

Finite State Machines

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- State
 - In order for a rotary lock to work, it has to keep track (remember) past events
 - If the passcode is R13-L22-R3, the sequence of states to unlock is:
 1. The lock is not open (locked), and no relevant operation has been performed
 2. Locked but user has completed R13
 3. Locked but user has completed R13-L22
 4. Unlocked: user has completed R13-L22-R3
 - A state diagram completely describes the operation of a sequential logic circuit
 - Another example of state is a traffic light
 - A standard Swiss traffic light has 4 states
 1. Green
 2. Yellow
 3. Red
 4. Red and Yellow
 - The sequence of these states is always as follows: $A \rightarrow B \rightarrow C \rightarrow D \rightarrow A$
 - When should the light change from one state to another?
 - * We need a clock to indicate this
 - * At the start of a clock cycle, the system changes state
 - During a clock cycle, the state always stays constant
- Changing State: The Notion of Clocks
 - Clock is a general mechanism that triggers transition from one state to another in a sequential circuit
 - Clock synchronizes state changes across many sequential circuit elements
 - Combinational logic evaluates for the length of the clock cycle
 - Clock cycle should be chosen to accommodate maximum combinational circuit delay
- Finite State Machines
 - What is a Finite State Machine (FSM)?
 - * A discrete-time model of a stateful system
 - An FSM can model
 - * A traffic light, an elevator, fan speed, a microprocessor, etc.
 - Five Elements:
 - * A finite number of states

- * A finite number of external inputs
- * A finite number of external outputs
- * An explicit specification of all state transitions
- * An explicit specification of what determines state
- Each FSM consists of three separate parts
 - * Next state logic
 - * State register
 - * Output logic
- Moore vs. Mealy FSMs
 - * Next state is determined by the current state and inputs
 - * Two types of finite state machines differ in the output logic:
 - Moore FSM: outputs depend only on the current state
 - Mealy FSM: outputs depend only on the current state and the inputs