Trad: Desigining Sociotechnical Systems (Group C)

Nirav Ajmeri

Scenario

When Alice falls sick, Bob as her parent takes her to a hospital. Bob also works under Steve who expects him to work during business hours. On one day Alice fell sick during Bob's work hours. Bob disregards his employer's expectation in light of the medical emergency involving his ward.

Finite State Machine

To model the behavior of a system, we use *state machines*. State machines indicate different states of a system at different times. The *state* of a system is considered as behavior of a system at any given time. A system can change from one state to another by triggering an action or an event. We call this action or event as a *transition*. Examples of state machines include vending machines, elevators, traffic lights, combination locks, and so on.

A finite state machine has the following properties

- The system must have finite number of states (S)
- The system has a particular initial state (s_0)
- The system must have finite number of inputs or events that can trigger transitions between states ($\sum$)
- The behavior of a system at the given time depends on the current state and the input or event that occur at that time
- The system has a set of final states (F)
- The state transition function is δ: S $\times \sum \rightarrow$ S

Consider an example of a turnstile that has two states: S = $\langle$Locked, Unlocked$\rangle$. There are two inputs: $\sum = \langle$coin, push$\rangle$. Coin indicates putting a coin in the slot. Push indicates pushing the arm. Consider the initial state as the locked state. In the locked state, the arm of the turnstile cannot be moved irrespective of how many times the arm is pushed (δ: Locked $\times$ push $\rightarrow$ Locked). However, when a coin is put, the state of machine moves from the locked state to the unlocked state (δ: Locked $\times$ coin $\rightarrow$ Unlocked). Putting an additional coin doesn't change the state (δ: Unlocked $\times$ coin $\rightarrow$ Unlocked). Now, when the arm is pushed, the state again moves from the unlocked state to the locked state (δ: Unlocked $\times$ push $\rightarrow$ Locked). Figure 1 represents the state diagram for a turnstile with its states, inputs, and state transitions.

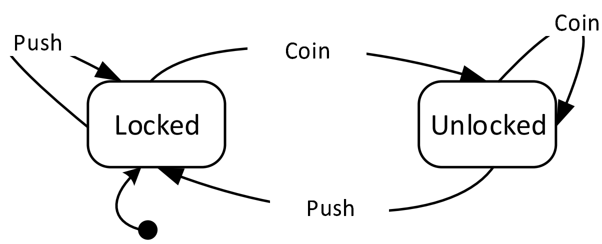

Figure 1: State diagram for a turnstile.

Deliverables

Your task is to carefully read and think of the nuances in the given scenario. Follow the methodology tutorial given to you, and

- Identify subscenarios from the scenario
- For each subscenario, create a state machine by identifying possible states (S), inputs ($\sum$), initial state (S_0), final state (F), and state transitions (δ)
- Create a state machine by combining state machines for each subscenario. In the combination process, you can create new states, inputs, state transitions, and final states.
- The final state machine can represent a specific set of transitions that cover the requirements in the scenario. It is not necessary to cover all possible set of transitions.

Solution

The subscenarios in the healthcare scenario are

- Bob takes Alice to a hospital, when Alice is sick
- Bob works for Steve during business hours
- Bob disregards Steve's expectation by taking Alice to a hospital during business hours

State machines for each subscenario are

- The state machine from the first subscenario has the following: S = $\langle$S$_1$, S$_2$, S$_3\rangle$, s$_0$ = S$_1$, $\sum$ = $\langle$sick, hospital$\rangle$, δ: S$_1$ $\times$ sick $\rightarrow$ S$_2$, S$_2$ $\times$ hospital $\rightarrow$ S$_3$
- The state machine from the second subscenario has the following: S = $\langle$S$_1$, S$_4$, S$_5\rangle$, s$_0$ = S$_1$, $\sum$ = $\langle$business hours, work$\rangle$, δ: S$_1$ $\times$ business hours $\rightarrow$ S$_4$, S$_4$ $\times$ work $\rightarrow$ S$_5$
- The state machine from the third subscenario has the following: S = $\langle$S$_1$, S$_6$, S$_7\rangle$, s$_0$ = S$_1$, $\sum$ = $\langle$business hours $\wedge$ sick, hospital$\rangle$, δ: S$_1$ $\times$ sick $\wedge$ business hours $\rightarrow$ S$_6$, S$_6$ $\times$ hospital $\rightarrow$ S$_7$, S$_6$ $\times$ work $\rightarrow$ S$_9$,

We obtain the final state machine as shown in Figure 2 by combining the above state machines.

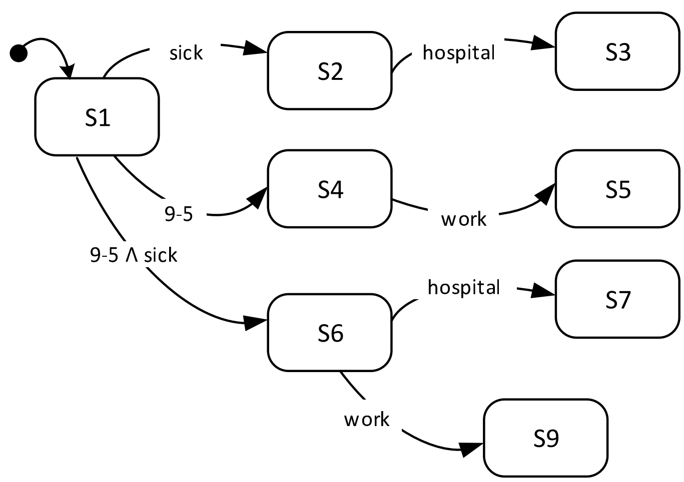

Figure 2: State diagram for the healthcare scenario.