


Software Engineering

Professor M. Brian Blake

Lecture 7: UML Modeling: State Diagrams

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State and State Diagrams

- If interactions describe the activities that represent change, states are the abstraction of the resulting change
- States are defined in terms of a subset of object attribute values and links
- Examples:
 - Gas Pump is ON
 - Totaling Checkout Items

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State Characterization

- Formatted description of state, its purpose, associated events
 - Name
 - Description of Purpose
 - Summarizes in natural language
 - Predecessor Event(s)
 - Lists sequence of events leading to current state
 - Condition(s)
 - Defines state with Boolean function of attribute
 - Stimulus - Response Table
 - For each possible incoming event, show possible successor event, resulting actions and states

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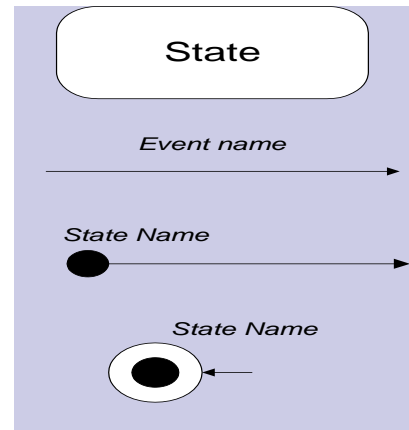
Transitions

- Response of an object to an event may include an action and/or a change of state
- A change of state caused by an event is a transition
- Resulting state depends on current state as well as the event

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State Diagram Symbols

- Nodes of state diagrams are the states
- Connections between nodes are the transitions
- Initial State
- Final State

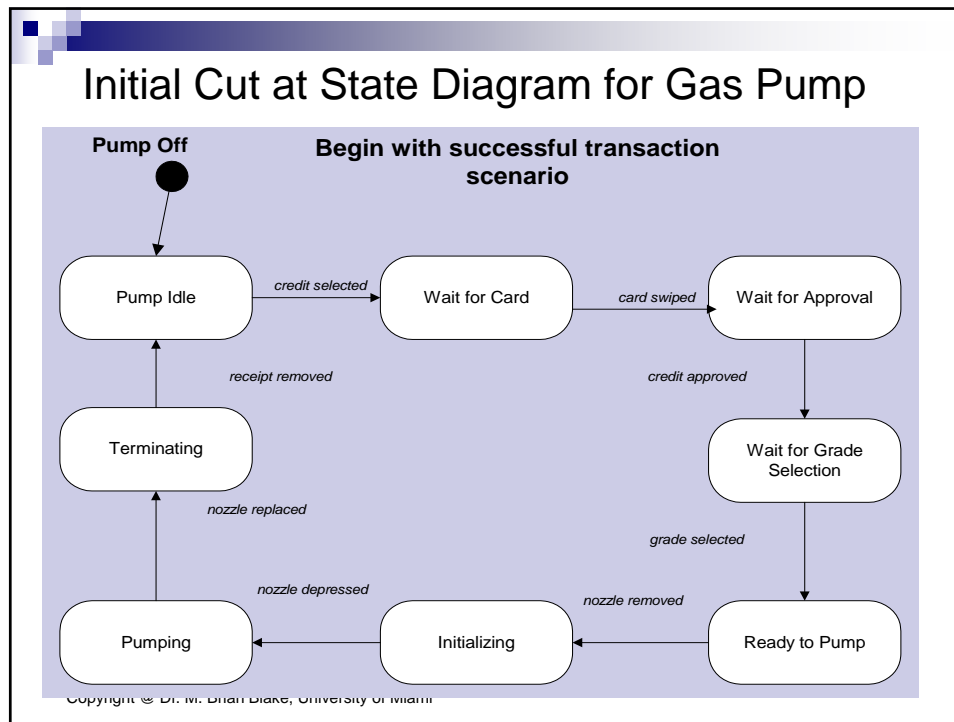


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State Diagram

- A state diagram can represent a continuous loop
- A state diagram can also represent a single pass with initial and final state
- A scenario corresponds to the tracking of a single path through a state diagram
- Begin by diagramming one scenario (usually the typical scenario), then add other scenarios

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Exercise 4.3 Add Scenarios to State Diagram

- Modify the preceding state diagrams to incorporate other scenarios defined in earlier exercises, e.g.
 - Cannot read credit card
 - Credit denied
 - Corporate Credit does not respond
 - Customer wishes to pay cash

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Advanced State Diagrams

- New additions to the present state diagram
 - Entry/Exit/Internal Actions
 - Activities
 - Automatic transitions
 - Guard conditions
- Can use generalization to develop nested state diagrams

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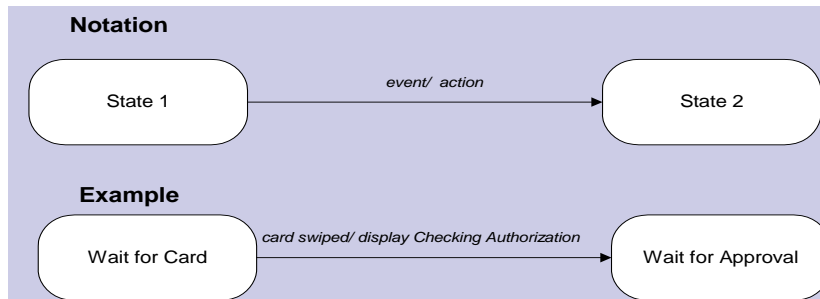
Action and Activities

- An action has no duration in time, relative to the time scale of the application
 - An action is associated with an event
 - For example, when the customer swipes the credit card through a reader the display changes to “Checking Authorization”
- An activity does have duration
 - An activity is associated with a state
 - For example, when in state “Wait for Approval” the activity includes sending card information to CC, waiting for response, etc.

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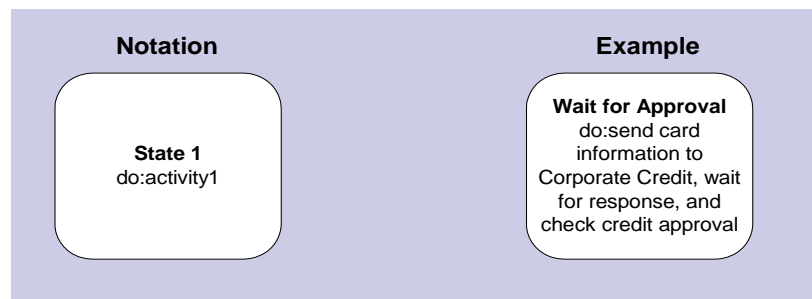
Representing an Action

- Actions ~ short time duration compared to the time scale of the application
 - Treated as instantaneous ~ associated with an event on a transition
 - Frequently used for internal control operations



Representing an Activity

- An activity has duration and is associated with a state
- It can be continuous, sequential, or automatically terminated after a period of time



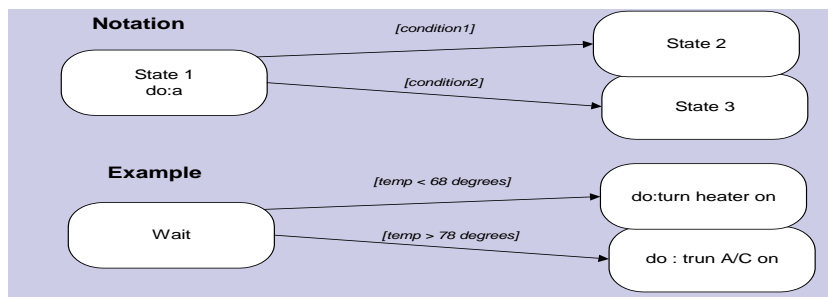
Guard conditions

- A condition is a Boolean function of attribute values
 - Valid over a period of time
 - Defines the state ~ being in state is a condition
 - Can guard a transition
- Notation
 - Event name followed by Boolean function in brackets
- Example
 - credit card swiped[mag-strip unreadable]

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Automatic Transitions

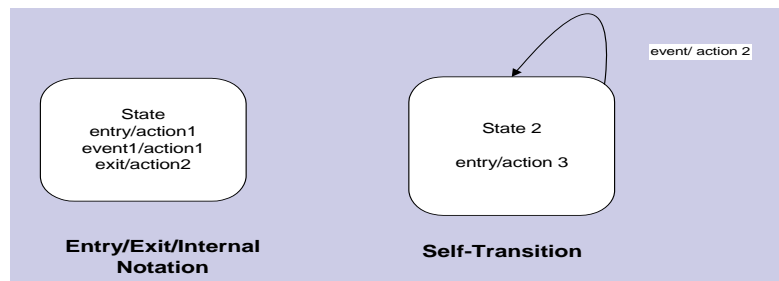
- Occurs when activity in state is complete, no event required
 - For a state with no activity, automatic transition occurs as soon as the state is achieved
 - Mostly automatic transitions have guard conditions



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Entry/Exit Actions

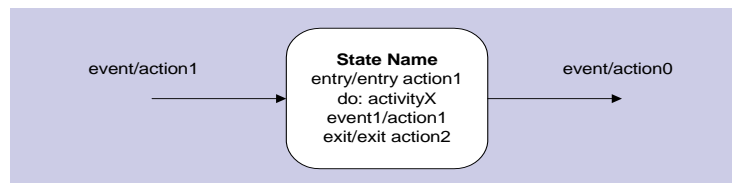
- Performed whenever as state is entered or exited
- Useful when all transitions entering/leaving a state share a common action
- Sometimes used with Self-Transitions



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Summary of Notation for Operations

- The order of operations on a state:
 - action on incoming transitions
 - entry action
 - do activities (interruptible by outgoing transitions)
 - exit actions
 - action on outgoing transitions



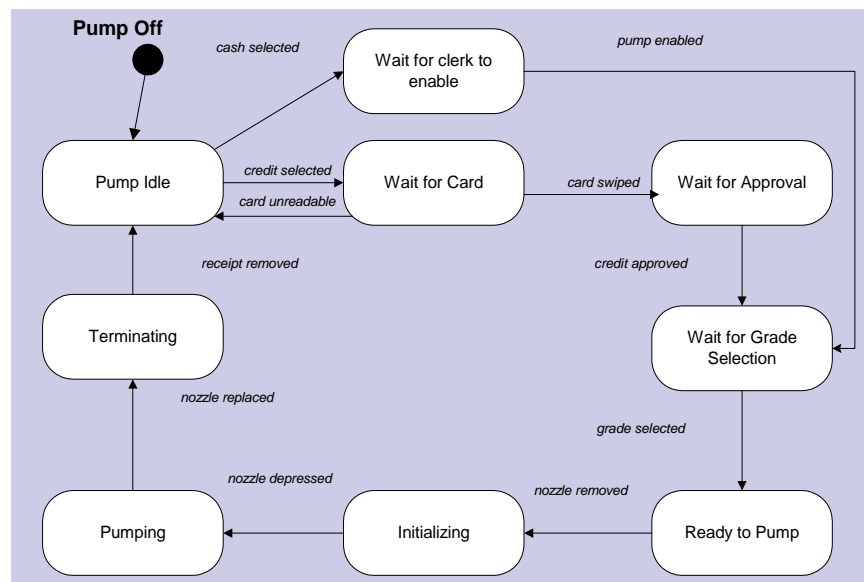
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Exercise 4.4 Enhance State Diagram

- Reuse early state diagram on the next page, insert actions and activities. The scenarios are good sources of these operations.
- Examples of actions and activities to be added include
 - Pump asks customer to select method of payment
 - Pump asks customer to swipe card
 - Pump reads card
- Remember, the state diagram represents one object: the gas pump. Actions and Activities on performed by other objects are indicated as events on the state diagram

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State Diagram for Gas Pump



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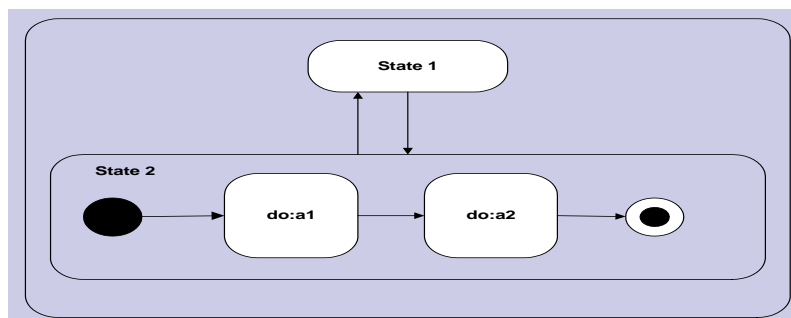
Generalization

- Generalization
 - Used to expand nested activities
 - Allows events and states to be organized into generalization hierarchies with inheritance

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Nested States

- Alternatively, represent the substates on the same diagram as the superstate
- Substates inherit the transition of the super state



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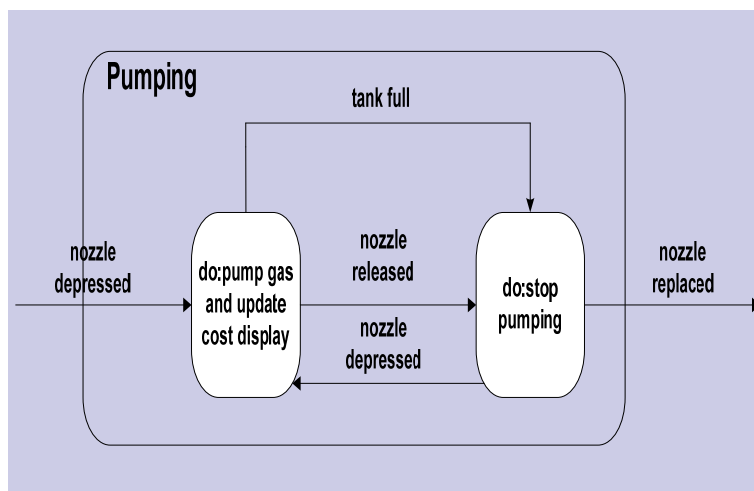
Exercise 4.5 Nested States

■ Generalization

- Define several substates for the state of Pumping
- Permit the customer to release and depress the nozzle several times during the pumping session

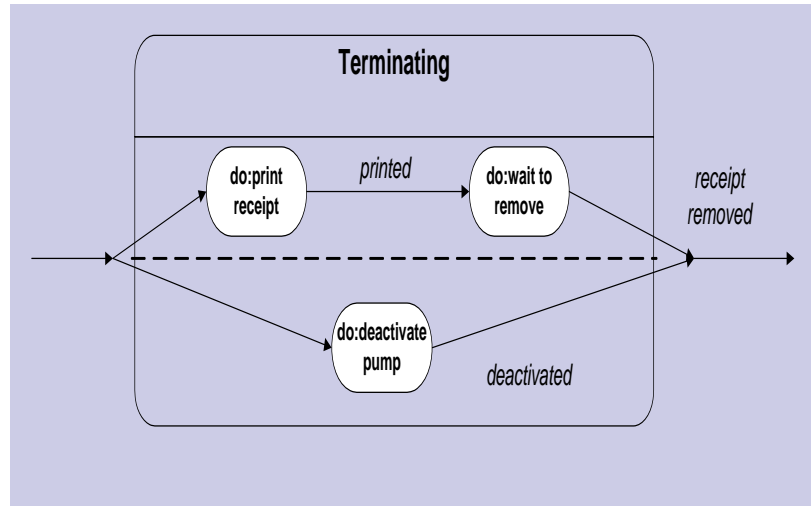
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Exercise 4.5 Suggested Solution



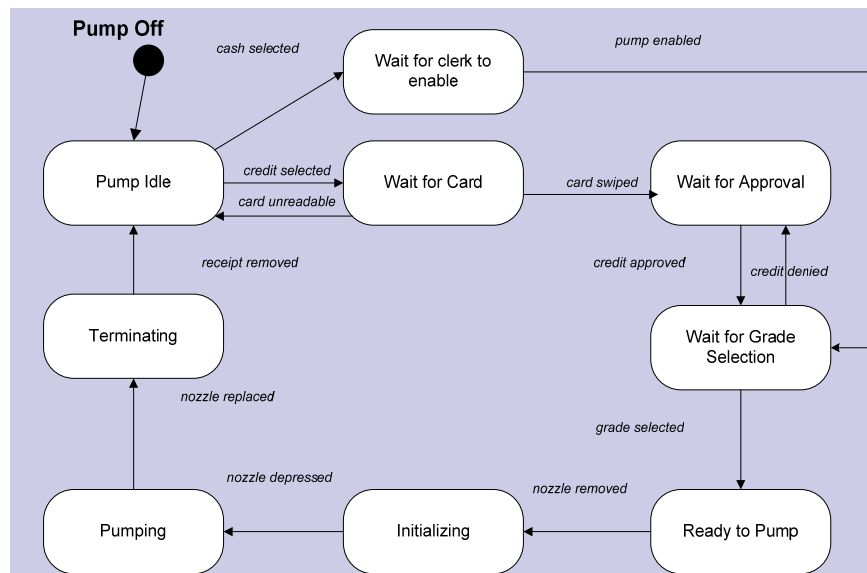
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Merging and Splitting Control



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Modified State Diagram for Gas Pump



Exercise 4.4 Suggested Solution

