Initial project pitch (approximately 2 pages)

Prepared for **Madison Metro Transit**

Prepared by **Bus Boys**

Team members

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Problem motivation

Madison Metro Transit is currently in the process of redesigning their bus routes, with a complete redesign planned for 2023. This leads to the question of what the optimal bus routes are for a city, which can lead to a simplified problem of minimizing the average travel time while also optimizing the fuel consumption costs. We will seek to find this optimal solution and analyze how the optimal routes are affected by the weighting of the objectives of travel time and fuel efficiency.

Discussion of mathematical model

The *decision* we are trying to make by working on this project is finding the optimal bus routes based on the travel time and fuel efficiency tradeoffs. For analyzing this, our *decision variables* will be the stops for each bus route or line, and the number of buses that run on these routes. The *constraints* we would have to take into consideration for our optimization problem would be that we can't move stops from their existing locations, the total inventory of buses available, the number of existing bus routes or lines and also that each line should have at least one bus plying on it. Finally, our *objective* is to minimize the average travel time while also minimizing the fuel consumption costs for Madison Metro Transit, and analyze the tradeoff between trying to optimize each of these to the maximum extent possible.

This is a *linear optimization problem (LP)*, which can be characterized by the decision variables, constraints and objectives mentioned above.

Proposed analysis

To analyze the bus routes in the city of madison, we have the two objectives of travel time and fuel cost. We plan to analyze the *pareto curve* as we vary the importance of our 2 objectives. We also plan to vary the parameter of the number of buses available to the model to investigate any improvements that may be possible by purchasing more buses or if there may be savings by running fewer.

Data gathering plan

For this problem we require information about the current ridership of the buses by bus stop locations in order to determine the current usage. This data is provided by Madison Metro on the City of Madison Open Data Portal, which tracks all boarding on the buses and makes the data available here.