CS331-HW12-Lukang-Sun

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p1. (see Figure 1.)

$f_1(x_0, x_1, x_2, x_3) := math.sin(x[0,0]+0.7)+math.sin(0.2*x[1,0]+0.5)+math.cos(0.1*x[3,0]+0.1)$

$f_2(x_0, x_1, x_2, x_3) := 0.5*(x[0,0]*x[0,0]+x[1,0]*x[1,0]+x[2,0]*x[2,0]+x[3,0]*x[3,0])$,

$f(x_0, x_1, x_2, x_3) = f_1(x_0, x_1, x_2, x_3) + f_2(x_0, x_1, x_2, x_3)$, it is easy to verify that f is not convex but is $L-$smoothness for some constant L. In the first four experiments, I choose $K = 2$, in the last experiment, I choose $K = 1$. The experiment results are shown in the following pictures, actually you can not see much differece there (all these methods converges fast)because of the selection of the test functions. The results quite match the theory.
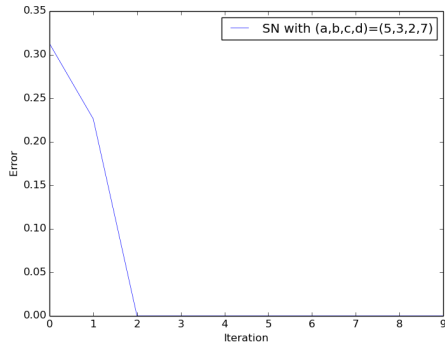
p2.

Proof.
$$\nabla f(x) = Ax + b, \quad \text{for any } x \in \mathbb{R}^n,$$
so
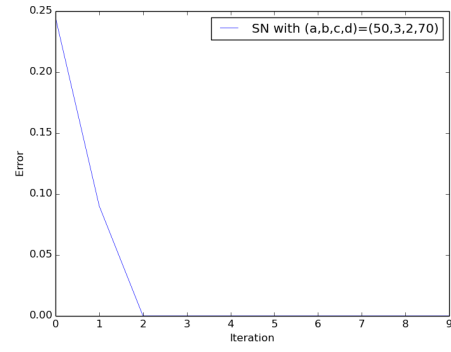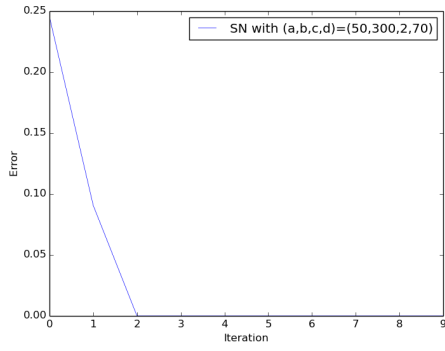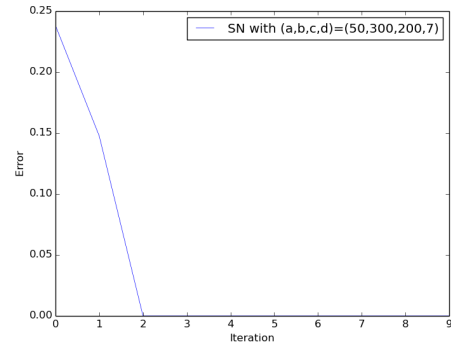$$\nabla f(x) - \nabla f(y) = A(x - y).$$

$\square$

(a)

(b)

(c)

(d)

Figure 1: The four pictures show the error with respect to the iteration number.