

Problem 3:

$$\begin{aligned} f &= a + \log \sum_{i=1}^N e^{x_i - a} \\ &= \log e^a + \log e^{-a} \cdot \sum_{i=1}^N e^{x_i} \\ &= \log e^a \cdot e^{-a} \cdot \sum_{i=1}^N e^{x_i} \\ &= \log \sum_{i=1}^N e^{x_i} \end{aligned}$$

Problem 4:

$$\frac{e^{x_i}}{\sum_{i=1}^N e^{x_i}} = \frac{e^{-a} \cdot e^{x_i}}{e^{-a} \cdot \sum_{i=1}^N e^{x_i}} = \frac{e^{x_i - a}}{\sum_{i=1}^N e^{x_i - a}}$$