Modeling with UML
Chapter 2, part 3

CS 4354
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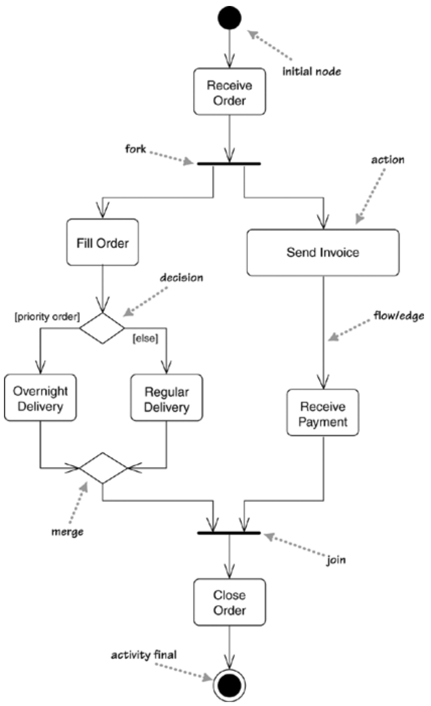
Activity Diagrams

- Describe the behavior of a system in terms of activities
- Represent the sequencing and coordination of actions or steps, similar to a control flow graph.

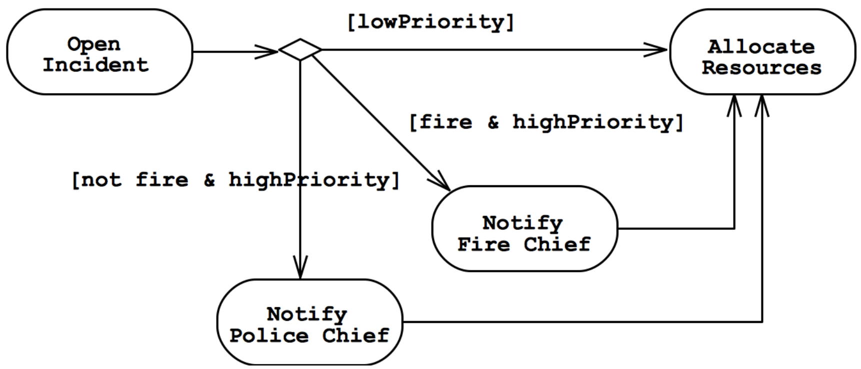
- Activity: Rounded rectangles represent actions called activities.
- Edges between activities represent control flow.
  - ✦branching, looping, concurrency
- Activity diagrams can be hierarchical:
  - ✦A given activity in a rounded rectangle could be further detailed in its own separate activity diagram.



Activity Diagrams: Branching

- Decisions (branches, alternates)
  - ✦Branch Node: diamond with one incoming arrow two or more outgoing arrows.
  - ✦Outgoing edges are labeled with guards (conditions in square brackets) that select that arrow when the condition is true.
  - ✦[else] can be used as a guard.
  - ✦Merge nodes (diamond with many incoming, one outgoing arrow) to mark the end of the branching.
  - ✦The diamonds are sometimes omitted, but should be included for clarity.

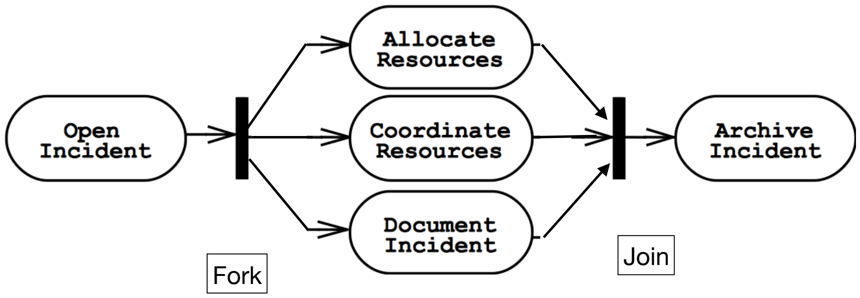
Decision in the Handle Incident process.



Activity Diagrams: Concurrency

- Fork nodes and Join nodes (concurrency)
  - ✦The **fork** is a line with one incoming edge and several outgoing edges.
  - ✦Fork: denotes splitting control into multiple threads, representing the fact that each outgoing edge can be done in parallel.
  - ✦The **join** is a line with many incoming edges and one outgoing edge.
  - ✦Join: denotes synchronizing threads back into one (waiting until all of the incoming activities are completed before moving forward).
  - ✦Fork and Join denote activities that may be done in any order (they are not **required** to be done concurrently).

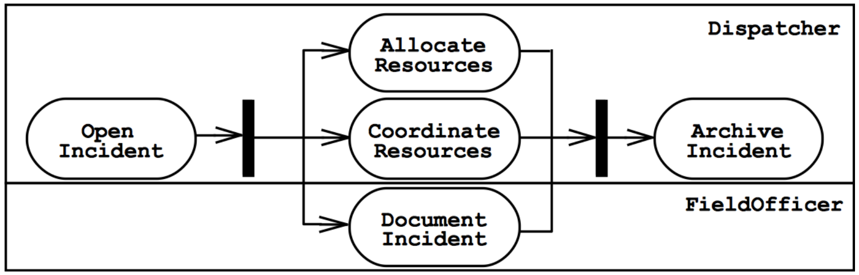
Concurrency in incident management process.



Activity Diagrams: swimlanes

- Swimlanes (activity partitions)
  - ✦Rectangles enclosing a group of activities
  - ✦Used to denotes responsibilities of objects or actors that carry out the activities in the given rectangle.
  - ✦Edges may cross swimlane boundaries

Swimlanes in incident management process.



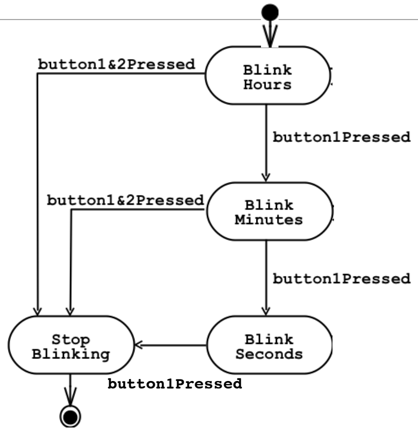
When and how to use Activity Diagrams

- When developing use cases
  - ✦activity diagrams are good at capturing business (and other) processes (also called workflows).
- During Object-Oriented design
  - ✦deciding what objects perform which activities (once you already have an activity diagram).
- When designing complicated operations/methods.
  - ✦use to model the control flow through a single method (like a flowchart or control flow diagram).
- When dealing with multithreaded applications.

State diagrams

- Describe the dynamic behavior of an individual object (or subsystem).
- A state diagram describes the sequence of states an object goes through in response to external events
  - ✦A graph: states are nodes, transitions are directed edges
- Transitions from one state to another occur as a result of external events

State diagram for the watch display



- edges are labeled with the event that triggers them
- small black circle: start state
- small black circle inside another circle: finish state

States

- A state is (often) represented as a value of an attribute of an object that is changed by an external event.
  - ✦An Incident can exist in four states: Active, Inactive, Closed and Archived
- A state is a node in the graph
- The node can specify some activity that is performed when the node is entered.
  - ✦ This is denoted inside a component of the state using the following syntax, where "activity" is replaced by a description of that activity:

    do/activity
  - ✦The activity could be interrupted by some external event.

Transitions

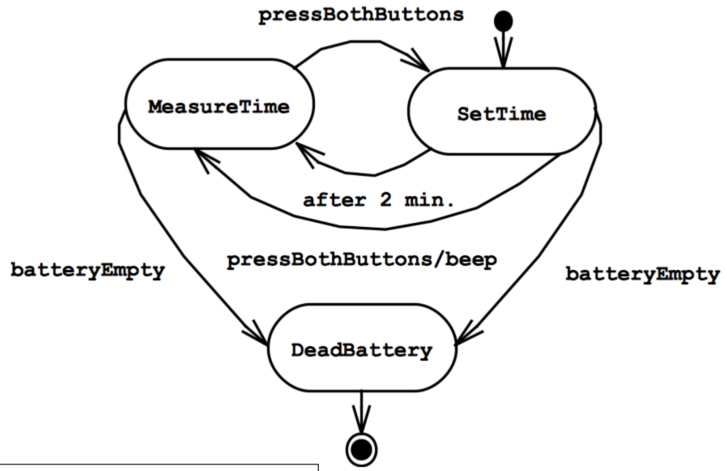
- A transition represents a change of state triggered by events, conditions, or time.
  - ✦Transitions are directed edges in the graph
  - ✦Edges are labelled by the event causing the transition:

    Event [Guard] / Action

    Each part is optional, Guard must be true to transition, Action is performed when transition occurs.
  - ✦If the Event is omitted, the transition occurs as soon as the activity in the given source state is completed.
  - ✦An event can represent the passing of a period of time:

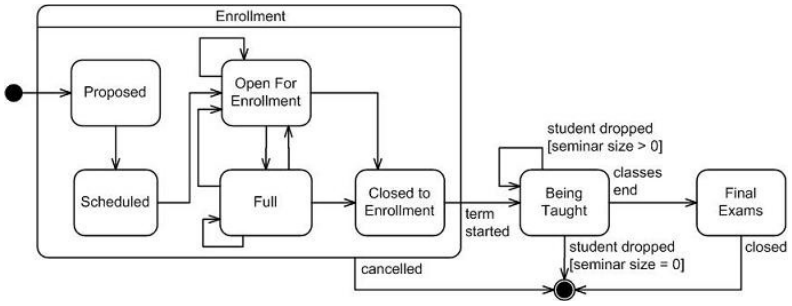
    after 20 minutes

State Machine diagram for 2Bwatch



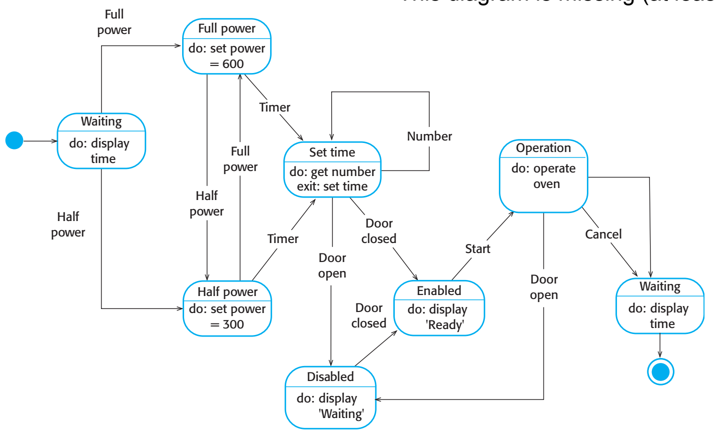
/beep is the action that happens when both buttons are pressed

State diagram with nested state and guards



State diagram of a microwave oven

This diagram is missing (at least) one arrow



When and how to use State Diagrams

- When designing a class that has an attribute that responds to external events (and determining which state the object is in is not trivial)
  - ✦Use the state diagram to document the transitioning behavior
- During testing
  - ✦If you have a state diagram, you can develop tests that perform a sequence of events and then verify that the object is in the correct state with respect to the diagram
- If your object (or system) does not have an attribute that responds to external events, do not use state diagrams.
- User Interface objects often have behavior that is useful to depict with a state diagram