Traffic Flow at the Albuquerque International Balloon Fiesta

New Mexico Supercomputing Challenge

Final Report

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Team: 62
Jackson Middle School

Team Members:

Kiara Onomoto, Ayvree Urrea, Delaney Montoya

Sponsor Teacher:

Karen Glennon

Mentor:

Nick Bennett

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Executive Summary:

The Albuquerque International Balloon Fiesta is an annual festival of hot air balloons that takes place in Albuquerque, New Mexico. Every year there is around 840,000 people who attend. This causes traffic which can be an inconvenience to the community and many visitors. The traffic causes many crashes and car back ups. The traffic is negative for the Albuquerque International Balloon Fiesta and we wanted to learn why it gets so backed up and how the situation could be improved. Our team created two programs. The first program is current state of traffic flow to include problem areas. The second program is future improvements for the traffic shown by lanes. This is the team's second year working on this project. This year the team focused on adding more variables to the program and strengthened our research. The new variables are car density and using an actual map in the program instead of a grid. We researched traffic theory, traffic flow, and Geographic Information Systems (GIS). This research has helped us learn more about traffic in general which gave us a better understanding of why the Balloon Fiesta traffic moves the way it does. It also gave us ideas for improvement. Another source we used from last year is Civil Engineer Designer, Zak Cottrell. He provided us a map of the actual Balloon Fiesta with roads they normally use and block off, which helped us design our program. He also answered many questions that we had about road engineers and how these engineers design roads for event traffic, like the Albuquerque International Balloon Fiesta.

Problem:

Why is the traffic is so backed up? What can be changed to help the problem?

We are doing this because the traffic at the Albuquerque International Balloon Fiesta is an inconvenience to people in the community like students, workers, pedestrians, and any other drivers. The traffic interrupts those who are trying to go to school, work, and overall just to get through. It causes delays and accidents for drivers and can put pedestrians at risk of being hit or it will take longer for them to get to their destination. This is our second year working on this project and we wanted to continue it because it is a local issue that has impacted many people's daily lives. Ultimately we believe the Albuquerque International Balloon Fiesta traffic can result in many consequences in the community around it.

Objectives:

Research:

- Research Balloon Fiesta Website
- Learn more about traffic flow.
- Research the park and ride feature
- Find more people as resources
- Learn more about GIS

Program:

- Add GIS to program
- Make at least two simulations displaying the traffic
- Make a model realistic to the actual Balloon Fiesta

Method:

Start of the Year:

This project is a continuation of last year. This year we decided we needed to find more data and instead of making only one simulation, we decided to make two. In the beginning of the year we were a team of three people between two different schools. As the year progressed one team member moved to California. Which made it more difficult to communicate with one another. Now we are a team consisting of three different schools, two in New Mexico and one in California. Although this change has caused challenges in communicating and our different schedules, it has also made us learn to be flexible when working with a team. It also taught us how to be more effective with our time and how to use online tools to communicate and collaborate.

Improvements from last year:

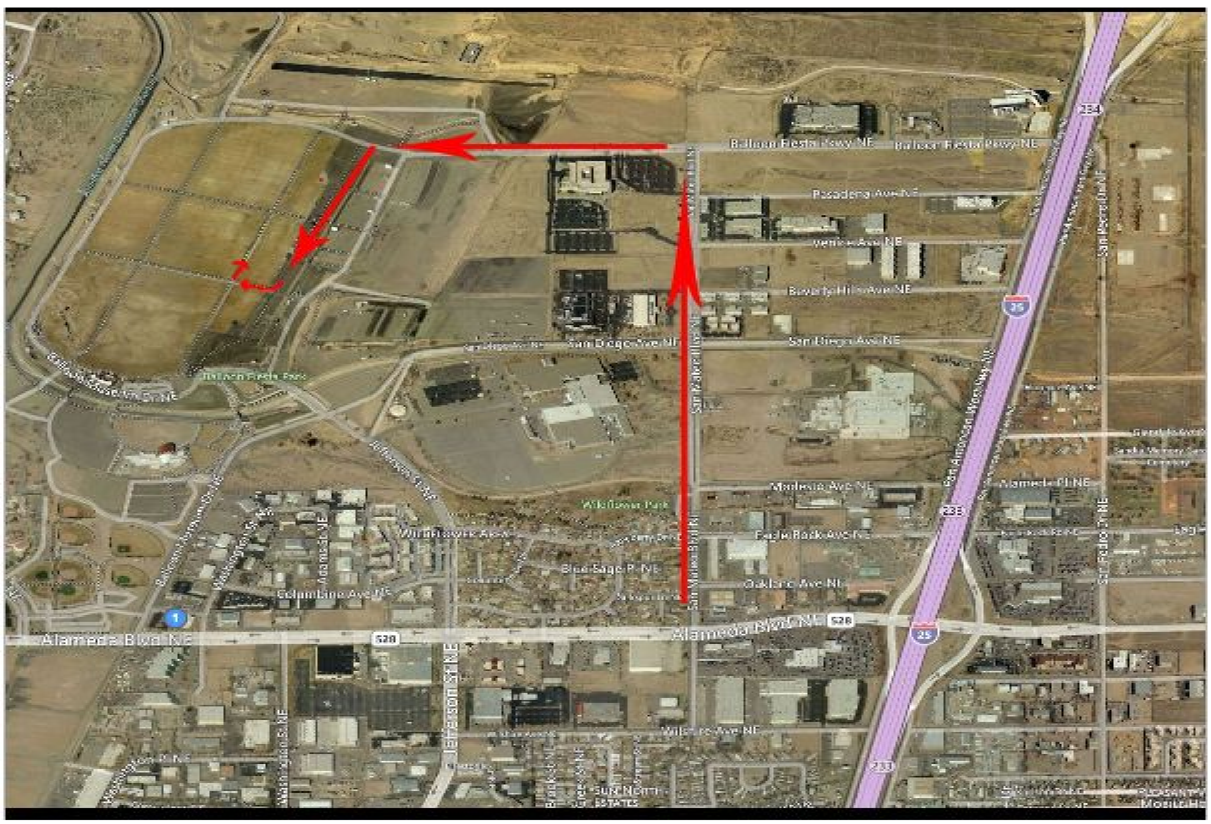
This year our project started off as a simple answer of what would improve the Albuquerque International Balloon Fiesta traffic. We had very little data and validation. We had nothing to prove why our theory was correct. This was one of the reasons why our project wasn't very successful. We also had a very simple program. Our simulation was a simple grid and provided no data nor conclusion. We wanted to get an exact answer for our problem. So after the Expo we decided we were going to expand our project. We knew that we would be able to gather more validation, resources, and data to find a solution.

Kickoff Feedback:

When we came back from Kickoff, we have learned more about the flaws of last years project and got advice on our project, after this we got a better understanding of what our goal was. At kickoff we learned from the scientists that it is best to start small and work from that. Which later helped out the contents of our results. They also told us that if we added too many variables that the simulation would be too confusing and hard to understand. This advice was definitely helpful to our simulation, which helped the decision of us using GIS.

Research:

This is our second year of doing this project. This year we started by reviewing the feedback from last year’s final presentations. We have used the Balloon Fiesta website as a source. This site provided us with a map of the Balloon Fiesta and the surrounding area, directions to the park, the most optimal route, and the new park and ride option. This site describes how the Balloon Fiesta perceives the traffic and their way of handling it. We used their directions as our first simulation in our model. This model shows how the is traffic is currently moving and their current directions to the park.



Another topic we decided to research is traffic flow. Traffic flow is essential to our project because it's the study of interactions between vehicles, pedestrians, and infrastructures, which is what the Albuquerque International Balloon Fiesta has to experience every year and has to record this data to improve their traffic

flow and to make it run smoother. There are two types of traffic flow, interrupted and uninterrupted. Interrupted flow means that the flow is controlled by an external source, an example could be a traffic signal. This flow has both vehicle-vehicle and vehicle-roadway interactions as a secondary role in traffic flow. Uninterrupted flow means it is only controlled by vehicle-vehicle and vehicle-roadway interactions with no external variable, an example is a highway. Both types are roles in the Balloon Fiesta area.

A feature in the Balloon Fiesta that we learned more about is the park and ride option. This year at the balloon fiesta, they decided to add this to make it more convenient for visitors by providing an easier way to get into the park. The park and ride feature works when a person is able to go to a location near them and be picked up by a bus that is headed to Balloon Fiesta.This is supposed to help them avoid the early morning traffic with less cars. Even though this option seemed to help with the traffic, many people disliked it due to the lines and prices of the park and ride which made it an inconvenience to the public. We learned that because of the amount of buses used, the whole road of Jefferson is closed off to the public. This means that there is one more road that could be used, but is currently being used by the buses. The picture below shows an example of the lines of people waiting for the park and ride.

Since we weren't able to find numerical data we had to create our own. We did this by first looking over traffic reports on the Albuquerque Journal website which gave us updates on the daily traffic during the Balloon Fiesta. These provided information on how the traffic was in the morning over the course of the

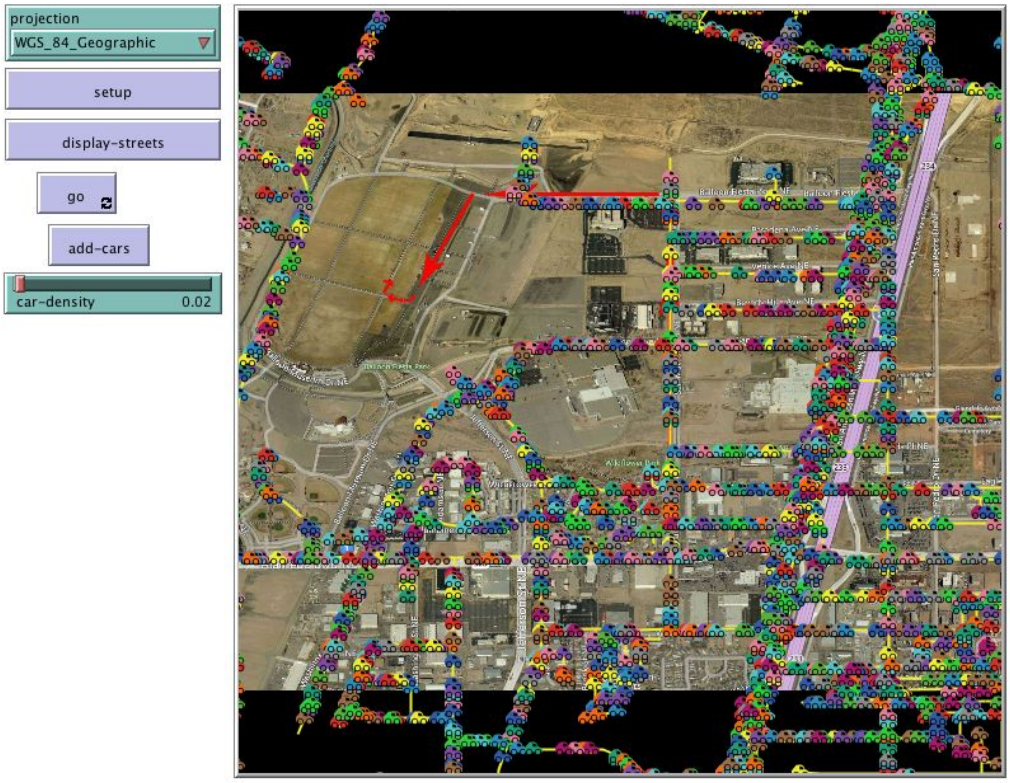
Balloon Fiesta days like accidents and delays on specific streets. This helped us get an accurate representation of what the traffic was really like on a day to day basis. Then we assigned a score to each hour in the morning. Scores ranging from 1 to 5, 1 being the least amount of traffic and 5 being the most. After this we compared each days scores to get the mean for every hour. This is the numerical data that we inserted into Netlogo.

This year we wanted to find more people as resources. Our first resource was, Sgt Zak Cottrell who is a civil engineer designer and we have kept in contact since last year. He has provided us with a board of roads, which helps us get a better visual representation of the real park and physical area around it. He has also answered many questions we have had about the traffic and how his team handles it and what they change every year. An example is that they close certain roads to the public for residents to get out of their house and reopen it once the morning rush is over. This year we took the information that Cottrell gave us and expanded on it by not only making it realistic but also accurate.

Lastly, we have researched Geographic Information Systems (GIS). GIS provided us with an accurate representation of the area we are modeling in our program.This means we downloaded an information system of the roads to help guide us to where we need our turtles to go. We learned that it shows different locations using geographic data. We have learned about GIS from Nick Bennett, who is our Netlogo mentor and has helped us with a majority of our code and directed us in planning our simulations.

Netlogo Program:

In our Netlogo program we are displaying the Balloon Fiesta traffic to simulate the roads and delays. We have made two different simulations: The first model displays how the traffic is currently moving and the flaws of it, for example delays. In the second model we show our theories of improvement. In our models we have decided to use GIS. This helps us get a more accurate map of the streets. We are also using car density to measure the amount of cars in the area. If the car density is high, this would mean that the time would be earlier in the morning since that is the busiest time of the day. When the car density is low it is later in the day. This image shows what our first program looks like.

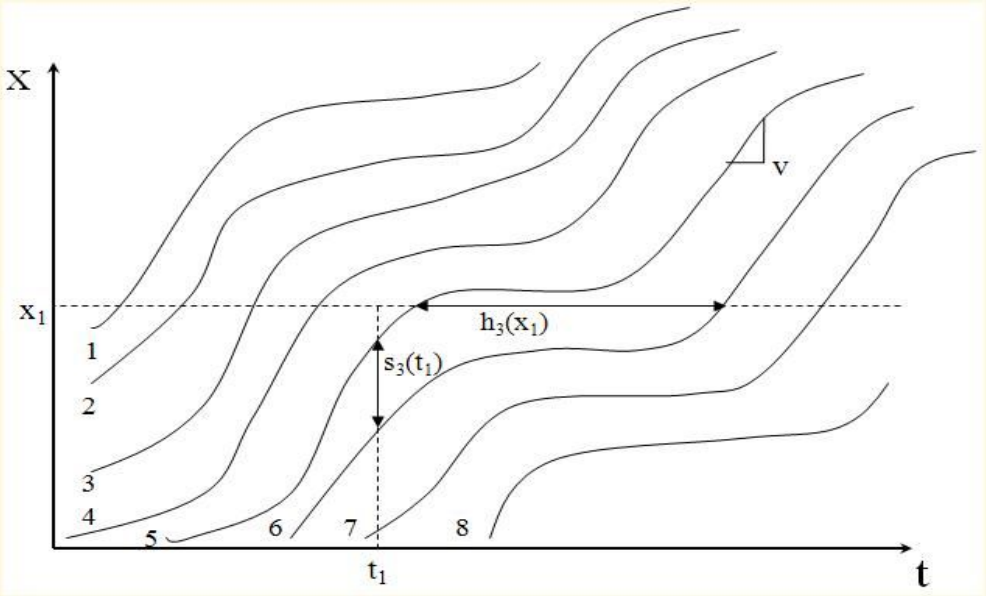


The picture below shows how we inserted our GIS into Netlogo. It shows how we were able to program and display files into our simulation, as well as how we were able to position it accurately within the picture.

```
10  trackers-own [ tick_no  minutes]
11
12  to setup
13    clear-all
14    ; Note that setting the coordinate system here is optional, as
15    ; long as all of your datasets use the same coordinate system.
16    gis:load-coordinate-system (word "streets.prj")
17    ; Load all of our datasets
18    set streets-dataset gis:load-dataset "streets.shp"
19    ; Set the world envelope to the union of all of our dataset's envelopes
20    gis:set-world-envelope [-106.604 -106.573 35.176 35.2065]
21    import-drawing "street-image.jpg"
22    set street-patches (patches gis:intersecting streets-dataset)
23
24
25    reset-ticks
26  end
27
```

Results:

In our research, we studied different traffic theories and used several sites to research how much traffic there is and which way to rearrange the streets. In the traffic theory we discovered that a lot of traffic is interrupted by sudden stops, switching of lanes, something running across the street, and more. We learned traffic would be better if cars could communicate and give signals off to each other instead of having intersections, for example self-driving cars. Traffic flow theory states that if one car gets distracted, switches lanes, or in any way slows down, traffic would increase. The image below shows how the traffic is affected when a car slows down.



We have also done research to find out when and where traffic is most common during the Balloon Fiesta. We have used Sergeant Zak Cottrell continuously as a resource because he is a Traffic Engineer Designer. He has helped us by answering many of the questions we have about the traffic flow and which streets commonly have the most traffic. In addition, we used an Albuquerque Journal article that tells us which time of the morning the traffic is the worst. It gives us accurate data from past Balloon Fiesta years on which streets get backed up and at what times.

After finishing our code and doing all of the research, we discovered the best way to rearrange the lanes on the streets is to find the alternative route without interrupted traffic. We turned Balloon Fiesta Parkway, which is a parallel road going into the Balloon Fiesta park, into a three lane street going West and one lane going East instead of having two lanes in each direction to help there be more uninterrupted traffic. This modification is best fit from the early morning until 9:30 am when the traffic is most prominent going in. After this set time we discovered that the lanes would be better off changing into one lane going West and three lanes going East as this is the time that people will be leaving the Balloon Fiesta rather than entering. Balloon Fiesta Dr. was also modified so that it only goes South instead of North and South for the people who want to leave earlier than 9:30. That will direct them to smaller roads like Venice, Modesto, and Eagle Rock with less traffic. Altogether, these changes will help visitors of the Balloon Fiesta park encounter less traffic entering and exiting to provide a more worthwhile experience.

Conclusion:

Overall, Balloon Fiesta traffic can be very problematic and stressful to all drivers. The solutions we found will help to minimize the traffic and find the optimal route during the fiesta season. The Balloon Fiesta traffic causes delays for many people trying to get to their destination whether it be to work, school, or the Balloon Fiesta itself. We used Netlogo to make models with GIS files showing the streets. These models identify the main problem areas so we can improve the traffic flow. The first model shows how the cars currently move during the Balloon Fiesta, so there are many cars covering the roads. The second model shows the improved version with roads going certain ways in order to minimize the traffic. These improvements will not only help the local drivers but also make a better impression on visitors coming into town. This will make them want to return to the Albuquerque International Balloon Fiesta.

Significant Achievements:

Delaney Montoya:

This year one of my achievements was that I was able to do more research and learn how to gather better information. I learned about which sites would be helpful to the project and what kind of information we would need to progress. I was also able to learn about how you can add different things into Netlogo such as a file, which was our GIS. Another achievement for me was being able to communicate and complete the project with my team while being in another state. This has helped me gain better teamwork and communication skills.

Ayvree Urrea:

As my first year in the SuperComputing Challenge, I have made several significant achievements. Some being learning about Netlogo and how it works, improving my speaking skills in front of people, and my researching and writing skills. Coming into this year I had no idea what Netlogo even was but I learned a lot about how it worked which helped me better understand how the traffic flow worked in the code. I was also quite nervous about talking to a scientist at the beginning of the year but now I have learned how to properly present without being scared and to say everything I need to. I also did a lot of research which helped me figure out which were the best sites to use and in my writing I have been learning how to write using better vocabulary.

Kiara Onomoto:

A significant achievement I have made this year, is that I have learned more about coding, and public speaking. Since I have been in Supercomputing, I have gotten the chance to learn how to code on Netlogo and get to simulate something that i've learned and research about, such as the Albuquerque Balloon Fiesta traffic, which I have experienced in the last year. Another achievement I am proud of is I feel more confident in speaking in public about my project. Since I started Supercomputing, I learned how to speak and project my ideas to people easier than I used to which will help me now and in the future.

Team:

The most significant achievement we had this year was our communication skills. We go to three different schools in two different states so it was very important that we all stayed in contact with each other. We had to text our progress to each other and be able to understand one another in that process. In addition, we had to video chat often to go over what we each wrote and the code. It was very important that we were able to communicate with each other especially in our situation since we did not see each other in person.

Acknowledgements:

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Nick Bennett

Bibliography:

“Getting To The Park.” *Albuquerque International Balloon Fiesta - Getting To The Park*, www.balloonfiesta.com/guest-guide/directions-maps.

“Officials Offer Tips To Avoid Balloon Fiesta Traffic.” *KOAT*, KOAT, 5 Oct. 2017,

www.koat.com/article/officials-offer-tips-to-avoid-balloon-fiesta-traffic/5034209.

Press, The Associated, et al. “Balloon Fiesta attendance leaves traffic at standstill.” *KRQE News 13*, 22 Feb. 2016, krqe.com/2014/10/11/balloon-fiesta-attendance-leaves-traffic-at-standstill

Press, The Associated, et al. “Balloon Fiesta goers encounter problems with park and ride.” *KRQE News 13*, 8 Oct. 2017, krqe.com/2017/10/08/balloon-fiesta-goers-encounter-problems-with-park-and-ride/.

Civil Engineering Designer, Sgt. Zak Cottrell, Albuquerque Police Department, Traffic Division/Motor Unit.

Works Cited

“Albuquerque Balloon Fiesta: A High Altitude Visual Treat.” *TripSavvy*, www.tripsavvy.com/balloon-fiesta-facts-and-figures-57351.

Albuquerque Journal. “The Albuquerque Journal.” *Albuquerque Journal*, www.abqjournal.com/category/balloon-traffic.

“Albuquerque Traffic.” *KOB 4*, www.kob.com/traffic/.

“Neighborhood Traffic Management Program.” *City of Albuquerque*, www.cabq.gov/neighborhood-traffic-management-program.

“What Is GIS.” *What Is GIS?* | *Geographic Information System Mapping Technology*, www.esri.com/en-us/what-is-gis/overview.