HW2_2

1

1)

$$
\begin{aligned}
maximize \quad & x_1 + x_2 \\
subject\ to \quad & x_1 + 2x_2 \leq 4 \\
& -x_1 + x_2 \leq 1 \\
& 4x_1 + 2x_2 \leq 12 \\
& x_1, x_2 \geq 0
\end{aligned}
$$

2)

$$
\begin{aligned}
& & y_1 \times \quad & x_1 + 2x_2 \leq 4 \\
& & y_2 \times \quad & -x_1 + x_2 \leq 1 \\
& & y_3 \times \quad & 4x_1 + 2x_2 \leq 12 \\
& yields & & (y_1 - y_2 + 4y_3)x_1 + (2y_1 + y_2 + 2y_3)x_2 \leq 4y_1 + y_2 + 12y_3 \\
& we\ want & & z = x_1 + x_2 \leq (y_1 - y_2 + 4y_3)x_1 + (2y_1 + y_2 + 2y_3)x_2 \\
so\ dual\ problem\ should\ be \quad & minimize & & 4y_1 + y_2 + 12y_3 \\
& subject\ to & & y_1 - y_2 + 4y_3 \geq 1 \\
& & & 2y_1 + y_2 + 2y_3 \geq 1 \\
& & & y_1, y_2, y_3 \geq 0
\end{aligned}
$$

2

- (a) GP
- (b) LP
- (c) SDP
- (d) QP

3

$$
\begin{aligned}
& & L(x,\nu) = f(x) + \nu(2x_1 - x_2 - 5) = x^T H x + \nu^T(Ax - b) \\
& where\ H = & \begin{bmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{2} \end{bmatrix}, A = \begin{bmatrix} 2 \\ -1 \end{bmatrix}^T, b = [5] \\
& & \nabla_x L(x,\nu) = x + A^T\nu = 0 \Rightarrow x = -A^T\nu \\
& & g(\nu) = L(-A^T\nu, \nu) = -\frac{1}{2}\nu^T A A^T \nu - b^T\nu \\
\nu \in \mathbb{R},^1\ the\ dual\ problem\ should\ be\ QP \quad & maximize & -\frac{1}{2}\nu^T A A^T \nu - b^T\nu = -\frac{5}{2}\nu^2 - 5\nu
\end{aligned}
$$

4

1)

13

2)

$$\{s, a, b, c, d\} \ and \ \{t\}$$