COMP4680/COMP8650: Advanced Topics in SML

Assignment #4: Applications

Due: 11:55pm on Sunday 30 September, 2018.
Submit as a single PDF file via Wattle.

Questions **X.YY** are from the textbook *Boyd and Vandenberghe*, "Convex Optimization", 2004. All questions are of equal value.

- **Conjugate functions.** Recall the definition of a congujate function is $f^*(y) = \sup_{x \in \mathbf{dom}(f)} \left\{x^T y - f(x)\right\}$.
  (a) Show $f(x) + f^*(y) \geq x^T y$ for all x, y.
  (b) Show $\inf_x f(x) = -f^*(0)$.
  (c) Compute f^* for $f(x) = \sum_{i=1}^n \alpha_i \log x_i$.
- **6.2** and in addition, for the ℓ_2-norm, find

$$\text{minimize}_x \quad \|xa - b\|_2,$$

  for $a, b \in \mathbb{R}^n$ and $x \in \mathbb{R}$.
- **6.6** (a) and (b) only.
- **7.6**

  Hint: For the second part consider minimizing first over b and then over a.
- **8.24** For this question we are looking for a convex optimization problem. You do not need to give a closed-form solution.