Game States

Image source: http://www.hutonggames.com/, 2014

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Conceptual Clarification

- What is the “Game State”?
  - The term *game state* is ambiguous!

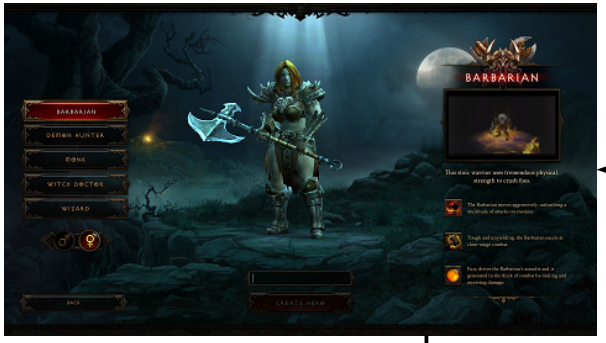
- **Meaning A:** The term *game state* refers to the current state of all dynamic game world elements, taken as a whole.
  - Each dynamic element changes its state over time.
    - E.g. location, orientation, internal attributes, etc.
  - Each entity might have its own *state machine*.
  - A save game can be created by serializing the current *game state.*

- **Meaning B:** The *game state* is the current logical state of the game.
  - E.g. menu, loading, gameplay, cutscene, QTE, boss battle, etc.
  - The *game state* is the active state of the game's *state machine*.

quicktimeevents

Example: Diablo III

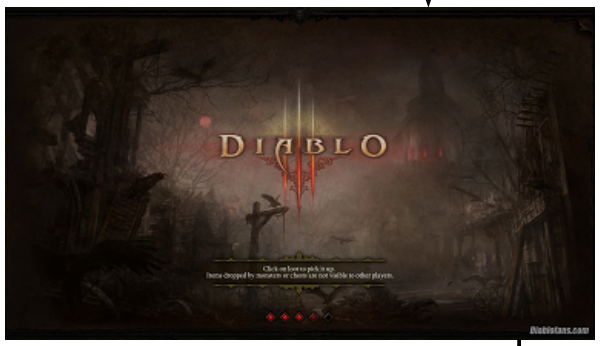
Character Selection



Main Menu

Options Menu

Loading Screen

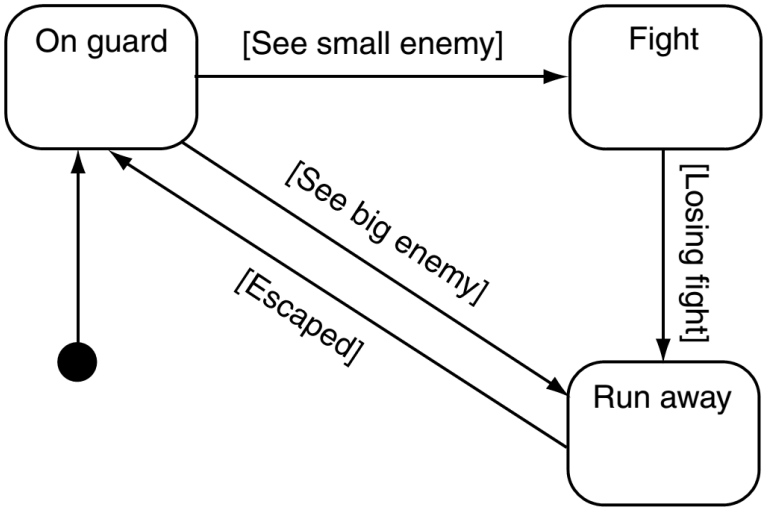


Boss Battle

Gameplay

Conversation

Simple State Machines

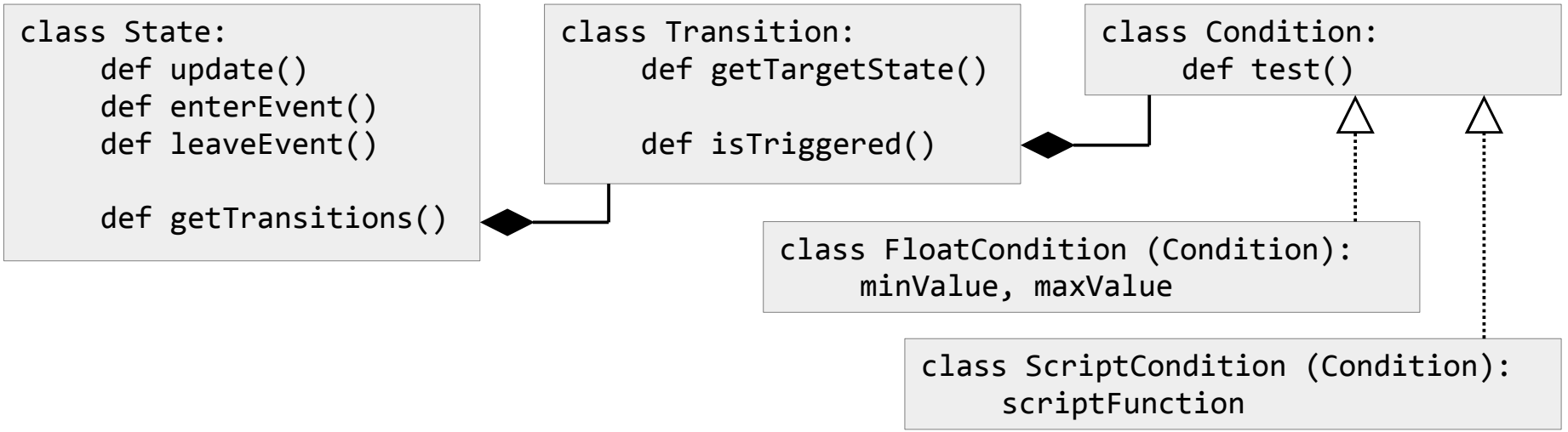



```
states = { OnGuard = 1, Fight = 2, RunAway = 3 }
state = states.OnGuard
function update()
  if (state == states.OnGuard) then
    if (seeSmallEnemy()) then state = states.Fight return end
    if (seeBigEnemy()) then state = states.RunAway return end
    -- TODO on guard
  elseif (state == states.Fight) then
    if (loosingFight()) then state = states.RunAway return end
    -- TODO fight
  elseif (state == states.RunAway) then
    if (escaped()) then state = states.OnGuard return end
    -- TODO run away
  else
    error("invalid state " .. state)
  end
end
```

- Potential problems
  - Can become very complex and difficult to maintain
  - Available transitions are not defined → any transition is always possible
  - States have no defined “enter” or “leave” events
  - The update can be interrupted at any time
  - Multiple state changes can be performed within a single update call

Finite State Machines (FSMs) (1/2)

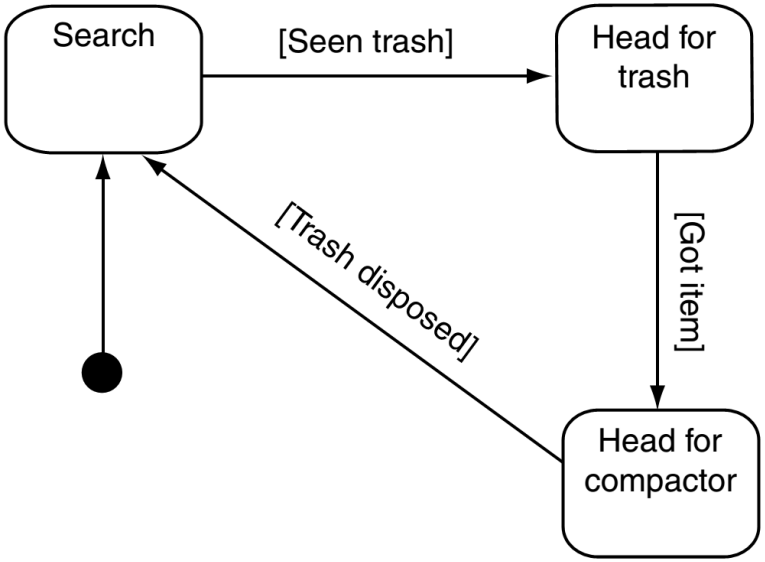
- A FSM is a mathematical model of computation used to design both computer programs and sequential logic circuits.
  - It's an abstract machine that can be in one of a finite number of *states*.
  - The *state* it is in at any given time is called the *current state*.
  - It can change from one state to another when initiated by a triggering event or *condition*; this is called a *transition*.
  - A particular FSM is defined by a list of its *states*, and the triggering *condition* for each *transition*.
- Data structures and interfaces (pseudo code)

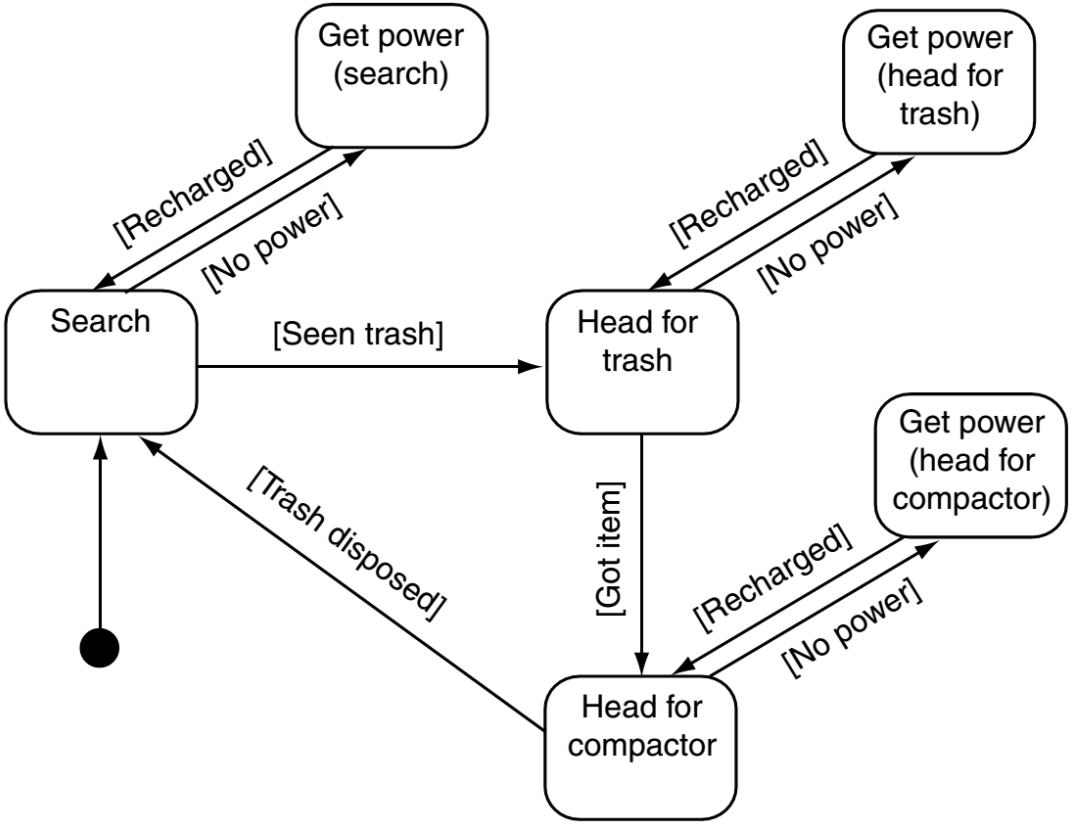


Hierarchical State Machines (1/2)

- It can be difficult to express certain behaviors with state machines.
  - E.g. *Alarm mechanism*: something that interrupts normal behavior to respond to something important.

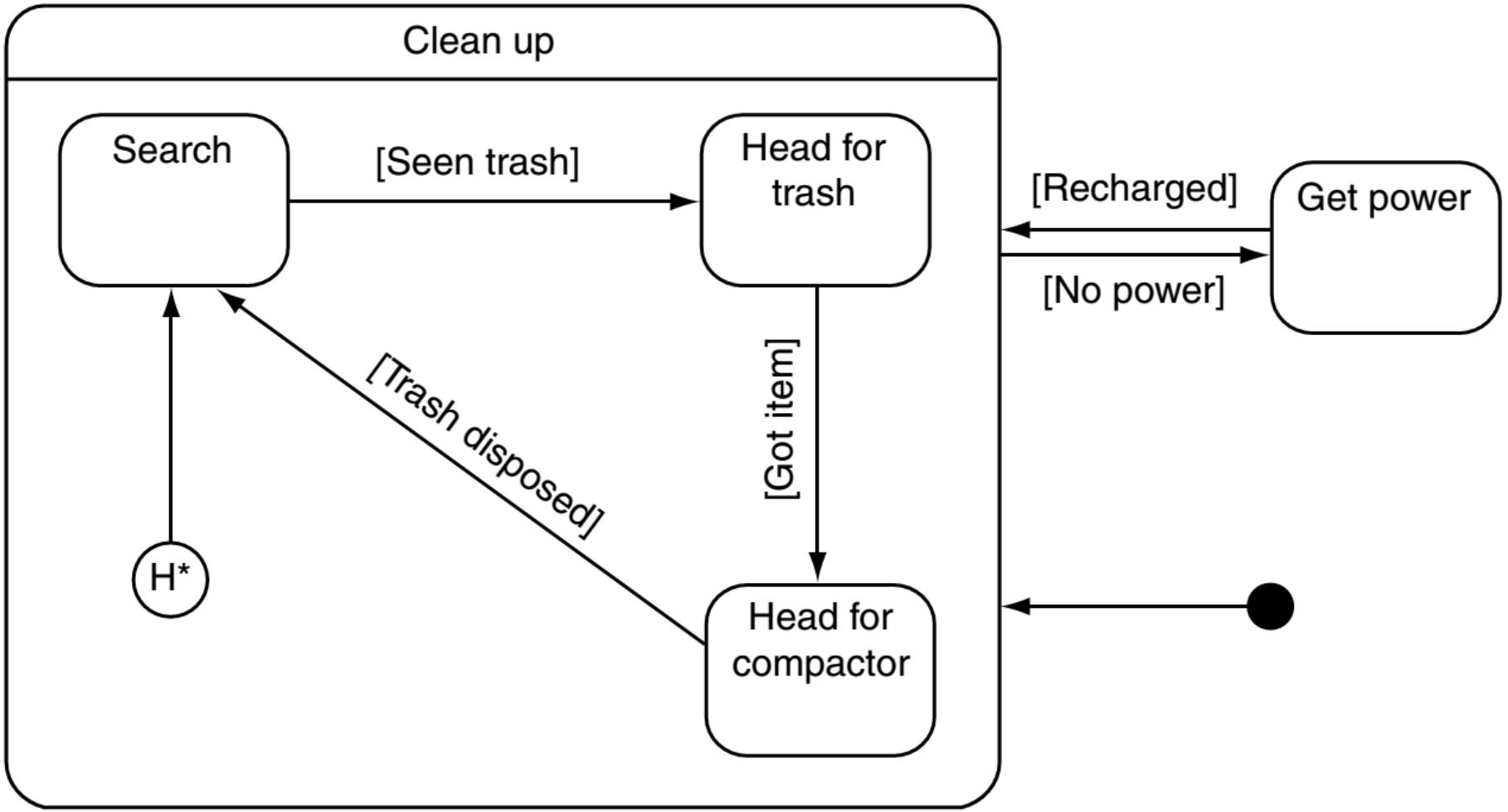
    => The number of states is multiplied, with each level of alarm!





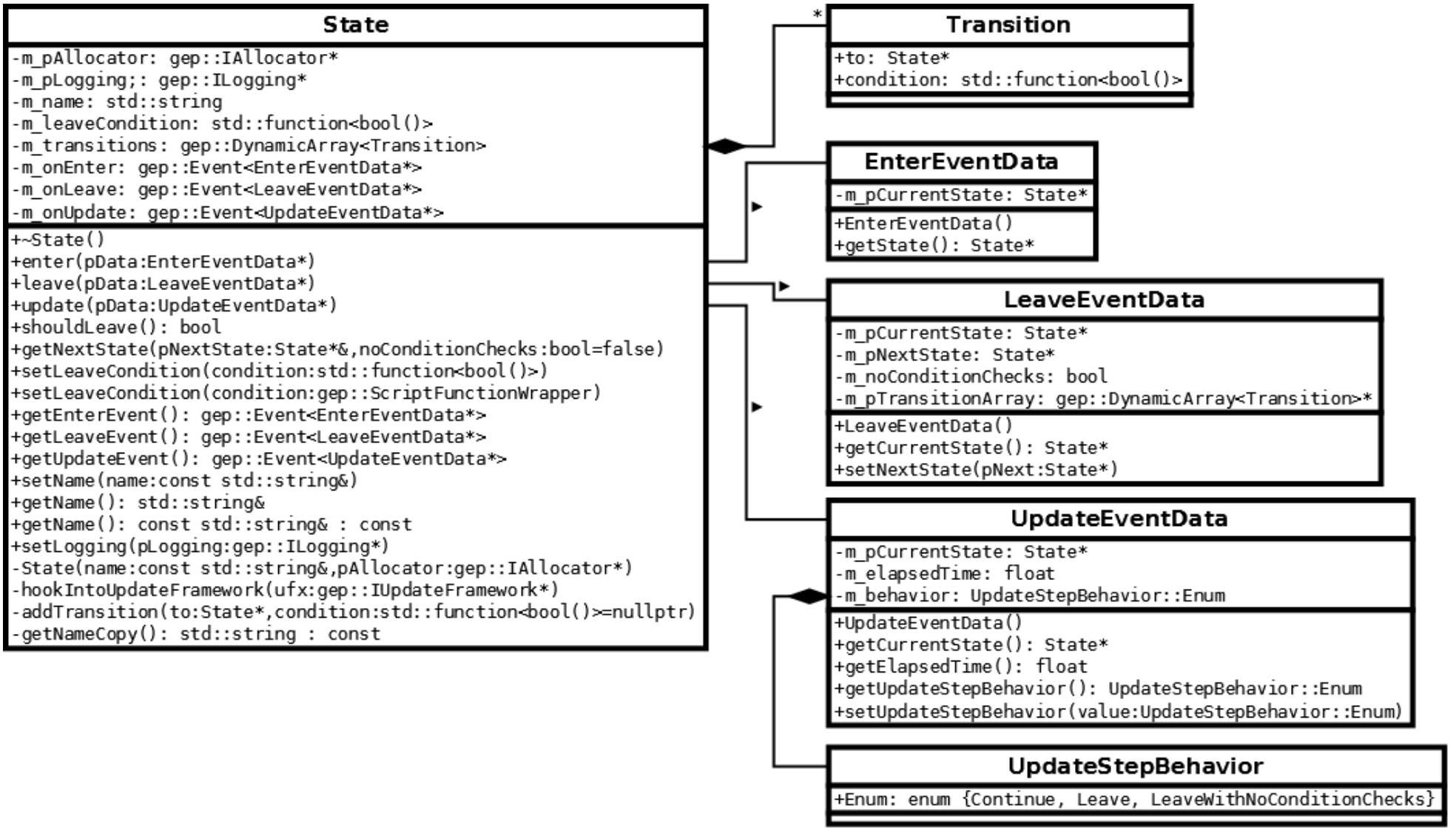
Hierarchical State Machines (2/2)

- Rather than having separate states to keep track of the non-alarm state, we introduce *nested states*.



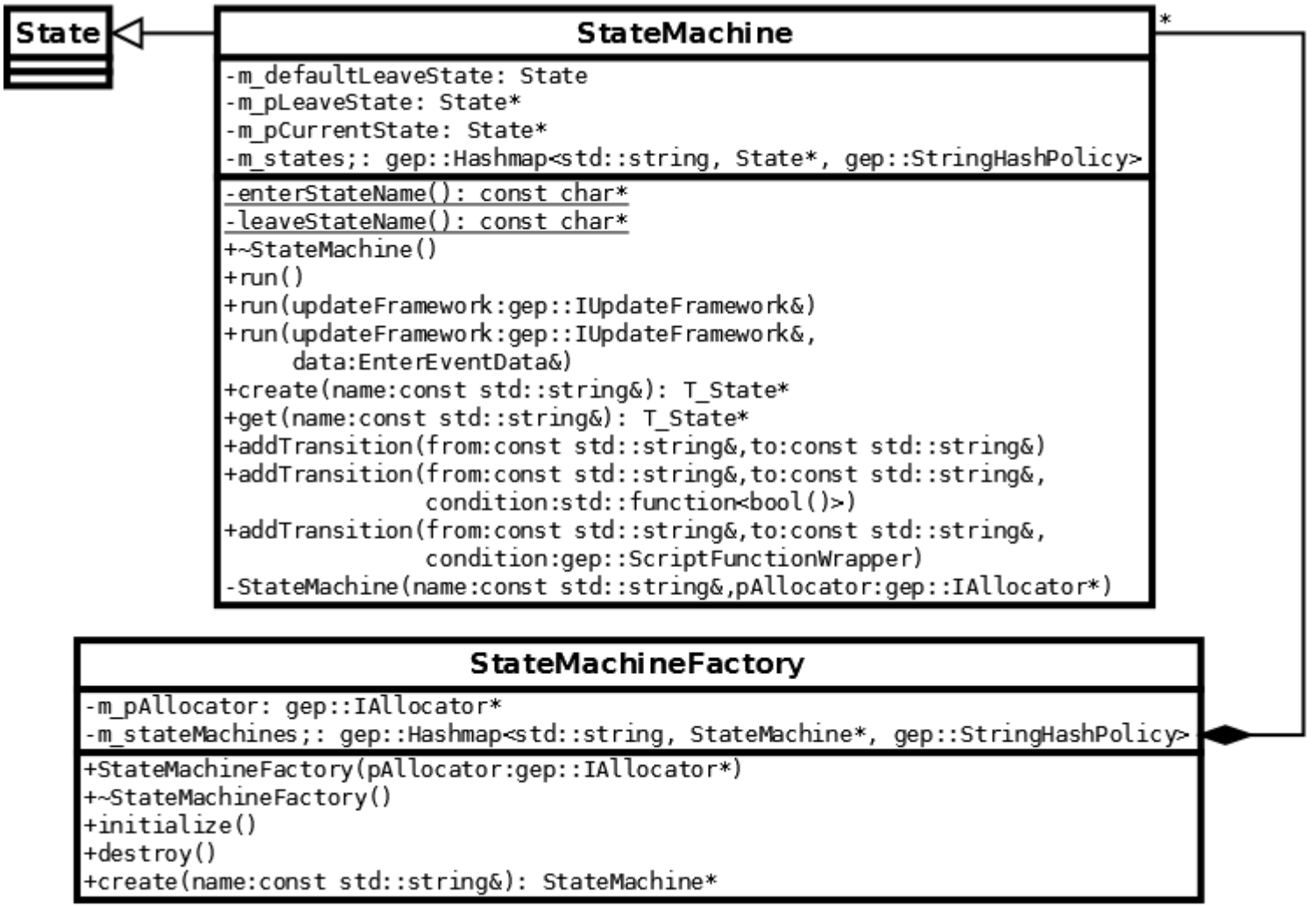
GPP State Machines (1/2)

- States, Conditions, Transitions, and Events



GPP State Machines (2/2)

- State Machines and State Machine Factory



Example: Dark Souls II → Enemies

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