

CS3773 Software Engineering

Lecture 08 UML State Machines

State Diagram

- Recall the delays in a sequence diagram, between when an object receives a message and when it outputs another message
- State diagram shows what the object does in between the receiving and the sending of messages
- Show the behavior of an object across several use cases
- One state diagram per class to describes possible behavior for each instance of the class

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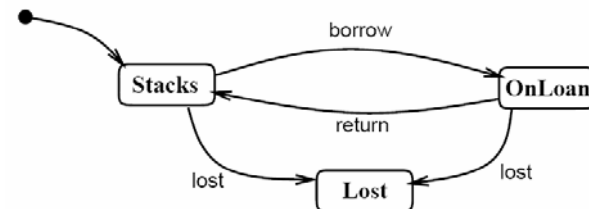
State Diagram

- State diagram shows how a system or an object's behavior changes over time depending on the input, rather than represent end-to-end behavior
- Shows how a system or an object reacts to messages received
 - Which state the object shall go to
 - When it outputs messages to other objects
 - How an object changes the values of its attributes by assignments

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State Diagram - An Example



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State Diagram

- Elements of a state diagram
 - State represents the mode of the system
 - Always an initial state (starting state)
 - Sometimes a final state
 - Transition describes a change in state due to the occurrence of an event
 - From one state to another state

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State

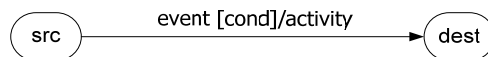
- Partitions object behavior
 - e.g., not being able to check out a borrowed book
- Represents the history of inputs so far
- Affects what input the object will react to
 - e.g., ignoring most input in the state "lost"
- Is an assignment to a collection of attributes

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Transition

- Elements of a transition
 - event(args)
 - [condition]
 - /activity
- Each of these parts is optional
- Form



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Event

- An event triggers the transition
 - A change in the environment
 - e.g., offHook
 - A message from another object (operation call)
 - A change in a condition: going from "false" to "true"
 - e.g., when(temperature > 100 degrees)
 - An occurrence of a specific date/time or passage of time
 - e.g., after (20 minutes)

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Event

- An event occurs instantaneously and it doesn't persist
- Events make an object change state
- If the object is in a state and there is no outgoing transition triggered by an event, the event is ignored
- Multiple events on a transition label are ORed together

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Condition

- A condition is a Boolean expression
- The value of a condition persists until the variables involved in the condition change their values
- The transition cannot fire unless the guard condition is "true",
- Examples
 - $x > 10$
 - `patronHasNoOverdueFine`

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Activity

- An activity is what an object does in response to events
- An activity is simple, fast, non-interruptible
- Most common activities are
 - variable assignment
 - send a message to an object
- Multiple activities on a transition are separated by ";" and executed sequentially

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State Activities

- A state can have activities associated with it
- Two types of state activities can manipulate object attributes or other variables
 - Activity: simple, non-interruptible
 - Associated with a transition
 - Performed on state entry or exit
 - Do activity: interruptible; may require much computation
 - Associated with a state
 - Interrupted by a transition

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State Activities

- States can be annotated with entry or exit activities, internal activities, and do activities:
- entry/activity
- event/activity (way to describe reactions to events that don't cause a state change -- internal transitions)
- exit/activity
- do/activity

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State Activities

- In a transition, the order of effects:
 - Exit activities of source
 - Transition activities
 - Entry activities of destination, and
 - State activities

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Self-Transition

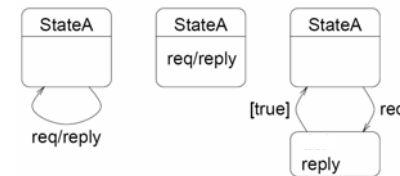
- A self-transition will cause reactivation of exit and then entry events
- If you want a self-transition that does not activate these events, you can use an internal transition, labeled with the event and the associated activity
e.g., "req/reply" in state "S"

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Self-Transition

- Compared to an activity on a transition, one could achieve the same behavior
 - as activity in state
 - as activity in another, special state



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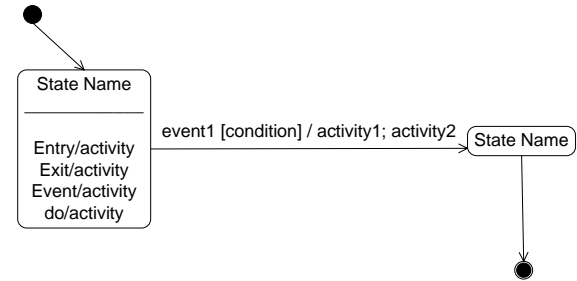
More on Transition

- If a transition has no event label, it can occur once any activity associated with the state is complete
- Guards on transitions (triggered by the same event) leaving a state should be mutually exclusive

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Summary on State and Transition



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Reading Assignments

- UML and The Unified Process
 - Chapter 21, "Basic state machines"

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