ME 575
Project 1: Design Project
Due Feb 14 at 11:50 p.m.

For your first project, you should select a design problem from you own discipline, develop the model and optimize it. For mechanical engineering students, some possible projects might be,

- Optimizing a mechanism
- Optimizing a control system
- Optimizing a truss
- Optimizing a heat exchanger
- Optimizing a problem from your research

Students in other disciplines should select a problem from their discipline they are interested in. Although the selection of the model is up to you, there are some requirements:

- You must be involved in developing the model; you can't just copy it from somewhere. However, this doesn't mean you have to build it from scratch.
- The model needs to include a minimum of four design variables and three design functions (more is usually better if they are realistic).
- There should be trade-offs involved with the model so we can't just guess the solution.
- The model should be continuous and differentiable, so it can be solved by a routine like `fmincon`. You may use whatever state-of-the-art routine or language you wish.
- I would expect the difficulty of the project to be a cut above the homework.

You may work on this in groups of no more than three if you wish. You are welcome to send a note to the TA indicating you'd like to find a group.

Turn in a report with the following sections (please keep to no more than five pages, single spaced, not including the Appendix or Title page):

1) Title Page with Summary. Give a brief description of the problem (less than 50 words) and your main results.
2) Procedure:
    a. Discuss the development of the model so I can understand it. This would include presenting important relationships and assumptions. Illustrations are helpful. I would appreciate having some sense of the computation sequence, as is given in Section 2.8.5 of the notes.
    b. Indicate how the model was tested and insured to be accurate and robust.
    c. Discuss what the optimization problem is by listing the design variables and functions.

3) Results and Discussion of Results:
    a. Provide a table showing the optimum values of variables and functions, with binding constraints and/or variables at bounds highlighted. How much did the objective improve over the starting design? Do you feel the optimum design is realistic? Visual representations of the optimum are encouraged.

b. Briefly discuss the optimum and the design space around the optimum. Include contour plots as appropriate, with the feasible region shaded and the optimum marked. Comment on what you learn about the design space from these. Do you feel this is a global optimum? Provide support for your conclusion.
c. Include any other observations you feel are pertinent. These may relate to the model, the results, the optimization process, the nature of the optimum, etc. This section should be a half page or less.

4) Appendix:
    a. Listing of `MATLAB or other programs`

Please turn in as a pdf on Learning Suite. Note: Include requested items (such as graphs or tables) in their respective sections as given above, and not in the Appendix. Any output from MATLAB should be integrated into the report with captions, explanatory comments, etc.