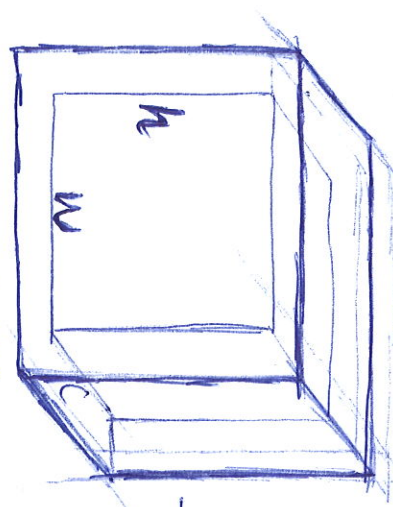


one image

zero padding original image



For num of images:

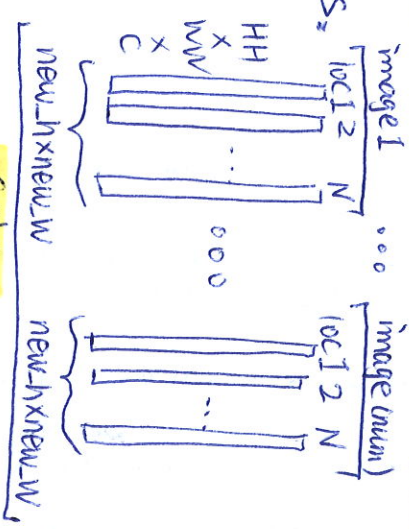
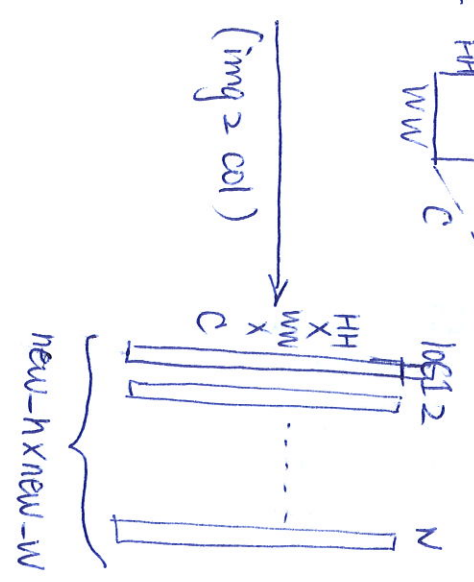


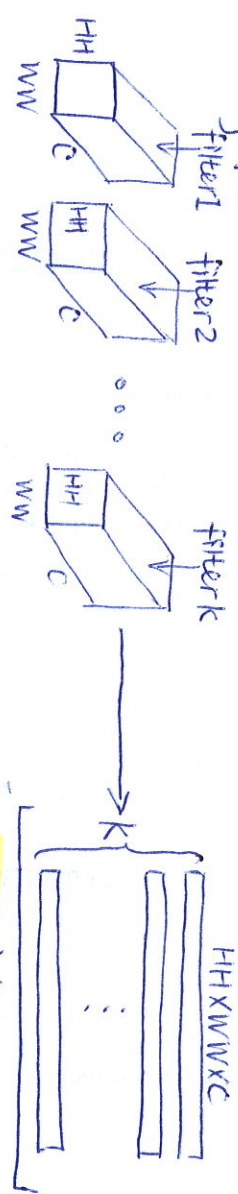
Image Convolution graph for Display.

one filter



Convolution process:

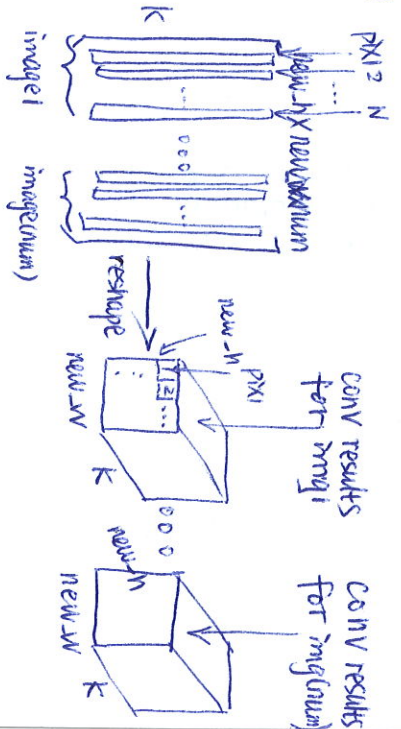
For K number of filters:



$F\text{-weights} \times \text{cols} = K$

$$\begin{bmatrix} H \times H \times W \times W \times C \\ \vdots \\ H \times H \times W \times W \times C \end{bmatrix} \times \begin{bmatrix} H \times H \times W \times W \times C \\ \vdots \\ H \times H \times W \times W \times C \end{bmatrix} = \begin{bmatrix} \text{new-h} \times \text{new-w} \times \text{num} \\ \vdots \\ \text{new-h} \times \text{new-w} \times \text{num} \end{bmatrix}$$

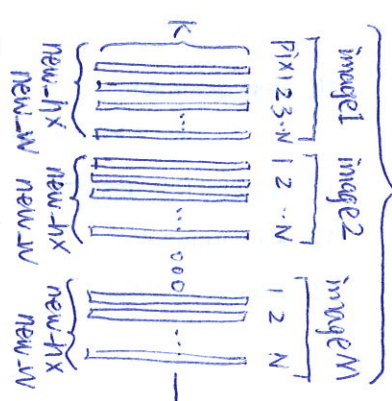
$F\text{-weights}$



Total num of images

Total num of images

conv results for image1
conv results for imageM



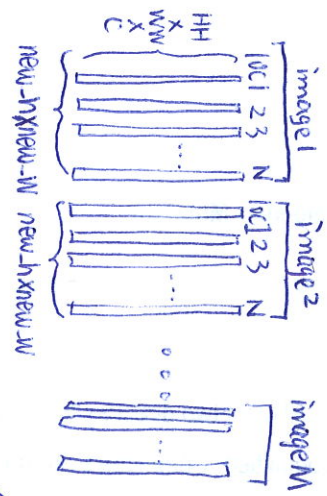
K: kernel size (num of filters)
C: image channels
HH: kernel height
WW: kernel width

W



$d(r\text{-weights}) = (w/s)^{-1} \times d(\text{out-col-b})$

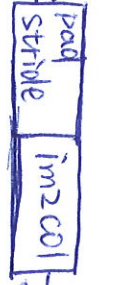
$[K, HH \times WW \times C]$



$[HH \times WW \times C, \text{new-h} \times \text{new-w} \times \text{new-hx} \times \text{new-wx}]$



X



$d(\text{cols})$

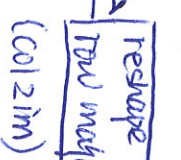
$= d(\text{out-col-b}) \times (r\text{-weights})^{-1}$

$b^{(K)}$

$d(b) = d(\text{out-col-b})$

out-col

out-col-b



out

dout

$[K, \text{new-h} \times \text{new-w} \times \text{num}]$

$[\text{num}, K, \text{new-h}, \text{new-w}]$

$\text{cols} \times r\text{-weights} + b = \text{out-col-b}$

$\Rightarrow d(\text{out-col-b}) = d(b)$

$d(\text{cols}) = d(\text{out-col-b}) \times (r\text{-weights})^{-1}$

$d(r\text{-weights}) = (\text{cols})^{-1} \cdot d(\text{out-col-b})$

Computational graph for Conv Neural Nets.

num: number of images
C: channels
H: image height
W: image width.