



## Assignment # 1

### LP Problems Solver

## 1 Objective:

This assignment aims to provide you with a comprehensive understanding of the Simplex method and its variations by implementing them programmatically. You will develop a software tool capable of solving linear programming (LP) problems using the following techniques:

1. **Standard Simplex Method:** For LP problems with all constraints in standard form ( $\leq$ ) and non-negative variables.
2. **BIG-M Method:** To handle “greater-than-or-equal-to” ( $\geq$ ) and equality ( $=$ ) constraints.
3. **Two-Phase Method:** An alternative approach to dealing with artificial variables introduced by the BIG-M method.
4. **Preemptive Method for Goal Programming:** Solving problems with multiple objectives and prioritized goals.

**Note:** You should add support for unrestricted variables

## 2 Requirements:

1. **Programming Language:** You can use any programming language of your choice (e.g., Python, Java, C/C++).
2. **Input:** The program should accept LP problems in a standard format, such as:
  - Objective function coefficients
  - Constraint coefficients
  - Right-hand side values
  - Constraint types ( $\leq$ ,  $\geq$ ,  $=$ )
  - Variable restrictions (non-negative, unrestricted)
  - The Chosen Method for Solution in case of Big-M or Two Phase Method
  - For goal programming, goal values and priority levels
3. **Output:** The program should output:



- The optimal solution (values of decision variables)
- The optimal objective function value
- Status of the problem (optimal, infeasible)
- For goal programming, the satisfaction of each goal
- The Tables used for the solution at each step in a readable trackable format, for example: in a file.

### 3 Bonus:

- Develop a user-friendly interface for inputting LP problems and displaying results.

### 4 Submission:

- Submit your code alongside a report containing a clear explanation of your code and provide some sample runs for your code.
- You should work in groups of 3.