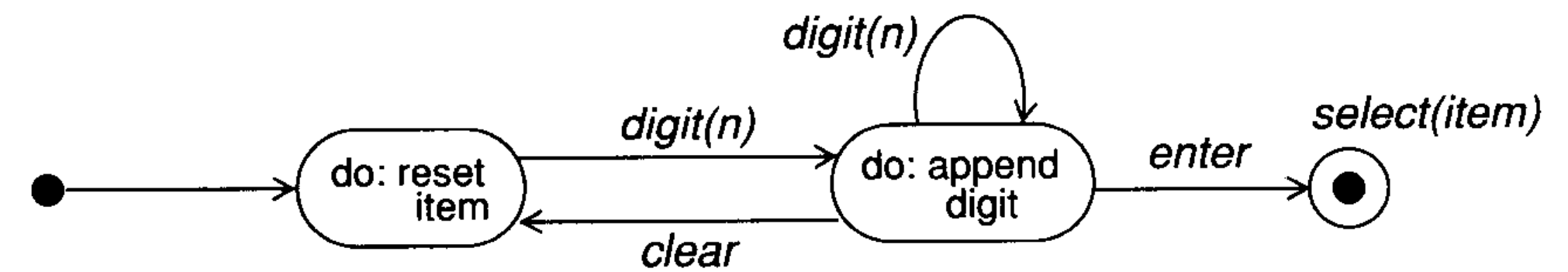


Vending Machine Model

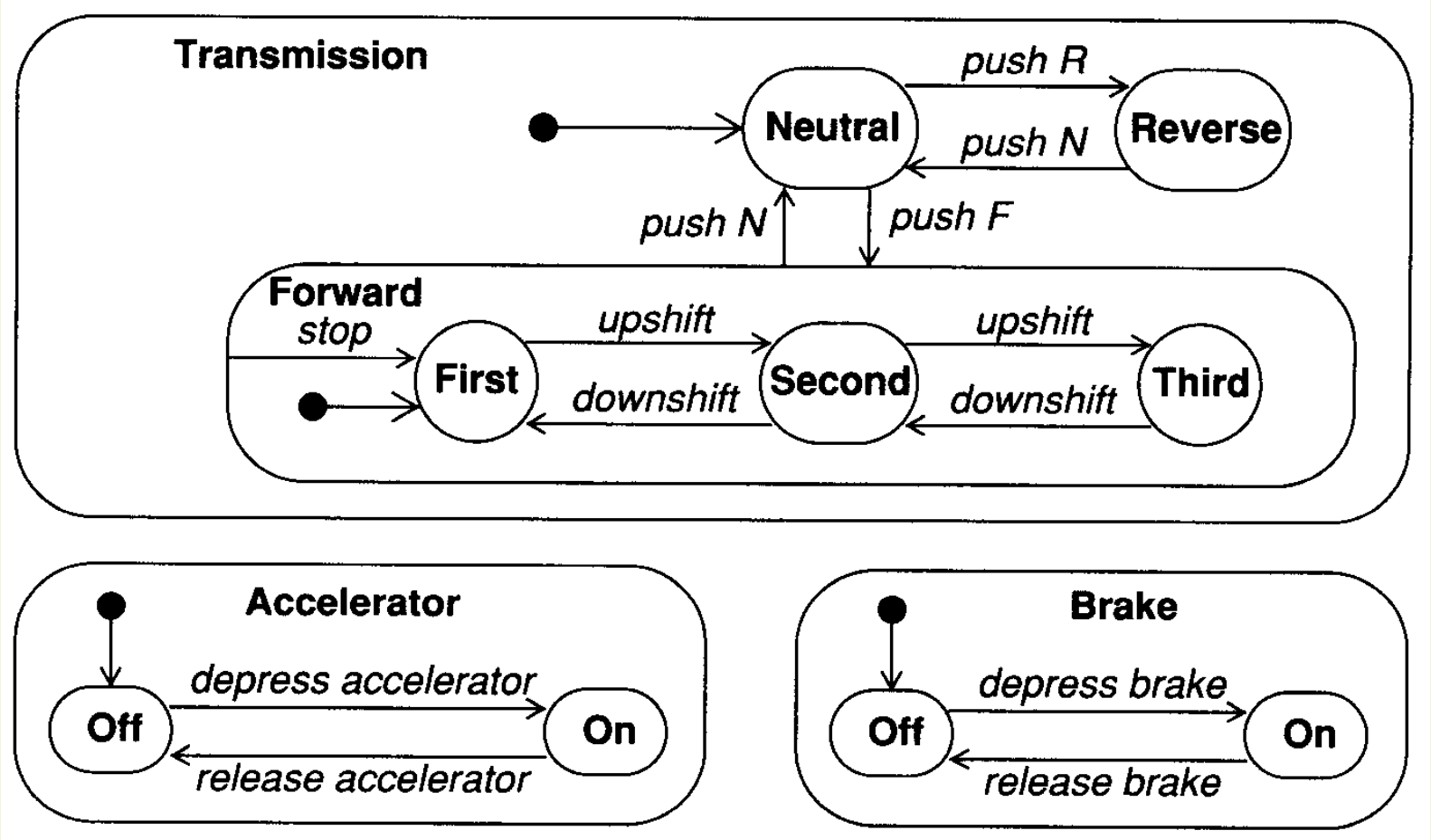


Dispense Item Activity of Vending Machine

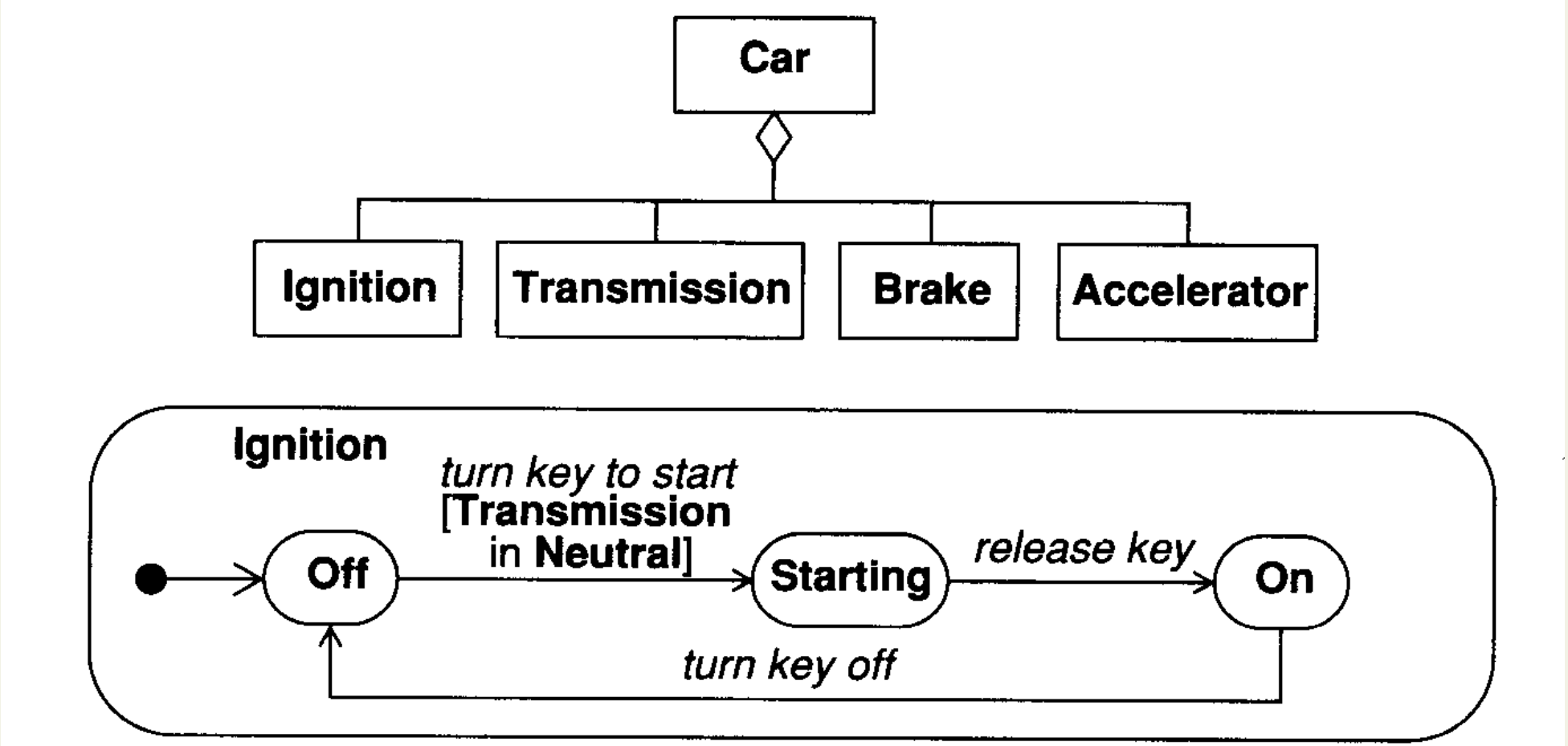
Select Item Transition of Vending Machine



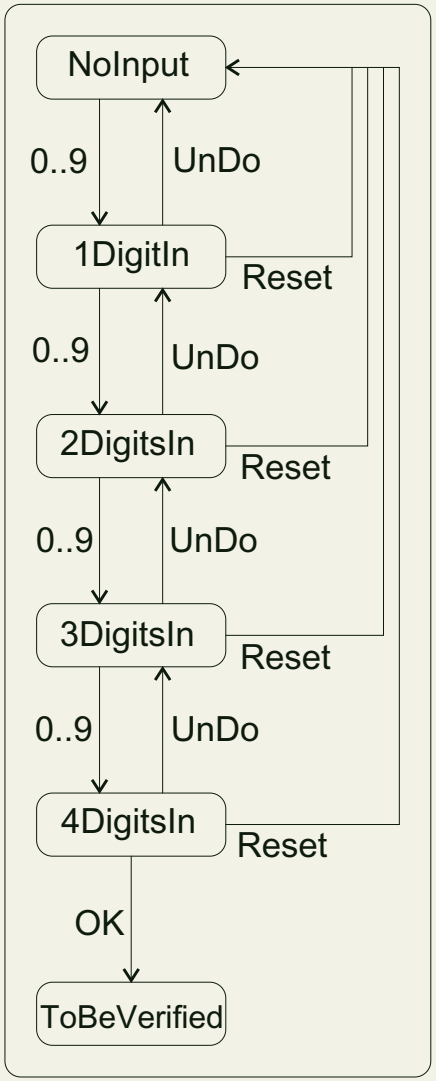
An Aggregation and its Concurrent State Diagrams (1)



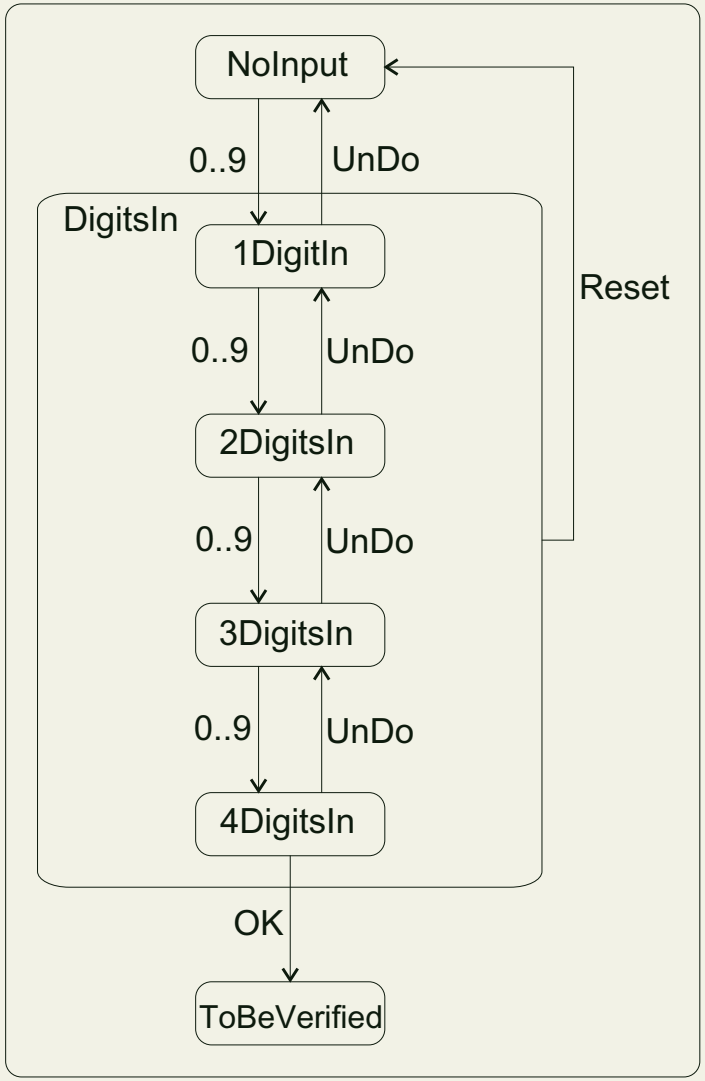
An Aggregation and its Concurrent State Diagrams (2)



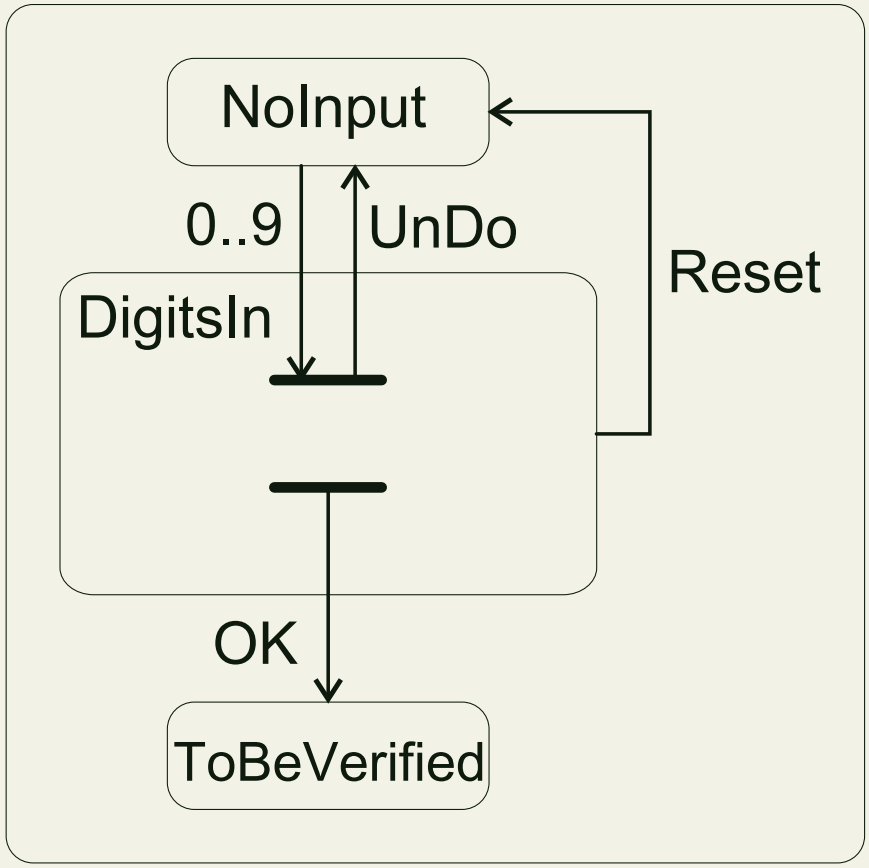
Entering a PIN Number (1)



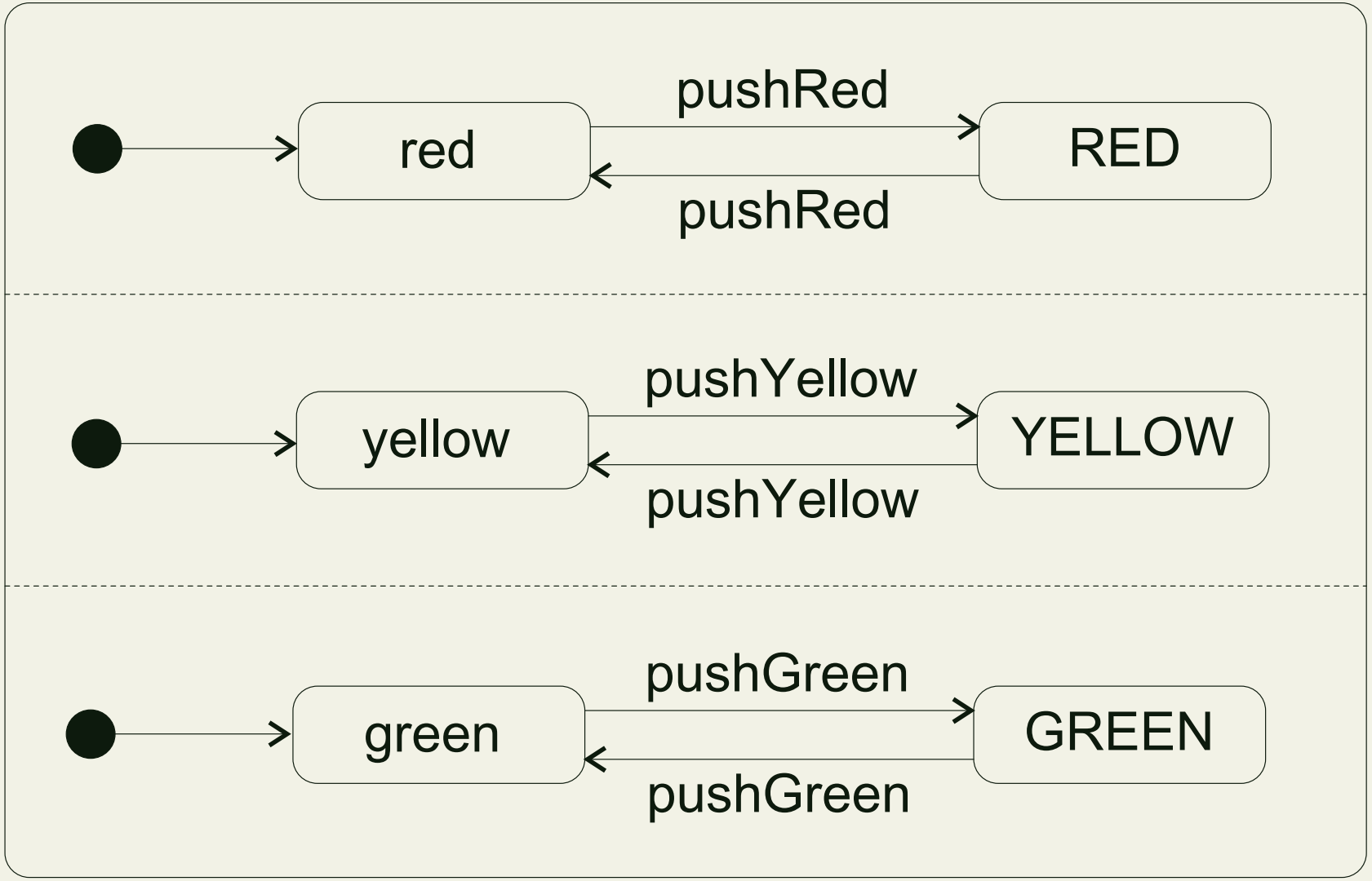
Entering a PIN Number (2)



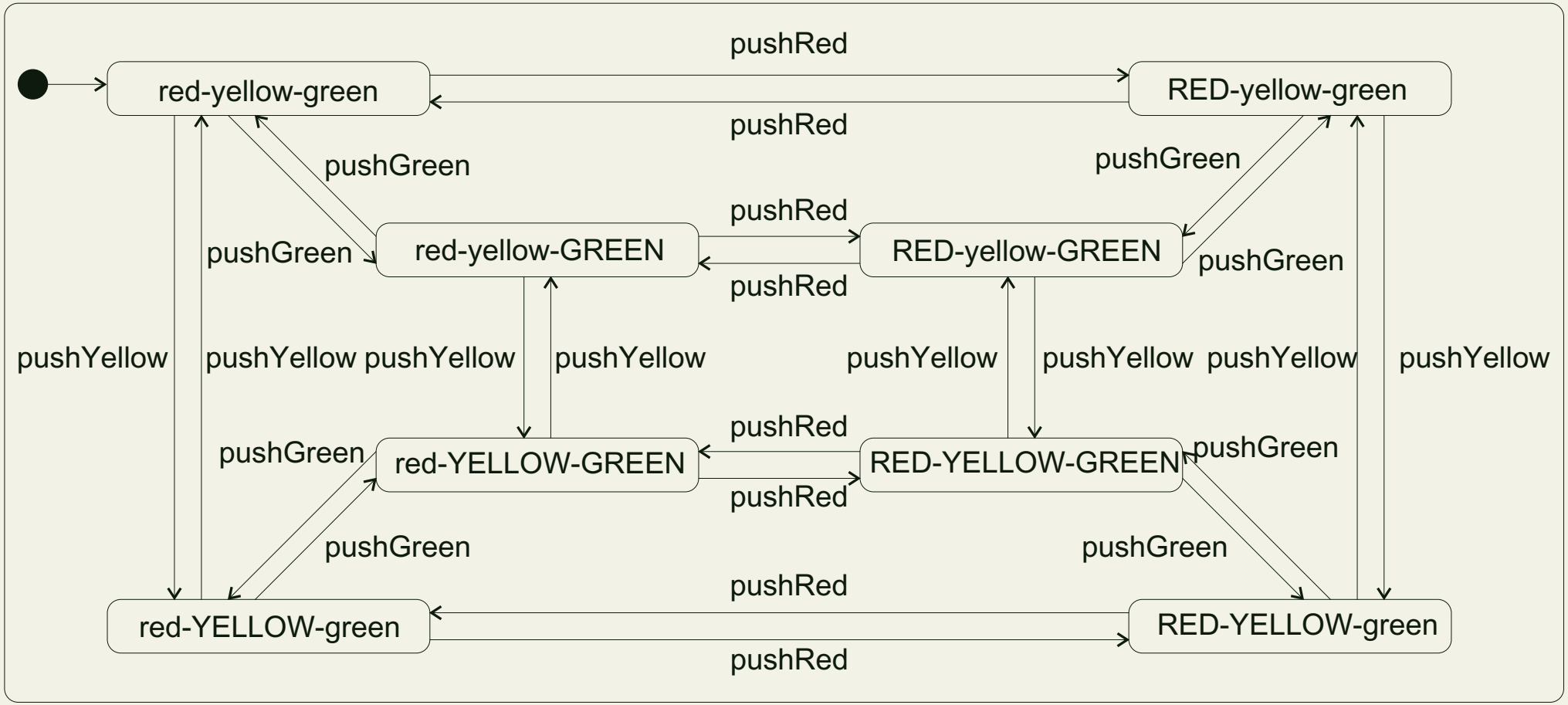
Entering a PIN Number (3)



Traffic Light (1)



Traffic Light (2)



5.2 Graph Transformation for Statecharts

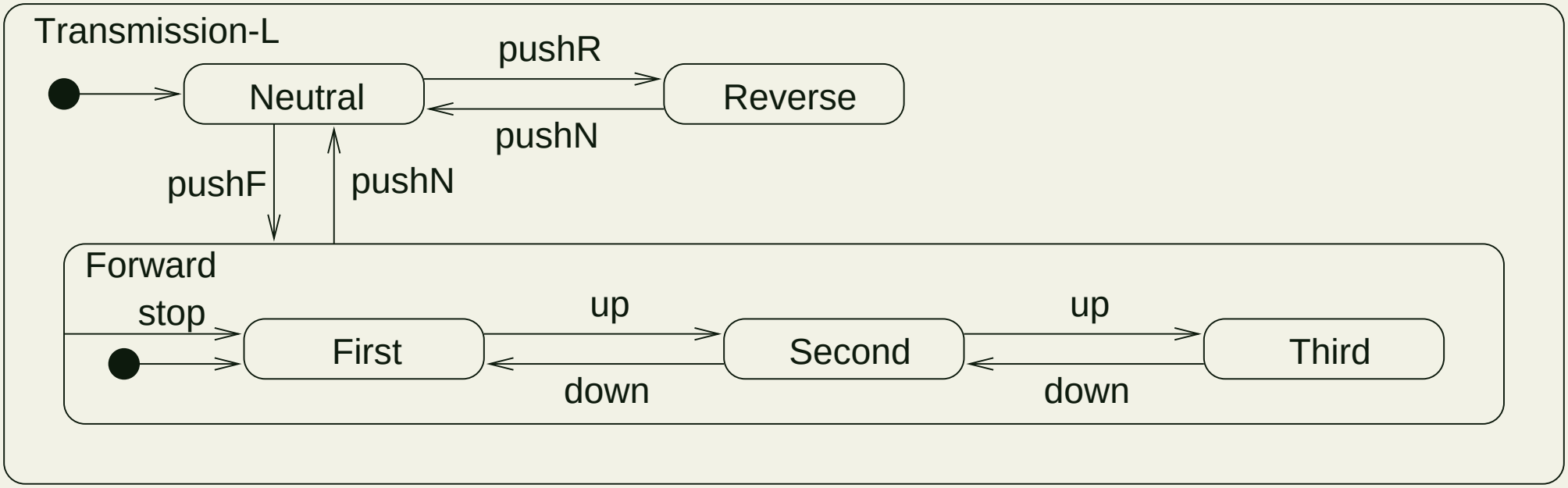
Explanation 1 (SC Diagram Semantics)

- explain state expansion in nested UML state diagrams
  1. adding boundary nodes introducing a precise interface for the state to be expanded
  2. expanding the state
  3. removing the boundary nodes
- our approach: intermediate step between original UML diagrams and a general comprehensive semantical framework

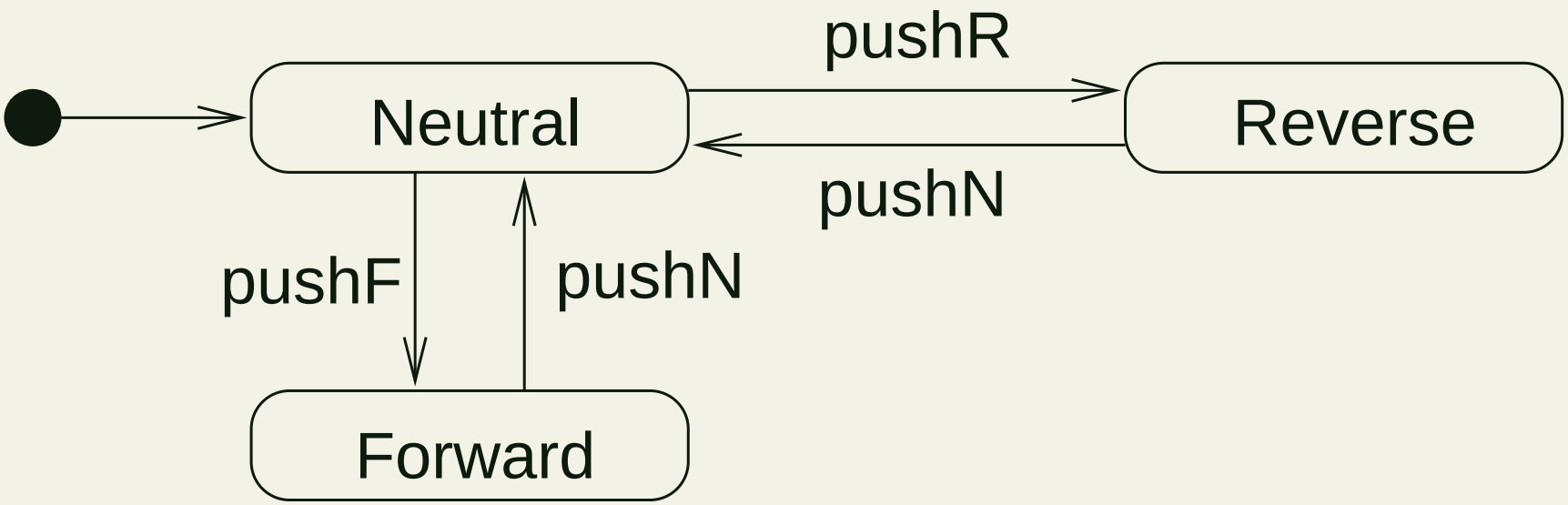
Explanation (Cont'd SC Diagram Semantics)

- graph notation: as close as possible to original UML representation, but a representation forcing an unambiguous interpretation
- resulting graphs (in the view of this section, the semantics of the UML state diagrams) can be translated into various semantical frameworks like temporal logics, streams, or (again) graph transformation systems (among other approaches)

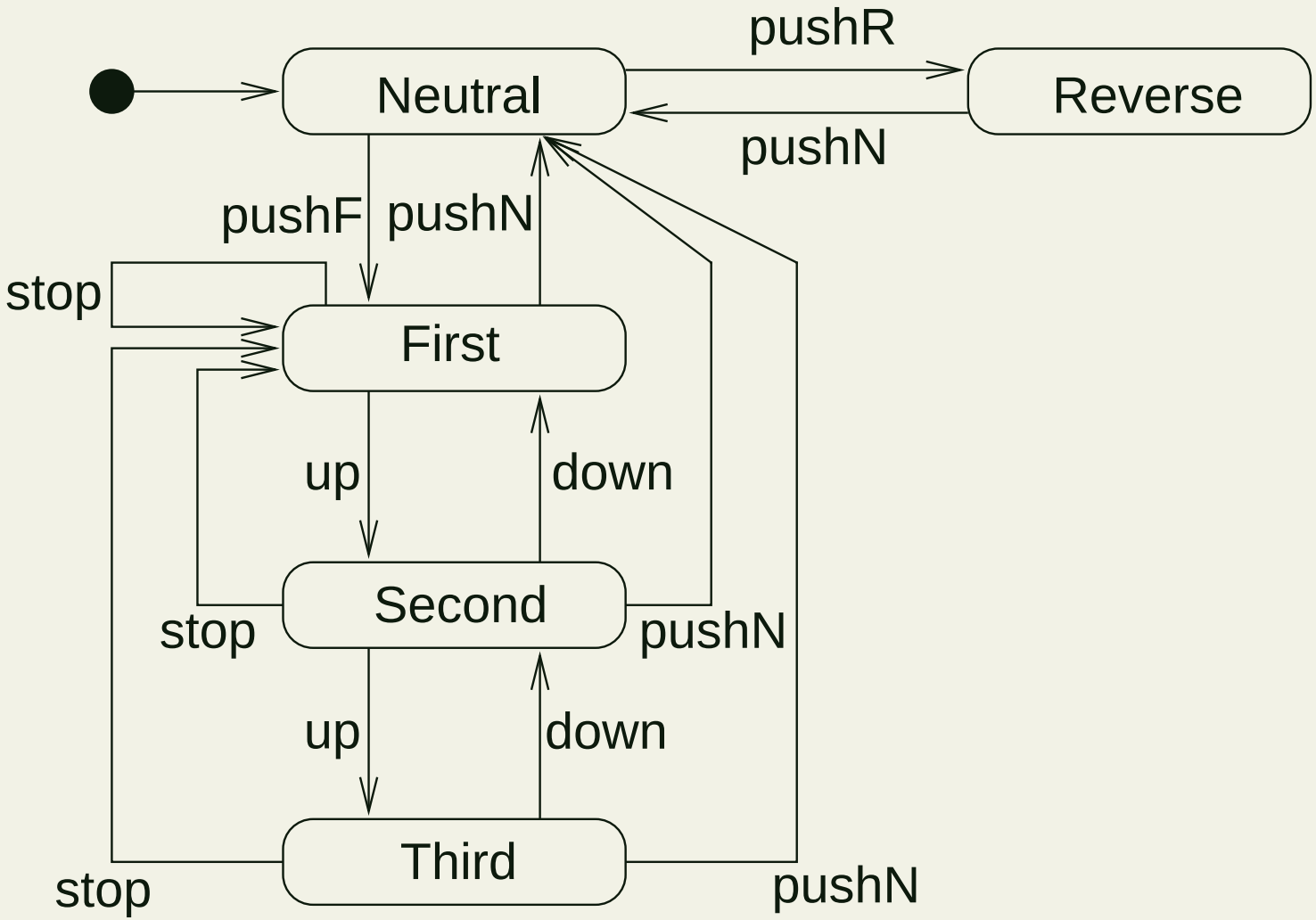
Car Transmission – UML High Level Diagram



Car Transmission – High Level Graph



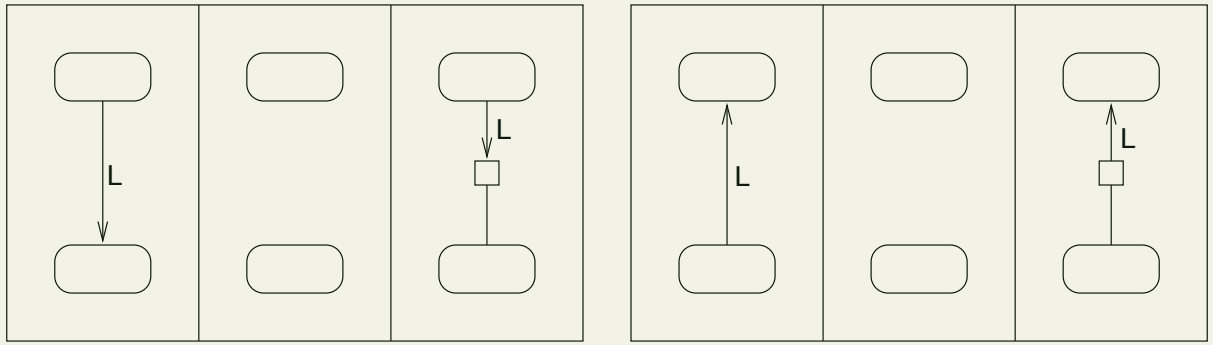
Resulting Low Level Graph



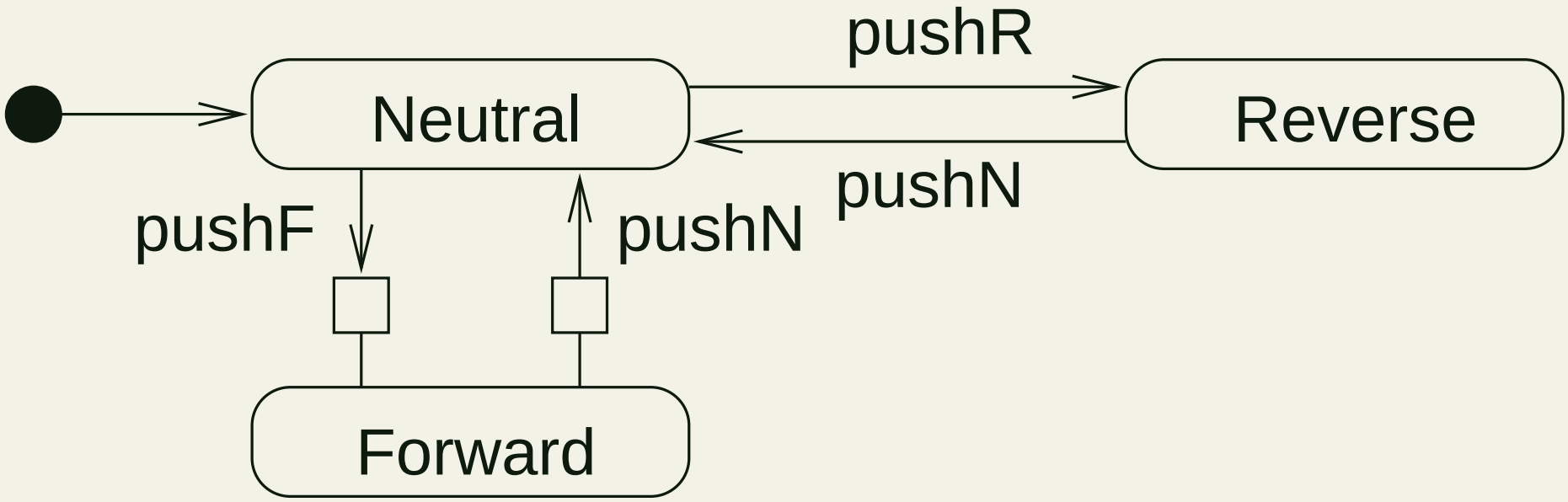
Graph Transformation System for Introducing the Boundary Nodes

Conventions for graph production layout

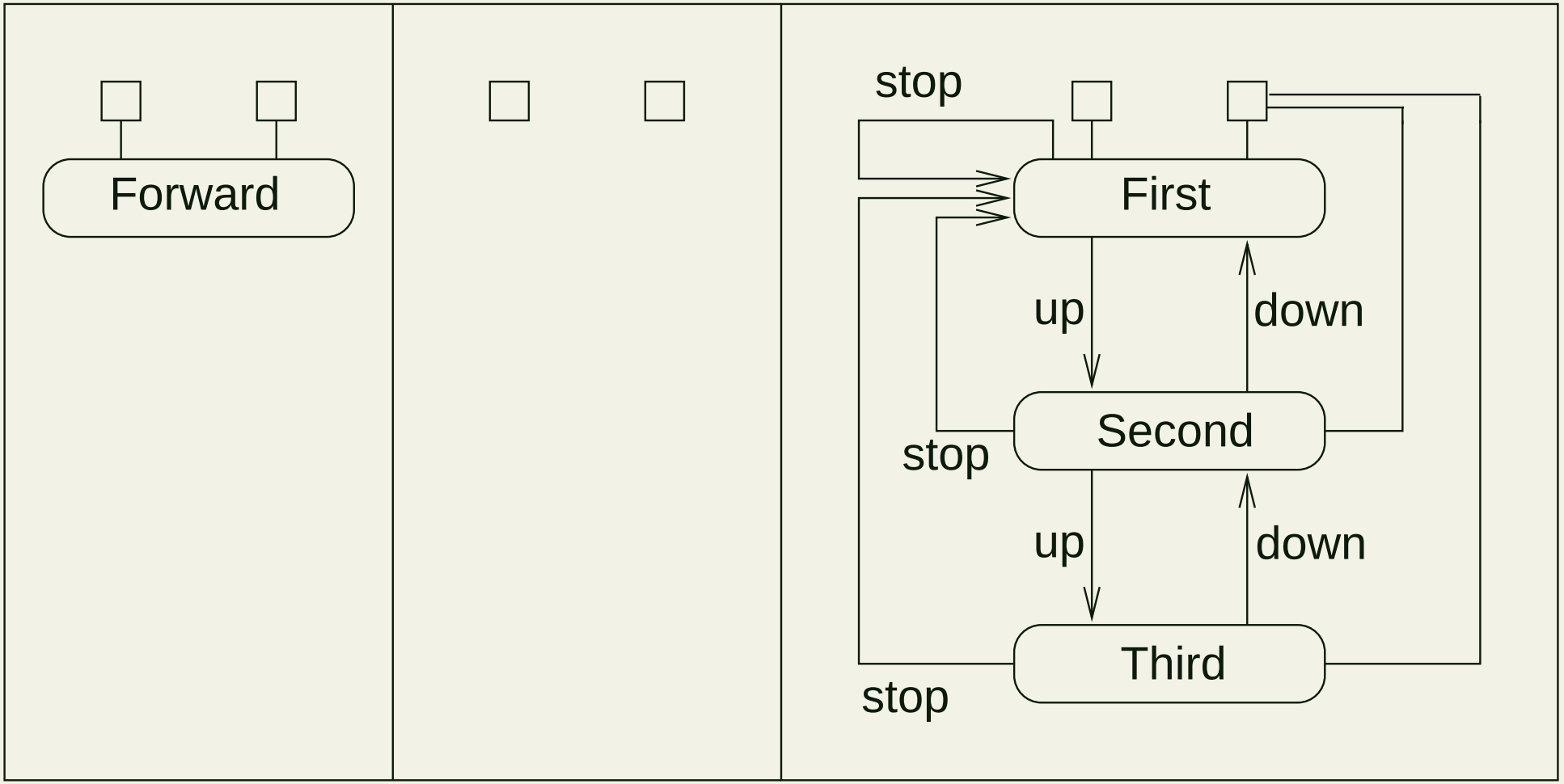
- nodes in the *top* of a production represent nodes *outside* the part to be expanded
- nodes in the *bottom* of a production represent nodes *inside* the part to be expanded



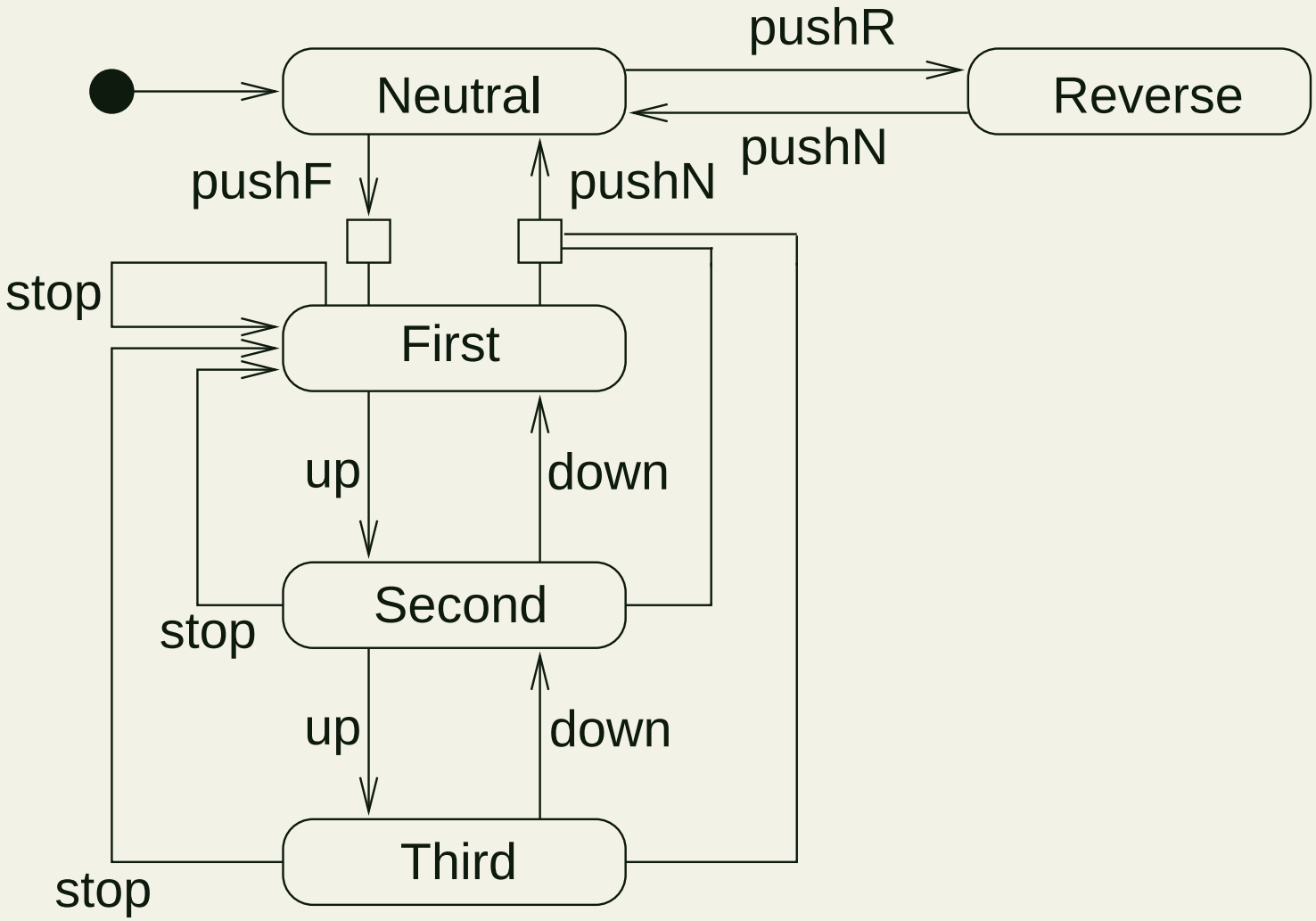
Car Transmission – Explicit Boundaries in the High Level Graph



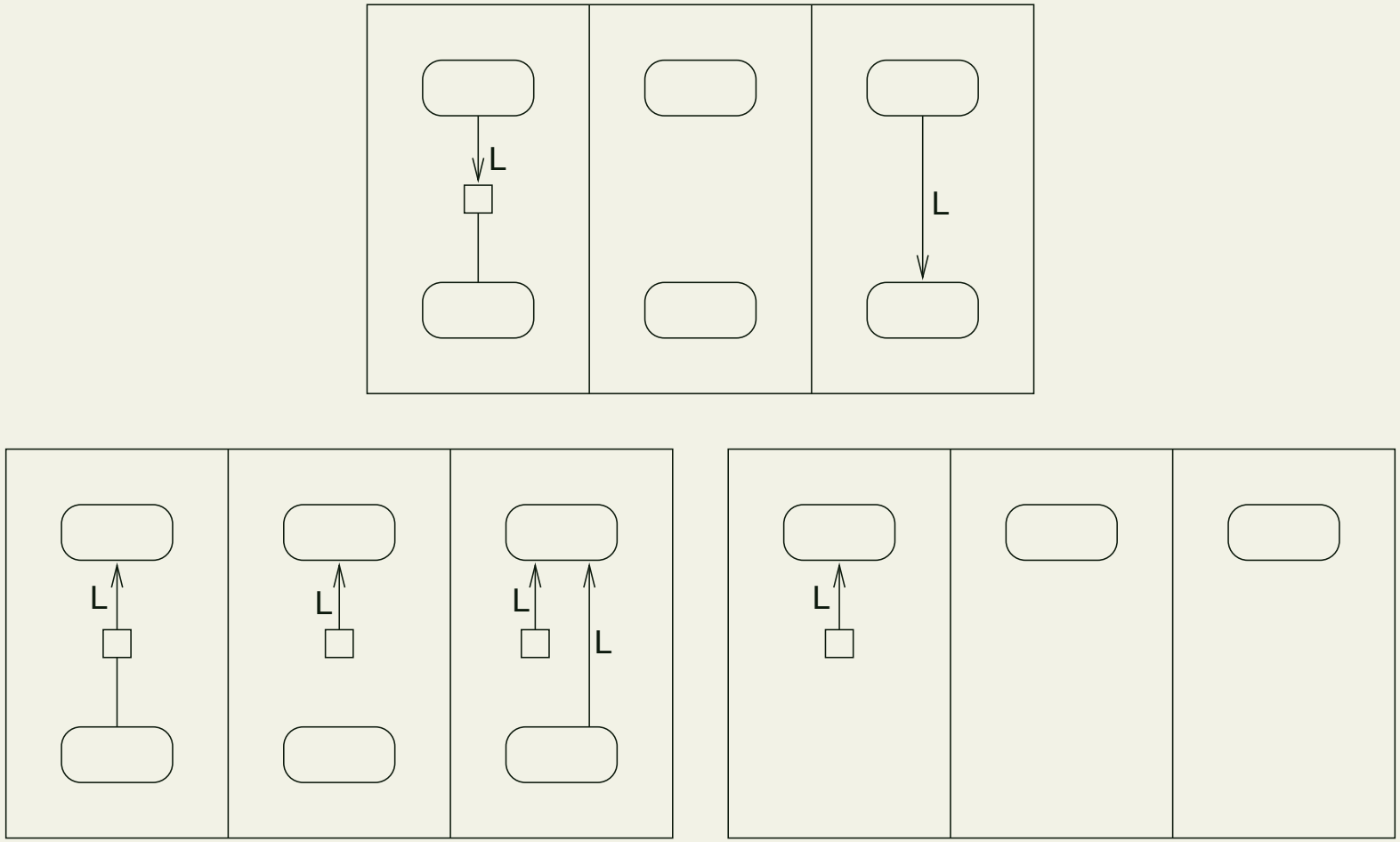
Graph Transformation System for the Car Transmission Example



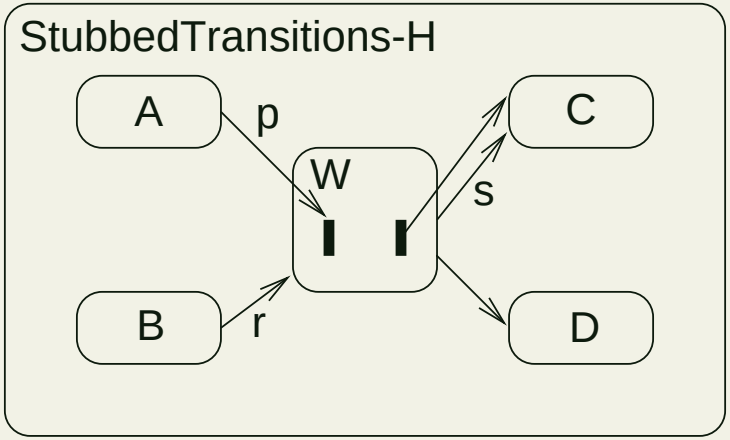
Applying the Rule in the High Level Graph

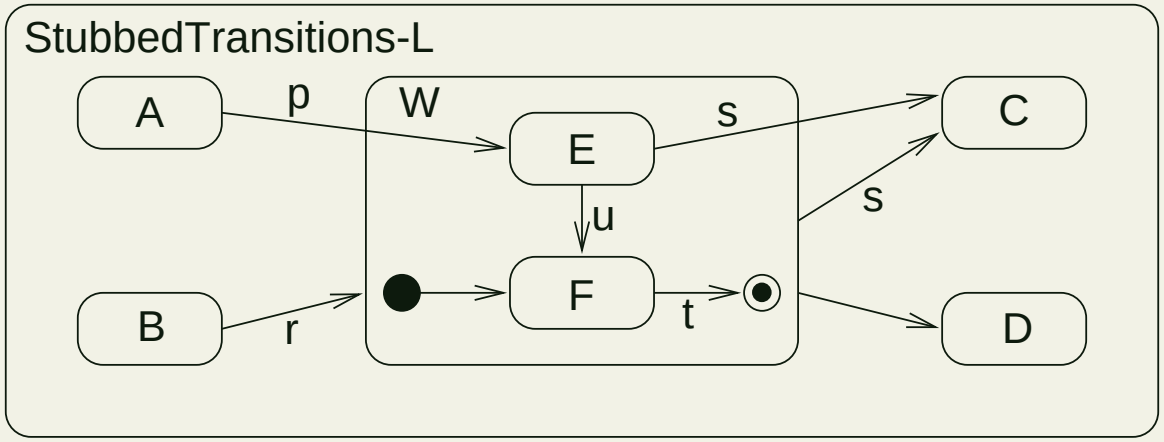


Graph Transformation System for Removing the Boundary Nodes

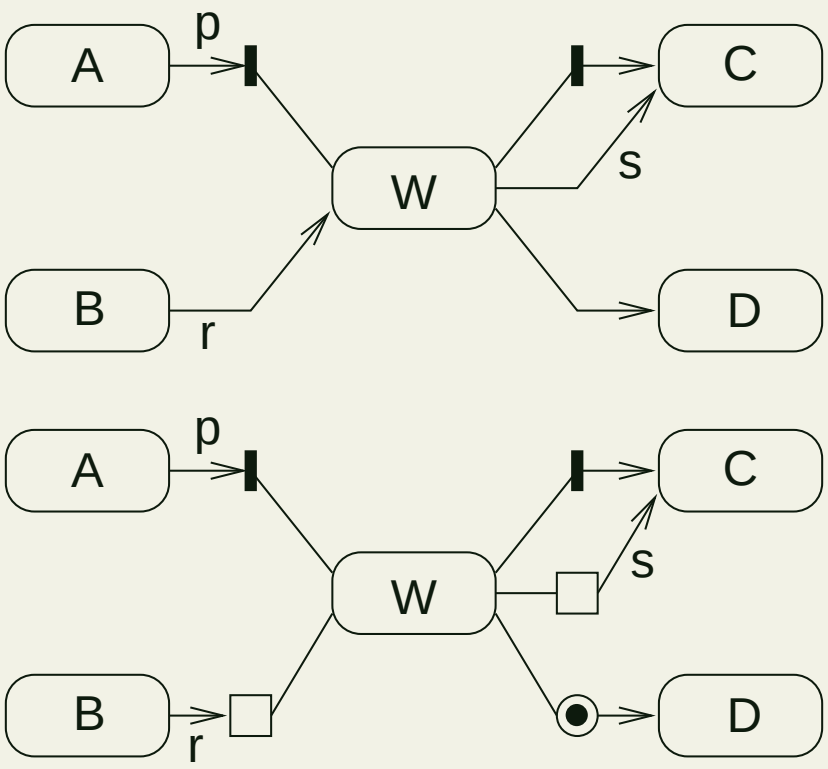


Stubbed Transitions – UML High and Low Level Diagram

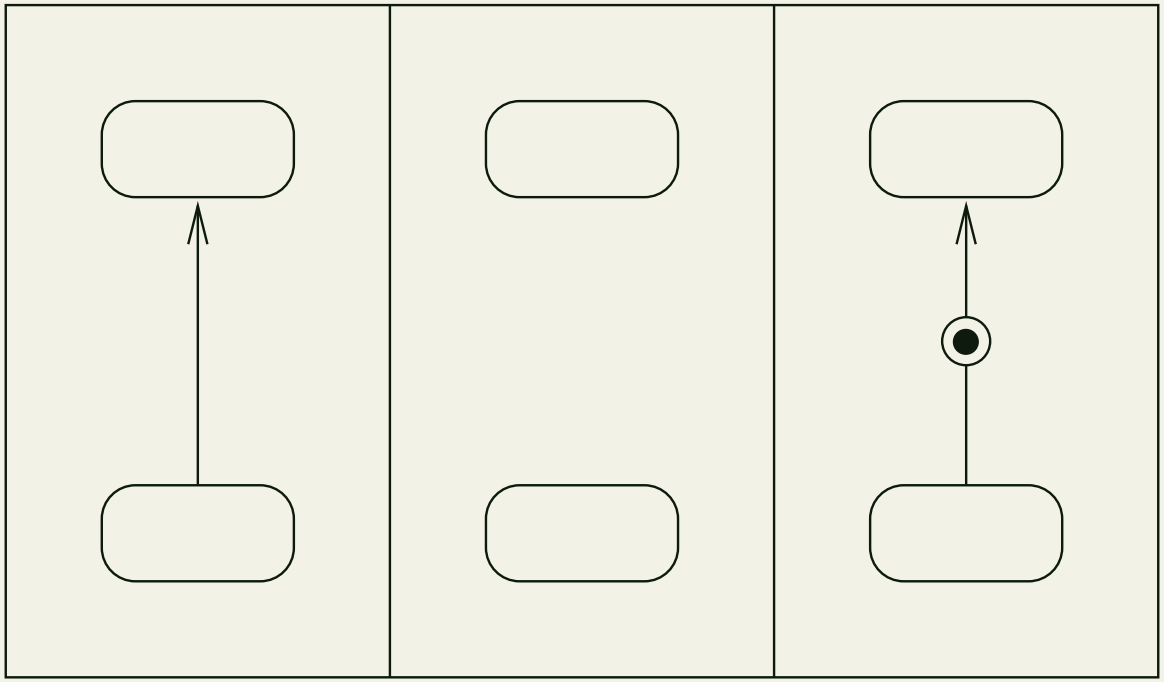




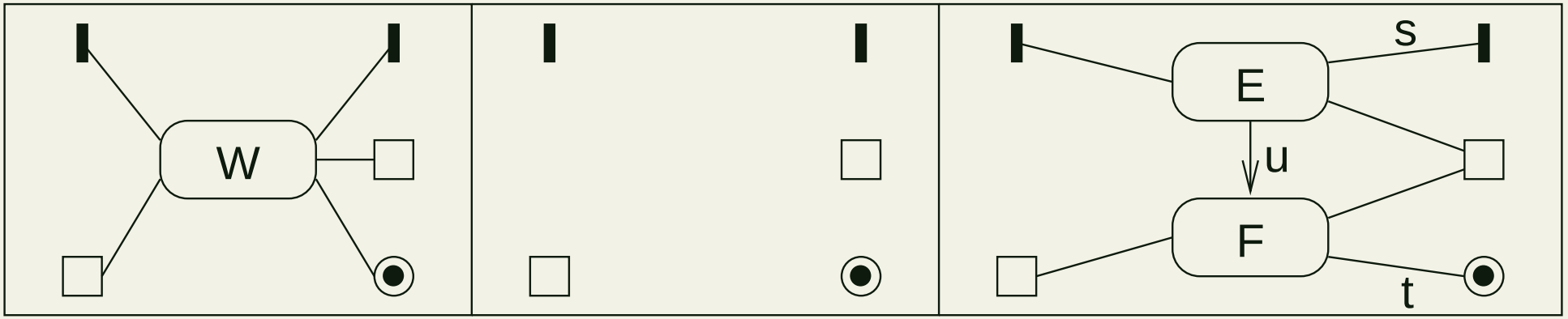
Stubbed Transitions - Explicit Stubs and Boundaries in the High Level Graph



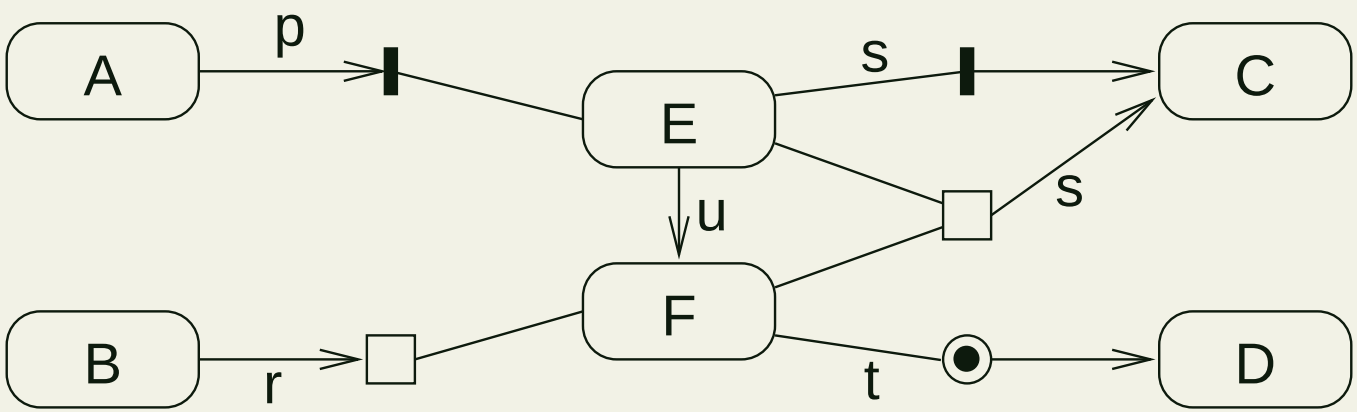
Graph Transformation System for Introducing the Final Node



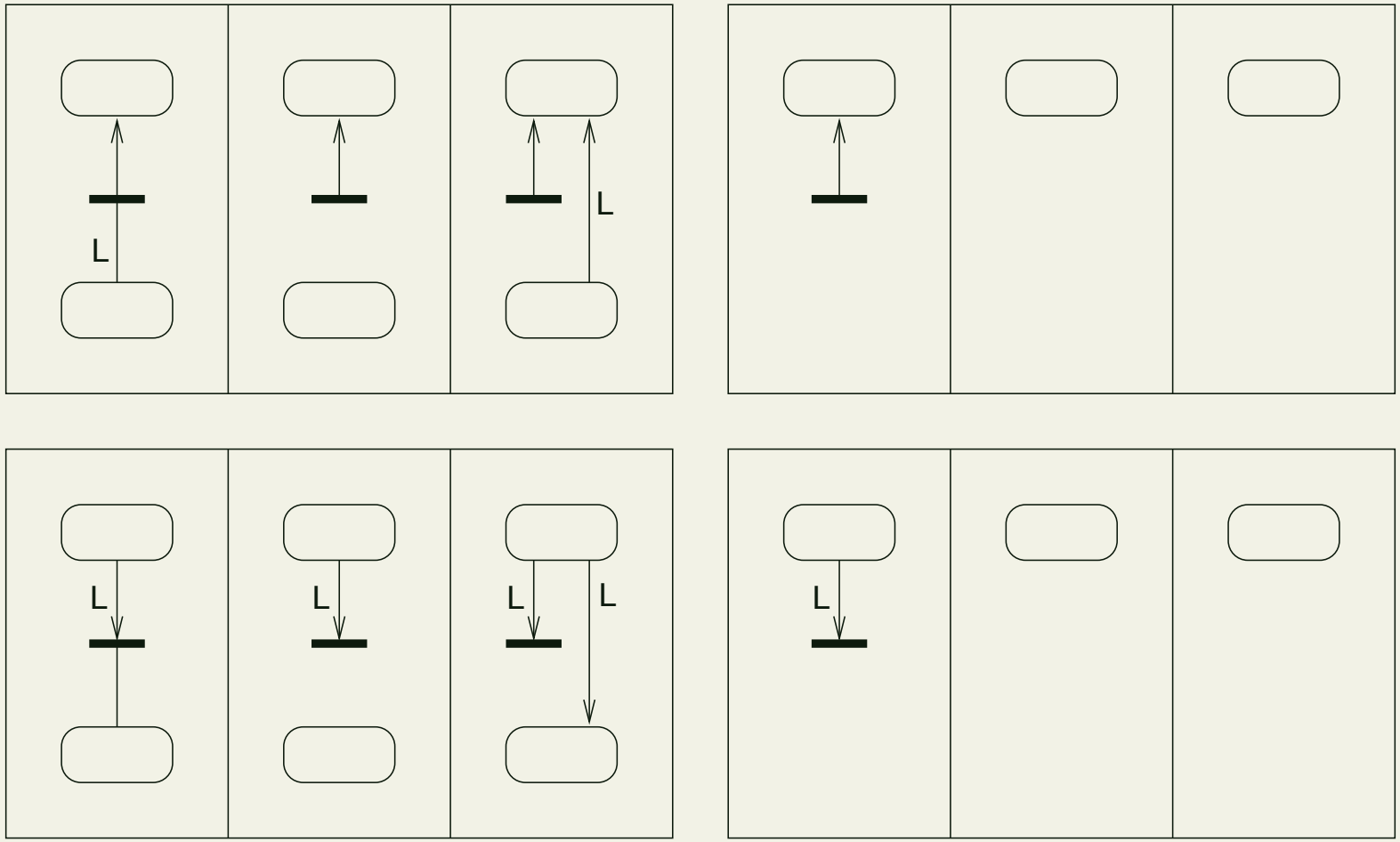
Graph Transformation System for the Stubbed Transitions Example



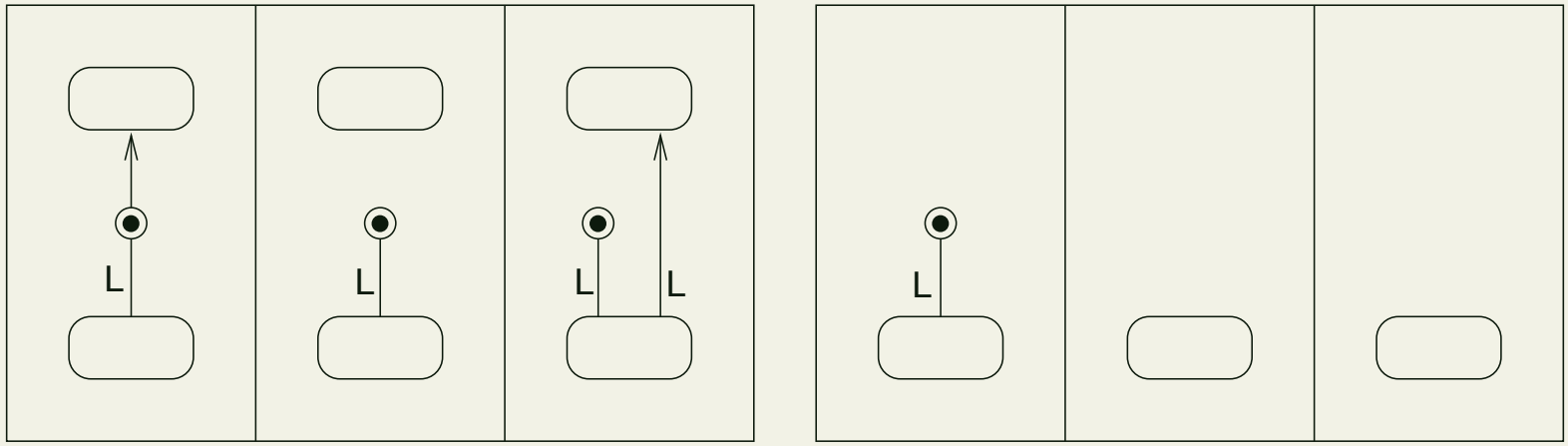
Stubbed Transitions – Applying the Rule in the High Level Graph



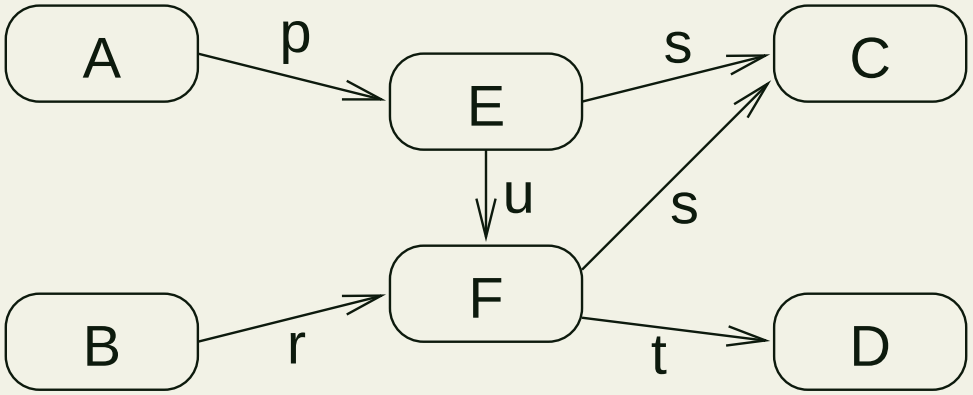
Graph Transformation System for Removing the Stubs



Graph Transformation System for Removing the Final Node



Stubbed Transitions – Resulting Low Level Graph



General Steps for Statechart Diagram Semantics

General steps

- Step 0: Consider productions for boundary and stub node insertion and deletion
- Step 1: Make explicit part to be expanded by introducing boundary nodes
- (Step 1$*$): If needed, make explicit stub nodes
- Step 2: Define graph transformation production for state expansion

General Steps for Statechart Diagram Semantics (cont'd)

- Step 3: Apply graph transformation production
- (Step 4$*$): If needed, remove stub nodes
- Step 4: Remove boundary nodes