Lecture 17: States and State Diagrams

States

- A state is a condition or situation during the life of an object that
  - satisfies some condition
  - performs some activity
  - or waits for some event
- An object transitions from one state to another when an event occurs
- As discussed previously, an event is an instantaneous and atomic transition between states; no state occurs during an event

Parts of a State

- Name - an identifier for the state; states can be anonymous (e.g. not named)
- Entry/Exit actions - actions that are executed when entering and exiting a state, respectively
  - an action is an atomic computation that results in a change of state of the object or the return of a value
- Internal Transitions - transitions that do not cause a change in state
- Substates - a state may contain substates that can be arranged either sequentially or concurrently
- Deferred Events - a list of events not handled in this state but which are postponed and handled in some other state

Simple Example

Note: a state diagram shows the states for a single object
Events

• An event is a specification of a significant occurrence
  – The act of turning a system off, for instance, can be specified by a shutdown event;
    • when the system turns off, a shutdown event is generated (and those who are interested in this event can respond)
  – In OO systems, events will correspond to signals, method calls, passage of time, and the state change of other objects
    • e.g. object b switching from state 1 to state 2 can generate an event to which some other object may respond

Transitions

• A transition is a relationship between two states
  – indicating that an object in the first state will perform certain actions and enter the second state
  – when a specified event occurs and specified conditions are satisfied

Transitions, continued

• More formally, a transition has the following parts
  – Source State - the initial state
  – Event Trigger - the event whose reception triggers the transition
  – Guard Condition - a boolean expression that enables/disables the transition
  – Action - an action that occurs during the transition
  – Target State - the destination state

Transition Labels

• Transitions are labeled in the following format
  – Event [Guard] / Action
  – Each of these parts are optional
• Examples
  – Graduation [person.isGraduated] / throw mortar board
  – / get first element
  – [object.isValid]
More complex example

![Diagram of state transition diagram]

Transition Example

![Diagram of state transition diagram]

Advanced States

- Tracking
  - entry/ setMode(onTrack)
  - exit/ SetMode(offTrack)
  - newTarget / tracker.Acquire()
  - do / followTarget
  - selfTest / defer

Concurrent States

- Checking
  - [item not present]
  - Dispatching
  - [item present]
- Authorizing
  - Authorized
  - Invalid credit card
  - Rejected
  - Cancelled
  - Delivered

Events with an action of a “defer” are saved until a subsequent state that lists a transition with the name of the deferred event; once that state is reached the deferred event occurs as if it was happening for the first time.