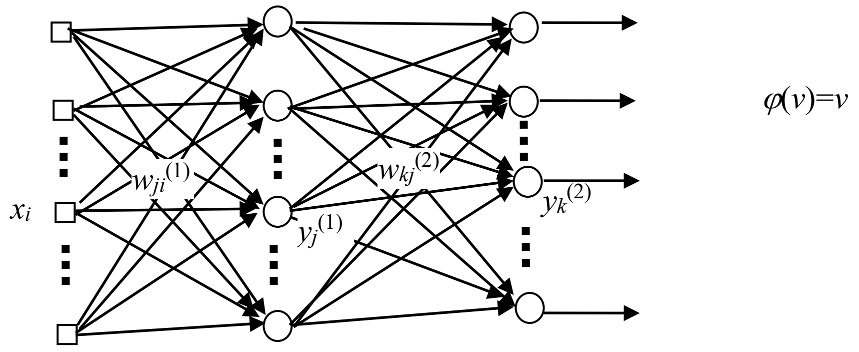
EE4305 Fuzzy/Neural Systems for Intelligent Robotics

SOLUTION FOR PB5

1.



$$y_k^{(2)} = \sum_j w_{kj}^{(2)} y_j^{(1)}$$

$$y_j^{(1)} = \sum_i w_{ji}^{(1)} x_i$$

Therefore,

$$y_k^{(2)} = \sum_j w_{kj}^{(2)} y_j^{(1)} = \sum_j w_{kj}^{(2)} \left(\sum_i w_{ji}^{(1)} x_i \right)$$

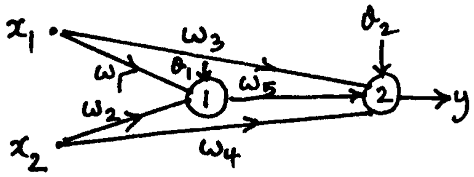
$$= \sum_j \sum_i \; w_{kj}^{(2)} w_{ji}^{(1)} x_i$$

$$= \sum_i \sum_j \; w_{kj}^{(2)} w_{ji}^{(1)} x_i$$

$$= \sum_i w_{ki} x_i$$

where $w_{ki} = \sum_j w_{kj}^{(2)} w_{ji}^{(1)}$

2.



$\varphi =$ sigmoid $\quad u =$ Neuron 1 output

$v_1 = \omega_1 x_1 + \omega_2 x_2 - \theta_1 \qquad u = \varphi(v_1)$

$v_2 = \omega_3 x_1 + \omega_4 x_2 + \omega_5 u - \theta_2, \; y = \varphi(v_2)$

$$\frac{\partial e}{\partial y} = \frac{d}{y} - \frac{(1-d)}{(1-y)} \; ; \quad \frac{\partial e}{\partial v_2} = \frac{\partial e}{\partial y} \cdot \frac{\partial y}{\partial v_2} = \frac{\partial e}{\partial y} \cdot \varphi'(v_2) \; ;$$

$$\frac{\partial e}{\partial u} = \frac{\partial e}{\partial v_2} \cdot \frac{\partial v_2}{\partial u} = \frac{\partial e}{\partial v_2} \cdot \omega_5 \; ; \quad \frac{\partial e}{\partial v_1} = \frac{\partial e}{\partial u} \cdot \frac{\partial u}{\partial v_1} = \frac{\partial e}{\partial u} \cdot \varphi'(v_1) \; ;$$

$$\frac{\partial e}{\partial x_1} = \frac{\partial e}{\partial v_1} \cdot \frac{\partial v_1}{\partial x_1} + \frac{\partial e}{\partial v_2} \cdot \frac{\partial v_2}{\partial x_1} = \frac{\partial e}{\partial v_1} \cdot \omega_1 + \frac{\partial e}{\partial v_2} \cdot \omega_3 \; ;$$

$$\frac{\partial e}{\partial x_2} = \frac{\partial e}{\partial v_1} \cdot \frac{\partial v_1}{\partial x_2} + \frac{\partial e}{\partial v_2} \cdot \frac{\partial v_2}{\partial x_2} = \frac{\partial e}{\partial v_1} \cdot \omega_2 + \frac{\partial e}{\partial v_2} \cdot \omega_4$$