Image Analysis Coursework

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Gradient Descent.

We can prove that the given function $f : \mathbb{R}^2 \to \mathbb{R}$ defined

$$f(x_1, x_2) = x_1^2 + \frac{x_2^2}{2}$$

is L-smooth with $L = 2$ via the following

The result given is, for learning rate $\eta = \frac{1}{L}$, and an L-smooth function f,

$$f(x_K) - f(x^*) \leq \frac{L||x_0 - x^*||_2^2}{2K}$$

It is important to note that this is an estimate that gives the accuracy as $\mathcal{O}(\frac{1}{K})$. We can use it to compute the estimate the number of steps to required to reach $\epsilon = 0.01$, but this will be an upper bound. Nonetheless, we can set the right-hand side to ϵ and rearrange to give:

$$K = \frac{L||x_0 - x^*||_2^2}{2\epsilon}$$

Substituting $\epsilon = 0.01$, $x^* = (0, 0)$, $x_0 = (1, 1)$, $L = 2$, we get $K = 200$.

3 Discussion

Results/conclusions Further work What I learned How I could have improved [1]

References

[1] X. Li *et al.*, "Three-dimensional structured illumination microscopy with enhanced axial resolution," *Nature Biotechnology*, vol. 41, pp. 1307–1319, 2023. [Online]. Available: https://doi.org/10.1038/s41587-022-01651-1

A Statement on the use of auto-generation tools