Practical work 08 - CNN with Keras

Exercise 1) Computation of convolutions

input: 1 3 -2 0 2 -1 3 1 2

filter weights: 2 1 -1

bias: 2

a) Output = ?

S = 1, P = 0

input: 1 3 -2 0 2 -1 3 1 2

filter weights: 2 1 -1

(S) 2 1 -1

(S) 2 1 -1

2 1 -1

2 1 -1

2 1 -1

bias: 2

output: computation of output: input $\cdot$ (filter weights)^T + b

matrix multiplication

$(1 \times 3) \quad (3 \times 1) \quad (1,1)$

output = 9 6 -4 5 2 2 7

S = 2, P = 0

input: 1 3 -2 0 2 -1 3 1 2

filter weights: 2 1 -1

2 1 -1

2 1 -1

bias: 2

output = 9 -4 2 7

S = 4, P = 0

input: 1 3 -2 0 2 -1 3 1 2

filter weights: 2 1 -1

2 1 -1

bias: 2

output = 9 2

S = 1, P = 1

input: 0 1 3 -2 0 2 -1 3 1 2 0

filter weights: 2 1 -1

2 1 -1

2 1 -1

2 1 -1

2 1 -1

2 1 -1

2 1 -1

2 1 -1

2 1 -1

bias: 2

output = 0 9 6 -4 5 2 2 7 6

S = 4, P = 1

input: 0 1 3 -2 0 2 -1 3 1 2 0

filter weights: 2 1 -1

2 1 -1

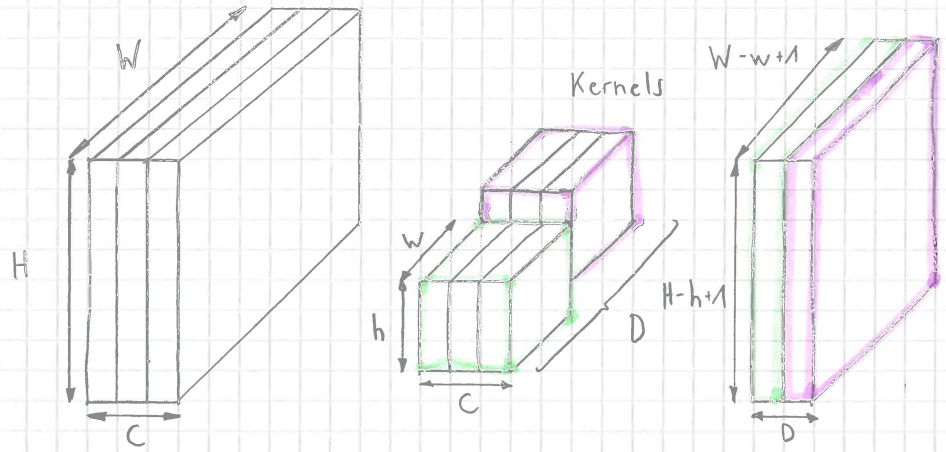
2 1 -1

output = 0 5 6

For S = 1 and P = 1 we get the same dimension as the input.

b) ① In this case we have two filters. Thus we will have two activation maps.

② Summary Slide 30



Input	Filters	Output
C channels	D filters	D activation maps = depth
1 image: $W \times H \times C$	1 filter: $w \times h \times C$	1 map: $(W-w+1) \times (H-h+1) \times D$
		↳ for $S=1$, $P=0$

In our case:

$W = 4$ $\quad w = 2$

$H = 4$ $\quad h = 2$

$C = 3$ $\quad C = 3$

dimension output $= (4-2+1) \times (4-2+1) \times 2$

$= \underline{\underline{3 \times 3 \times 2}}$

③ $S = 2$, $P = 0$

$$O_W = \frac{W - w + 2P_W}{S_W} + 1 \quad ; \quad O_H = \frac{H - h + 2P_H}{S_H} + 1$$

$$O_W = \frac{4 - 2 + 0}{2} + 1 \quad ; \quad O_H = \frac{4 - 2 + 0}{2} + 1$$

$= 2$ $\qquad\qquad$ $= 2$

dimension output: $\underline{\underline{2 \times 2 \times 2}}$

④ input dimension: $4 \times 4 \times 3$

with $S = 1$; $P = 2$ and $D = 3$ (3 filters with dim $3 \times 3 \times 3$)

$$O_W = O_H = \frac{W - w + 2P}{S} \quad \text{with } w = h = 3 \Rightarrow \text{output dim}$$

↳ $4 \times 4 \times 3$