SYDE/BME 411 Optimization and Numerical Methods

Course Project Guidelines

This is a group project that involves searching for a real-world engineering optimization problem by you, which is formulated mathematically, and then solved and analyzed by applying a suitable optimization technique, which is implemented in MATLAB or Python. A presentation is required, in addition to submitting a final report and related MATLAB or Python code, as described below.

Please send the names of your group members (4 people) until **Friday, October 2, 2020** to your TA: Sheida Marashi (Email: smarashi@uwaterloo.ca).

Important Notes:

1) The optimization problem chosen by you should be multivariable with some constraints such that for solving it, applying optimization techniques is needed, and finding a solution for it without computer programming/software tools is very hard. A one-page proposal focusing on general description of the considered problem should be submitted through a Dropbox folder on LEARN by **Friday, October 23, 2020**.

2) A proper set of the design variables should be selected and the objective function and constraints should be formulated accordingly in a mathematical programming form. The problem will be then solved by implementing a proper optimization algorithm or an optimization toolbox in MATLAB or Python (the use of another software package or computer programming is possible by permission). The results should be analyzed with taking into account the nature of the solution (local or global optimum), considered optimization technique performance (convergence, computational speed, etc.), characteristics of the problem like its feasible region, unimodality, convexity, continuity, and so on.

Deliverables:

1) A Powerpoint presentation (3 minutes for your slides plus 2 minutes for Q&A, totally 5 minutes) with 3 main slides on: i) problem description, ii) formulation and optimization method, and iii) some results/analyses.

2) A technical report (main body less than 10 pages, having appendix is fine), including the problem description, modeling & formulation, assumptions, choice of applied optimization technique, results, analyzes, conclusions and suggestions for future steps. A soft copy of the report and MATLAB or Python files should be submitted through a Dropbox folder on LEARN.

The project report should be submitted by **Friday, November 27, 2020**. The presentations will be given on **Thursday December 3, Friday December 4, Monday December 7, 2020**.

Evaluation:

Please note that the following factors will be taken into account for marking the project report:

- Proper background, motivation, and context for the selected optimization problem.

- Clarity and validity of the problem description, formulation, constraints, objective function, feasible region, etc.

- Using a suitable method (and the related logic) to solve the problem, implementing properly the method for the given problem formulation, a clear explanation or flowchart for this process.

- Clarity, validity, and justification of solutions/results.

- Mindful discussions of convergence and computational efficiency of the optimization method, discussing the nature of solution (global or local) and related justifications, convexity, unimodality/multimodality of the objective function, constraint satisfactions, the effects of initial guess (when a numerical method is used), any other thoughtful explanations from an optimization perspective.

- Level of complexity of the considered problem including number of constraints and optimization variables, complex objective function, discontinuity, multimodality, etc.

- Any innovation in the optimization formulation or methodology to solve the selected optimization problem.

- Report format/structure, figure qualities, grammar, conclusions & suggestions for future steps, etc.

Please note this is a group project and requires the participation of all group members for the entire tasks. If you need further information, please contact the instructors. Enjoy your project!