EE 457 - Homework 3

The objective of this homework is to implement and evaluate the performances of several iterative algorithms for the Rosenbrock function

$$F(x) = \sum_{i=1}^{2} 100(x_{i+1} - x_i^2)^2 + (x_i - 1)^2$$

with the initial condition $x^{(0)} = [3, -1, 0]^T$ and termination criteria $\|\nabla F(x)\| \leq 0.01$.

P1. Implement in MATLAB the gradient algorithm with a fixed step size of $\alpha = 0.001$. Does the algorithm meet the termination criteria given? Repeat with $\alpha = 10^{-4}$. Plot $x_1^{(k)}$, $x_2^{(k)}$, $x_3^{(k)}$ and $f(x^{(k)})$ vs k for each case.

P2. Implement in MATLAB the steepest descent algorithm using the golden section method for the exact line search. Plot $x_1^{(k)}$, $x_2^{(k)}$, $x_3^{(k)}$ and $f(x^{(k)})$ vs k.

P3. Implement in MATLAB the gradient descent algorithm using the first Armijo condition for the line search (the parameter choices are upto you). Plot $x_1^{(k)}$, $x_2^{(k)}$, $x_3^{(k)}$ and $f(x^{(k)})$ vs k.

P4. Implement in MATLAB the gradient descent algorithm using the Armijo-Goldstein conditions for the line search (the parameter choices are upto you). Plot $x_1^{(k)}$, $x_2^{(k)}$, $x_3^{(k)}$ and $f(x^{(k)})$ vs k.

P5. Implement in MATLAB the Newton's method. Plot $x_1^{(k)}$, $x_2^{(k)}$, $x_3^{(k)}$ and $f(x^{(k)})$ vs k.

P6. Implement in MATLAB the modified Newton method using the golden section method for the exact line search. Plot $x_1^{(k)}$, $x_2^{(k)}$, $x_3^{(k)}$ and $f(x^{(k)})$ vs k.

P7. Implement in MATLAB the modified Newton method using the first Armijo condition for the line search (the parameter choices are upto you). Plot $x_1^{(k)}$, $x_2^{(k)}$, $x_3^{(k)}$ and $f(x^{(k)})$ vs k.

P8. Implement in MATLAB the modified Newton method using the Armijo-Goldstein conditions for the line search (the parameter choices are upto you). Plot $x_1^{(k)}$, $x_2^{(k)}$, $x_3^{(k)}$ and $f(x^{(k)})$ vs k.

P9. Compare the results of the algorithms employed in P1-P8 by making a table showing (i) the number of iterations for the vector update, (ii) the number iterations for the line search, (iii) the eventual function value.

For submission of your homework, use the Moodle system to upload all of your MATLAB codes and report in a single compressed file including your name and homework number. Make sure that each file in the compressed one is named using your fullname and question number (i.e. FirstName_LastNameEE457hwXqX.m) .