$$\hat{p}_{cd} = \frac{\sum_{i=1}^{N} x_{id} 1(y_i = c)}{\sum_{i=1}^{N} 1(y_i = c)}$$

$$\hat{P}(y_i = c) = \frac{\sum_{i=1}^{N} 1(y_i = c)}{N}$$

$$\begin{aligned} g_c(\boldsymbol{x}) &= \log \left[\prod_{d=1}^{D} p(x_d | y = c) \right] + \log P(y = c) \\ &= \log \left[\prod_{d=1}^{D} \hat{p}_{cd}^{x_d} (1 - \hat{p}_{cd})^{1 - x_d} \right] + \log \hat{P}(y = c) \\ &= \sum_{d=1}^{D} \left[x_d \log(\hat{p}_{cd}) + (1 - x_d) \log(1 - \hat{p}_{cd}) \right] + \log \hat{P}(y = c) \end{aligned}$$