COIS2240 Lecture 5

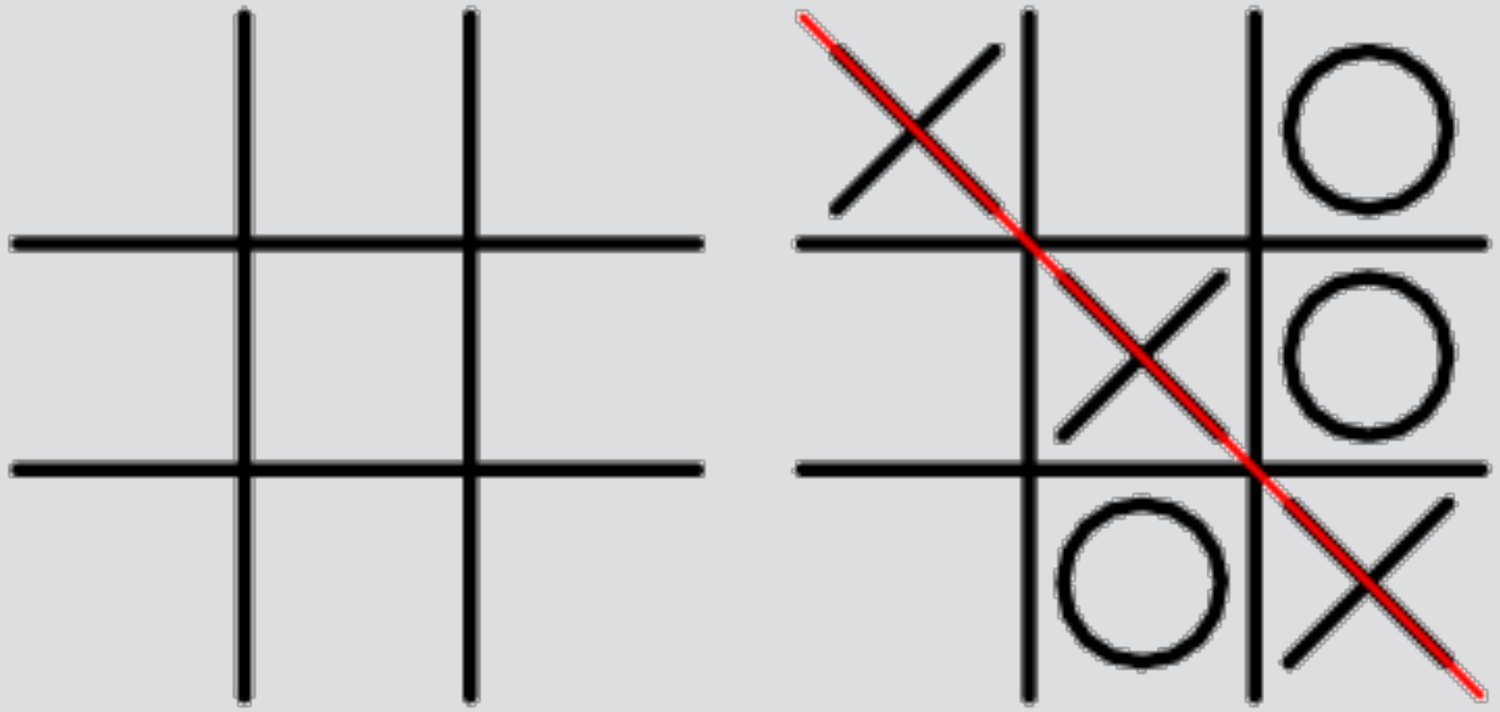
State Diagrams

A state diagram describes the behaviour of a *system*, some *part* of a system, or an *individual object*.

- At any given point in time, the system or object is in a certain state.
  - —Being in a state means that it is will behave in a *specific way* in response to any events that occur.
- Some events will cause the system to change state.
  - —In the new state, the system will behave in a different way to events.
- A state diagram is a directed graph where the nodes are states and the arcs are transitions.

State diagrams – an example

- tic-tac-toe game (also called noughts and crosses)



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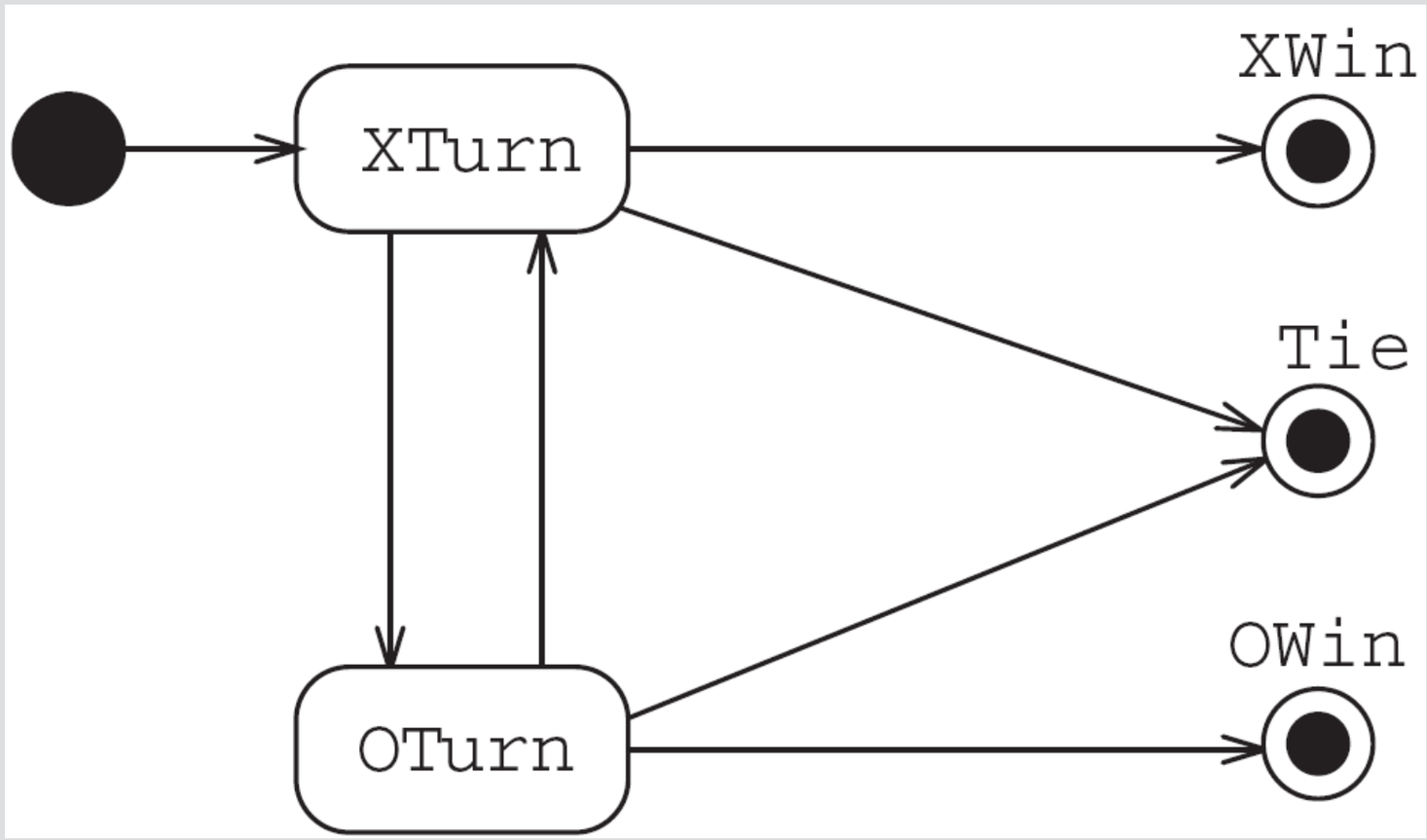


States

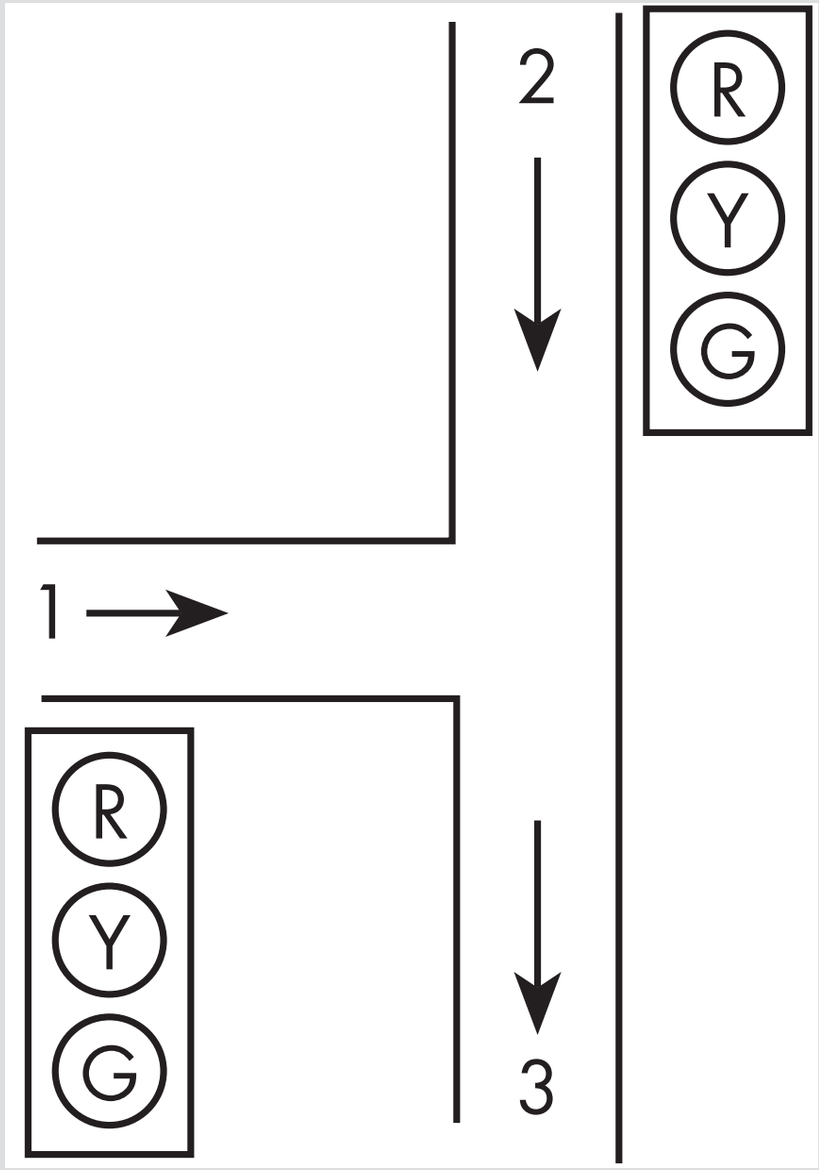
- At any given point in time, the system is in one state.
- It will remain in this state until an event occurs that causes it to change state.
- A state is represented by a rounded rectangle containing the name of the state.
- Special states:
  - A black circle represents the *start state*
  - A circle with a ring around it represents an *end state*

Transitions

- A transition represents a change of state in response to an event.
  —It is considered to occur instantaneously.

- The label on each transition is the event that causes the change of state.

State diagrams – an example of transitions with time-outs and conditions



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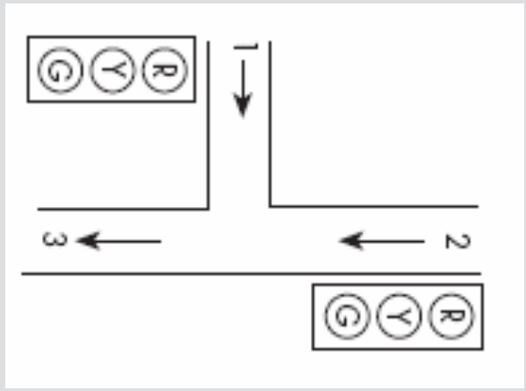
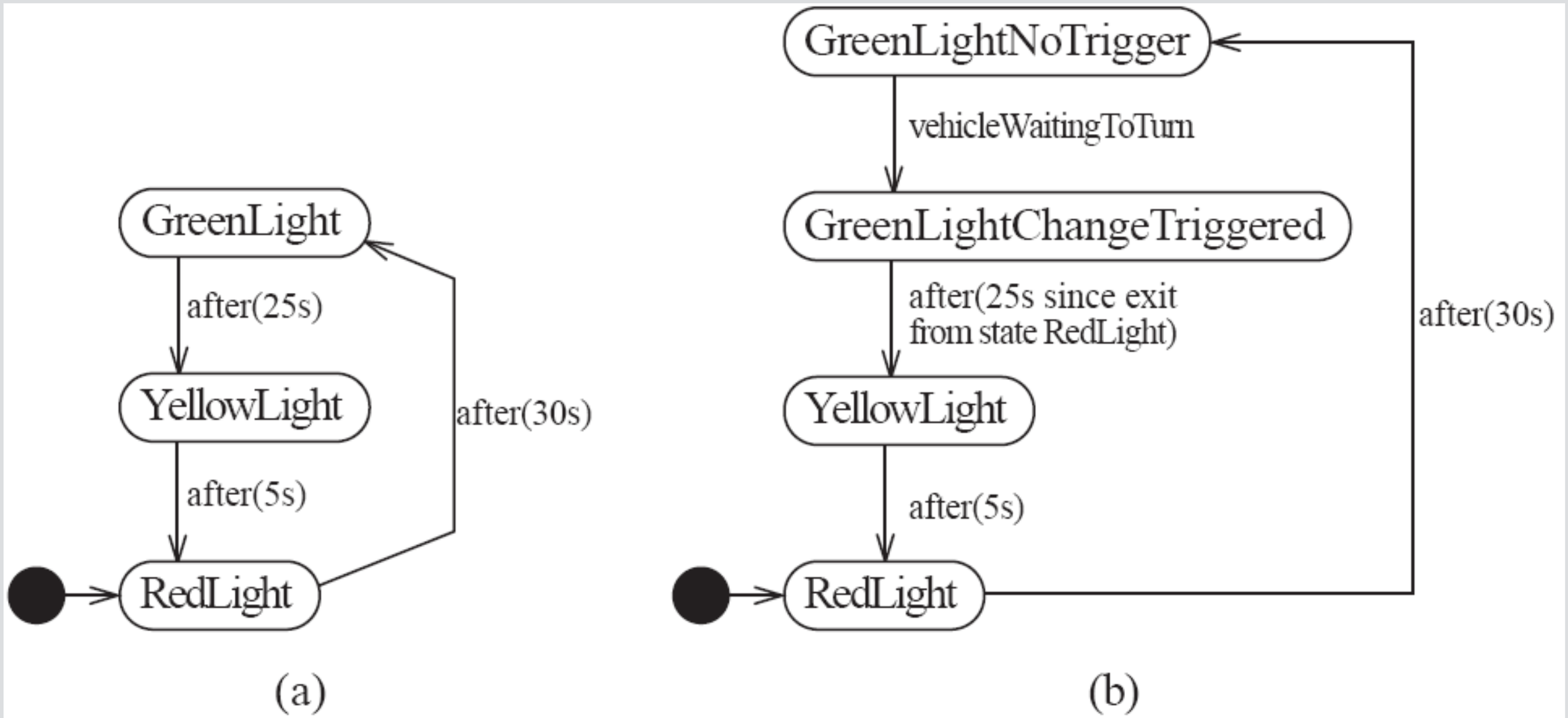
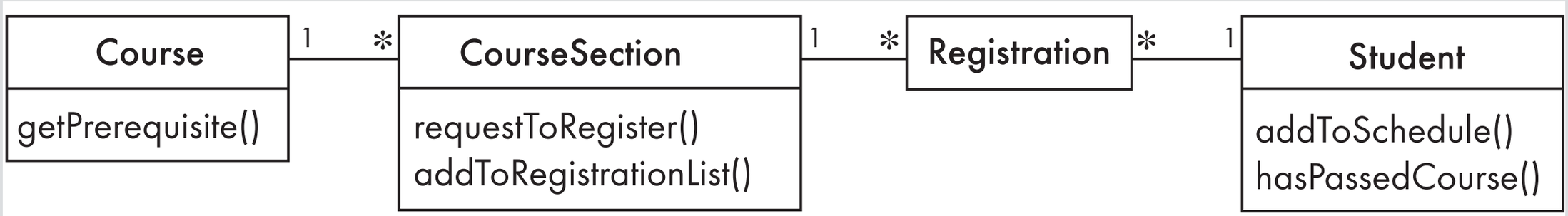




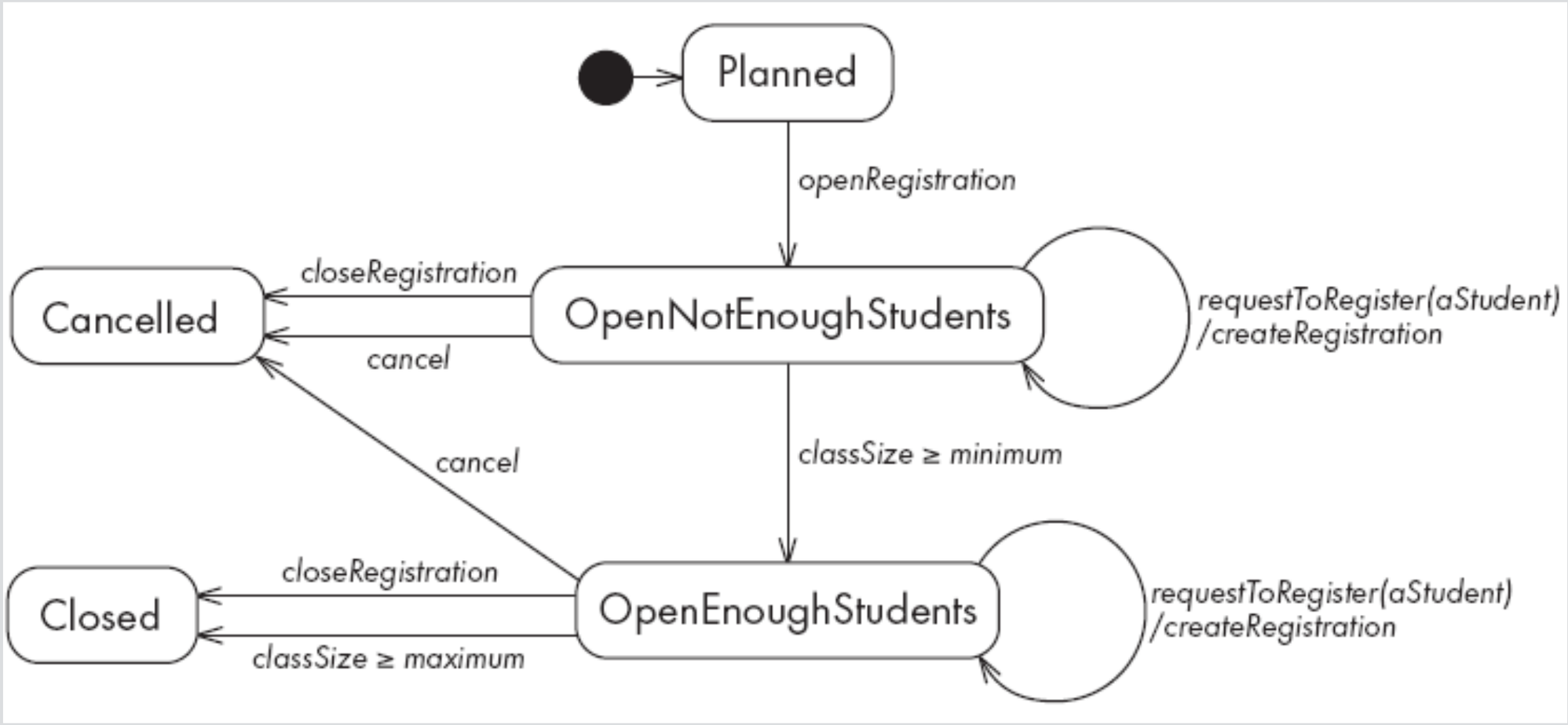
State diagrams – an example with conditional transitions



Behaviour of instances of CourseSection class?

State diagrams – an example with conditional transitions

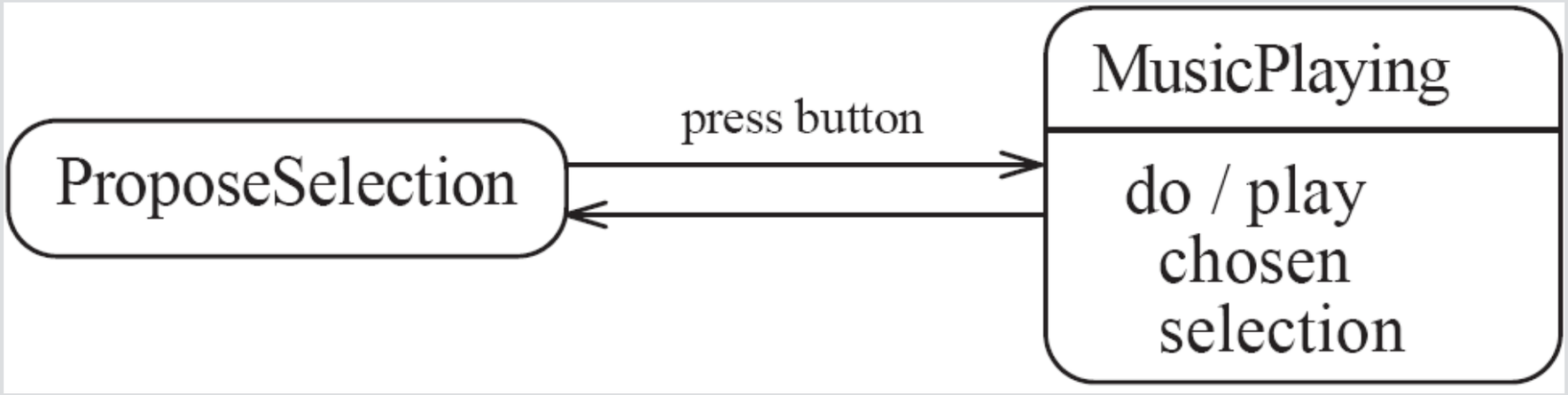
Behaviour of instances of CourseSection class



Activities in state diagrams

- An *activity* is something that takes place while the system is *in* a state.
  - —It takes a period of time.
  - —The system may take a transition out of the state in response to completion of the activity,
  - —Some other outgoing transition may result in:
    - The interruption of the activity, and
    - An early exit from the state.

State diagram – an example with activity



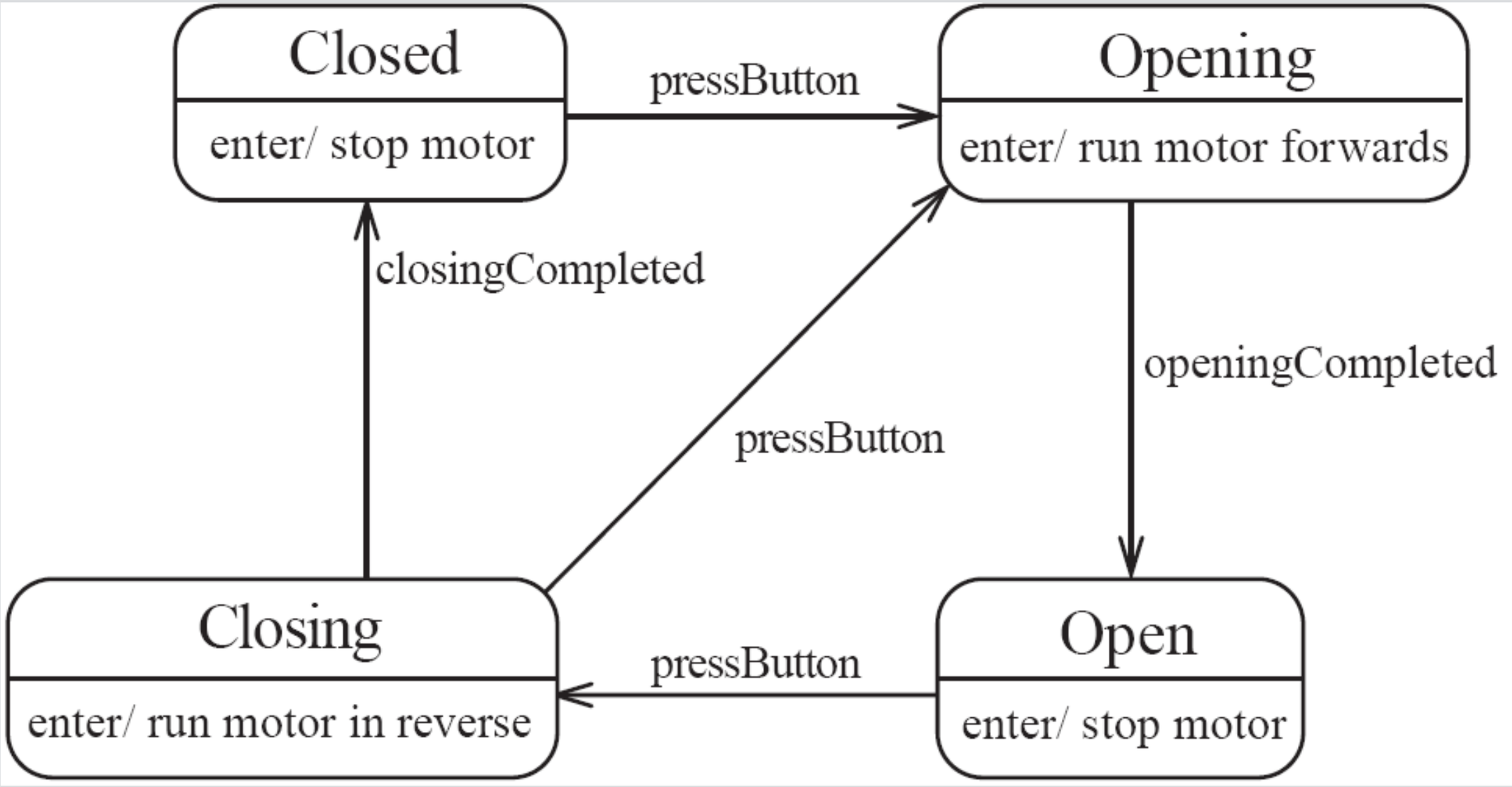
An activity is shown textually within a state box by the word ‘do’ followed by a ‘/’ symbol, and a description of what is to be done.

Actions in state diagrams

- An *action* is something that takes place effectively *instantaneously*
  - When a particular transition is taken,
  - Upon entry into a particular state, or
  - Upon exit from a particular state

- An action should consume no noticeable amount of time

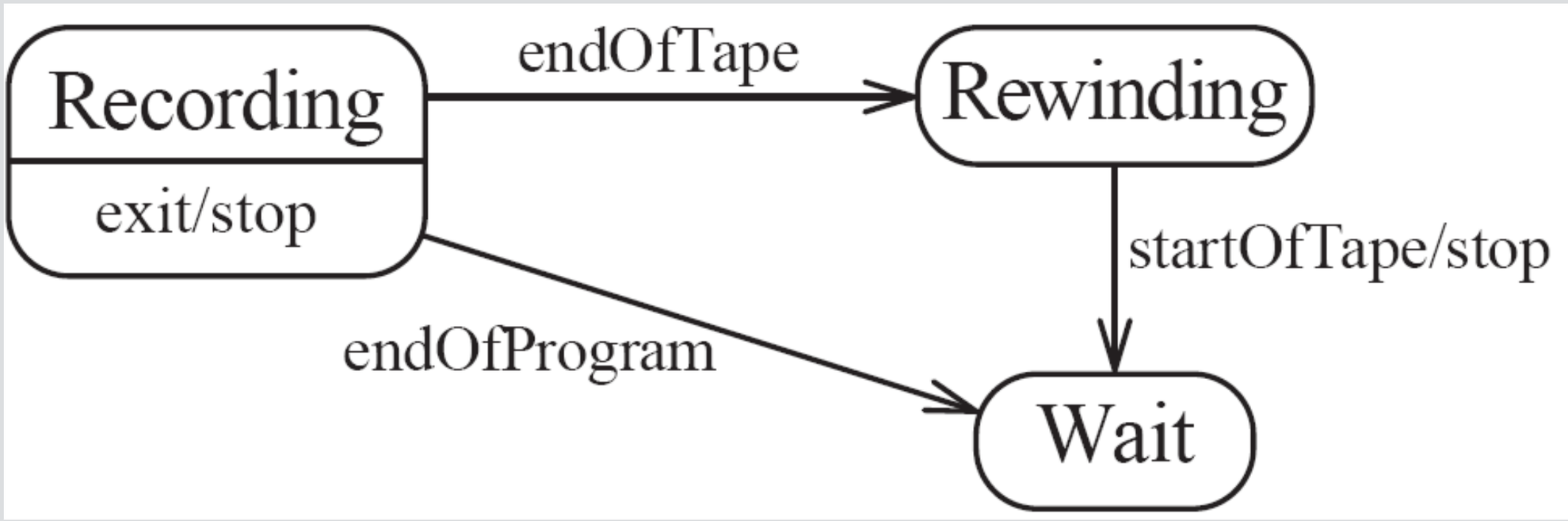
State diagram – an example with actions



If the action is to be performed when entering or exiting a state, then it is written in the state box with the notation enter/action or exit/action.

State diagrams – another example

If the action is to be performed during a transition, then the syntax is event/action.

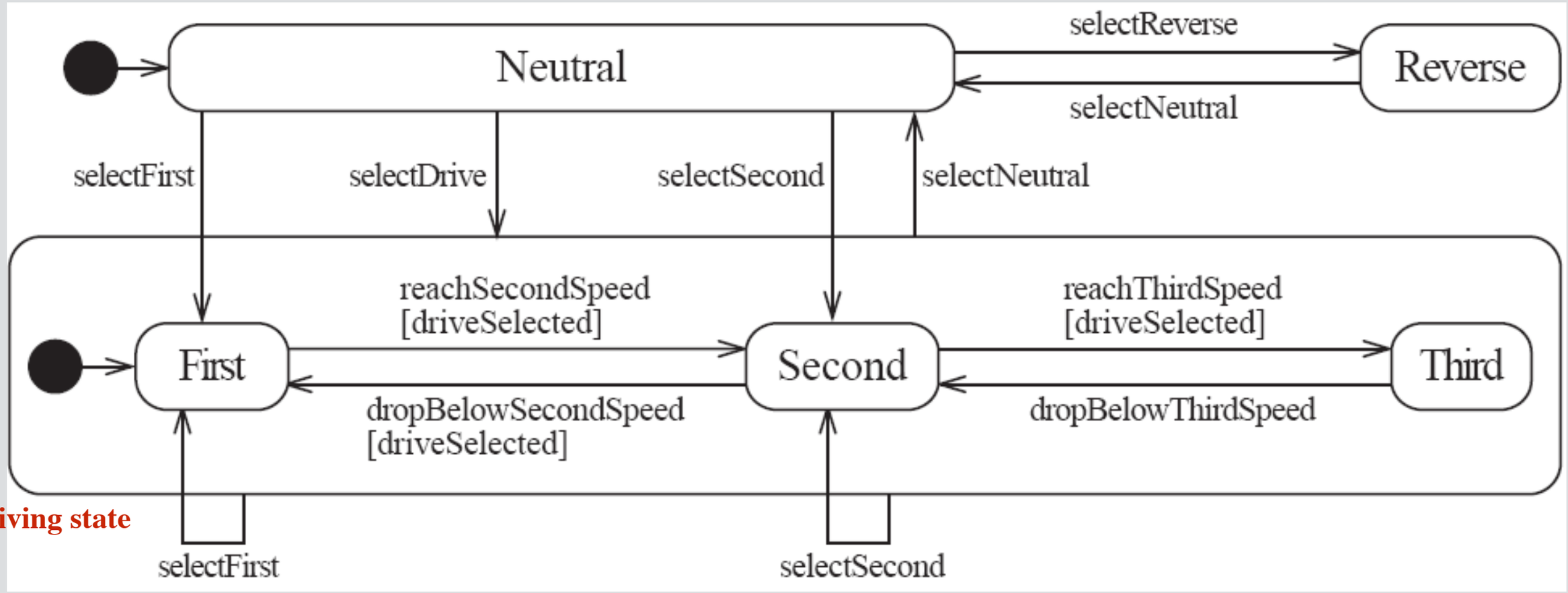


An important part of validating a state diagram is to ensure that each state has at least one outgoing transition, and at least one incoming transition.

Nested substates and guard conditions

A state diagram can be nested inside a state.

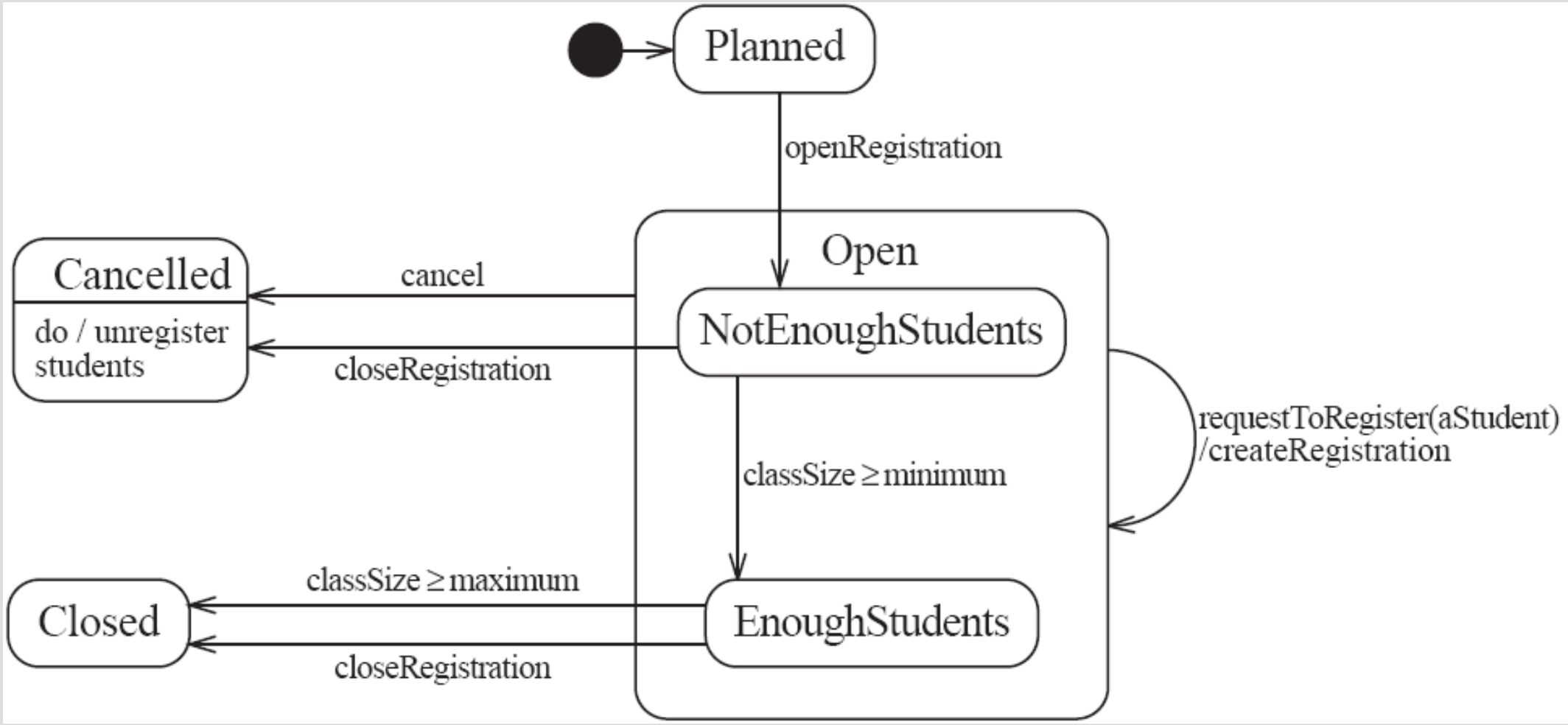
- The states of the inner diagram are called *substates*.



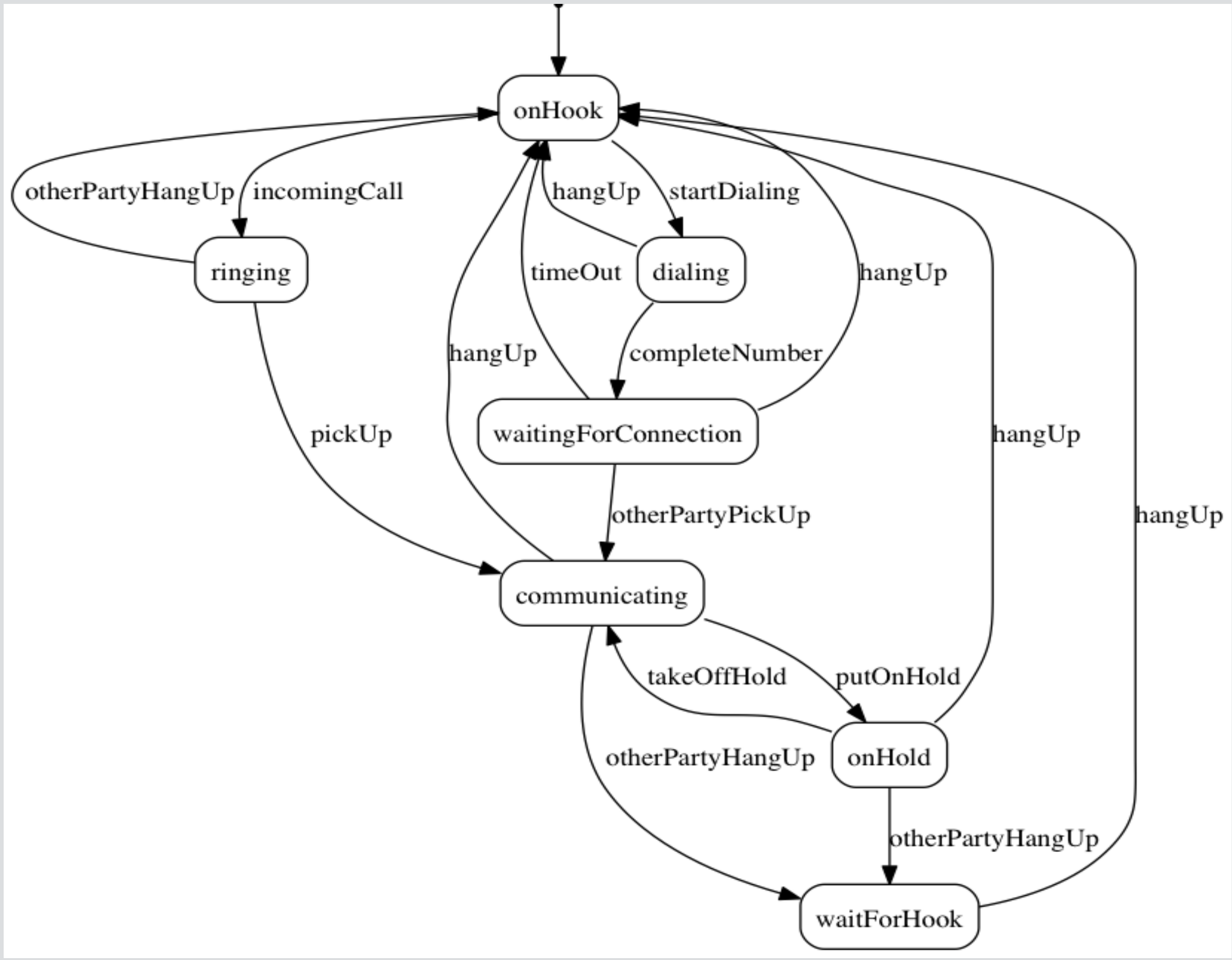
The notation reachSecondSpeed[driveSelected] illustrates the use of a *guard condition*.

The system will only respond to the indicated event (reachSecondSpeed) if the condition in square brackets is true.

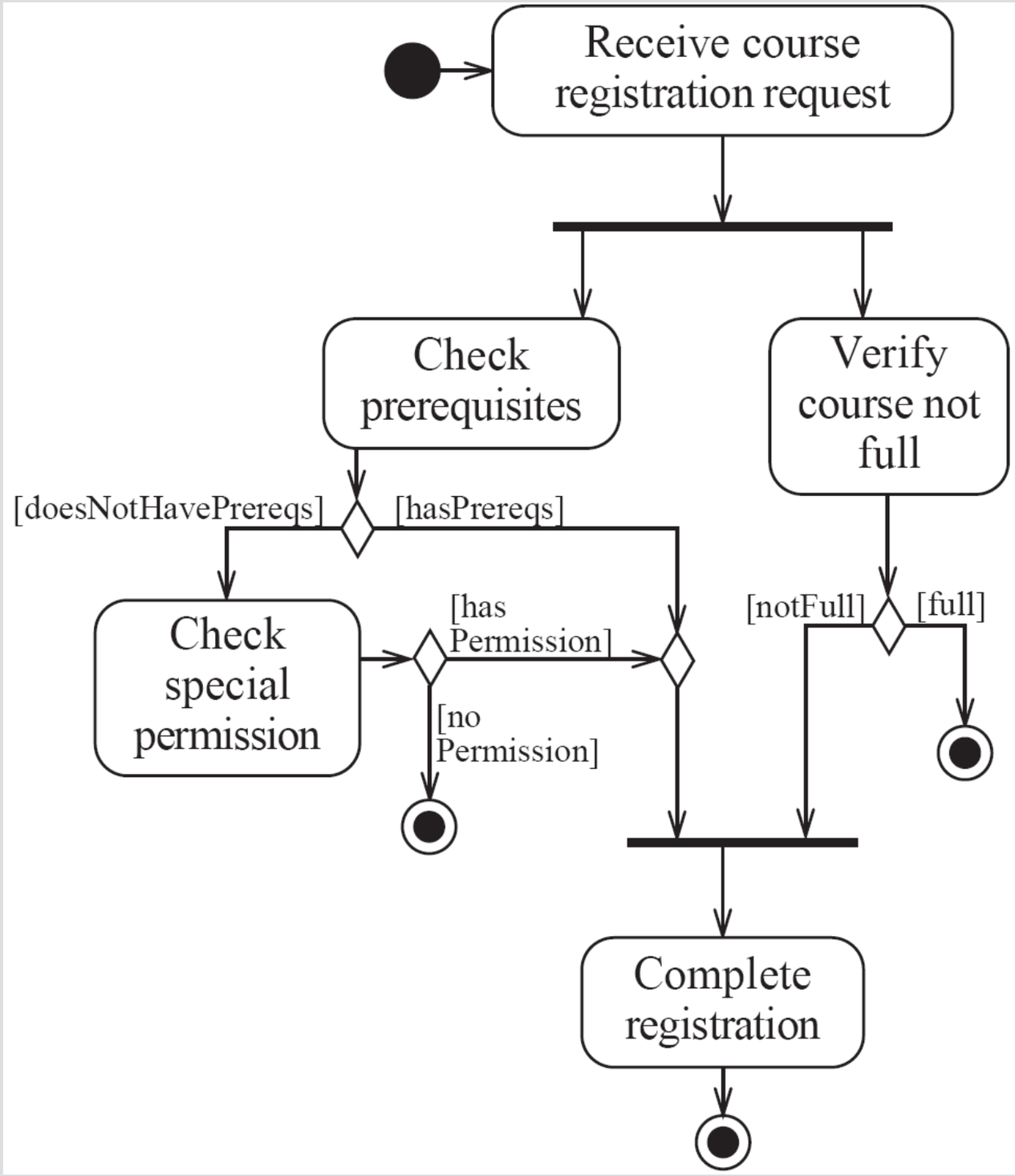
State diagram – an example with substates



State machine for a Phone Line



Activity diagrams – an example



Representing concurrency

- Concurrency is shown using forks, joins and rendezvous.
  - A *fork* has one incoming transition and multiple outgoing transitions.
    - The execution splits into two concurrent threads.
  - A *rendezvous* has multiple incoming and multiple outgoing transitions.
    - Once all the incoming transitions occur all the outgoing transitions may occur.

Representing concurrency

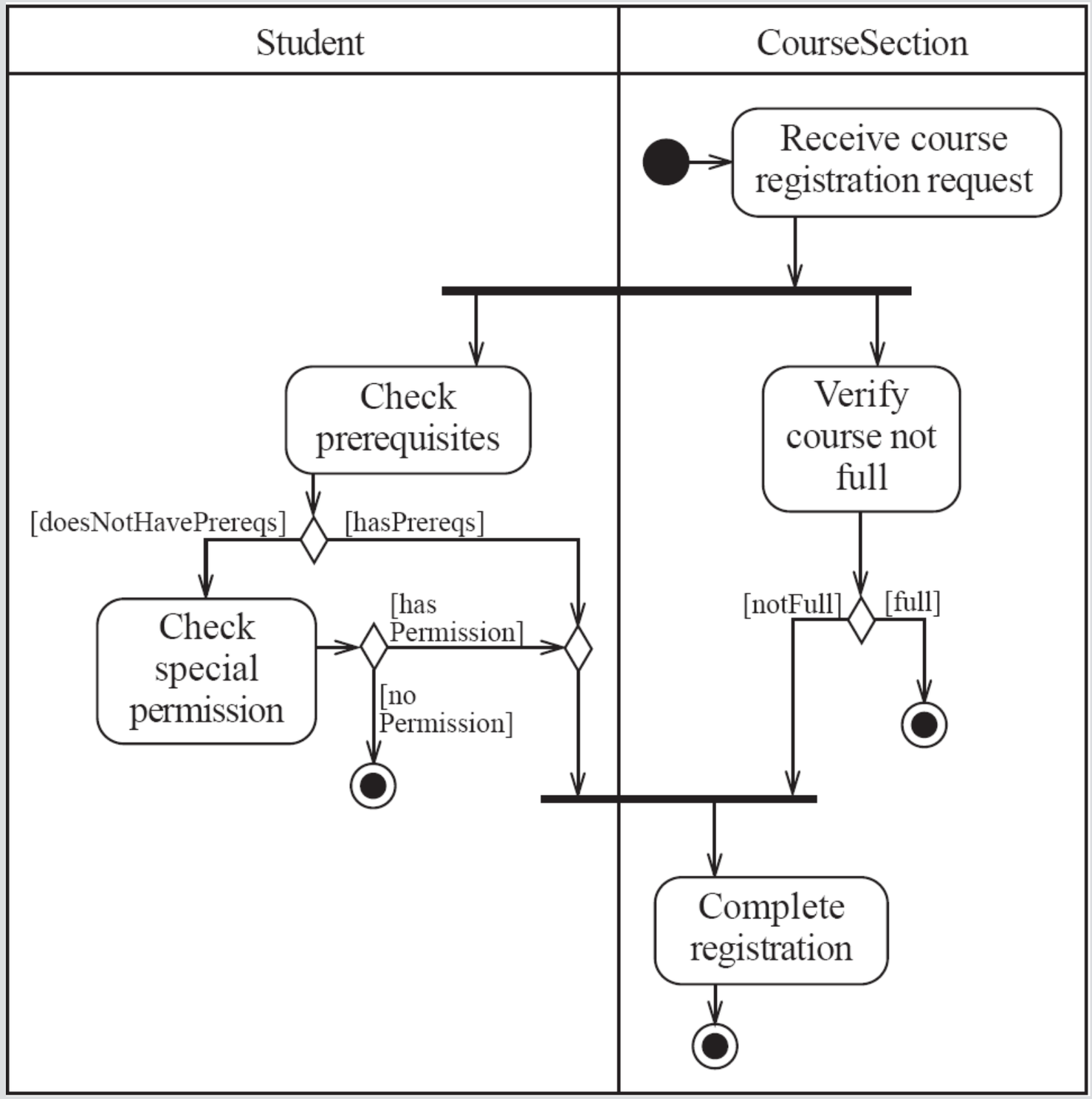
— A *join* has multiple incoming transitions and one outgoing transition.
  - The outgoing transition will be taken when all incoming transitions have occurred.
  - The incoming transitions must be triggered in separate threads.
  - If one incoming transition occurs, a wait condition occurs at the join until the other transitions occur.

Swimlanes

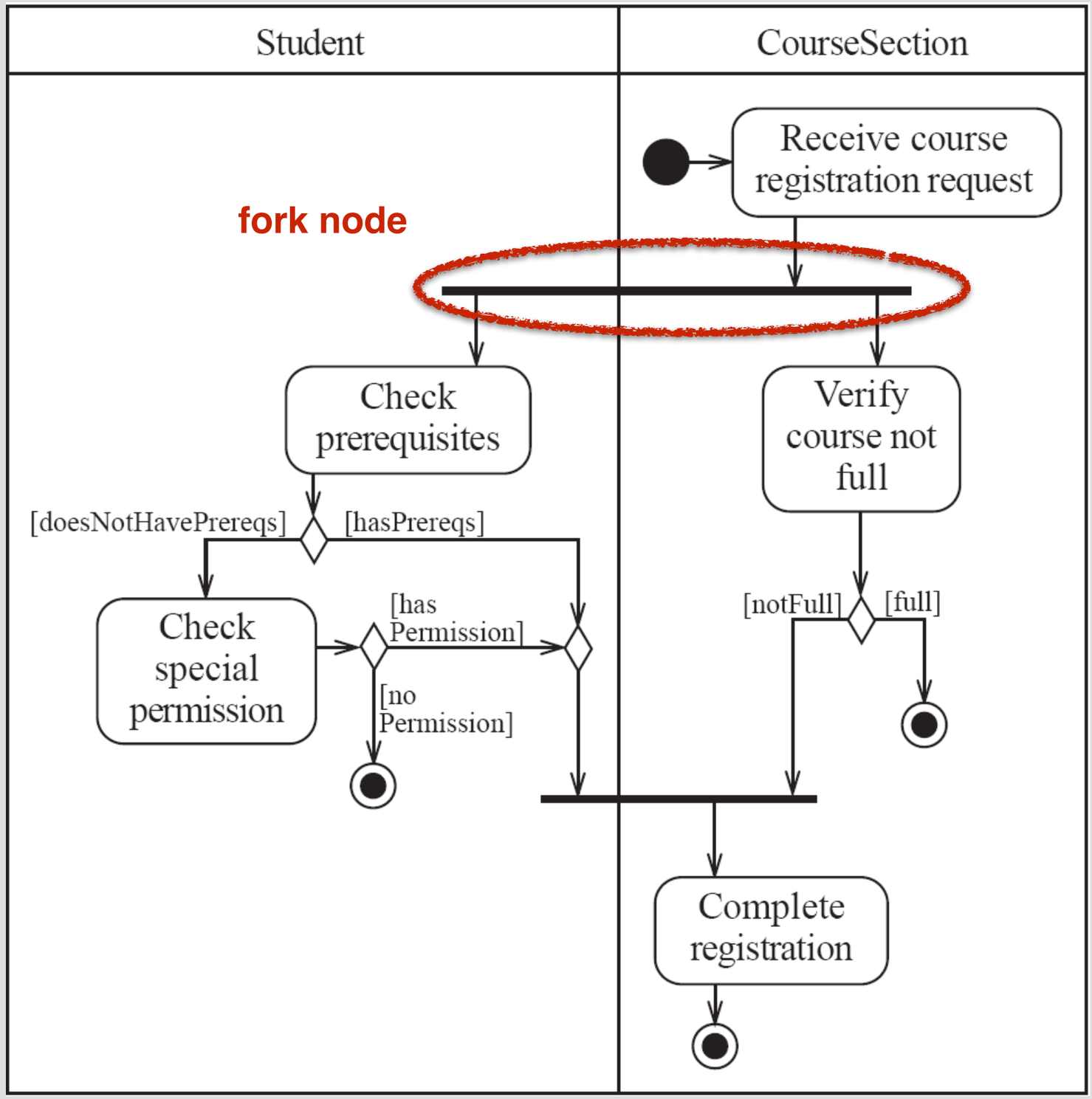
Activity diagrams are most often associated with several classes.

- The partition of activities among the existing classes can be explicitly shown using *swimlanes*.

Activity diagrams – an example with swimlanes



Activity diagrams – an example with swimlanes



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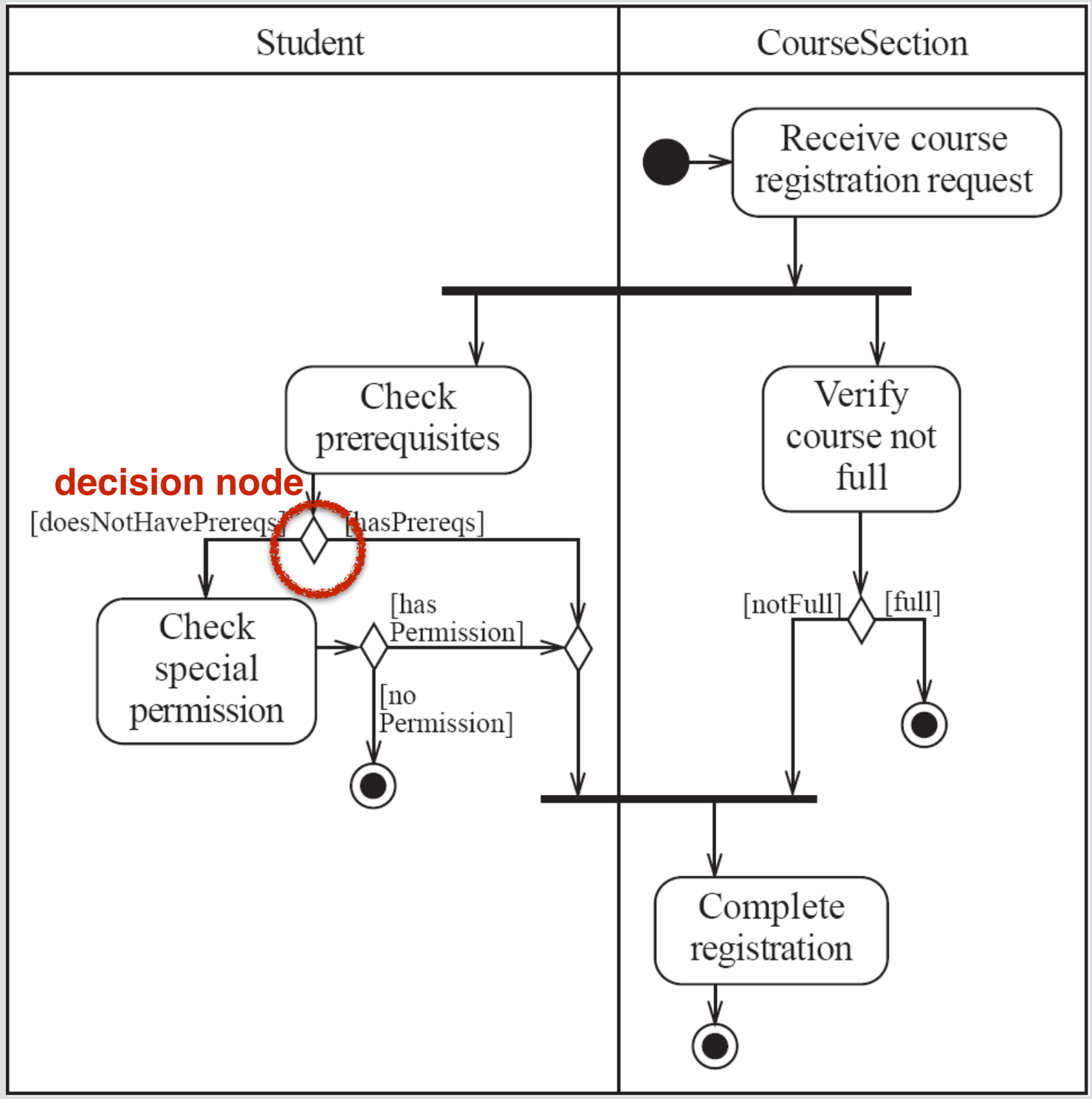

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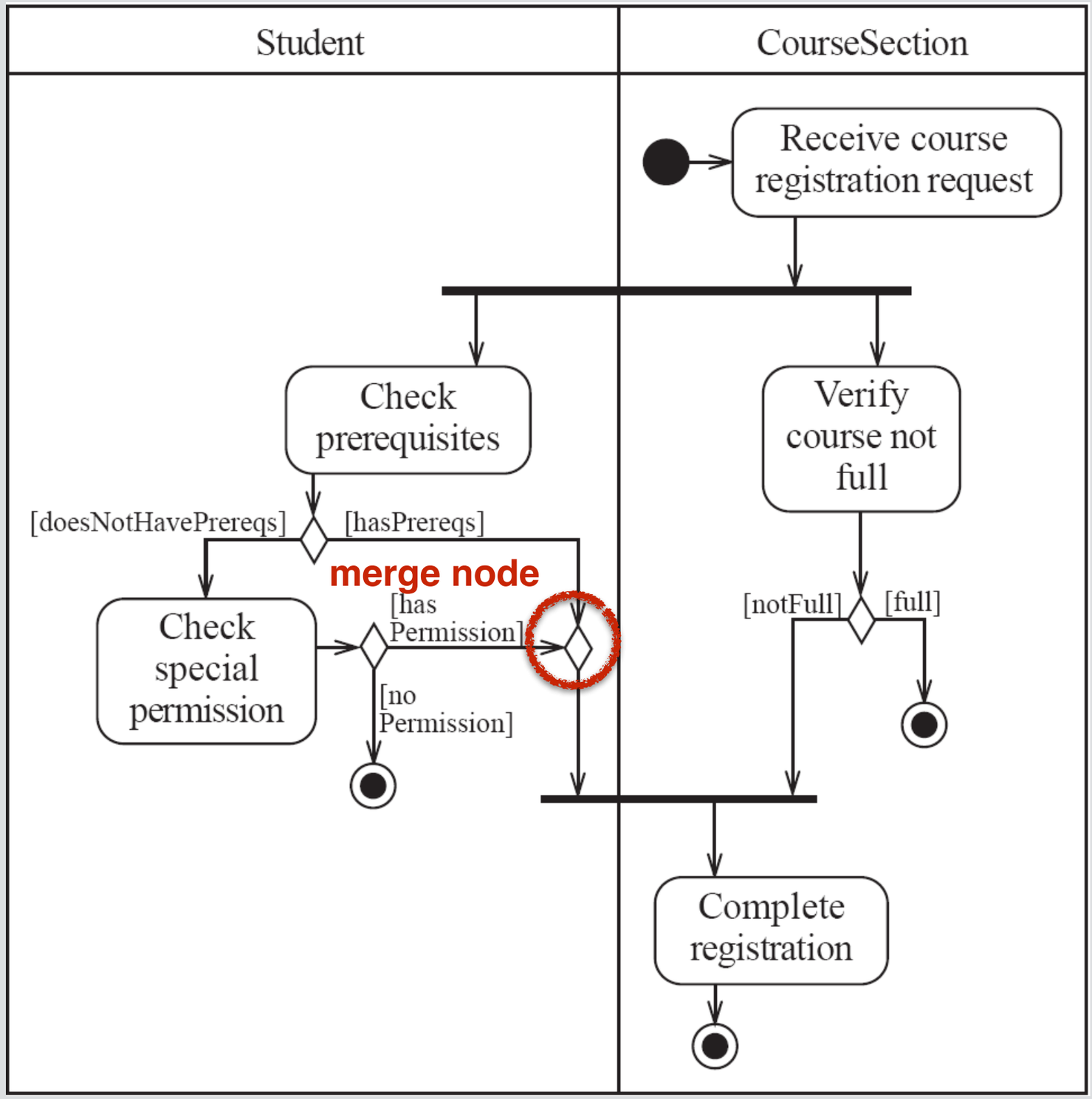

Activity diagrams – an example with swimlanes