SYSC 3303 Real-Time Concurrent Systems
Final Report

Report Title: Elevator Systems

Lab Section: L2
Group Number: 10

Report Due: 10 April 2019

Group Members

#	Name	Student #
1	Akash Noozhumuriyil	101063364
2	Gabriele Sarwar	101010867
3	Jolar Tabungar	101030060
4	James Richards	100966651
5	Ryan Tordesillas	101041626

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3. Breakdown of responsibilities

Iteration 1:	
Gabriel	Coding, ReadMe file.
Akash	State Machine Diagrams
Jolar	Test cases, coding, data structures
Ryan	UML Diagrams
James	ReadMe file, State Machine Diagram, Group Roles, Created GitHub Repo

Iteration 2:	
Gabriel	Coding, ReadMe file.
Akash	Sequence/Timing diagrams for the error scenarios of the elevator system,pseudo code of cases at different positions of the elevator
Jolar	Test cases, Coding, Data structures
Ryan	UML class diagrams
James	Pseudo code of the scheduler logic, State Machines

Iteration 3:	
Gabriel	Made group role file on Github, reviewed sequence diagram for errors
Akash	Sequence/Timing diagrams for the error scenarios of the elevator system
Jolar	Test cases, Coding, Data Structures
Ryan	UML class diagrams, Test cases, Debugging
James	Input parser file

Iteration 4:	
Gabriel	Made group role file on Github, worked on code with the group
Akash	Timing diagrams for the rate monotonic analysis among the elevator, scheduler and floor subsystem and helped with the code
Jolar	Test cases, Coding, Data structures
Ryan	UML class diagrams, Test cases
James	Input parser file and helped with code

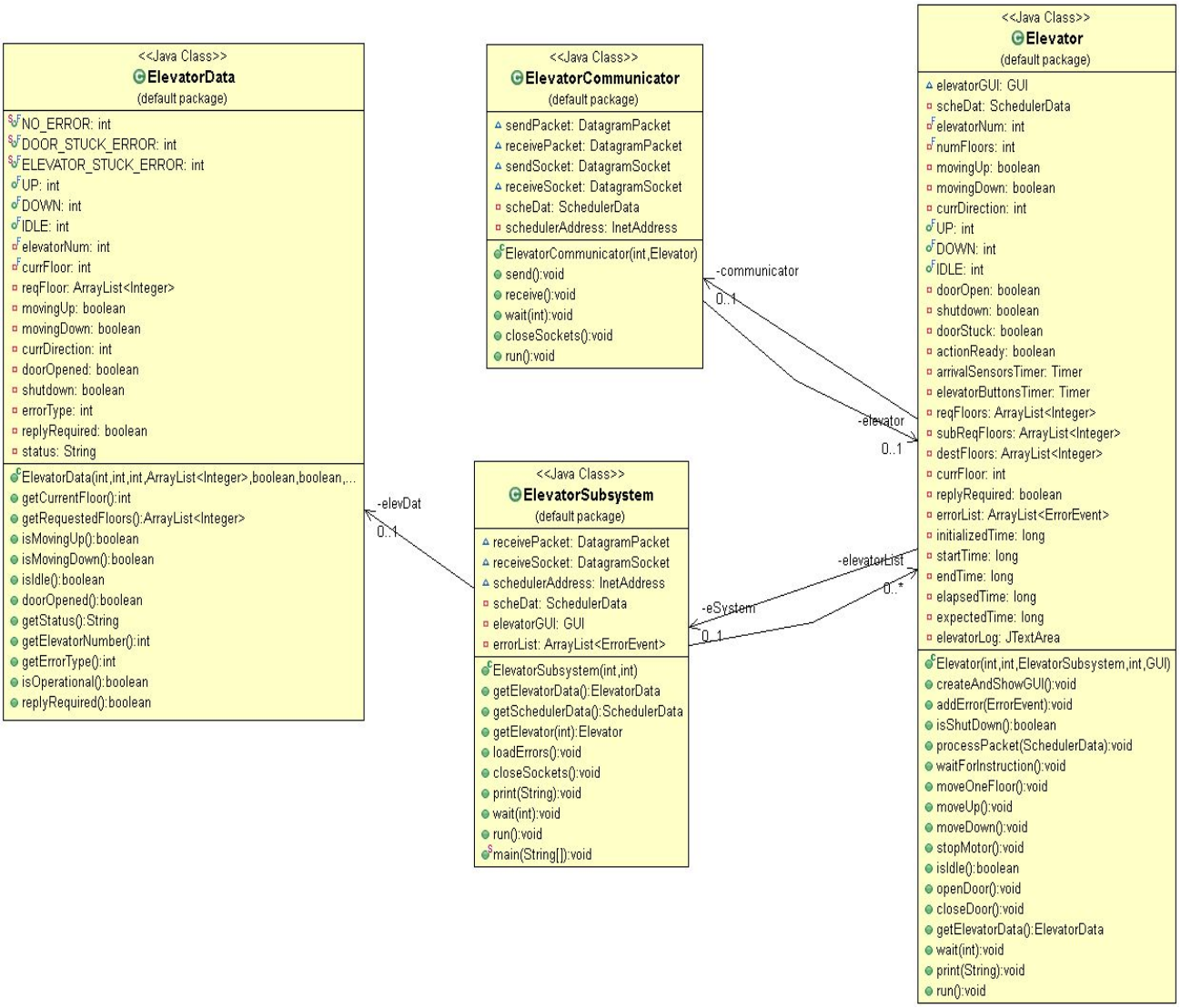
Iteration 5:	
Gabriel	Made group roles file, worked on Discussion for what we preferred/didn't prefer and table of contents
Akash	Measurements results, Rate Monotonic Analysis, Timing diagrams for the Measured results
Jolar	Test cases, Coding, Analysis of the system of schedulability
Ryan	UML class diagrams, Test cases, Debugging, GUI for final presentation
James	Input parser file, helped with coding/debugging, Final Report Formatting

4. Diagrams

4.1 UML Class Diagrams

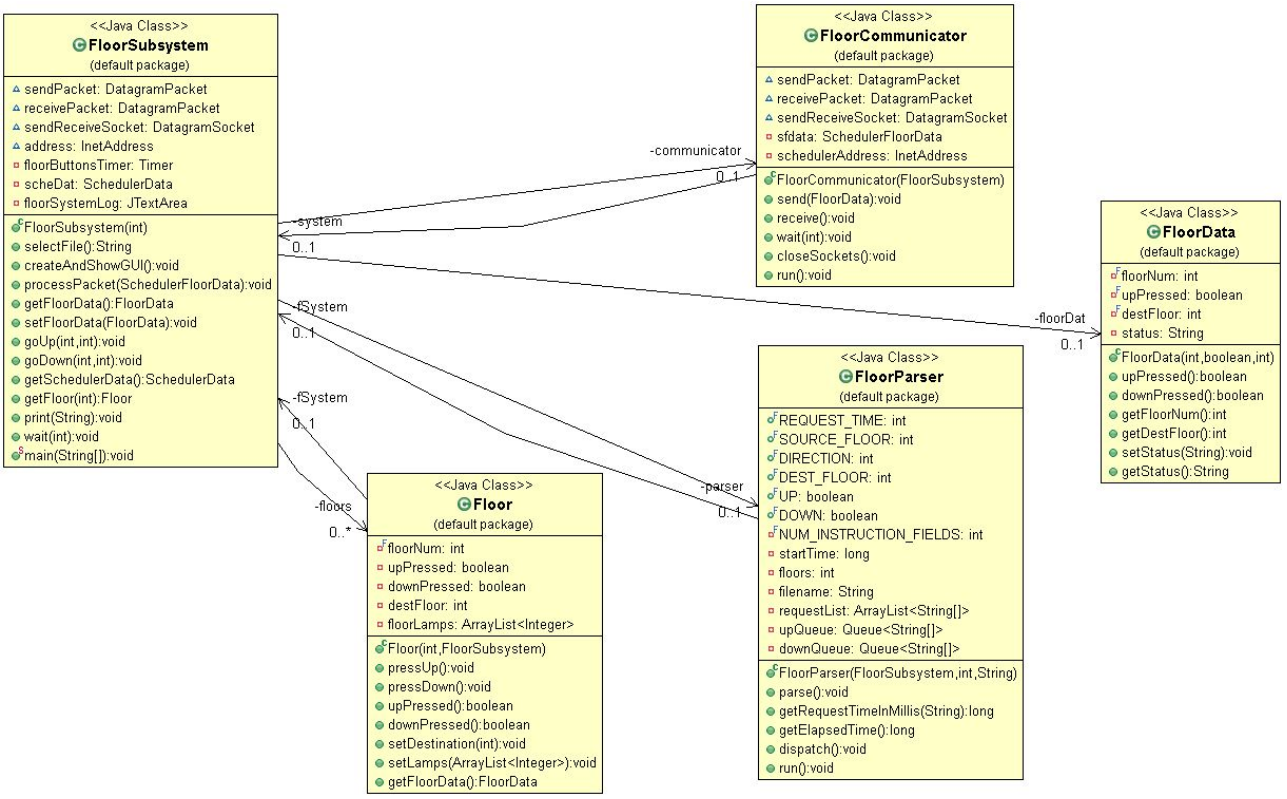
Class diagrams are one of the most useful types of diagrams, they clearly map out the structure of a system by modeling its classes, attributes, operations, and relationships between objects.

4.1.1 Elevator Subsystem



4.1.2 Scheduler Subsystem

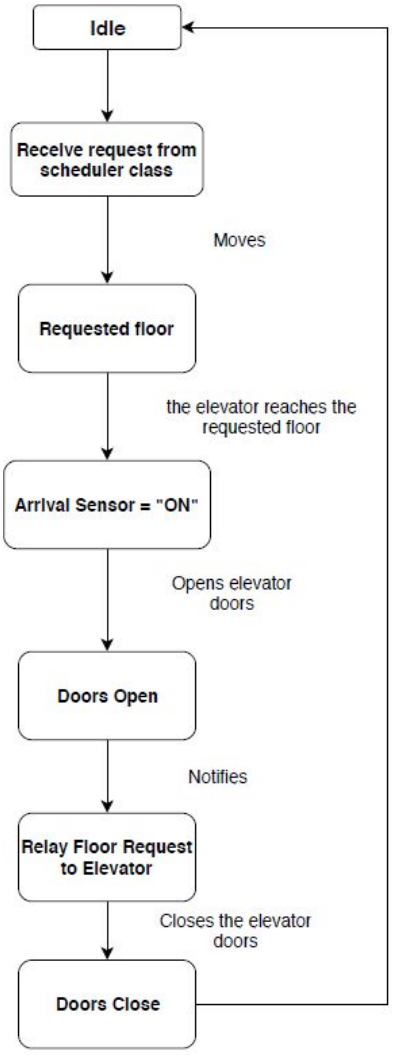
4.1.3 Floor Subsystem



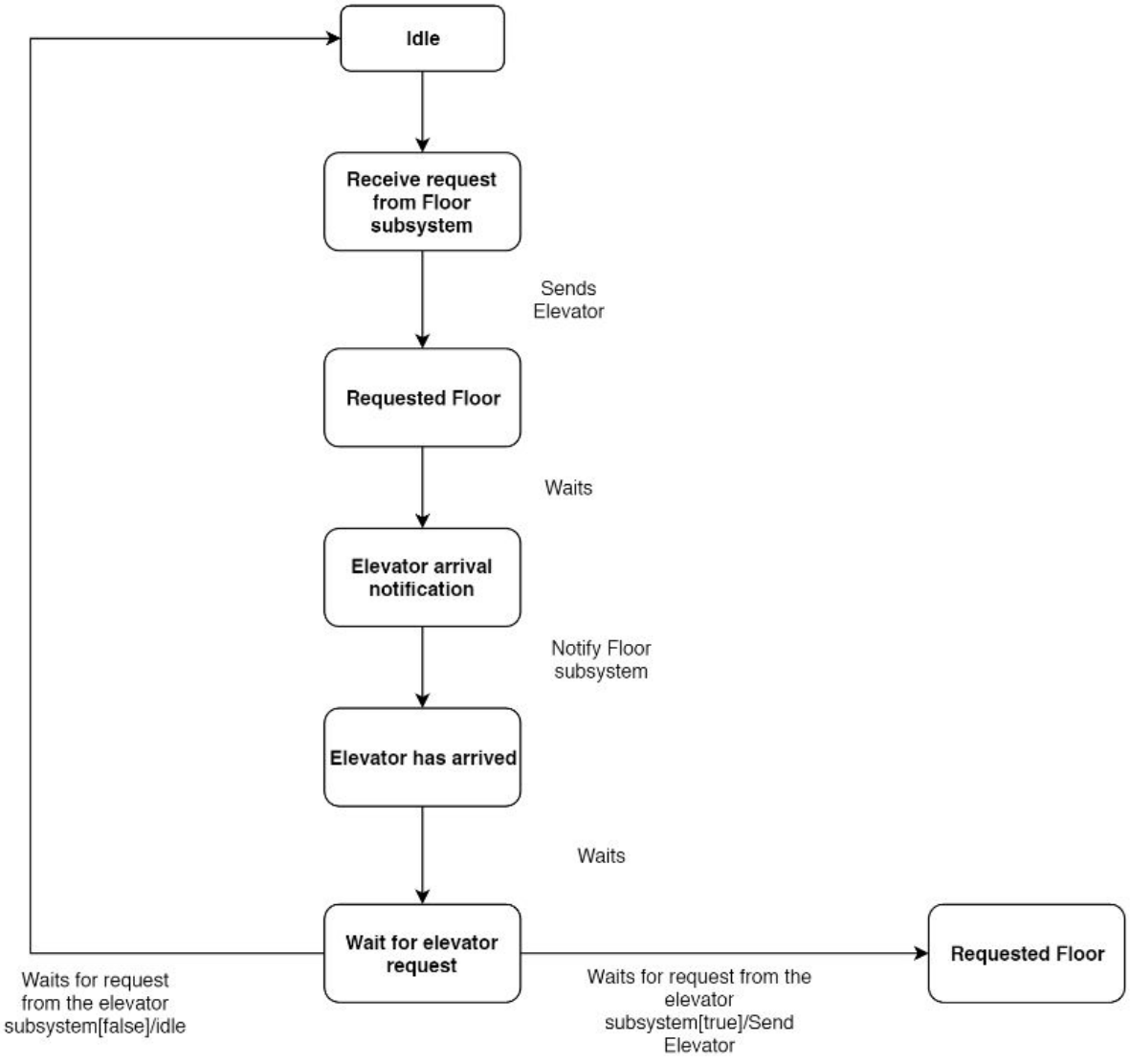
4.2 State Machine Diagrams

A State machine diagram is a behavior diagram which describes the behavior of a system through state transitions.

4.2.1 Elevator Subsystem



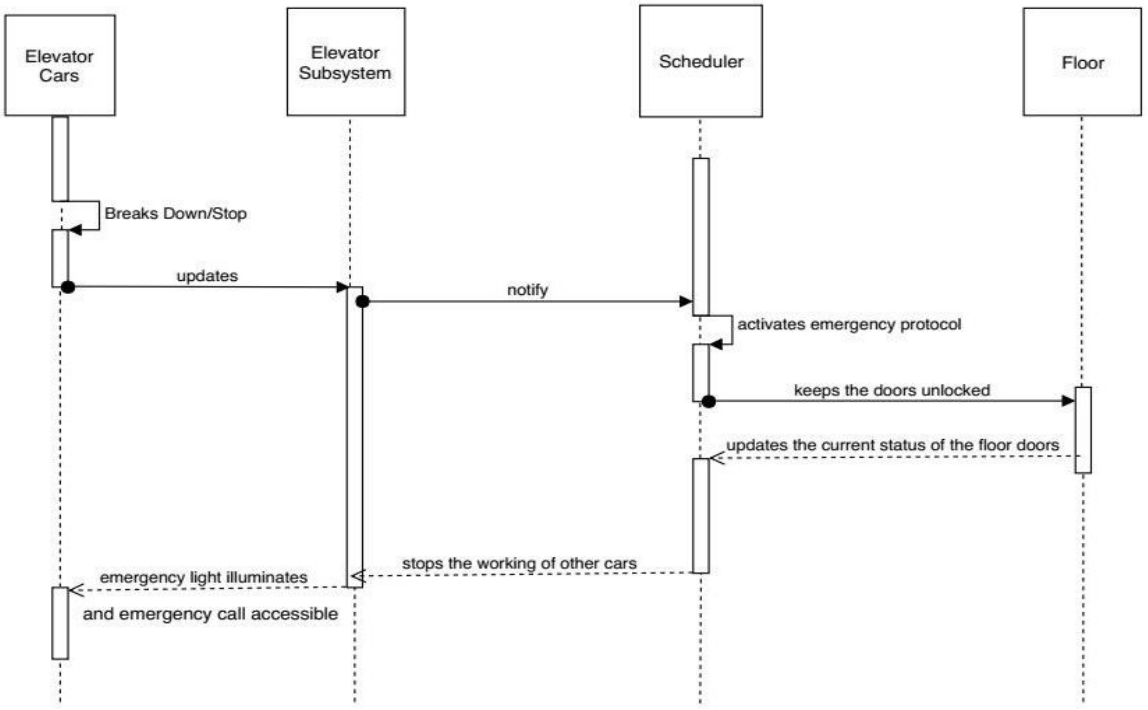
4.2.2 Scheduler Subsystem



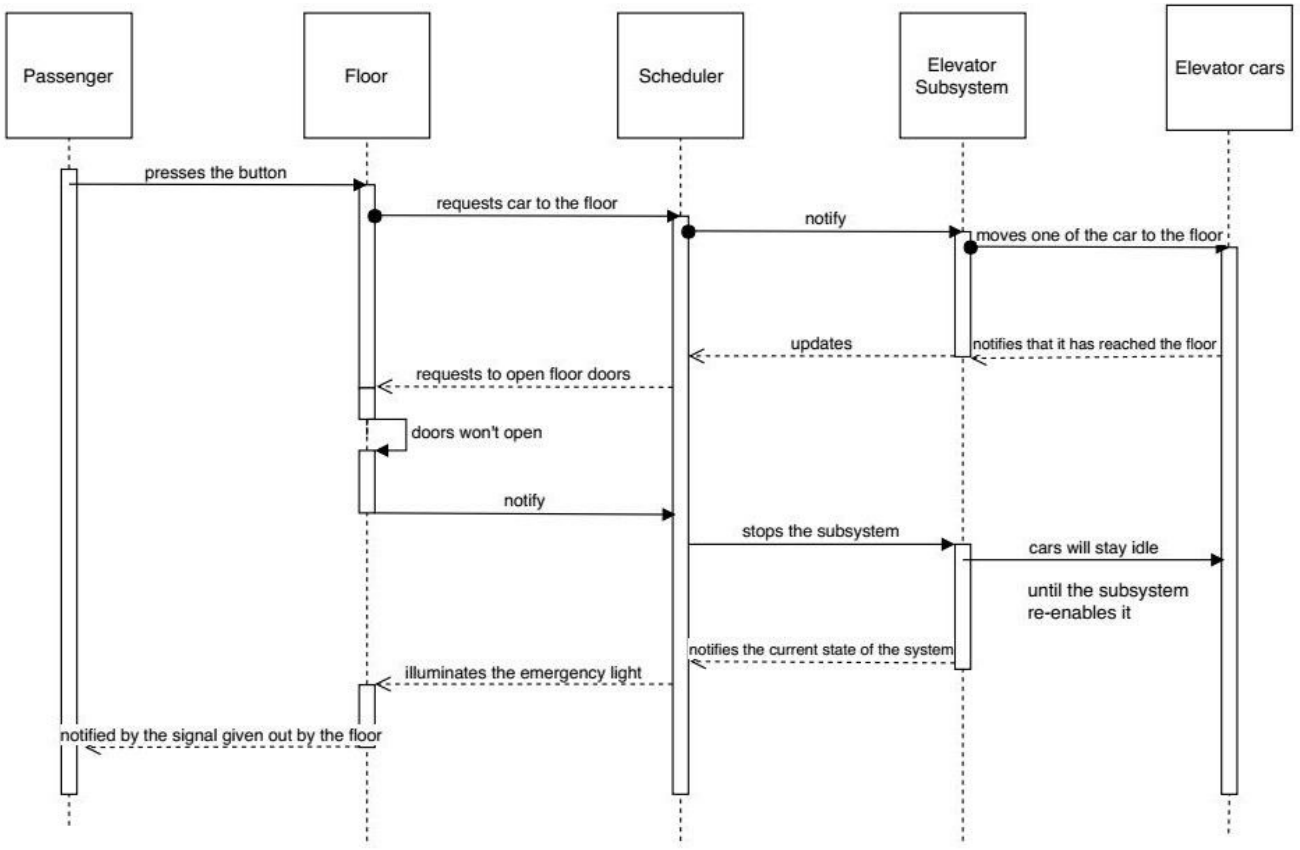
4.3 Error Scenario Sequence Diagrams

A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. By showing sequence diagrams of possible error scenarios we can analyze how our system will respond to them.

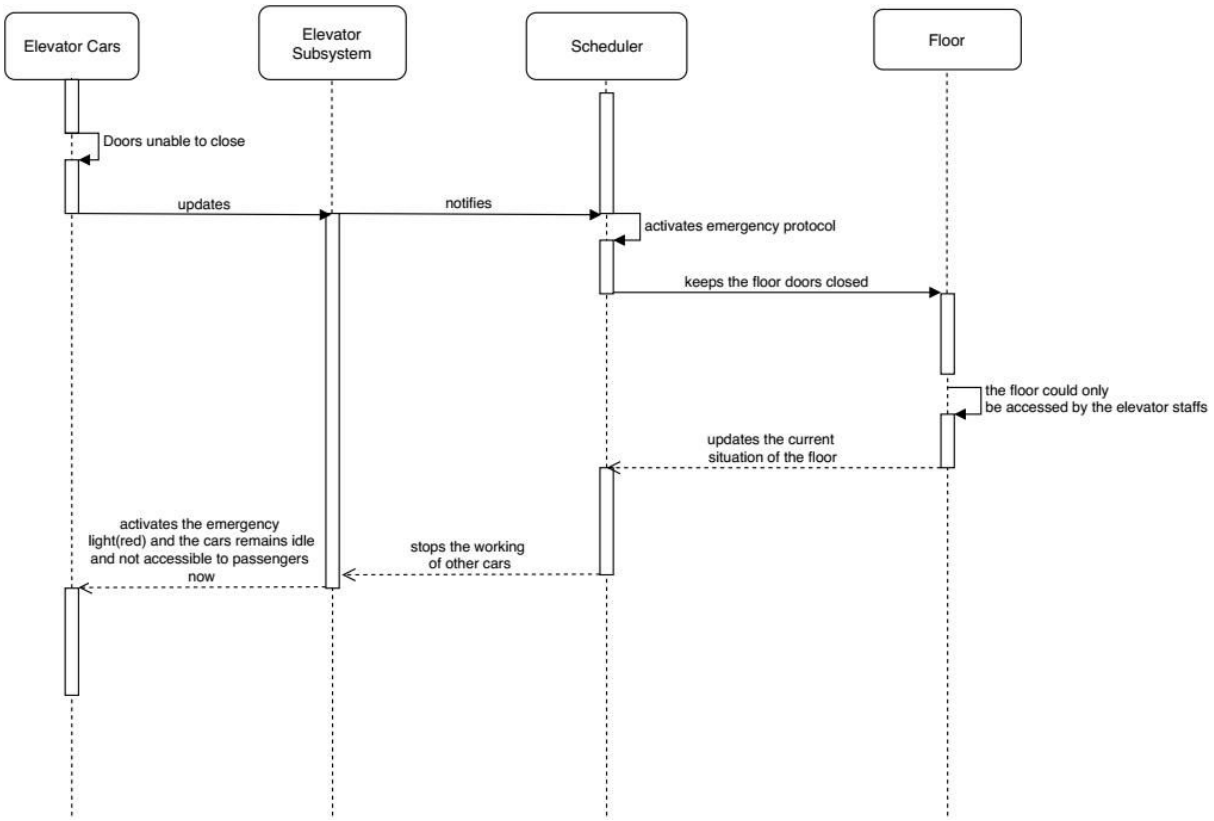
4.3.1 Elevator Breaks Down



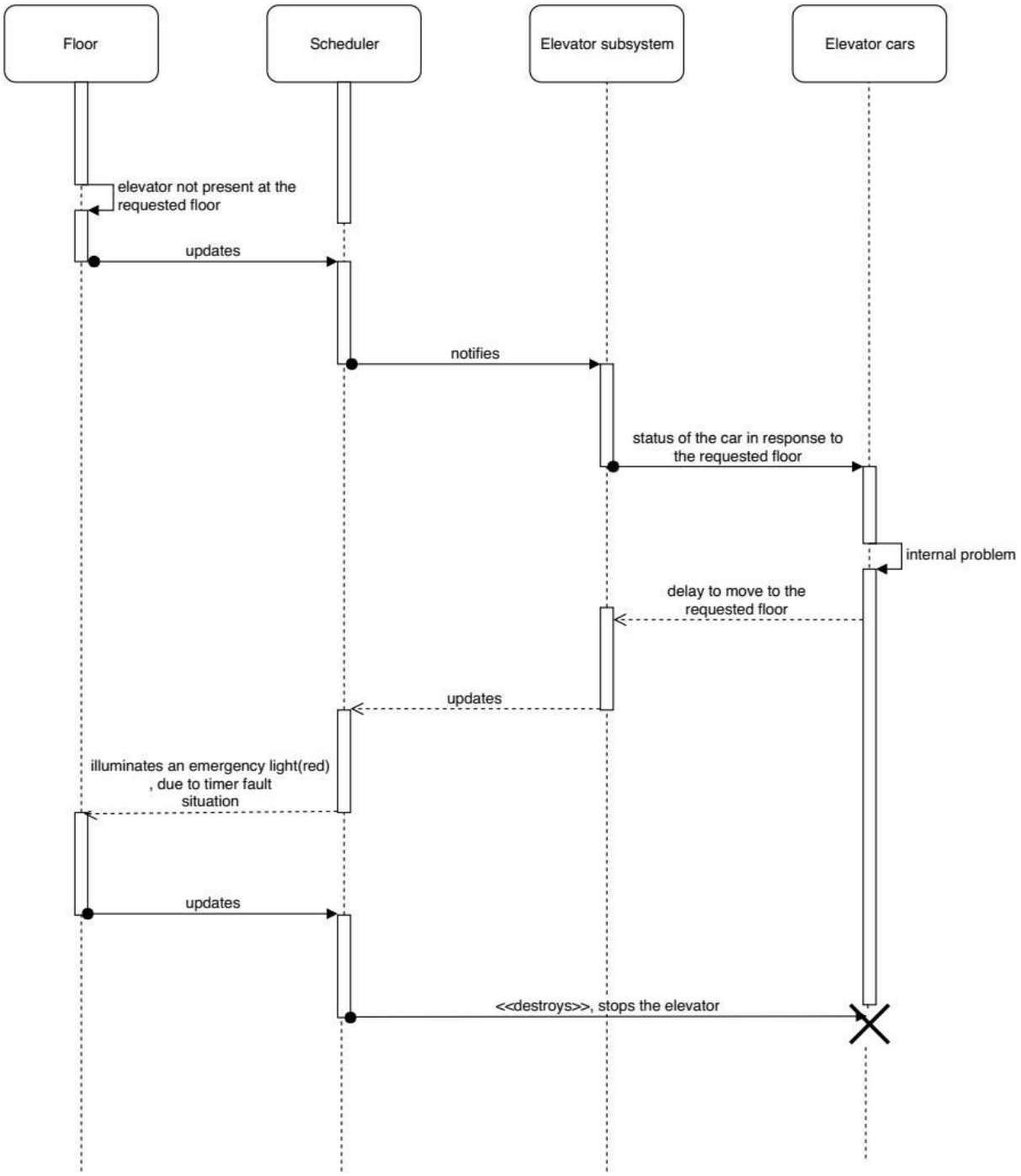
4.3.2 Elevator doors unable to open



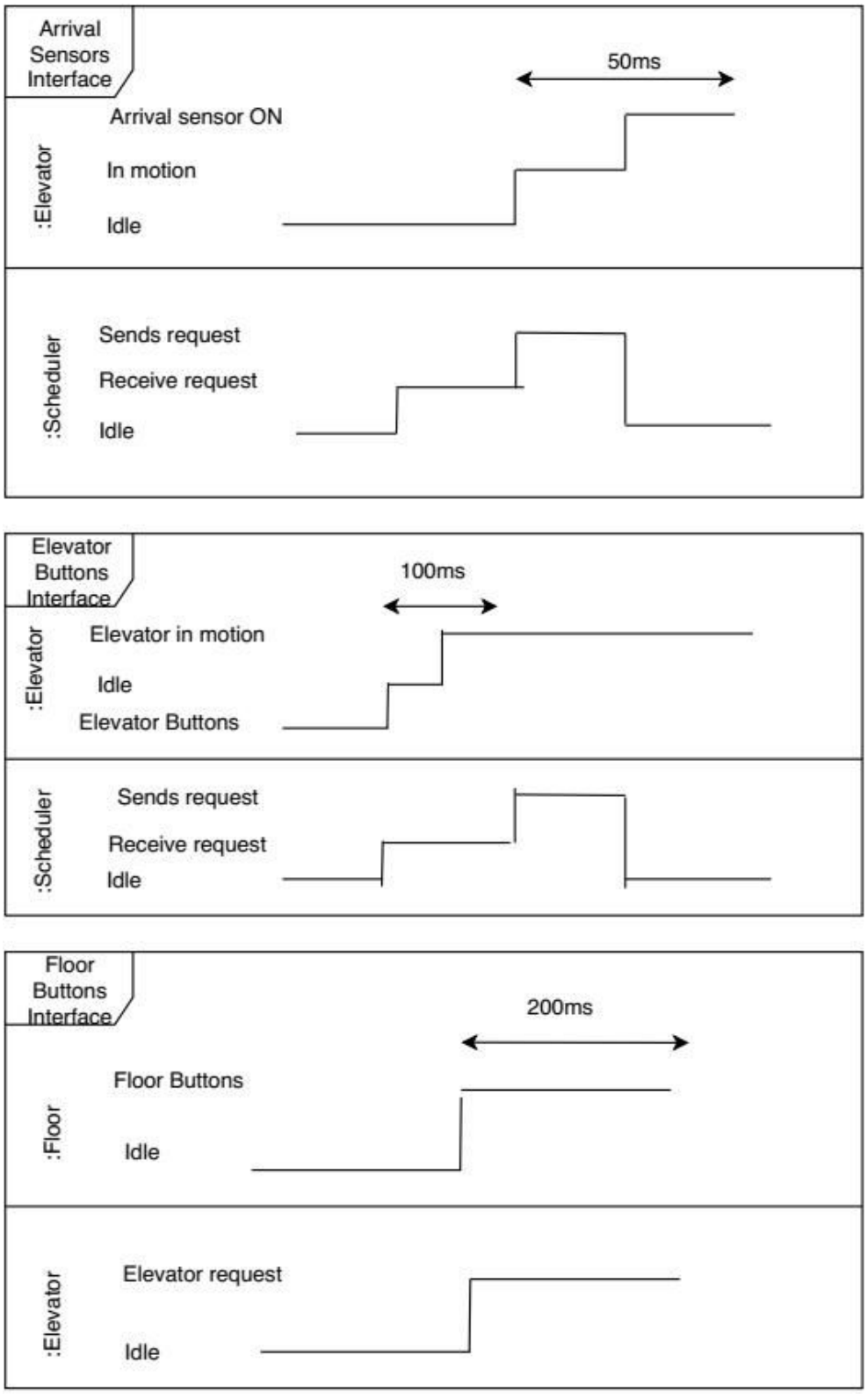
4.3.3 Elevator Doors unable to close



4.3.4 Elevator delayed when moving to requested floor



4.4 Scheduler Timing Diagrams



5. Setup & Test instructions

5.1 Setup Instructions

In order to run the system on one computer:

Run > Main as a Java Application

When prompted to input values:

Select -> Use Defaults

When prompted for selecting the run configurations for the floor subsystem and scheduler:

Select -> Same Computer As Elevator Subsystem

Select -> Same Computer As Scheduler

When prompted to select a request file:

Select -> default_values.txt

Alternatively,

In order to run the system on separate computers, run each class on its respective computer in the following order

Run > ElevatorSubsystem.java as a Java Application

Run > Scheduler.java as a Java Application

Run > FloorSubsystem.java as a Java Application

When prompted to input values:

Select -> Use Defaults

When prompted for selecting the run configurations for the floor subsystem and scheduler:

Select -> Separate Computer

Enter the Elevator subsystem's IP address

Select -> Separate Computer

Enter the Scheduler's IP address

When prompted to select a request file:

Select -> default_values.txt

5.2 Testing Instructions

In order to run the test cases, in Eclipse:

Run > TestCases.java

All Tests should pass.

6. Measurement Results

We calculated the mean, standard deviation and variance from the data taken from Arrival Sensors, Elevator Buttons and Floor Buttons text files. The mean, standard deviation and variance were calculated using the in-built functions in MS Excel.

Arrival Sensors	2	Elevator Buttons	305	Floor Buttons	79
	2		305		1
	2		305		15
	8		314		2
	3		305		1
	3		305		1
	201		314		1
	61		305		1
	229		285		1
	211		255		95
	1		252		79
	1		270		1
	1		305		15
	35		314		2
	66		285		1
	80		255		1
	28		252		1
	75		305		1
	51		270		95
	127		314		79
	89		305		1
	1		285		15
	1		255		2
	237		252		1
Mean	63.125	Mean	288.2083	Mean	20.45833
Standard deviation	79.87997	Standard Deviation	23.89648	Standard Deviation	34.53288
Variance	6380.81	Variance	571.0417	Variance	1192.52

7. Analysis of System for Schedulability

Process	Period (ms)	Computation Time(ms)	Priority	Response Time
Arrival Sensors	50	63.125		1.2625
Elevator Buttons	100	288.2083		2.8821
Floor Buttons	200	20.4583		0.1023

Total = 4.2169

The utilization time is 42.169% which is below the theoretical bound of 77%. This system of three processes is schedulable (which means that each of the processes can meet its deadline).

Elevator Buttons Interface:

From the elevator_buttons.txt file, we took 24 observations and calculated the mean, standard deviation and variance. The following results are shown below:

Mean = 288.21 (using the AVERAGE function in MS Excel)

Standard Deviation = 23.89 (using the STDEV function in MS Excel)

Variance = 571.04 (using the VAR function in MS Excel)

Arrival Sensors Interface:

From the arrival_sensors.txt file, we took 24 observations and calculated the mean, standard deviation and variance. The following results are shown below:

Mean = 63.13 (using the AVERAGE function in MS Excel)

Standard deviation = 79.88(using the STDEV function in MS Excel)

Variance = 6380.81 (using the VAR function in MS Excel)

Floor Buttons Interface:

From the floor_buttons.txt file, we took 24 observations and calculated the mean, standard deviation and variance. The following results are shown below:

Mean = 20.46 (using the AVERAGE function in MS Excel)

Standard Deviation = 34.53 (using the STDEV function in MS Excel)

Variance = 1192.52 (using the VAR function in MS Excel)

8. Design Reflection

We believe the project was completed and met all of the requirements that were given. We are very happy with the GUI interface of the system since it gives a visual representation of the state of the system (ie. location of elevators, and door state) making it easier to see where the elevators were going. This was an improvement from just having a text-based log for every component, which was hard to follow when so much was happening at once. One thing that can be improved is the efficiency of the scheduler. By improving the routing logic, to always send the most efficient elevator to service a request, we could decrease the overall time it takes to service each request.

Overall, thanks to our Teachers Assistant Ian’s guidance and the team's hard work, the project was a success.