MA3236 NONLINEAR PROGRAMMING

Semester 1, 2018/2019

Assignment 1

Deadline: 16 October. Late submission will not be accepted.
Submit a report including answers and graphs (softcopy only) and files of matlab codes ($\cdots$.m), to Lam Xin Yee (email: lamxinyee@u.nus.edu).

1. Program the steepest descent and Newton algorithms using the backtracking line search (Procedure below, set $\rho = 0.9$, $c = 0.6$). Use them to minimize the Rosenbrock function

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

First try the initial point $\mathbf{x}_0 = (1.2; 1.2)$ and then the more difficult point $\mathbf{x}_0 = (-1.2; 1)$. Plot the contour of the function and then plot the path of iterates obtained by each method on the contour. (You can use 'help contour' and 'help plot' to find instructions of using 'contour' and 'plot'.)

Procedure (Backtracking Line Search).

Choose $\rho, c \in (0, 1)$; Set $\alpha \leftarrow 1$;

repeat until $f(\mathbf{x}_k + \alpha \mathbf{p}_k) \leq f(\mathbf{x}_k) + c\alpha \nabla f(\mathbf{x}_k^T)\mathbf{p}_k$

$\alpha \leftarrow \rho\alpha$;

end (repeat)

Terminate with $\alpha_k = \alpha$.

2. Run ten iterations of the steepest descent and conjugate gradient algorithms to find approximate minimizers of the quadratic function $f(\mathbf{x}) = \frac{1}{2}\mathbf{x}^T\mathbf{A}\mathbf{x} - \mathbf{b}^T\mathbf{x}$, where $\mathbf{A}$ and $\mathbf{b}$ are given in the file 'Ab.mat', starting from $\mathbf{x}_0 = 0$. Print the error $\|\mathbf{x}_{10} - \mathbf{x}^*\|$ for each method, where $\mathbf{x}^* = \mathbf{A}^{-1}\mathbf{b}$.