4.16 The negative log-likelihood is given by the cross-entropy (as per 4.90), giving us:

$$-\ln p(\mathbf{t}|\mathbf{\Phi}) = -\sum_{n=1}^{N}\{\pi_n \ln p(t=1|\boldsymbol{\phi}) + (1-\pi_n)\ln(1-p(t=1|\boldsymbol{\phi}))\}$$

$$\implies \ln p(\mathbf{t}|\mathbf{\Phi}) = \sum_{n=1}^{N}\{\pi_n \ln p(t=1|\boldsymbol{\phi}) + (1-\pi_n)\ln(1-p(t=1|\boldsymbol{\phi}))\}$$