

# **Advanced Behavioral Modeling**

# Events and Signals

- Signal events, call events, time events, and change events
- Modeling a family of signals
- Modeling exceptions

An **event** is the specification of a significant occurrence that has a location in time and space. In the context of state machines, an event is an occurrence of a stimulus that can trigger a state transition.

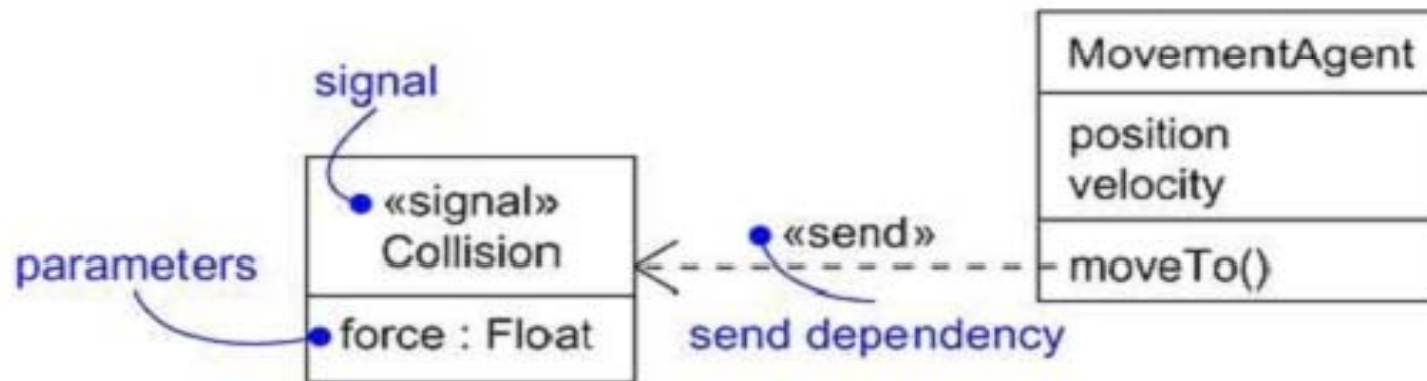
## Kinds of Events

**External events** are those that pass between the system and its actors.

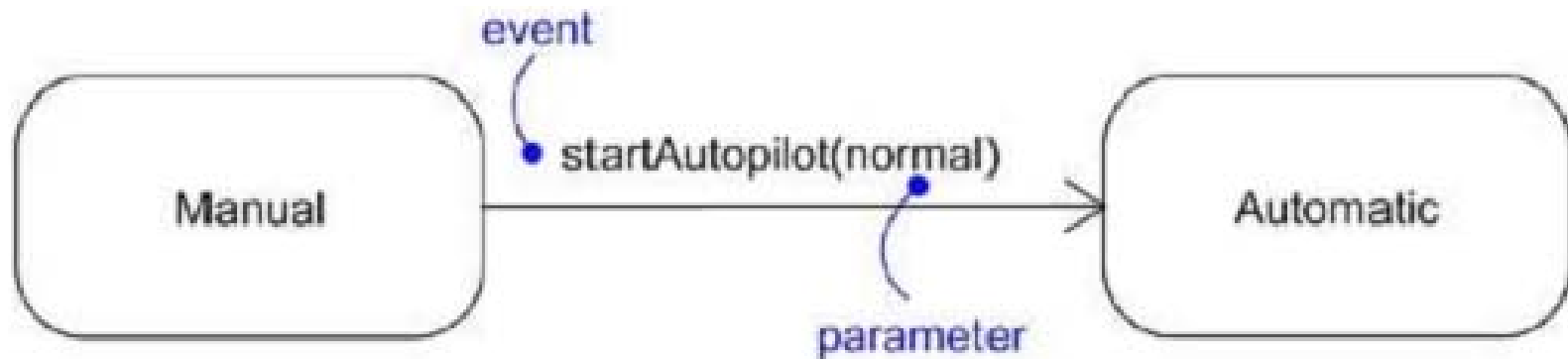
**Internal events** are those that pass among the objects that live inside the system.

## Signals

A **signal** represents a named object that is dispatched (thrown) asynchronously by one object and then received (caught) by another.



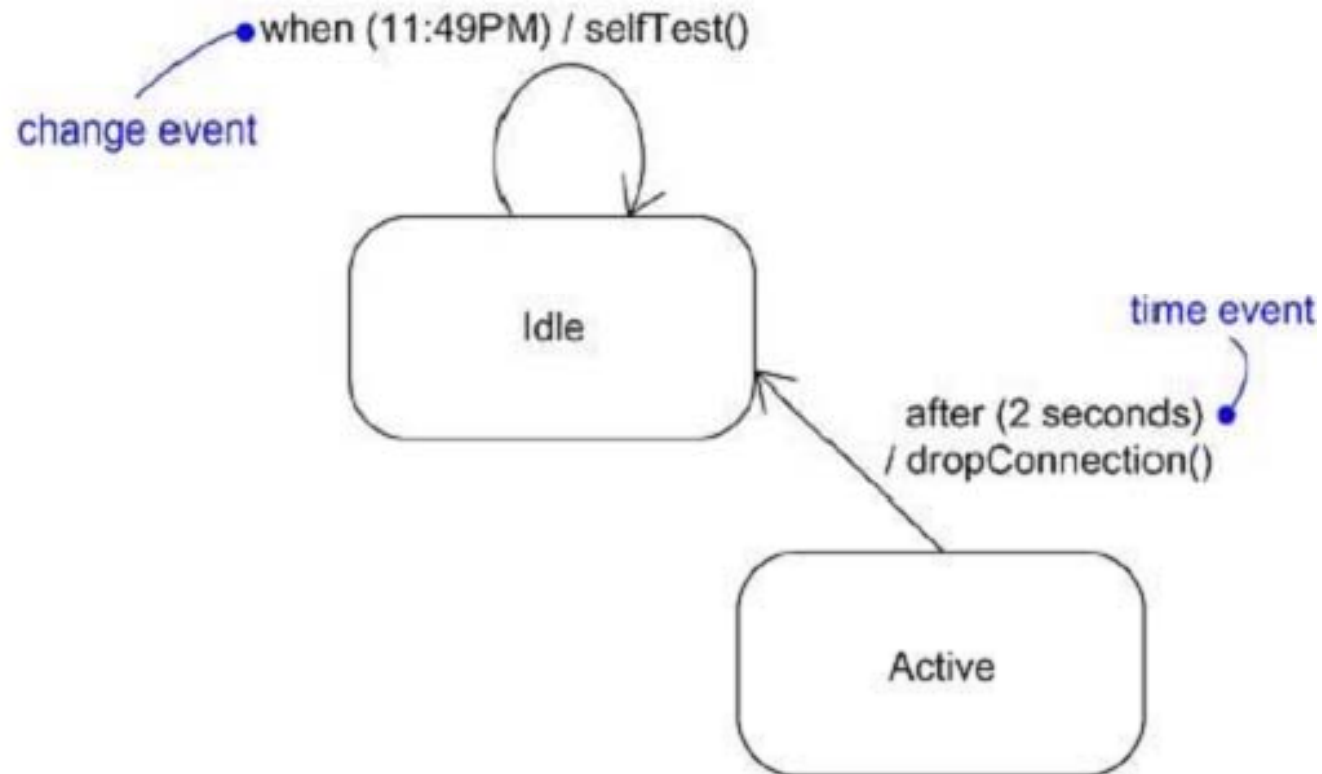
- A **signal** is an asynchronous event, a **call event** is, in general, synchronous, that when an object invokes an operation on another object that has a state machine, control passes from the sender to the receiver, the transition is triggered by the event, the operation is completed, the receiver transitions to a new state, and control returns to the sender.



## Time and Change Events

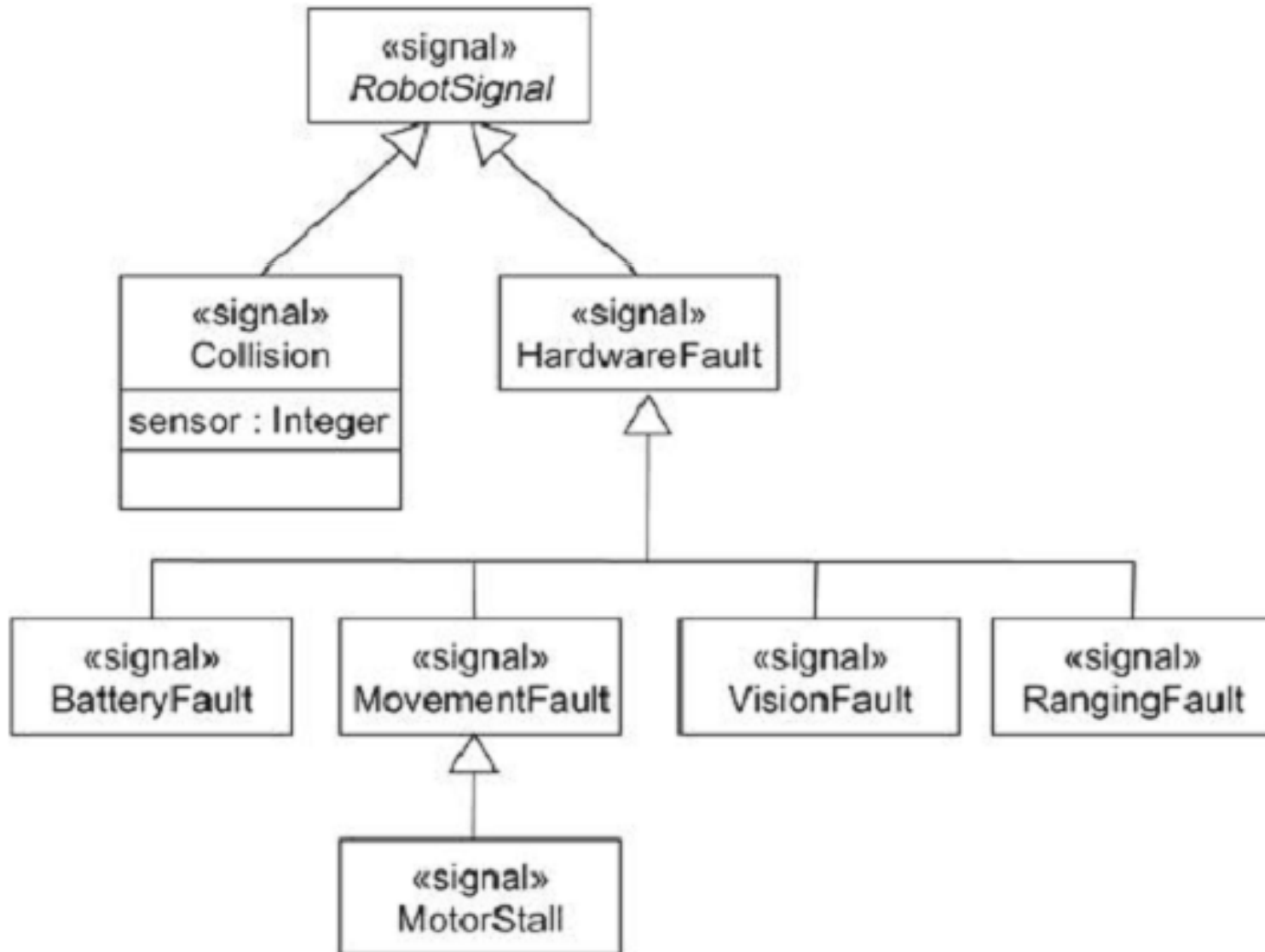
A time event is an event that represents the passage of time.

A change event is an event that represents a change in state or the satisfaction of some condition.

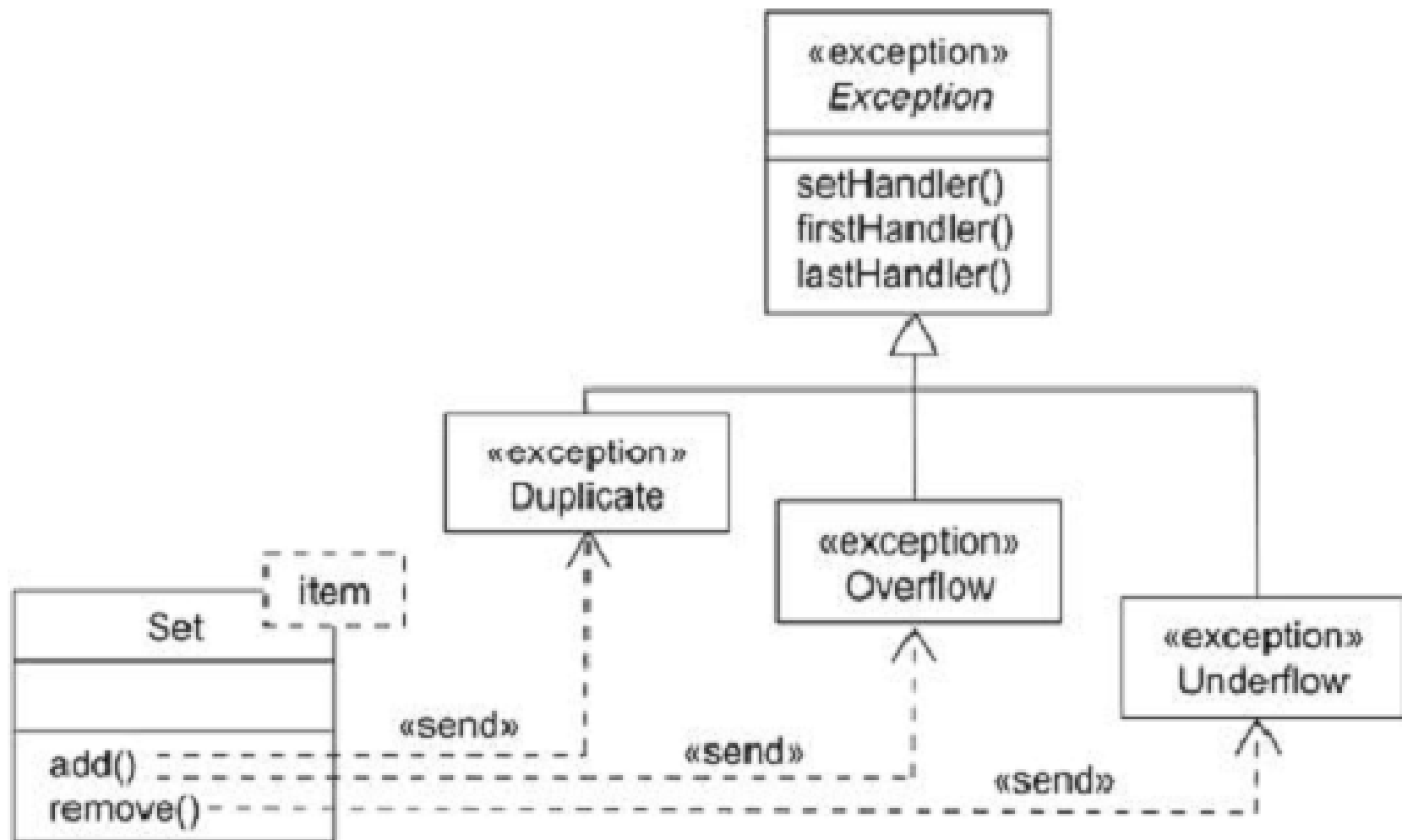


# Common Modeling Techniques

## Modeling a Family of Signals



## Modeling Exceptions



# State Machines

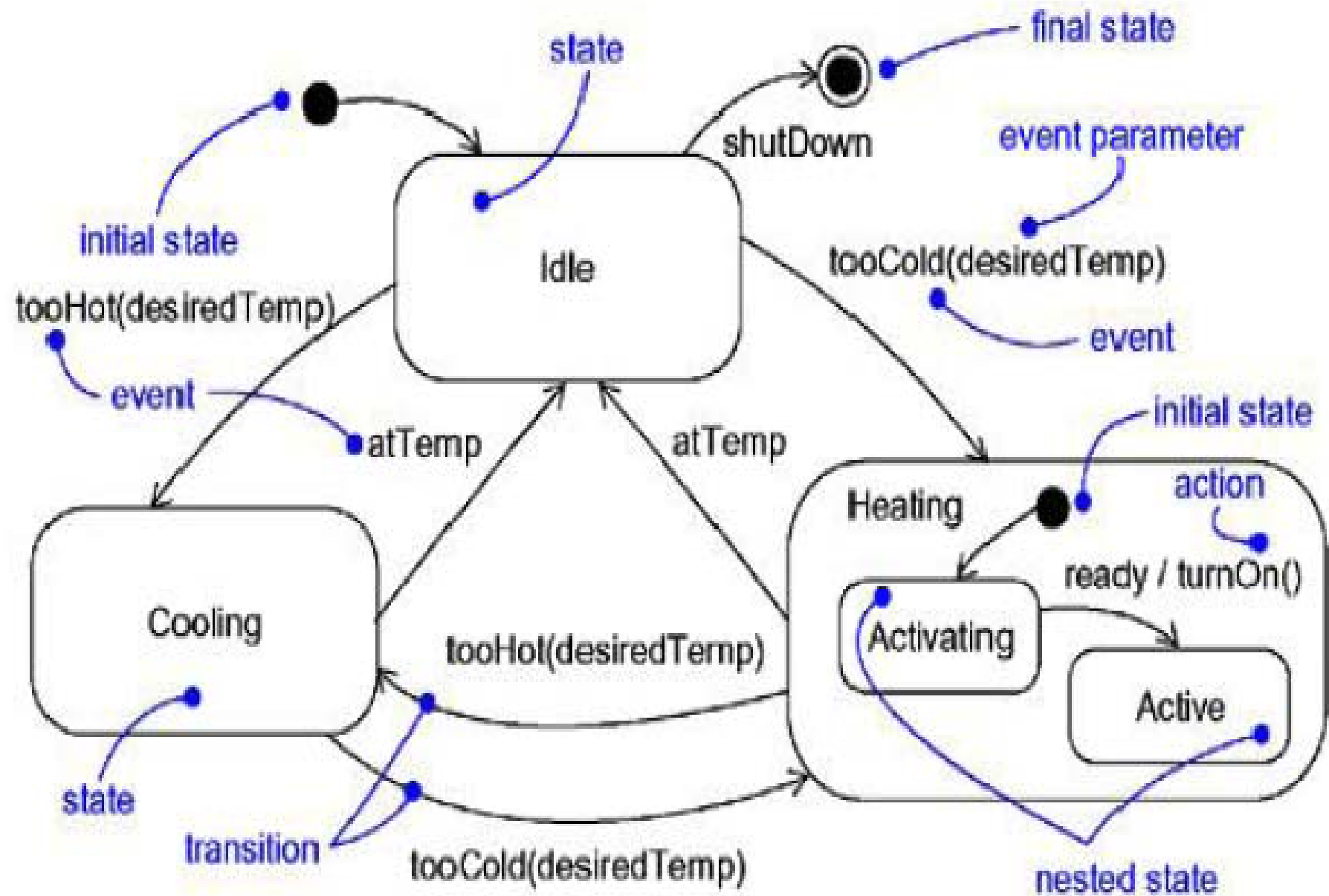
- States, transitions, and activities
- Modeling the lifetime of an object
- Creating well-structured algorithms

A **state machine** is a behavior that specifies the sequences of states an object goes through during its lifetime in response to events, together with its responses to those events.

A **state** is a condition or situation during the life of an object during which it satisfies some condition, performs some activity, or waits for some event.

An **event** is the specification of a significant occurrence that has a location in time and space.





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.

An ***activity*** is ongoing non-atomic execution within a state machine.

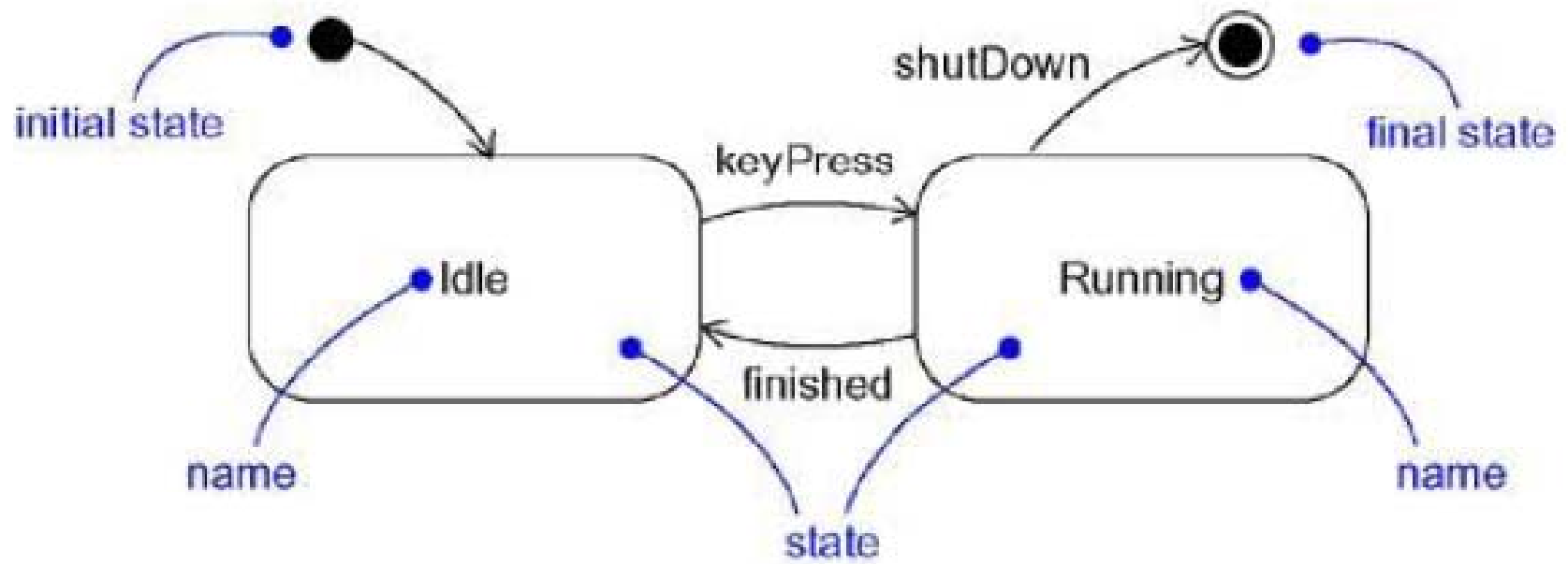
An ***action*** is an executable atomic computation that results in a change in state of the model or the return of a value.

## **States**

A state is a condition or situation during the life of an object during which it satisfies some condition, performs some activity, or waits for some event.

A state has several parts.

1. Name - A textual string that distinguishes the state from other states; a state may be anonymous, meaning that it has no name.
2. Entry/exit actions - Actions executed on entering and exiting the state, respectively.
3. Internal transitions - Transitions that are handled without causing a change in state
4. Substates - The nested structure of a state, involving disjoint (sequentially active) or concurrent (concurrently active) substates.
5. Deferred events - A list of events that are not handled in that state but, rather, are postponed and queued for handling by the object in another state



## 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.

A transition has five parts.

1. **Source state** – initial state of the object, states gets with respect to the guard condition or triggered event of the transition.
2. **Event trigger** - The event whose reception **by the object in the source state makes the transition eligible to fire**, providing its guard condition is satisfied.
3. **Guard condition** - A Boolean expression
4. **Action** - An executable atomic computation that may directly act on the object that owns the state machine, and indirectly on other objects that are visible to the object
5. **Target state** - The state that is active after the completion of the transition

# CONCURRENT SUBSTATES

