2. $$L = \sum_{i=1}^{I} w_i \log\left[\frac{1}{1+\exp[-\phi^T x_i]}\right] + \sum_{i=1}^{I} (1-w_i) \log\left[\frac{\exp[-\phi^T x_i]}{1+\exp[-\phi^T x_i]}\right]$$

Here, $$sig(\phi^T x_i) = \frac{1}{1+\exp[-\phi^T x_i]}$$

$$1 - sig(\phi^T x_i) = \frac{\exp[-\phi^T x_i]}{1+\exp[-\phi^T x_i]}$$

Now,

$$L = \sum_{i=1}^{I} w_i \log[sig(\phi^T x_i)] + \sum_{i=1}^{I} (1-w_i) \log[1 - sig(\phi^T x_i)]$$

$$\frac{\partial L}{\partial \phi} = \frac{\partial}{\partial \phi}\left(\sum_{i=1}^{I} w_i \log[sig(\phi^T x_i)] + \sum_{i=1}^{I}(1-w_i) \log[1 - sig(\phi^T x_i)]\right)$$

$$= \sum_{i=1}^{I} w_i \frac{1}{sig(\phi^T x_i)} \cdot \frac{\partial\, sig(\phi^T x_i)}{\partial \phi} + \sum_{i=1}^{I} (1-w_i) \frac{1}{1 - sig(\phi^T x_i)} \cdot - \frac{\partial\, sig(\phi^T x_i)}{\partial \phi}$$

$$= \sum_{i=1}^{I} \left(\frac{w_i}{sig(\phi^T x_i)} - \frac{(1-w_i)}{1 - sig(\phi^T x_i)}\right) \frac{\partial\, sig(\phi^T x_i)}{\partial \phi}$$

$$= \sum_{i=1}^{I} \left(\frac{w_i - \cancel{w_i\, sig(\phi^T x_i)} - sig(\phi^T x) + \cancel{w_i\, sig(\phi^T x_i)}}{\cancel{sig(\phi^T x_i)(1 - sig(\phi^T x_i))}}\right) \cancel{sig(\phi^T x_i)(1 - sig(\phi^T x_i))} \cdot x_i$$

$$= \sum_{i=1}^{I} \left(w_i - sig(\phi^T x)\right) x_i$$

$$= - \sum_{i=1}^{I} \left(sig(\phi^T x) - w_i\right) x_i$$

$$\frac{\partial L}{\partial \phi} = - \sum_{i=1}^{I} \left(\frac{1}{1+\exp[-\phi^T x_i]} - w_i\right) x_i$$