COMP 6704: Advanced Topics in Optimization

Individual Assignment

PolyU Fall 2025

1   Problem Topics

Essentially, most problems in computer science and engineering can be formulated as optimization problems. For this assignment, you are required to select a topic relevant to the field of optimization and conduct an independent study to strengthen your understanding of optimization methods. Below are several suggested topics you may explore; however, you are welcome to propose your own topic based on your research interests and strengths. **Please note that you are required to choose a topic that is different from your group project.**

1. **Your research areas**: The best topic is to combine optimization methods with problems from your own research area. This involves formulating a problem within your domain as an optimization problem and identifying efficient methods for it. For your reference, past projects have explored topics such as image processing, recommender systems, signal processing, wireless sensing systems, online learning systems, multiprocessor scheduling, multispectral color measurement, and more.

2. **Machine learning**: You may investigate and develop new optimization methods to improve training processes of machine learning models. For example, you could conduct a comprehensive survey of optimization methods used in deep learning and evaluate approaches such as Momentum, Adagrad, Nesterov Accelerated Gradient, Adam, RMSprop, and batch normalization. After thoroughly understanding these methods, you are encouraged to propose and experiment with ideas for enhancing these algorithms.

3. **General optimization techniques**: You may conduct an in-depth study of general optimization techniques such as the stochastic gradient descent algorithm, interior point methods, dual methods, coordinate descent methods, and the alternating direction method of multipliers (ADMM). Your study would involve comprehending the fundamentals, implementing the selected method, and evaluating its performance on real or synthetic datasets.

2 Requirement

You are required to submit a report for your project. You should clearly state the connection of your report to optimization and the concepts you learned in class. Your report should include the motivation for your problem, a review of relevant literature, a formal problem formulation, and a thorough description of solution methods, whether drawn from prior work or of your own design. Please describe in detail how you formulated your optimization problems, the algorithms you attempted to solve them, whether they are effective or ineffective, and the conclusions drawn from your results. Comprehensive experimentation with large-scale real-world datasets is highly encouraged and will be considered a significant plus.

3 Submission Guideline

Submission Deadline: **11:59PM, 30 November**. Late submissions will incur a deduction of 20 points from a maximum score of 100 for each day of delay.

Report length (Page limit: up to 10 pages): The report should cover all key aspects of the project, including Abstract, Introduction, Methodology, Experimental Results and Analysis, and Conclusions. Since the same problem can be solved using different optimization algorithms, you are expected to implement diverse algorithms and compare their performance (convergence rate, stability, etc.). You are encouraged to include visualizations to better demonstrate the comparison results and characteristics of different optimization algorithms. **Please provide your Name and Student ID at the beginning of the report.**

Submission Rule: Please convert your final report into a PDF file and submit it on Blackboard. Your report is encouraged to use the NeurIPS 2025 template[1]. Please name the file with your name and student ID, such as "ZHANG San+23039997r.pdf". The final PDF file should be submitted to **Blackboard** and the submission entry is: Assessments/Individual Assignment. Please keep the size of the uploaded file less than 20 MB. Don't forget to double-check if the submission is saved successfully before leaving. Multiple submissions are allowed, and we will only mark the latest version.

Extra Note Engaging in any form of cheating or plagiarism, including copying assignments from other students or senior students, if detected, will lead to a score of zero for this project, and all individuals involved will be reported to the department and Graduate School.

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[1]https://media.neurips.cc/Conferences/NeurIPS2025/Styles

4 Grading Rubrics

The individual report will be assigned according to the quality of the report.

- **Clarity and Organization:** clear description of the research problem and its motivation.

- **Comprehensive survey:** comprehensive review of the related works and discusses some of the latest developments.

- **Novelty and Depth:** novelty of the proposed solution as well as the depth of the theoretical analysis

- **Comprehensive Experiments:** extensive and thorough experimental comparisons with related work, with clear visualizations or statistical analyses related to the optimization process

The specific marking criteria are summarized in Table 1.

5 Consultation

You are welcome to send any questions regarding the individual assignment to the teaching assistant, Mr. YAN Yinsong (yinsong.yan@connect.polyu.hk). It is strongly recommended that your email subject line begins with "COMP6704+Individual Assignment". If you do not receive a reply within 48 hours, please forward your query to the course instructor.

Table 1: Evaluation Metrics

Category	Metric	Weightage	Description
Report	Literature Survey	20%	You should clearly state the connection of your project to optimization and the concepts you learned in class. A comprehensive review of the related work serves as the research foundation of your project.
Report	Problem Formulation	20%	A clear formulation of the problem and the motivation to study it are expected to be included.
Report	Proposed Algorithms	20%	The complexity of the proposed algorithms and the diversity of baseline algorithms are important indicators for evaluating the comprehensiveness, innovation, and depth of the project.
Report	Experimental Analysis	30%	The comprehensiveness of experimental results and analysis, including visualization or theoretical analysis of optimization process, stability analysis, convergence rate, convergence conditions, computational complexity, etc.
Report	Code Readability and Reproducibility	10%	The code involved in the project should be included in the report through footnotes, end of abstract, etc. Moreover, code readability and good README documentation are crucial for collaborative projects and long-term maintenance. Please make sure we can reproduce relevant experimental results in your report.