CS 472 Assignment 5
Urban Evacuation (Team 2) Due: April 28, 2017

Team Number: 2
Team Name: Urban Evacuation
Team Members: Bradley Griffee, Rebekah Warnock, Giovanni Gaito, Grant Doohen, Shaun Cross, Nasi Robinson

1. **Mission and goals**
    a. What was the theme, mission and goals of the project?
        i. The theme of our project was to design an artificial intelligence system that could deal with the dynamic nature of routing people an emergency. Our project aimed to be able to take the input of a person's location and then be able to efficiently route that person to a designated escape point. This was to be done by taking into account the number of other people that are also getting routed out of the area, as well as any changes to the environment such as road closings.
    b. How is the project relevant to a real-world problem (describe the problem)?
        i. This application has the potential to be a literal life saver. The appropriate routing in an emergency could significantly reduce the average travel time for everyone involved. By getting everyone out of a dangerous area efficiently we benefit not only the people who are leaving, but also emergency services by allowing them to get around easier through reducing road congestion.
2. **Project implementation**
    a. How did your team carryout the project?
        i. The project was carried out in a few parallel development tasks. These were the retrieval of necessary information to compute routes, development of a heuristic optimized for traffic flow, and prototyping a user interface. Combined, these three systems allow for a user to request a route and automatically get back the most efficient path at that time.
    b. How was the project broken down into discrete tasks? what were those tasks?
        i. Our team broke the project down into three distinct sections: a database that contains all the necessary information to do route calculations, an algorithm to find the routes, and an app which shows the user their assigned route.
    c. How were those tasks carried out by team members and who were the team members working on specific tasks?
        i. Initially Shaun and Brad oversaw getting the data and putting it into a database accessible via web-requests. Bekah and Grant oversaw deciding on the algorithm we would use and creating a heuristic to be used. Nasi and Gio were then left to prototype a simple application that could be used to convey all the information. As the project progressed Shaun was able to manage and work on optimizing the database alone. Bekah, Brad, and Grant worked on implementations of the algorithm, one in python and another in Java (since we didn't know which was going to work at first), which was later reduced to just the java implementation. Nasi and Gio continued their work on the application through the end of the project.
    d. Show a time line for the completion of the tasks and project
        i. See attached for time line.
3. **Method and Approach**
    a. What methodology did your team use?

i. Due to the size of the information we needed to process our group tried to separate the project out and develop individual sections in parallel. We were able to make continuing progress by meeting weekly to determine the specifications for interactions between the parts of the system. For example, once the database had been fully implemented the API to access information on the database was posted so that the people developing the algorithm knew how to read in the data.

b. Describe the general approach used by your team to design and build this project (languages, platforms, etc.)

   i. Generally speaking, our implementation breaks down into 3 parts: the database, the algorithm (back end), and the app (front end). The database is a PostgreSQL database with the OSM (OpenStreetMap) data read in as tables. The back end is implemented alongside the database in Java with optimizations made to read the data into memory to prevent thrashing. Finally, the app is written for the iPhone in Swift, using web requests to interface with the back end.

c. Describe what about the project makes it an AI project.

   i. This project is a near definition of a dynamic path finding problem because it is required for our implementation to take into account both the changing environmental conditions as well as the changing road saturation's.

d. Briefly describe the tools that your team used (Watson, OpenStreetMaps, NLPTK, etc.)

   i. Our team’s primary source of information was from the OpenStreetMaps database of map data. We also used PostgreSQL to collect and manage this data, along with Java and Swift for implementation of our program.

4. How is the project application used?

a. This section should include a description of a walk-though of the use of the resulting application

   i. We wanted to keep the user side of our application as simple as possible since in the case that someone is using our product they want to get straight to having a route. Thus, to use our application the user opens our app and presses a single button which sends your location to our server. The server then returns the route you should take out in a map format with pins along your route so that you know where to go at each step.

   On the administrative side there is a command line interface for closing roads and, if necessary, a database interface for making changes to or updating the OSM data that is used for calculations.

   It is worthy noting the process which is used for each “instance” of an emergency. When the program is started it reads in the relevant information from the database to create a network of nodes that it can work with for routing into memory. Due to reading a very large amount of data in at once (tens of thousands of nodes) and then performing pre-calculations for each one, the server start up time was considerable. Although with later optimizations we were able to reduce this time fairly significantly. However, in a real world application this start up time is negligible, because the server would either be always running, or started as soon as there was a hint of a possible emergency situation. Once the database has been loaded into memory it can be used to compute the actual routes at the request of the application. This is also where the implementation for closing roads comes into play. Since roads would be conditionally closed depending on the situation there are no closed roads in the database (just all roads that exist). When the application is running, you can go in from the administrative side and close roads as necessary. Any closings will then be propagated out to the appropriate route calculations.

In addition, due to the nature of our project and our decision to use a real-world road network rather than a fictitious one, our project was bottle-necked at several points by the computing power of our laptops. We have made efforts to optimize the code to be scale-able, such that with little effort it could be put onto a more powerful computing cluster and run optimally.

5. **Application effectiveness**
    a. What methodology was used to assess the effectiveness of the project application?
        i. The most important measurable goal of our project was if it was able to output the necessary information to give a person a route of the situation or not. In this case the effectiveness was a binary yes or no. After our testing, we determined that we did in fact accomplish this goal. However, this is not the only measure of effectiveness. The other measure that we were aiming for but cannot effectively measure is the measure of average travel time. From our calculations, we do believe we have improved upon the average travel time with our project compared to a similar non-AI project. The reason this is difficult to measure is that the heuristic we have developed to and calculate routes dependent upon road saturation is the heuristic we would need to use to see if it successfully got the minimum average travel time. Thus, no matter what data we put into our system it would be optimizing exactly that heuristic, always showing an improvement over conventional systems. The only way to test our system then is to actually test it in the real world where all the conditions we cannot account for come into play. Which obviously we cant do without 10 thousand volunteers and all the roads in Morgantown shutdown for half a day. Or alternatively, we would need a perfect traffic simulator, which we do not have, nor do we believe even exists.
    b. How well did the resulting application meet the goals of the project?
        i. As far as the goal of getting people out of the disaster area our project works as intended. Although it could use some more polish, the functionality is all implemented and working.
    c. If the project application did not completely meet project goals or expectations, how might it be improved.
        i. The only thing missing from our project is a more polished interface primarily with respect to the Admin interface. Since right now it is only a command line it would be beneficial in most circumstances to have some kind of portal that allows for an easier way of closing roads and seeing what kind of web requests are actually being made.

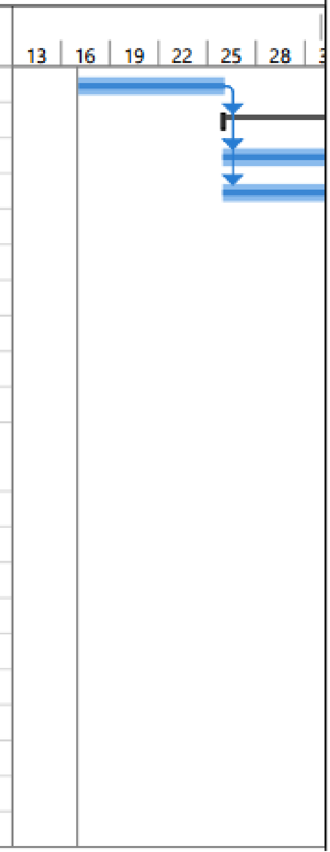
6. **Beyond the horizon…**
    a. If the project were to extend beyond this semester, this class, where might you take it? How would you extend it, or apply to a more general problem area?

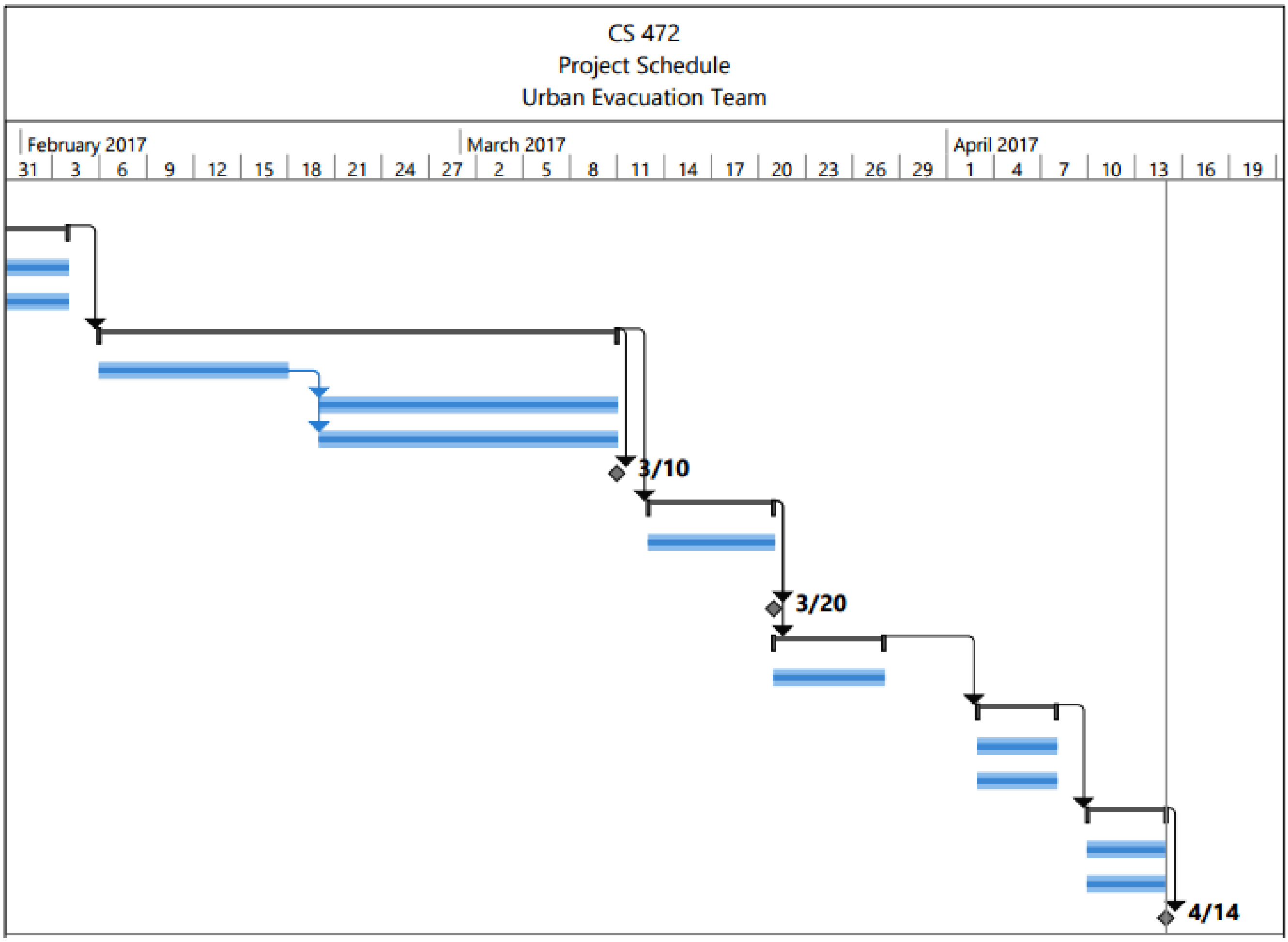
i. This project could be taken further by putting more effort into testing the real-world outcome of using it for routing. As we mentioned before the application is extremely hard to test without some sort of traffic simulation software or without using a ton of people on real roads. Due to that, our project is not very well tested in the sense that our heuristic could most likely be much more finely tuned. Unlike the projects in which teams were able to access tens of thousands of confirmed good and bad system inputs and get a statistic for how accurate the system is, we do not have any data to test our system against or compare to.

7. **List of significant contributors to this report (who participated in the meeting where this report was constructed?)**
   a. All members were present in the meeting this report was written during, and all members reviewed the report for accuracy before submission.

CS 472
Project Schedule
Urban Evacuation Team

ID		Task Mode	Task Name	Duration	Start	Finish
1			Scope	7 days	Tue 1/17/17	Wed 1/25/17
2			**Prototype**	**7 days**	**Thu 1/26/17**	**Fri 2/3/17**
3			Front-End Example	7 days	Thu 1/26/17	Fri 2/3/17
4			Database Example	7 days	Thu 1/26/17	Fri 2/3/17
5			**Implementation**	**25 days**	**Mon 2/6/17**	**Fri 3/10/17**
6			Database	10 days	Mon 2/6/17	Fri 2/17/17
7			API	15 days	Mon 2/20/17	Fri 3/10/17
8			Application	15 days	Mon 2/20/17	Fri 3/10/17
9			Working Components	0 days	Fri 3/10/17	Fri 3/10/17
10			**Integration Testing**	**6 days**	**Mon 3/13/17**	**Mon 3/20/17**
11			Application with Database	6 days	Mon 3/13/17	Mon 3/20/17
12			Working Product	0 days	Mon 3/20/17	Mon 3/20/17
13			**Documentation**	**5 days**	**Tue 3/21/17**	**Mon 3/27/17**
14			API Documents	5 days	Tue 3/21/17	Mon 3/27/17
15			**Testing**	**5 days**	**Mon 4/3/17**	**Fri 4/7/17**
16			Bug Fixing	5 days	Mon 4/3/17	Fri 4/7/17
17			Use Case Tests	5 days	Mon 4/3/17	Fri 4/7/17
18			**Presentation**	**5 days**	**Mon 4/10/17**	**Fri 4/14/17**
19			Write Materials	5 days	Mon 4/10/17	Fri 4/14/17
20			Practice	5 days	Mon 4/10/17	Fri 4/14/17
21			Done	0 days	Fri 4/14/17	Fri 4/14/17

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Project Schedule
Urban Evacuation Team
February 2017
March 2017
April 2017
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