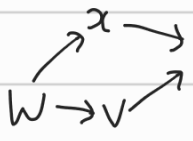
2020314482 인공지능융합전공 황선우

Homework #3

1. $y=\frac{1}{v+x}$, $v=\sin(w)$, $x=e^w$, $w=0$

$w=0$, $x=1$, $v=0$



$$\frac{\partial y}{\partial w}=\frac{\partial y}{\partial x}\frac{\partial x}{\partial w}+\frac{\partial y}{\partial v}\frac{\partial v}{\partial w}$$

$$=-\frac{1}{(v+x)^2}\cdot e^w+-\frac{1}{(v+x)^2}\cdot\cos(w)$$

$$\left.\frac{\partial y}{\partial w}\right|_{w=0}=-\frac{1}{(0+1)^2}\cdot e^0+-\frac{1}{(0+1)^2}\cdot\cos(0)$$

$$=-1-\cos(0)=-2$$

$$\therefore \left.\frac{\partial y}{\partial w}\right|_{w=0}=-2$$

2. $E_1(w)=\frac{1}{2}\sum_{k=1}^{3}(t_{1k}-o_{1k})^2=\frac{1}{2}\{(0.4-0.5)^2+(0.6-0.3)^2+(0.9-0.4)^2\}$

$=\frac{1}{2}(0.01+0.09+0.25)=\frac{1}{2}\cdot 0.35=0.175$

$E_2(w)=\frac{1}{2}\sum_{k=1}^{3}(t_{2k}-o_{2k})^2=\frac{1}{2}\{(0.5-0.5)^2+(0.5-0.4)^2+(0.7-0.5)^2\}$

$=\frac{1}{2}(0+0.01+0.04)=\frac{1}{2}\cdot 0.05=0.025$

$E_3(w)=\frac{1}{2}\sum_{k=1}^{3}(t_{3k}-o_{3k})^2=\frac{1}{2}\{(0.1-0.1)^2+(0.8-0.8)^2+(0.1-0.1)^2\}$

$=\frac{1}{2}\cdot 0=0$

$$E(w)=\sum_{n=1}^{3}E_n(w)=0.175+0.025+0=0.2$$

$\therefore E(w)=0.2$

다음장에 계속 >>

3. $\frac{\partial E}{\partial W_{kj}} = \frac{\partial E}{\partial net_{nk}} \frac{\partial net_{nk}}{\partial W_{kj}} = \left(\frac{\partial E}{\partial h_{nk}} \frac{\partial h_{nk}}{\partial net_{nk}}\right) \frac{\partial net_{nk}}{\partial W_{kj}} = \delta_{nk} h_{nj}$

$\frac{\partial E}{\partial W_{ji}} = \frac{\partial E}{\partial net_{nj}} \frac{\partial net_{nj}}{\partial W_{ji}} = \left(\frac{\partial E}{\partial h_{nj}} \frac{\partial h_{nj}}{\partial net_{nj}}\right) \frac{\partial net_{nj}}{\partial W_{ji}}$

$= \left(\left(\sum_{k=1}^{K} \frac{\partial E}{\partial net_{nk}} \frac{\partial net_{nk}}{\partial h_{nj}}\right) \frac{\partial h_{nj}}{\partial net_{nj}}\right) \frac{\partial net_{nj}}{\partial W_{ji}}$

$= \left(\left(\sum_{k=1}^{K} \delta_{nk} W_{kj}\right) \frac{\partial h_{nj}}{\partial net_{nj}}\right) h_{ni} = \delta_{nj} h_{ni}$

$\frac{\partial E}{\partial W_{ip}} = \frac{\partial E}{\partial net_{ni}} \frac{\partial net_{ni}}{\partial W_{ip}} = \left(\frac{\partial E}{\partial h_{ni}} \frac{\partial h_{ni}}{\partial net_{ni}}\right) \frac{\partial net_{ni}}{\partial W_{ip}}$

$= \left(\left(\sum_{j=1}^{J} \frac{\partial E}{\partial net_{nj}} \frac{\partial net_{nj}}{\partial h_{ni}}\right) \frac{\partial h_{ni}}{\partial net_{ni}}\right) \frac{\partial net_{ni}}{\partial W_{ip}}$

$= \left(\left(\sum_{j=1}^{J} \delta_{nj} W_{ji}\right) \frac{\partial h_{ni}}{\partial net_{ni}}\right) h_{np} = \delta_{ni} h_{np}$

$\delta_{nk} = \frac{\partial E}{\partial h_{nk}} \frac{\partial h_{nk}}{\partial net_{nk}} = -(t_n - h_{nk}) h_{nk}(1 - h_{nk})$

$\delta_{nj} = \left(\sum_{k=1}^{K} \delta_{nk} W_{kj}\right) \frac{\partial h_{nj}}{\partial net_{nj}} = \left(\sum_{k=1}^{K} \delta_{nk} W_{kj}\right) h_{nj}(1 - h_{nj})$

$\delta_{ni} = \left(\sum_{j=1}^{J} \delta_{nj} W_{ji}\right) \frac{\partial h_{ni}}{\partial net_{ni}} = \left(\sum_{j=1}^{J} \delta_{nj} W_{ji}\right) h_{ni}(1 - h_{ni})$

다음장에 계속 >>

4. $x=1, y=1$

$w_1^0=1, w_2^0=1$

$f(x)=\frac{1}{1+e^{-x}}$

$h=f(w_1 x)=f(1)=\frac{1}{1+e^{-1}}$

$o=f(w_2 h)=f(h)=f(\frac{1}{1+e^{-1}})$

$w_2' = w_2^0 - \eta (y-o) o (1-o) h$

$w_1' = w_1^0 - \eta x h (1-h) w_2^0 (y-o) o (1-o)$

$w_2' = 1 - 0.1 (1-f(h)) f(h) (1-f(h)) h = 1 - 0.1 (1-f(h))^2 h f(h)$

$w_1' = 1 - 0.1 \cdot 1 \cdot h (1-h) \cdot 1 \cdot (1-f(h)) f(h) (1-f(h)) = 1 - 0.1 (1-f(h))^2 h f(h) (1-h)$

$w_2' = 1 - 0.1 \left(1 - f\left(\frac{1}{1+e^{-1}}\right)\right)^2 \cdot \frac{1}{1+e^{-1}} \cdot f\left(\frac{1}{1+e^{-1}}\right) = 0.9948$

$w_1' = 1 - 0.1 \left(1 - f\left(\frac{1}{1+e^{-1}}\right)\right)^2 \cdot \frac{1}{1+e^{-1}} \cdot f\left(\frac{1}{1+e^{-1}}\right) \left(1 - \frac{1}{1+e^{-1}}\right) = 0.9986$

```
import numpy as np
def sigmoid(x):
  return 1/(1+np.exp(-x))
```

```
w2 = 1-0.1*((1-sigmoid(sigmoid(1)))**2)*sigmoid(1)*sigmoid(sigmoid(1))
w1 = 1-0.1*((1-sigmoid(sigmoid(1)))**2)*sigmoid(1)*sigmoid(sigmoid(1))*(1-sigmoid(1))
```

```
print(w2)
print(w1)
```

```
0.9947886947063983
0.9985984641471458
```