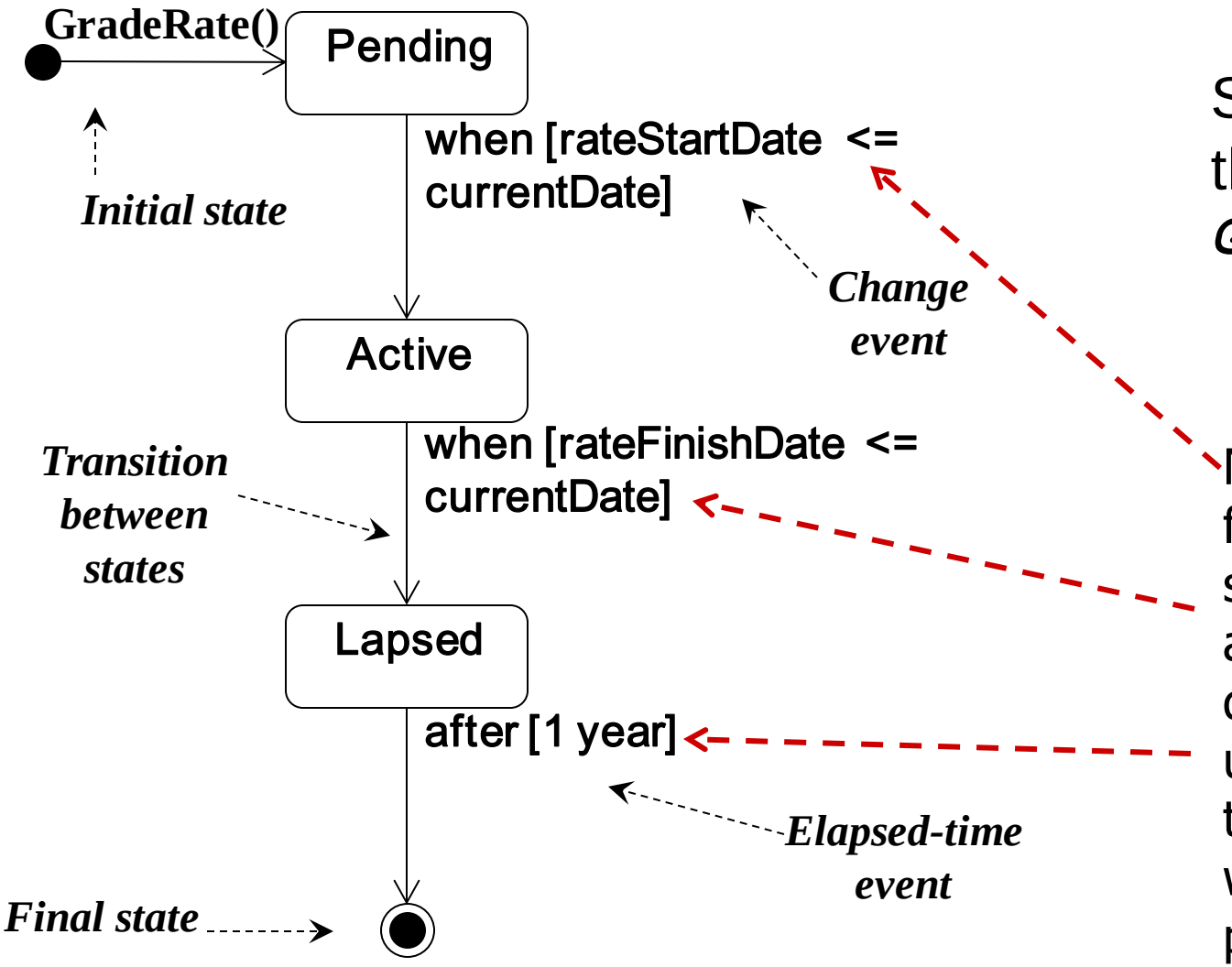
State

- The current state of an object is determined by the current value of the object's attributes and the links that it has with other objects
- For example the class **`StaffMember`** has an attribute **`startDate`** which determines whether a **`StaffMember`** object is in the probationary state
- 'A state is a condition during the life of an object or an interaction during which it satisfies some condition, performs some action or waits for some event....

State Diagram and Statechart Diagram

- **State Diagrams** are used to capture the behavior of a software system.
- UML State diagrams can be used to model the behavior of a class, a subsystem, a package, or even an entire system.
- It is also called a Statechart diagram.
- These diagrams are used to model the event-based system.
- A state of an object is controlled by an event.
- Statechart diagrams are used to describe various states of an entity within the application system.

Statechart Diagram



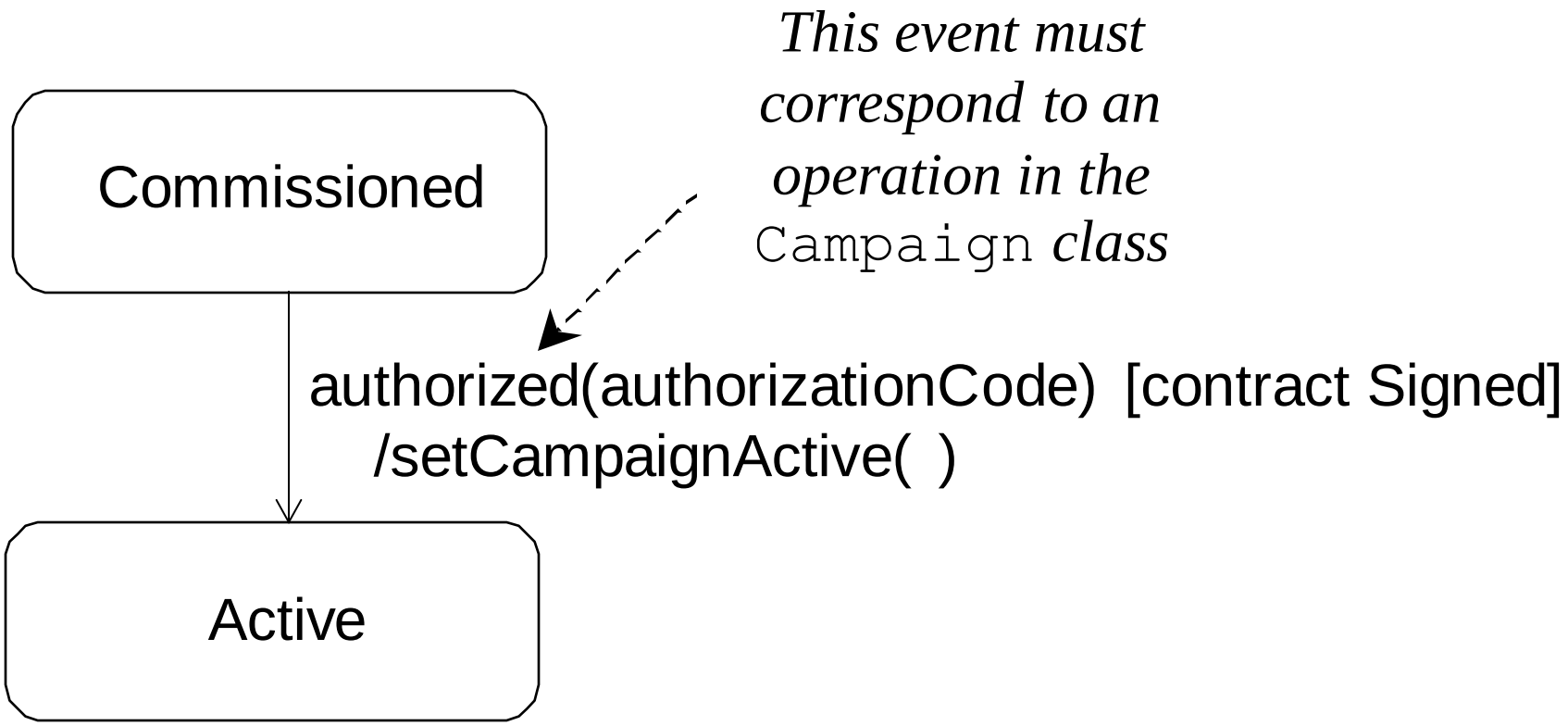
Statechart for the class ***GradeRate***

Movement from one state to another is dependent upon events that occur with the passage of time.

Types of Event

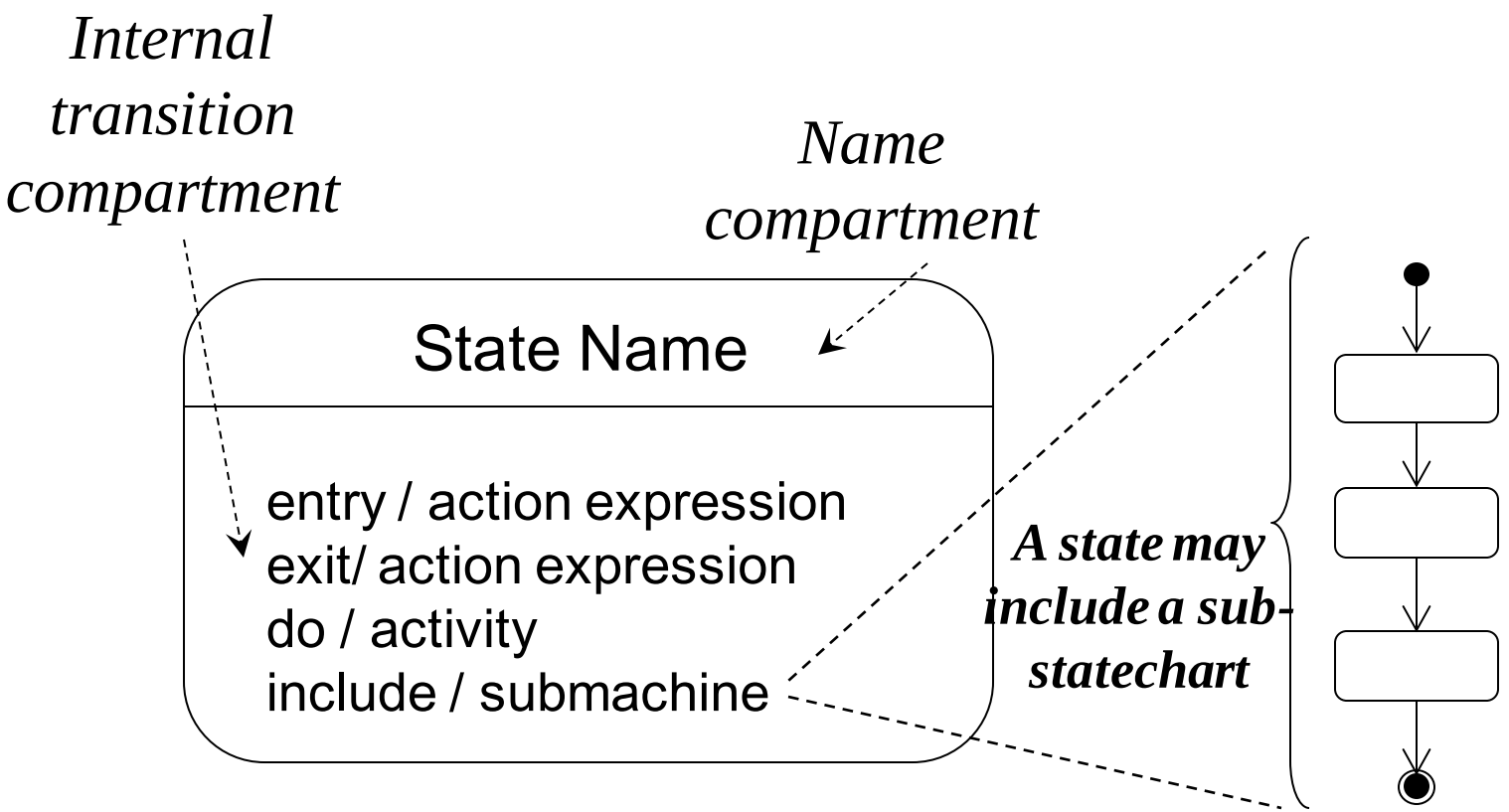
- A ***change event*** occurs when a condition becomes true
- A ***call event*** occurs when an object receives a call to one of its operations either from another object or from itself
- A ***signal event*** occurs when an object receives a signal (an asynchronous communication)
- An ***elapsed-time event*** is caused by the passage of a designated period of time after a specified event (frequently the entry to the current state)

Events


Commissioned
This event must correspond to an operation in the Campaign class
authorized(authorizationCode) [contract Signed]
/setCampaignActive( )
Active

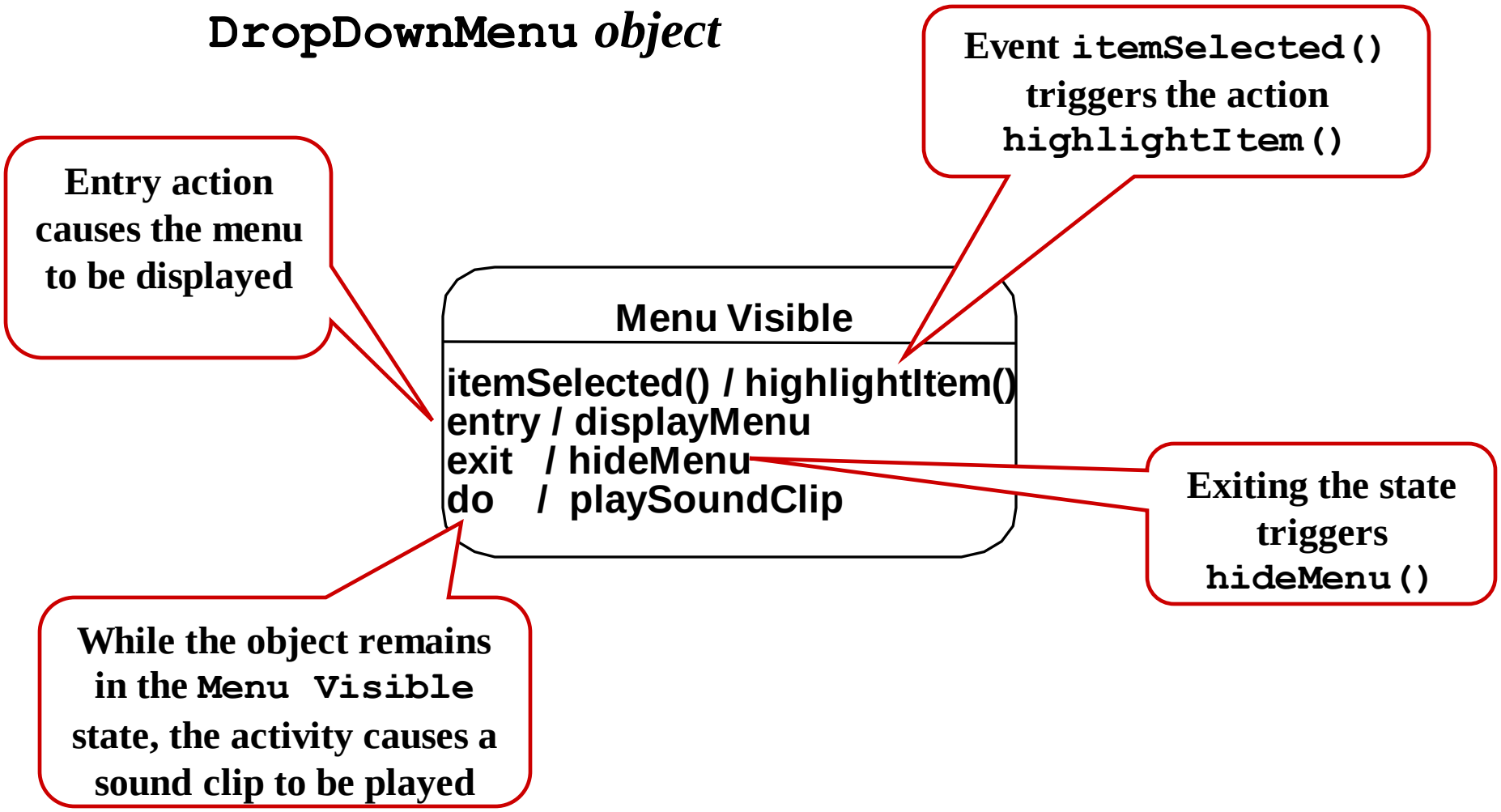
Actions and Activities

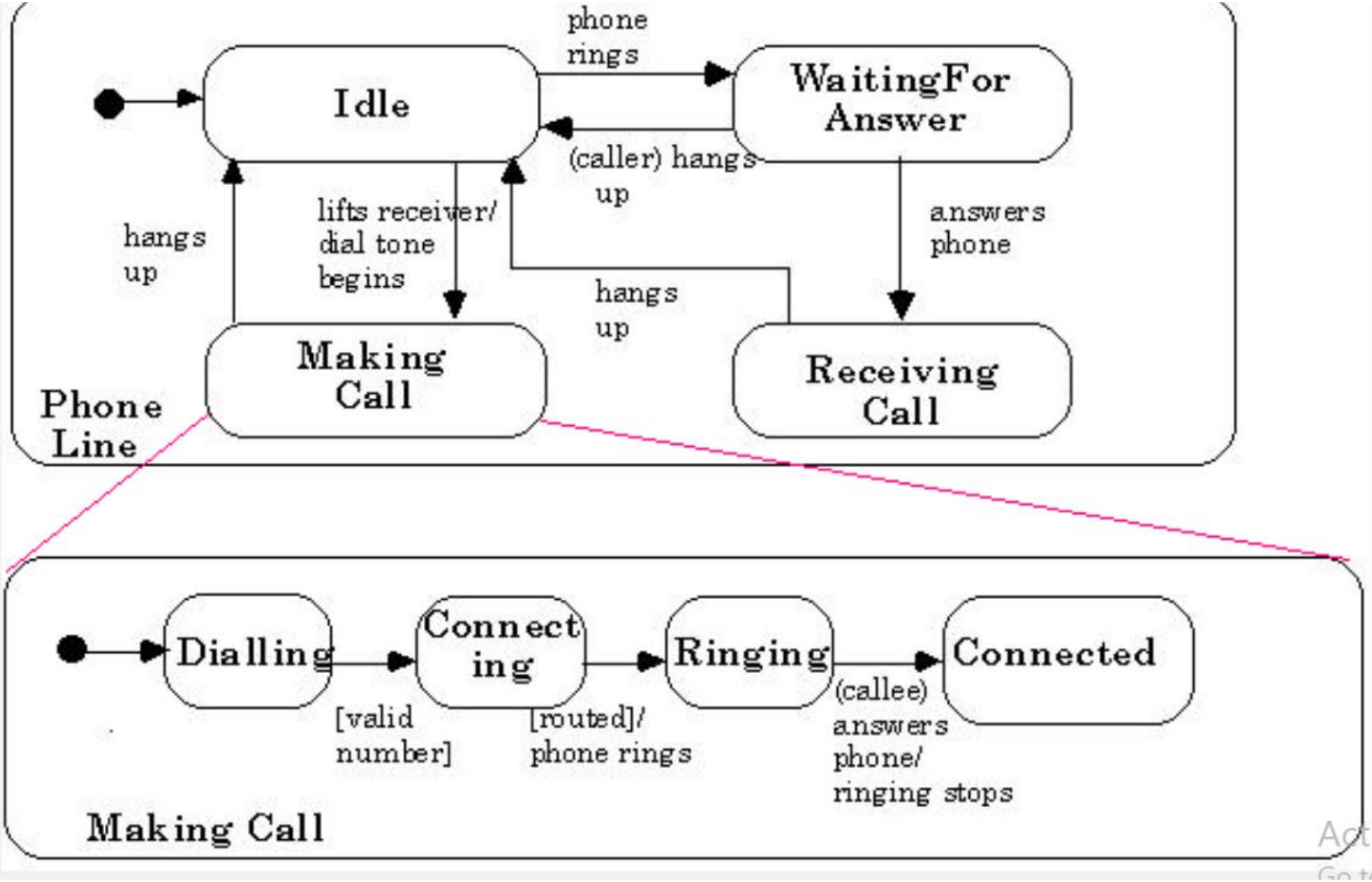
Internal actions and activities for a state

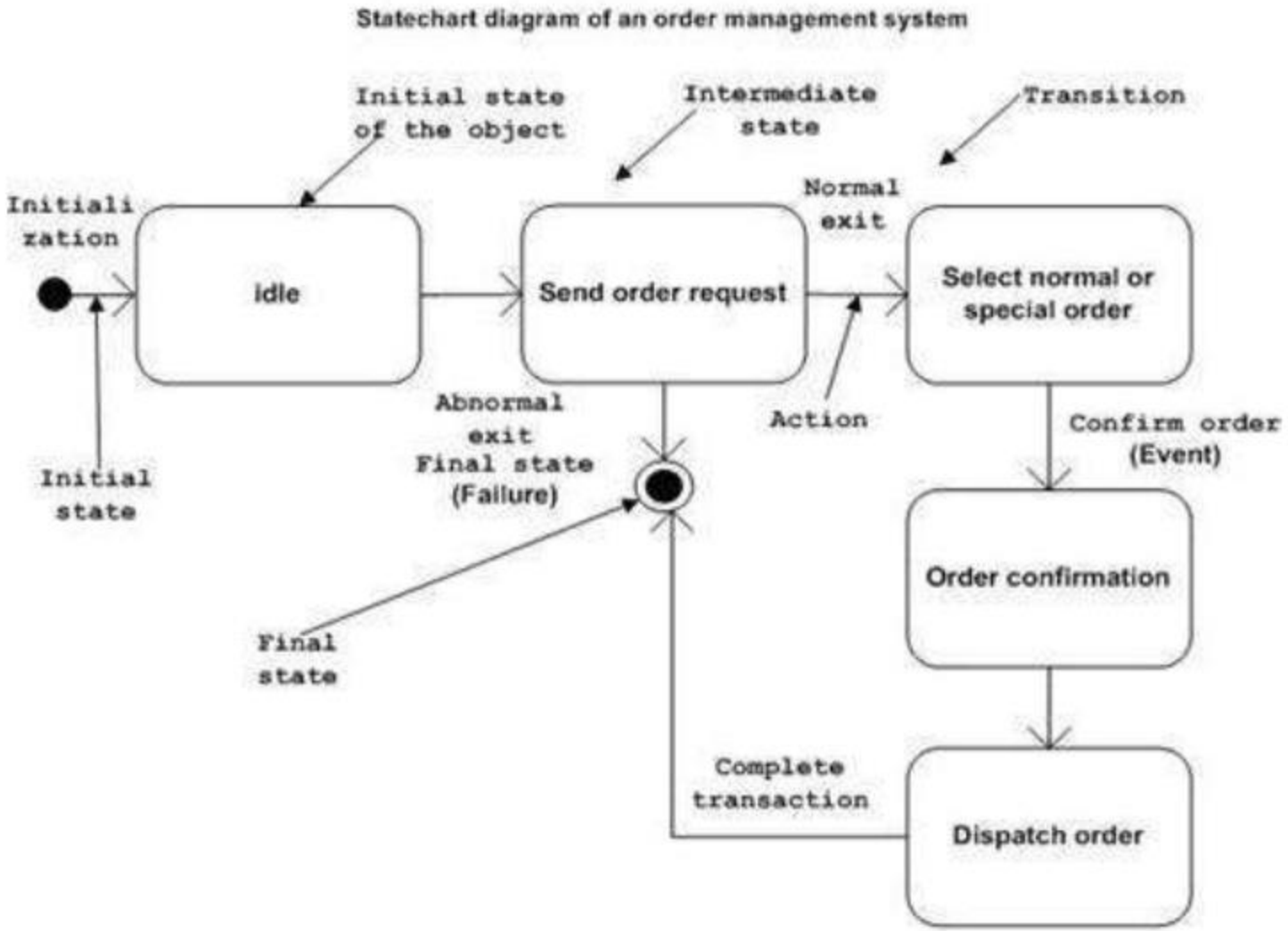


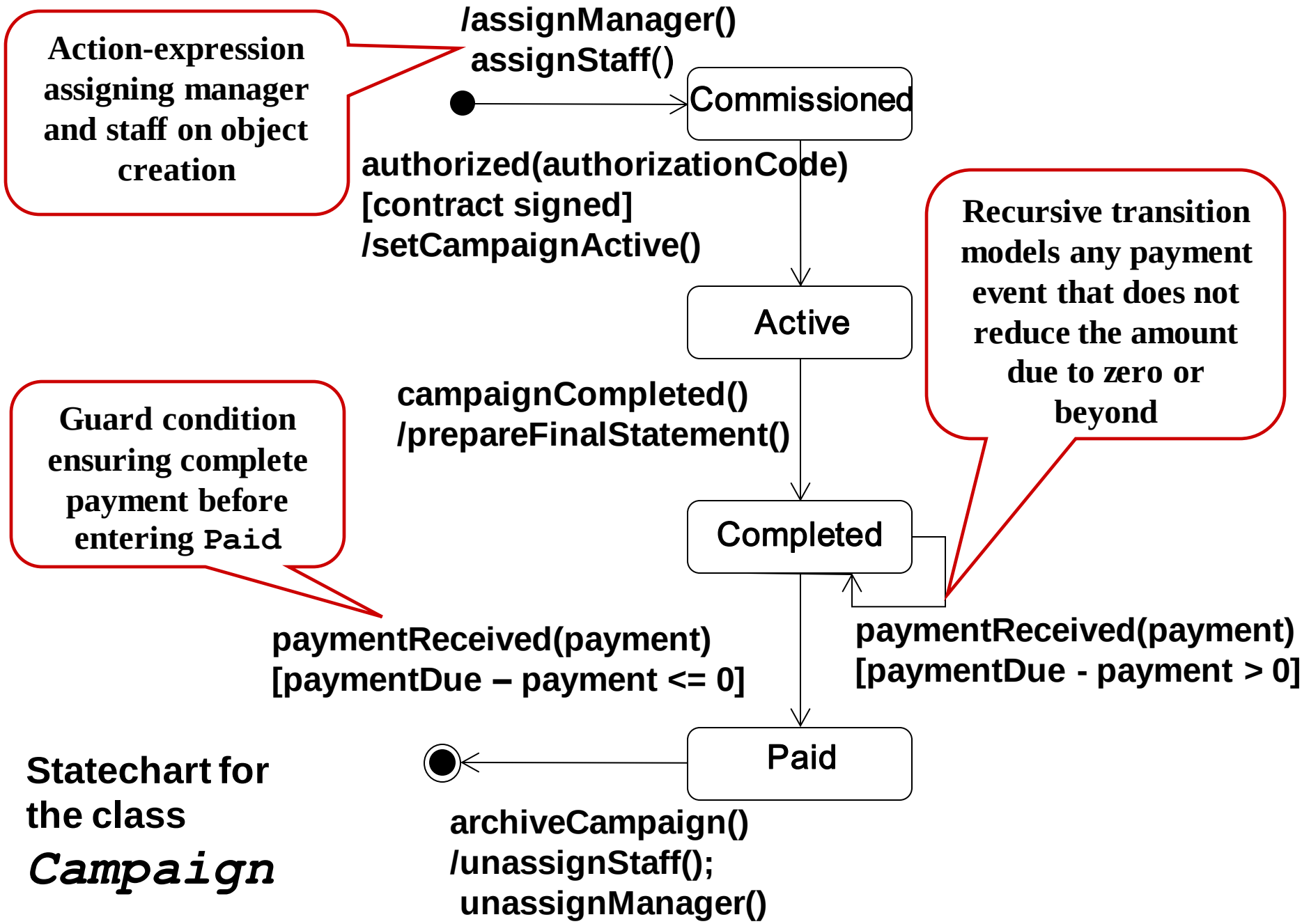
Actions and Activities

`Menu Visible` *state for a* `DropDownMenu` *object*



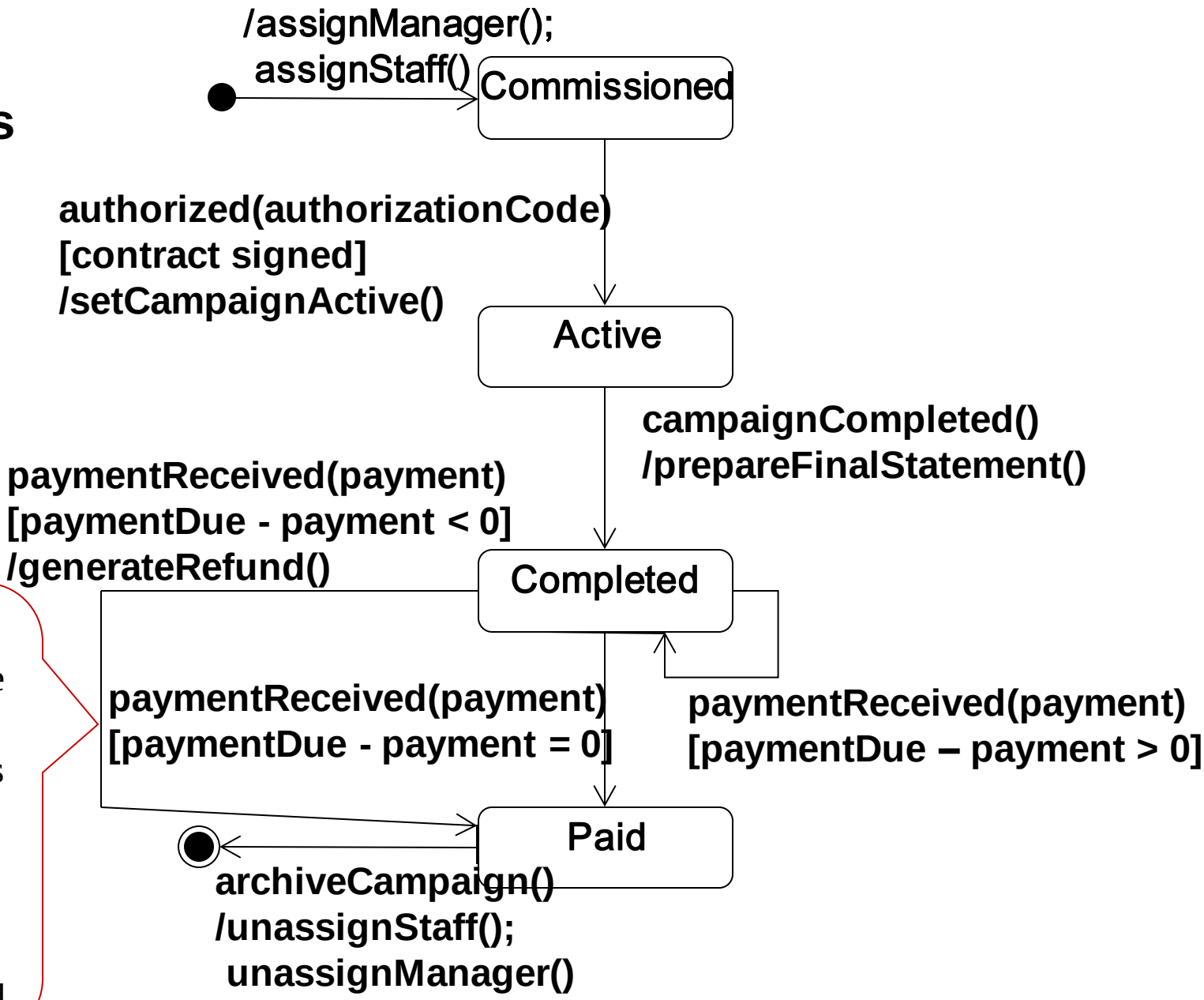

phone rings
Idle
WaitingFor Answer
(caller) hangs up
hangs up
lifts receiver/ dial tone begins
answers phone
hangs up
Making Call
Receiving Call
Phone Line
Dialling
Connecting
Ringing
Connected
[valid number]
[routed]/ phone rings
(callee) answers phone/ ringing stops
Making Call


Statechart diagram of an order management system
Initial state of the object
Intermediate state
Transition
Initiali zation
Normal exit
idle
Send order request
Select normal or special order
Abnormal exit
Final state (Failure)
Action
Confirm order (Event)
Initial state
Order confirmation
Final state
Complete transaction
Dispatch order



Statechart for the class ***Campaign***

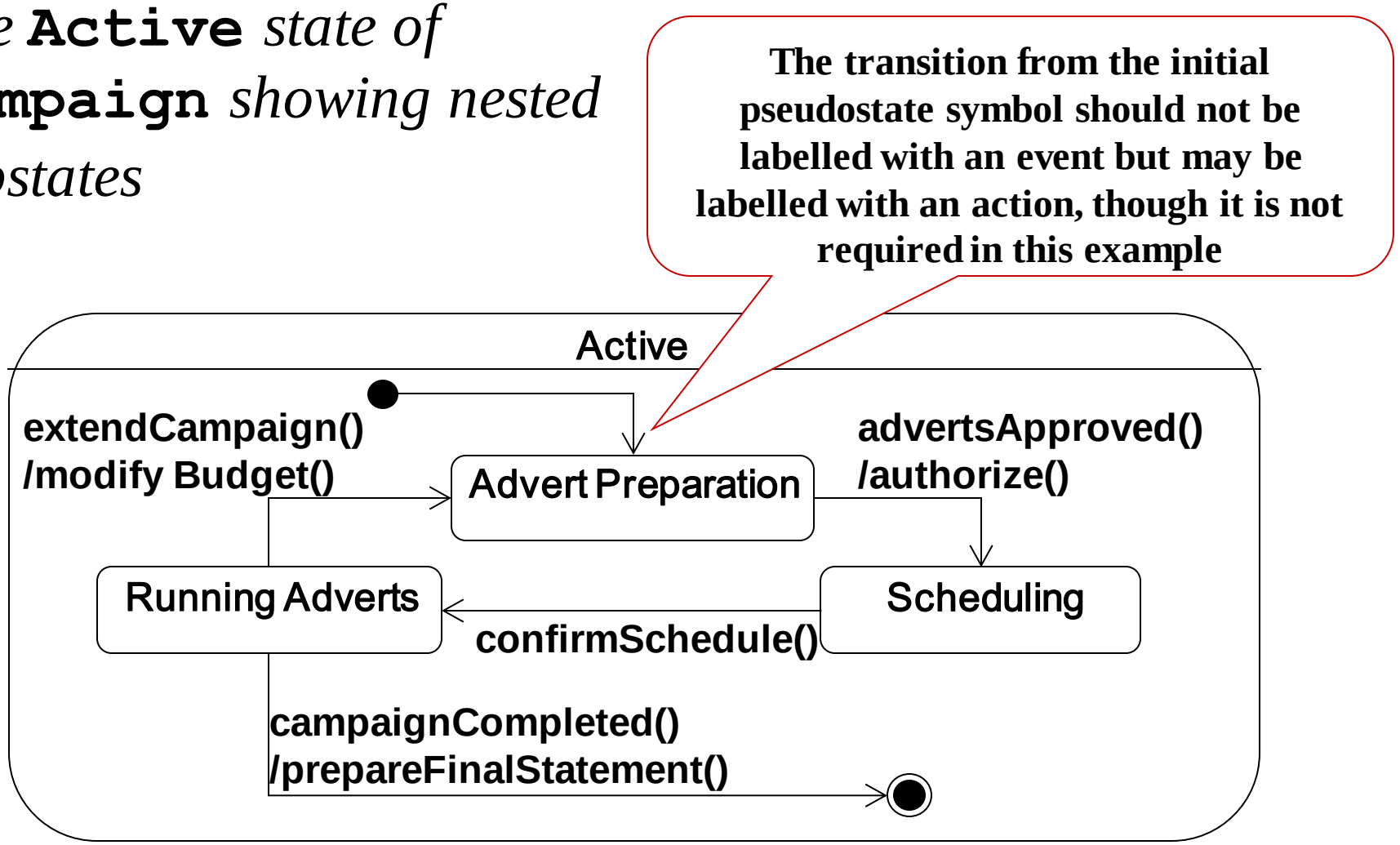
A revised statechart for the class *Campaign*



If the user requirements were to change, so that an overpayment is now to result in the automatic generation of a refund, a new transition is added

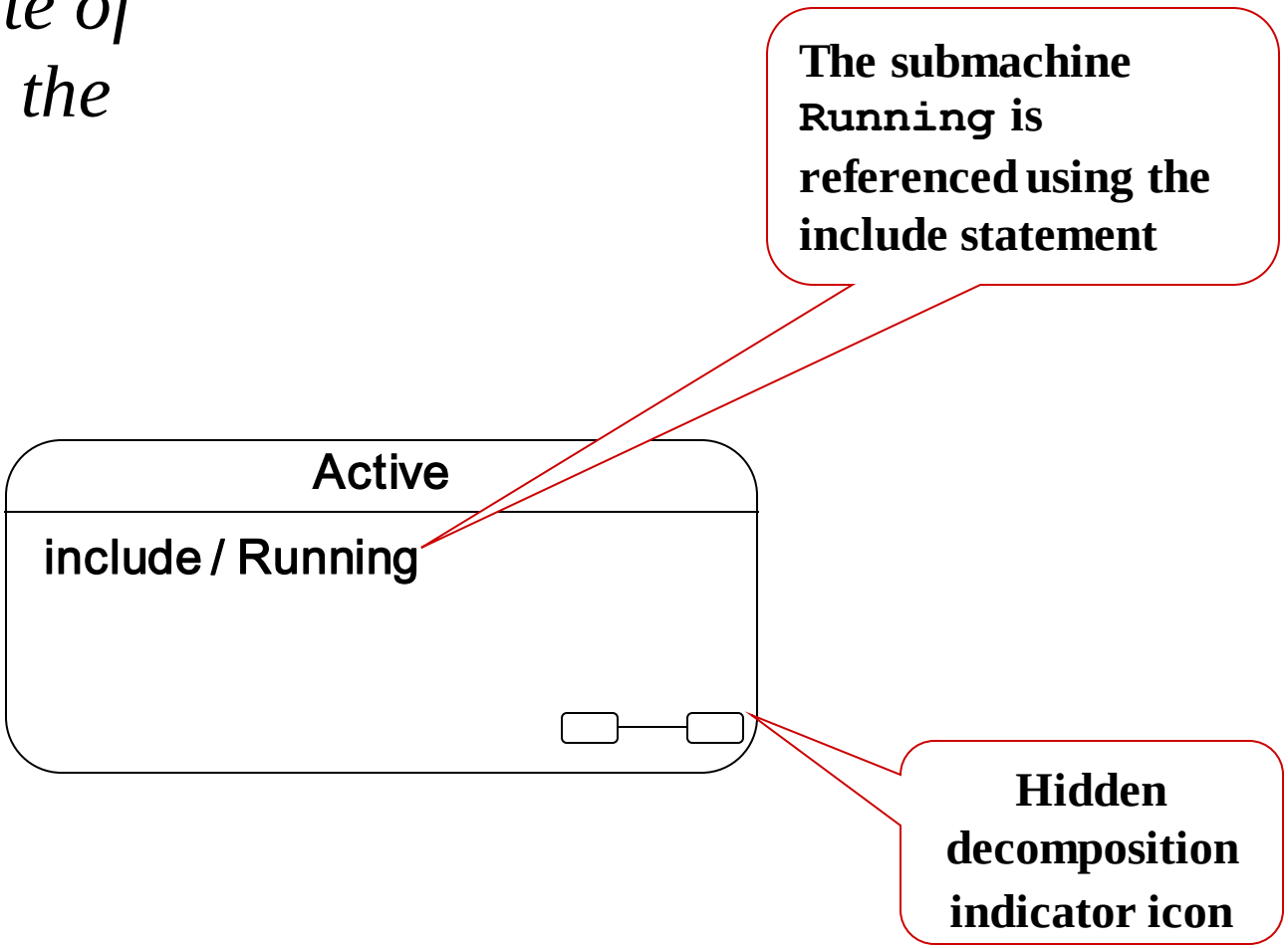
Nested Substates

The **`Active`** *state of* **`Campaign`** *showing nested substates*

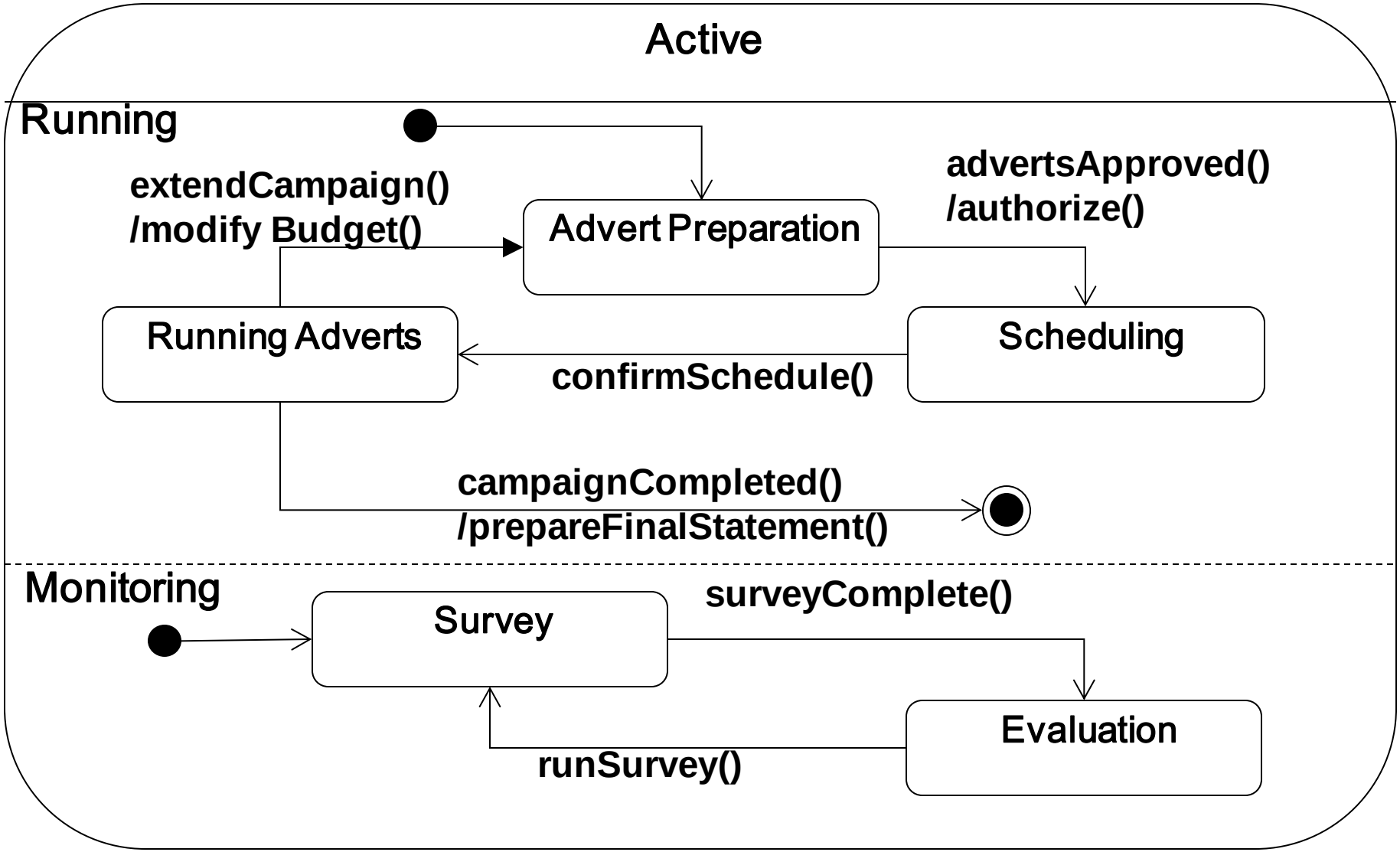


Nested States

The **`Active`** *state of* **`Campaign`** *with the detail hidden*



The `Active` State with Concurrent Substates



Concurrent States

- A transition to a complex state is equivalent to a simultaneous transition to the initial states of each concurrent statechart

- An initial state must be specified in both nested statecharts in order to avoid ambiguity about which substate should first be entered in each concurrent region

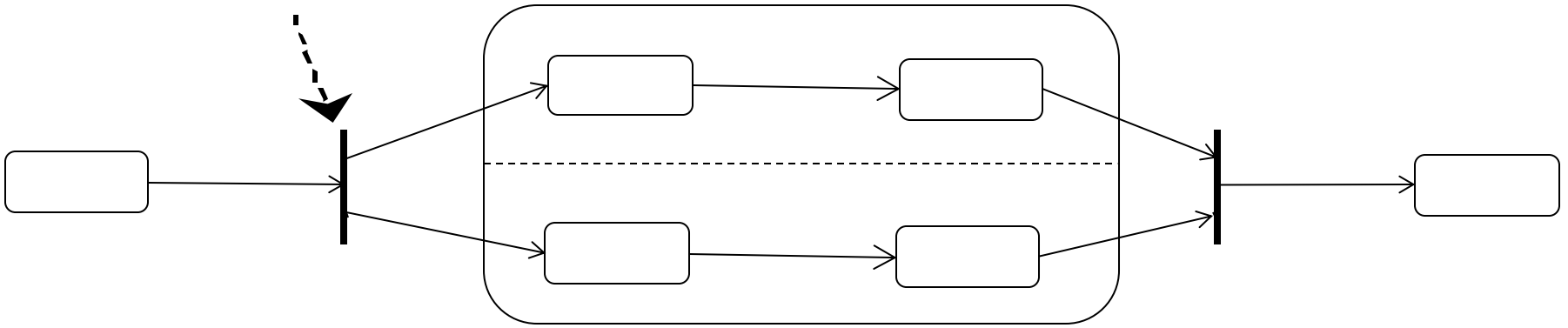
- A transition to the **`Active`** state means that the **`Campaign`** object simultaneously enters the **`Advert Preparation`** and **`Survey`** states

Concurrent States

- Once the composite states is entered a transition may occur within either concurrent region without having any effect on the state in the other concurrent region
- A transition out of the **`Active`** state applies to all its substates (no matter how deeply nested)

Synchronized Concurrent Threads.

Synchronization bar



- Explicitly showing how an event triggering a transition to a state with nested concurrent states causes specific concurrent substates to be entered
- Shows that the composite state is not exited until both concurrent nested statecharts are exited

Preparing Statecharts

- Two approaches may be used:
  - Behavioural approach
  - Life cycle approach

Behavioural Approach

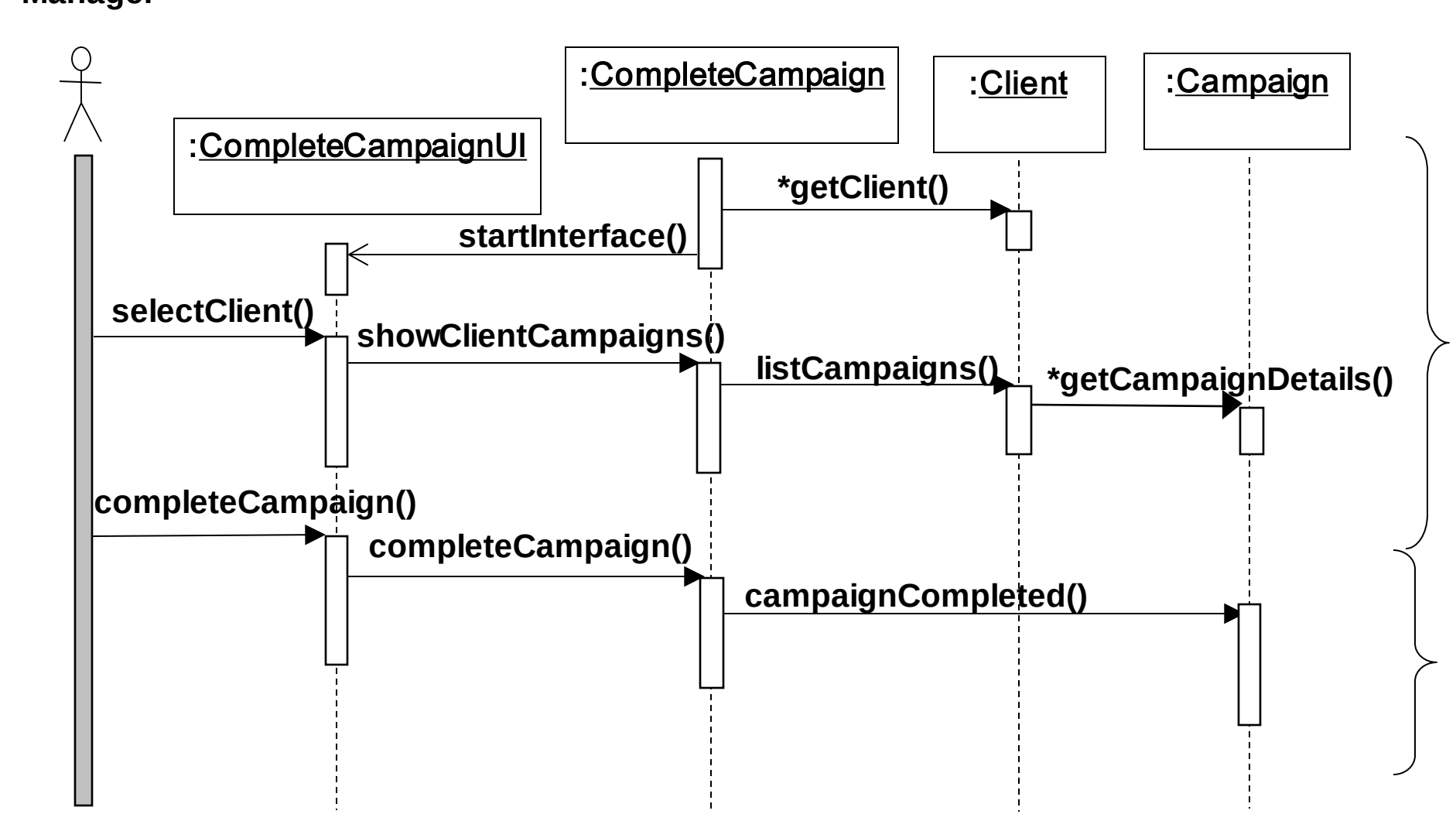
1. Examine all interaction diagrams that involve each class that has heavy messaging.
2. Identify the incoming messages on each interaction diagram that may correspond to events. Also identify the possible resulting states.
3. Document these events and states on a statechart.
4. Elaborate the statechart as necessary to cater for additional interactions as these become evident, and add any exceptions.

Behavioural Approach

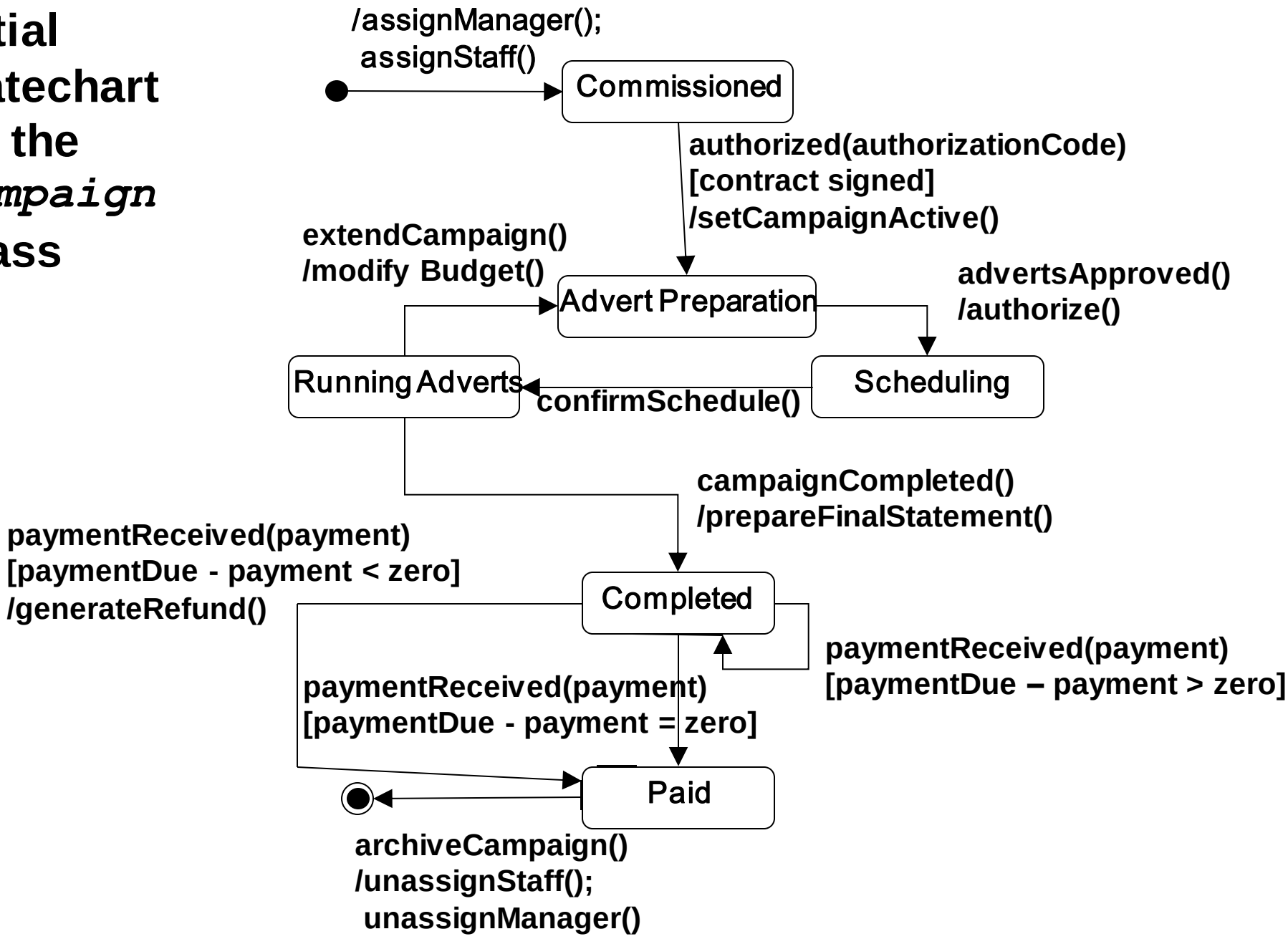
5. Develop any nested statecharts (unless this has already been done in an earlier step).
6. Review the statechart to ensure consistency with use cases. In particular, check that any constraints that are implied by the statechart are appropriate.
7. Iterate steps 4, 5 and 6 until the statechart captures the necessary level of detail.
8. Check the consistency of the statechart with the class diagram, with interaction diagrams and with any other statecharts and models.

Sequence Diagram with Implicit States

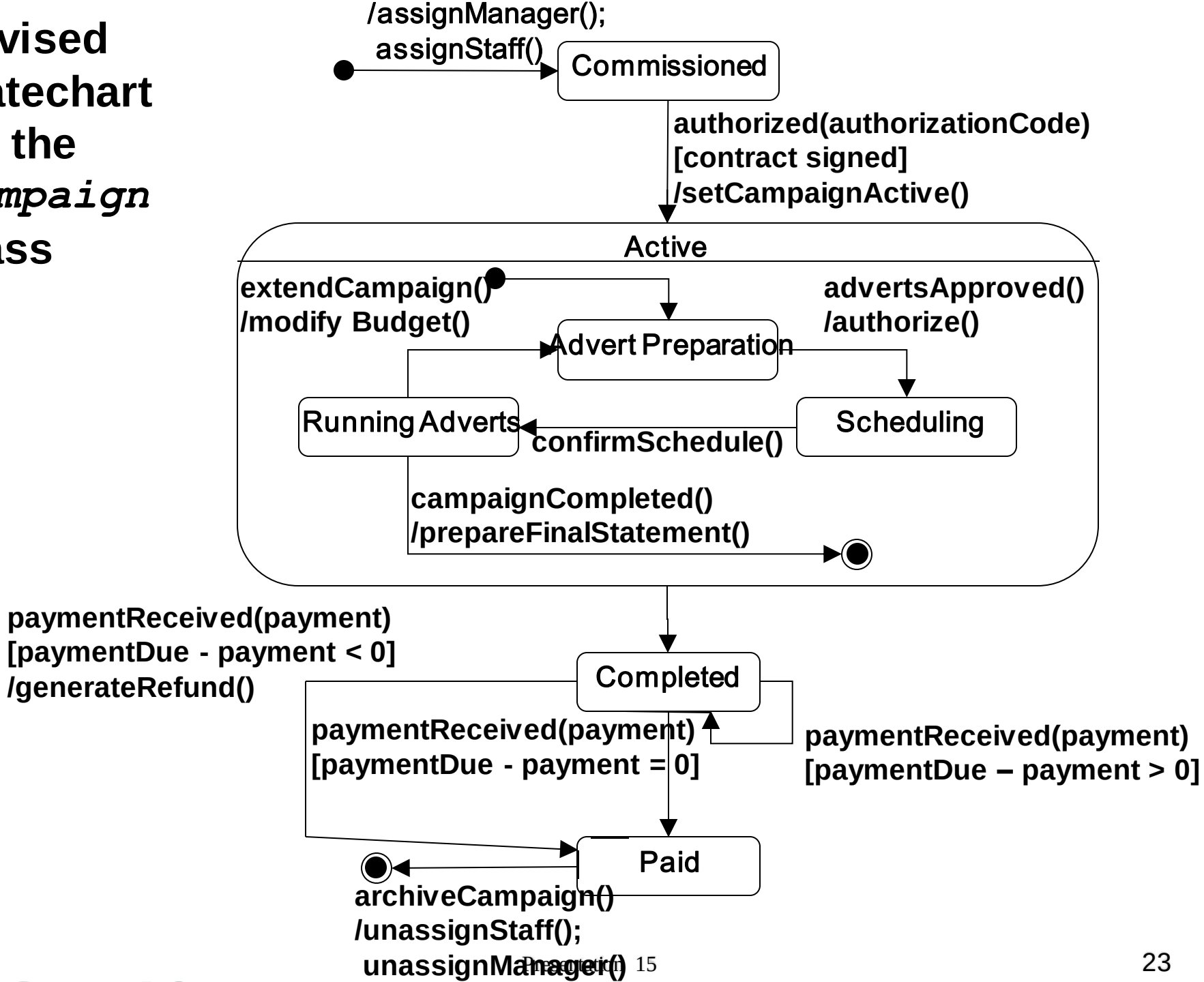
Sequence diagram for use case `Set Campaign Completed`



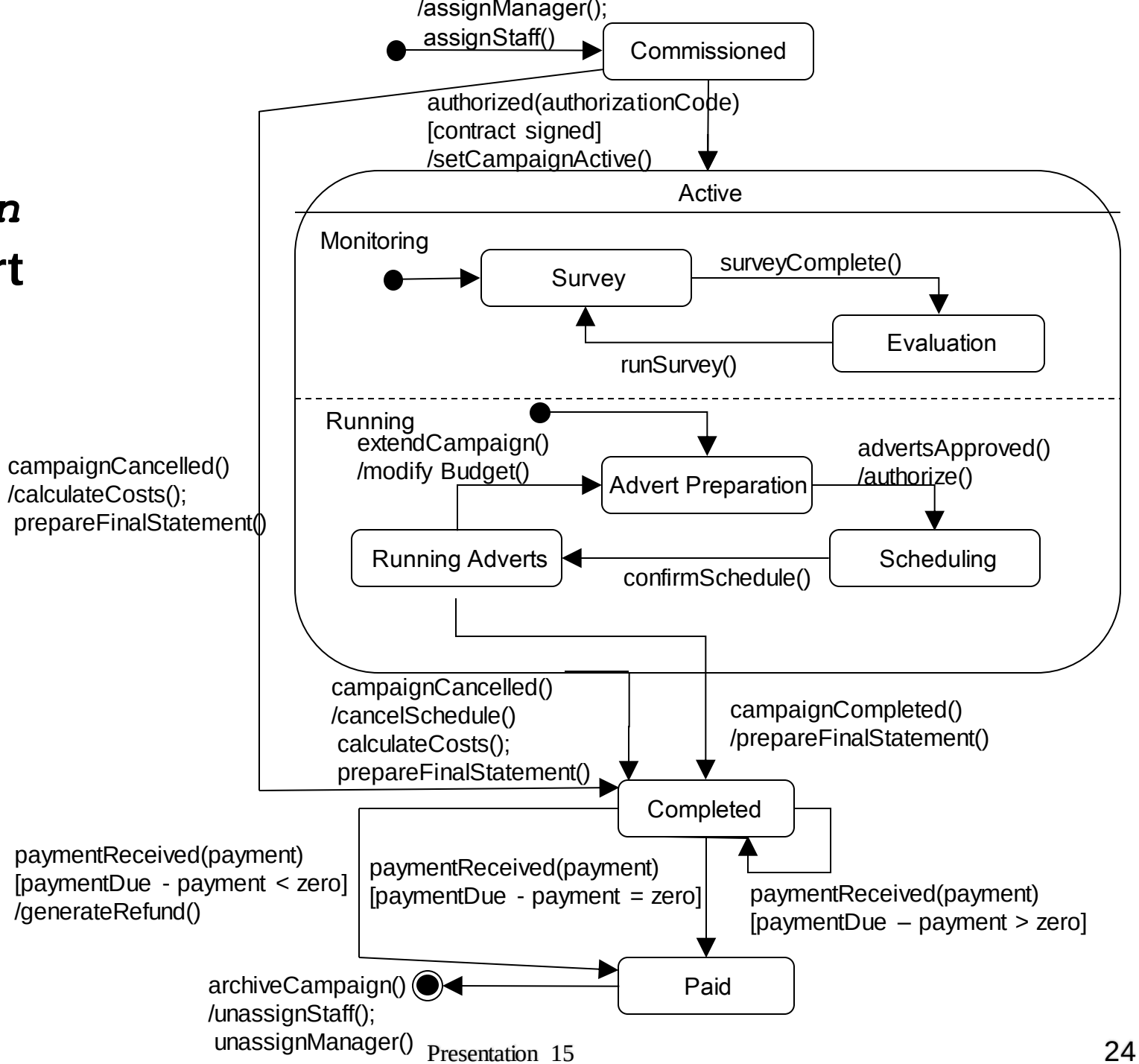
Initial statechart for the *Campaign* Class

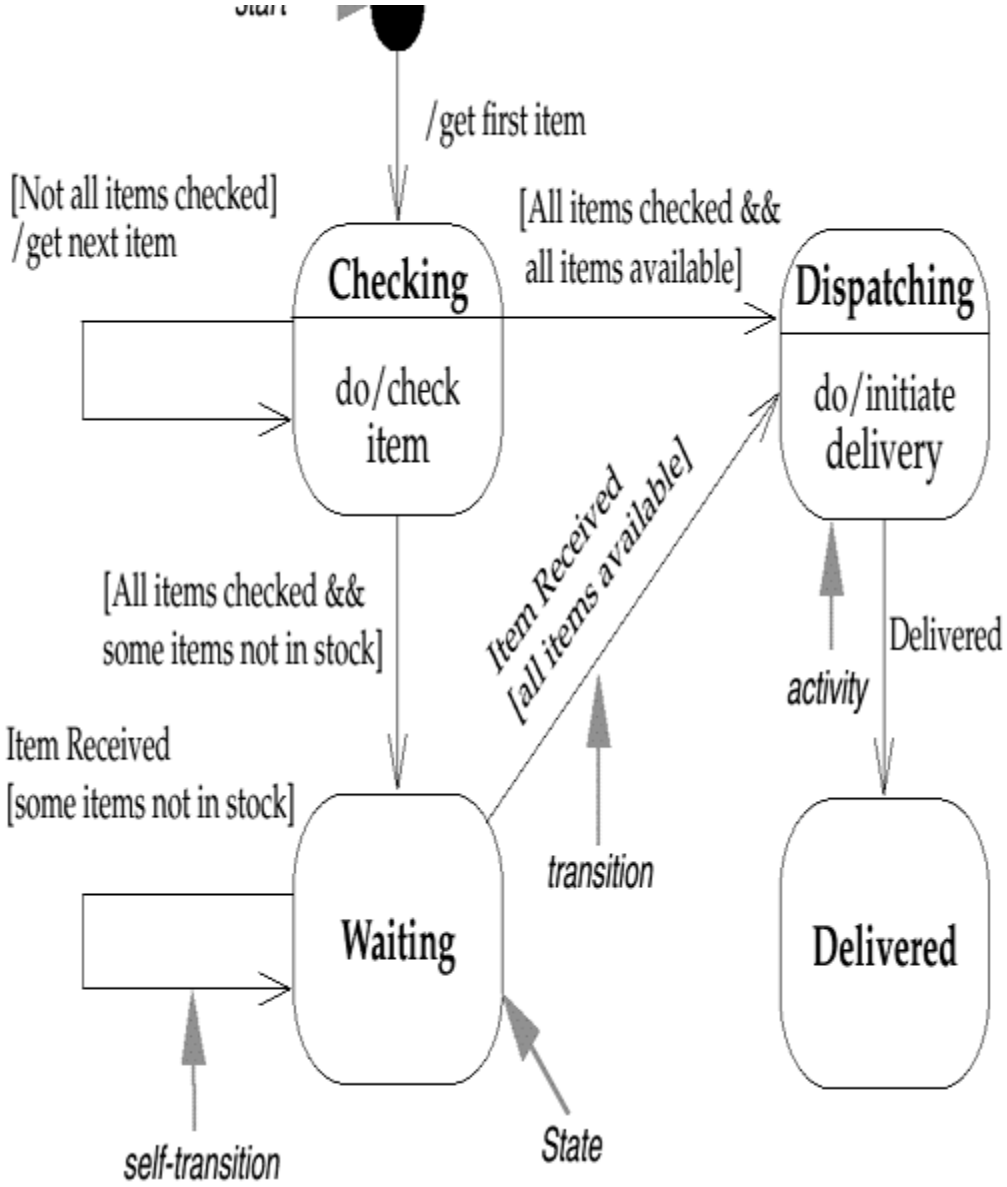


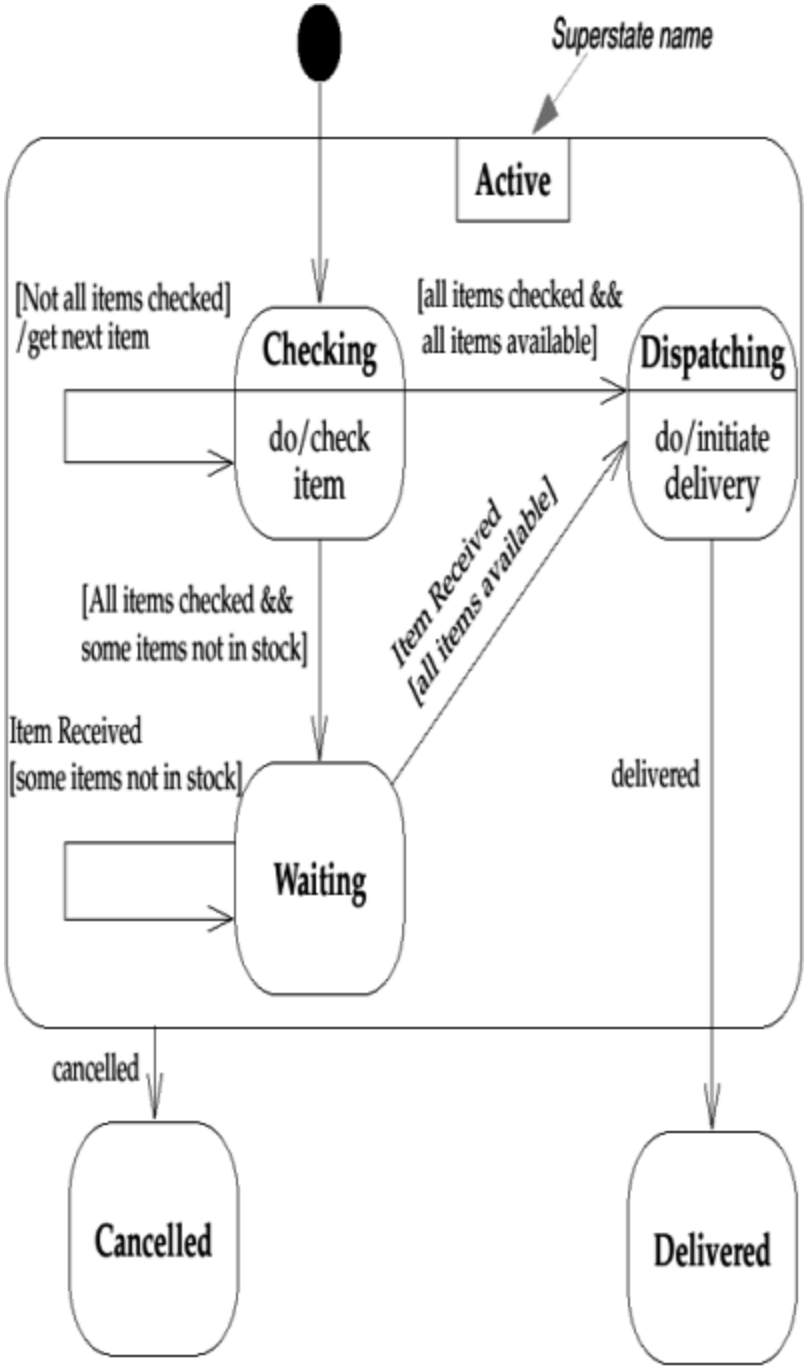
Revised statechart for the *Campaign* class

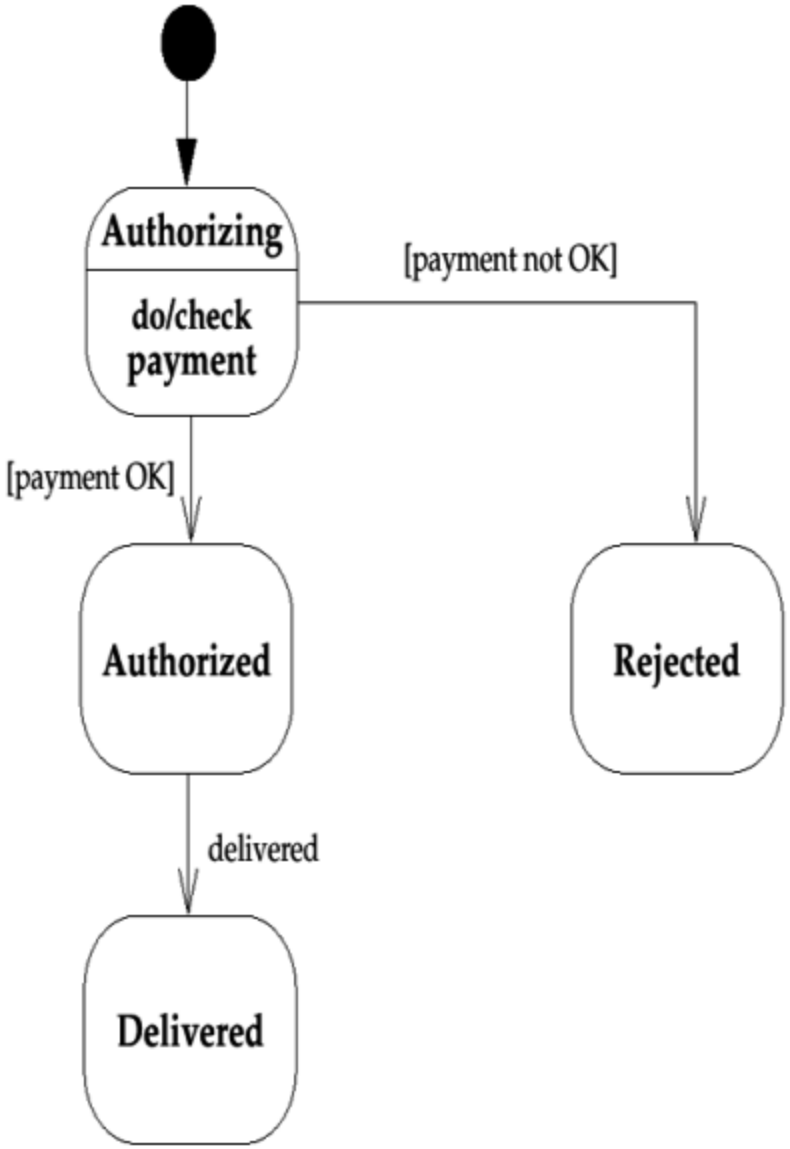


Final version of *Campaign* statechart




/get first item
[Not all items checked]
/get next item
Checking
do/check item
[All items checked &&
all items available]
Dispatching
do/initiate delivery
[All items checked &&
some items not in stock]
Item Received
[some items not in stock]
Item Received
[all items available]
activity
Delivered
transition
Waiting
Delivered
self-transition
State


Superstate name
Active
[Not all items checked]
/get next item
Checking
do/check
item
[all items checked &&
all items available]
Dispatching
do/initiate
delivery
[All items checked &&
some items not in stock]
Item Received
[all items available]
Item Received
[some items not in stock]
Waiting
delivered
cancelled
Cancelled
Delivered


Authorizing
do/check payment
[payment not OK]
[payment OK]
Authorized
Rejected
delivered
Delivered