Aspects of the UML

CA212 - Week 11
Dynamic Modelling
with
State Diagrams

Unified Modelling Language

Modelling Behaviour

Object Interactions

System Dynamics

Models

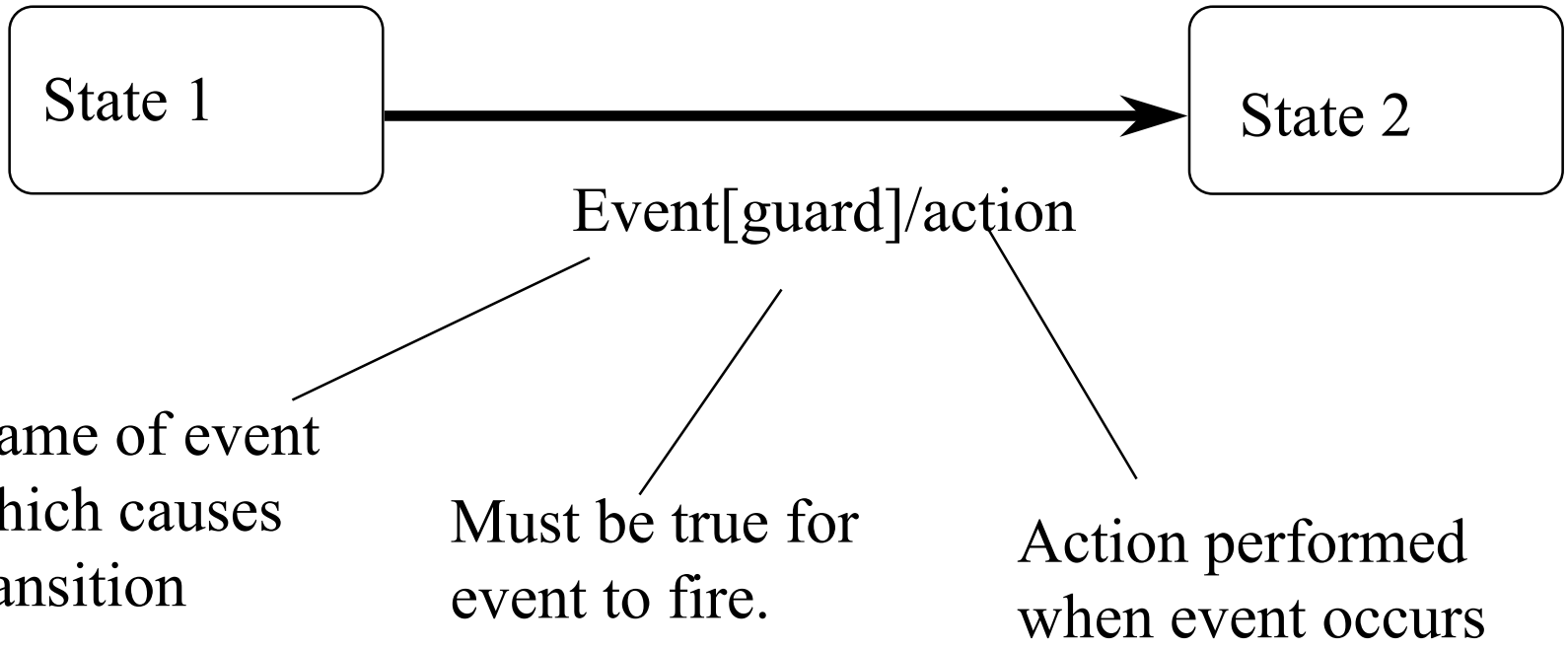
Describing Behaviour

- Dynamic Modelling
  - ***UML State Diagram***
  - ***UML*** Sequence Diagram
  - ***UML*** Collaboration Diagram
  - ***UML*** Activity Diagram

State Diagram

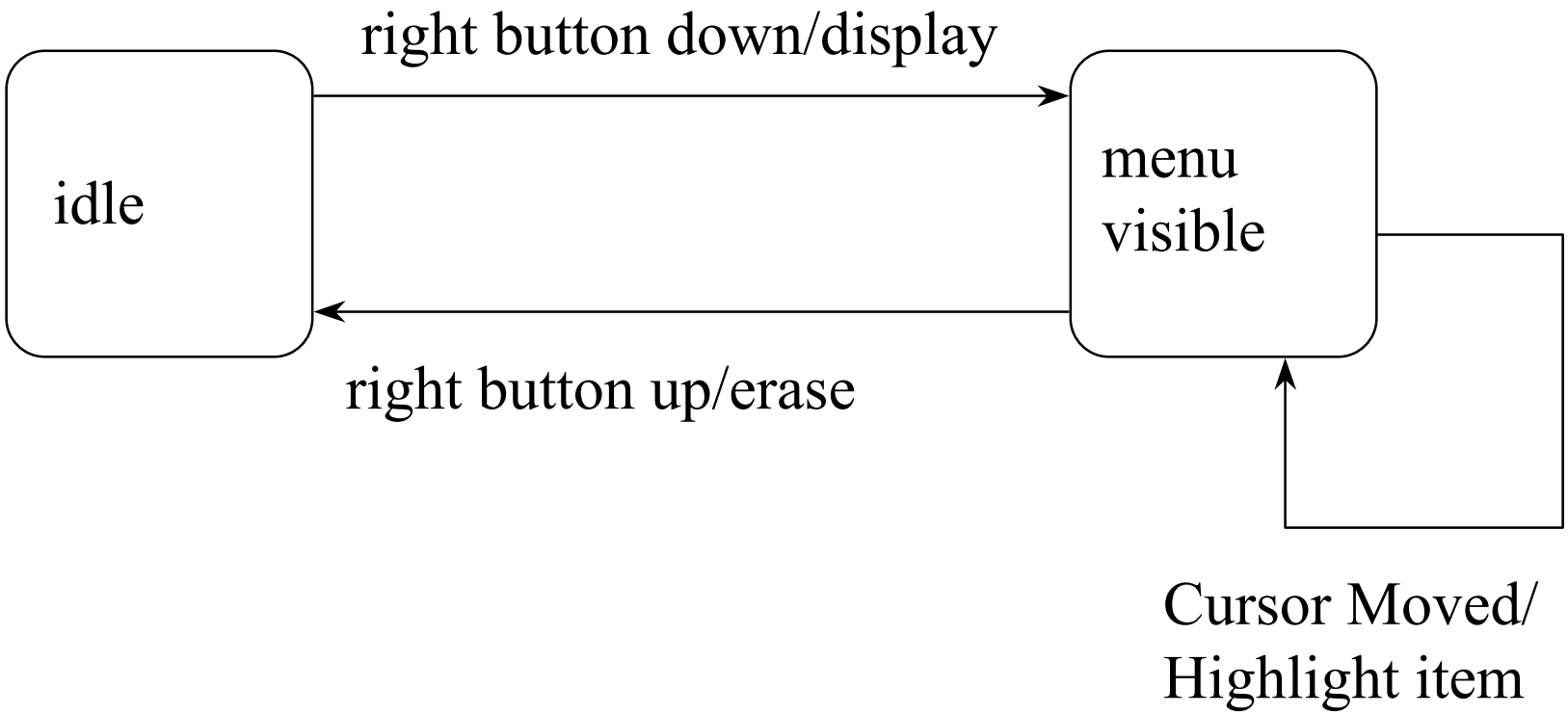
- Each Class may have an optional associated State Diagram.
- Developed by Harel.
- Incorporated into OO methods by Rumbaugh (OMT) and many others.

Notation


State 1
State 2
Event[guard]/action
Name of event which causes transition
Must be true for event to fire.
Action performed when event occurs

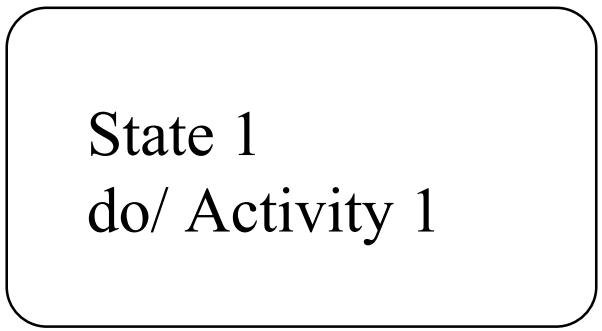
Example

- Pop-up menu control



Activity

- An activity is an operation that takes time to complete. Activities are associated with states

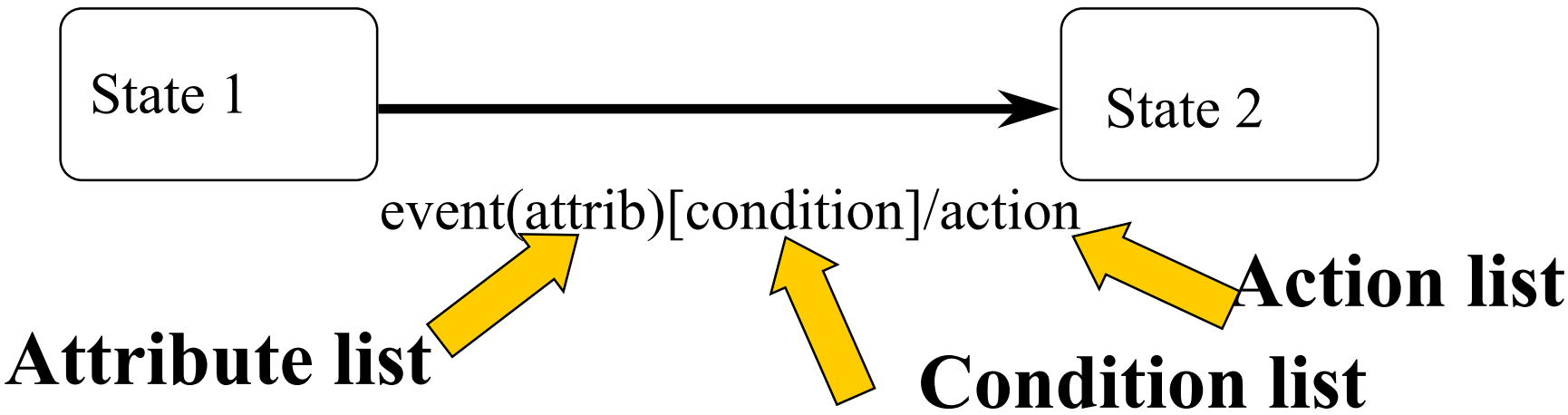


Action

- An action is an *instantaneous* operation associated with an event.
- Semantics of *instantaneous* is ambiguous.

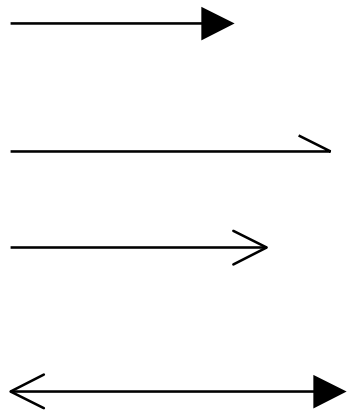
General Notation

- Event may have optional attributes associated (event supplies data)
- Optional guard conditions (pre-conditions) must be satisfied before a transition occurs.



Message Notation

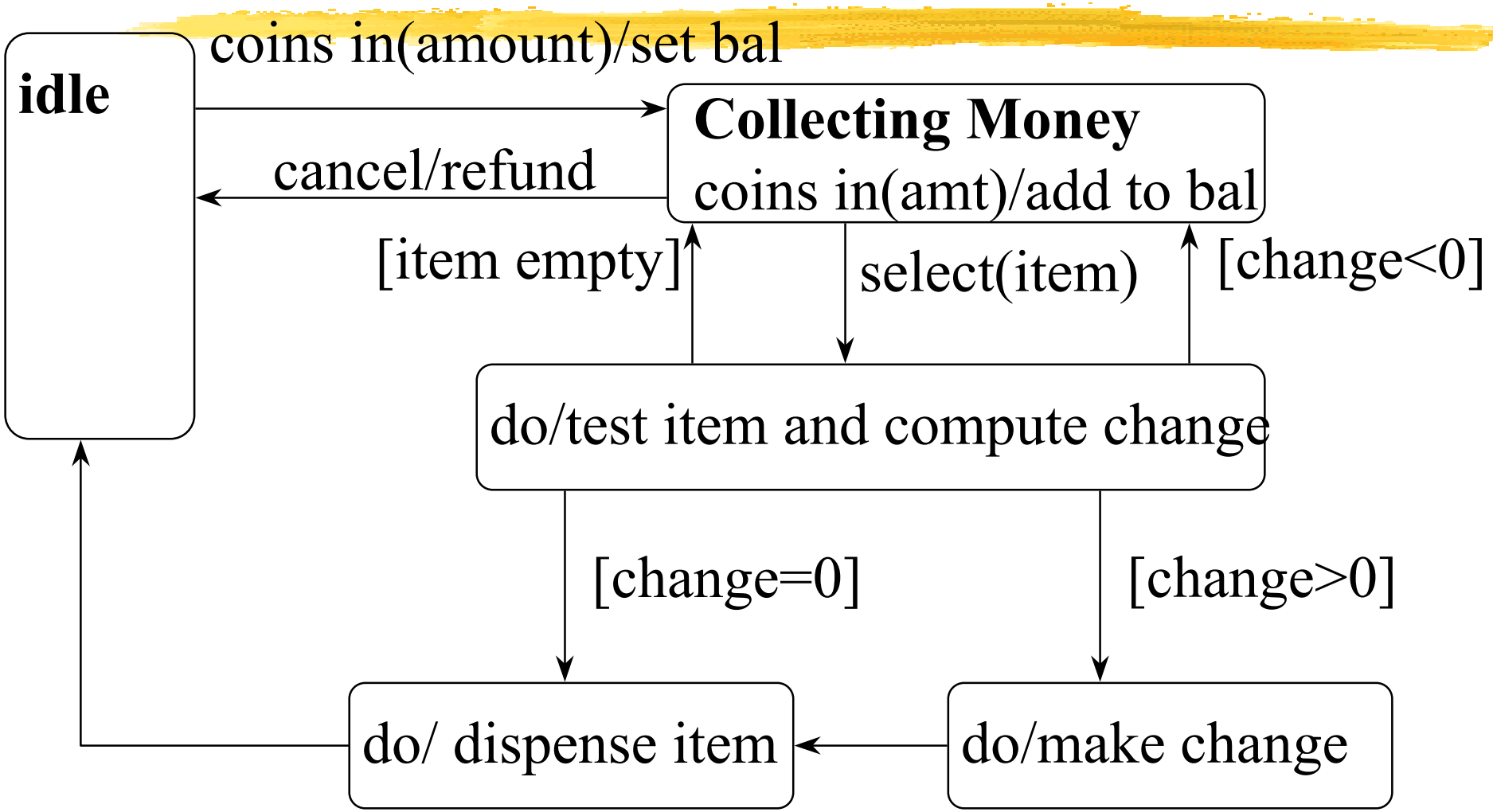
- Synchronous: blocking call.
- Asynchronous: non blocking call
- Simple: no details about communication.
- Synchronous with immediate return.



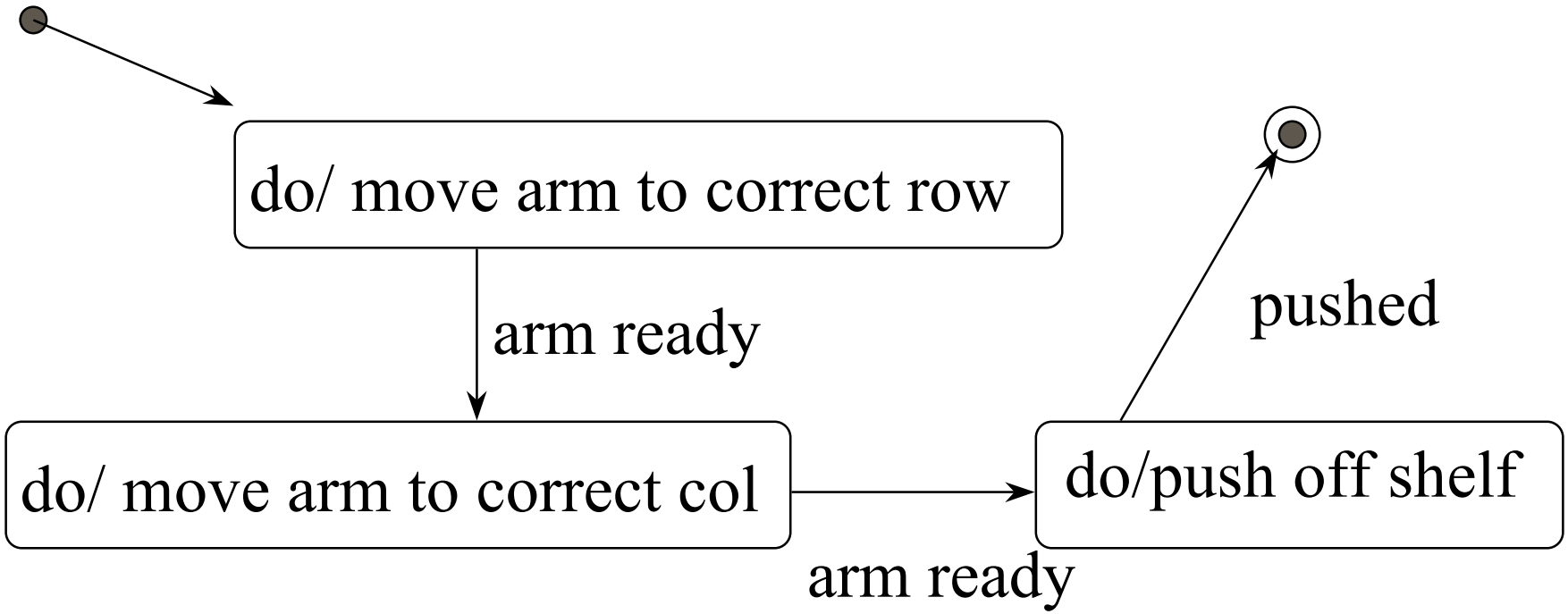
Nesting State Diagrams

- State diagrams for an Object may be nested, allowing the control mechanism to be viewed at different levels.

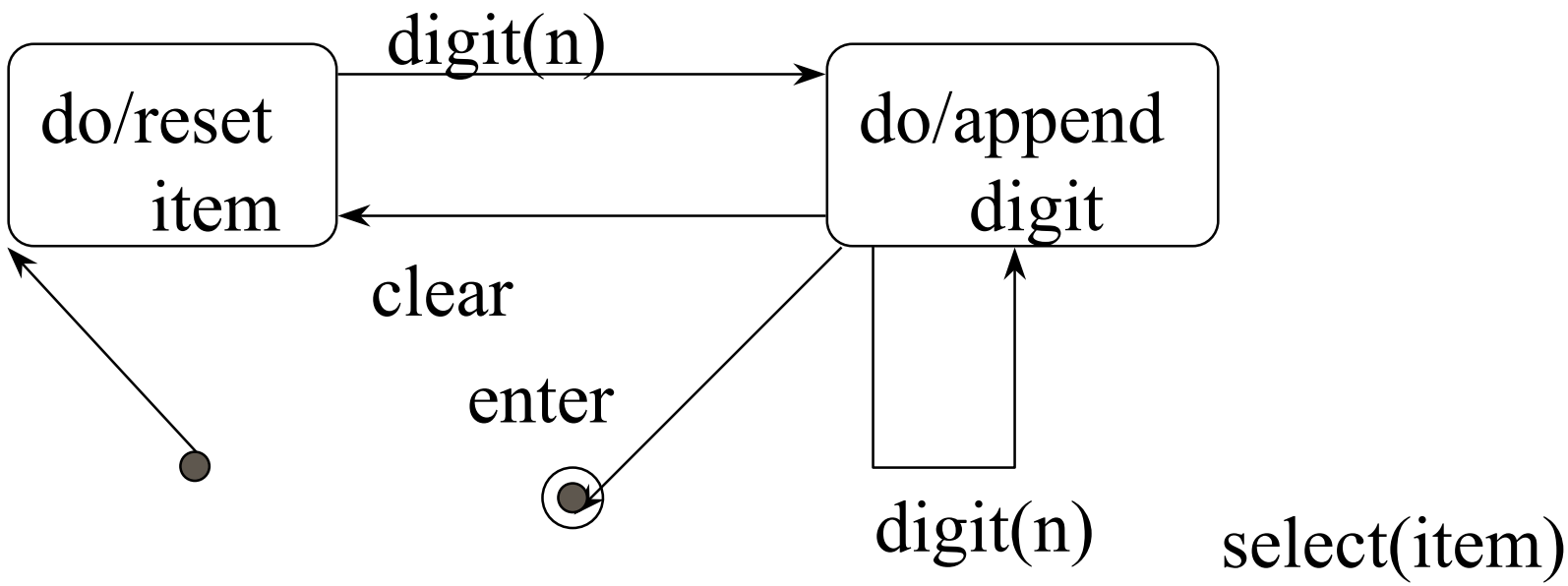
Example: Vending Machine



Example: Dispense Item



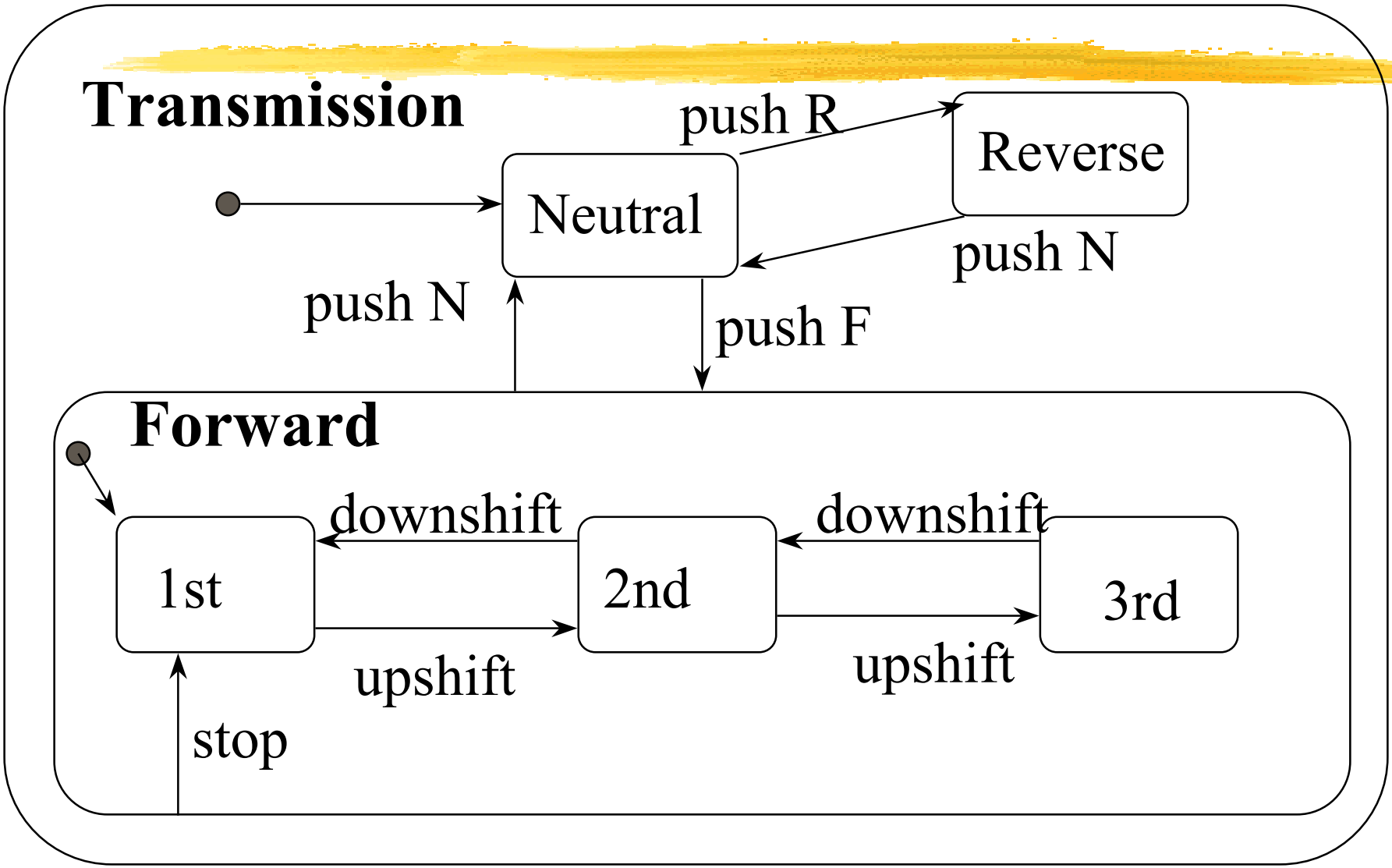
Example: Select Item



Generalisation of States

- Groups of substates with common transitions can be combined into a single superstate, and inherit transitions from the superstate.

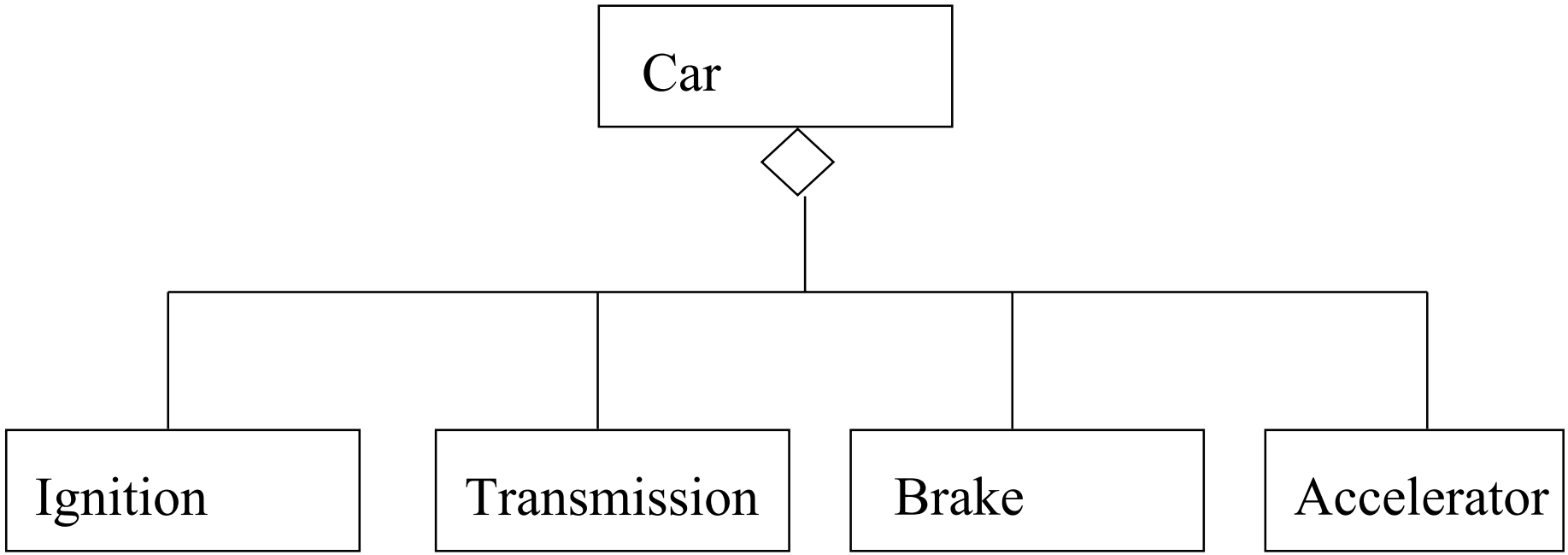
Example: Transmission



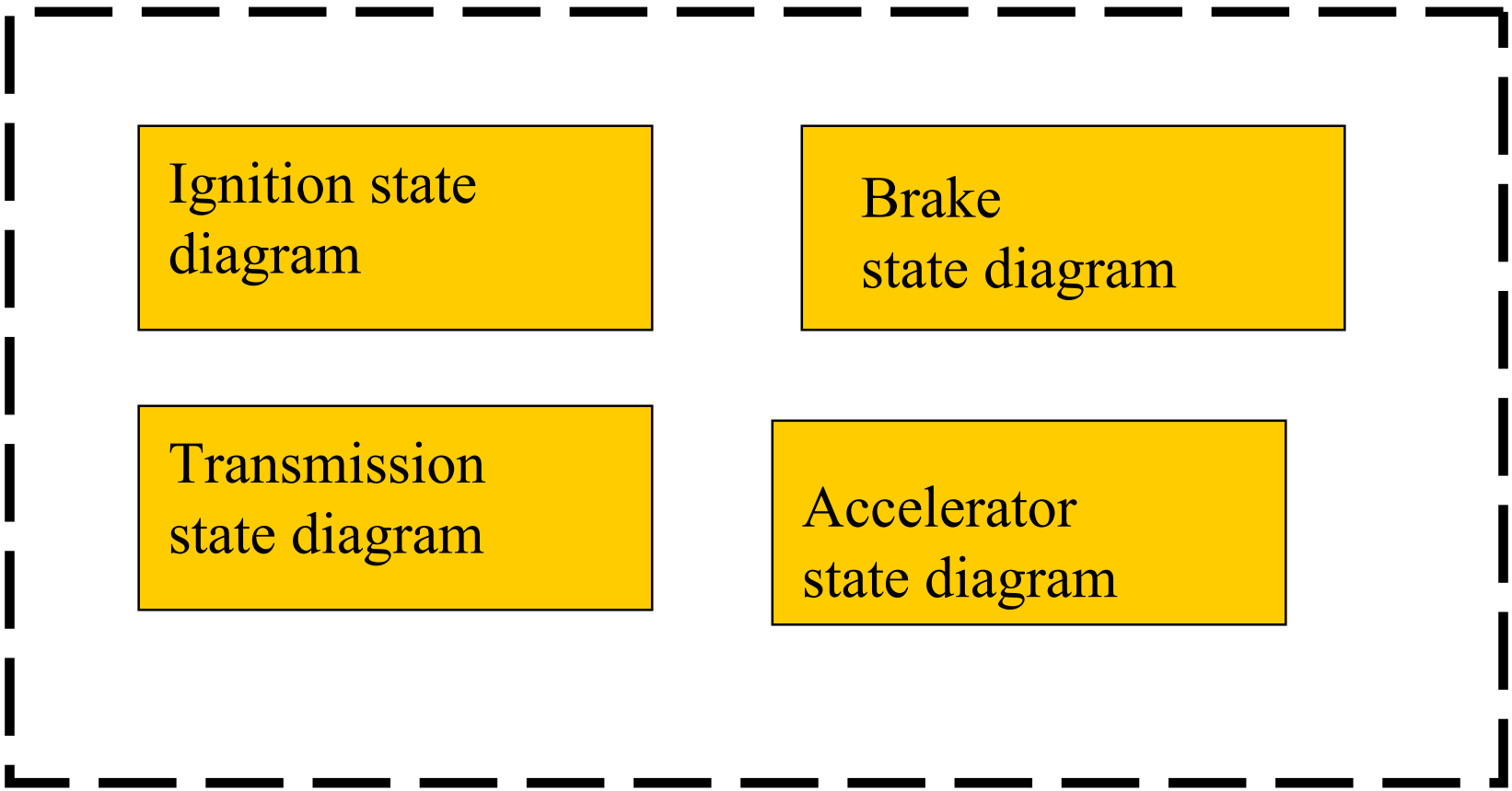
Example: Generalisation

- **Forward** is an abstract state.
- Selecting **N** in any forward gear will cause a transition to **Neutral**.
- Selecting **Stop** in any forward gear will cause a transition to **First.**

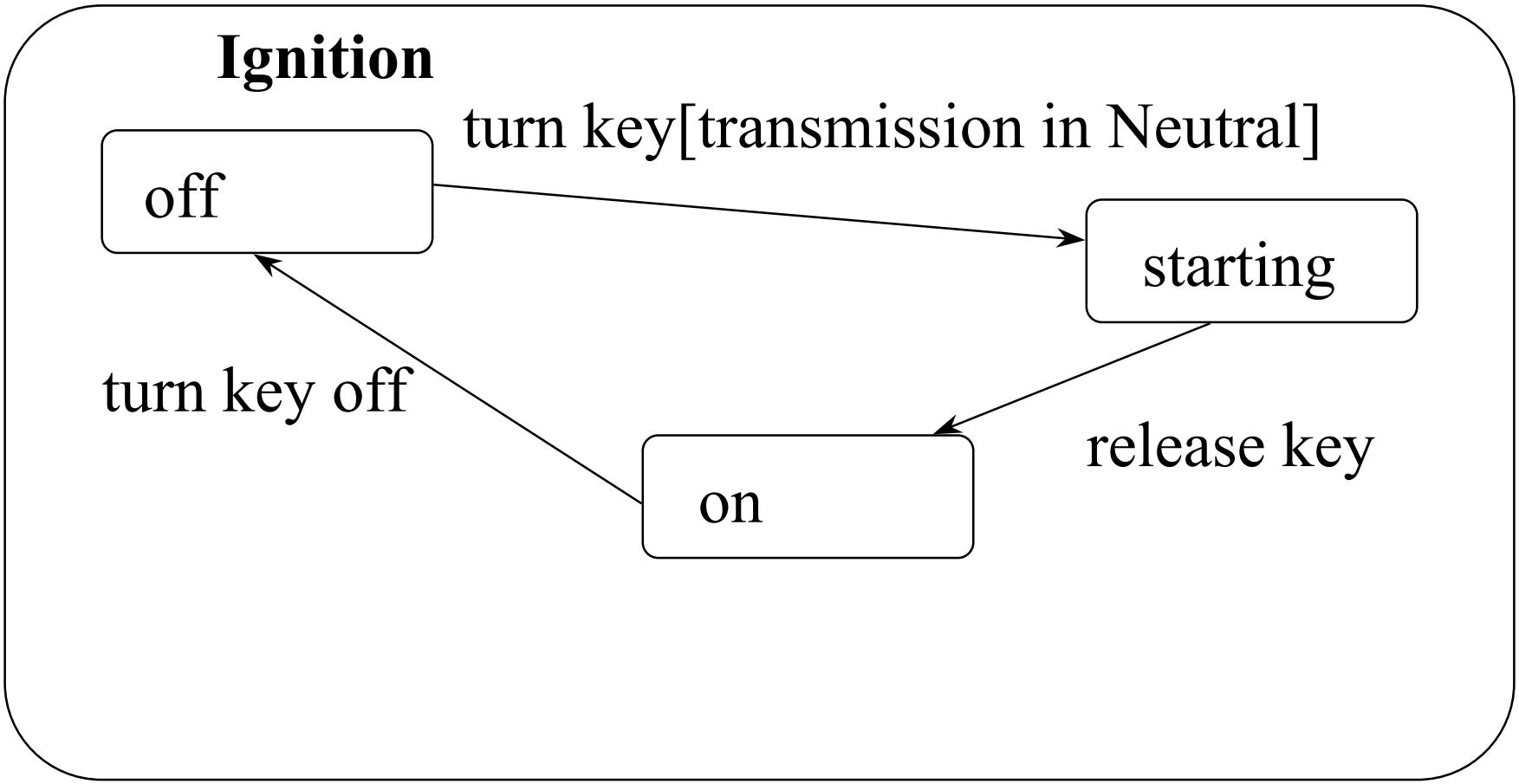
Example: Object Model



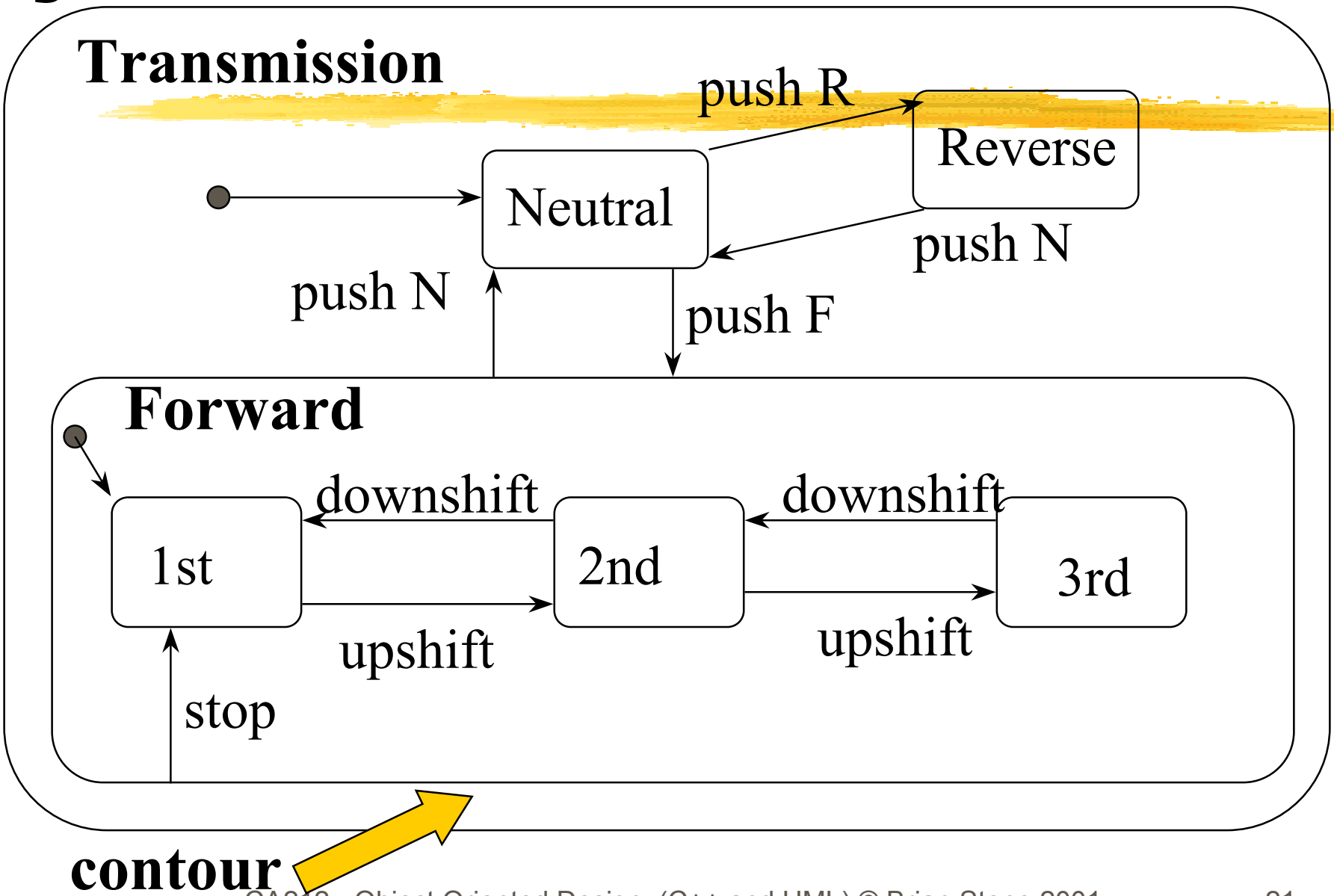
Dynamic Model



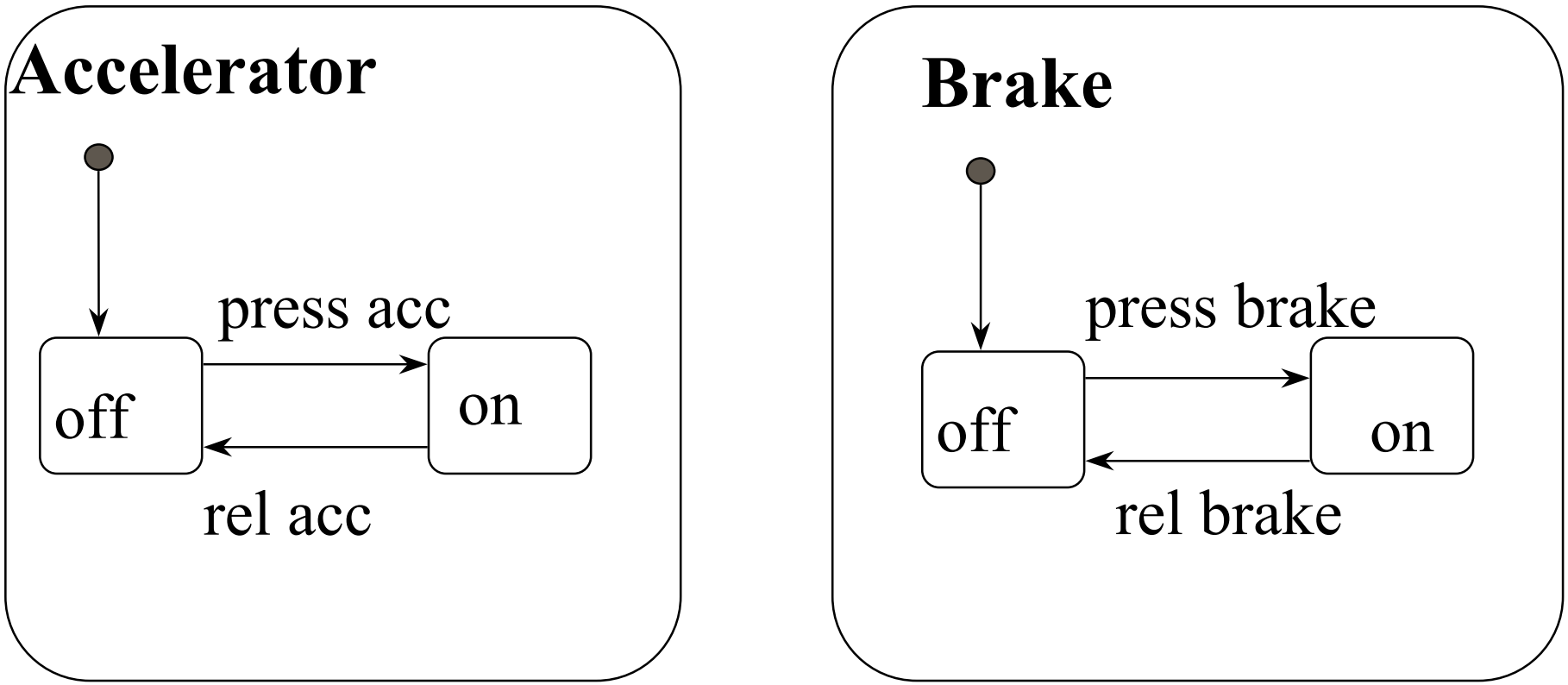
Dynamic Model: Ignition



Dynamic Model: Transmission

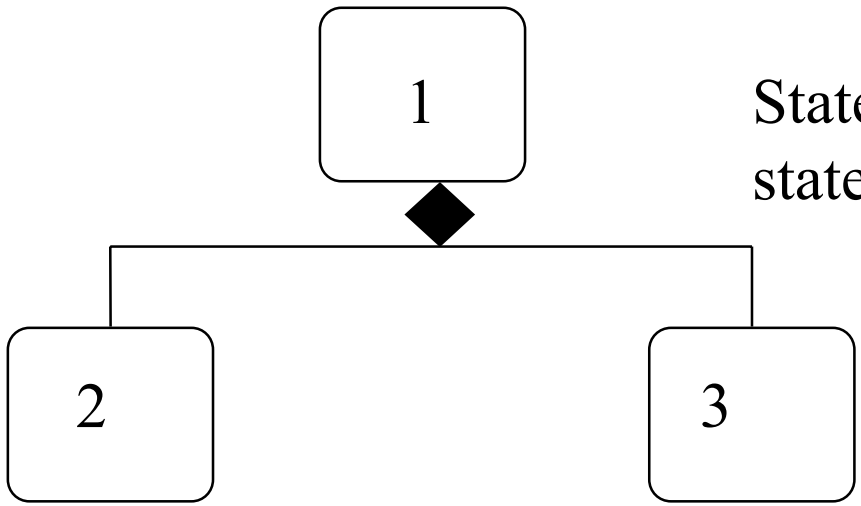


Dynamic Model: Accelerator & Brake



Concurrency

- Aggregation concurrency: The aggregate state corresponds to the combined states of all the components.

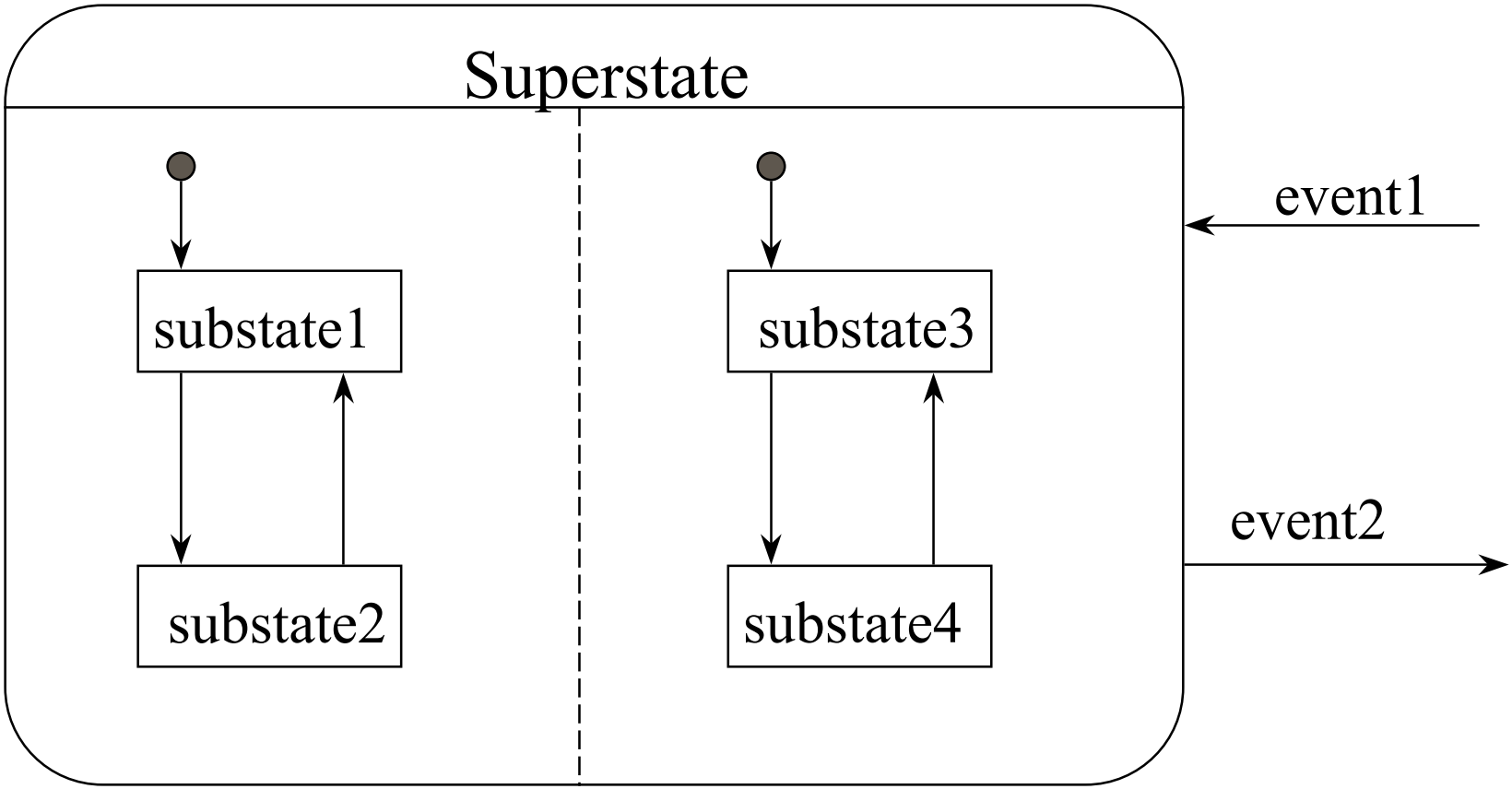


State of 1 is defined by state of 2 and of 3

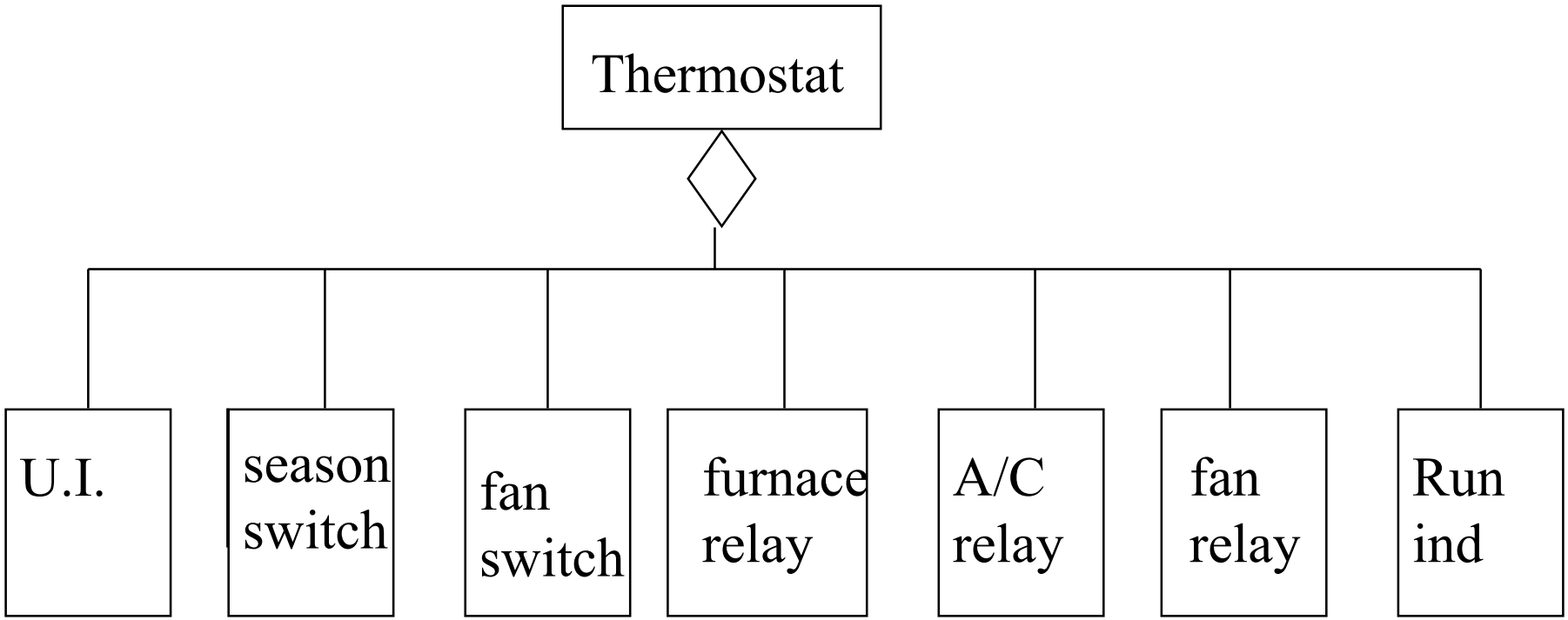
Concurrency (cont..)

- Concurrency within an Object:- Concurrency within the state of a single Object arises when an object can be partitioned into subsets of attributes or links, each of which has its own state diagram.

Concurrency (cont..)



Example: Programmable Thermostat



Example of Aggregation Concurrency

Links to the Class Diagram

- Keep SD as simple as possible.
- Events, actions, activities **must** each map directly to functions on the *UML* Class Diagram.
- A "dictionary" of all functions and data is maintained for consistency across all diagrams and models.

Class and State Diagrams

- If a function appears on a State Diagram, then it must appear on a corresponding Class Diagram, otherwise there is no rigor.
- CASE tools like Rational Rose help support this rigor by assisting modeller with lists of operations and generating reports of orphan operations (not on Class diagram).

OO Method Adaptations

- ROOM
- Octopus
- INSYDE's OMT*
  - http://www.compapp.dcu.ie/~bstone/research
- Catalysis
  - http://www.iconcomp.com
- Rational's Process (Objectory)
  - http://www.rational.com

UML Tools

- At present there are two main UML tool vendors…
  - Rational: the Rose CASE tool
    - http://www.rational.com
  - Object Team: the Cayenne CASE tool.
    - http://www.objectteam.com

Graded Exercise

- This is the final exercise. Well worth doing!!!
- An ATM case-study is defined on the public directory.
  - Develop a Class Diagram for the ATM
  - Develop a State Diagram for performing a Query on Account.
  - Use Rational Rose.
- Hints: Make "Transaction" a class. "Query" is a type-of "Transaction" (inherited from).
- Partial Telecomms example available on public directory for reference.