

Bin Packing Project

MATH 384 • Spring 2024

due Tuesday, March 5

The bin packing problem is a classic combinatorial optimization problem. Given N items of various sizes and M bins which can hold the items, the goal is to “pack” the items into the bins so that each bin has the same total size of items. It can be very difficult to find the optimal solution when N and M are big, but we can find approximate solutions using simulated annealing.

Your Tasks

1. Read the “Bin Packing” subsection on pages 303–305 in *Computational Mathematics*.
2. Implement a simulated annealing algorithm to solve the bin packing problem. Make your implementation sufficiently general so that you can easily experiment with different numbers of items (N) and bins (M).
3. Explore the effectiveness of simulated annealing for solving the bin packing problem. How close can you get to an optimal solution? How many iterations of the simulated annealing does this require? How does this depend on N and M ?

For projects in MATH 384, *communication* is at least as important as *computation*. You should turn in a well-organized notebook that clearly explains, using sentences and paragraphs, what you computed and what conclusions you can draw.

Grading

This project will be graded on the EMRN scale, as described in the syllabus. To receive a grade of *Meets Expectations*, your notebook should exhibit the following characteristics:

- You demonstrate computational exploration of the effectiveness of simulated annealing solutions to the bin packing problem.
- Your observations allow you to answer the questions above.
- Your reasoning is explained using sentences, and your notebook is well-formatted and easy to read.
- No significant gaps or errors are present.

To receive a grade of *Excellent*, your notebook should meet the expectations above and further exhibit:

- Methodology that demonstrates mastery of concepts that we have studied in the course.
- Computation that is of high quality, demonstrating skillful and generalizable use of programming constructs.
- Exposition is clear and precise, thoroughly explaining your methodology and reasoning. Any assumptions necessary for the estimates are reasonable and clearly stated.
- The work extends beyond the project requirements in a creative or insightful direction.

Following the initial submission and grading, you will have the opportunity to revise and resubmit your project.