
Algorithm 1 Resilient propagation algorithm (RPROP). Recommended parameter values are $\Delta_0 = 0.1$, $\Delta_{\min} = 10^{-6}$, $\Delta_{\max} = 50$, $\eta_- = 0.5$, $\eta_+ = 1.2$. Note that $\text{sign}(0) = 0$.

Initialization: for $\forall w_{ij}$

Set $w_{ij}^{(0)}$ randomly

$$\Delta_{ij}^{(0)} = \Delta_0$$

$$\Delta w_{ij}^{(0)} = -\text{sign}\left(\frac{\partial E}{\partial w_{ij}}^{(0)}\right) \cdot \Delta_0$$

Weight update step: for $\forall w_{ij}$

$t = 1$

$$w_{ij}^{(t)} = w_{ij}^{(t-1)} + \Delta w_{ij}^{(t-1)}$$

repeat until convergence

if $\frac{\partial E}{\partial w_{ij}}^{(t-1)} \cdot \frac{\partial E}{\partial w_{ij}}^{(t)} > 0$

$$\Delta_{ij}^{(t)} = \min \left\{ \Delta_{\max}, \Delta_{ij}^{(t-1)} \cdot \eta_+ \right\}$$

$$\Delta w_{ij}^{(t)} = -\text{sign}\left(\frac{\partial E}{\partial w_{ij}}^{(t)}\right) \cdot \Delta_{ij}^{(t)}$$

elseif $\frac{\partial E}{\partial w_{ij}}^{(t-1)} \cdot \frac{\partial E}{\partial w_{ij}}^{(t)} < 0$

$$\Delta_{ij}^{(t)} = \max \left\{ \Delta_{\min}, \Delta_{ij}^{(t-1)} \cdot \eta_- \right\}$$

$$\Delta w_{ij}^{(t)} = -\Delta w_{ij}^{(t-1)}$$

$$\frac{\partial E}{\partial w_{ij}}^{(t)} = 0$$

else

$$\Delta_{ij}^{(t)} = \Delta_{ij}^{(t-1)}$$

$$\Delta w_{ij}^{(t)} = -\text{sign}\left(\frac{\partial E}{\partial w_{ij}}^{(t)}\right) \cdot \Delta_{ij}^{(t)}$$

end

$$w_{ij}^{(t+1)} = w_{ij}^{(t)} + \Delta w_{ij}^{(t)}$$

$t = t + 1$

end

Termination: for $\forall w_{ij}$

Output $w_{ij}^{(t)}$
