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Team Control Number

56361

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Problem Chosen

B

2017

MCM/ICM

Summary Sheet

(Your team's summary should be included as the first page of your electronic submission.)

Type a summary of your results on this page. Do not include the name of your school, advisor, or team members on this page.

Suppose you've had a long day and just want to go home and relax. The toll plaza is backed up, and when you are driving through the plaza, you never really feel safe. People are just merging all over the place. It's backed up so much, you're burning gas like crazy. Can you even make it to the next gas station? You'd have to go through an additional toll plaza anyways. You just wanted to get home. Safety, speed, and efficiency are all you really want in your life. This is all you need in a toll plaza, all anyone needs really. Why couldn't it be better? That's where we come in.

Our goal for this project is to create a toll plaza simulator which would allow us to explore various shapes and merging patterns to optimize everything that you care about. To do this, we created a series of car driving artificial intelligences of increasing complexity in order to simulate driving through existing toll plaza designs, and then designs of our own. The cars would drive through our grid based world, making the toll plazas easy to customize. Initially, the cars only cared about themselves as they drove. This was really good for some things, as the cars would avoid slamming into walls, and they would drive as fast as they desired. However, they would often slam into each other. To eliminate this issue, we gave the cars predictive powers. The cars could foresee where they would hit the other cars, preventing accidents from happening. This allowed us to simulate the cars intelligently driving through the toll plaza, in a way that looked human (or self-driving, as needed). Though each car exhibited only self-optimizing behaviors, real life effects appeared in our simulations emergently, such as the traffic jams occurring when car density reached a critical level.

Once we had these simulations in place, we were able to explore many different toll plaza designs, and evaluate them with respect to important variables like safety, throughput, cost, and speed. We varied the merging patterns and the general shape of the toll plaza, eventually discovering a rather exotic, original shape which performed extremely well.

We created a toll plaza design that divides the flow of traffic. This enforces good behavior from the cars, not aggressive optimization. Additionally, this improves safety, speed, and throughput, while keeping cost to a minimum. We believe that by creating our comprehensive toll plaza simulator, we were able to successfully address every concern. Our simulator allows us to explore how to save time, and lives, and we believe that by using our ideas, you can get home faster, safer, using less gas, and feeling less stressed.