Optimization Methods - Assignment 1.1

A Description

The One-Dimensional Bin Packing Problem (1D-BPP) is a fundamental combinatorial optimization problem where a set of items, each with a given size, must be packed into the minimum number of fixed-capacity bins. The objective is to assign all items to bins such that the sum of item sizes in each bin does not exceed the bin capacity, and the total number of bins used is minimized. The 1D-BPP has important applications in logistics, manufacturing, and resource allocation, and is known to be NP-hard.

The objective of this assignment is to implement a C++ program using IBM CPLEX to solve the One-Dimensional Bin Packing Problem. Students are required to:

- Build a mathematical model of the 1D Bin Packing Problem using IBM CPLEX in C++.

- Investigate and justify the choice of constraints and variables in the model.

- Search for and select benchmark data instances for the 1D Bin Packing Problem available online, and use them to validate the model.

- Solve the 1D-BPP model using CPLEX.

- Validate the solution obtained using at least 10 benchmark instances of different sizes.

- Deliver a comprehensive report.

- Submit the source code of the implemented program.

B Resources

The following resources are provided to assist students in completing the assignment:

- Publicly available benchmark data sets for the 1D Bin Packing Problem (e.g., OR-Library, Bin Packing Problem Library, etc.).
- Sample code snippets for reading data files and building optimization models in the folder *assets/cvrpcode/* (adapt as needed).
- IBM CPLEX documentation and tutorials available on IBM's official website.

C Submission Guidelines

Students are required to submit the following deliverables by the specified deadline:

- A comprehensive report in PDF format detailing the implementation, model investigation, solution process, and results.

- A zip file containing the source code of the implemented program.

The report must include the following sections:

1. Introduction: Briefly describe the One-Dimensional Bin Packing Problem and its significance.

2. Mathematical Model: Present and discuss the mathematical model of the 1D Bin Packing Problem using IBM CPLEX, including a discussion of the modeling choices.

3. Benchmark Data: Describe the process of searching for and selecting benchmark data sets, and provide references to the sources.

4. Implementation: Describe the implementation in C++ using IBM CPLEX.

5. Solution Process: Explain the process of solving the 1D-BPP model and validating the solution.

6. Results: Present the results obtained using tables, graphs, and visualizations.

7. Conclusion: Summarize the key findings and insights from the assignment.

8. References: Include any references used in the assignment, especially for benchmark data.

Note that the report should be well-structured, clearly written, and properly formatted. The source code should be well-documented and organized for easy understanding. Late submissions will not be accepted.