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42-1(a)

$$E(m,c) = \frac{1}{2}\left(y_i^a - mx_i^a - c\right)^2$$

$$g_m = \frac{\partial E(m,c)}{\partial m} = -\left(y_i^a - mx_i^a - c\right)x_i^a$$

$$g_c = \frac{\partial E(m,c)}{\partial c} = -\left(y_i^a - mx_i^a - c\right)$$

Step 1 : Read dataset and initialise respective variables

$$m = m_0,\ c = c_0,\ E^2_{g_m,0} = E^2_{g_c,0} = 0$$

Step 2 : Set Iteration $t = 1$

Step 3 : Set sample $i = 1$

Step 4 : Calculate g_m and g_c. Using those, calculate $E^2_{g_m,t}$ and $E^2_{g_c,t}$

$$E^2_{g_m,t} = \gamma E^2_{g_m,t-1} + (1-\gamma)\left[g_m\right]^2$$

$$E^2_{g_c,t} = \gamma E^2_{g_c,t-1} + (1-\gamma)\left[g_c\right]^2$$

Step 5: Update m and c

$$m = m - \frac{\eta}{\sqrt{E^2_{g_m,t} + \epsilon}} * g_m$$

$$c = c - \frac{\eta}{\sqrt{E^2_{g_c,t} + \epsilon}} * g_c$$

Step 6 : Set sample $i = i+1$, if $i > n_s$ go to next step else go to Step 4

Step 7 : Set iteration $t = t+1$, if t max iter go to next step else go to step 3

Step 8 : Compute error metrics

Step 9 : Stop

421(b): Backpropagation + RMSProp

Step 1: Calculate net_j for hidden layer by using

$$net_j = W_{ij}^T * X + b_j$$

Step 2: Calculate output of hidden layer

$$O_j = \frac{1}{1+e^{-net_j}}$$

Step 3: Calculate net_K for output layer

$$net_K = w_{jK}^T * O_j + b_K$$

Step 4: Calculate output of output layer using equation

$$O_K = \frac{e^{net_K}}{\sum e^{net_K}}$$

Step 5: Update the weights between hidden layer and output layer/next layer using the below equation

$$W_{jK} = W_{jK} + \Delta W_{jK}$$

$$\Delta W_{jK} = -\frac{2}{\sqrt{E^2_{g_m,t} + \epsilon}} * g_m \quad \because \text{RMSprop}$$

Step 6: Update the bias parameter between hidden layers and output layer / next layer

$$b_t = b_k + \Delta b_k$$

where

$$\Delta b_k = \frac{-2}{\sqrt{E^2_{g,t} + \epsilon}} * g_t \quad \because \text{RMSprop}$$

Step 7: Update the weights & bias in the similar fashion in between the rest of the layers till input layer.