Traffic Simulation

INFO 6205 Program Structure and Algorithms

Team #1

Repository

Introduction

Boston is one of the most congested cities in the United States. I-93, one of the highways connecting Boston, Somerville and Cambriadge, plays an important role in daily commutes of the Greater Boston Area. Different vehicles from different cities merge on here. The goal of this project is trying to simulate the merge traffic where situations are similar to I-93.

In daily life, when a traffic accident occurs or the road surface needs to be repaired, the driveway will be temporarily unavailable. In addition, in order to meet the requirements of reducing the width of the road, the lanes will also be designed to merge. The project aims at simulating the traffic where merge happens. Through this simulation, we would like to get actual data and intuitive experience about traffic merging. Figure 1 depicts the image.
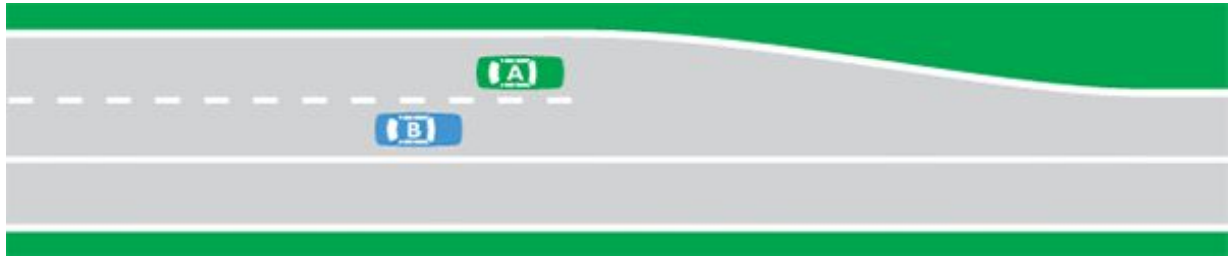
Figure 1. Lanes merge

Project Description

The project consists of three main parts. First is **Vehicle**, objects of vehicles are given basic attributes such as position(px,py), vehicle length, speed ect. Second is **Move**, which is trying to mimic every situation about cars moving in this merge traffic. For example, whether or not a car is accelerating; how cars can cut into the line and when to stop etc. Third part is GUI, implemented in **Road**, **Car**, and **Truck** with the support from **Swing** framework. They visually show what cars do. Also, the personally defined thread **TrafficThread** is used to manage the program status.

UML

In Figure 2, the project is conducted by the object-oriented programming language Java. With the critical trait of inheritance, all classes are designed as shown.
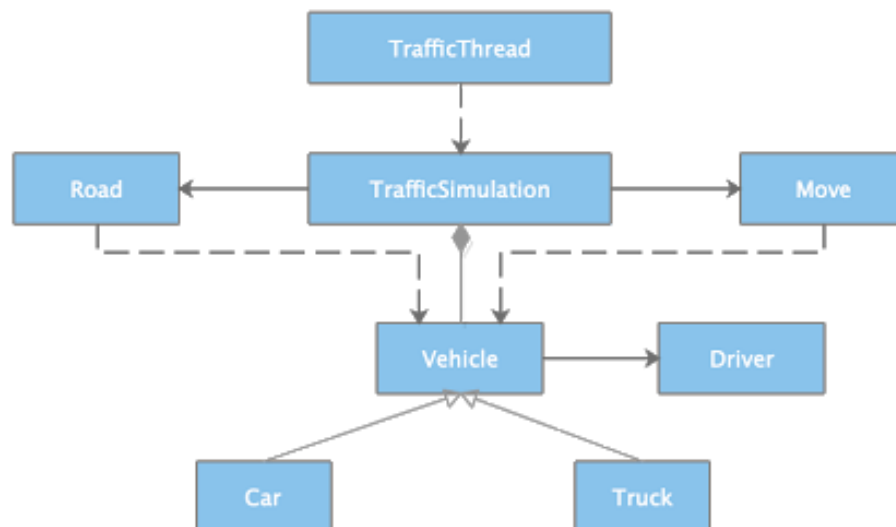

Figure 2. Class relationship

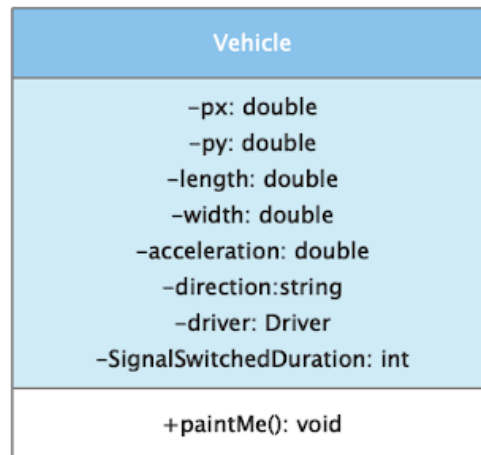The structure of the core class **Vehicle** is as Figure 3.

Figure 3. Vehicle class

Design

In the project, three types of factors have been considered to simulate the real traffic situation. And it assumes the situation that five lanes merge to four lanes. The variants and constants are defined in **TrafficSimulation** class and can be utilized by other classes as static invariants.

- Variants
    - Stopping Distance
    - Traffic Density
    - Vehicle Length & Width
    - Driver Type & Possibility of Giving Way
- Constants
    - Road Condition: Dry
    - Distance to Previous and Next Interchange
    - Lane Width
    - Limit of Speed, Acceleration, & Deceleration
- Interruptions
    - Special Vehicle

Based on the assumption, the project simulate four situation: 4 lanes, 5 lanes, 4 lanes with special vehicle interruption, and 5 lanes with special vehicle interruption.

Output

Figure 4 demonstrates the situation of the program running. In the most left part, there are five lanes, and only four lanes in the most right side.

Click the 'Start' button, and the simulation generates the fixed number of vehicles running on the screen. When one of them is willing to change the direction to left or right, the lights on the car head and tail will turn on to inform other cars in the road.

Click the 'Stop' button, and all cars become static because the thread is stopped.

The components in the north are Counter and Flow. Counter indicates the current number of vehicles in the graph. Also, Flow points out how many vehicles pass in a certain time.
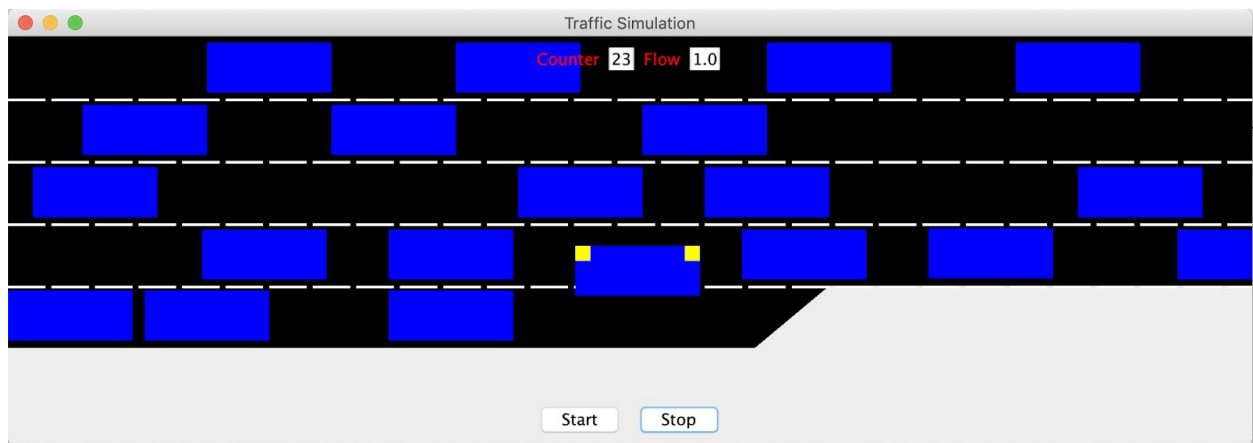

Figure 4. Overall Simulation for merging

Figure 5 demonstrates the situation of speed limit in both situations. The speed limit for this highway is 100. If there is no car in front, the maximum speed is 100. If there is a car in front. The maximum speed is determined by the previous car and so on.
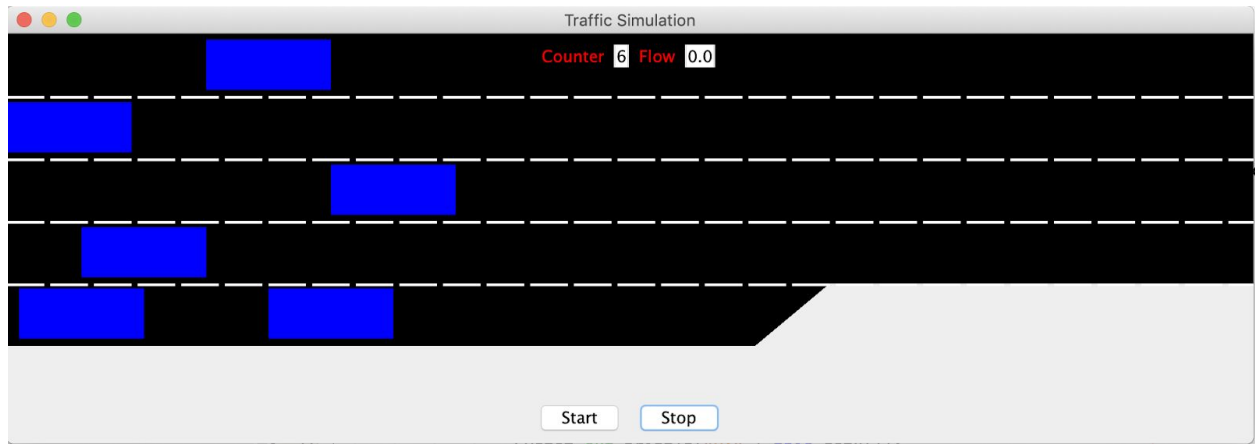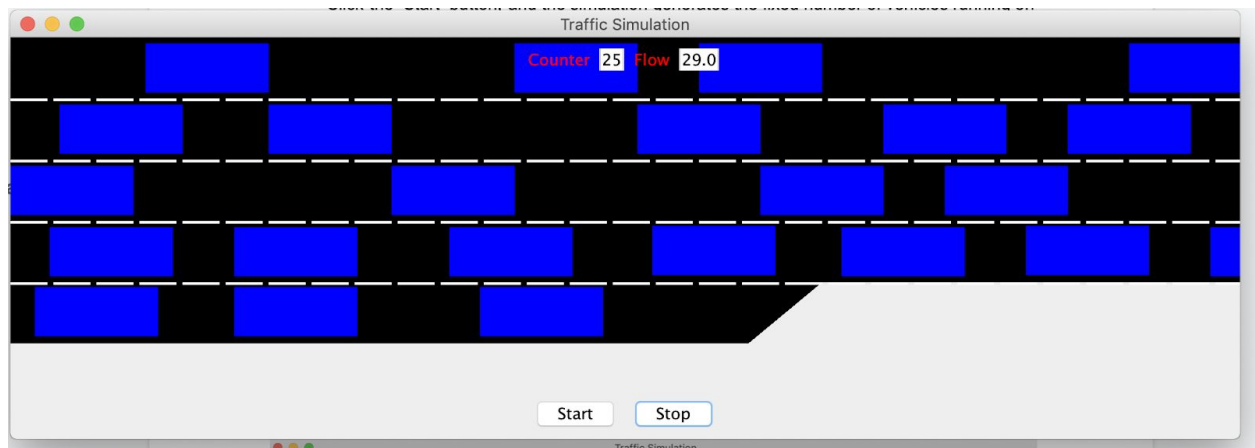
Figure 5. Maximum speed if no cars in front

Figure 6. Maximum speed if there is a previous car

Figure 7 demonstrates what happens when a special vehicle is there. Other vehicles in front of special vehicle will either go left or right to clear the way.
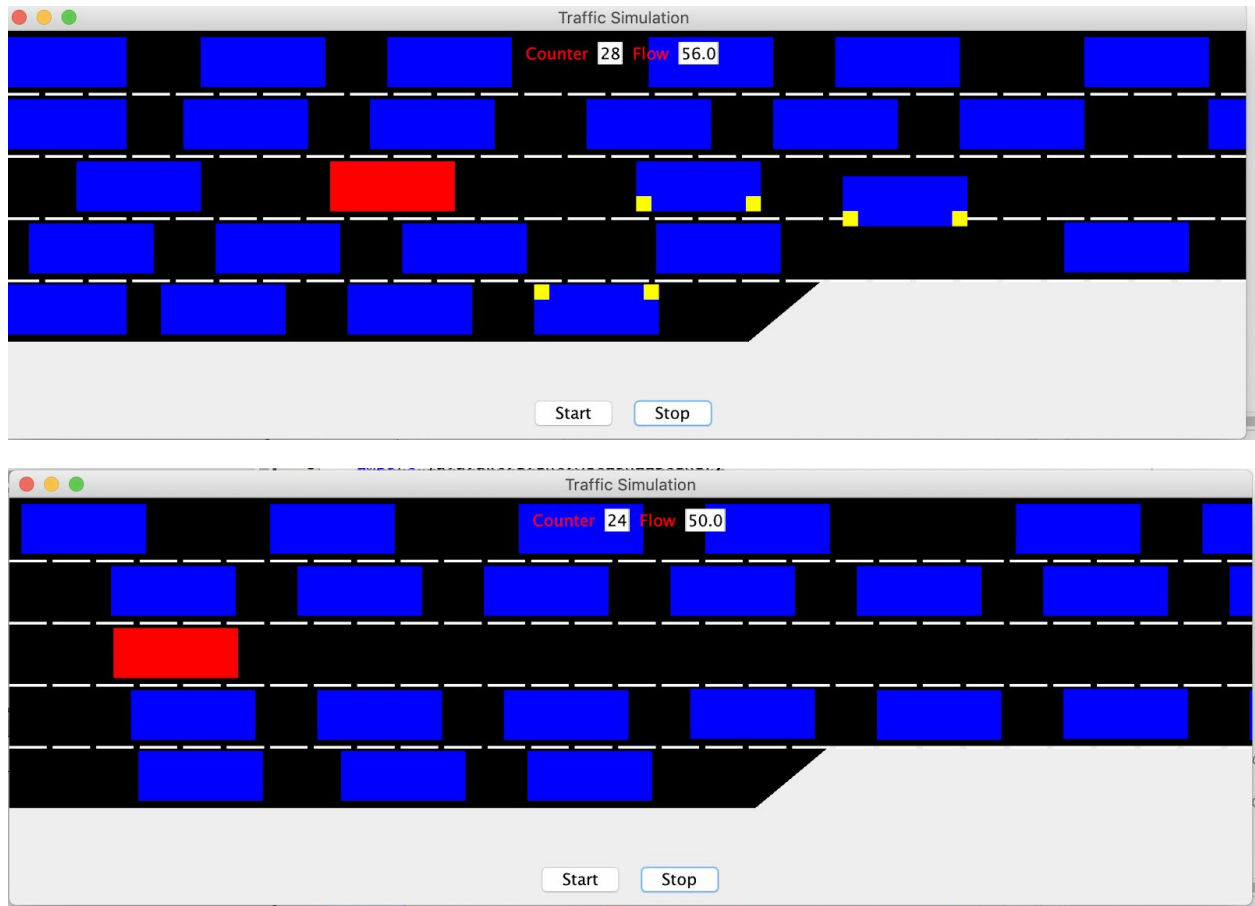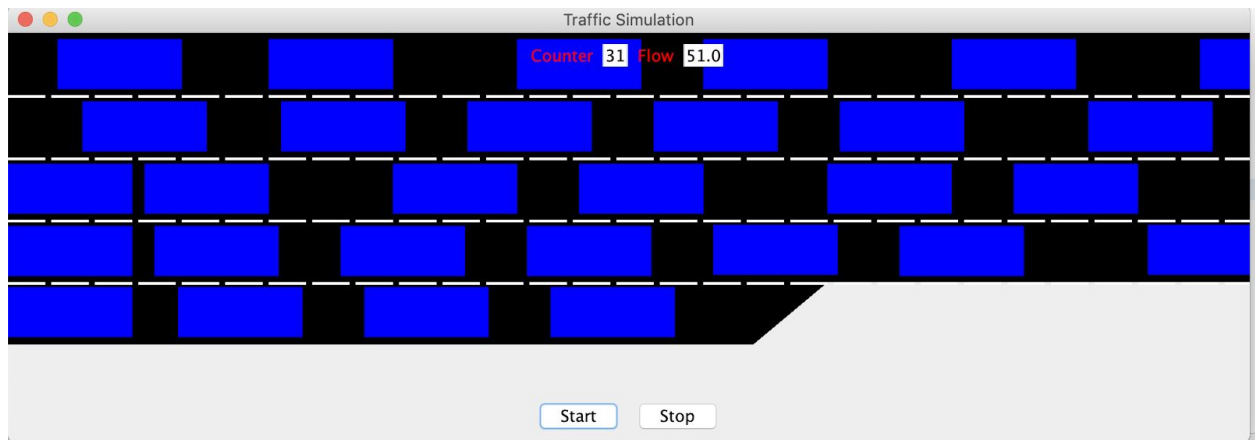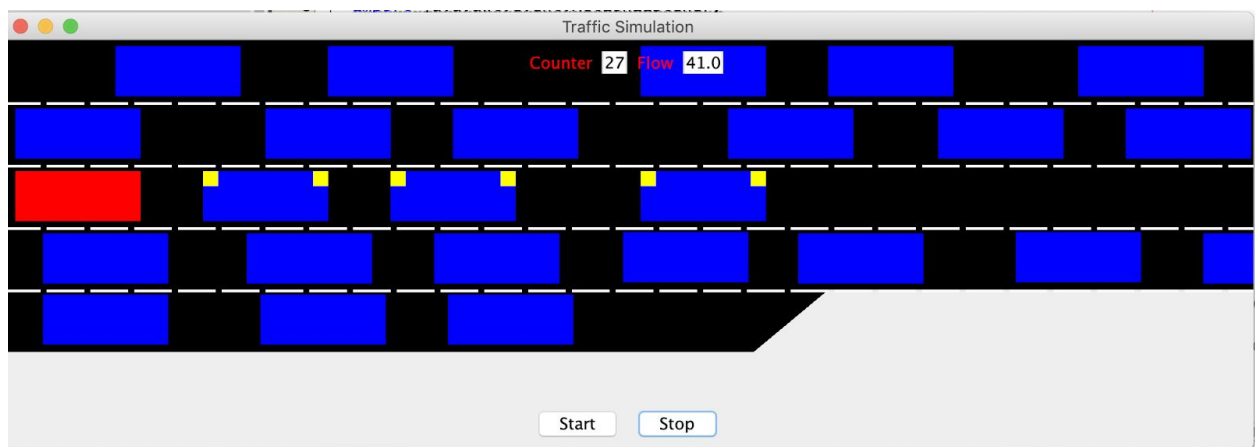
Figure 7. Special Vehicles

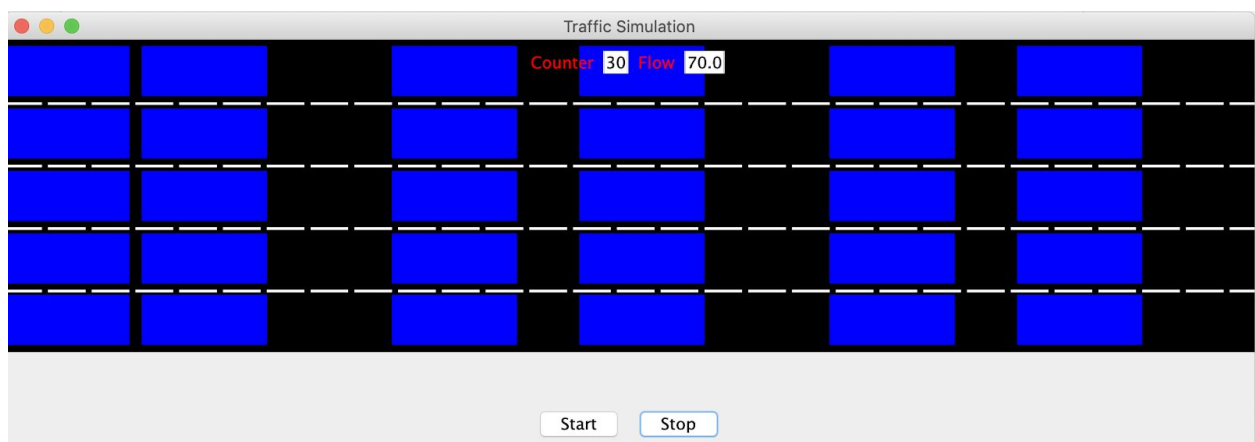Four overall situations and flow comparison:

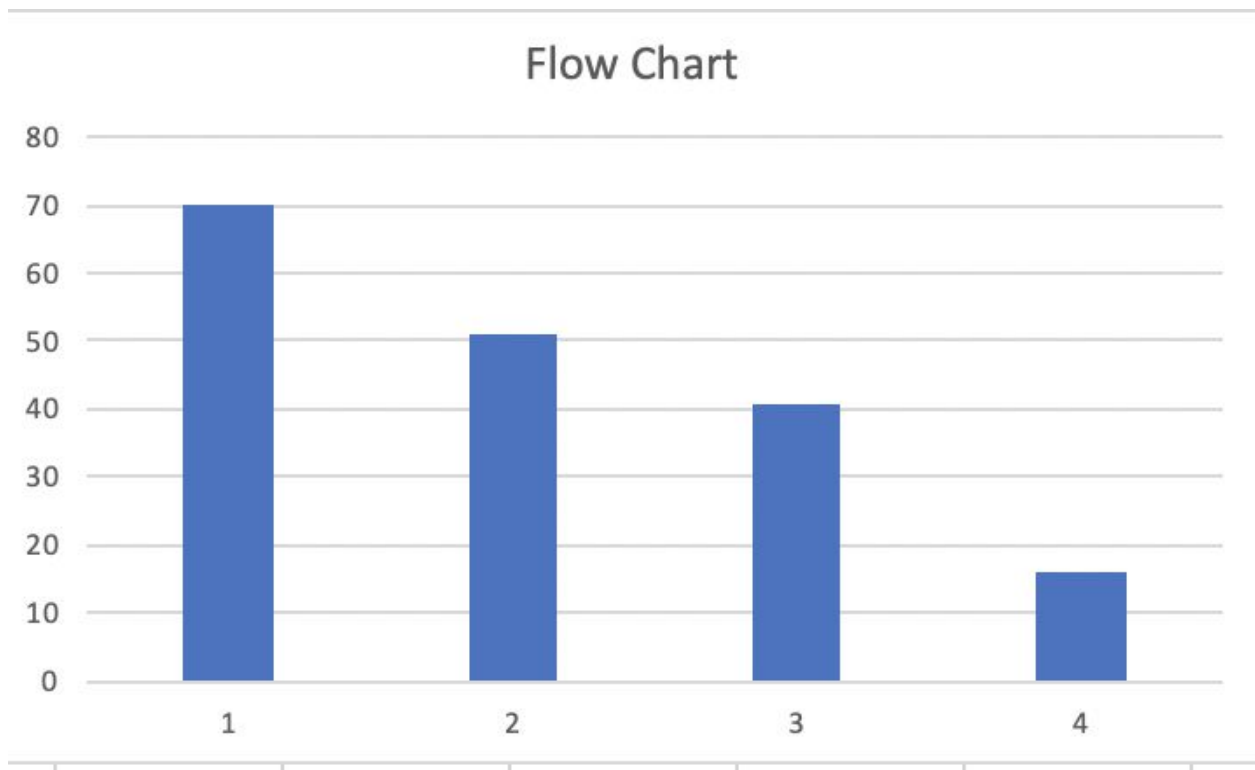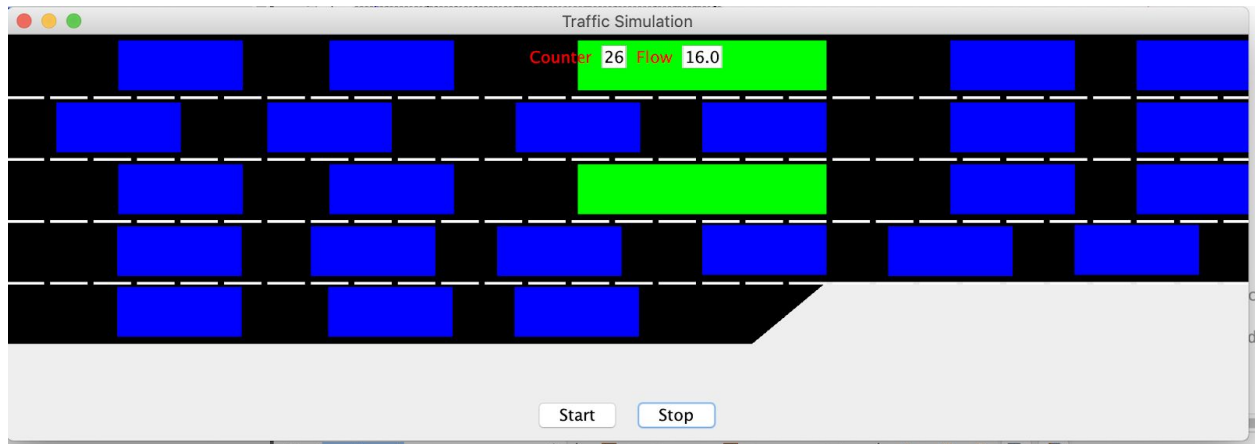Situation 1: simulation with merge without special vehicle

Situation 2:simulation with merge with special vehicle

Situation3:simulation without merge without special vehicle

Situation4:simulation with merge with special vehicle with truck

Flow Chart

Conclusion: In normal no need to merge situations, the flow is 70 which is highest among situations. When merge occurs, flow is reduced to 51. When we add a special vehicle in a merge situation, flow is again reduced to 41. Finally, when we add big vehicles, special vehicles and merge situations together, the flow is lowest which is 16.