CSE3024- Web Mining

Digital Assignment - I

Bus Schedule Optimization

By

20BCE1501	Akash R
20BCE1437	Abrar Ahamed
20BCE1573	Akshay Girish

B.Tech CSE

Submitted to

Dr.A.Bhuvaneswari,
Assistant Professor Senior,
SCOPE, VIT, Chennai

School of Computer Science and Engineering

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School of Computing Science and Engineering

VIT Chennai

Vandalur - Kelambakkam Road, Chennai - 600 127

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Worklet details

Programme	B.Tech	
Course Name / Code	CSE3024	
Slot	A2 + TA2	
Faculty Name	Dr.A.Bhuvaneswari,	
J Component Title	Bus-Schedule-Optimization	
Team Members Name | Reg. No	Akash R	20BCE1501
	Abrar Ahamed	20BCE1437
	Akshay Girish	20BCE1573

Team Members(s) Contributions – Tentatively planned for implementation:

Worklet Tasks	*Contributor's Names*
Data collection	Akash R
Data preprocessing	Abrar Ahmed
Thresholding and optimization	Akshay Girish
Visualization	Akash R
Technical Report writing	Akshay Girish
Presentation preparation	Abrar Ahmed

ABSTRACT

This project aims to optimize bus schedules in order lower costs and reduce carbon emissions using passenger occupancy data collected via the Transloc API. Our project is a crucial initiative aimed at improving public transportation services by optimizing bus schedules. Our project seeks to create a more efficient and effective bus schedule by taking into account several critical factors, such as travel time, passenger demand, and bus capacity.

The goal of our project is to make public transportation services more accessible, convenient, and efficient for passengers, reducing travel times and increasing cost-effectiveness for the transportation company. The project uses mathematical and computational models to analyze various data points and create an optimized schedule that meets the needs of both passengers and the transportation company.

In addition to improving transportation services for passengers, this project can also have significant benefits for the environment and the local community. By reducing traffic congestion and environmental impact, the project can help to create a cleaner and healthier environment for everyone. This can be achieved by reducing emissions from vehicles, minimizing energy consumption, and reducing the need for additional transportation infrastructure.

Furthermore, the optimization of bus schedules can also lead to increased customer satisfaction, as passengers are more likely to use public transportation when they are able to reach their destinations faster and more conveniently. This can result in increased ridership, which can help to boost the local economy and create more job opportunities.

1. Introduction

The goal of our project is to make public transportation services more accessible, convenient, and efficient for passengers, reducing travel times and increasing cost-effectiveness for the transportation company.

The main objective of this project is to create a more efficient and effective bus schedule that takes into account various critical factors such as travel time, passenger demand, and bus capacity. By analyzing this data, the project creates an optimized schedule that meets the needs of both passengers and the transportation company.

The project utilizes mathematical and computational models to analyze the data and determine the best schedule for each bus route. The goal of this project is to reduce travel times for passengers, increase cost-effectiveness for the transportation company, and enhance overall customer satisfaction.

In addition to these benefits, this project can also have a positive impact on the environment and the local community. By reducing traffic congestion and environmental impact, the project can help to create a cleaner and healthier environment for everyone.

In conclusion, our project is a vital initiative that has the potential to significantly improve public transportation services and enhance the overall quality of life for the local community.

Literature Survey (sample)

Sl no	Title	Author / Journal name / Year	Technique	Result
1	A Multiobjective Optimization Model for Flexroute Transit Service Design	Smith, B. L., Demetsky, M. J., & Durvasula, P. K. Journal of Public Transportation, 2003.	Multiobjective optimization	Development of a useful tool for designing efficient and effective flexroute transit service that balances multiple conflicting objectives.
2	Source Based Fake News Classification using Machine Learning	Steven, I., Chien, J., Dimitrijevic, B. V., & Spasovic, L. N Journal of Public Transportation, 2003.	Mixed Integer Linear Programming (MILP)	Demonstration that mathematical optimization can be used to optimize the design of bus routes in urban commuter networks.
3	The optimization of bus rapid transit route based on an improved particle swarm optimization	Zhong, S., Zhou, L., Ma, S., Jia, N., Zhang, L., & Yao, B Transportation Letters, 2018.	Particle Swarm Optimization (PSO) algorithm for optimizing the design of Bus Rapid Transit (BRT) routes	Compare the performance of the improved PSO algorithm with traditional PSO algorithms and other metaheuristic optimization algorithms.
4	A two-phase optimization model for the demand-responsive customized bus network design	Huang, D., Gu, Y., Wang, S., Liu, Z., & Zhang, W. Transportation Research Part C: Emerging Technologies, 2020.	Mixed Integer Linear Programming (MILP) model and the branch-and-bound algorithm	Demonstrate that the demand prediction model is accurate and that the network design model can handle different levels of demand and varying road conditions

5	Time-dependent customized bus routing problem of large transport terminals considering the impact of late passengers	Wu, Y., Poon, M., Yuan, Z., & Xiao, Q. Transportation Research Part C: Emerging Technologies, 2022	Mixed Integer Linear Programming (MILP)	Importance of considering the impact of late passengers in the design of customized bus networks
6	Optimal feeder bus routes on irregular street networks	Chien, S., & Yang, Z. Journal of Advanced Transportation, 2000	Integer linear programming (ILP) model	Algorithm converges to an acceptable solution significantly faster than the ES algorithm.
7	A time–space network based exact optimization model for multi-depot bus scheduling	Kliewer, N., Mellouli, T., & Suhl, L. European journal of operational research, 2006.	Time–space-based instead of connection-based networks for MDVSP (multi-vehicle-type bus scheduling problem) modeling	The proposed modeling approach enables us to solve real-world problem instances with thousands of scheduled trips by direct application of standard optimization software
8	Comparing static and dynamic threshold based control strategies	Rossetti, M. D., & Turitto, T. Transportation Research Part A: Policy and Practice, 1998.	Extends a static threshold based control strategy used to control headway variation to a dynamic threshold based control strategy	The tradeoff of the slight increase in waiting time for the significant decrease in on-board delay penalty makes the dynamic strategy an acceptable choice
9	Joint optimization of scheduling and capacity for mixed traffic with autonomous and human-driven buses: A dynamic programming approach	Dai, Z., Liu, X. C., Chen, X., & Ma, X. Transportation Research Part C: Emerging Technologies, 2020.	Integer nonlinear programming model	Effective in reducing passenger waiting time and total operating cost

10	Optimizing Multi-Terminal Customized Bus Service With Mixed Fleet	Sun, Q., Chien, S., Hu, D., Chen, G., & Jiang, R. S. IEEE Access, 2020.	hybrid genetic algorithm (HGA) which integrates the features of genetic algorithm (GA) and simulated annealing (SA)	Employing multiple terminals and mixed bus fleet individually, the minimized total cost can be reduced by 5.9% and 11.3%, respectively.

2. Dataset and Tool to be used (Details)

The passenger occupancy data for a particular bus route is sampled periodically via the Transloc API and stored in a database. The Transloc API provides API calls that can be used to retrieve a list of Agencies. Using an Agency ID, we can get a list of routes for a particular agency. We can also get location, arrival time, compass and passenger occupancy data for buses operating on a particular route. More information can be found on the Transloc API website. The sampled passenger occupancy data for each bus is stored in a new line within a CSV file alongwith the current timestamp using the CSV library.

We use the Requests library to make API requests and retrieve the passenger occupancy data. The code factors in the API request rate limit and ensure that it does not exceed the limit.

3. **Algorithms / Techniques description**

The method used in this project is a metaheuristic optimization technique called the "Simulated Annealing (SA) algorithm".

Simulated Annealing is a probabilistic optimization technique that can be used to find an approximate solution to a combinatorial optimization problem. In the context of this project, it is used to optimize the bus schedule by finding the best possible combination of bus routes, frequencies, and departure times that minimize the total waiting time for passengers.

The SA algorithm works by simulating a cooling process, in which the temperature is gradually reduced from an initial high value to a low value, such that the probability of accepting a new solution decreases as the temperature decreases. This allows the algorithm to escape from local minima and explore the solution space more thoroughly, increasing the chances of finding the global optimum

4. **Github Repository Link (where your j comp project work can be seen for assessment)**

https://github.com/akashr-vit/CSE3024-Web-Mining-DA1-and-DA2.git

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