ME 575 - Assignment #5 Constrained Optimization

Objective: Learn more about how constrained optimization works by continuing to use existing tools and develop our own basic implementation.

5.1 KKT Conditions

Solve by hand (i.e. show work) for the optimal point and the lagrange multipliers that satisfy the KKT conditions for the following optimization problem:

$$\min_{x,y} \quad f(x,y) = (x+2y-7)^2 + (2x+y-5)^2 \tag{1}$$

$$\text{subject to:} \quad g_1(x) = x^2 + y^2 - 10 \leq 0 \tag{2}$$

$$g_2(x) = x + y - 3 \leq 0 \tag{3}$$

5.2 Constrained Optimization

Select **three** functions found here:
https://en.wikipedia.org/wiki/Test_functions_for_optimization
Don't select the Booth function (that's 5.1) and don't worry about the multi-objective functions right now. For each function, identify two constraints that would make your optimization somewhat exciting (i.e. at least one of those constraints should be active at x^*). Do not choose two equality constraints if the design space is two-dimensional. (That's a trivial solution. Do you know why?)

Solve your three problems using an existing optimizer. Show the **contour plot for each** (with constraints, the iteration history, and the optimal point) and a **convergence plot for each**. You may want to start from different initial guesses. Note, you can make adjustments to the functions (like changing coefficients), but make sure the function is still exciting, interesting, or somewhat challenging.

5.3 Student-Defined Optimizer

Write a *basic* constrained gradient-based optimizer using a penalty method. Test your method out on your three functions and constraints you identified in question 5.2 above. In a table, compare the solution accuracy and convergence efficiency of your own method against the optimizer you used in 5.2. Briefly describe what you learned in 400 words or less.

Notes: Don't forget to include your code in a zipped folder and one pdf document reporting your findings (not in the folder) submitted to Learning Suite