Assignment-1: Real-Life Optimization Problem

Course: Optimization for Data Science

Instructor: Dr. Nishant Kumar

Submission Format: IEEE Double Column (Word File and Pdf file, Both)

Submission Deadline: 25th October 2025

Total Marks: 15 Marks

Plagiarism Limit: Not more than 20% (I will Check it via Turnitin)

Dear Students,

This is your **first major assignment** in the Optimization Techniques course.

The purpose of this assignment is to help you **identify, define, and mathematically formulate a real-life optimization problem** related to your area of interest.

Later, in the next assignment, you will solve this same problem using one or more optimization techniques that we have discussed in class.

Task Description

You are required to **choose one real-life optimization problem** from any domain of science, engineering, or technology, based on your own interest or research area.

Once you select your problem, you must write a **detailed report** in **IEEE double-column format** as described below.

The same problem will be **used in your next assignment**, where you will apply suitable optimization techniques to solve it.

Techniques to be Used in the Next Assignment

Your selected problem should be suitable for solution using **classical optimization methods**, such as: Dichotomous Search Fibonacci Search, Golden Section Search, Bisection Method, Newton Method, Line Search Methods, Least Squares, Steepest Descent Method, Newton Method (for multivariable functions), Quasi-Newton Method Conjugate Gradient Methods… etc

- **Not Heuristic or metaheuristic optimization techniques**

Assignment Report Format

Your report must be written in **IEEE double-column format** (in Word file) with **Times New Roman, font size 10, single spacing**.

The content should be divided into the following clearly labelled sections:

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1. Introduction (Approximately 1000 Words)

- Introduce your chosen **real-life optimization problem** clearly.
- Explain **why this problem is important** in your selected field (scientific, industrial, or societal relevance).
- Discuss **previous research or similar studies** (a short literature survey).
  - Mention how other researchers have approached similar problems.
  - Specify which optimization techniques they have used.
  - Highlight what gaps, challenges, or limitations still exist.
- Summarize **why your chosen problem is relevant and worth studying**.
- All references cited in this section must appear in your reference list.

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2. Objective Function Formulation

- Write the **mathematical form** of your objective function.
- Define **each variable and parameter** clearly.
- Explain the **meaning and purpose** of the objective function (for example: minimizing cost, time, energy consumption, error, or maximizing efficiency, accuracy, or output).
- Mention the **physical or logical interpretation** of the objective.

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3. Constraints

- Write down the **mathematical equations or inequalities** that represent the limitations or governing conditions of your problem.
- These may include technical limits, boundary conditions, balance equations, resource limits, or quality conditions.
- Explain the **significance of each constraint**, why it is required and what real-world condition it represents.

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4. Test Conditions / Data Sets

- Define **3 to 4 test cases** for your problem.

  - Label them as **Case 1, Case 2, Case 3**, and **Case 4 (optional)**.

- For each case, provide a **numerical data set** (values or range for variables, parameters, or coefficients).

- Each case should represent a **different real-life condition**.
  Examples:

  - Case 1: X condition

  - Case 2: Y condition

  - Case 3: Z condition

  - Case 4: … etc

- Explain **the physical or practical meaning** of each case.

- These data sets will be used for testing and solving your problem in the next assignment.

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5. References

- Add **10–15 references** in proper **IEEE citation style**.

- Use **authentic and reputed sources** such as IEEE, Elsevier, Springer, ScienceDirect, or other peer-reviewed journals and conferences.

- You must **cite each reference properly** in the introduction section using IEEE format (for example: [1], [2], etc.).

- Avoid unreliable or unverified web sources.

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6. Figures / Illustrations

- Include **1–2 figures** in your report anywhere you find suitable.

  - Examples: schematic diagram, system layout, block diagram, or flowchart of your optimization approach.

- Figures should be **clear, labeled, and referred to in the text** (for example: "as shown in Fig. 1").

Additional Instructions on Equations, Tables, and Page Limit

Equations

- All **mathematical equations** must be written using **Microsoft Word's Equation Editor**, **not as images or screenshots**.
- Each equation should be **numbered sequentially** on the right side, for example: *(1), (2), (3), ...*
- Every **symbol, variable, and constant** used in the equations must be **clearly defined and explained** immediately after the equation.
- Example format:

$$F = m \times a \quad (1)$$

where, F = Force (N), m = Mass (kg), a = Acceleration (m/s²).

- Equations should be properly aligned and formatted for readability in the IEEE double-column layout.

Tables

- All **tables** must be created using **Word's table tool** (Insert → Table), not pasted as images.
- Each table must have a **table number and title** above it (e.g., *Table 1. Test Data for Case 1*).
- All columns and units must be clearly labeled.
- Below each table, write a short **one-line explanation** describing what the table represents (for example: "Table 1 shows the data set used for Case 1 under normal conditions.").
- Avoid unnecessary decorative formatting; keep tables clean, readable, and consistent with IEEE style.

Page Limit

- The total length of the report should be **a minimum of 2.5 pages and a maximum of 3 pages** in **IEEE double-column format**.
- This page count includes figures, tables, and references.
- Reports exceeding 3 pages or shorter than 2.5 pages will not be evaluated for full marks.

Formatting Requirements

Parameter	Specification
Format	IEEE double column
Font	Times New Roman
Font Size	10 pt
Spacing	Single (1.0)
File Type	Word (.docx)
Page Margins	Standard IEEE format
Figures	Insert properly with captions
References	IEEE format (numbered style)
Plagiarism Limit	≤ 20% (checked via Turnitin)

Note: If plagiarism or similarity exceeds 20%, your assignment will receive **zero marks**. Ensure that all content is written in your **own words**.

Page limit: **A minimum of 2.5 pages and a maximum of 3 pages** in **IEEE double-column format**

Submission Guidelines

1. Prepare your assignment strictly in **Word format (.docx)** using the **IEEE double-column template** (to be shared separately).
2. Use the following file naming format:
   YourName_Optimization_Assignment1.docx
3. Submit the completed file **by 25th October 2025**.
4. Submit through **Google Classroom or email** (submission link or address will be shared).
5. **Late submissions will not be accepted.**

Important Notes

- You can choose your problem from **any domain**, electrical, mechanical, civil, chemical, computer science, environmental science, data analysis, etc.
- Choose a problem that has **clear objectives and measurable variables**, so that you can apply optimization methods to it later.

- The same problem will be **used again in the next assignment**, where you will solve it using techniques like gradient methods, Newton methods, or search-based approaches.
- Use your own **original writing style**. Do not copy directly from books or internet sources.
- Maintain professional language, proper structure, and logical flow of ideas.

Marks will be awarded only if:
- The report is properly formatted in IEEE style,
- The problem is well-defined and realistic,
- All sections are clearly written,
- The plagiarism limit is within 20%.

End of Instructions

Best of luck with your assignment!

Dr. Nishant Kumar