MECH 579: Multidisciplinary Design Optimization
Department of Mechanical Engineering, McGill University

Project #2: Constrained Optimization
Due 15th. October, 2013

Write a numerical code to minimize the Rosenbrock function defined below using a slew of gradient based optimization algorithms. The function is a non-convex function and has a global minimum at $(1, 1)$. The minimum is at the bottom of a narrow parabolic valley that is curved on the x-y plane. The problem statement is as follows

$$
\begin{array}{rl}
\text{minimize} & f(x, y) = (1 - x)^2 + 100(y - x^2)^2 \\
\text{with respect to} & x \in \mathbb{R}^n \\
\text{subject to} & \hat{c}_1(x) = 1 - x - y = 0 \\
 & \text{(or)}\;\; \hat{c}_2(x) = 1 - x^2 - y^2 = 0
\end{array}
$$

1. Write an SQP algorithm to find the minimum of the function subject to two single equality constraints. Use a simple backtracking line search method. Employ a Newtons method as well as a Quasi-Newtons method. Use only one constraint at a time. Show the following results for each combination of method and constraint.

2. Provide the following in a written report for each of the constraints:

   (a) Convergence of the gradient (y-axis: log of the gradient, x-axis: iteration) and a comparison of the convergence.

   (b) Contour plot of the path of the optimization algorithm.

   (c) Discuss and compare the plots, as well as discuss the choice of parameters used in your results and their effect on the optimization.

Reports must be handed in a PDF format. All plots must have both x- and y-axis labels, a legend clearly describing the various lines, and a title with a Figure number. Plots generated with MS Excel are not acceptable and assignments will not be graded.