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:

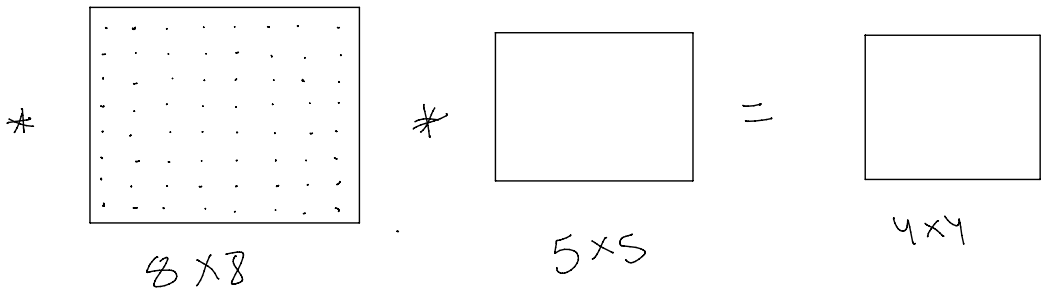
$$\begin{bmatrix} 1 & 0 & 2 \\ 2 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix} * \begin{bmatrix} 3 & 0 & 1 \\ 2 & 1 & 2 \\ 1 & 0 & 1 \end{bmatrix} = 13$$

$$\begin{bmatrix} 2 & 4 & 3 \\ 7 & 3 & 6 \\ 8 & 1 & 2 \end{bmatrix} * \begin{bmatrix} 3 & 4 & 3 \\ 4 & 5 & 4 \\ 4 & 3 & 2 \end{bmatrix} = 137$$

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

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

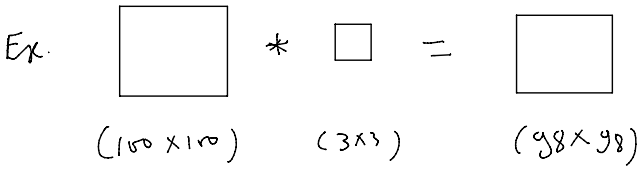
8 X 8 * 3X3 = 6X6



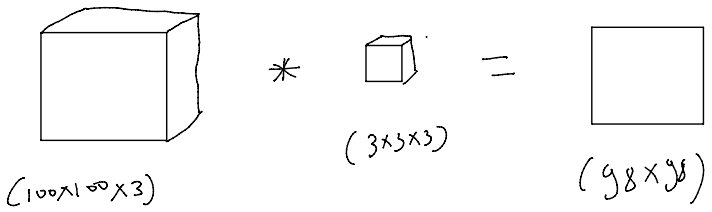
> $n \times n$: Shape of input
> $n_f \times n_f$: Shape of filter

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

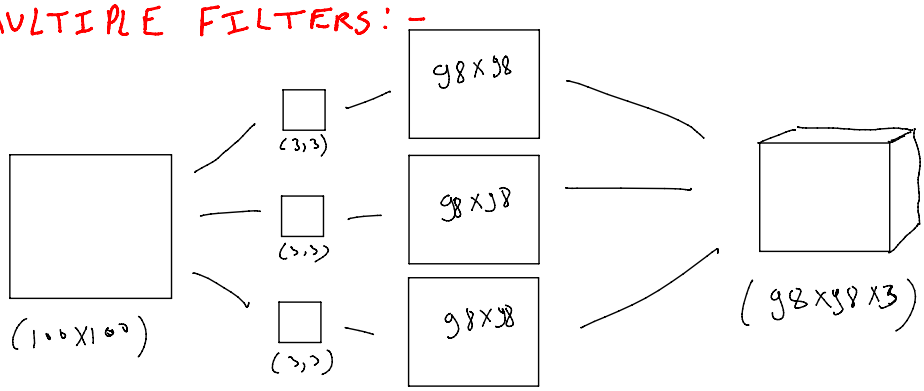
Ex.



* RGB IMAGES :-



* MULTIPLE FILTERS :-



* MULTIPLE FILTERS (RGB) :-

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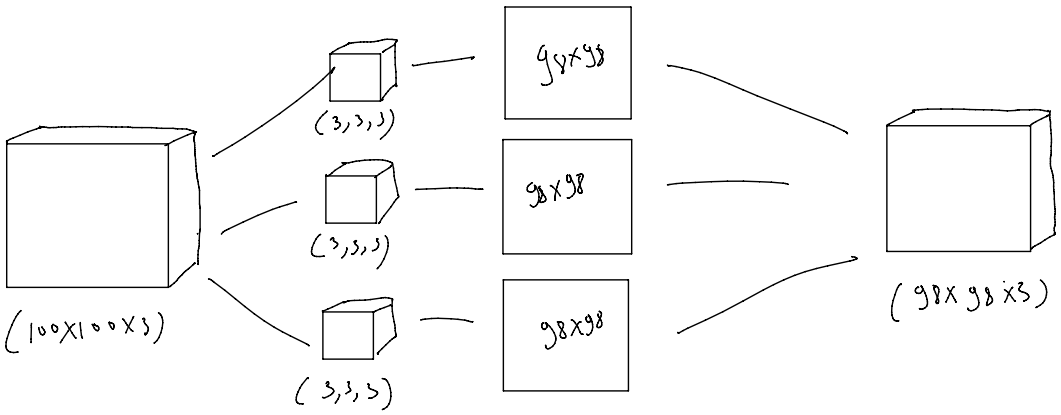
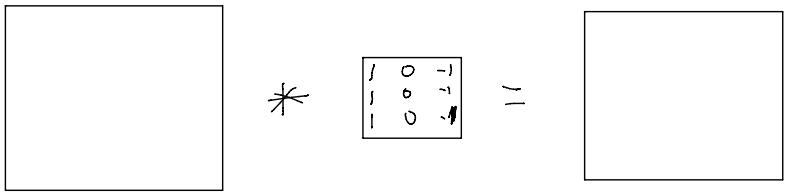
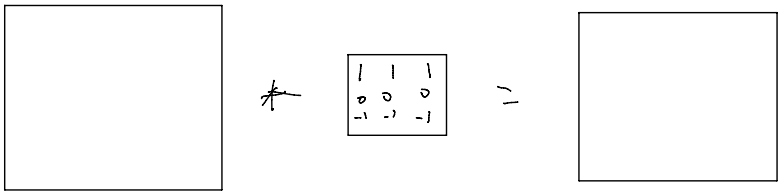


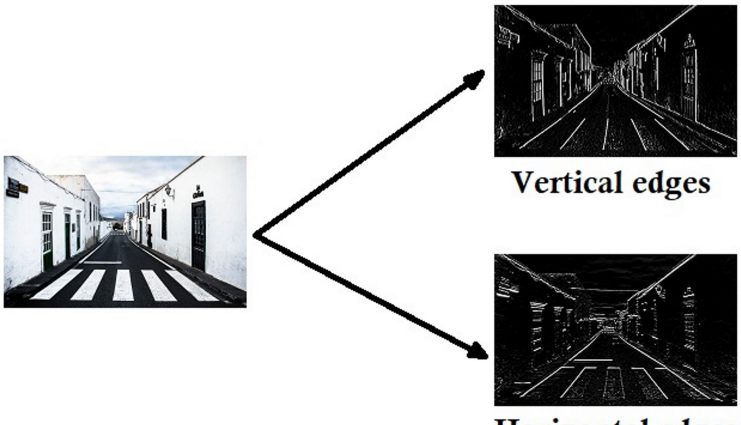
* SIGNIFICANCE OF CONVOLUTION OPERATION:-



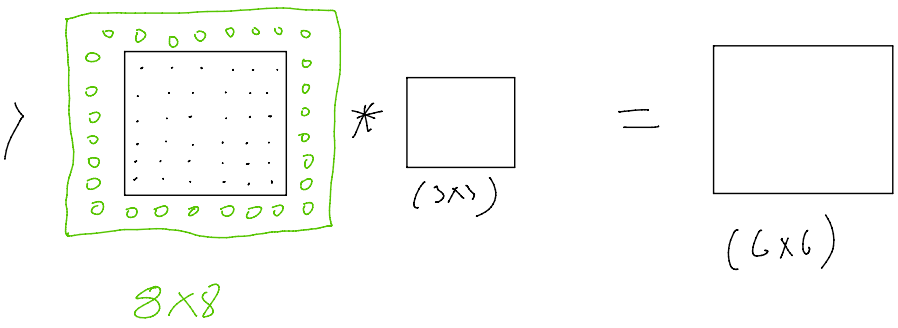
Vertical edge

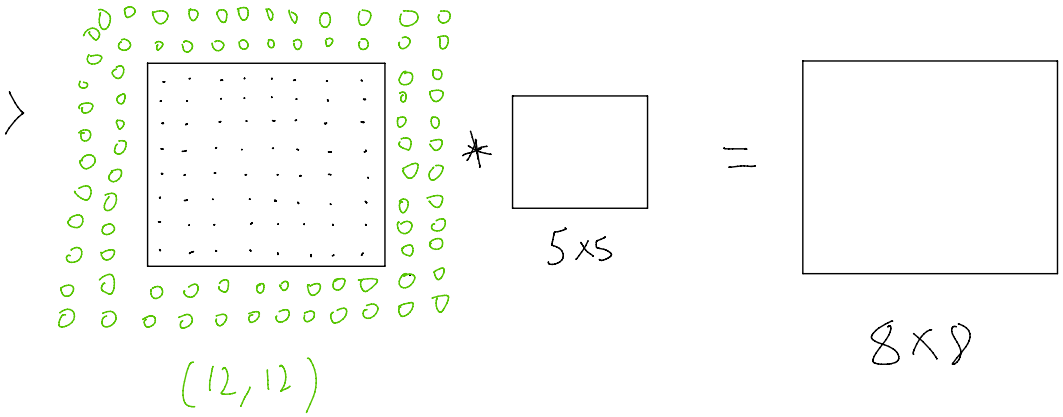


Horizontal edges



* 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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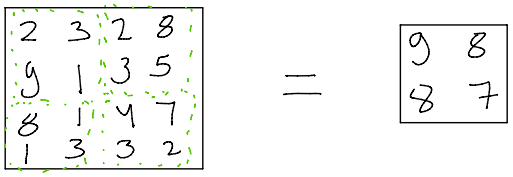
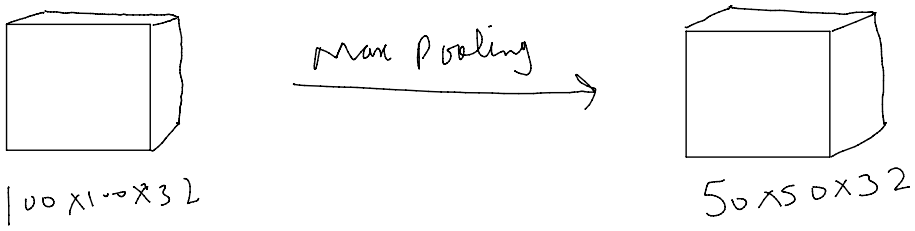
* STRIDES :-

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

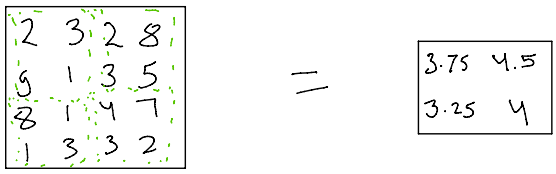
* POOLING :-

1) MAX POOLING :-

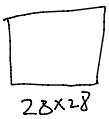




2) AVERAGE POOLING :-



* 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]
[10, 1]

FLATTEN()
DENSE(100)
DENSE(10)

[100,1]
[10,1]