Convolutional Neural Networks

23 January 2024 08:23 PM

1) CONVOLUTION
2) PADDING
3) POOLING
4) STRIDES

1) CONVOLUTION OPERATION:

A * F =

$$\begin{aligned} &a_{00}f_{00} + a_{01}f_{01} + a_{02}f_{02} \\ &+ a_{10}f_{10} + a_{11}f_{11} + a_{12}f_{12} \\ &+ a_{20}f_{20} + a_{21}f_{21} + a_{22}f_{22} \end{aligned}$$

EX1:

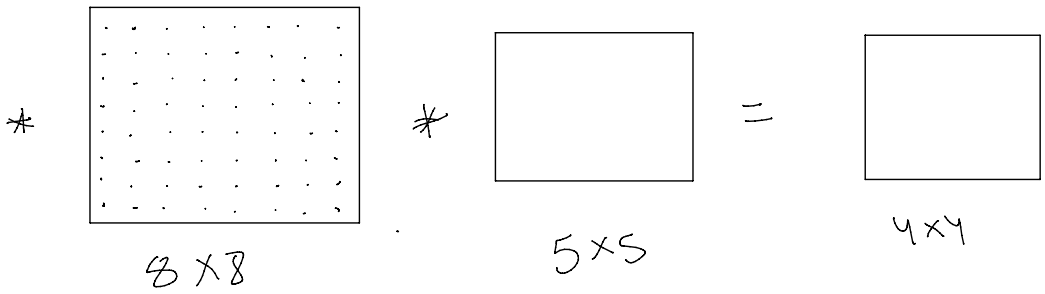
$$\begin{bmatrix} 1 & 0 & 2 \\ 2 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix} * \begin{bmatrix} 3 & 0 & 1 \\ 2 & 1 & 2 \\ 1 & 0 & 1 \end{bmatrix} = 13$$

$$\begin{bmatrix} 2 & 4 & 3 \\ 7 & 3 & 6 \\ 8 & 1 & 2 \end{bmatrix} * \begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 3 & 1 & 2 \end{bmatrix} = 49$$

$$\begin{bmatrix} 1 & 0 & 2 & 3 & 1 & 1 \\ 2 & 1 & 2 & 4 & 2 & 3 \\ 3 & 2 & 0 & 1 & 4 & 1 \\ 2 & 1 & 0 & 1 & 2 & 1 \\ 1 & 0 & 3 & 2 & 1 & 3 \\ 3 & 0 & 1 & 2 & 1 & 1 \end{bmatrix} * \begin{bmatrix} 1 & 0 & 2 \\ 1 & 2 & 1 \\ 2 & 1 & 0 \end{bmatrix} = \begin{bmatrix} 19 & 19 & 17 & 22 \\ 18 & 14 & 18 & 24 \\ 9 & 9 & 20 & 14 \\ 12 & 12 & 16 & 15 \end{bmatrix}$$

INPUT (6,6) * FILTER (3,3) = (4,4)

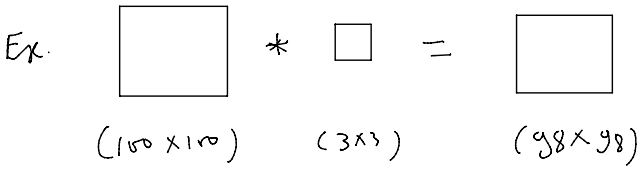
8 X 8 * 3X3 = 6X6



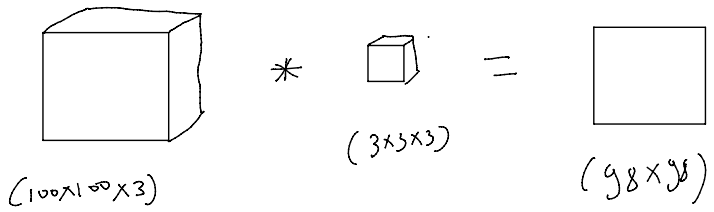
> $n \times n$: Shape of input
> $n_f \times n_f$: Shape of filter

OUTPUT SHAPE : $n - n_f + 1, n - n_f + 1$

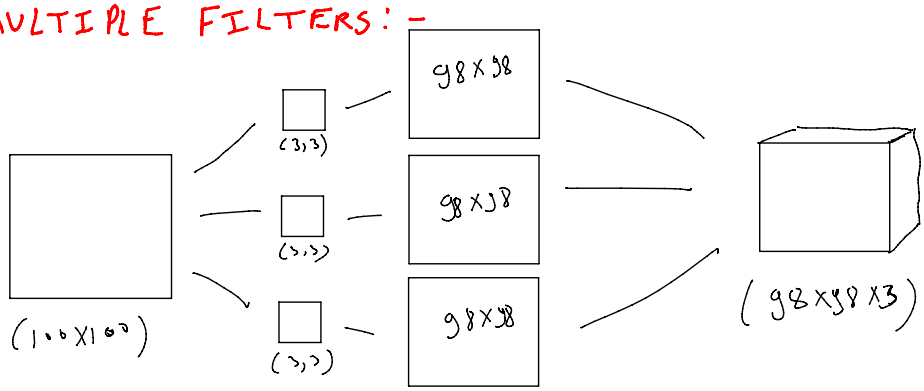
Ex.



* RGB IMAGES :-

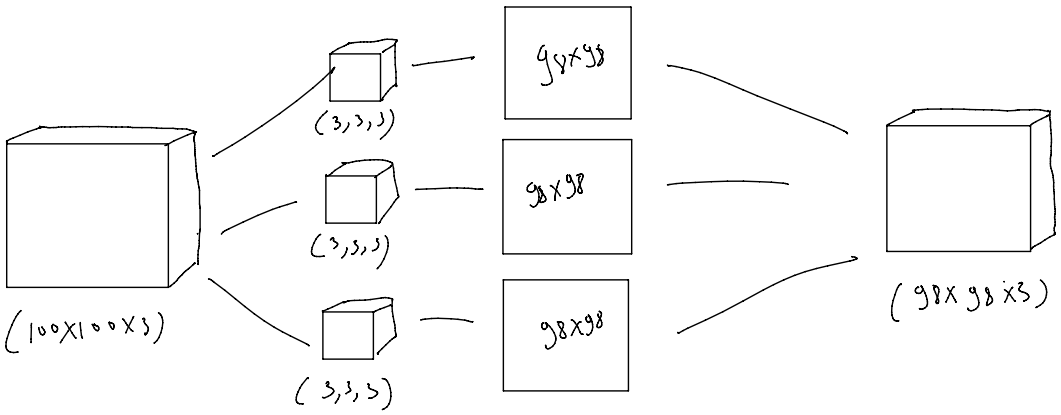


* MULTIPLE FILTERS :-

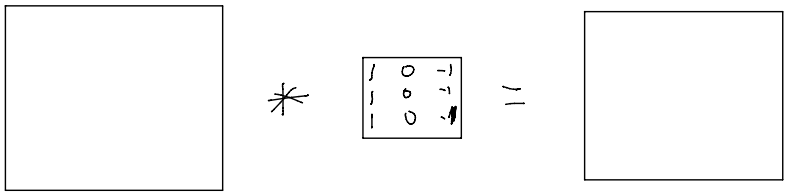


* MULTIPLE FILTERS (RGB) :-

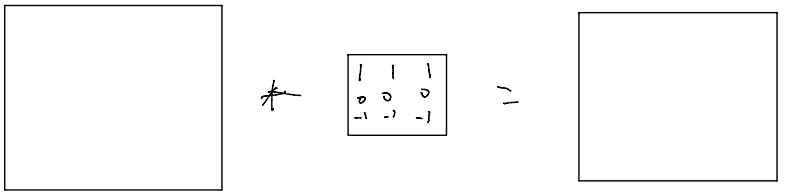
* MULTIPLE FILTERS (RGB):-



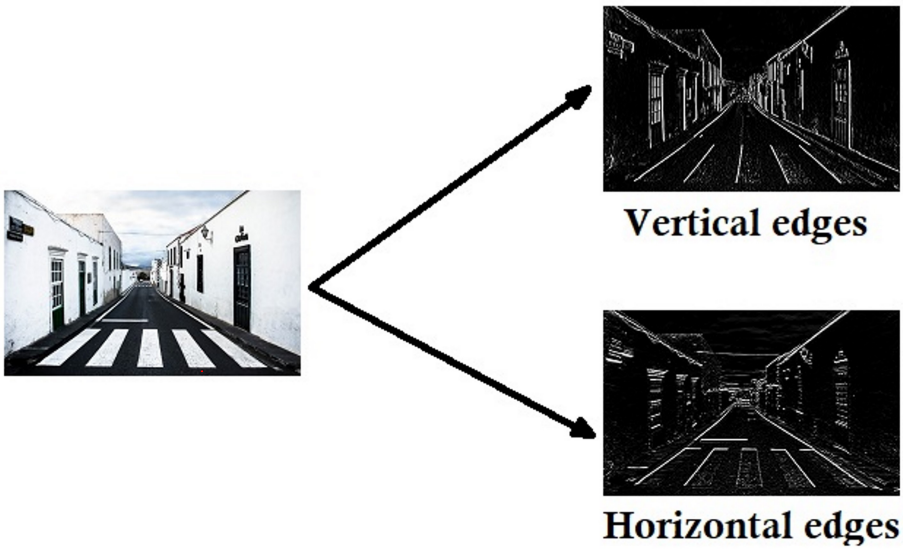
* SIGNIFICANCE OF CONVOLUTION OPERATION:-



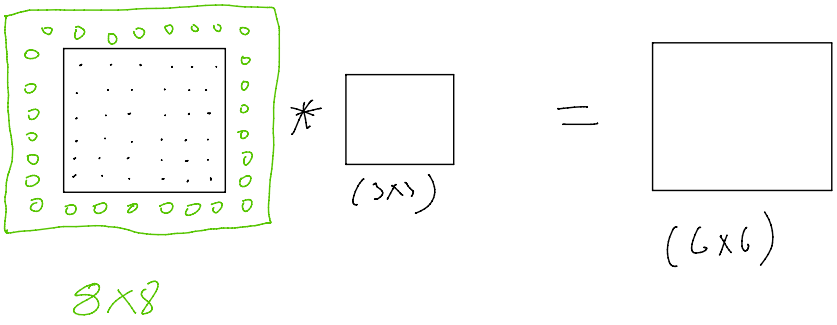
Vertical edge

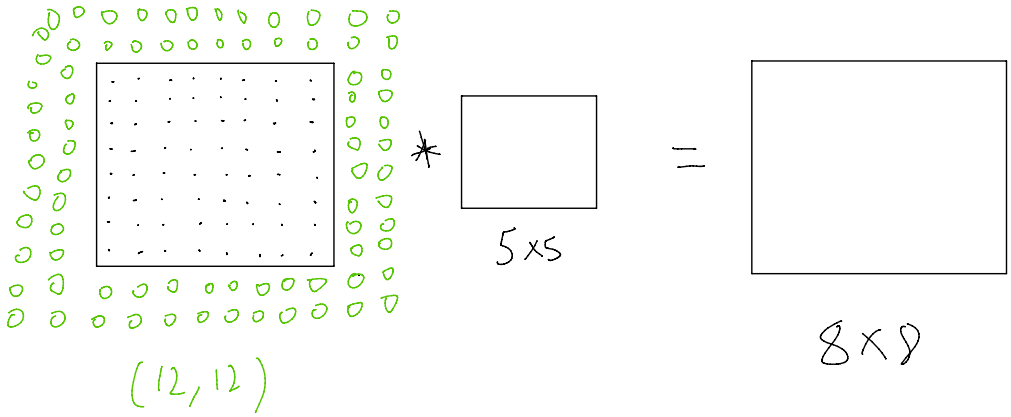


Horizontal edges



* PADDING:-





* VALID = No Padding
* SAME = Maintain Resolution

> $n \times n$: Shape of input
> $n_f \times n_f$: Shape of filter
> p : no. of padding layer

OUTPUT SHAPE : $n - n_f + 1 + 2p$, $n - n_f + 1 + 2p$

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* STRIDES :-

OUTPUT : $\frac{n - n_f + 2p}{s} + 1$, $\frac{n - n_f + 2p}{s} + 1$

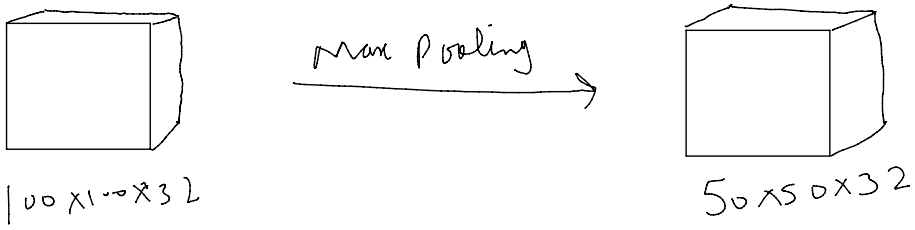
* POOLING :-

1) MAX POOLING :-

2	3	2	8
9	1	3	5
8	1	4	7
1	3	3	2

$=$

9	8
8	7



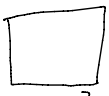
2) AVERAGE POOLING :-

2	3	2	8
9	1	3	5
8	1	4	7
1	3	3	2

$=$

3.75	4.5
3.25	4

* CONVOLUTIONAL NEURAL NETWORK :-

INPUT : 

CONV1 (16, 3x3, Padding : 'Same')	: 28 X 28 X 16
MAXPOOLING (2,2)	: 14 X 14 X 16
CONV2 (32, 3x3, Padding : 'Valid')	: 12 X 12 X 32
MAXPOOLING (2,2)	: 6 X 6 X 32
FLATTEN ()	: [1152,1]
DENSE (100)	: [100,1]

FLATTEN()
DENSE(100)
DENSE(10)

[100,1]
[10,1]

Input 100x100x3

Ex.2 Conv1(16, 5x5, Padding = 'valid')
MaxPool1(2,2)
Conv2(32, 3x3, Padding = 'valid')
MaxPool(2,2)
Conv3(64, 3x3, Padding = 'Same')
MaxPool(2,2)
Conv4(128, 3x3, Padding = 'Same')
MaxPool(2,2)

O/P	# Parameters
96x96x16	5x5x3x16 + 16
48x48x16	
46x46x32	3x3x16x32 + 32
23x23x32	
23x23x64	3x3x32x64 + 64
11x11x64	
11x11x128	3x3x64x128 + 128
5x5x128	

Flatten()
Dense(500)
Dense(100)
Dense(1)

[3200]
[500]
[100]
[1]
O/P

200x200

Ex: 3 Conv1(32, 7x7, 'valid')
MaxPool(2,2)
Conv2(64, 5x5, 'Same')
MaxPool(2,2)
Conv3(128, 3x3, 'valid')
MaxPool(2,2)
Conv4(256, 3x3, 'valid')
MaxPool(2,2)

194x194x32	7x7x32+32
97x97x32	
97x97x64	5x5x32x64+64
48x48x64	
46x46x128	3x3x64x128 + 128
23x23x128	
21x21x256	3x3x128x256 + 256
10x10x256	