1. Consider the optimization problem \((Q)\) of the form
\[
\begin{align*}
\text{minimize} & \quad \frac{1}{2}x^TP_0x + q_0^Tx \\
\text{subject to} & \quad \frac{1}{2}x^TP_i x + q_i^Tx + r_i \leq 0 \quad \text{for } i = 1, \ldots, m, \\
& \quad Ax = b, x \in \mathbb{R}^n
\end{align*}
\]
where the inputs are the binary encodings of \(A \in \mathbb{Q}^{k \times n}\), \(P_0, P_1, \ldots, P_m \in \mathbb{Q}^{n \times n}\), \(b \in \mathbb{Q}^k\), \(q_0, q_1, \ldots, q_m \in \mathbb{Q}^n\), \(r_1, \ldots, r_m \in \mathbb{Q}\). Show an equivalent decision version of \((Q)\).

2. Show that \((Q)\) from problem 1 is NP-hard.

   Hint: Let \(D-Q\) be an equivalent decision version. Show that for some NP-complete problem \(L\) we have \(L \leq_P D-Q\).

3. Show that if every NP-hard language is also PSPACE-hard, then PSPACE = NP. (Clarification: A language \(A\) is PSPACE-hard if for every language \(B \in \text{PSPACE}\) we have \(B \leq_P A\). A language \(A\) is NP-hard if for every language \(B \in \text{NP}\) we have \(B \leq_P A\).

4. Show that TQBF restricted to formulas where the part following the quantifiers is in conjunctive normal form is still PSPACE-complete.