Universität Kaiserslautern
Prof. Dr. C. Helmberg, B. Guta

Kaiserslautern, May 7, 2002
Date of Submission: May 14, 2002

Nonlinear Programming
Exercises 4

1. For the Rosenbrock function $f(x) = 100(x_2 - x_1^2)^2 + (1 - x_1)^2$ implement, in Matlab, Newton's method with backtracking line search (initial step length $\bar{\alpha} = 1$, contraction parameter $\rho = 0.6$ and $c_1 = 0.1$) to minimize $f(x)$ within an accuracy of 10^{-4}. For starting points

   (i) $x_0 = (1.2, 1.2)$ (ii) $x_0 = (-1.2, 1)$.

   print step length and function value at each step and display the progress in a contour plot.

2. Do the same as in 1. for the steepest descent direction with a line search procedure that ensures the Wolfe conditions. Compare the number of function evaluations in both methods.

3. Consider the problem
$$\min f(x, y)$$
   where $f(x, y) = \frac{cx^2+y^2}{2}$, $(x, y) \in \mathbb{R}^2$, $0 < c < 1$. Show that for the steepest descent method with exact line search, starting at $x_0 = (1, c)$, the points
$$x_k = (q^k, (-1)^k c q^k), \qquad k = 1, 2, 3, \ldots$$
   where $q = \frac{1-c}{1+c}$ are reached during the iterations. How many iterations are necessary to get to the minimum within an accuracy of 10^{-6} in case $c = 10^{-3}$.

4. Consider the proof of Theorem II.7 in the Lecture. Show that
$$\|p_k\| = O(\|x_k - x^*\|).$$