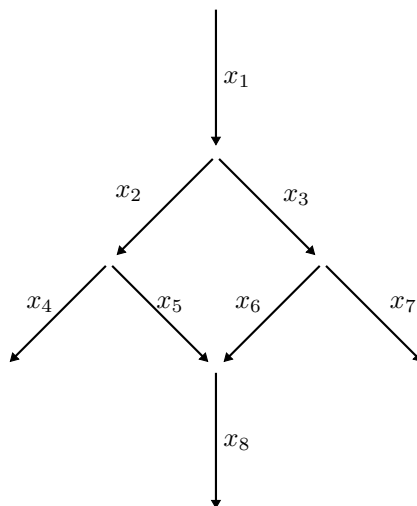# Exercises on Consensus for Distributed Optimization

**Exercise 1.** *Consider the following figure illustrating the structure of an optimization problem.*



1. *Solve the following optimization problem using a centralized algorithm for method of multipliers (try with both augmented and normal Lagrangian)*

$$\text{minimize } \alpha^T x$$
$$\text{subject to } Ax = b,$$

*with $x_i \geq 0$ and*

$$\alpha = \begin{bmatrix} 1 & 2 & 2.3 & 2.5 & 3 & 2.4 & 2.1 & 2.2 \end{bmatrix}$$

$$A = \begin{bmatrix} 1 & -1 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & -1 & -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1 & -1 & 0 \\ 0 & 0 & 0 & 0 & -1 & -1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

$$b = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 2 \\ 3 \end{bmatrix}$$

2. *Solve the previous optimization problem using a distributed implementation of ADMM with consensus. You should have four optimization problems*

   (a) *Problem 1 must include $x_1$, $x_2$, and $x_3$.*

   (b) *Problem 2 must include $x_2$, $x_4$, and $x_5$.*

   (c) *Problem 3 must include $x_3$, $x_6$, and $x_7$.*

   (d) *Problem 4 must include $x_5$, $x_6$, and $x_8$.*