a)

$$l(w) = \sum_{n=0}^{N-1} ln(1 + e^{-y_n w^T x_n})$$

Where $w \in R^p, y \in \{-1; 1\}, x \in R^p$

Find gradient w.r.t. "w" : $\frac{dl(w)}{dw}$

$$\frac{dl(w)}{dw_1} = \sum_{n=0}^{N-1} \frac{e^{-y_n w^T x_n}(-y_n x_1)}{1 + e^{-y_n w^T x_n}}$$

$$\frac{dl(w)}{dw_2} = \sum_{n=0}^{N-1} \frac{e^{-y_n w^T x_n}(-y_n x_2)}{1 + e^{-y_n w^T x_n}}$$

$$\frac{dl(w)}{dw_i} = \sum_{n=0}^{N-1} \frac{e^{-y_n w^T x_n}(-y_n x_i)}{1 + e^{-y_n w^T x_n}}$$

$$\frac{dl(w)}{dw} = \sum_{n=0}^{N-1} \frac{e^{-y_n w^T x_n}}{1 + e^{-y_n w^T x_n}}(-y_n) \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

b)

$$l(w) = \sum_{n=0}^{N-1} ln(1 + e^{-y_n w^T x_n}) + Cw^T w$$

where $C \geq 0$, regularization constant

$$\frac{dl(w)}{dw} = \sum_{n=0}^{N-1} \frac{e^{-y_n w^T x_n}}{1 + e^{-y_n w^T x_n}}(-y_n)\vec{x} + 2C\vec{w}$$