LOG-SUM-EXP

Imagine we want to calculate:

$$c = \log \sum_{i=1}^{n} e^{x_i}$$

If the scale of x is very small or large it can create a number, C, that is too small or large to represent on the computer. This is called underflow and overflow. The log-sum-exp trick exploits the fact that:

$$\log \sum_{i=1}^{n} e^{x_i} = a + \log \sum e^{x_i - a} \quad \text{where } a = \max(x)$$

This allows us to shift the center so the greatest value of $(x_i - a)$ is zero, preventing underflow and overflow.