Assignment 1

Objective:

The purpose of this assignment is to deepen your understanding of the simplex method as a pivotal tool in solving linear programming problems. You will be applying the simplex method to a series of linear programming problems in python (provided as text cases while evaluating your submissions), converting them into standard form, and executing the simplex algorithm.

Instructions:

- Given a test case in input.txt, read the file for A, b, c, objective, and constraint_type.
- Convert the linear programming problems into standard form, if necessary.
- Solve the problems using the simplex method, showing all steps:
    - Formulate the initial simplex tableau.
    - Perform the pivot operations required to reach the optimal solution.
    - Interpret the final tableau and print the optimal solution in the context of the problem.
- For computational analysis, input for A, b, and c matrices will be taken from a text file (input.txt) following the specified format.
- You will be required to submit a python file named as EntryNumber1_EntryNumber2_EntryNumber3_ EntryNumber4_A1.py

Input Format:

Your A, b, and c matrices, along with the constraint types and objective ('maximize' or 'minimize'), should be taken as input from a text file (input.txt) following the specified format. An example of the same has been provided.

- The [objective] section should clearly state whether the problem is a "maximize" or "minimize" problem. This will dictate the direction of your optimization in solving the problem.
- The [A] section contains the coefficients of the variables in the linear constraints. Each row in this section represents a constraint, and each column corresponds to a variable.
- The [b] section lists the right-hand side (RHS) values for each constraint, with each row corresponding to a constraint in the [A] section.
- The [constraint_types] section specifies the type of each constraint corresponding to the rows in [A] and [b]. Use <= for less than or equal to, >= for greater than or equal to, and = for equality constraints.
- The [c] section contains the coefficients of the objective function's variables in one row.

Submission:

Submit a python file as EntryNumber1_EntryNumber2_EntryNumber3_ EntryNumber4_A1.py containing a function named "simplex_algo" which reads input.txt and return the following dictionary in the given order:

- Initial Tableau (initial_tableau)
- Final Tableau (final_tableau)
- Status of Solution (solution_status) : "optimal"/ "infeasible"/ "unbounded"

- Optimal Solution Vector (optimal_solution): Your code should return the optimal solution vector x*, which contains the values of the decision variables [x_1, x_2, ..., x_n] that maximize or minimize the objective function, depending on the problem statement. This vector should be in a standardized format, such as a list or a NumPy array
- Optimal Value (optimal_value): Real values

The format of the tableau will be like a matrix having m rows, where m is the number of equations given in constraints and the columns will be as follows: first column for the values of current BFS, followed by the variables in optimization problem, followed by slack/surplus variables, and finally artificial variables.

You can use NumPy or any other library for these. The submission deadline is 18th of February.