# EE364a Homework 2 additional problems

1. *'Hello World' in CVX.* Use CVX to verify the optimal values you obtained (analytically) for exercise 4.1.

2. *Continued fraction function.* Show that the function

$$f(x) = \cfrac{1}{x_1 - \cfrac{1}{x_2 - \cfrac{1}{x_3 - \cfrac{1}{x_4}}}}$$

   defined where every denominator is positive, is convex and decreasing. (There is nothing special about $n = 4$ here; the same holds for any number of variables.)

3. *Dual of intersection of cones.* Let $C$ and $D$ be closed convex cones in $\mathbf{R}^n$. In this problem we will show that

$$(C \cap D)^* = C^* + D^*.$$

   Here, $+$ denotes set addition: $C^* + D^*$ is the set $\{u + v \mid u \in C^*,\ v \in D^*\}$. In other words, the dual of the intersection of two closed convex cones is the sum of the dual cones.

   (a) Show that $C \cap D$ and $C^* + D^*$ are convex cones. (In fact, $C \cap D$ and $C^* + D^*$ are closed, but we won't ask you to show this.)

   (b) Show that $(C \cap D)^* \supseteq C^* + D^*$.

   (c) Now let's show $(C \cap D)^* \subseteq C^* + D^*$. You can do this by first showing

$$(C \cap D)^* \subseteq C^* + D^* \iff C \cap D \supseteq (C^* + D^*)^*.$$

   You can use the following result:

   If $K$ is a closed convex cone, then $K^{**} = K$.

   Next, show that $C \cap D \supseteq (C^* + D^*)^*$ and conclude $(C \cap D)^* = C^* + D^*$.

   (d) Show that the dual of the polyhedral cone $V = \{x \mid Ax \succeq 0\}$ can be expressed as

$$V^* = \{A^T v \mid v \succeq 0\}.$$