therefore (Dual) is equivalent to:

$$\min_{\nu} \quad \nu^T Q \nu + p^T \nu$$
$$\text{s.t.} \quad A\nu \preccurlyeq b$$

where $\quad Q = \frac{1}{2} I_n \succcurlyeq 0 \qquad p = -y$

$\qquad b = \lambda \mathbb{1}_{2d} \qquad A = \begin{pmatrix} X^T \\ -X^T \end{pmatrix} \in \mathbb{R}^{2d \times n}$

Log-barrier method: we aim to minimise (over v):

$$t f_0(v) - \sum_{i=1}^{2d} \log(-f_i(v))$$

where $\quad f_0 : v \mapsto v^T Q v + p^T v$

$\qquad f_i : v \mapsto (Av - b)_i$

We compute: $\quad \nabla \phi(v) = \sum_{i=1}^{2d} \frac{A_i^T}{-A_i v + b_i} = A^T \frac{1}{b - Av}$

$$\nabla^2 \phi(v) = \sum_{i=1}^{2d} \frac{A_i^T A_i}{(A_i v - b_i)^2} = A^T \operatorname{diag}\left(\frac{1}{Av - b}\right) A$$

where

$$A = \begin{pmatrix} A_1 \\ \vdots \\ A_i \\ \vdots \\ A_{2d} \end{pmatrix} \in \mathbb{R}^{2d \times n}$$