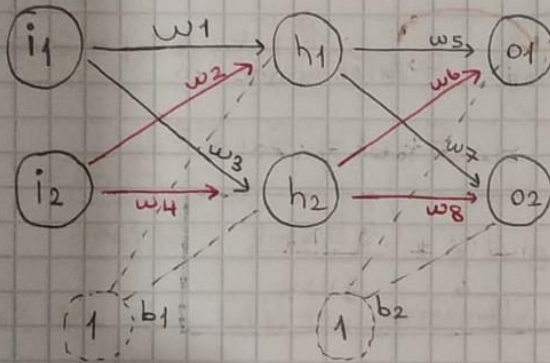


14) Backpropagation Example

Basic Structure :



Forward Pass

$$\rightarrow \text{net}_{h1} = w_1 * i_1 + w_2 * i_2 + b_1 * 1$$

$$\text{out}_{h1} = \frac{1}{1 + e^{-\text{net}_{h1}}}$$

$$\text{net}_{o1} = w_5 * \text{out}_{h1} + w_6 * \text{out}_{h2} + b_2 * 1$$

$$\text{out}_{o1} = \frac{1}{1 + e^{-\text{net}_{o1}}}$$

$$\star \text{ Total Error} = E_{o1} + E_{o2}$$

$$\rightarrow E_{o1} = \frac{1}{2} (\text{target}_{o1} - \text{out}_{o1})^2$$

Backward Pass :

a) Örneğin w_5 "üzerinden gidelim. (We aim to find how much a change in w_5 affects the Total Error (output layer))

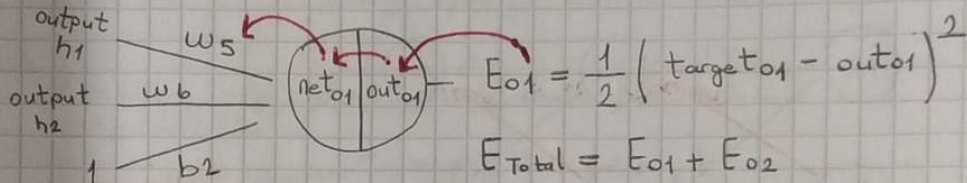
$$\text{Error } \frac{\partial E_{\text{Total}}}{\partial w_5}$$

$\frac{\partial E_{\text{Total}}}{\partial w_5}$ is read as "The partial derivative of E_{Total} with respect to w_5 ."

By applying Chain Rule;

$$\frac{\partial E_{Total}}{\partial w_5} = \frac{\partial E_{Total}}{\partial out_{o1}} * \frac{\partial out_{o1}}{\partial net_{o1}} * \frac{\partial net_{o1}}{\partial w_5}$$

Görsel olarak



Yeni w_5 değeri \Rightarrow

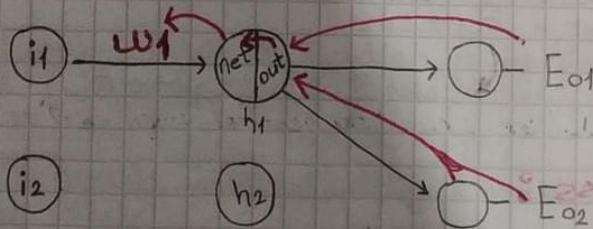
$$w_5 - \underset{\substack{\downarrow \\ \text{(learning rate)}}}{\gamma} * \frac{\partial E_{Total}}{\partial w_5}$$

b) Örneğin w_1 üzerinden gidelim. (Hidden Layer)

$$\frac{\partial E_{Total}}{\partial w_1} = \frac{\partial E_{Total}}{\partial out_{h1}} * \frac{\partial out_{h1}}{\partial net_{h1}} * \frac{\partial net_{h1}}{\partial w_1}$$

Görsel olarak

$$\frac{\partial E_{o1}}{\partial out_{h1}} + \frac{\partial E_{o2}}{\partial out_{h1}}$$



Sırası ile : 1) $\frac{\partial E_{Total}}{\partial out_{h1}} = \frac{\partial E_{o1}}{\partial out_{h1}} + \frac{\partial E_{o2}}{\partial out_{h1}}$

2) $\frac{\partial E_{o1}}{\partial out_{h1}} = \frac{\partial E_{o1}}{\partial net_{o1}} * \frac{\partial net_{o1}}{\partial out_{h1}}$ $\xrightarrow{=w_5}$
 $net_{o1} = w_5 * out_{h1} + w_6 * out_{h2} + b_2 * 1$

$$\frac{\partial E_{o1}}{\partial out_{o1}} * \frac{\partial out_{o1}}{\partial net_{o1}}$$

3) Aynı işlemler $\frac{\partial E_{02}}{\partial \text{outh}_1}$ için de yapılır.

4) We have $\frac{\partial E_{\text{Total}}}{\partial \text{outh}_1}$

$$5) \text{outh}_1 = \frac{1}{1 + e^{-\text{net}_1}}$$

$$\frac{\partial \text{outh}_1}{\partial \text{net}_1} = \text{outh}_1 (1 - \text{outh}_1)$$

6) We calculate the partial derivative of the total net input to h_1 with respect to w_1 .

$$\text{net}_1 = w_1 * i_1 + w_3 * i_2 + b_1 * 1$$

7) Put all together;

$$\frac{\partial E_{\text{Total}}}{\partial w_1} \text{ hesaplanır.}$$

8) Yeni w_1 değeri \Rightarrow

$$w_1 = \gamma * \frac{\partial E_{\text{Total}}}{\partial w_1}$$

9) Kalan tüm w 'ler için Güncellemeler aynı şekilde yapılır.

! Tüm olay şu sorunun cevabını bulmakta aslında.

How does a small change in one weight (ör: w_1) affect the final Loss ($J(w)$)?