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Ex9

Task 1)

@ KKT conditions:

1. Primal feasibility: $g_p(x_1, x_2) = x_1 + 2x_2 - 3 = 0$ ①

2. Dual feasibility: $\lambda \geq 0$

3. Complementary slackness: $\lambda \nabla h_q = 0 \quad \forall q$ $\left\{ \begin{array}{l} \rightarrow \text{Since we don't have inequality} \\ \text{constraints, these are satisfied!} \end{array} \right.$

4. Stationarity: $\nabla f(x) + \sum_p v_p \nabla g_p(x) + \sum_q \lambda_q \nabla h_q(x) = 0$

$$\Rightarrow \begin{pmatrix} 2x_1 \\ 2x_2 \end{pmatrix} + v \begin{pmatrix} 1 \\ 2 \end{pmatrix} = 0 \Rightarrow \begin{cases} 2x_1 + v = 0 & ② \\ 2x_2 + 2v = 0 & ③ \end{cases}$$

From ①, ②, ③ we get the optimum solution $x^* = \left(\frac{3}{5}, \frac{6}{5}\right), v^* = -\frac{6}{5}$