$$J(w) = -\frac{1}{m} \sum_{i=1}^{m} \log P_w\left(y^{(i)} \mid x^{(i)}\right)$$

$$= \frac{1}{m} \sum_{i=1}^{m} L\left(\underline{w}, x^{(i)}, y^{(i)}\right)$$

where $L(\underline{w}, x, y) = -\log P_{\underline{w}}(y \mid x)$