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Question 1

$n = 0.2$

$C1 = \{(1,1,1), (1,0,0)\}$ $\quad X_0 = 1$

$C2 = \{(-1,0,1), (-1,1,0)\}$

$w_0 = 0.5 \quad w_1 = 0.5 \quad w_2 = 0.5 \quad w_3 = 0.5$

$C1 = (1,1,1)$

Actual output $= 1 * w_0 + 1 * w_1 + 1 * w_2 + 1 * w_3$

$= 0.5 + 0.5 + 0.5 + 0.5 = 2$

Error $= 0 - 2 = -2$

Update weights: $w_n + n * \text{Error} * 1$

$w_0 = 0.5 + 0.2 * -2 * 1 = 0.1$
$w_1 = 0.5 + 0.2 * -2 * 1 = 0.1$
$w_2 = 0.5 + 0.2 * -2 * 1 = 0.1$
$w_3 = 0.5 + 0.2 * -2 * 1 = 0.1$

$C1 = (1,0,0)$

Actual output $= 1 * 0.1 + 1 * 0.1 + 0 = 0.2$
Error $= 0 - 0.2 = -0.2$

$w_0 = 0.1 + 0.2 * -0.2 * 1 = .06$
$w_1 = 0.1 + 0.2 * -0.2 * 1 = .06$
$w_2 = 0.1 + 0.2 * -0.2 * 0 = 0.1$
$w_3 = 0.1 + 0.2 * -0.2 * 0 = 0.1$

$C_2 = (-1, 0, 1)$

Actual Output $= 1 * .06 + -1 * .06 + 0 * .1 + 1 * .1$

$= .06 + -.06 + 0 + .1 = .1$

Error $= 1 - .1 = 0.9$

Update $w_0 = .06 + 0.2 * (0.9) * 1 = 0.24$

$w_1 = .06 + 0.2 * (0.9) * -1 = -0.12$

$w_2 = .1 + 0.2 * (0.9) * 0 = 0.1$

$w_3 = .1 + 0.2 * (0.9) * 1 = 0.24$

$C_2 = (-1, 1, 0)$

Actual Output $= 1 * 0.24 + -1(-0.12) + 1(0.1) + 0(0.24)$

$= 0.24 + .12 + 0.1 + 0 = 0.46$

Error $= 1 - 0.46 = 0.54$

$w_0 = 0.24 + 0.2(0.54) * 1 = 0.348$

$w_1 = -0.12 + 0.2(0.54) * -1 = -0.228$

$w_2 = 0.1 + 0.2(0.54)(1) = 0.208$

$w_3 = 0.24 + 0.2(0.54)(0) = 0.24$

$$MSE = \frac{\left((-2)^2 + (-0.2)^2 + (0.9)^2 + (0.54)^2\right)}{4} =$$

$$4 + 0.04 + 0.81 + 0.2916 = \frac{5.1416}{4} = 1.2854$$

$X_0 = 1$

Input	Weight	v	Desired Output	Output	Δw weight
(1,1,1)	(0.5,0.5,0.5,0.5)	2	0	2	(0.1,0.1,0.1,0.1)
(1,0,0)	(0.1,0.1,0.1,0.1)	0.2	0	-0.2	(0.6,0.6,0.1,0.1)
(-1,0,1)	(0.6,0.6,0.1,0.1)	0.1	1	0.9	(0.24,-0.12,0.1,0.24)
(-1,1,0)	(0.24,-0.12,0.1,0.24)	0.46	1	0.54	(0.348, -0.228, 0.208, 0.24)

Question 2

0	0	0	0
1	0	0	1
0	1	1	0
0	0	0	1

1	-1
-1	1

$= 1(0) + -1(0) + -1(1) + 1(0) = -1$

$= 1(0) + -1(0) + -1(0) + 1(0) = 0$

$= 1(0) + -1(0) + -1(0) + 1 = 1$

$= 1(1) + -1(0) + -1(0) + 1(1) = 2$

$= 1(0) + -1(0) + -1(1) + 1(1) = 0$

$= 1(0) + -1(1) + -1(1) + 1(0) = -2$

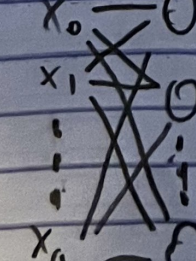
$= 1(0) + -1(1) + -1(0) + 1(0) = -1$

$= 1(1) + -1(1) + -1(0) + 1(0) = 0$

$= 1(1) + -1(0) + -1(0) + 1(1) = 2$

-1	0	1
2	0	-2
-1	0	2

The feature map is 3x3 so we need 9 neurons



9 neurons

10 inputs (including Bias)

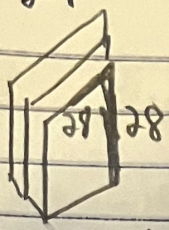
Fully connected = 9x10 = 90 parameters*

The filter is 2x2 = 4 weights*

Question 3

(Conv2D 1)

Input



3 color channels

28×28

Output

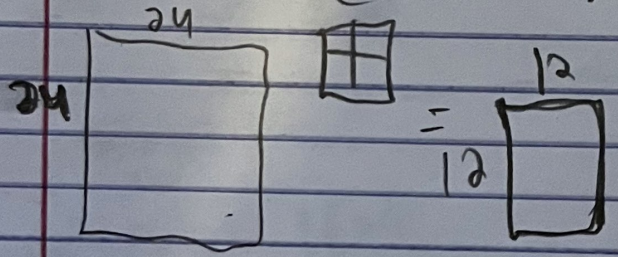
28-5+1=24

⇒ 24×24×32 filters

weights = 5*5=25×3=75*32=2400

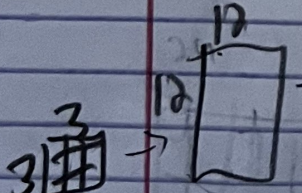
(Max Pooling 1) ⇒ output size = 12×12×32

24×24 (stride 2)



(Conv2D 2) input = 12×12×32

output = 10×10×64

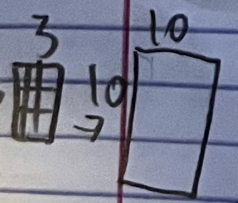


12-3+1=10

weights = (3×3×32)*64 = 18,432 weights

(Conv2D 3) input = 10×10×64

output = 8×8×64

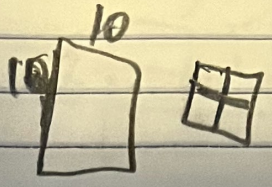


10-3+1=8

weights = (3×3×64)*64 = 36,864 weights

Question 3

(Max Pooling 2)



Input = 10 x 10 x 64

output = 5 x 5 x 64

Flatten

Input = 5 x 5 x 64

Output = 1600

Dense 1 =

Input = 1600

output = 256

weights = 1600 x 256 = 409,600

Dense 2

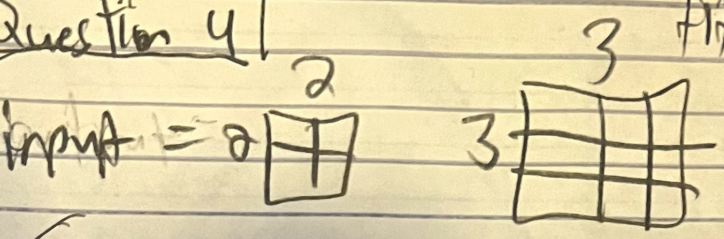
Input = 256

Output = 100

weights =

256 x 100 = 25,600 weights

Question 4



$$\frac{(\text{Input Size} + 2 * \text{Padding} - \text{Filter size})}{\text{Stride}} + 1$$

$$= 4 + 2 * 0 - 3 = \frac{1}{1} + 1 = 2$$

-2

input = 2 x 2

Output = (Same) 2 x 2

$-1(1) + 1(-1) + -1(1) + -1(1)$

$-1 + 1 + -1 + -1$

$0 = -2$

input = 2 x 2

$-2(1) = -2$

Output = 2 x 2

I thought it stayed the same 2x2 throughout, but the first filter may reduce the input to 1 x 1 dimensions = -2,

the second filter would keep constant at -2