3.1 First we show how tanh and logistic sigmoid function are related:

$$\sigma(2a) = \frac{1}{1+exp(-2a)}$$

$$\implies 2\sigma(2a)-1 = \frac{2}{1+exp(-2a)} - 1$$

$$= \frac{2-(1+exp(-2a))}{1+exp(-2a)} = \frac{1-exp(-2a)}{1+exp(-2a)} = \frac{1-\frac{1}{exp(2a)}}{1+\frac{1}{exp(2a)}}$$

$$= \frac{\frac{exp(2a)-1}{exp(2a)}}{\frac{exp(2a)+1}{exp(2a)}} = \frac{exp(2a)-1}{exp(2a)+1} = tanh(a).$$

From the above result, we can see that $\sigma(a) = \frac{1}{2}(tanh(\frac{a}{2})+1)$.

Applying that to the general linear combination of logistic sigmoid functions of this form:

$$w_0 + \sum_{j=1}^{M} w_j \sigma\left(\frac{x-\mu_j}{s}\right)$$

we get :

$$= w_0 + \sum_{j=1}^{M} w_j \left(\frac{1}{2}\left(tanh\left(\frac{x-\mu_j}{2s}\right)+1\right)\right)$$

$$= w_0 + \sum_{j=1}^{M} \frac{w_j}{2} tanh\left(\frac{x-\mu_j}{2s}\right) + \sum_{j=1}^{M} \frac{w_j}{2}$$

$$\implies u_0 = w_0 + \sum_{j=1}^{M} \frac{w_j}{2}$$

and

$$\implies u_j = \frac{w_j}{2}, \quad \forall j \neq 0.$$

Note: typo in (3.102), the denominator should be 2s not s.