State Pattern

Thursday, October 30, 2025   7:57 PM

⚙️ STATE PATTERN LEARNING ROADMAP

Goal: Go from beginner → intermediate → project-ready mastery in C++.

✴️ PHASE 1 — Foundations (Beginner)

Focus: Core mechanics, polymorphic state switching, simple transitions.

🔷 Topics
1. Concept & motivation of State Pattern
2. Abstract State class + Context delegation
3. Dynamic transitions (setState)
4. Entry / exit actions
5. Invalid transition guards
6. Shared data in context
7. Time-driven transitions
8. Enum vs class-based states
9. Immutability of context logic
10. Basic diagrams & modeling

🧠 Examples (Guided)
1. Lamp On / Off
2. Fan Speed Controller
3. Music Player (Play / Pause / Stop)
4. Door (Open / Close / Lock)
5. Battery Charging (Idle / Charging / Full)
6. Traffic Light (Timed)
7. Printer (Idle / Printing / Error)
8. Vending Machine (Idle / Accepting / Dispensing)
9. Microwave Oven (Idle / Cooking / Done)
10. Simple Stopwatch

✴️ Exercises (You do)
1. Coffee Machine
2. Elevator
3. ATM
4. Washing Machine
5. Heater
6. Smartphone Profile Manager
7. Garage Door
8. Toaster
9. Drone Battery
10. Basic Thermostat

🧠 PHASE 2 — Intermediate Systems

Focus: Timers, nested states, event-driven transitions, observers.

🔷 Topics
1. Event queues & event-driven design
2. Timers & delayed transitions
3. Hierarchical (sub)states
4. Observer + State combos
5. Command + State
6. Singleton states
7. Saving / restoring state (Memento)

8. Combining Strategy & State
9. Dependency injection into states
10. Composite context (multi-component systems)

🧠 **Examples (Guided)**
1. Advanced Traffic Light (Emergency + Timed)
2. Car Transmission (Park / Drive / Reverse / Neutral)
3. Phone Call (Ringing / Talking / Ended)
4. Printer Queue with Error Handling
5. Media Player with Buffering / Seek / Error
6. AI Character (Patrol / Chase / Attack)
7. Vending Machine Pro (Stock / Change / Maintenance)
8. File Downloader (Connecting / Downloading / Failed / Completed)
9. Smart Light (Color / Brightness / Network)
10. Security System (Armed / Disarmed / Alarm)
11. Game Character (Idle / Jump / Attack)
12. Network Connection (Connecting / Connected / Failed)
13. Smart Oven (Preheat / Bake / Done)
14. Bank Account (Active / Overdrawn / Closed)
15. Elevator with Maintenance Mode
16. Thermostat (Cooling / Heating / Idle)
17. Notification Center (Delivering / Waiting)
18. Drone Controller
19. Power Management System
20. Workflow Manager

🍀 **Exercises (You do)**
20 creative variations — design & code small state systems yourself (e.g. Drone flight, Music streamer with buffering, Chat connection handler, etc.)

🚀 PHASE 3 — Applied Projects (20 mini-projects)

Focus: Realistic, multi-component state machines combining timers, events, and persistence.

💡 **Projects**
1. Traffic Control System
2. Smart Home Network
3. Robot Vacuum (Idle / Cleaning / Charging)
4. ATM Full Simulation
5. Elevator Building Controller
6. Car Dashboard Simulation
7. Game NPC AI (Patrol / Alert / Combat)
8. Media Streaming Client
9. Power Grid Node Controller
10. Smart Oven with Recipes
11. Chatbot Conversation Flow
12. Workflow Engine
13. Online Order Tracker
14. Ticket Booking Flow
15. Game Menu State Machine
16. Drone Flight System
17. Bluetooth Connection Manager
18. Airport Traffic Simulation
19. Robot Arm Controller
20. Mini OS Power States