Assigned: Thursday Feb. 2, 2017
Due Date: Thursday Feb. 16, 2017

MATH 565: Homework 2
Spring 2017

1. Page 63: Problem 6.

2. Page 64: Problem 8 (We did most of this proof in class, just finish last step).

3. Page 64: Problem 12.

4. For the quadratic function

$$f(\underline{x}) = \frac{1}{2}\underline{x}^T \underline{\underline{B}}\underline{x} - \underline{x}^T \underline{b}$$

where $\underline{\underline{B}} \in \mathbb{R}^{n \times n}$ is symmetric positive definite, show that that the Newton search direction with $\alpha = 1$ satisfies the sufficient decrease assumption (3.4) for any $c_1 \leq \frac{1}{2}$ and the curvature conditions (3.5) for any $c_2 > 0$.

5. Consider the function:

$$f(\underline{x}) = 20\left(x_2 - x_1^2\right)^2 + (1 - x_1)^2.$$

Write a MATLAB steepest descent code to find the minimizer of this function. The function should be in the form

```
xstar = SteepestDescent(f,x0,TOL,MaxIters)
```

Use $x_0 = (1.2, 1.2)^T$. Use an exact line search to find α. You can use your 1D rootfinding code from Homework 1 to compute the exact line search solution α. Plot the contour lines of f and superimpose the various guesses (each connected to the next via a line segment) made by the steepest descent algorithm. Produce a table of your approximations and the errors (if there are many iterations, you can just show the first 10 iterations and last 10 iterations).

6. Consider the function:

$$f(x) = 20\left(x_2 - x_1^2\right)^2 + (1 - x_1)^2.$$

Write a MATLAB Newton descent code to find the minimizer of this function. The function should be in the form

```
xstar = NewtonDescent(f,x0,TOL,MaxIters)
```

Use $x_0 = (1.2, 1.2)^T$. Use $\alpha = 1$. Use the backslash operator to invert the appropriate matrices. Plot the contour lines of f and superimpose the various guesses (each connected to the next via a line segment) made by the Newton descent algorithm. Produce a table of your approximations and the errors (if there are many iterations, you can just show the first 10 iterations and last 10 iterations).