## 1 Exercise Set No. 1

1. Prove or disprove that the following functions are convex:

- $f(x)=-\log (x) \quad x \in \mathbb{R}^{>0}$
- $f(x)=|x| \quad x \in \mathbb{R}$
- $f(x)=x \quad x \in \mathbb{Z}$

2. Consider the following optimization:

$$
\begin{gather*}
\min _{x_{1} \in \mathbb{R} \geq 0, x_{2} \in \mathbb{R} \geq 0}\left(x_{1}-\frac{1}{2}\right)^{2}+\left(x_{2}-a\right)^{2} \\
\text { s.t. } \\
x_{1}+x_{2} \leq 1  \tag{1}\\
2 x_{1}-x_{2} \geq b
\end{gather*}
$$

(a) Set $b=1$ and plot the feasible region.
(b) For which values of $b$ the optimization is infeasible?
(c) Write a CVX code which solves this optimization. Set $a=b=1$. What is the optimal value? What is the optimal point?
(d) Set $b=\frac{1}{2}$. Investigate by calculation for every value of $a$ which constraints in CVX are active at the optimal point.

