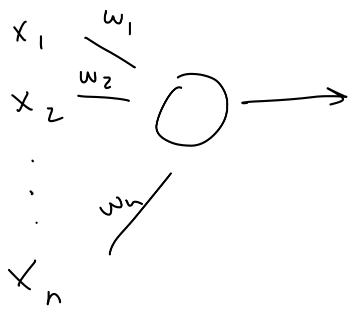
1.1



$$net = w_1 x_1 + w_2 x_2 + \dots$$

$$o = f(net)$$

$$o = w_0 + w_1 (x_1 + x_1^2) \dots + w_i (x_i + x_i^2)$$

$$w_i^{new} = w_i^{old} - \eta \left(\frac{\partial o}{\partial w_i} \right)$$

$$\frac{\partial o}{\partial w_i} = x_i + x_i^2$$

$$w_i^{new} = w_i^{old} - \eta \left(x_i + x_i^2 \right)$$

1.2

(a)

$$y_5 = h\left(w_{53} x_3 + w_{54} x_4 \right)$$

$$= h\left(w_{53}\, h(w_{31} x_1 + w_{32} x_2) + w_{54}\, h(w_{41} x_1 + w_{42} x_2) \right)$$

(b)

$$= h\left(w_{53}\, h(w^{(1)(1)} \cdot x) + w_{54}\, h(w^{(1)(2)} \cdot x) \right)$$

$$y_5 = h\left(w^{(2)}\, h\left(w^{(1)} x \right) \right)$$

(c)

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

$$e^x \cdot h_s(x) =$$

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

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

$$\frac{e^x}{e^x + 1} + \frac{e^{x^2}}{e^x + 1} = \frac{e^{x^2} + e^x}{e^x + 1}$$

$$\frac{e^x - e^{-x}}{e^x + e^{-x}} = \frac{e^x}{e^x + e^{-x}} - \frac{e^{-x}}{e^x + e^{-x}}$$

$$= e^{-x} \left(\frac{1}{1 + e^{2x}} \right) - e^{-x} \left(\frac{e^{2x}}{1 + e^{2x}} \right)$$

$$= e^x \left(\frac{e^{-2x}}{e^{-2x} + 1} - \frac{1}{e^{-2x} + 1} \right)$$

$$= e^x \left(\frac{e^{-x^2} - 1}{e^{x^2} + 1} \right)$$

$$= e^{x}\left(\frac{e^{-x^2}}{e^{x^2}+1} - \frac{1}{e^{-x^2}+1}\right)$$

$$e^{x}\left(\frac{1}{1+e^{-2x}}\right) - e^{x}\left(\frac{e^{-2x}}{1+e^{-2x}}\right)$$

$$= e^{x}\left(\frac{1}{(e^{-x})^2+1} - e^{x}\left(\frac{(e^{-x})^2}{1+(e^{-x})^2}\right.\right.$$

$-$

$$\frac{e^{x}+e^{-x}-2e^{-x}}{e^{x}+e^{-x}} = \cancel{\frac{e^{x}+e^{-x}}{e^{x}+e^{-x}}}^{\,1} - \frac{2e^{-x}}{e^{x}+e^{-x}}$$

$$= 1 - \frac{2e^{-x}}{e^{x}+e^{-x}}\,\frac{(e^{x})}{(e^{x})}$$

$$= 1 - 2\left(\frac{1}{e^{2x}+1}\right)$$

$$= 1 - 2\quad(1-h_s(2x))$$

$$= 1-2 \quad + 2\,h_s(2x)$$

$h_f(s)$ $\quad = 2h_s(2x) - 1$

$$\frac{1}{1+e^{-x}}$$

$$\frac{1+e^{-x}}{1+e^{-x}} - \frac{1}{1+e^{-x}}$$

$$\frac{e^{-x}}{1+e^{-x}}$$

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

$$\frac{1}{e^{2x}+1} = 1-h_s(2x)$$