CS726, Fall 2008
Homework 5
(due Friday 10/10/08)

Please submit your Matlab file `modNewtonDogleg.m` electronically. Once you have set up the path in your user directory, you need to put this file in a single directory and run the command

```
handin -c cs726-1 -a hwk5 -d <directory name>
```

1. Exercise 4.4 from the text.
2. Exercise 4.6 from the text.
3. Exercise 4.12 from the text.
4. Program a dogleg trust-region algorithm that uses a modified Hessian approximation B_k. Specifically, set $B_k = \nabla^2 f(x_k) + \delta_k I$, where δ_k is nonnegative, and just large enough to make all eigenvalues of B_k great than or equal to

$$\min\left(\|\nabla f(x_k)\|_2, 10^{-2}\right).$$

The first line of the function should be

```
function [inform,x] = modNewtonDogleg(fun, x, mNparams)
```

The inputs `fun` and `x` are the same as in Homework 3, while `mNparams` is the following structure:

```
mnparams = struct('maxit',10000,'toler',1.0e-4,'eta',1.0e-4,...
              'DeltaMax',100,'Delta0',1.0);
```

The parameters η, Δ_0 and $\Delta_{\max} = \hat{\Delta}$ are as defined in Algorithm 4.1.

Terminate modNewtonDogleg when either $\|\nabla f(x_k)\|_2 \leq$ `mnparams.toler` or `mnparams.maxit` iterations of the algorithm have been performed, whichever comes first.

Comment on the properties of the Hessian at the final point, and on how the performance of the algorithm on the "Powell badly scaled" function might be improved.

The output `inform` is a structure containing two fields: `inform.status` is 1 if the gradient tolerance is achieved and 0 if not, while `inform.iter` is the number of steps taken. The output `x` is the solution structure, with point, function, and gradient values at the final value of x.

Use the file `hwk5.m` to test your code.

Be sure not to make unnecessary evaluations of the function, gradient, and Hessian.