

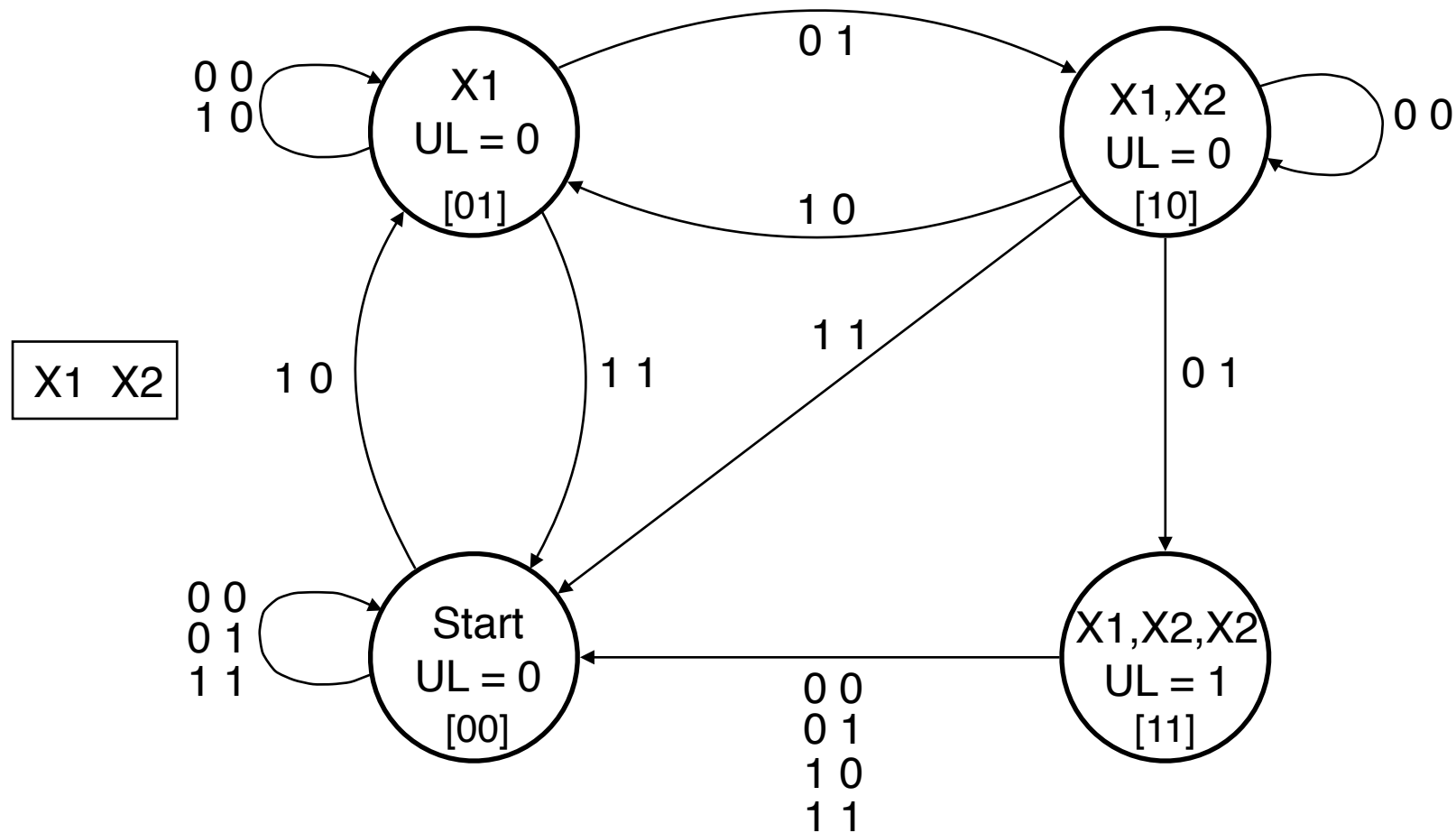
ECE 2300
Digital Logic & Computer Organization
Fall 2016

Factoring FSMs
Analyzing FSMs



Cornell University

Pushbutton Lock: Moore State Diagram



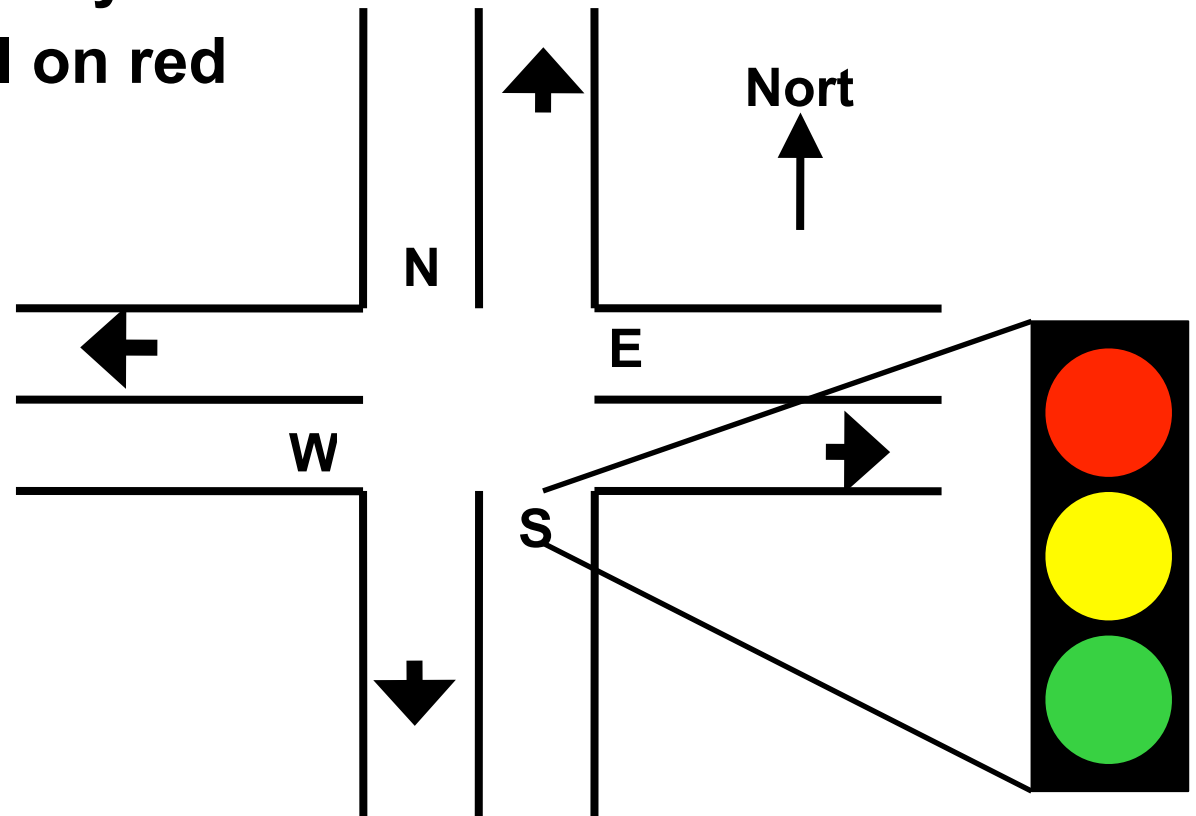
Next State *always* Block

Output *always* Block

State FFs *always* Block

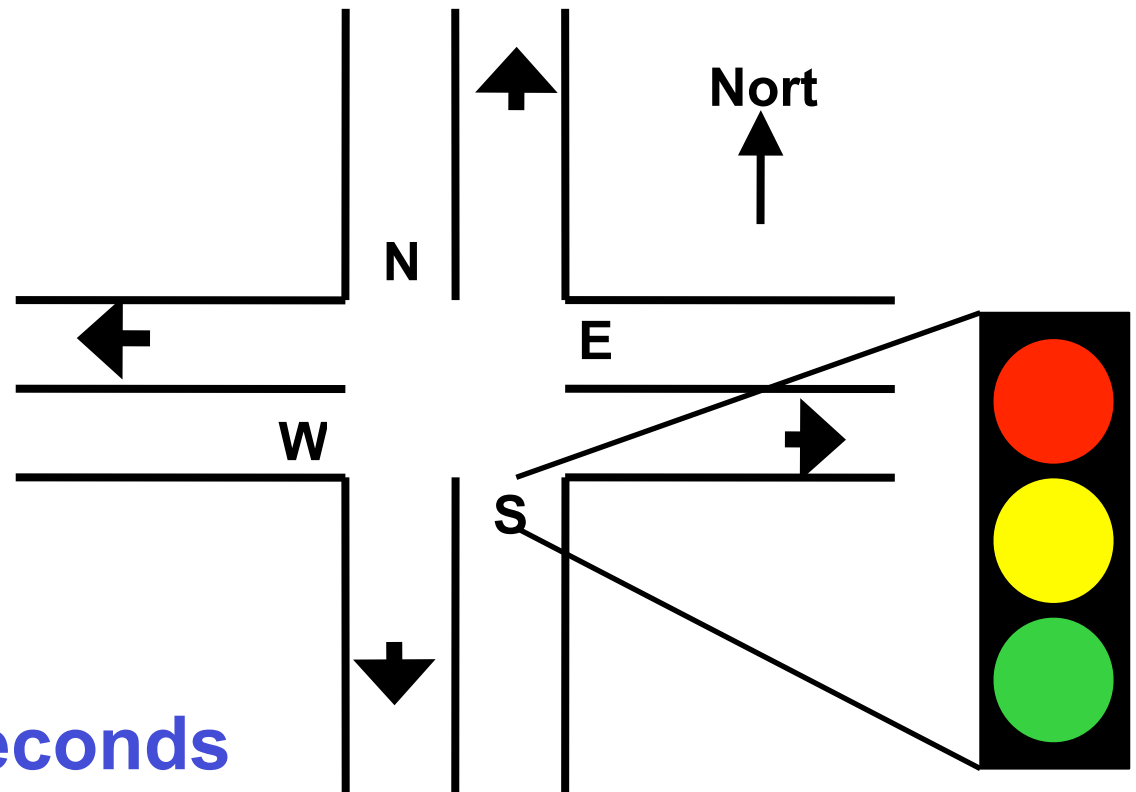
Traffic Light Controller

- 4-way intersection with traffic lights
- Opposing lanes sequence together
 - 20 seconds dwell on green
 - 5 seconds dwell on yellow
 - 25 seconds dwell on red



Traffic Light Controller States

- E & W Green / N & S Red for 20 seconds
- E & W Yellow / N & S Red for 5 seconds
- E & W Red / N & S Green for 20 seconds
- E & W Red / N & S Yellow for 5 seconds



- Clock period = 5 seconds

Traffic Light Controller States

- **10 states**

- E & W Green / N & S Red1 for 5 seconds
- E & W Green / N & S Red2 for 5 seconds
- E & W Green / N & S Red3 for 5 seconds
- E & W Green / N & S Red4 for 5 seconds

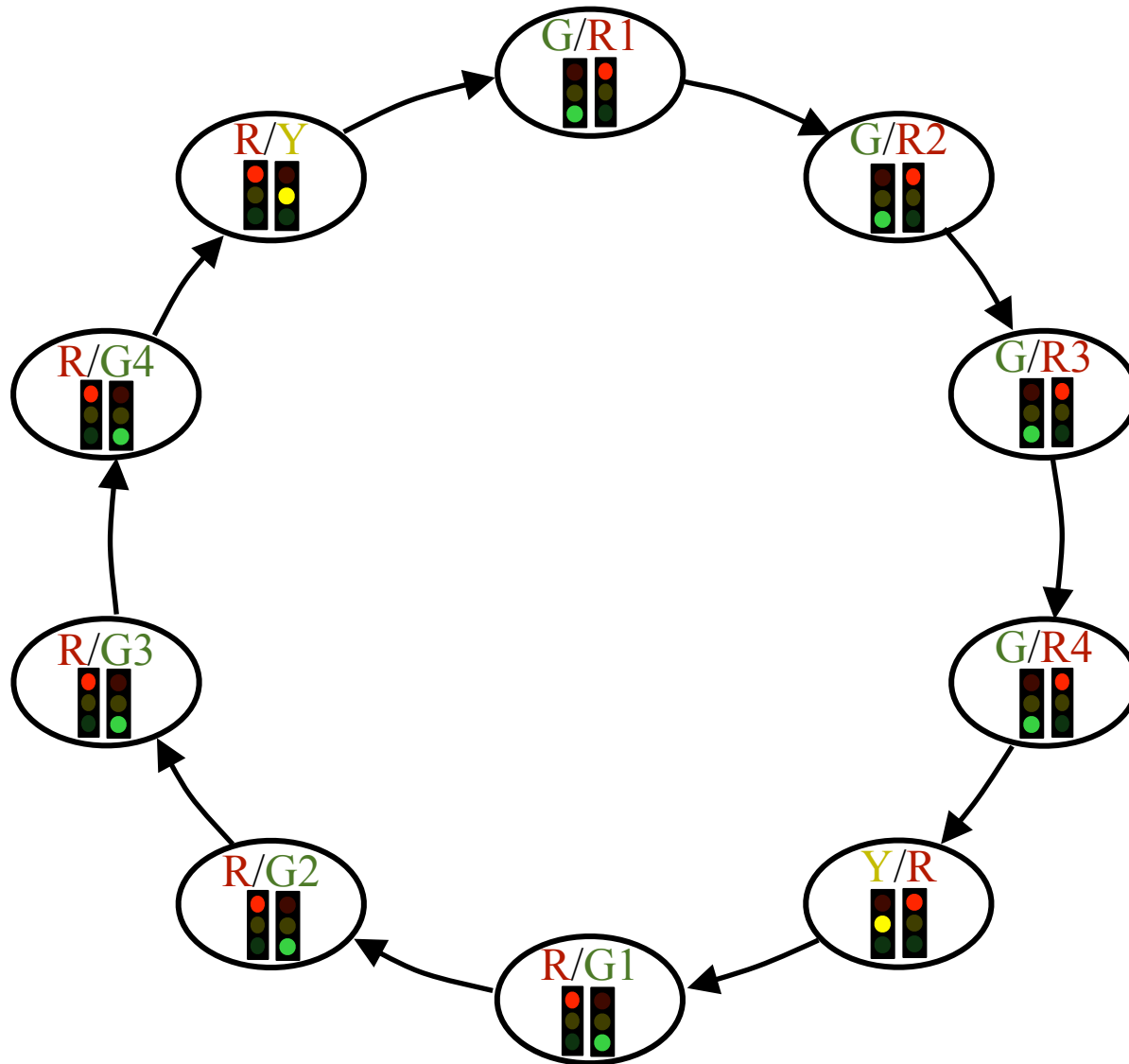
} 4 clock periods

- E & W Yellow / N & S Red for 5 seconds
- E & W Red / N & S Green1 for 5 seconds
- E & W Red / N & S Green2 for 5 seconds
- E & W Red / N & S Green3 for 5 seconds
- E & W Red / N & S Green4 for 5 seconds

} 4 clock periods

- E & W Red / N & S Yellow for 5 seconds

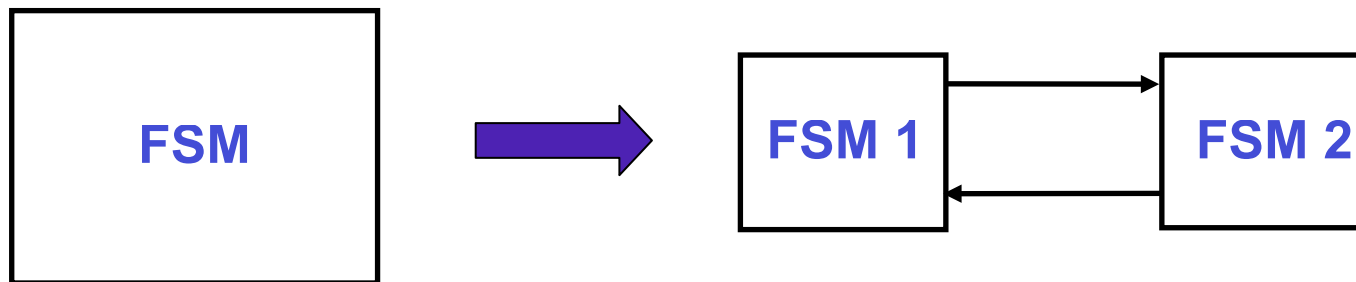
Traffic Light Controller FSM



State (EW/NS)
Outputs

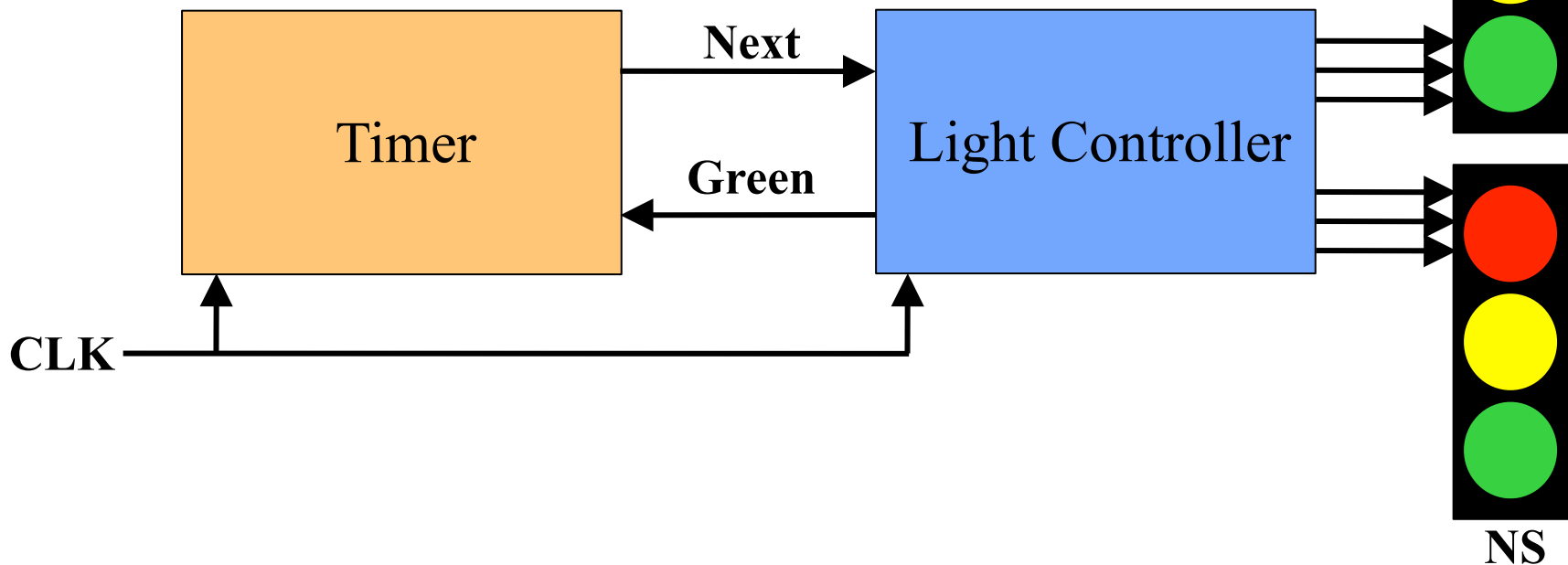
Factoring FSMs

- Break FSM into multiple communicating FSMs
- Simplifies large FSMs
- May result in fewer states

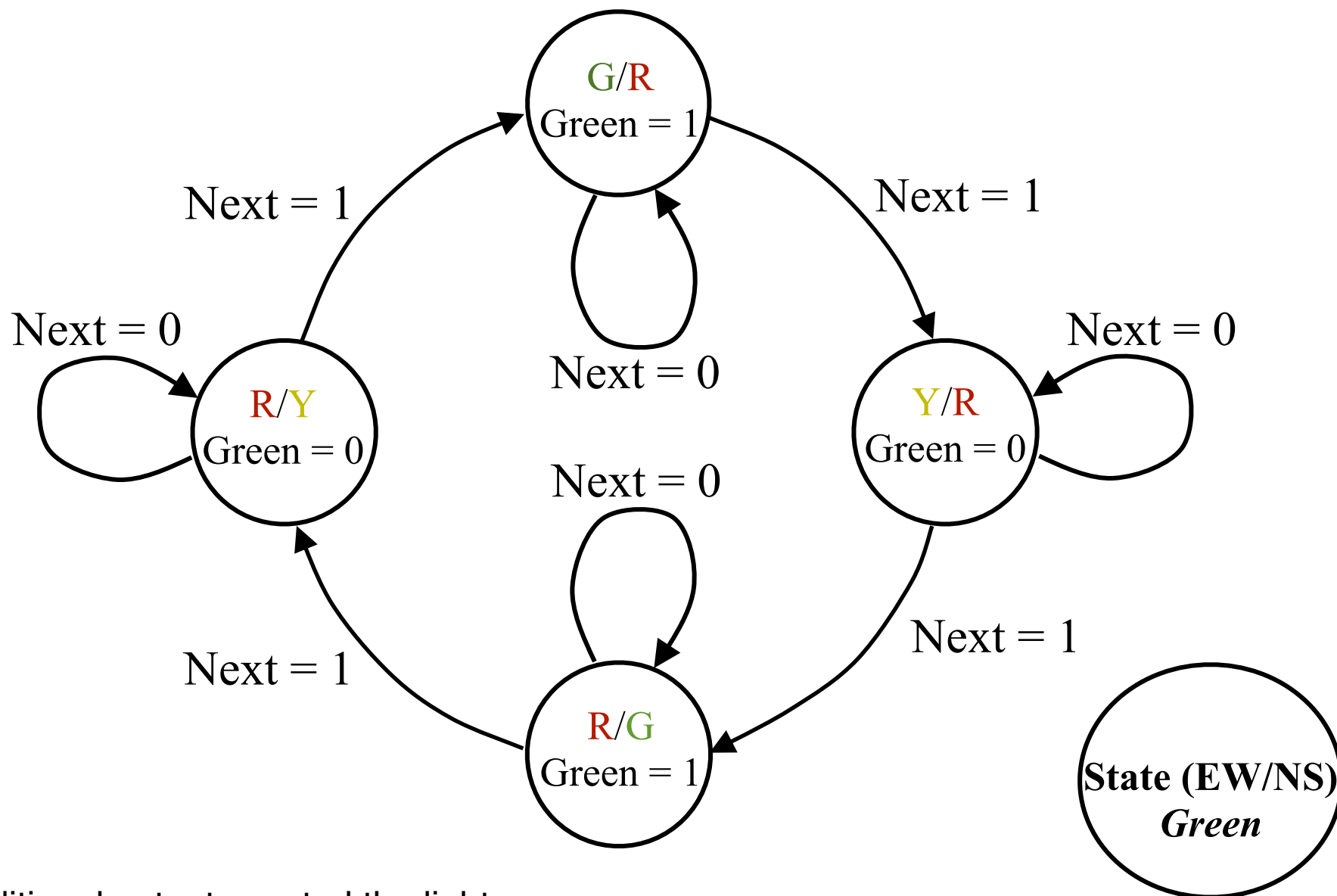


Traffic Light Controller Using 2 FSMs

- Light Controller FSM has 4 states
 - G/R, Y/R, R/G, R/Y
- Timer FSM controls when the LC FSM advances to the next state
 - Keeps LC in *Green* states for 4 clock cycles

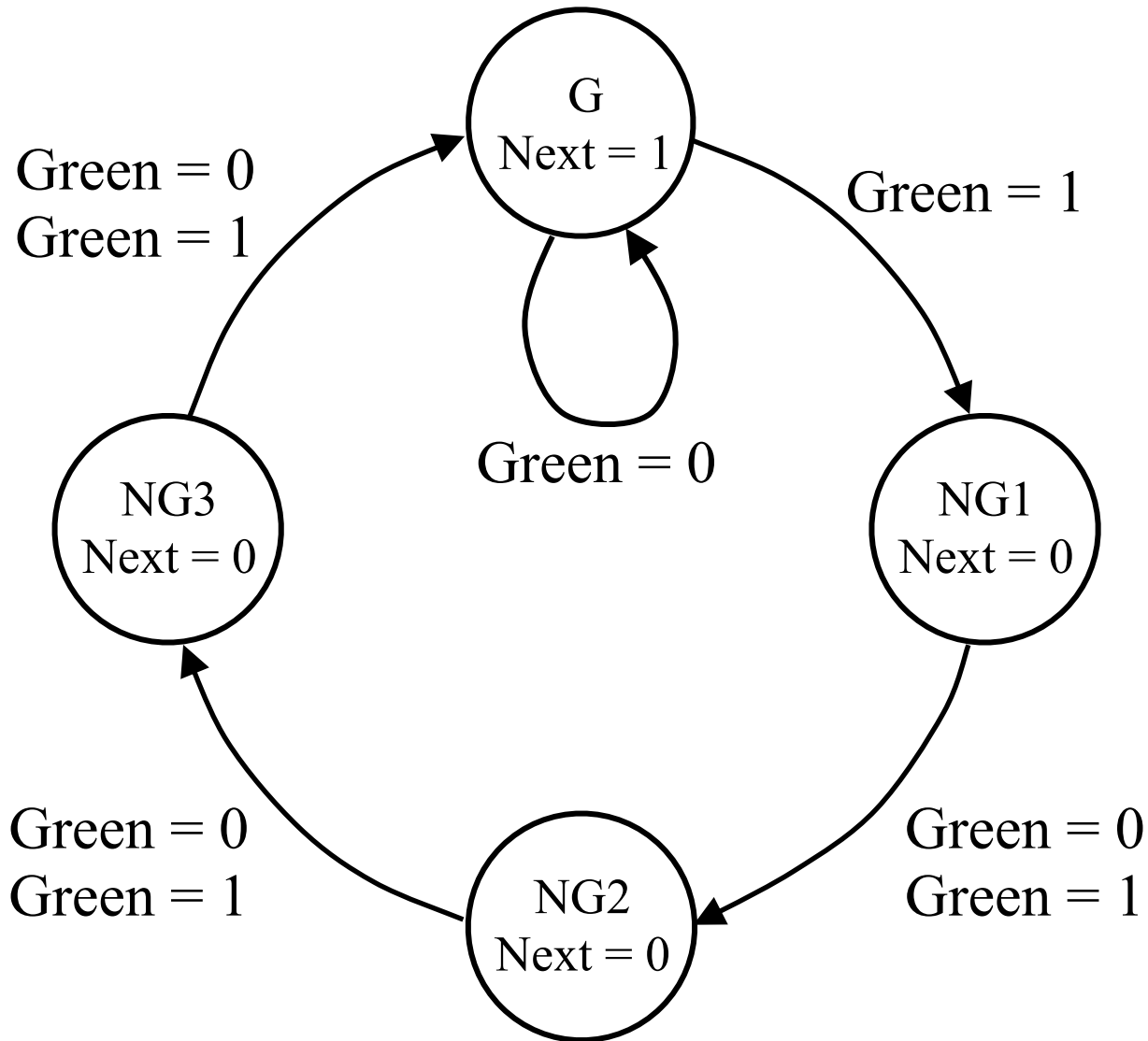


Light Controller FSM

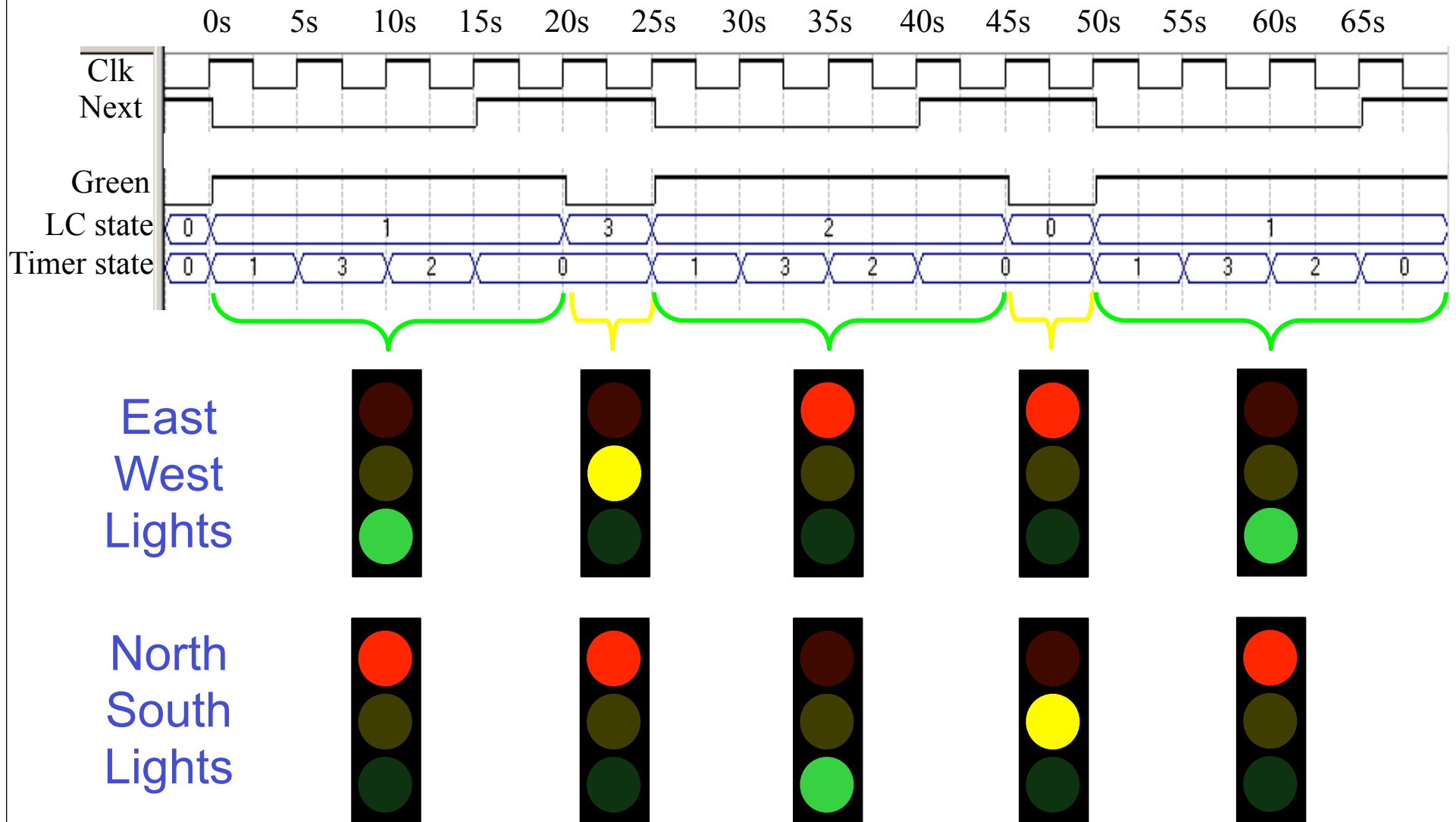


Additional outputs control the lights

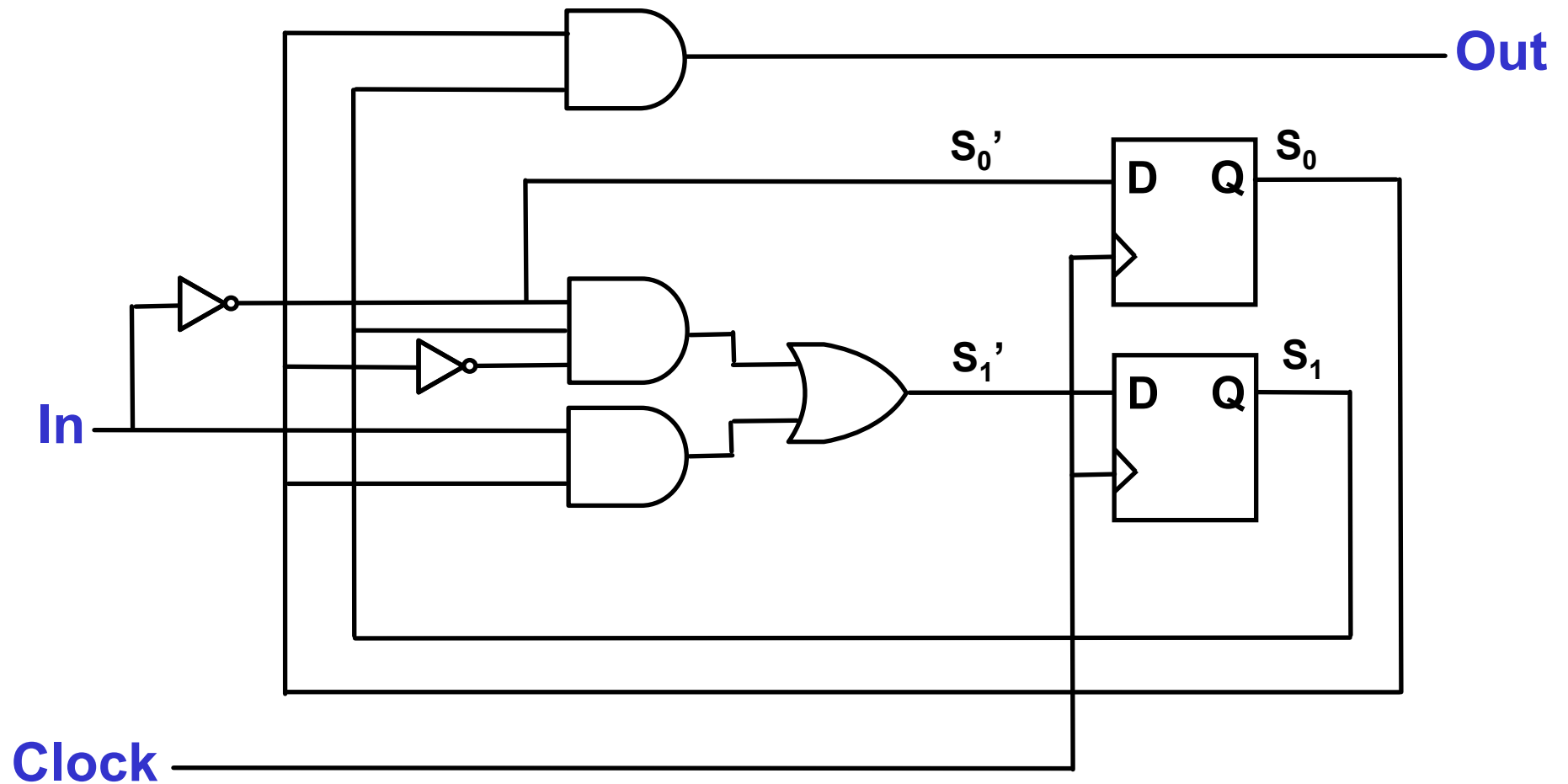
Timer FSM



Traffic Light Controller Operation



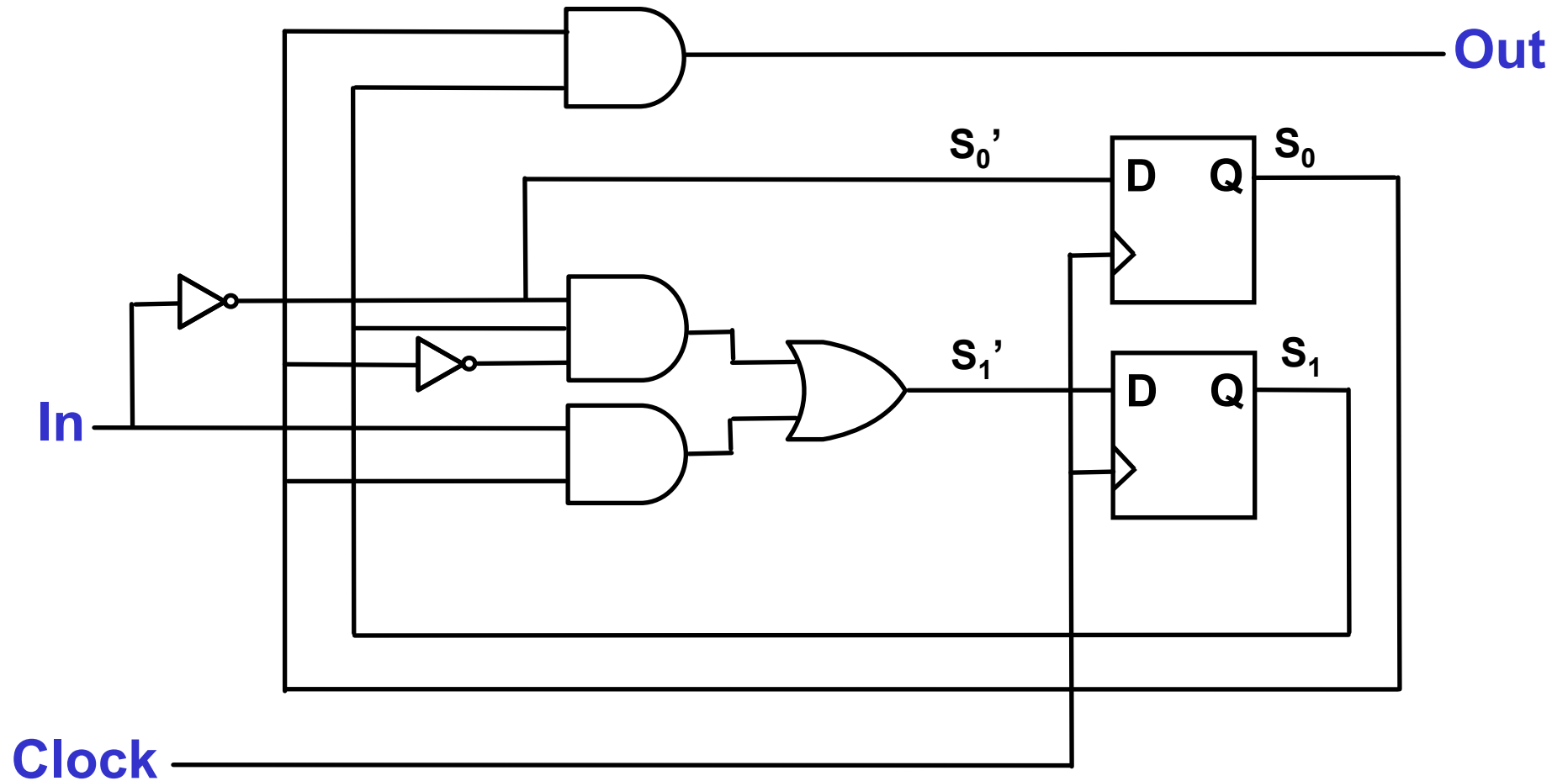
What Does This Circuit Do?



Steps to Analyzing a FSM

- (1) Write the Boolean equations for next state (transition equations) and the outputs**
- (2) Determine if it is a Moore or Mealy machine**
- (3) Create the Transition/Output Table**
- (4) Draw a state diagram**
- (5) Determine the function of the FSM and give description names to states**

Analyzing the FSM



Transition and Output Equations

Transition/Output Table

State Diagram

Before Next Class

- H&H 2.9, 3.5-3.5.5

Next Time

Hazards, Clocking, Timing