

Assignment 2- Optimal Chemical Mixing Problem

About the problem:

The chemical mixing optimization problem involves finding the best proportions of different chemicals to achieve a desired property (e.g., strength, color intensity, or heat resistance) at the minimum cost. Each chemical has upper and lower bounds for its proportion, and the overall mixture must satisfy specific constraints on total proportions while minimizing the cost.

What you are required to do:

Write a genetic algorithm to determine the optimal proportions of chemicals in a mixture to minimize the total cost while meeting all the constraints.

What the input looks like:

You will be given an input file with the following format:

1. First line: Number of datasets (at least 1).
2. For each dataset:
 - First line: Number of chemicals and total proportion constraint (e.g., 100%).
 - Next line: Lower and upper bounds for each chemical (two space-separated numbers per chemical).
 - Next line: Cost coefficients for each chemical (a space-separated list, where each coefficient represents the cost per unit proportion of that chemical).

Example Input:

```
1
3 100.0
5.0 25.0 10.0 40.0 15.0 35.0
8.5 6.2 7.8
```

Explanation:

- The input specifies 1 dataset.
- There are 3 chemicals, and the total mixture proportion must sum to 100%.
- Chemical 1 must be between 5% and 25%, Chemical 2 between 10% and 40%, Chemical 3 between 15% and 35%.
- The cost coefficients are 8.5, 6.2, 7.8, and 5, meaning 1% of Chemical 1 costs 8.5 units, Chemical 2 costs 6.2 units, and so on.

What the output should look like:

The output should specify the dataset index, the optimal proportions for each chemical, and the total cost of the mixture.

Example Output:

```
Dataset 1
Chemical Proportions: 20.5 40.0 39.5
Total Cost: 850.75
```

Important remarks:

1. Chromosome Representation:

- Represent each solution as a list of proportions for the chemicals.
 - Ensure the total proportion equals the specified constraint (e.g., 100%) and respects the lower/upper bounds for each chemical.
 - Implement tournament selection, 2-point crossover, non-uniform mutation, and elitist replacement
 - You must read the input from file and write the output to a file.
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Assignment submission notes:

- The maximum number of students in a team is 3 and the minimum is 2.
- The deadline will be on Friday 29- Nov- 2024 at 11:59 pm , and no late submission is allowed.
- Please submit one compressed folder. The folder name should follow this structure: ID1_ID2_ID3_MAJOR_MINOR_GROUP
- Cheating students will take negative grades and no excuses will be accepted. If you have any problems during the submission, contact your TA but don't, under any circumstances, give your code to or take the code from your friends.

Grading Criteria: (6 marks):

Representation and initialization	10
Fitness function	10

Selection ,Crossover,Mutation and replacement.	10
Handling infeasible solutions.	60
Output	10