CS-3252

Section 01

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Assignment #1 Finite Automata

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Read Section 2.1 ”An Informal Picture of Finite Automata (Protocols that support electronic money)

Describe informally (in a couple of pages) another application domain of finite automata

Another application domain of finite automata lies in mechanical devices. The best suited devices for examination are ones that are required to manage state, which facilitates the creation of distinct states in the finite automaton itself. A few prime examples are vending machines (the classic example of a finite state machine), elevators, and traffic lights.

For instance, vending machines, are required to manage an internal state of not only what items are available, and what change is available inside the machine (to correctly reimburse the user if an excess is entered) but also the current total of change that the user has entered thus far. In the slighlty less complex of example of elevators, the floors accessible to elevators can be represented with finite automata but the situation is somewhat more complex when considering cases such as multiple elevators in the same building, multiple elevators in the same building with the restriction that certain elevators are only able to access certain floors, elevators that only grant access to certain floors upon some form of authentication (RFID). Lastly, in the case of traffic lights, the key internal state is what color the external display is showing, obviously controlling nearby drivers. In the case of traffic lights, instead of a naive approach of maintaining an internal timer and changing periodically, a method that I’ve noticed in Nashville since moving here that I did not previously experience in my hometown Edison, New Jersey, was the optimization to allow for increased flexibility of traffic lights during certain hours (as conveyed by the blinking yellow signal). This approach can be compared to that of a traffic light that sense when cars are nearby and evidently the use cases of both are different - the increased flexibility of traffic lights (blinking yellow) at certain times may be more suitable for larger intersections where both roads are close in frequency or likelihood of being driven on whereas traffic lights that sense when drivers are nearby are more suitable when the frequency of the use of roads at an intersection is vastly different - thus the road significantly less traveled can be defaulted to red but changed in cars are within a certain proximity. A similar example, similar enough to the example of traffic lights to not be belabored, is the pedestrian walk sign which are very closely tied to traffic signals and can implement the same naive and "smarter"approaches to maintaining order in traffic (whether by foot or by vehicle).

The states of certain mechanical devices represented with finite automata will be described with the focus mainly on vending machines, elevators, and traffic lights. In vending machines, the machine can have a "current value inputted by user "state and examples of possible states are 0.00, 0.01, 0.02... Evidently the transition from these states are from the user's actions of inputting different coins or bills. So, the order of which these states are visited depends on the value of the money and transitions from the value of however much was in the machine previously. Furthermore, the state of item selected has to have an arrow to itself since the stock of one item could be sold out and the machine should not transition to actually depositing solely based on the reason that the machine does not have a certain item in stock. Also, technically an item should be able to be selected from any of the value states but movement to releasing the item and depositing payment should be conditional upon the key fact that enough money has been entered into the machine. Next, the states in an elevator can be examined. It is obvious that each level is a state and the accessibility of each state is restricted by authentication and the capabilties of each elevator. Thus, each elevator would have its own finite automaton, although multiple could be represented by the same if the levels they accessed were identical. Moreover, one could be used but each connection could be the number or some unique identification for each elevator. Lastly, for the example of the traffic light, the states would clearly be the different states of the light, consisting of red, yellow, green, and blinking yellow. The transitions between these would mostly be controlled by time (since the blinking yellow usually is used at night) or could also be due to sensors watching for nearby cars. The transition to blinking yellow would be from any state to itself with the restriction of time and a path leaving would be restricted by time as well. The transitions within the sensing light would be whether or not a car was present to move to yellow and a timed sequence to red for the main light and green for the less frequently traveled road when the pairing light turns red.

An interesting application of what was learned from the Chapter 2.1 reading is to analyze the participants in each scenario (in the example of the protocols to support electronic money, the participants were the customer, the store, and the bank). In the mechanical device example of a vending machine, the participants are the consumer and the machine, where the consumer's actions consist of inserting money and selecting a drink and the machine's actions consist of incrementing money inserted, depositing money, and ejecting drink. In the example of the elevator the participants are the user who can provide authentication and select a floor, and the elevator which can go to floors. Lastly, in the example of the traffic lights, the participants are the light which can change color and vehicles which can drive nearby.