Enhancement Three: Database

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Artifact Description

This artifact is a **full-stack web application** designed for a local school to address their current carpool system. The project began about three months ago when the school approached me with a challenge to replace their walkie-talkie-driven carpool method with a more efficient, real-time solution. This application allows teachers and students to stay in their classrooms while accurately tracking which students need to be sent to the carpool line. The application was developed using modern web technologies, including Node.js, Express, PostgreSQL, Redis, and WebSockets, showcasing my proficiency in developing comprehensive, efficient, and scalable solutions.

Justification for Inclusion

I selected this artifact for inclusion in my ePortfolio because it demonstrates my capability to create a practical full-stack application that solves a real-world problem. The artifact highlights my skills in:

- **Software Development**: The project demonstrates my ability to build a complete application using Node.js, integrate databases, and create real-time updates using WebSockets.
- **Database Management**: It showcases my ability to optimize database queries, implement Redis for in-memory NOSQL data storage, and handle high-frequency data requests effectively.
- **Refactoring and Optimization**: The project initially faced load issues due to inefficient PostgreSQL queries. I addressed this by transitioning the main table to a more efficient in-memory NoSQL database, Redis, significantly improving performance and scalability.
- **Code Structuring**: I successfully refactored the codebase from a monolithic design into a modular architecture, improving maintainability and extensibility. The project is now divided into smaller, manageable components, making it easier to enhance and troubleshoot.

Meeting Course Outcomes

The project aligns with the course outcomes, specifically:

- **Design and Evaluate Computing Solutions (Outcome 3)**: The project demonstrates my ability to design and implement a computing solution that effectively solves the carpool problem using appropriate computer science practices.
- **Use of Innovative Techniques (Outcome 4)**: By implementing Redis to handle in-memory operations and refactoring the code for better performance, I employed innovative techniques to improve the application's efficiency and scalability.
- **Security Mindset (Outcome 5)**: While focusing on performance, I ensured that the application adhered to security best practices, such as validating inputs and securing WebSocket connections, which are crucial in preventing adversarial exploits.

I met the course outcomes I planned to achieve, and this project further solidified my understanding and application of computer science principles in a practical setting.

Reflection on Enhancement Process

The enhancement and modification of this artifact were insightful and challenging. Here are some key learning points and challenges faced during the process:

- **Refactoring and Modularization**: Breaking down the code into smaller, manageable modules was both challenging and rewarding. It involved careful planning and testing to ensure that the application remained functional and efficient after refactoring. This process taught me the importance of clean code architecture and its impact on project maintainability and scalability.
- **Redis Integration**: Researching and implementing Redis as an in-memory database was a crucial learning experience. It highlighted the advantages of using Redis for applications that require fast data retrieval and high-frequency updates, which was a perfect fit for the carpool system's needs.
- **Handling High Traffic**: The switch to Redis helped alleviate the server load issues, demonstrating the importance of choosing the right database solution for specific use cases. This experience enhanced my understanding of database performance tuning and trade-offs.
- **WebSocket Implementation**: Implementing WebSockets for real-time communication was another highlight. It was essential for providing immediate updates to teachers and students, enhancing the application's user experience. This task required understanding the intricacies of WebSocket connections and handling potential connection issues gracefully.

Conclusion

This project provided an excellent opportunity to apply my skills in a real-world scenario, demonstrating my ability to deliver a full-stack application that meets specific client needs. By including this artifact in my ePortfolio, I am showcasing my technical expertise, problem-solving skills, and commitment to developing efficient and effective solutions using modern technologies.