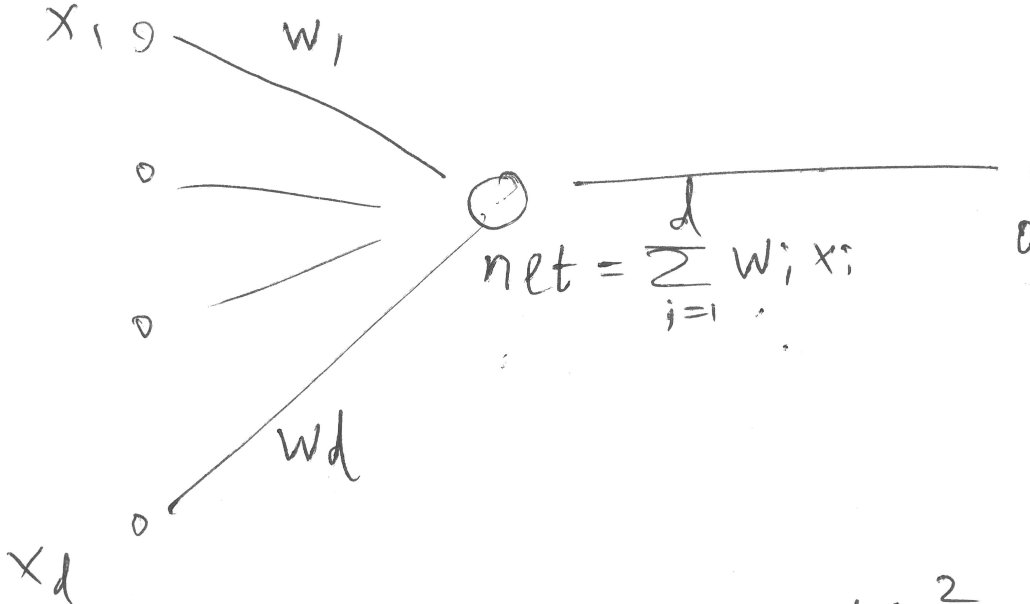


$$net = \sum_{i=1}^{d} w_i x_i \qquad o = \sigma(net)$$

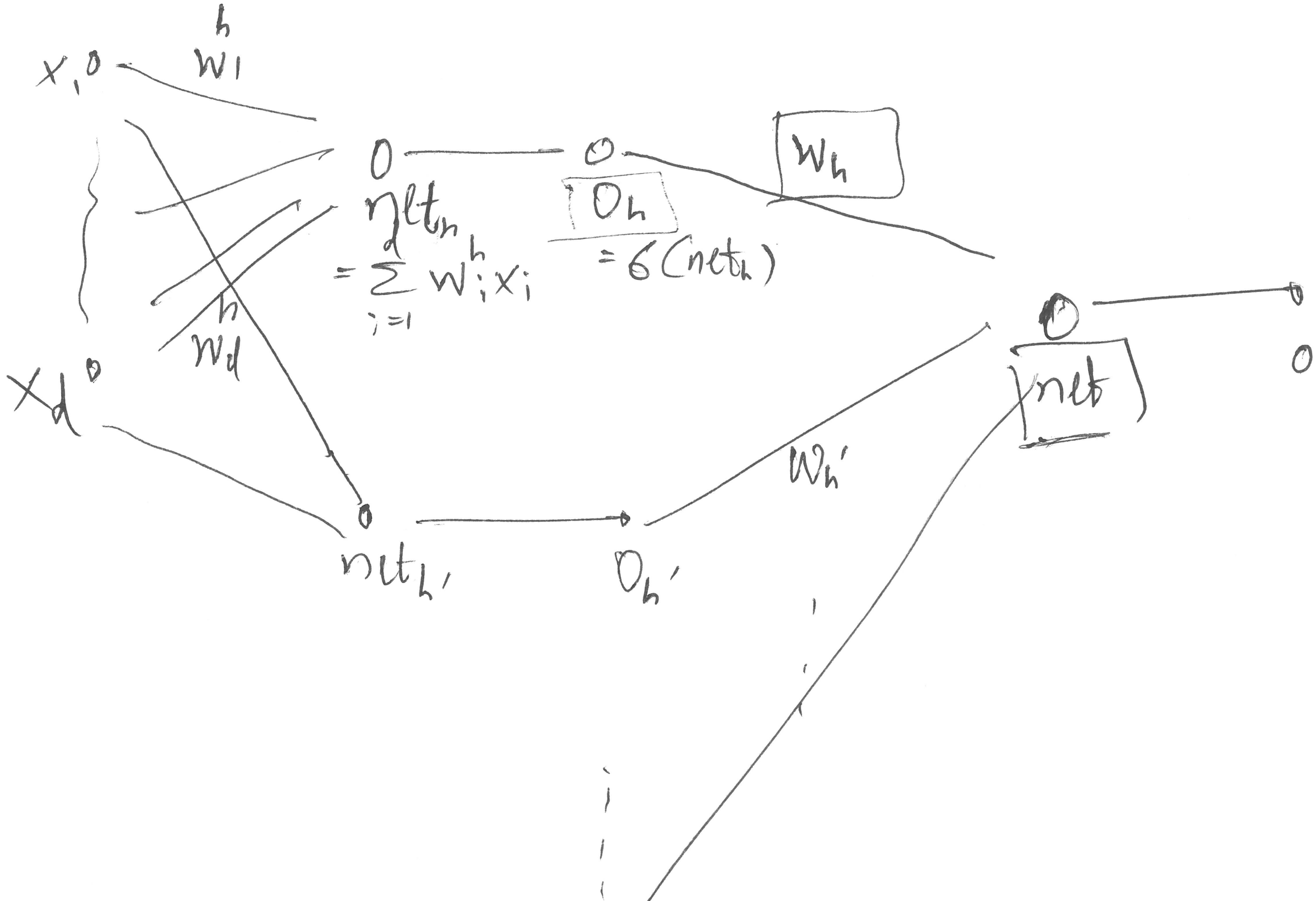
$$E(w) = \frac{1}{2}\sum_{l=1}^{n} (y^l - o^l)^2$$

$$\frac{\partial E(w)}{\partial w_1} = \sum_{l} (o^l - y^l) \boxed{\frac{\partial o^l}{\partial w_1}}$$

$$\frac{\partial o^l}{\partial w_1} = \boxed{\frac{\partial o^l}{\partial net^l}} \boxed{\frac{\partial net^l}{\partial w_1}}$$

$$\boxed{\frac{\partial \sigma(x)}{\partial x} = \sigma(x)(1-\sigma(x))} = o^l(1-o^l)\, x_1^l$$

$$\frac{\partial E(w)}{\partial w_1} = \sum_{l} -(y^l - o^l)\, o^l(1-o^l)\, x_1^l$$

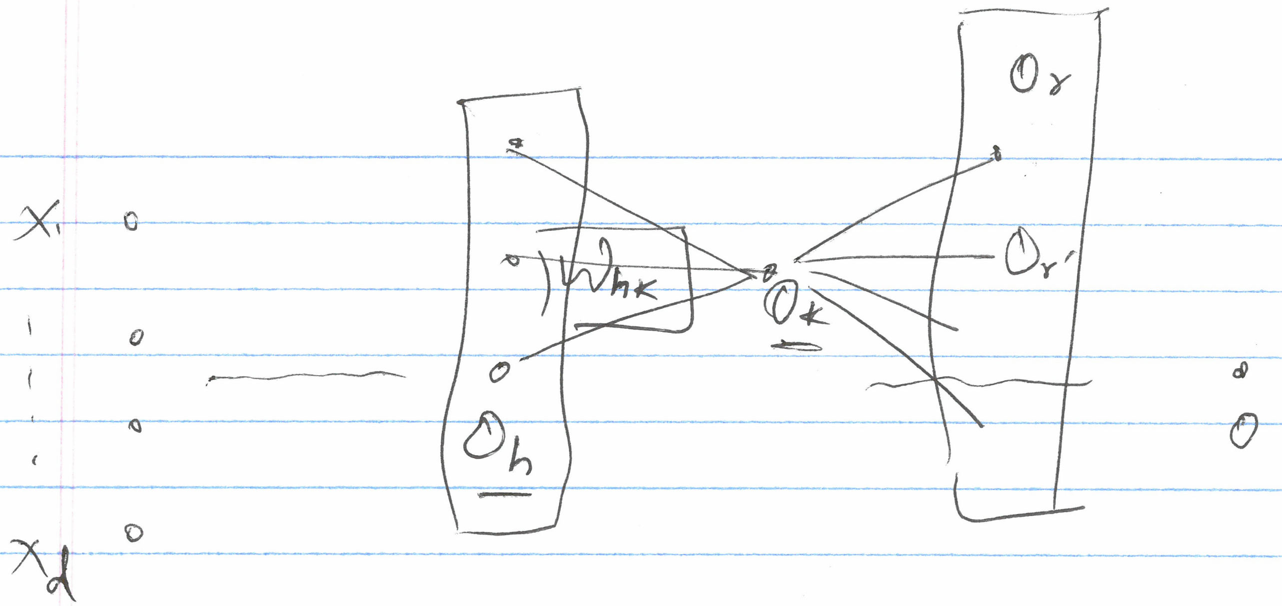


$$E(w) = \frac{1}{2}\sum_{l} (y^l - O^l)^2$$

$$\frac{\partial E(w)}{w_h} = \sum_{l} -(y^l - O^l)\frac{\partial O^l}{\partial w_h}$$

$$\frac{\partial O^l}{\partial w_h} = \frac{\partial O^l}{\partial net^l}\boxed{\frac{\partial net^l}{\partial w_h}}$$

$$= O^l(1-O^l) \quad O_h^l$$



$E(W)$

$$\frac{\partial E}{\partial W_{hk}} = \frac{\partial E}{\partial O_k} \frac{\partial O_k}{\partial W_{hk}}$$

$$\frac{\partial O_k}{\partial W_{hk}} = O_k(1-O_k)\, O_h$$

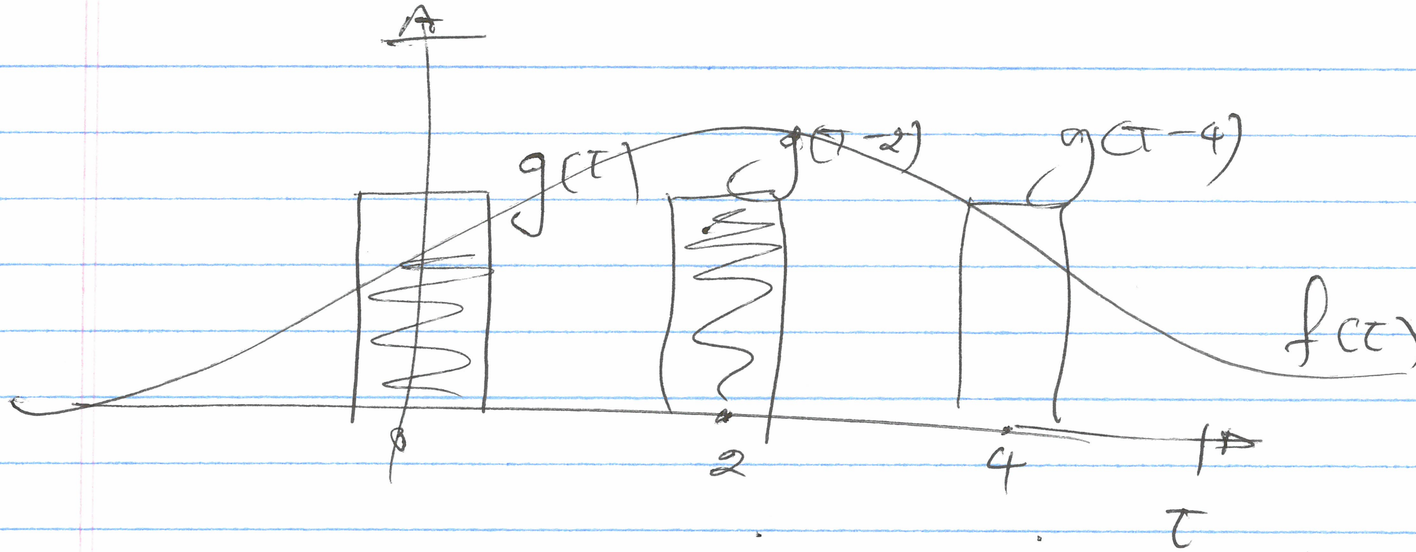
$$\frac{\partial E}{\partial W_{hk}} = \boxed{O_h}\, \underbrace{\boxed{O_k(1-O_k)\frac{\partial E}{\partial O_k}}}_{\delta_k}$$

$$= O_h\, \delta_k$$

$$\frac{\partial E}{\partial O_k} = \sum_{r \in \text{Next LAYER}} \frac{\partial E}{\partial O_r} \frac{\partial O_r}{\partial O_k}$$

$$= \sum_r \overbrace{\boxed{\frac{\partial E}{\partial O_r}\, O_r(1-O_r)}}^{\delta_r} W_{kr}$$

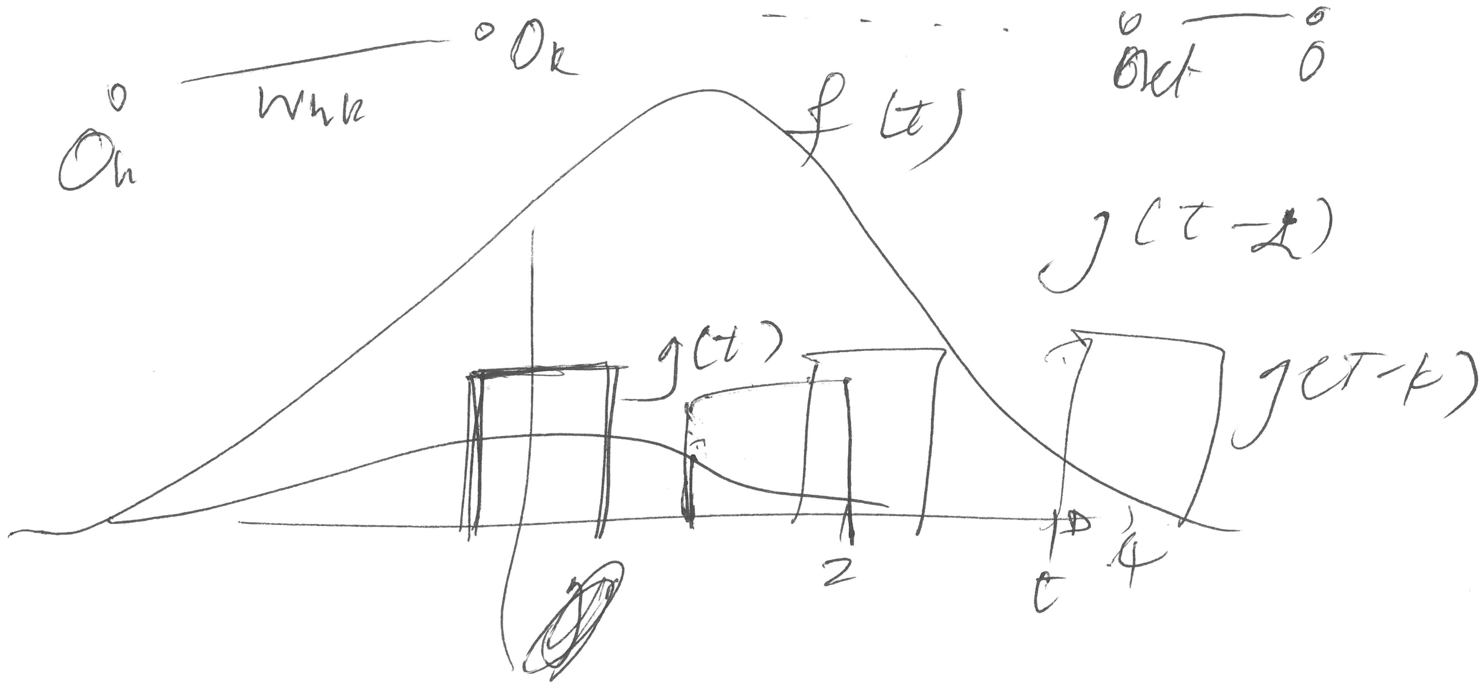
$$\delta_k = \; = \left(\sum_r \delta_r W_{kr}\right) O_k(1-O_k)$$



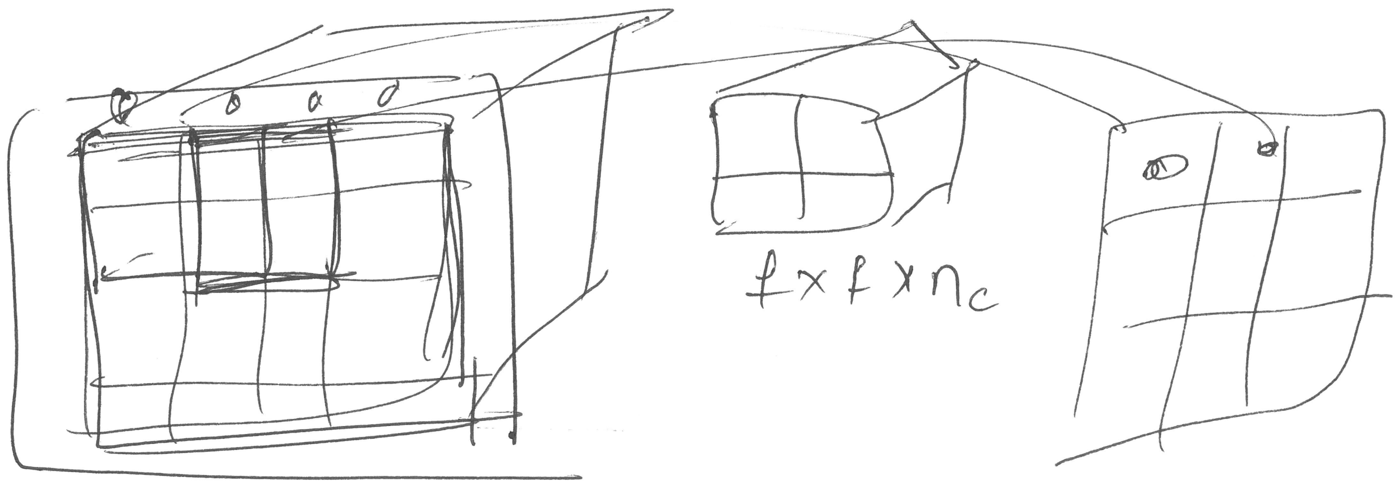
$$(f*g)(0) = \int g(\tau)\, f(\tau)\, d\tau$$

$$(f*g)(2) = \int g(\tau-2)\, f(\tau)\, d\tau$$

$$(f*g)(t) = \int g(\tau-t)\, f(\tau)\, d\tau$$



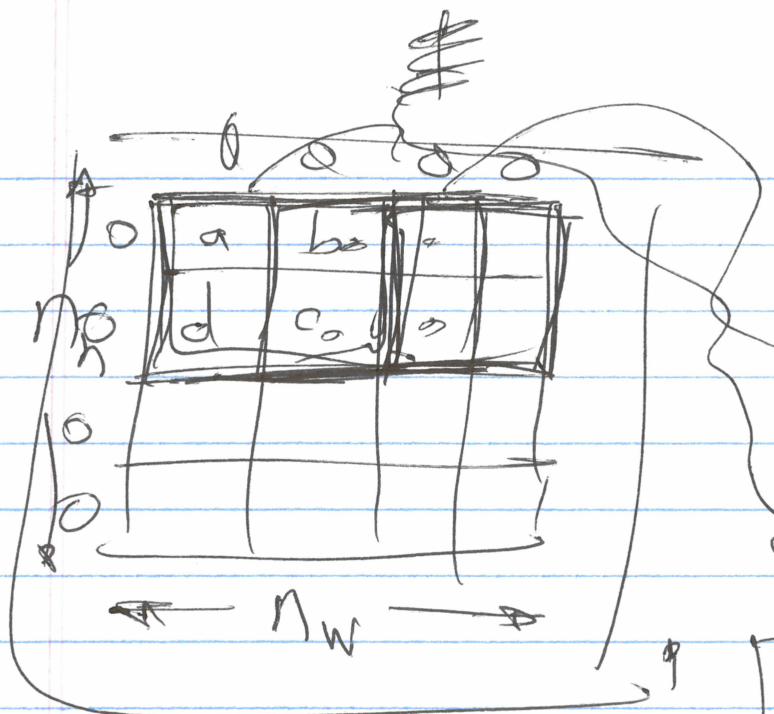
$$(f * g)(t) = \int_\tau g(t-\tau)\, f(\tau)\, d\tau$$

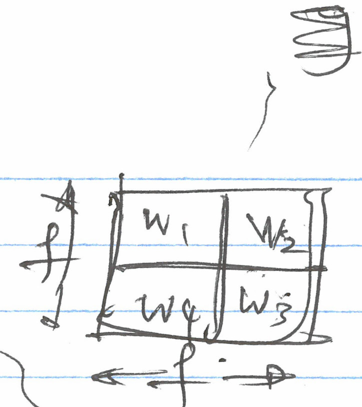


$n_h \times n_w \times n_c$

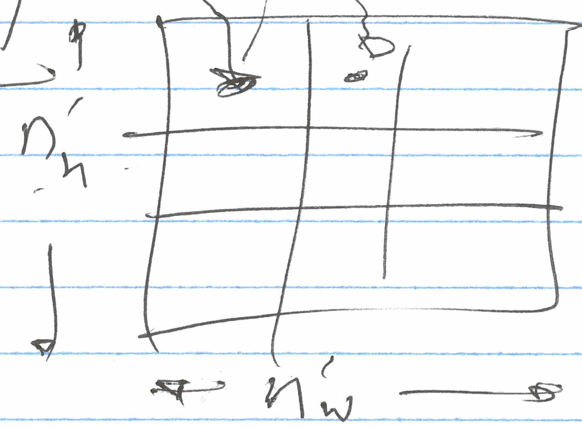
$n_h - f + 1 \times n_w - f + 1$

$$\frac{n_h + 2p - f + 1}{s} \cdot \frac{n_w + 2p - f + 1}{s}$$





$a w_1 + b w_2 + c w_3 + d w_4$

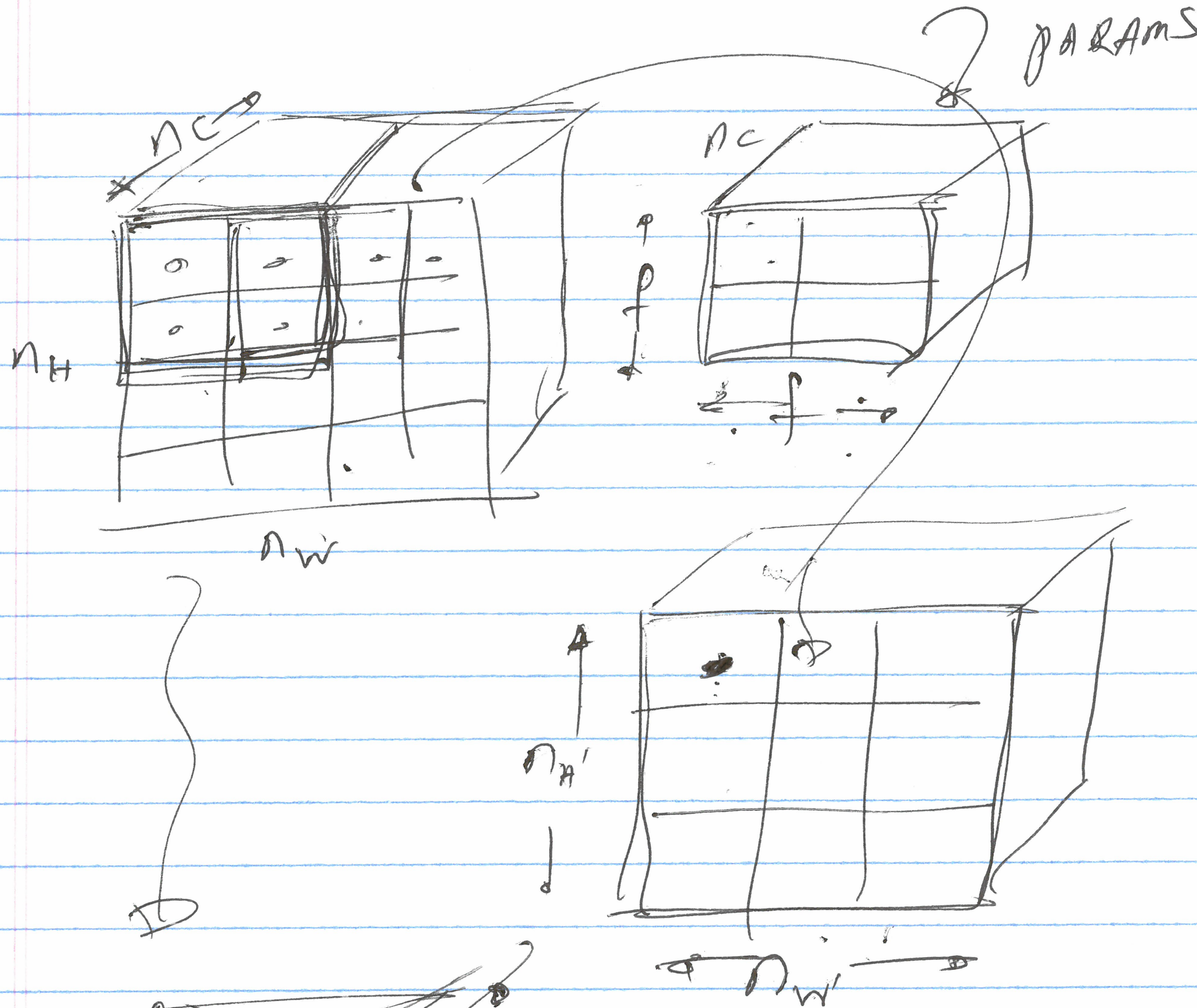


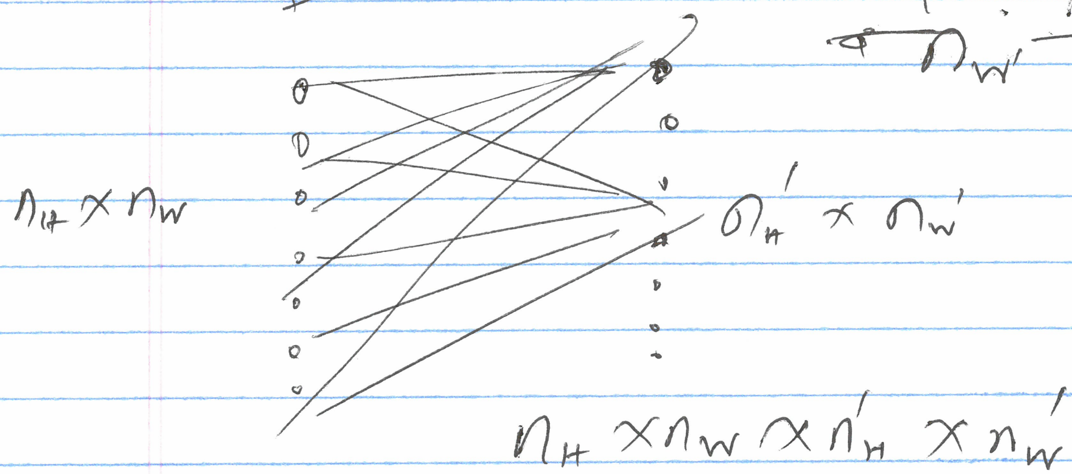
$$n'_h = \frac{n_h + 2p - f}{s} + 1$$

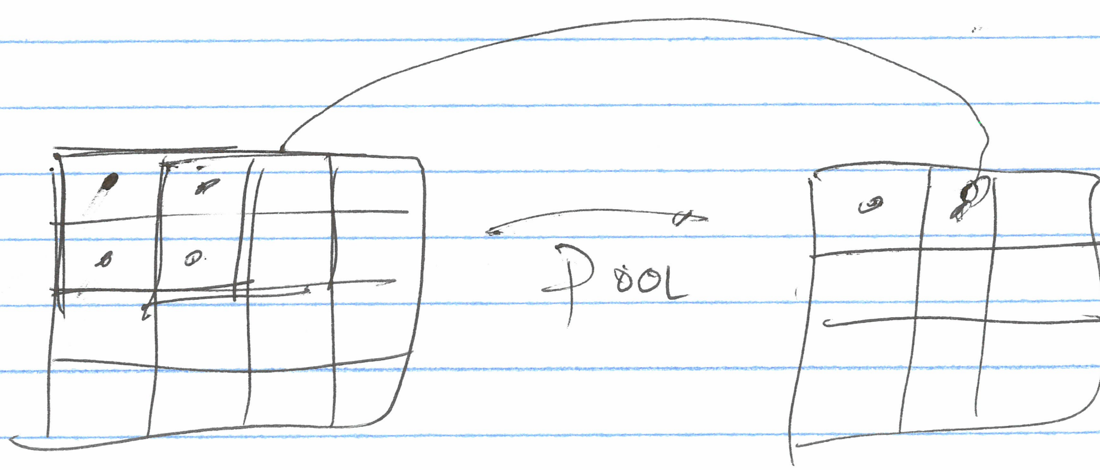
$$n'_w = \frac{n_w + 2p - f}{s} + 1$$

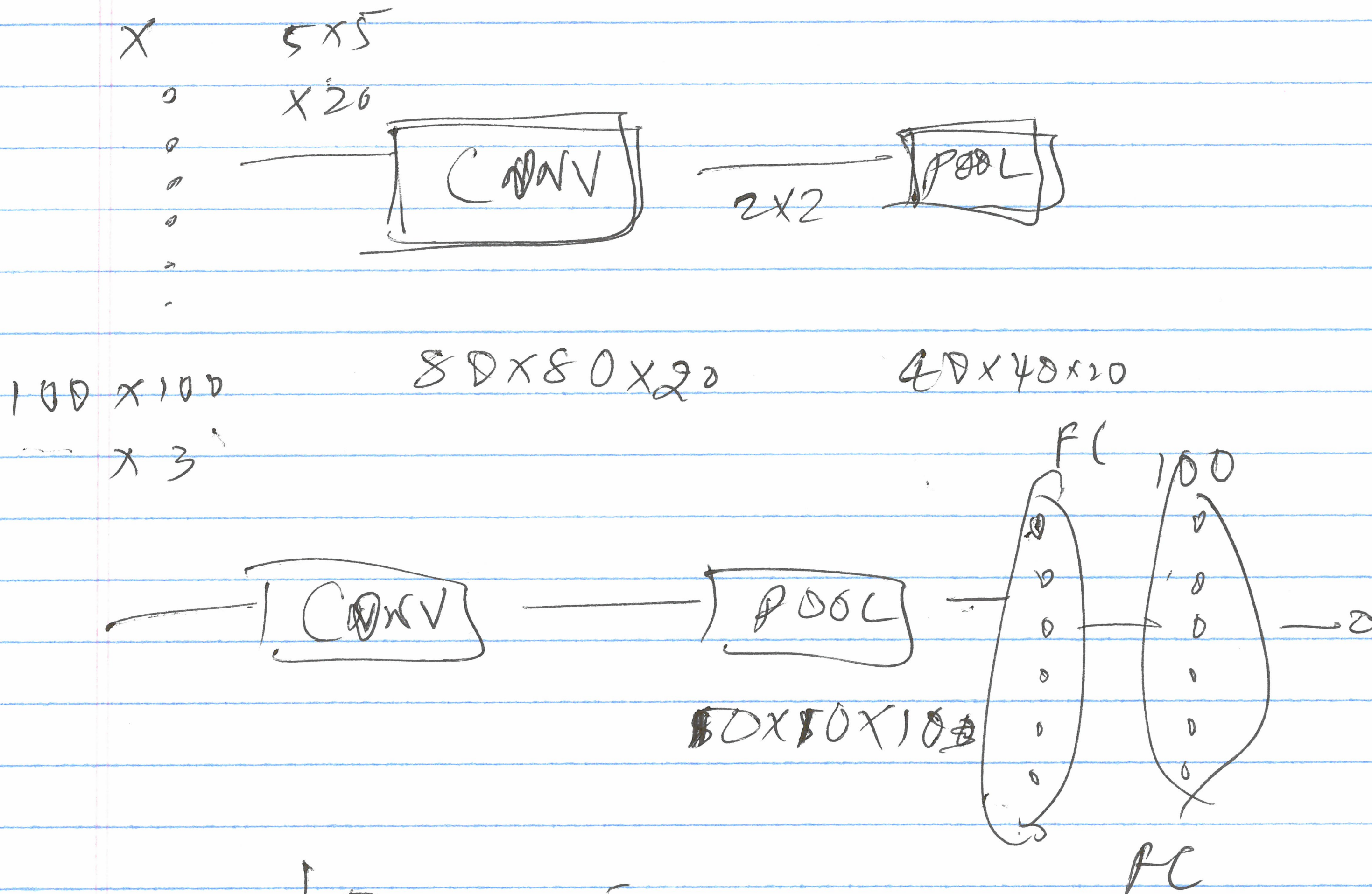
STRIDE s

PADDING p


? PARAMS
nc
nc
nH
f
f
nW
nH'
nW'


nH x nW
nH' x nW'
nH x nW x nH' x nW'


POOL


X
5x5
x20
CONV
2x2
POOL
80x80x20
40x40x20
100x100
x3
CONV
POOL
FC
100
FC

LENET-5