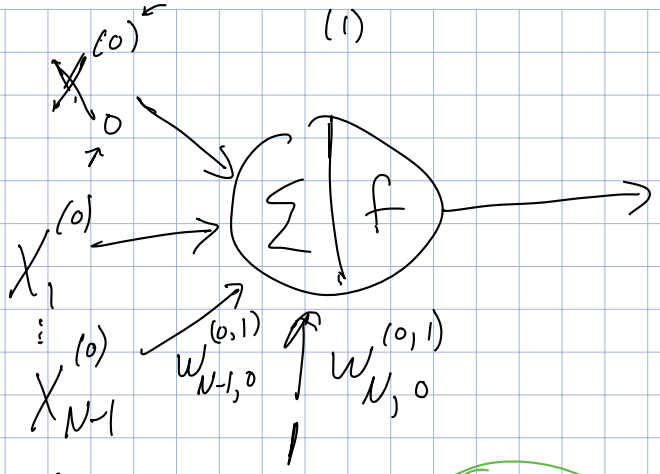


$$n_0^{(1)} = \sum_{i=0}^{N-1} x_i^{(0)} w_{i,0}^{(0,1)} + w_{N,0}^{(0,1)}$$

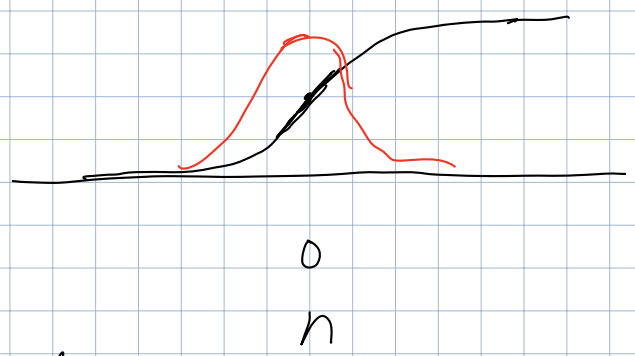
$$x_0^{(1)} = f\left(n_0^{(1)}\right)$$

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

$$n_0^{(1)} = w^T x$$

$$x = \begin{bmatrix} x_0 \\ x_1 \\ x_2 \\ \vdots \\ x_{N-1} \\ 1 \end{bmatrix}$$

$$w = \begin{bmatrix} w_{0,0} \\ w_{1,0} \\ \vdots \\ w_{N-1,0} \\ w_{N,0} \end{bmatrix}$$

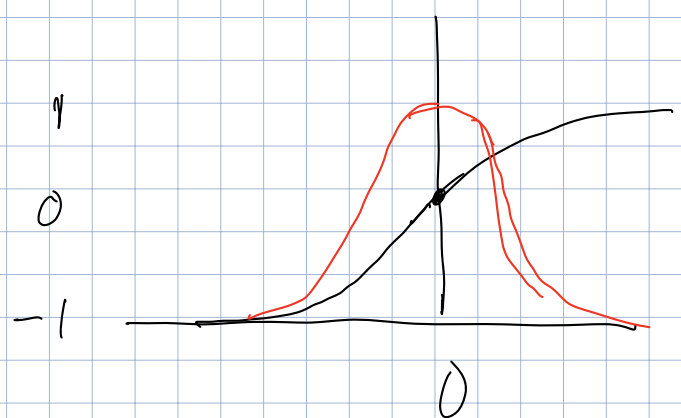


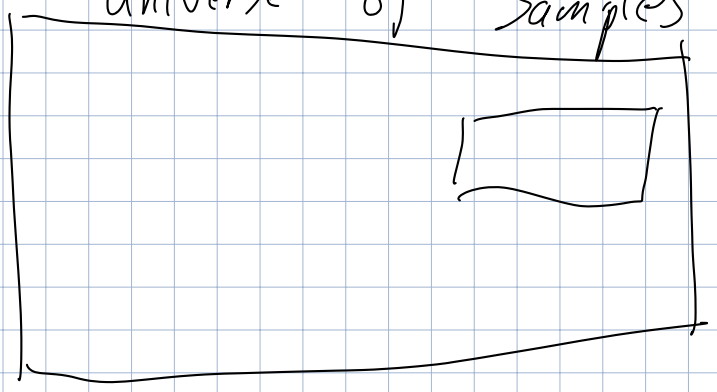
$$f'(n) = f(n)\left(1-f(n)\right)$$

sigmoid
logistic function

$$f(n) = \frac{e^{2n}-1}{e^{2n}+1} = \frac{e^n - e^{-n}}{e^n + e^{-n}}$$

$$f'(n) = 1 - f(n)^2$$





X_0 , Y_0

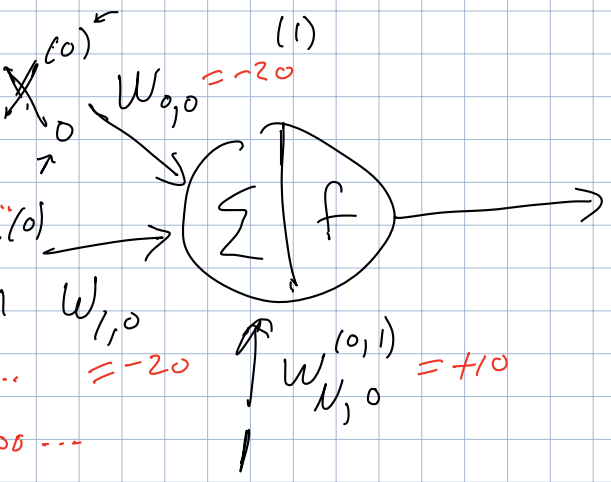
X_1 , Y_1

$\vdots$ $\vdots$

$$E = \text{Cost} = \frac{1}{|P|}\sum_{p \in P} \left(X_{0,p}^{(1)} - Y_p\right)^2$$

Mean Squared error

	$X_1^{(0)}$	$X_0^{(0)}$	Y	$n_0^{(1)}$	$X_0^{(1)}$
0	0	0	1	10	.9999...
1	0	1	0	-10	.000...
2	1	0	0	-10	.000...
3	1	1	0	-30	.000000...



NOR

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

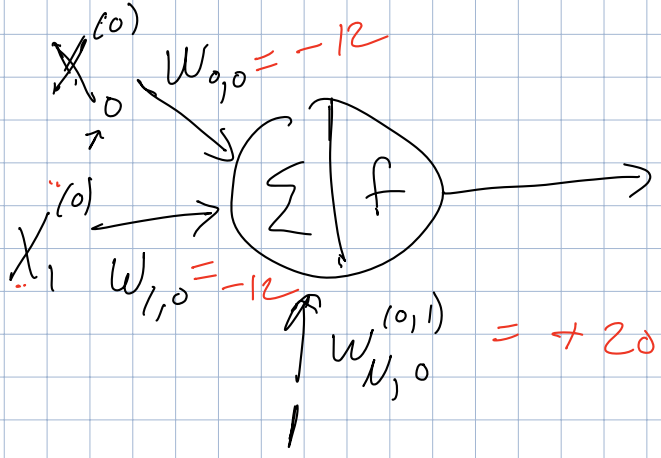
$f(2) = 0.88$

$f(3) = 0.95$

$f(4) = 0.98$

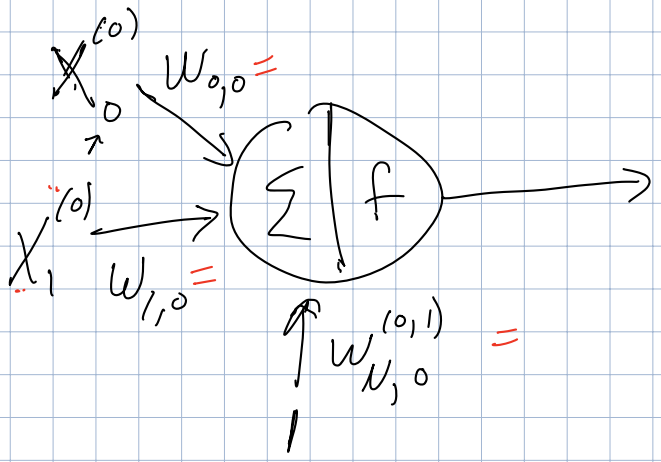
NAND

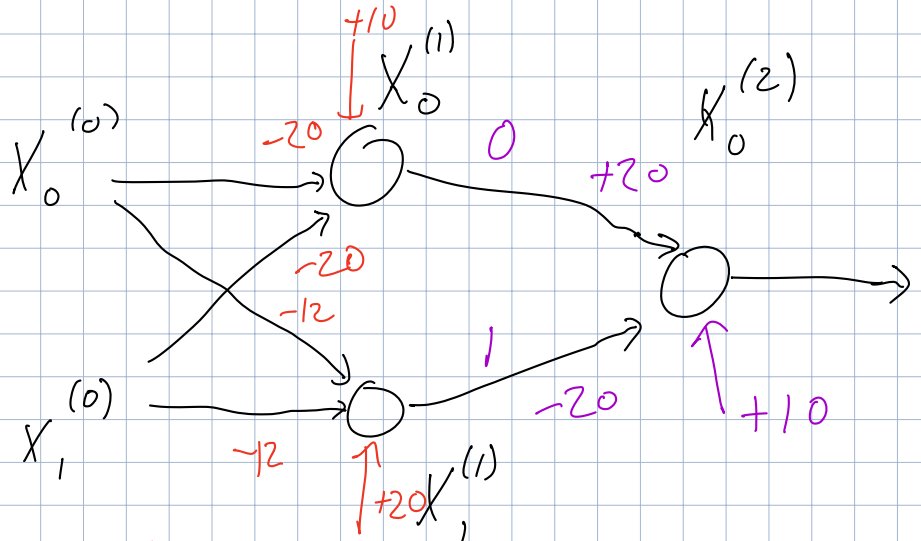
	$X_1^{(0)}$	$X_0^{(0)}$	Y	$n_0^{(1)}$	$X_0^{(1)}$
0	0	0	1	+20	~1
1	0	1	1	+8	~1
2	1	0	1	+8	~1
3	1	1	0	-4	0.02



NXOR

	$x_1^{(0)}$	$x_0^{(0)}$	y	$n_0^{(1)}$	$x_0^{(1)}$
0	0	0	1		
1	0	1	0		
2	1	0	0		
3	1	1	1		





$x_1^{(0)}$	$x_0^{(0)}$	$x_0^{(1)}$	$x_0^{(1)}$	y	$n_0^{(2)}$	$x_0^{(2)}$
0	0	1	~1	1	+10	~1
0	1	1	0	0	-10	~0
1	0	1	0	0	-10	~0
1	1	~0	0	1	+10	~1

p = "pattern" $\quad X_p, \; y_p$

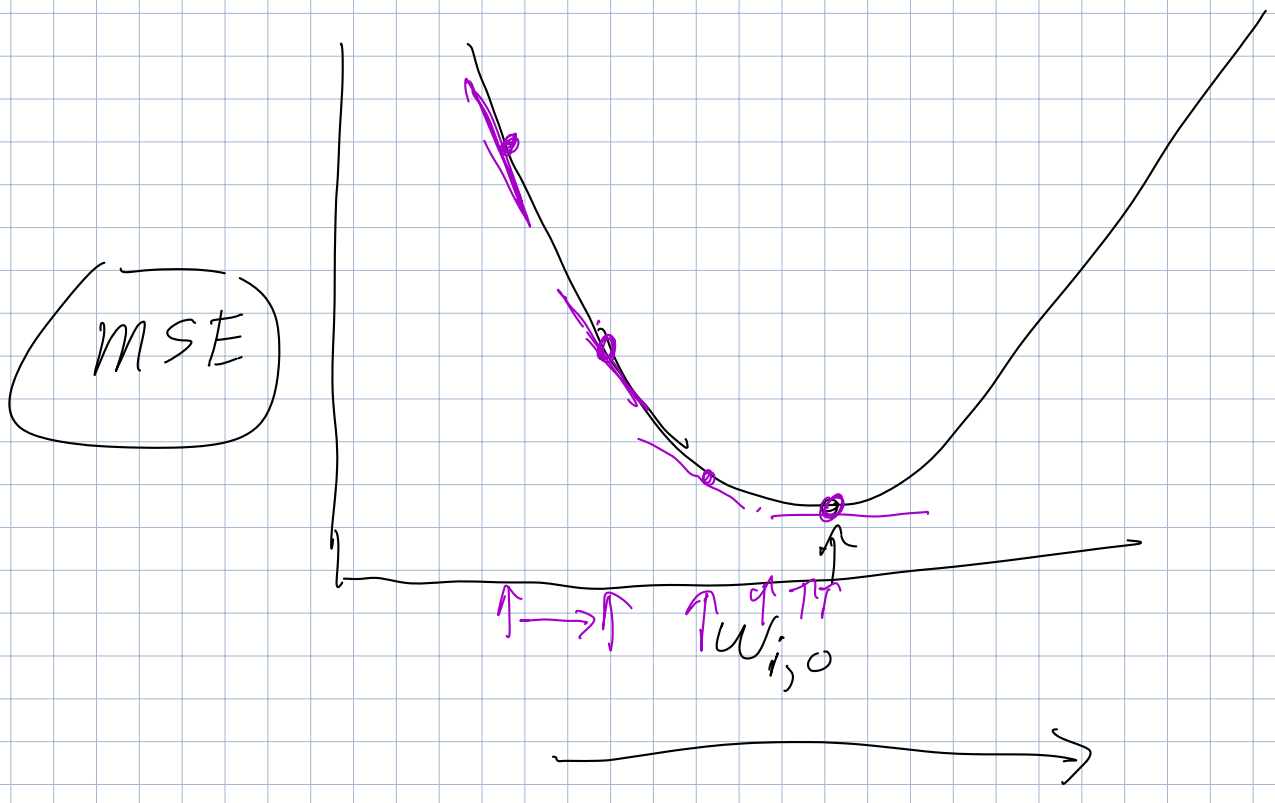
$$E_p = \left(y_p - x_{o,p}^{(1)}\right)^2$$

1 output unit

$f(n) = n$

$$MSE = \sum_{p \in P} E_p$$

$(N+1)$ parameters



- Pick random W's
- While "not happy"

  Estimate $\frac{\partial MSE}{\partial w_{i,0}}$

  $w_{i,0} \leftarrow w_{i,0} - \alpha \frac{\partial MSE}{\partial w_{i,0}}$