

# Assignment-5

- Given function  $f(x) = -5x^2 + 5x$ , work out its conjugate function and plot it out

- Suppose  $f : S \subset R \rightarrow R$  is convex. Let  $a, b \in S$  and  $a < b$ . Show

$$f(x) \leq \frac{b-x}{b-a}f(a) + \frac{x-a}{b-a}f(b), \quad \forall x \in [a, b] \quad (1)$$

- Given functions  $f(x)$  and  $g(x)$  are convex in  $\text{dom } f$  and  $\text{dom } g$ , please prove  $h(x) = f(x) + g(x)$  is convex in  $\text{dom } h$ .
- Please prove function  $f(x, y) = x\log(x) + y\log(y)$ , where  $x, y > 0$  is convex.
- Please convert the following Lasso regression model into a standard QP problem without changing the objective function.

$$\begin{aligned} \text{Max.} \quad & \|y - \theta^T X\|_2^2 \\ \text{s.t.} \quad & \begin{cases} \|\theta\|_1 \leq t \\ y \in R, X \in R^{n+1}, \theta \in R^{n+1} \end{cases}, \quad (2) \\ & \text{where } t \text{ is a positive constant.} \end{aligned}$$

- Hints

- Submission due: **2025/Dec./5**
- Submit to [lecwlzhao@163.com](mailto:lecwlzhao@163.com), email title “assigment5\_your-name + your student number”