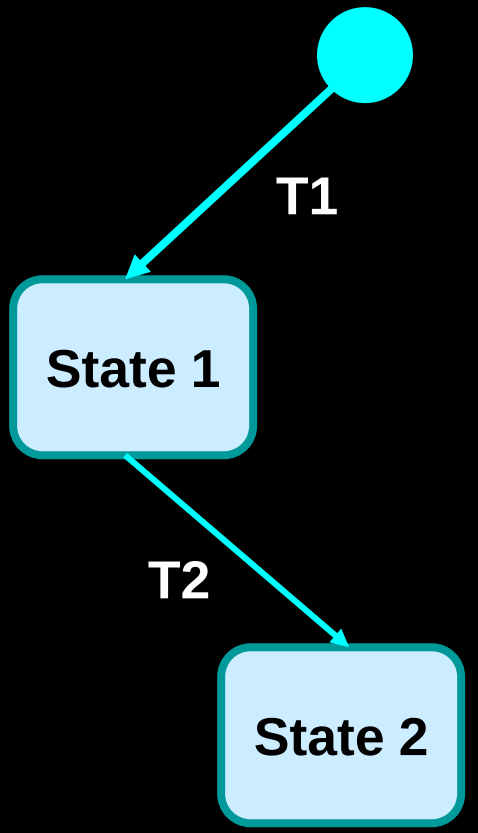
Overview

- Model Dynamic behaviour
  - The sequences of expected interactions
- Introduce statecharts
  - Basic Structure
  - Modelling decisions
- Show example application

State Machines

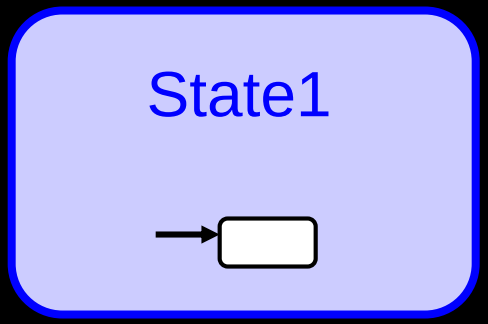
- Defines the behavior of an active entity/object
- Made up of
  - States
  - Transitions
    - Input Events
    - Output Events
    - Associated actions/activities



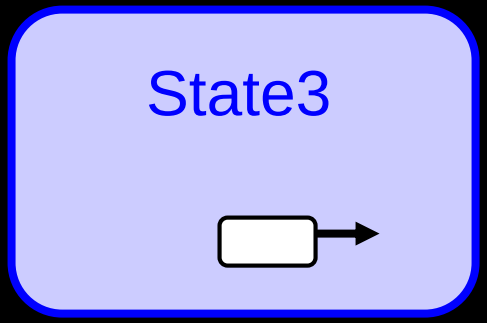
State Diagram: States

- A state is the condition of an object that persists for a given time
- States are receptive to events
- States can be nested
- A state consists of:
  - A name
  - Entry/Exit actions
  - Activities

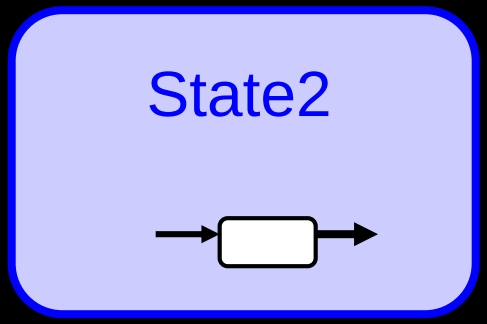
State with Entry Action



State with Exit Action



State with Entry and Exit Actions



Actions and Activities

- Actions
  - Non-interruptible
  - Are considered to take zero time
  - Occur on transitions and entry/exit to states
- Activities
  - Take time
  - Are interruptible
  - Activities take place within states

Actions and Activity definition in States

- Actions
  - entry/[action-list]
  - exit/[action-list]
  - reaction/internal transitions [action-list]
- Activities
  - do/[activity-list]
- Deferred events
  - deferred/[event list]

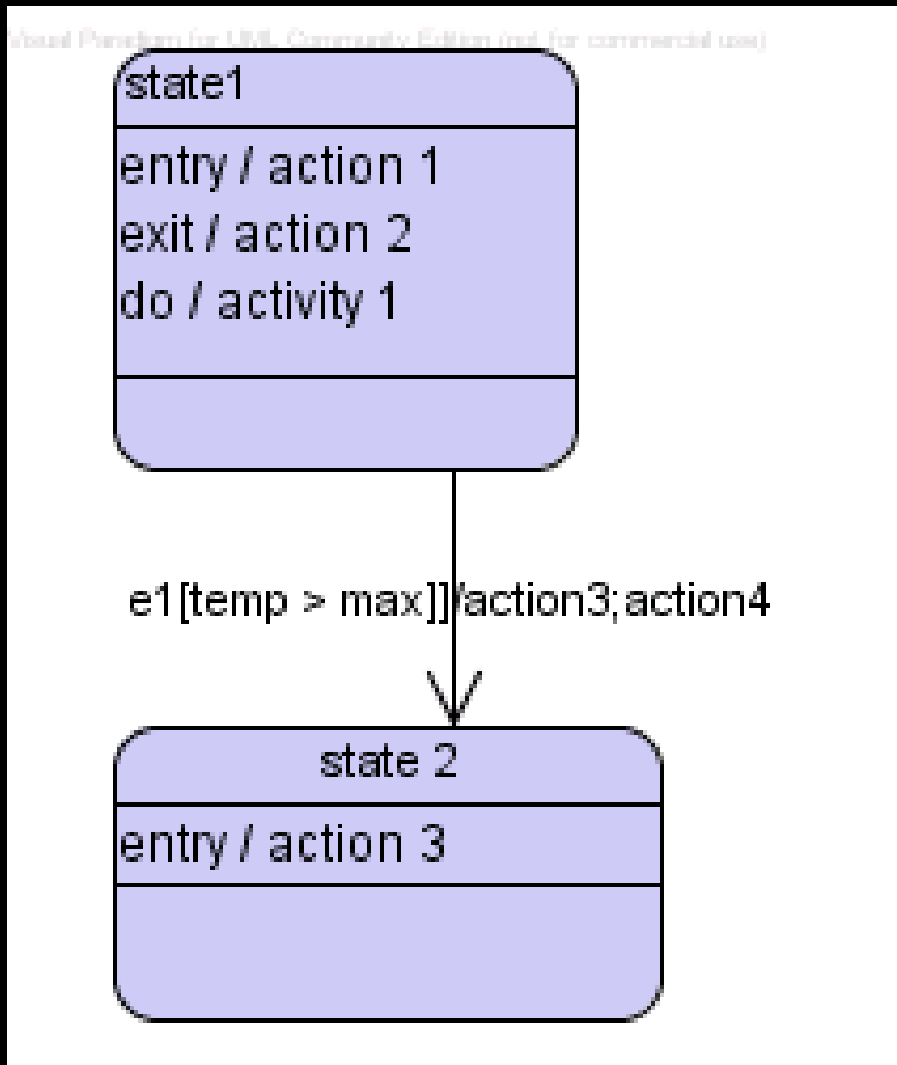
State Diagram: Transitions

- A transition represents the execution path to be taken when a triggering event occurs
  - From “source state” to “destination state”
  - Must be in the source state for the trigger to fire
  - Triggering conditions can be set
  - Source and destination states can be the same
    - “Self-Transitions”

- A transition has the following parts:
  - E.g e1[temp > max]/action 3;action4
    - Trigger - e1
    - Guard Condition (true or false) - [temp > max]
    - Action list – action3;action4

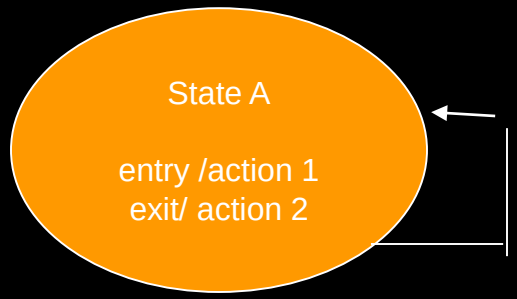
Processing Triggered by Transitions

- If e1 occurs and temp > max
  - Stop activity 1
  - action 2
  - action 3
  - action 4
  - action 3



Self and Internal Transitions

- Self Transitions
- On transition
  - action 1; action2

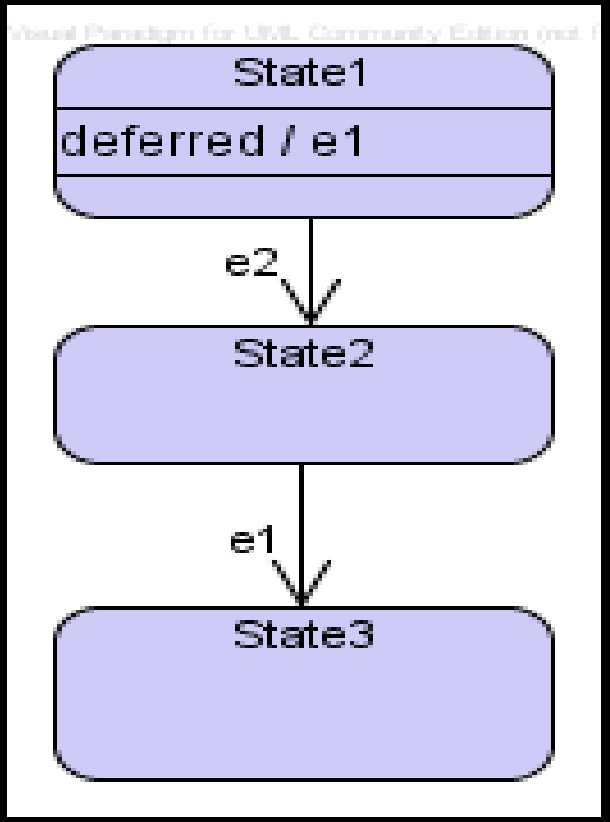


- Internal Transitions
- On transition
  - No exit/entry actions
  - Show graphically Or Keyword
    - “reaction”

Deferred Events

- Deferred events persist until a state is entered that does not defer the event
  - The event then triggers a defined event
  - Or is discarded

- Say e1 occurs in state1
- e2 occurs
- State2 does not defer e1
- e1 is defined as a trigger
- State 3 is reached



Pseudo States

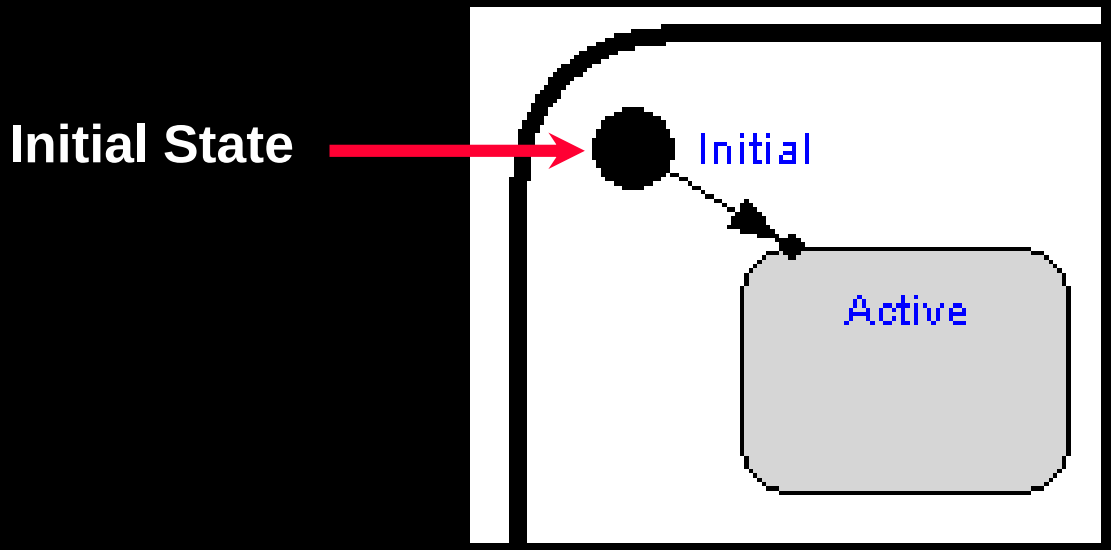
- Used to Represent structure
- Single Level
  - Initial state
  - Terminal state
  - Choice point
- Hierarchical/Composite States
  - History state
  - Synchronisation bar
  - Synchronisation state

Statechart Descriptive Power

- Comes from
  - Pseudo state Structuring mechanisms
  - Use of state variables in
    - guards e.g [temp > max]
    - actions e.g temp = temp +1.
- This allows a large number of states to be represented.
- Also allows modelling of continuous behaviour.

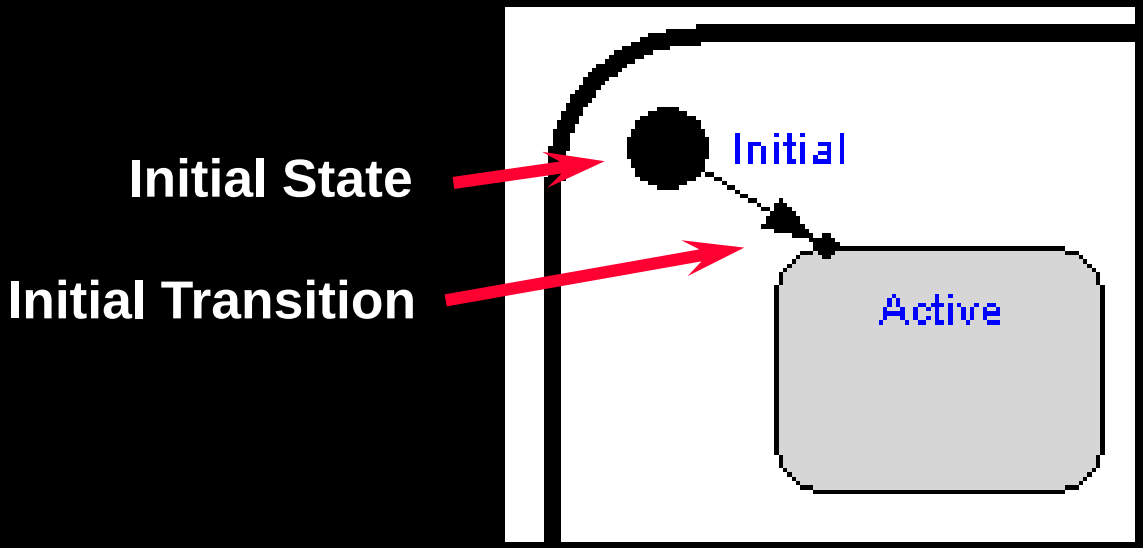
Initial State

- An initial state is a special state that explicitly shows the starting point for state machine execution
- There is only one initial state allowed in each state diagram level



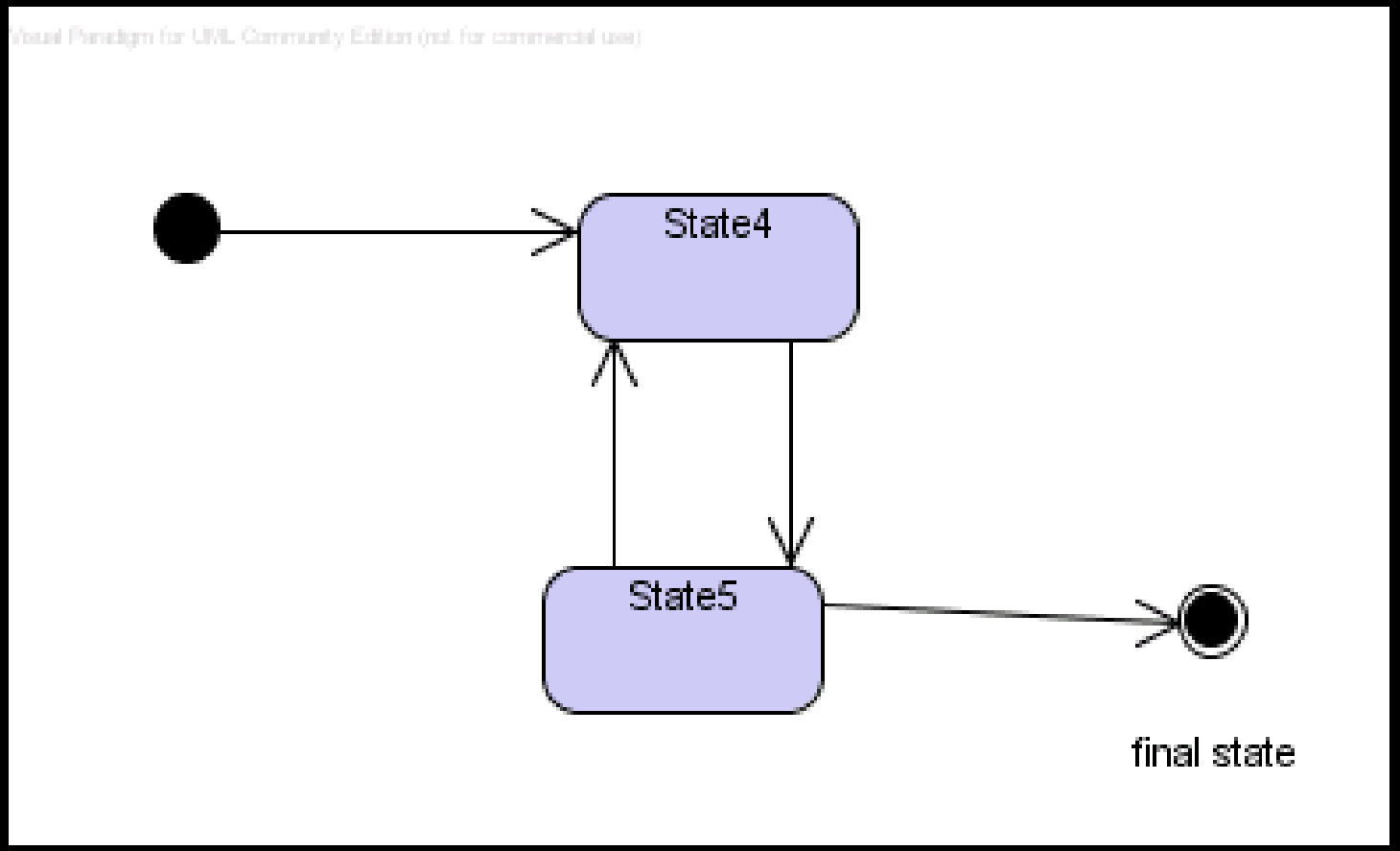
State Diagram: Initial Transition

- The transition from the initial state to the start state is called the initial transition
- The initial transition is always the first transition taken
- The initial transition has an implicit trigger



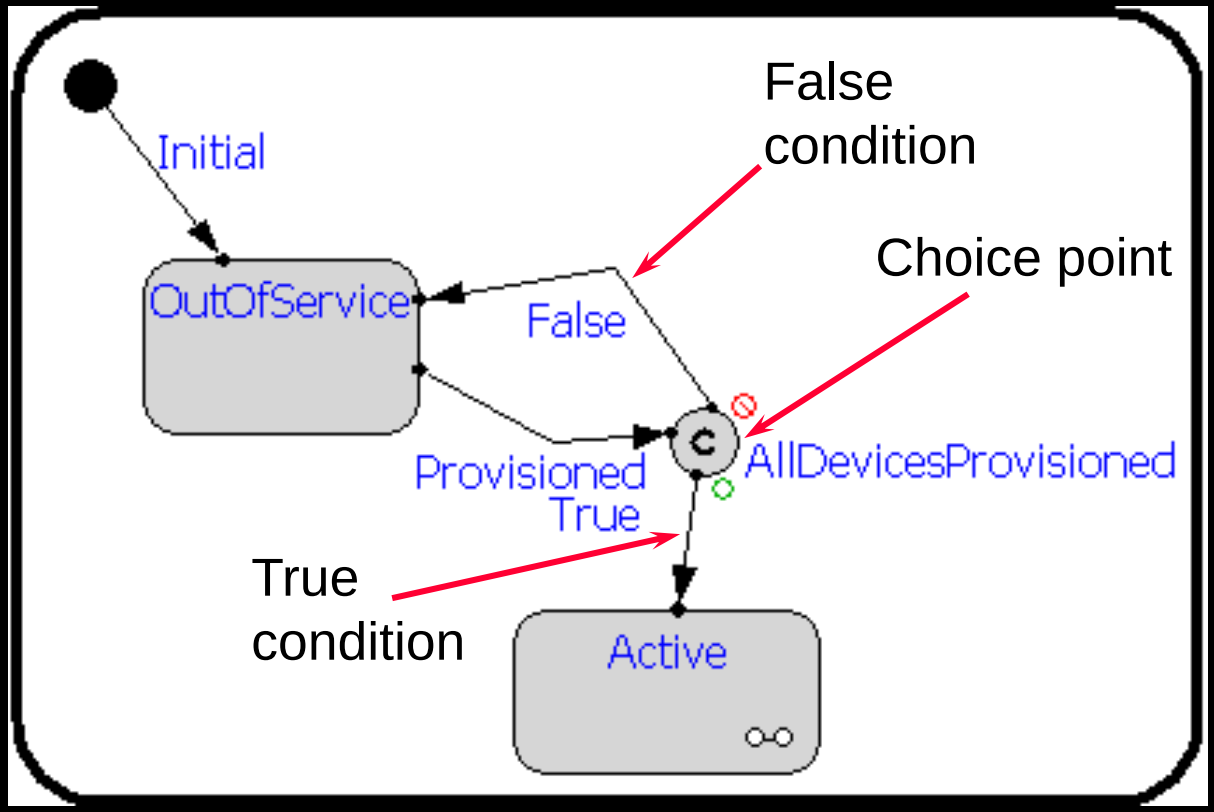
Terminal/Final State

- Indicates termination of local state.



State Diagram: Choice Points

- Choice points use a Boolean test to determine how to switch a transition to one of two outgoing segments, each can terminate on a different state



Example Vending Machine - Problem

A user of a vending machine inputs coins and selects the item of choice. The machine accepts the coins and checks that the amount input is >= the item price. The item is then dispensed and any change is returned.

Exceptions:

- item selected but not available
- Amount input < item price

Example Car Club 1

- A car club maintains a fleet of cars for its members to use. If a car is available, a member may book it.
- They then collect the reserved car from the location where it is parked and drive it for as long as they require. When they are finished they return the car to the same location.
- If the member notes a fault while driving the car they report it and he club sends the car for repair.
- The car is not available again for bookings until the repair is complete.

Example Car Club 2

- In addition, cars are cleaned regularly. If, when a car is returned, its mileage since it was last cleaned exceeds 1000 miles it is sent for cleaning and does not become available again until the cleaning is complete.
- Otherwise when the car is returned it becomes available at once.

- Draw a statechart diagram to represent the states of a car and the transitions between them. Assume that initially a car is available.