MATH 5750/6880 OPTIMIZATION
HOMEWORK 4

Due: Mon Dec 1st 2008

1. **Problem 16.21** (Nocedal and Wright p495). This asks you to redo the derivation of the interior point method for convex quadratic programming (§16.6 pp 480–482) so that equality constraints are included as well.
2. **Problem 18.3** (Nocedal and Wright p562). Here you need to implement sequential quadratic programming and use it to solve a small non-linear problem. Here some implementation advice:
   - The initial point x_0 and the solution x^* are swapped in the textbook, and the solution x^* has been rounded in a strange way.
   - No globalization procedure is required for this problem, you should get convergence with the full steps.
   - An equality constrained quadratic programming (EQP) solver is in the class website: `eqp.m`. It uses the nullspace method described in §16.2.
   - The objective function, gradient and Hessian computations for the given function are tedious to do by hand, so they are given in the file `f_18_3.m`. You are responsible for the gradients and Hessians of the constraints.
   - The initial guess λ_0 for the Lagrange multipliers is not very relevant, as long as $\nabla^2_{xx} L(x_k, \lambda_k)$ is symmetric positive definite in $\mathcal{N}(c'(x_k))$.
   - Use $\|c(x_k)\|_2 < \epsilon$ as the stopping criterion with say $\epsilon = 10^{-8}$. This is not a general purpose stopping criterion and stopping when $\nabla_x L(x_k, \lambda_k)$ is small does not work in general. A better stopping criterion is: $\|c(x_k)\|_2 < \epsilon$ and $\left\|Z_k^T \nabla_x L(x_k, \lambda_k)\right\| < \epsilon$, but you are not required to implement this. Here Z_k is a representation of the nullspace of the linearized constraints at the current iterate.
3. (extra credit) **Problem 18.7** in (Nocedal and Wright p562) with the second stopping criterion above.