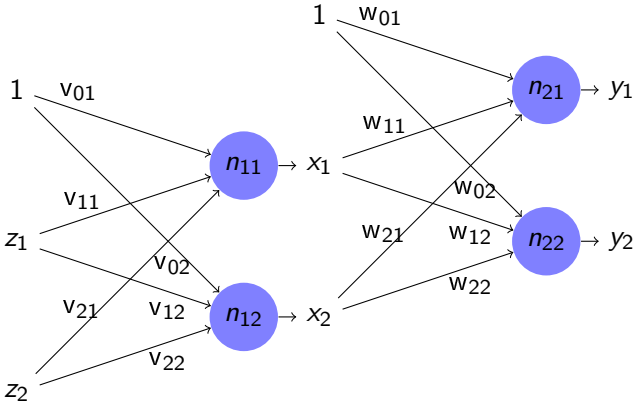
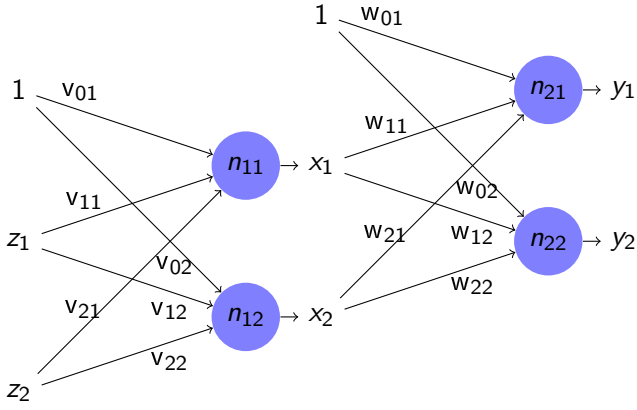
Обратное распространение ошибки

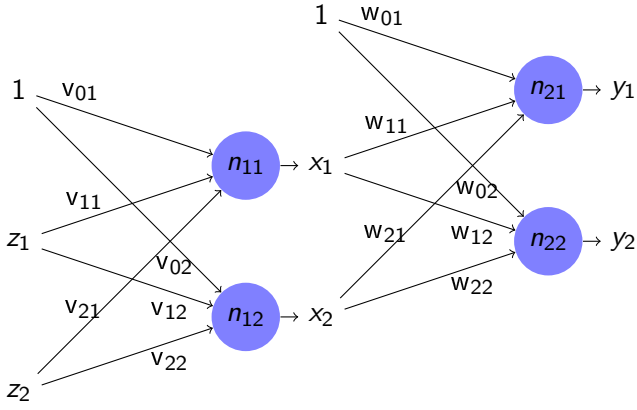


Обратное распространение ошибки



$$E_k(W) = D_k(y_1, \ldots, y_n)$$

Обратное распространение ошибки



$$E_k(W) = D_k(y_1, \ldots, y_n) \quad y_i = y_i(x_1, \ldots, x_m)$$

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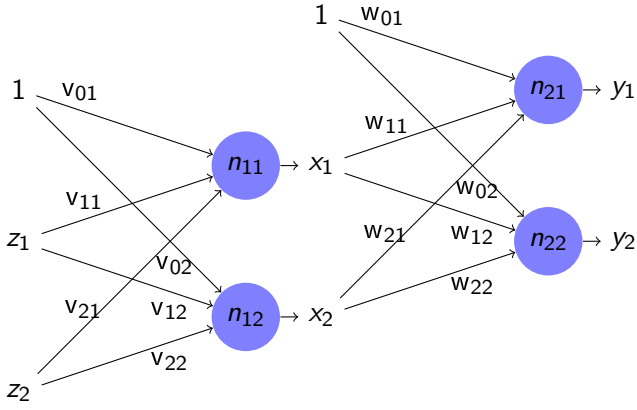
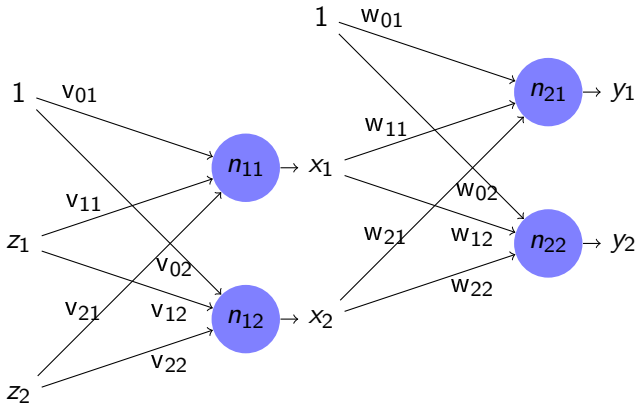


$$E_k(W) = D_k(y_1, \ldots, y_n) \quad y_i = y_i(x_1, \ldots, x_m) \quad x_j = x_j(v_{0j}, \ldots, v_{rj})$$

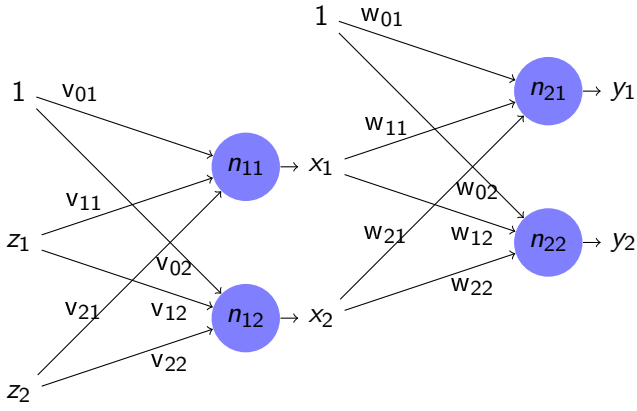
Обратное распространение ошибки



$$E_k(W) = D_k(y_1, \ldots, y_n) \quad y_i = y_i(x_1, \ldots, x_m) \quad x_j = x_j(v_{0j}, \ldots, v_{rj})$$

Если бы $D_k = D_k(x_1, \ldots, x_m)$, то $\frac{\partial E_k}{\partial v_{rs}} = \sum_{j=1}^{m} \frac{\partial D_k}{\partial x_j} \frac{\partial x_j}{\partial v_{rs}}$

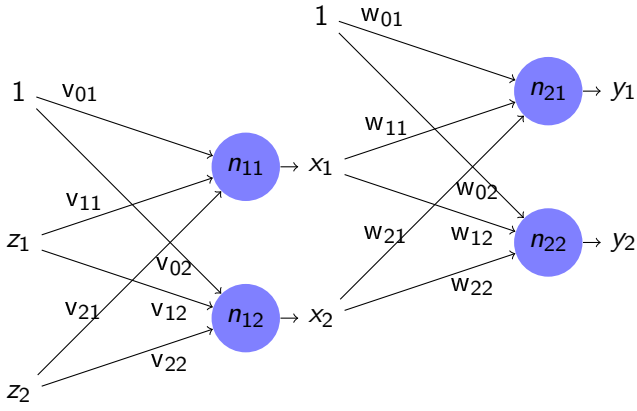
Обратное распространение ошибки



$$E_k(W) = D_k(y_1, \ldots, y_n) \quad y_i = y_i(x_1, \ldots, x_m) \quad x_j = x_j(v_{0j}, \ldots, v_{rj})$$

$$\frac{\partial E_k}{\partial v_{rs}} = \sum_{j=1}^{m} \frac{\partial D_k}{\partial x_j} \frac{\partial x_j}{\partial v_{rs}}$$

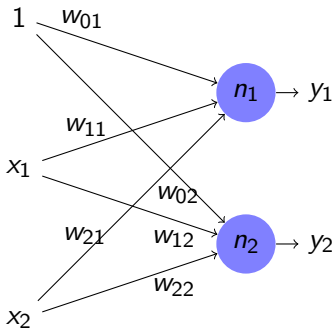
Обратное распространение ошибки



$$E_k(W) = D_k(y_1, \ldots, y_n) \quad y_i = y_i(x_1, \ldots, x_m) \quad x_j = x_j(v_{0j}, \ldots, v_{rj})$$

$$\frac{\partial E_k}{\partial v_{rs}} = \sum_{j=1}^{m} \frac{\partial D_k}{\partial x_j} \frac{\partial x_j}{\partial v_{rs}} \quad \frac{\partial D_k}{\partial z_l} = \sum_{j=1}^{m} \frac{\partial D_k}{\partial x_j} \frac{\partial x_j}{\partial z_l}$$

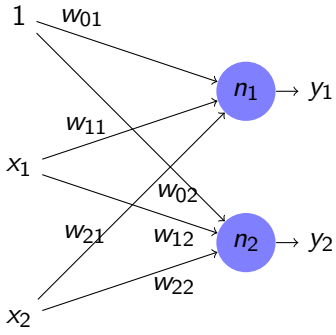
Обратное распространение ошибки



$$D_k(y_1, y_2) = (y_1 - a_1)^2 + (y_2 - a_2)^2$$

$$\frac{\partial D_k}{\partial y_1} = 2(y_1 - a_1) \quad \frac{\partial D_k}{\partial y_2} = 2(y_2 - a_2)$$

Обратное распространение ошибки

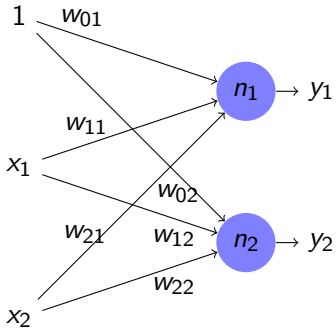


$$D_k(y_1, y_2) = (y_1 - a_1)^2 + (y_2 - a_2)^2$$

$$\frac{\partial D_k}{\partial y_1} = 2(y_1 - a_1) \quad \frac{\partial D_k}{\partial y_2} = 2(y_2 - a_2)$$

$$y_1 = f\underbrace{(w_{01} + x_1 w_{11} + x_2 w_{21})}_{s_1}$$

Обратное распространение ошибки



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$$\frac{\partial y_1}{\partial x_1} =$$

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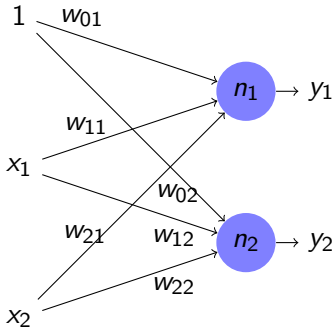

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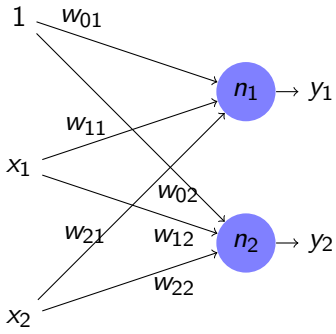
$$\frac{\partial y_1}{\partial x_1} = f'(S_1) w_{11}$$

Обратное распространение ошибки



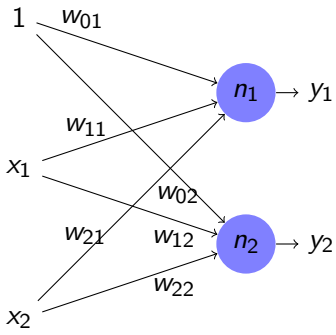
$$D_k(y_1, y_2) = (y_1 - a_1)^2 + (y_2 - a_2)^2$$

$$\frac{\partial D_k}{\partial y_1} = 2(y_1 - a_1) \quad \frac{\partial D_k}{\partial y_2} = 2(y_2 - a_2)$$

$$y_2 = f\underbrace{(w_{02} + x_1 w_{12} + x_2 w_{22})}_{S_2}$$

$$\frac{\partial y_1}{\partial x_1} = f'(S_1) w_{11}$$

Обратное распространение ошибки



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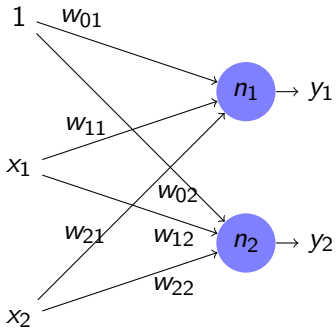
$$\frac{\partial y_1}{\partial x_1} = f'(S_1) w_{11} \qquad \frac{\partial y_2}{\partial x_1} =$$

Обратное распространение ошибки



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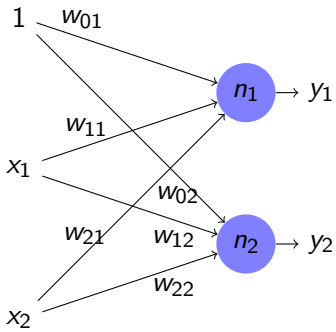
Обратное распространение ошибки



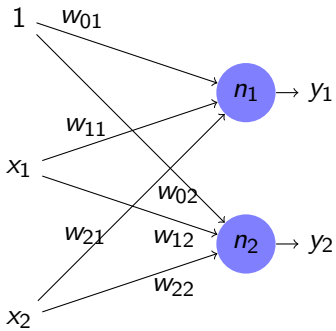
$$D_k(y_1, y_2) = (y_1 - a_1)^2 + (y_2 - a_2)^2$$

$$\frac{\partial D_k}{\partial y_1} = 2(y_1 - a_1) \quad \frac{\partial D_k}{\partial y_2} = 2(y_2 - a_2)$$

$$\frac{\partial y_1}{\partial x_1} = f'(S_1)w_{11} \qquad \frac{\partial y_2}{\partial x_1} = f'(S_2)w_{12}$$

$$\frac{\partial D_k}{\partial x_1} =$$

Обратное распространение ошибки



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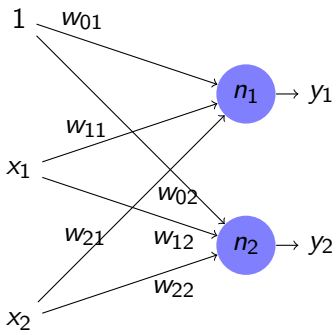
$$\frac{\partial y_1}{\partial x_1} = f'(S_1)w_{11} \qquad \frac{\partial y_2}{\partial x_1} = f'(S_2)w_{12}$$

$$\frac{\partial D_k}{\partial x_1} = \frac{\partial D_k}{\partial y_1}\frac{\partial y_1}{\partial x_1} + \frac{\partial D_k}{\partial y_2}\frac{\partial y_2}{\partial x_1} =$$

$$= 2(y_1 - a_1)f'(S_1)w_{11} + 2(y_2 - a_2)f'(S_2)w_{12}$$

Обратное распространение ошибки



$$D_k(y_1, ..., y_n) = (y_i - a_i)^2 + ... + (y_n - a_n)^2$$

$$\frac{\partial D_k}{\partial y_i} = 2(y_i - a_i)$$

$S_i = \sum_{j=0}^{m} x_j w_{ji}$ $\qquad$ $y_i = f(S_i)$ $\qquad$ $\frac{\partial y_i}{\partial x_j} =$

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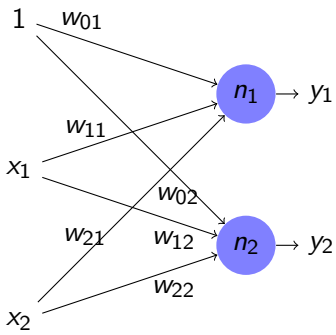

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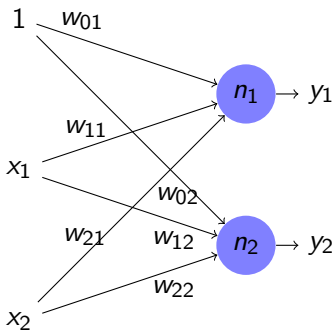

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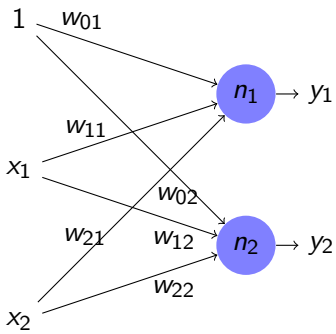

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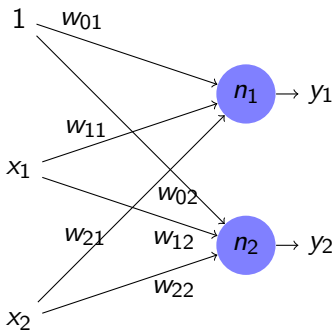

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$$= 2 \sum_{i=1}^{n} (y_i - a_i) f'(S_i) w_{ji}$$