State Transition Diagram

State Transition Diagram

- It is a type of diagram that is used to represent different transition (changing) states of a System.

- It is generally used to graphically represent all possible transition states a system can have and model such systems.

- It is very essential and important and right for object-oriented modeling from the beginning.

- The System consists of various states that are being represented using various symbols in the state transition diagram.

Symbols

Type of state	Description	Graph
Initial State	In a System, it represents Starting state.	
Final State	In a System, it represents Ending state.	
Simple State	In a System, it represents a Simple state with no substructure.	
Composite State	In a System, it represents a Composite state with two or more parallel or concurrent states out of which only one state will be active at a time and other states will be inactive.	

Why Use State transition Diagrams?

- State transition diagrams typically are used to describe state-dependent behavior for an object
  - An object responds differently to the same event depending on what state it is in
  - Usually applied to objects but can be applied to any element that has behavior
    - Actors, use cases, methods, subsystems, systems
- State transition diagrams are typically used in conjunction with interaction diagrams (usually sequence diagrams)
  - A state transition diagram describes all events (and states and transitions for a single object)
  - A sequence diagram describes the events for a single interaction across all objects involved

States

- Show what the dependencies are between the state of an object and its reactions to messages or other events
- State
  - is a condition or situation during the life of an object within which it performs some activity, or waits for some events
  - Has a name
  - Has actions -- execute the state
  - Has internal transitions -- transitions cause no change in a state
  - substates -- the nested structure of a state involving disjoint or concurrent substates

Initial and Final States

- The initial state of a state machine is indicated with a solid circle
  - Known as a pseudo-state
  - A transition from this state will show the first real state
- The final state of a state machine is shown as concentric circles
  - closed loop state machine does not have a final state; the object lives until the entire system terminates
  - An open loop state machine represents an object that may terminate before the system terminates

Initial and Final States
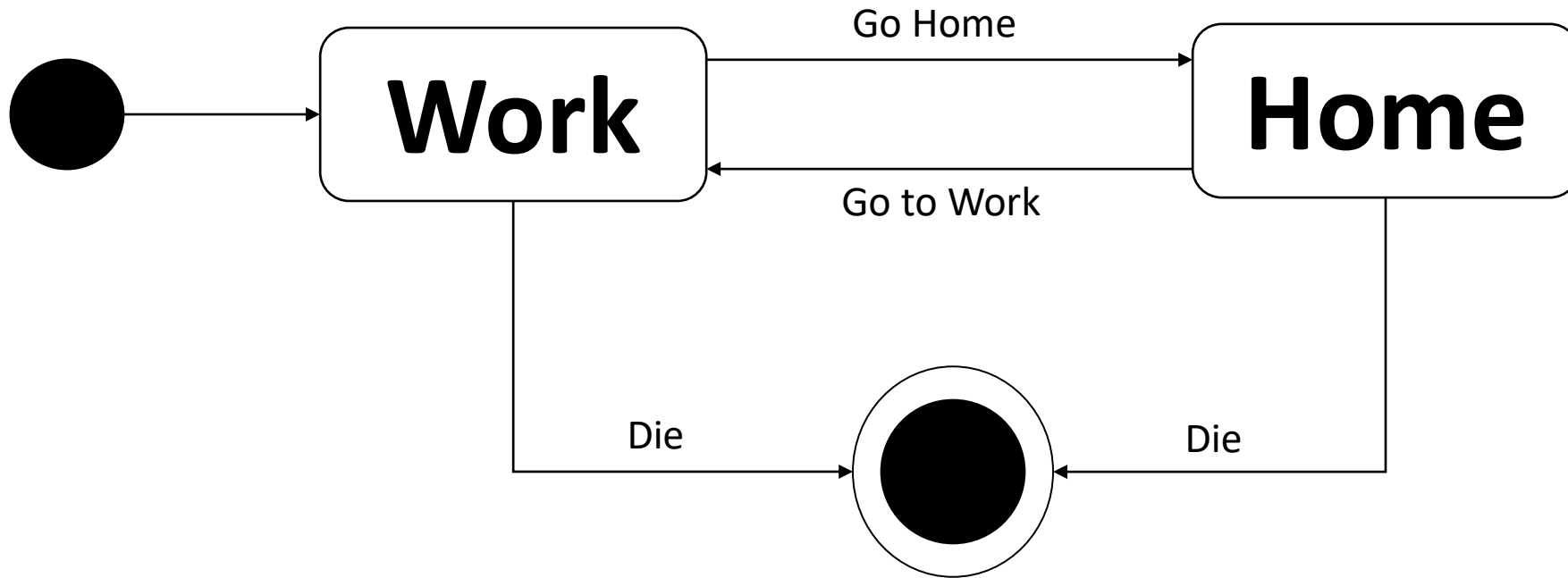
Actions and Activities

- Action
  - is an executable atomic computation
  - includes operation calls, the creation or destruction of another object, or the sending of a signal to an object
  - associated with transitions and during which an action is not interruptible -- e.g., entry, exit
- Activity is associated with states
  - Non-atomic or ongoing computation
  - May run to completion or continue indefinitely
  - Will be terminated by an event that causes a transition from the state in which the activity is defined

Events

- An event signature is described as
  - Event-name (comma-separated-parameter-list)
- Events appear in the internal transition compartment of a state or on a transition between states
- An event may be one of four types
  - Signal event
    - Corresponding to the arrival of an asynchronous message or signal
  - Call event
    - Corresponding to the arrival of a procedural call to an operation
  - Time event
  - Change event

Events

- A time event occurs after a specified time has elapsed
  - Event name is specified as keyword after
  - Parameter list is an expression evaluating to a time interval
    - after(10 seconds after state "At Work" is entered)
  - No specified start time implies "since entry to the current state"
    - after(2 seconds)

Events

- A change event occurs whenever a specified condition is met
  - Event name is specified as keyword **when**
  - Parameter list is a Boolean expression
  - The event occurs when both of the following conditions are met, irrespective of the order when they happen
    - The expression evaluates to true
    - The object is in the required state
  - For example
    - when (state = At Work)
    - when (date = January 1 2007)

Transitions

A transition is drawn as an arrow between states annotated with a transition string

- The transition string denotes the event and consequent action

- Only one form of arrowhead is used on state chart
  - The distinction between call events and signal events must be deducted from elsewhere e.g. an interaction diagram

A transition string is described as

- Event-signature [guard-condition]/action-expression object-message

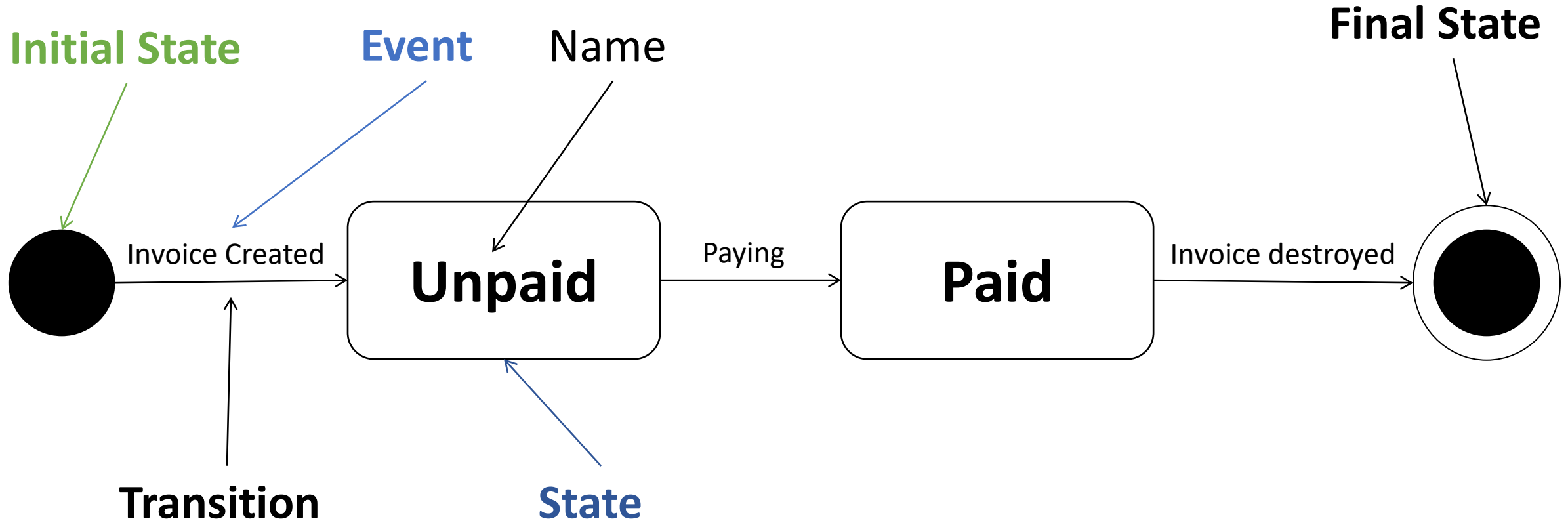- If the guard condition is met the transition occurs immediately

Transitions

- A transition whose string contains neither an event signature nor a guard condition is said to be unlabeled

  - Occurs immediately
  - May still carry an action expression

Transitions

- A transition is triggered when its event occurs
  - If the guard condition is met, the transition is fired
  - If the condition is not met the event is discarded
    - The guard condition is checked only once
- If there is no guard condition, triggering will always cause firing
- Note the distinction between a guard condition and a change event
  - A guard condition is evaluated once, when the associated event occurs
  - A change event occurs whenever its associated condition is met
    - Behavior is as if the condition were being continually evaluated

State transition diagram

Initial State

Event

Name

Final State

Invoice Created

Unpaid

Paying

Paid

Invoice destroyed

Transition

State

ATM

- When the customer inserts the bank or credit card in the ATM's card reader, the entry action "read card" is performed by the ATM machine.

- If the card is not valid then the machine will perform exit action.

- After the card is being read successfully, the ATM machine will ask for Pin. Then the customer enters the pin and ATM machine then reads pin.

- If the pin entered is not valid then machine will perform exit action.

- If the pin entered is valid, then the machine further process towards transaction.

- After successful transaction, machine undergoes the exit action "eject card" that discharges the customer's card.

State Transition Diagram of ATM
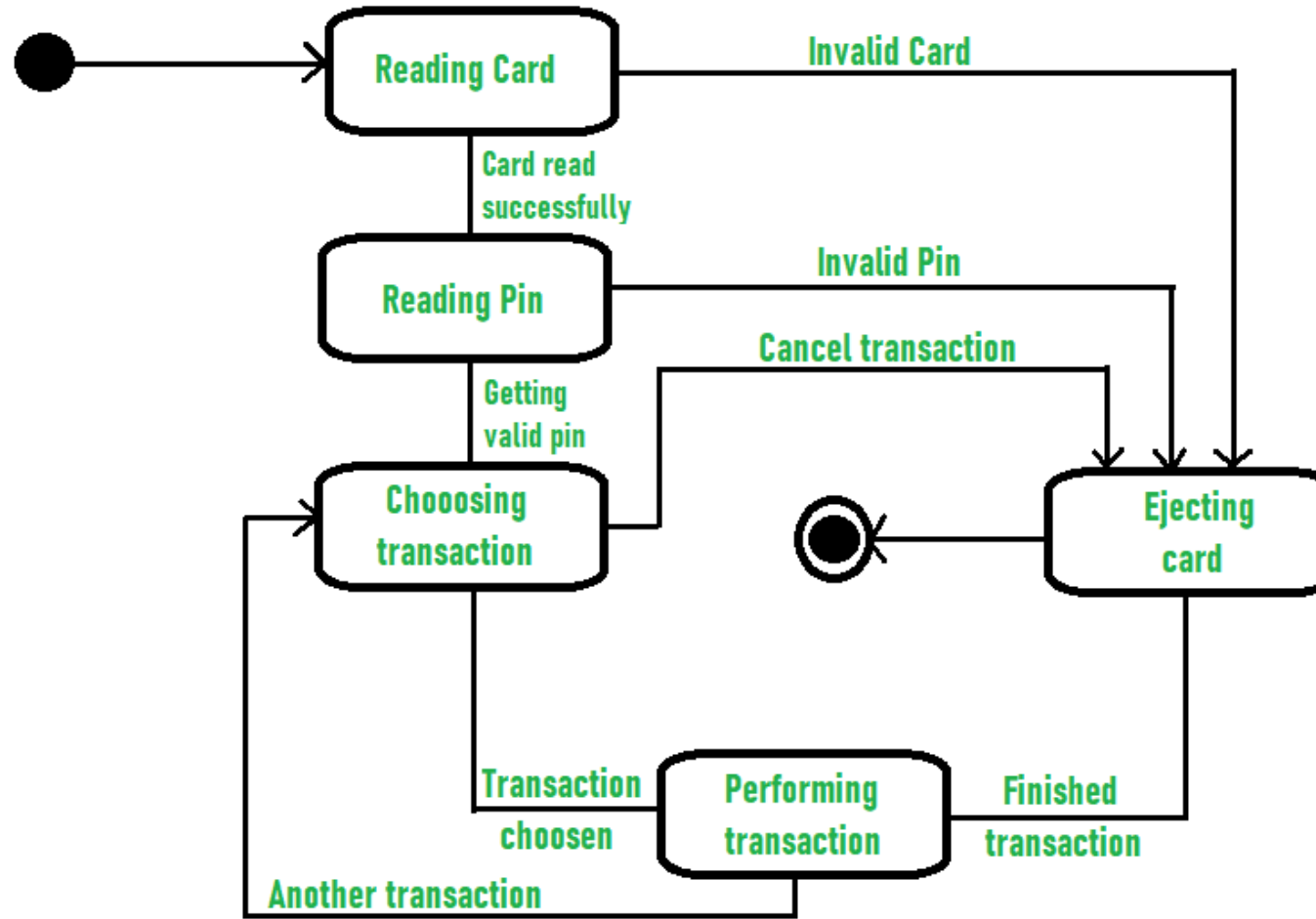
State Transition Diagram for ATM System