2 layer MLP

FF

$net^1 = w^1 * X^T$

$o^1 = f^1(net^1) = Sigmoid(net^1)$

$net^2 = w^2 * o^1$

$o^2 = f^2(net^2) = net^2$

BP

$$w^2 = w^2 - \eta \left(\frac{\partial E}{\partial e} \frac{\partial e}{\partial o^2} \frac{\partial o^2}{\partial net^2} \frac{\partial net^2}{\partial w^2} \right) *$$

$e \quad -1 \quad 1 \quad o^1$

$$w^1 = w^1 - \eta \left(\frac{\partial E}{\partial e} \frac{\partial e}{\partial o^2} \frac{\partial o^2}{\partial net^2} \frac{\partial net^2}{\partial o^1} \frac{\partial o^1}{\partial net^1} \frac{\partial net^1}{\partial w^1} \right)$$

$e \quad -1 \quad 1 \quad w^2 \quad f'^1 \quad X^T$

3 layer MLP

FF

$net^1 = w^1 * x^T$

$o^1 = f'(net^1) = Sigmoid(net^1)$

$net^2 = w^2 * o^1$

$o^2 = f'(net^2) = Sigmoid(net^2)$

$net^3 = w^3 * o^2$

$o^3 = f'(net^3) = net^3$

BP

$$w^3 = w^3 - \eta\left(\frac{\partial E}{\partial e}\frac{\partial e}{\partial o^3}\frac{\partial o^3}{\partial net^3}\frac{\partial net^3}{\partial w^3}\right)$$

$e \quad -1 \quad 1 \quad o^2$

$$w^2 = w^2 - \eta\left(\frac{\partial E}{\partial e}\frac{\partial e}{\partial o^3}\frac{\partial o^3}{\partial net^3}\frac{\partial net^3}{\partial o^2}\frac{\partial o^2}{\partial net^2}\frac{\partial net^2}{\partial w^2}\right)$$

$e \quad -1 \quad 1 \quad w^3 \quad f'^2 \quad o^1$

$$w^1 = w^1 - \eta\left(\frac{\partial E}{\partial e}\frac{\partial e}{\partial o^3}\frac{\partial o^3}{\partial net^3}\frac{\partial net^3}{\partial o^2}\frac{\partial o^2}{\partial net^2}\frac{\partial net^2}{\partial o^1}\frac{\partial o^1}{\partial net^1}\frac{\partial net^1}{\partial w^1}\right)$$

$e \quad -1 \quad 1 \quad w^3 \quad f'^2 \quad w^2 \quad f'^1 \quad x^T$

3 layer AE + 2 layer MLP + Global Train

FF

$net^{e1} = w^{e1} * X^T$

$h^1 = f^{e1}(net^{e1}) = Sigmoid(net^{e1})$

$net^{e2} = w^{e2} * h^1$

$h^2 = f^{e2}(net^{e2}) = Sigmoid(net^{e2})$

$net^{e3} = w^{e3} * h^2$

$h^3 = f^{e3}(net^{e3}) = Sigmoid(net^{e3})$

$net^1 = w^1 * h^3$

$o^1 = f^1(net^1) = Sigmoid(net^1)$

$net^2 = w^2 * o^1$

$o^2 = f^2(net^2) = net^2$

BP

$$w^{e1} = w^{e1} - \eta\left(\frac{\partial E}{\partial e}\frac{\partial e}{\partial o^2}\frac{\partial o^2}{\partial net^2}\frac{\partial net^2}{\partial o^1}\frac{\partial o^1}{\partial net^1}\frac{\partial net^1}{\partial h^3}\frac{\partial h^3}{\partial net^{e3}}\frac{\partial net^{e3}}{\partial h^2}\frac{\partial h^2}{\partial net^{e2}}\frac{\partial net^{e2}}{\partial h^1}\frac{\partial h^1}{\partial net^{e1}}\frac{\partial net^{e1}}{\partial w^{e1}}\right)$$

$e \quad -1 \quad 1 \quad w^2 \quad f'^1 \quad w^1 \quad f'^{e3} \quad w^{e3} \quad f'^{e2} \quad w^{e2} \quad f'^{e1} \quad X$

$$w^{e2} = w^{e2} - \eta\left(\frac{\partial E}{\partial e}\frac{\partial e}{\partial o^2}\frac{\partial o^2}{\partial net^2}\frac{\partial net^2}{\partial o^1}\frac{\partial o^1}{\partial net^1}\frac{\partial net^1}{\partial h^3}\frac{\partial h^3}{\partial net^{e3}}\frac{\partial net^{e3}}{\partial h^2}\frac{\partial h^2}{\partial net^{e2}}\frac{\partial net^{e2}}{\partial w^{e2}}\right)$$

$e \quad -1 \quad 1 \quad w^2 \quad f'^1 \quad w^1 \quad f'^{e3} \quad w^{e3} \quad f'^{e2} \quad h^1$

$$w^{e3} = w^{e3} - \eta\left(\frac{\partial E}{\partial e}\frac{\partial e}{\partial o^2}\frac{\partial o^2}{\partial net^2}\frac{\partial net^2}{\partial o^1}\frac{\partial o^1}{\partial net^1}\frac{\partial net^1}{\partial h^3}\frac{\partial h^3}{\partial net^{e3}}\frac{\partial net^{e3}}{\partial w^{e3}}\right)$$

$e \quad -1 \quad 1 \quad w^2 \quad f'^1 \quad w^1 \quad f'^{e3} \quad h^2$

$$w^1 = w^1 - \eta\left(\frac{\partial E}{\partial e}\frac{\partial e}{\partial o^2}\frac{\partial o^2}{\partial net^2}\frac{\partial net^2}{\partial o^1}\frac{\partial o^1}{\partial net^1}\frac{\partial net^1}{\partial w^1}\right)$$

$e \quad -1 \quad 1 \quad w^2 \quad f' \quad h^3$

$$w^2 = w^2 - \eta\left(\frac{\partial E}{\partial e}\frac{\partial e}{\partial o^2}\frac{\partial o^2}{\partial net^2}\frac{\partial net^2}{\partial w^2}\right)$$

$e \quad -1 \quad 1 \quad o^1$

3 layer AE + 3 layer MLP + Global Train

FF

$net^{e1} = w^{e1} * x^T$

$h^1 = f^{e1}(net^{e1}) = Sigmoid(net^{e1})$

$net^{e2} = w^{e2} * h^1$

$h^2 = f^{e2}(net^{e2}) = Sigmoid(net^{e2})$

$net^{e3} = w^{e3} * h^2$

$h^3 = f^{e3}(net^{e3}) = Sigmoid(net^{e3})$

$net^1 = w^1 * h^3$

$o^1 = f^1(net^1) = Sigmoid(net^1)$

$net^2 = w^2 * o^1$

$o^2 = f^2(net^2) = Sigmoid(net^2)$

$net^3 = w^3 * o^2$

$o^3 = f^3(net^3) = net^3$

BP

$$w^{e1} = w^{e1} - \eta\left(\underbrace{\frac{\partial E}{\partial e}}_{e}\underbrace{\frac{\partial e}{\partial o^3}}_{-1}\underbrace{\frac{\partial o^3}{\partial net^3}}_{1}\underbrace{\frac{\partial net^3}{\partial o^2}}_{w^3}\underbrace{\frac{\partial o^2}{\partial net^2}}_{f'^2}\underbrace{\frac{\partial net^2}{\partial o^1}}_{w^2}\underbrace{\frac{\partial o^1}{\partial net^1}}_{f'^1}\underbrace{\frac{\partial net^1}{\partial h^3}}_{w^1}\underbrace{\frac{\partial h^3}{\partial net^{e3}}}_{f'^{e3}}\underbrace{\frac{\partial net^{e3}}{\partial h^2}}_{w^{e3}}\underbrace{\frac{\partial h^2}{\partial net^{e2}}}_{f'^{e2}}\underbrace{\frac{\partial net^{e2}}{\partial h_1}}_{w^{e2}}\underbrace{\frac{\partial h_1}{\partial net^{e1}}}_{f'^{e1}}\underbrace{\frac{\partial net^{e1}}{\partial w^{e1}}}_{X}\right)$$

$$w^{e2} = w^{e2} - \eta\left(\underbrace{\frac{\partial E}{\partial e}}_{e}\underbrace{\frac{\partial e}{\partial o^3}}_{-1}\underbrace{\frac{\partial o^3}{\partial net^3}}_{1}\underbrace{\frac{\partial net^3}{\partial o^2}}_{w^3}\underbrace{\frac{\partial o^2}{\partial net^2}}_{f'^2}\underbrace{\frac{\partial net^2}{\partial o^1}}_{w^2}\underbrace{\frac{\partial o^1}{\partial net^1}}_{f'^1}\underbrace{\frac{\partial net^1}{\partial h^3}}_{w^1}\underbrace{\frac{\partial h^3}{\partial net^{e3}}}_{f'^{e3}}\underbrace{\frac{\partial net^{e3}}{\partial h_2}}_{w^{e3}}\underbrace{\frac{\partial h^2}{\partial net^{e2}}}_{f'^{e2}}\underbrace{\frac{\partial net^{e2}}{\partial w^{e2}}}_{h^1}\right)$$

$$w^{e3} = w^{e3} - \eta\left(\underbrace{\frac{\partial E}{\partial e}}_{e}\underbrace{\frac{\partial e}{\partial o^3}}_{-1}\underbrace{\frac{\partial o^3}{\partial net^3}}_{1}\underbrace{\frac{\partial net^3}{\partial o^2}}_{w^3}\underbrace{\frac{\partial o^2}{\partial net^2}}_{f'^2}\underbrace{\frac{\partial net^2}{\partial o^1}}_{w^2}\underbrace{\frac{\partial o^1}{\partial net^1}}_{f'^1}\underbrace{\frac{\partial net^1}{\partial h^3}}_{w^1}\underbrace{\frac{\partial h^3}{\partial net^{e3}}}_{f'^{e3}}\underbrace{\frac{\partial net^{e3}}{\partial w^{e3}}}_{h^2}\right)$$

$$w^1 = w^1 - \eta\left(\underbrace{\frac{\partial E}{\partial e}}_{e}\underbrace{\frac{\partial e}{\partial o^3}}_{-1}\underbrace{\frac{\partial o^3}{\partial net^3}}_{1}\underbrace{\frac{\partial net^3}{\partial o^2}}_{w^3}\underbrace{\frac{\partial o^2}{\partial net^2}}_{f'^2}\underbrace{\frac{\partial net^2}{\partial o^1}}_{w^2}\underbrace{\frac{\partial o^1}{\partial net^1}}_{f'^1}\underbrace{\frac{\partial net^1}{\partial w^1}}_{h^3}\right)$$

$$w^2 = w^2 - \eta\left(\underbrace{\frac{\partial E}{\partial e}}_{e}\underbrace{\frac{\partial e}{\partial o^3}}_{-1}\underbrace{\frac{\partial o^3}{\partial net^3}}_{1}\underbrace{\frac{\partial net^3}{\partial o^2}}_{w^3}\underbrace{\frac{\partial o^2}{\partial net^2}}_{f'^2}\underbrace{\frac{\partial net^2}{\partial w^2}}_{o^1}\right)$$

$$w^3 = w^3 - \eta\left(\underbrace{\frac{\partial E}{\partial e}}_{e}\underbrace{\frac{\partial e}{\partial o^3}}_{-1}\underbrace{\frac{\partial o^3}{\partial net^3}}_{1}\underbrace{\frac{\partial net^3}{\partial w^3}}_{o^2}\right)$$