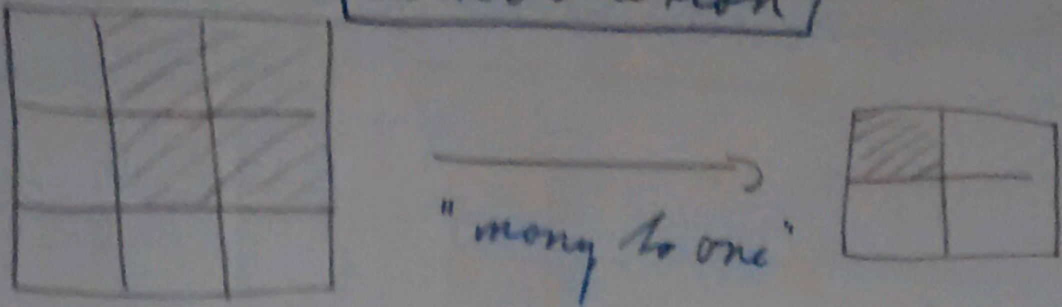
convolution



example:

image

1	2	3
4	5	6
7	8	9

kernel

1	1
2	3

→

26	33
47	54

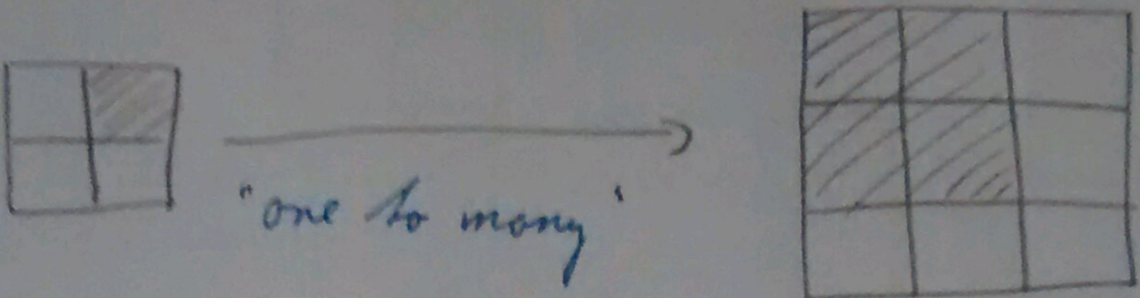
as matrix multiplication:

convolution matrix C

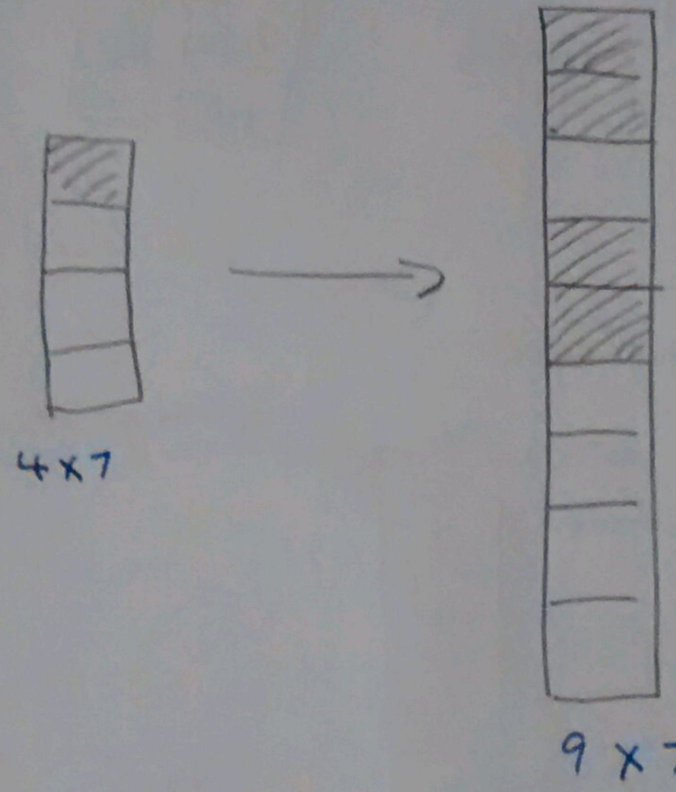
image as vector

$$\underbrace{\begin{pmatrix} 1 & 1 & 0 & 2 & 3 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 2 & 3 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 & 2 & 3 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 & 2 & 3 \end{pmatrix}}_{4 \times 9} \underbrace{\begin{pmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \\ 9 \end{pmatrix}}_{9 \times 1} = \underbrace{\begin{pmatrix} 26 \\ 33 \\ 47 \\ 54 \end{pmatrix}}_{4 \times 1}$$

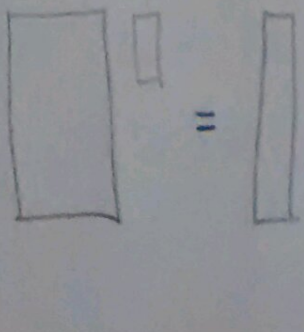
transpose convolution



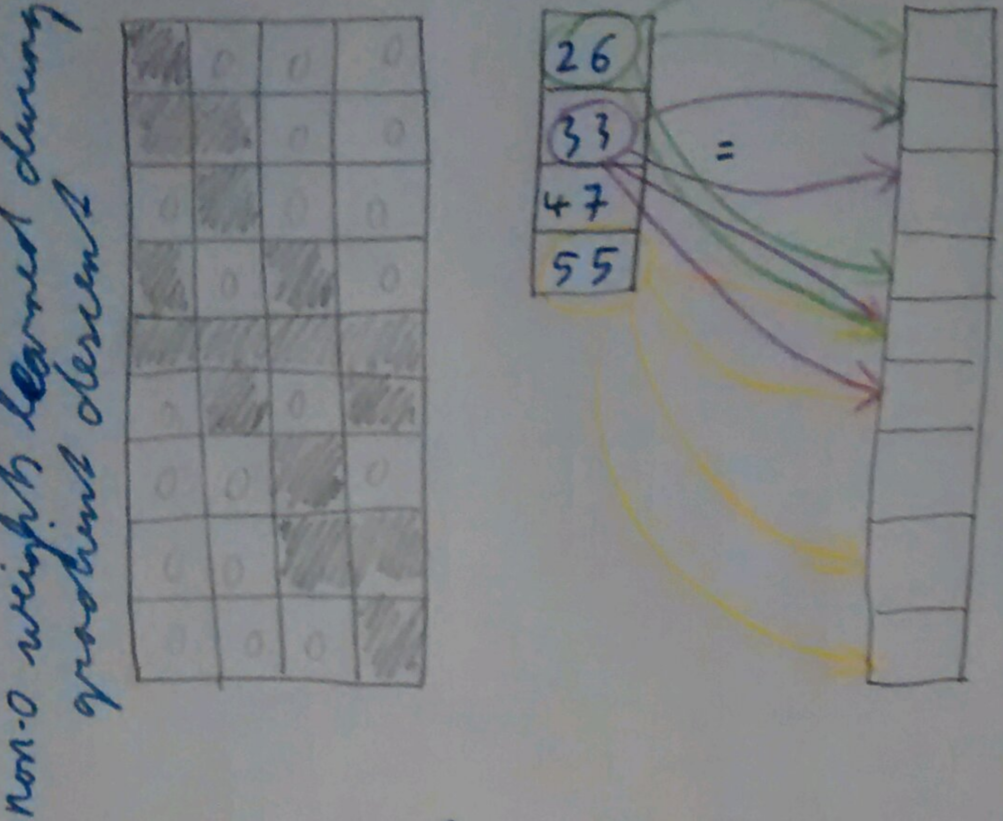
vectorized:



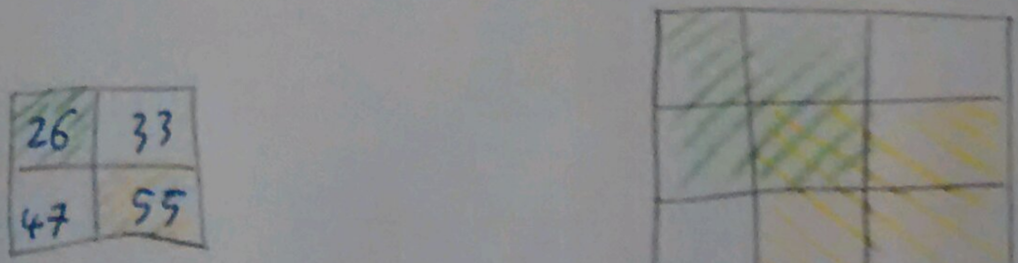
solution: 9×~~2~~4 matrix (like C')



preserve local connectivity:
some entries 0 as in C



vectors shaped into matrices:



local connectivity preserved by 0-entries