EE 457 - Homework 4

Due 28/04/2018

Problem 1 The objective of this problem is to implement and evaluate the performance 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 $k > 1000$.

(i) Implement in MATLAB the conjugate gradient algorithm. Plot $x_1^{(k)}$, $x_2^{(k)}$, $x_3^{(k)}$ and $f(x^{(k)})$ vs k.

(ii) Implement in MATLAB the rank one correction algorithm. Plot $x_1^{(k)}$, $x_2^{(k)}$, $x_3^{(k)}$ and $f(x^{(k)})$ vs k.

(iii) Implement in MATLAB the DFP algorithm. Plot $x_1^{(k)}$, $x_2^{(k)}$, $x_3^{(k)}$ and $f(x^{(k)})$ vs k.

(iv) Implement in MATLAB the BFGS algorithm. Plot $x_1^{(k)}$, $x_2^{(k)}$, $x_3^{(k)}$ and $f(x^{(k)})$ vs k.

(v) Compare the results of the algorithms employed in (i)-(iv).

Problem 2 Write MATLAB programs to implement naive random search and simulated annealing. Use the neighborhood

$$N(x^{(k)}) = \{x : x_i^{(k)} - \alpha \leq x_i \leq x_i^{(k)} + \alpha\}$$

where $\alpha > 0$ is pre-specified, and pick $z^{(k)}$ to be uniformly distributed on $N(x^{(k)})$. Test both algorithms on minimizing the Rosenbrock function in Problem 1 for $\alpha = 0.001$ and $\alpha = 0.01$.

Problem 3 Consider the data for USD/TL parity given in Table 1. Let (t_i, y_i) represent the data points for $i = 1, \ldots, 20$. The objective is determine the best fitting line $y = mt + c$ to minimize

$$f(m,c) = \frac{1}{2} \sum_{i=1}^{N} (mt_i + c - y_i)^2 \tag{0.1}$$

(i) Implement in MATLAB the recursive least squares algorithm starting with the initial two data points and using two weeks data at each iteration. Plot $m^{(k)}$, $c^{(k)}$ and $f(m^{(k)}, c^{(k)})$ vs k.

Table 1: USD/TL data

Date	USD/TL
10-07-2015	2.68424
17-07-2015	2.64755
24-07-2015	2.68472
31-07-2015	2.75736
07-08-2015	2.77880
14-08-2015	2.77856
21-08-2015	2.88432
28-08-2015	2.92674
04-09-2015	2.92866
11-09-2015	3.01290
18-09-2015	3.03274
25-09-2015	3.00027
02-10-2015	3.02782
09-10-2015	2.97552
16-10-2015	2.91740
23-10-2015	2.89356
30-10-2015	2.88655
06-11-2015	2.85020
13-11-2015	2.89398
20-11-2015	2.86638

(ii) Implement in MATLAB the least squares solution using all data points. Compare the results obtained with those in (i).

Problem 4 Consider the measurement data given in Table 2 where (t_i, y_i) represent the data points for $i = 1, \ldots, 21$. The objective is determine the best fitting sine curve $y = A\sin(\omega t + \phi)$ to minimize

$$\sum_{i=1}^{21} (y_i - A\sin(\omega t_i + \phi))^2 \tag{0.2}$$

(i) Implement in MATLAB the Gauss-Newton algorithm to determine the sinusoid of best fit.

(ii) Implement in MATLAB the Levenberg-Marquardt algorithm to determine the sinusoid of best fit. Compare the result with the one in (i).

Important!

- For submission of your homework, use Moodle system to upload all of your MATLAB codes and reports in a single compressed file including your name and homework number. Also make sure each file in the compressed one is named using your fullname and question number (i.e. FirstName_LastNameEE457hw4Qx.m).

Table 2: Measurement data

t_i	y_i
0	0.9783
0.4000	1.4617
0.8000	2.0580
1.2000	2.0265
1.6000	2.2238
2.0000	1.5446
2.4000	1.0970
2.8000	0.2566
3.2000	-0.5050
3.6000	-0.8899
4.0000	-1.5676
4.4000	-2.1563
4.8000	-1.9748
5.2000	-2.2858
5.6000	-1.6735
6.0000	-1.0813
6.4000	-0.1376
6.8000	0.6637
7.2000	1.0799
7.6000	1.7931
8.0000	2.1022

- Academic dishonesty will not be tolerated.