

Task 1

a)

1	0	0	0	0	0	0	0
0	1	0	2	3	1	0	0
0	3	2	0	2	0	0	0
0	0	6	1	1	4	0	0
0	0	0	0	0	0	0	0

Using Padding!

First Convolution

$$15 \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 3 & 2 \end{bmatrix} * \begin{bmatrix} -1 & 0 & 1 \\ 2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} = \underline{2}$$

(1.2)

$$\begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & 2 \\ 3 & 2 & 0 \end{bmatrix} * \begin{bmatrix} -1 & 0 & 1 \\ 2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} = \begin{matrix} -2 - 3 + 4 \\ -1 \end{matrix}$$

(1.3)

$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 2 & 3 \\ 2 & 0 & 7 \end{bmatrix} * \begin{bmatrix} -1 & 0 & 1 \\ 2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} = \begin{matrix} -2 + 6 + 7 \\ 11 \end{matrix}$$

Continue this Pattern

$$\text{Convolution} = \begin{bmatrix} 2 & -1 & 11 & 2 & 13 \\ +10 & -4 & 8 & 2 & -18 \\ 14 & -1 & -5 & 6 & -9 \end{bmatrix}$$

Task 1'

b) Which layer reduces the sensitivity to translational variations in the input

Use the same filter to look for the same features everywhere. Pooling summarises the features present in a region and not precisely positioned features. Used in combination with convolution to find features anywhere.

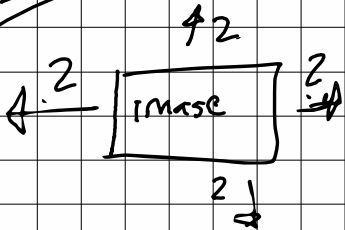
i) Max Pooling

c) Stride of: 1

Kernel Size: 5×5 and 6 filters

Want Conv layer to take $(\text{Height} \times \text{Width}) = \text{input image (HxW)}$
How much padding?

2 on each side, top, bottom



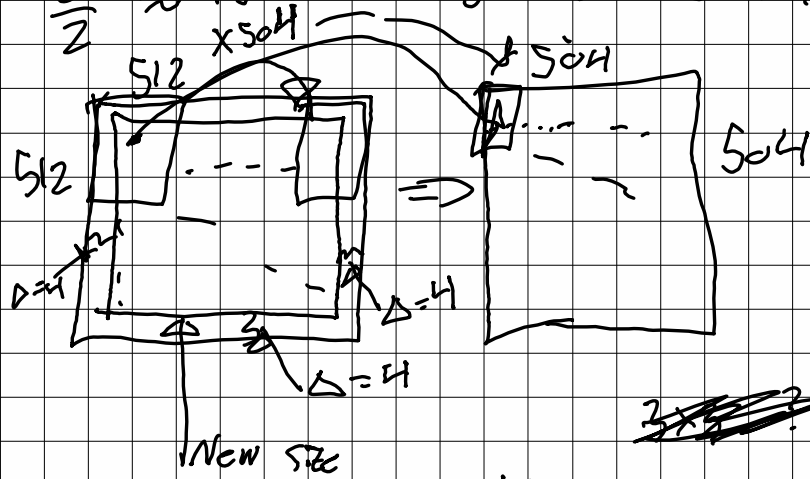
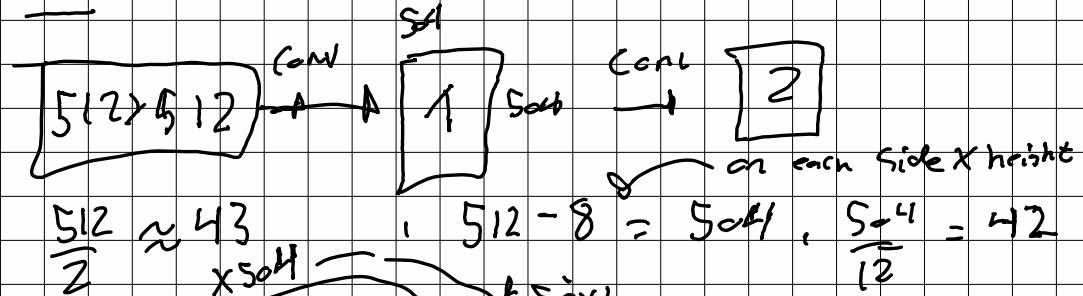
2 from each side removed each time, 6 filters
 \Rightarrow 6 outputs

Image $3 \times 512 \times 512$

Two Convolutional layers

a) First layer: - feature maps 504×504
- 12 feature maps

• No padding, stride of 1, Square kernel of odd num.
What are the spatial dimensions of these kernels?



~~3x3?~~ stride on both sides, same size, same size

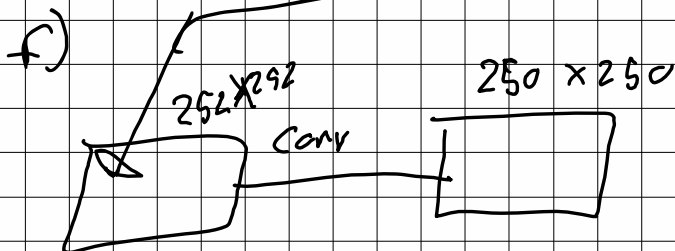
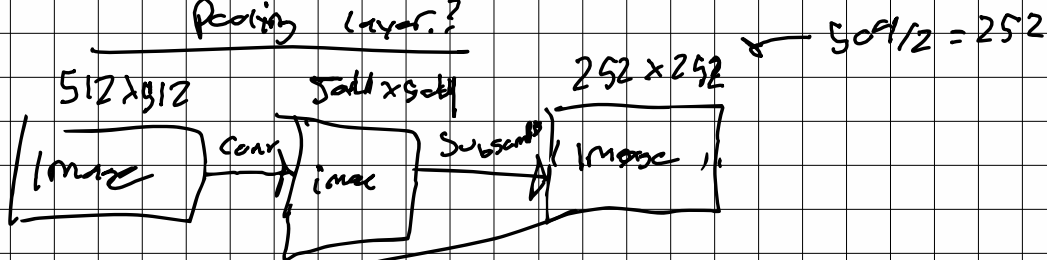
In our case "remove" 4 on each side
the kernel must be 9×9 because no padding is used

Kernel is 9×9

c) Subsampling after first convolutional layer.

- Neighborhoods of 2×2
- Stride $= 2$

What are the spatial dimensions of the pooled feature maps in the first pooling layer?

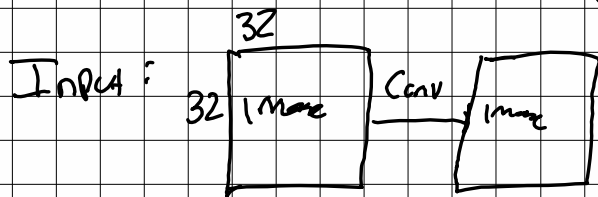


Kernel 3×3 , no padding, stride: 1

Feature maps is 250×250 with 4 feature maps

g) Convolutional Layer : - 5×5 Filter
 - Padding 2
 - Stride 1

MaxPool 2D : - Stride 2
 - Kernel 2×3



$$(F \times F \times D_{in} + 1)^{xK} \text{ for Conv}$$

Num Parameters = Num Weights + Num biases
 32×32

Layer :

1: $(5 \times 5 \times 3 + 1) \cdot 32 = 2432$ 16×16

2: $(5 \times 5 \times 32 + 1) \cdot 64 = 5126$ 8×8

3: $(5 \times 5 \times 64 + 1) \cdot 128 = 204928$ 4×4

4: $(128 \times 4 \times 4 + 1) \cdot 64 = 131136$

5: $(6 \times 4 \times 4 + 1) \cdot 64 = 6450$

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