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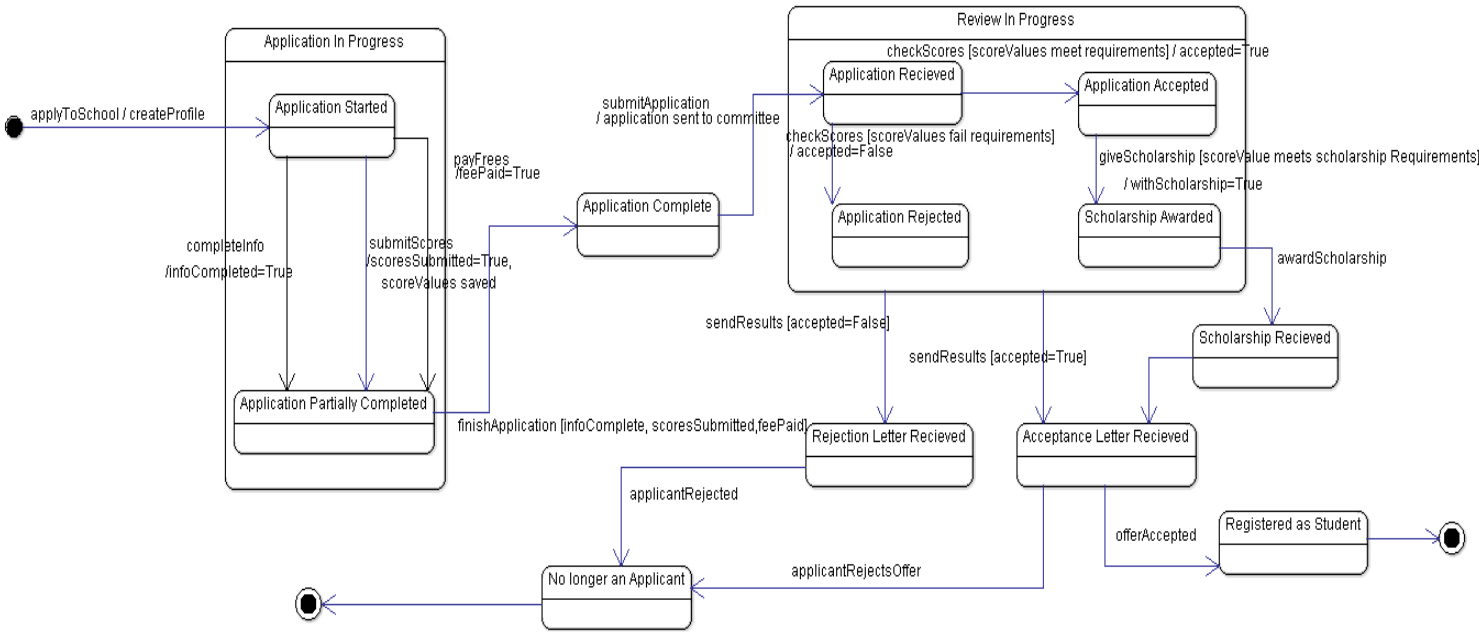
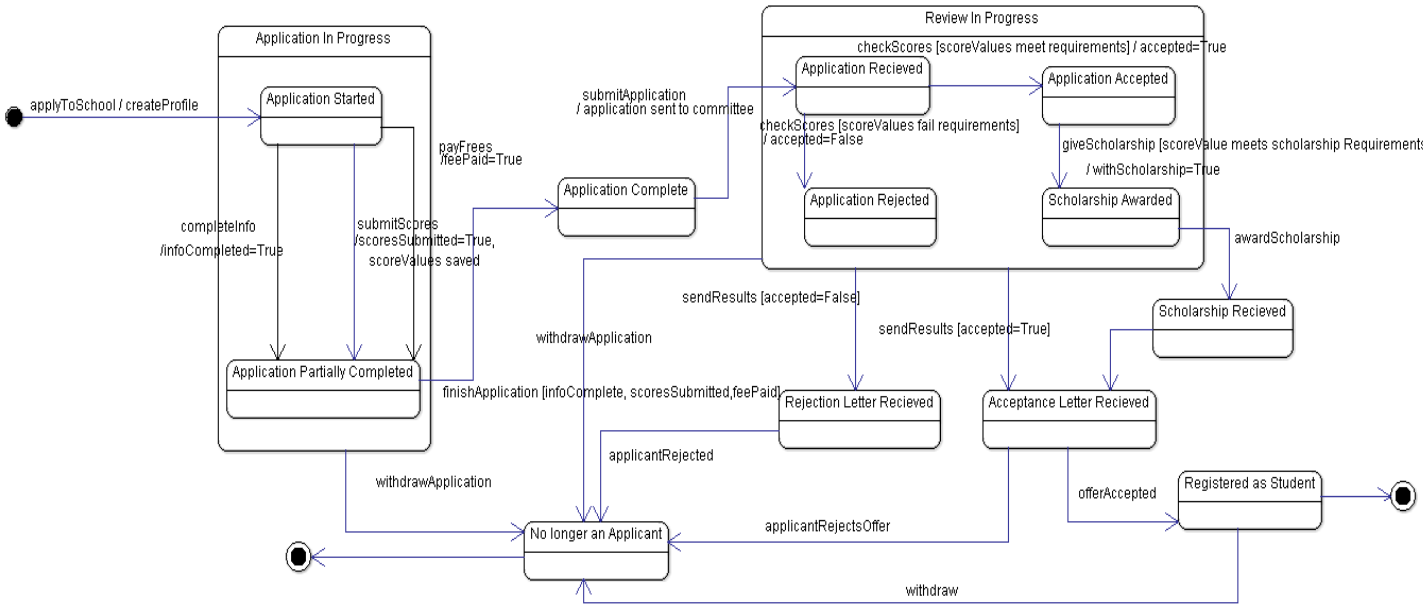
Homework 2

1. (a) Specify and draw a UML statechart to represent the stages of a person applying to become a student at a university: application, conditional or unconditional acceptance, or rejection, and for conditionally accepted students, confirmation of acceptance or rejection (once further information is available]. Finally, accepted applicants are registered as students of the college.

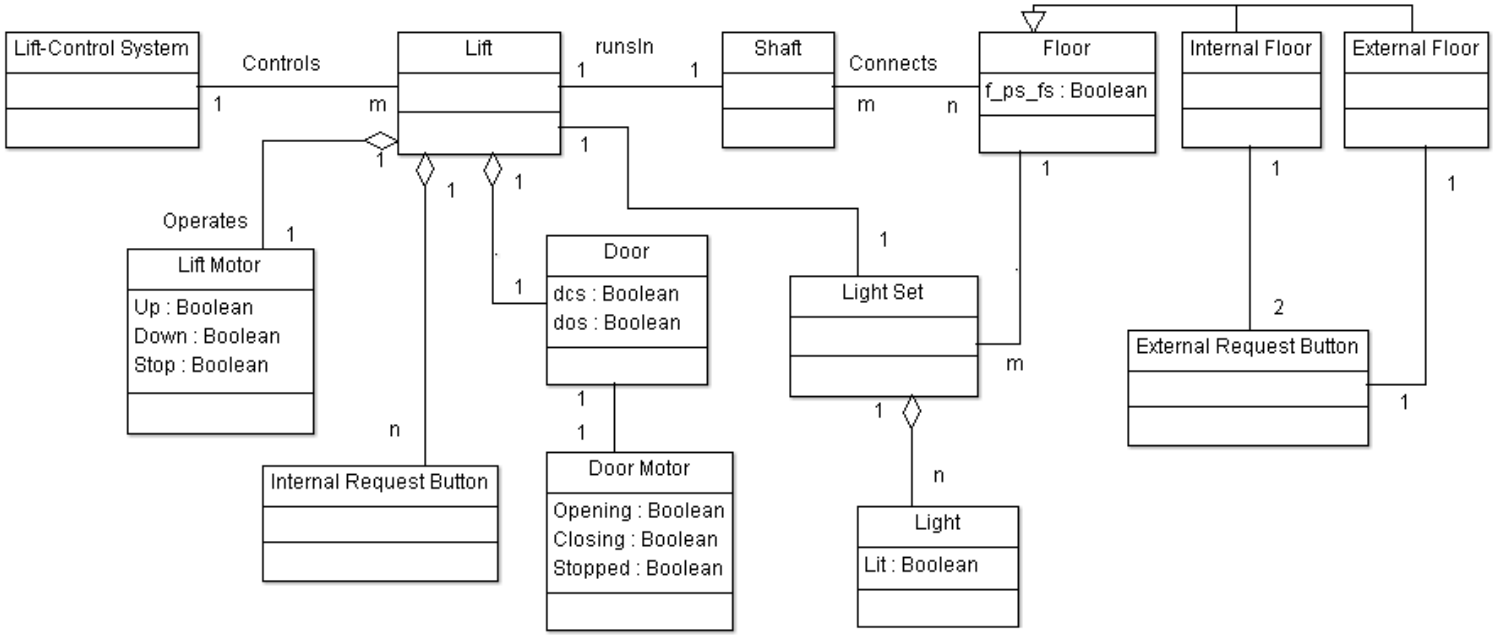


(b) Extend the previous solution by adding an event, withdraw that terminates the applicant's application lifecycle regardless of which state they are in.

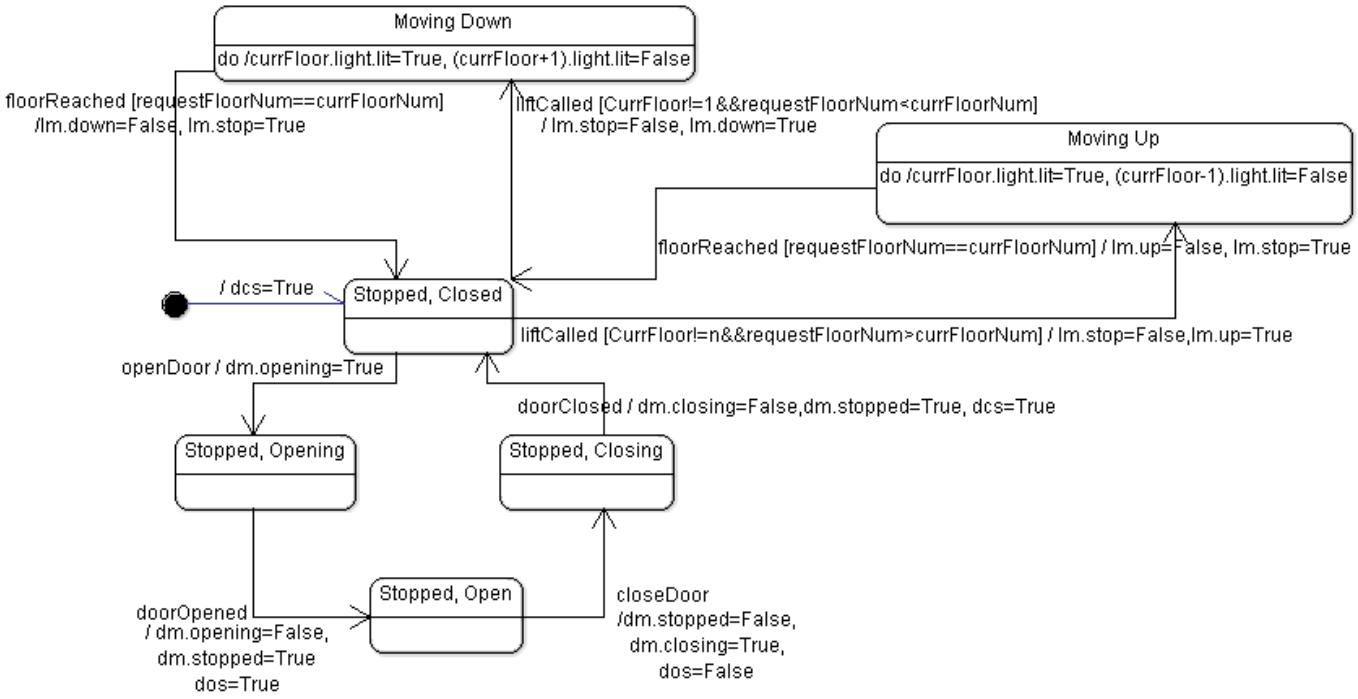


2. A lift-control system is to be developed to control the operation of a set of m lifts running between n floors of a building, where 1 < m < n. Each lift has a lift motor lm, which can be set to up, down, or stop. It also has a door motor dm, which can be set to opening, closing, and stopped. There are similar doors on each floor for each shaft. The system has a set of internal request buttons in each lift, one button per floor. These are lit when a request has been made and continue to stay lit until the floor is visited after the request. There are also two external request buttons (for up and down) on every floor except the top (down button only) and bottom (up only) floors. On every floor, and for each lift shaft, there is a set of lights (one per floor) showing where the lift is. There is similar set inside each lift. For each floor f there is a sensor f psfs: Boolean for each shaft s, which registers if a lift is positioned at that floor in that shaft. The doors of this shaft can only open on floor f if f psfs = true. The lift and floor doors should always open and close together (their door motors should always be set identically). For each door, there are Boolean sensors dcs and dos, indicating whether the door is completely closed or opened, respectively. The lifts should respond to requests without duplicating effort (external requests will only be answered by one lift, internal requests in a lift will only be answered by the lift itself).

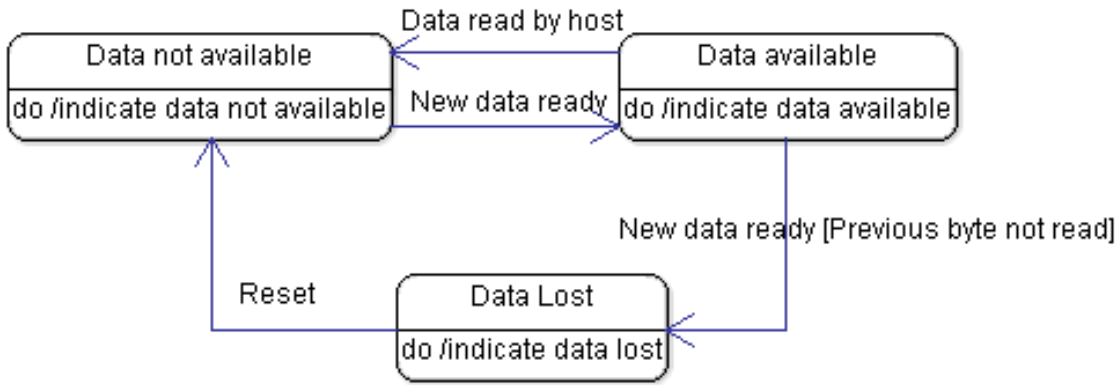
   (a) Draw a UML class diagram for this system.



(b) Draw a UML statechart of an individual lift's behavior. Assume that m = 2 and n = 10, but ensure that the diagrams can be reused for other settings of these parameters.



3. In a personal computer, a disk controller is typically used to transfer a stream of bytes from a floppy disk drive to a memory buffer with the help of a host such as the CPU or a DMA controller. The controller signals the host each time a new byte is available. The data must then be read and stored before another byte is ready. When the disk controller senses that the data has been read, it indicates that data is not available, in preparation for the next byte. If any byte is not read before the next one comes along, the disk controller asserts a data lost error signal until the disk controller is reset. Add the following to the diagram: reset, indicate data not available, indicate data available, data read by host, new data ready, indicate data lost.

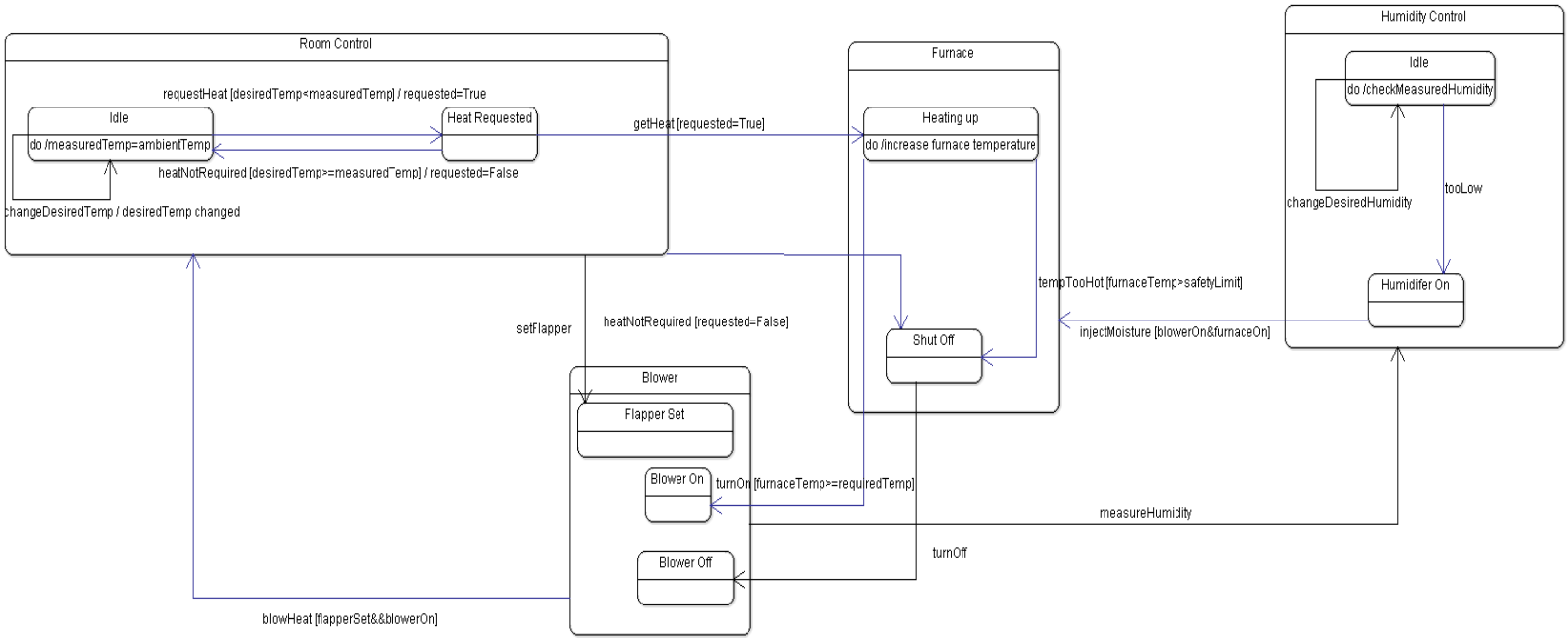


4. A gas-fired, forced hot-air, home heating system maintains room temperature and humidity in the winter using distributed controls. The comfort of separate rooms may be controlled somewhat independently. Heat is requested from the furnace for each room based on its measured temperature and the desired temperature for that room. When one or more rooms require heat, the furnace is turned on. When the temperature in the furnace is high enough, a blower on the furnace is turned on to send hot air through heating ducts. If the temperature in the furnace exceeds a safety limit, the furnace is shut off and the blower continues to run. Flappers in the ducts are controlled by the system to deliver heat only to those rooms that need it. When the room(s) no longer require heat, the furnace is shut off, but the blower continues to deliver hot air until the furnace has cooled off.

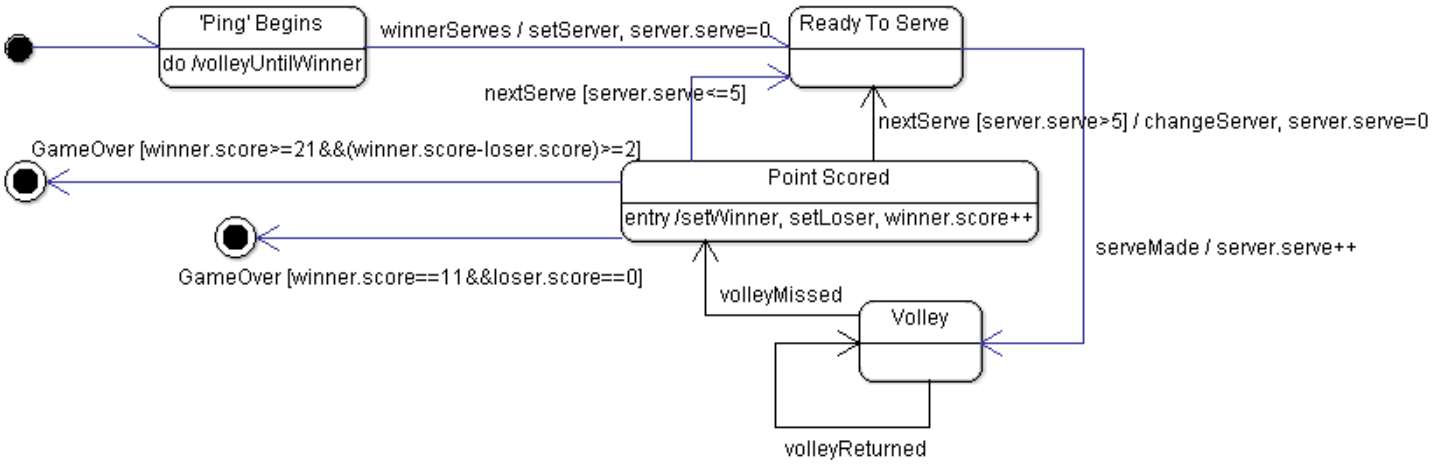
   Humidity is also maintained based on a strategy involving desired humidity, measured humidity, and outside temperature. The desired humidity is set by the user for the entire home. Humidity of the cool air returning to the blower is measured. When the system determines that the humidity is too low, a humidifier in the furnace is turned on, whenever the blower is on, to inject moisture into the air leaving the blower.

   Partition the control of this system into concurrent state diagrams. Describe the functioning of each state diagram without actually going into details of states or activities.

I partitioned the system into the room control (each room would be its own state diagram), the furnace, the blower, and the humidity control. The room requests heat when temperature goes below the desired temp. Then the furnace heats up. After it is heated, the blower sends the hot air to the appropriate room by adjusting the correct flappers. This continues until either the room gets hot enough or the furnace gets too hot. Then the furnace turns off and the fan blows until the furnace has shut off. During this, the humidity control is going to make sure the air has enough moisture. If not, it injects it into the flow. I sketched this system below.



5. Construct a state model corresponding to a given class model for table tennis.



I used external sources on this problem just to better understand table tennis rules. (https://www.allabouttabletennis.com/table-tennis-rule.html & https://sports.stackexchange.com/questions/5675/who-serves-when-in-ping-pong)