



Master Advanced Machine Learning and Multimedia Intelligence

Developing a University Timetabling System

A Step-by-Step Guide Using Spring Boot, Java, CPLEX and MySQL, Based on Integer Programming Formulation

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Summary

This report represents the outcome of our work over the past month. The objective of this project is to design and implement a web application for generating university timetables. The methodology adopted was inspired by the research presented in the article, *"An Integer Programming Formulation for a Case Study in University Timetabling"* by S. Daskalaki, T. Birbas, and E. Housos. The article provided insights into modeling university timetabling as a 0-1 integer programming problem, addressing operational constraints and optimization to ensure feasible and quality schedules.

Before entering the development phase, we began by analyzing requirements and defining specifications, guided by the concepts in the article. Following this, we conducted a detailed design based on the Unified Modeling Language (UML). This study allowed us to establish the technical choices adopted in the development process and to create a structured work plan, enabling us to achieve good results while adhering to quality standards.

This report also demonstrates how the proposed system was incrementally developed, starting with simple terminal-based data demonstrations, progressing to database integration, and finally presenting a full-stack implementation using Spring Boot, Java, and MySQL.

Conclusion

This project has been a challenging yet rewarding experience that deepened my understanding of solving real-world problems using technology. The university timetabling problem, while seemingly straightforward, proved to be complex due to the numerous constraints that needed to be considered, such as class schedules, teacher availability, and room capacity.

I approached this challenge methodically. Initially, I decided to simplify the process by bypassing the use of a database and directly sending inputs from the React frontend to the Spring Boot backend for processing. This decision allowed me to focus on the core logic of timetable generation without being bogged down by CRUD operations.

The complexity of the project came from identifying and applying the constraints correctly. Each constraint represented a unique challenge, and balancing them required careful planning and optimization. To address this, I avoided CRUD operations and frontend data input entirely, instead opting to instantiate the required data directly within the program using a dedicated **TimetablingData** class. This approach allowed me to focus entirely on building the logic and ensuring the constraints were properly formulated before implementing a solver to generate feasible schedules. Leveraging tools like CPLEX made it possible to handle these constraints effectively and produce an optimized timetable.

This project taught me the importance of breaking down a problem into manageable parts. By focusing on the essentials first, such as constraint formulation and logic implementation, I was able to build a strong foundation before improving the system with a simple yet intuitive user interface. The output, displayed at *localhost:8080/api/timetable/solve*, provided a clear and user-friendly view of the generated timetable, showcasing the practical value of the solution.

Overall, I found this project both intellectually stimulating and deeply fulfilling. It reinforced my problem-solving skills, my ability to tackle complexity, and my confidence in applying advanced tools and frameworks like Spring Boot and CPLEX. It was **not just** about building a solution, **it was about learning how to navigate challenges, think critically, and deliver results.**

Resources:

 GitHub Repository: <https://github.com/elidrissilaoukili/timetabling>

 Project Website : <https://elidrissilaoukili.github.io/timetabling>