Homework #3

1. Evaluate $\left.\frac{\partial y}{\partial w}\right|_{w=0}$ when $y = \frac{1}{v+x}$, $v = \sin(w)$, $x = e^{w}$, $w = 0$

2. Given input-target pairs and output of NN. Evaluate $E(w)$

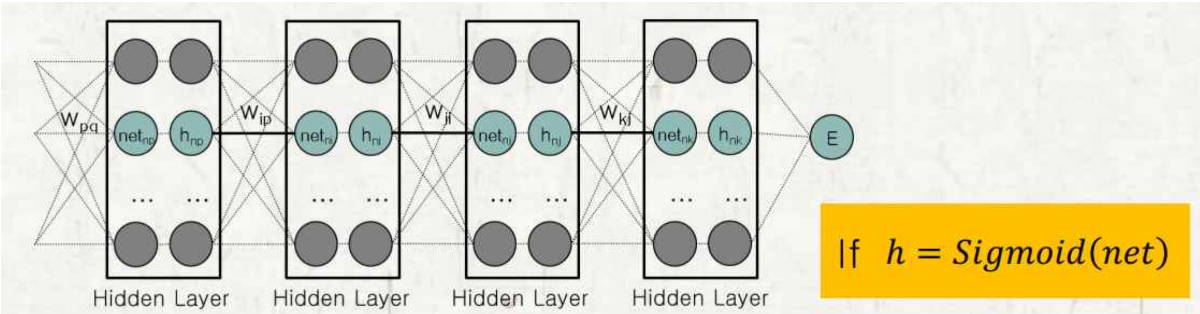
$$D_1 = (x_{11}, x_{12}, x_{13}, t_{11}, t_{12}, t_{13}), D_{1\,output} = (o_{11}, o_{12}, o_{13})$$
$$D_2 = (x_{21}, x_{22}, x_{23}, t_{21}, t_{22}, t_{23}), D_{2\,output} = (o_{21}, o_{22}, o_{23})$$
$$D_3 = (x_{31}, x_{32}, x_{33}, t_{31}, t_{32}, t_{33}), D_{3\,output} = (o_{31}, o_{32}, o_{33})$$

And $t_{11} = 0.4, t_{12} = 0.6, t_{13} = 0.9, o_{11} = 0.5, o_{12} = 0.3, o_{13} = 0.4$
$t_{21} = 0.5, t_{22} = 0.5, t_{23} = 0.7, o_{21} = 0.5, o_{22} = 0.4, o_{23} = 0.5$
$t_{31} = 0.7, t_{32} = 0.8, t_{33} = 0.1, o_{31} = 0.7, o_{32} = 0.8, o_{33} = 0.1$

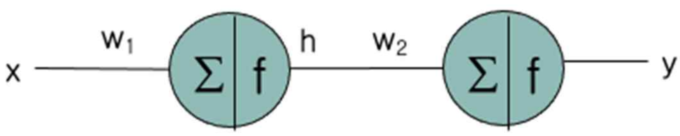
$$E(w) = \sum_{n=1}^{N} E_n(w), \quad where \quad E_n(w) = \frac{1}{2}\sum_{k=1}^{m}(t_{nk} - o_{nk})^2$$

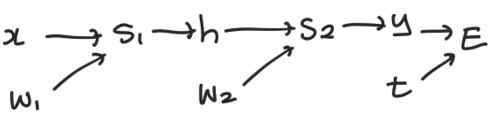
* 왜 cost function E는 W의 함수인가?
: (x,t) 데이터가 주어진 상황에서 오차를 구할 때, 변수는 W뿐이므로 W가 바뀌면 출력값이 바뀌므로 W의 함수이다.

3. Describe $\frac{\partial E}{\partial w_{kj}}, \frac{\partial E}{\partial w_{ji}}, \frac{\partial E}{\partial w_{ip}}$ when $D_n = (x_{n1}, x_{n2}, \dots, x_{nd}, t_{n1}, t_{n2}, \dots, t_{nm})$



4. An input is given $x = 1, t = 1$. The initial connection weights are $w_1 = 1, w_2 = 1$. The learning rate is $\eta = 0.1$. Update the connection weights once by EBP.





$x=1, t=1, W_1=1, W_2=1$
$net_1 = 1, h = sig(1), net_2 = sig(1)$
$y = sig(sig(1))$

$$\frac{\partial E}{\partial w_2} = \frac{\partial E}{\partial y} \cdot \frac{\partial y}{\partial net_2} \cdot \frac{\partial net_2}{\partial w_2} = (y-t)\cdot y(1-y)\cdot h$$

$$\frac{\partial E}{\partial w_1} = \frac{\partial E}{\partial y} \cdot \frac{\partial y}{\partial net_2} \cdot \frac{\partial net_2}{\partial h} \cdot \frac{\partial h}{\partial net_1} \cdot \frac{\partial net_1}{\partial w_1} = (y-t)y(1-y)\cdot W_2 \cdot h(1-h)\cdot x$$