Bachelor Project Summary

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Advisor: Prof. Antonio Carzaniga
Co-Advisors: (if applicable)
Project Title: **Implementation and Comparison of Algorithms for the Knapsack Problem with Integer Linear Programming (ILP) Formulation**

Project Objectives:
The goal of this project is to implement and compare different algorithmic approaches for solving the Knapsack Problem, a well-known combinatorial optimization problem. The core objective is to explore and evaluate various approaches, such as dynamic programming, greedy methods, branch-and-bound, and genetic algorithms. Additionally, the project will involve transforming the Knapsack Problem into an **Integer Linear Programming (ILP)** model, which allows for the application of ILP solvers to find optimal solutions. The project aims to assess the efficiency, performance, and scalability of these algorithms and solvers, particularly when dealing with large instances of the problem. This comparison will highlight the advantages and limitations of different approaches to combinatorial optimization.

Project Plan

Week ID	Expected Activity	Expected Results	Performed Activity (to be filled weekly)
W1	Review literature on the Knapsack Problem and ILP transformation	Summarized 3-4 key papers, outlined initial approach	
W2	Set up the project environment (choose tools, languages)	Development environment ready for implementation	
W3	Implement the Greedy algorithm for the Knapsack Problem	Basic greedy algorithm code completed and tested	
W4	Implement Dynamic Programming (DP) solution	DP algorithm code implemented and tested	
W5	Compare Greedy and DP on small datasets, test performance	Performance comparison on small instances documented	
W6	Implement Branch-and-Bound algorithm	Branch-and-Bound algorithm implemented and tested	

W7	Implement Genetic Algorithm for the Knapsack Problem	Genetic algorithm implemented and tested
W8	Transform the Knapsack Problem into an ILP model	ILP model of Knapsack Problem formulated
W9	Solve the ILP Knapsack Problem using an ILP solver (e.g., PuLP, Gurobi)	ILP solutions computed for small and large instances
W10	Compare the performance of ILP solutions with other algorithms	Comparative analysis of ILP vs. other algorithms
W11	Finalize analysis, prepare project report and presentation	Completed project report and presentation slides
W12	Submit final report and presentation	Final submission of project report and presentation