1. Do Exercise 7-1-3
2. Do Exercise 7-2-2
3. (a) Write down the KKT conditions for the problem
\[
\begin{align*}
\text{minimize} & \quad x_1^2 + x_2^2 + x_3^2 \\
\text{subject to} & \quad x_1 + x_2 + x_3 \geq 1 \\
& \quad x_1 - x_2 - x_3 \geq 1 \\
& \quad x_1 + x_2 - x_3 \geq 1 \\
& \quad x \geq 0
\end{align*}
\]
(b) Find an optimal primal dual pair which solves the KKT conditions.
4. Consider the equality constrained least-squares problem
\[
\begin{align*}
\text{minimize} & \quad \|Ax - b\|_2^2 \\
\text{subject to} & \quad Gx = h
\end{align*}
\]
where \( A \in \mathbb{R}^{m \times n} \) with rank(A) = n and \( G \in \mathbb{R}^{p \times n} \) with rank(G) = p. Write down the the KKT conditions, and derive expressions for the optimal primal solution \( \bar{x} \) and dual solution \( \bar{u} \).
5. Consider the quadratic program
\[
\begin{align*}
\text{minimize}_x & \quad c_1 x_1 + c_2 x_2 + c_3 x_3 \\
\text{subject to} & \quad x_1^2 + x_2^2 + x_3^2 \leq 1
\end{align*}
\]
Here \( x \) is the variable and \( c_1, c_2, \) and \( c_3 \) are constants.
(a) Write down the Lagrangian for this problem. Be careful about the sign of the Lagrange multiplier!

(b) By minimizing with respect to $x$, write down the dual problem.

(c) Solve the dual problem.

(d) Use the dual optimal solution to solve the original quadratic program.