

Appendix B: An Example of Back- propagation algorithm

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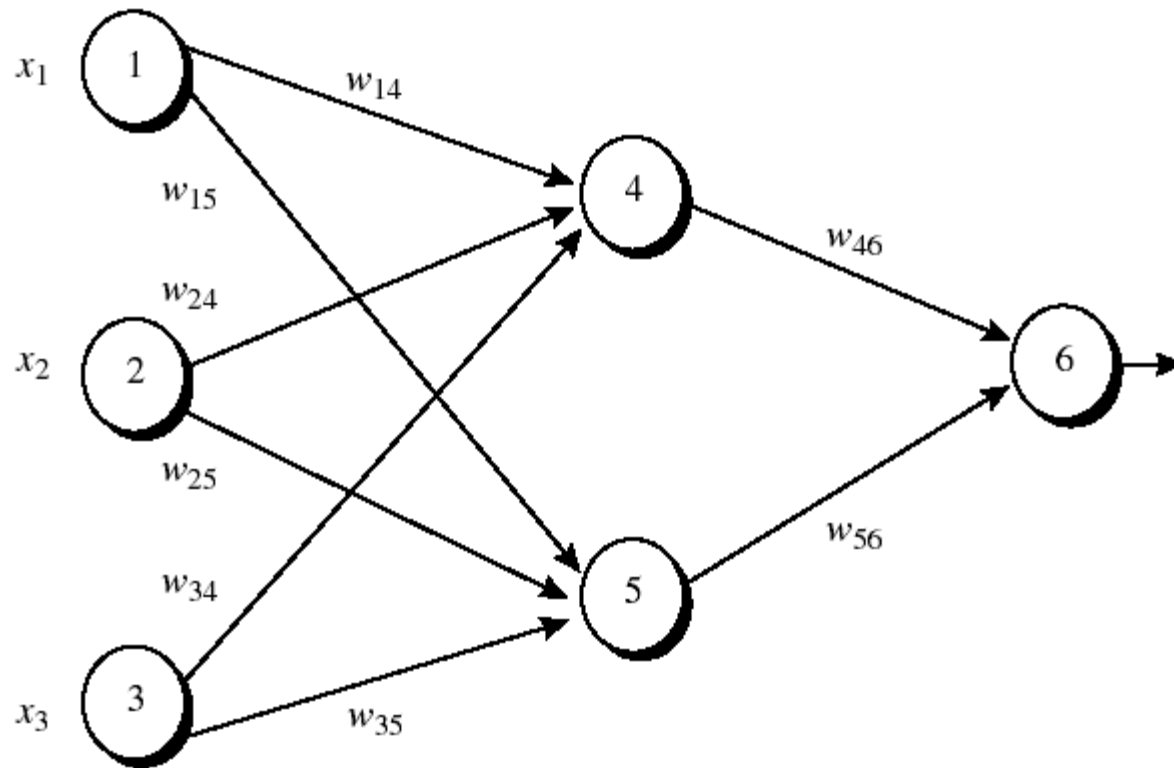


Figure 1: An example of a multilayer feed-forward neural network. Assume that the learning rate η is 0.9 and the first training example, $X = (1,0,1)$ whose class label is 1.

Note: The sigmoid function is applied to hidden layer and output layer.

Table 1: Initial input and weight values

X_1	X_2	X_3	W_{14}	W_{15}	W_{24}	W_{25}	W_{34}	W_{35}	W_{46}	W_{56}	W_{04}	W_{05}	W_{06}
1	0	1	0.2	-0.3	0.4	0.1	-0.5	0.2	-0.3	-0.2	-0.4	0.2	0.1

Table 2: The net input and output calculation

Unit j	Net input I_j	Output O_j
4	$0.2 + 0 - 0.5 - 0.4 = -0.7$	$1/(1+e^{0.7})=0.332$
5	$-0.3 + 0 + 0.2 + 0.2 = 0.1$	$1/(1+e^{0.1})=0.525$
6	$(-0.3)(0.332) - (0.2)(0.525) + 0.1 = -0.105$	$1/(1+e^{0.105})=0.474$

Table 3: Calculation of the error at each node

Unit j	δ_j
6	$(0.474)(1-0.474)(1-0.474)=0.1311$
5	$(0.525)(1-0.525)(0.1311)(-0.2)=-0.0065$
4	$(0.332)(1-0.332)(0.1311)(-0.3)=-0.0087$

Table 4: Calculation for weight updating
WeightNew value

W_{46}	$-0.3 + (0.9)(0.1311)(0.332) = -0.261$
W_{56}	$-0.2 + (0.9)(0.1311)(0.525) = -0.138$
W_{14}	$0.2 + (0.9)(-0.0087)(1) = 0.192$
W_{15}	$-0.3 + (0.9)(-0.0065)(1) = -0.306$
W_{24}	$0.4 + (0.9)(-0.0087)(0) = 0.4$
W_{25}	$0.1 + (0.9)(-0.0065)(0) = 0.1$
W_{34}	$-0.5 + (0.9)(-0.0087)(1) = -0.508$
W_{35}	$0.2 + (0.9)(-0.0065)(1) = 0.194$
W_{06}	$0.1 + (0.9)(0.1311) = 0.218$
W_{05}	$0.2 + (0.9)(-0.0065) = 0.194$
W_{04}	$-0.4 + (0.9)(-0.0087) = -0.408$