Proof of convexity

Adithya Hosapate
Sushant Meena

IIT Hyderabad

ee16btech11040@iith.ac.in

es16btech11021@iith.ac.in

March 15, 2019

$$\min_x ||Ax - b||^2 + \lambda ||x||_1$$

- $||x||^2$ is convex as $\nabla^2 ||x||^2 = 2I \succeq 0$.
- $||Ax - b||^2$ is convex as is an affine transformation of a convex function.
- $||x||_1$ is convex as $||\lambda x + (1 - \lambda)y||_1 \leq \lambda ||x||_1 + (1 - \lambda)||y||_1$ (From triangle inequality).
- $||Ax - b||^2 + \lambda ||x||_1$ is convex as it is a positive weighted sum of 2 convex functions.