Homework 1

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1 Problem

$NW^2 - 3.1$: Program the steepest decent and newton algorithms to use the backtracking line search. Use them to minimize the Rosenbrock function

$$f(\bar{x}) = 100(x_2 - x_1^2)^2 + (1 - x_1)^2$$

Set the initial step length $\alpha_0 = 1$ and report the step length used by each method at each iteration. First try the initial point $\bar{x}_0 = [1.2, 1.2]^T$ and then the more difficult starting point $\bar{x}_0 = [-1.2, 1]^T$.

Suggested values: $alpha_0 = 1$, $\rho = \frac{1}{2}$, $c = 10^{-4}$. Stop when $|f(\bar{x}_k| < 10^{-8}$ or $||\nabla f(\bar{x}_k|| < 10^{-8}$S

2 Results

2.1 Steepest Decent

The steepest decent direction converges regardless of the starting point.

2.1.1 Case 1, $\bar{x}_0 = [1.2, 1.2]^T$

2.1.2 Case 1, $\bar{x}_0 = [-1.2, 1]^T$

2.2 Newton Direction

The Newton Direction only converged with the first starting point.

2.2.1 Case 1, $\bar{x}_0 = [1.2, 1.2]^T$

2.2.2 Case 1, $\bar{x}_0 = [-1.2, 1]^T$

Table 1: Database file

$\theta_{2,i}$		X
1		0.0009765625
2		0.0009765625
3		0.0009765625
4		0.0009765625
5		0.001953125
6		0.001953125
7		0.001953125
8		0.0009765625
9		0.0078125
10		0.0009765625
11		0.00390625
12		0.001953125
13		0.0009765625
14		0.0078125
15		0.0009765625
16		0.00390625
17		0.001953125
18		0.0009765625
19		0.0078125
20		0.0009765625
21		0.00390625
22		0.001953125
23		0.0009765625
24		0.0078125
25		0.0009765625
26		0.00390625
27		0.001953125
28		0.0009765625
29		0.0078125
30		0.0009765625
31		0.00390625
32		0.001953125
33		0.0009765625
34		0.0078125
35		0.0009765625
36		0.00390625
37		0.001953125
38		0.0009765625
39		0.0078125
40		0.0009765625
41		0.00390625
42		0.001953125
43		0.0009765625
44		0.0078125
45		0.0009765625
46		0.0078125
47	2	0.0009765625
48		0.00390625
49		0.001953125
50		0.0009765625