	TTK4135 Optimization and Control Spring 2018
Norwegian University of Science and Technology Department of Engineering Cybernetics	**Exercise 3** Hints

Problem 1 (35 %) LP and KKT conditions (Exam August 2000)

a

b There are three requirements for convex optimization problems; see page 8 in the textbook. With the help of the definition of a convex function (also page 8), it can be shown that all linear programs are convex.

Using the definition of convexity (equation (1.4) in the textbook) on the objective function, we have

c This is covered in the textbook and in class. Put the dual problem in standard form, define the Lagrangean, and use the KKT conditions (Theorem 12.1).

d

e

f this problem is essentially about the link between rank and linear independence.

Problem 2 (40 %) LP

a This problem is very similar to the modeling problem in the previous assignment. Make sure you formulate a minimization problem, and reformulate any inequality constraints as equality constraints.

b

c Modify the example file to run the simplex function. Make sure the dimensions on all vectors and matrices agree.

d

e

Problem 3 (25 %) QP and KKT Conditions (Exam May 2000)

A quadratic program (QP) can be formulated as

$$
\begin{aligned}
\min_x \quad & q(x) = \frac{1}{2}x^\top G x + x^\top c && \text{(1a)}\\
\text{s.t.} \quad & a_i^\top x = b_i, \qquad i \in \mathcal{E} && \text{(1b)}\\
& a_i^\top x \geq b_i, \qquad i \in \mathcal{I} && \text{(1c)}
\end{aligned}
$$

where G is a symmetric $n \times n$ matrix, $\mathcal{E}$ and $\mathcal{I}$ are finite sets of indices and c, x and $\{a_i\}, i \in \mathcal{E} \cup \mathcal{I}$, are vectors in $\mathbb{R}^n$.

a

b The KKT conditions for a QP are stated in Chapter 16. Make sure you transpose correctly when deriving the conditions.