CL603: Optimization
Tutorial 5

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Specific Aim: To implement the Powell Dogleg Trust Region method on the Rosenbrock function.
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Consider the following function (known as Rosenbrock function):

$$f(\mathbf{x}) = 100(x_2 - x_1^2)^2 + (1 - x_1)^2$$

Use $x_{\text{initguess}} = [1.5 \quad 1.5]^T$, $N = 1000$ as the maximum number of iterations and $\epsilon = 10^{-8}$ as the tolerance on square of gradient-norm.
Do the following in Python or MATLAB:

1. Implement Powell Trust Region approach. Use analytically computed gradient and Hessian wherever required.

The various parameters to be used in the trust region approach are:

$$\bar{\Delta} = 1, \ \Delta_0 = 0.5, \ \eta = 0.2$$

Refer to Pseduo Code for "Trust Region Approach" and the related discussions in the notes to interpret the meaning of the parameters listed above. In this approach $\mathbf{p}^k$ is obtained by Powell Dogleg Method which either takes a Newton step or a Cauchy step (corresponding to a steepest descent step) or a combination of the two. Once again refer to notes to see the details. To visualize the results, do the following:

1. Plot $\mathbf{x}$ versus iteration number i.e. x_1 with iteration number and x_2 with iteration number in same figure.

2. Generate a figure which shows the value of $f(\mathbf{x})$ versus iteration number.

3. Label the axis and give title in each figure you generate.

Note: If you have worked out all the past tutorials, then at the end of this tutorial you should now have implementation of all the line search methods: Steepest-descent, Newton, Quasi-Newton (BFGS, DFP), and FR-CG on the Rosenbrock function as well as a Trust Region method (Powell Dogleg Method). You can compare performances of all these methods yourself and play around with various parameters (such as those used in inexact line search or the initial conditions or the parameters in the trust region approach) to compare the performances of the various methods.

Learning is fun. Best of Luck!