Advanced Machine Learning

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The Convolution Operation

Convolution is an operation on two functions of a real-valued argument.

$$s(t) = \int x(a)w(t-a)da$$

$$s(t) = (x * w)(t)$$

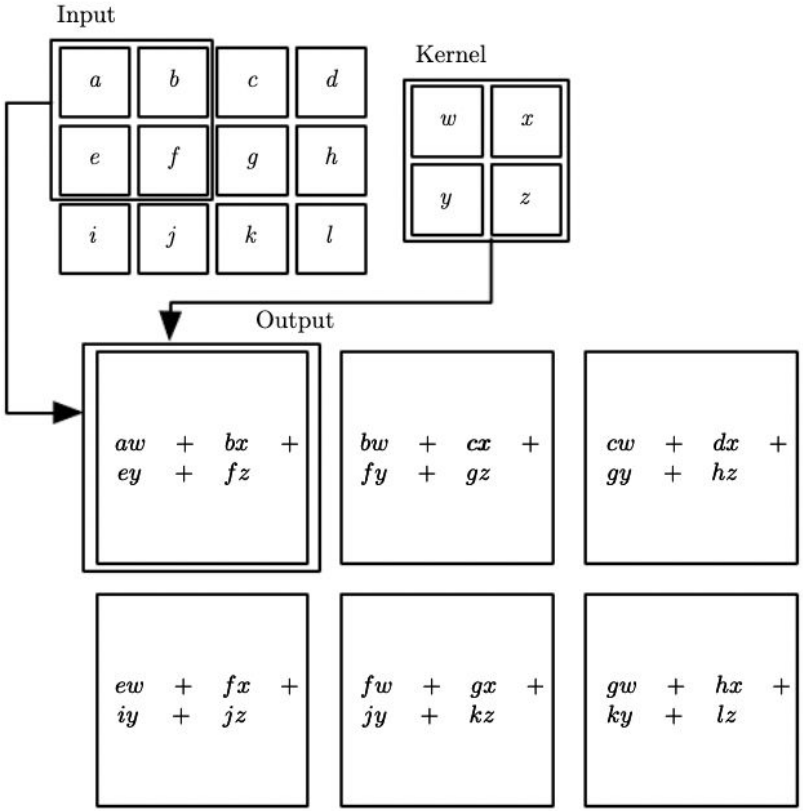
The Convolution Operation

Convolution is an operation on two functions of a real-valued argument.

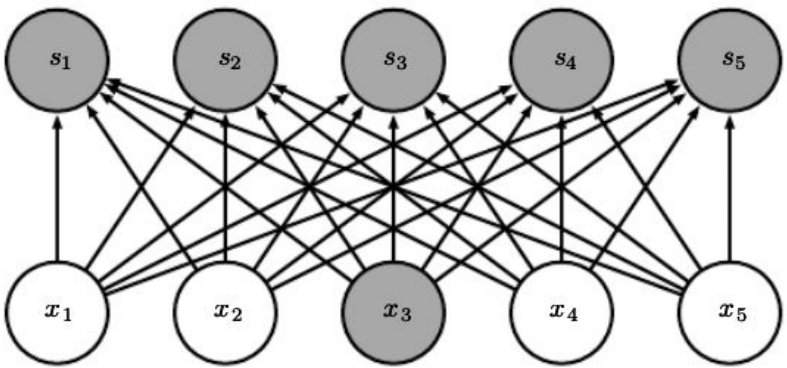
$$s(t) = (x * w)(t) = \sum_{a=-\infty}^{\infty} x(a)w(t-a)$$

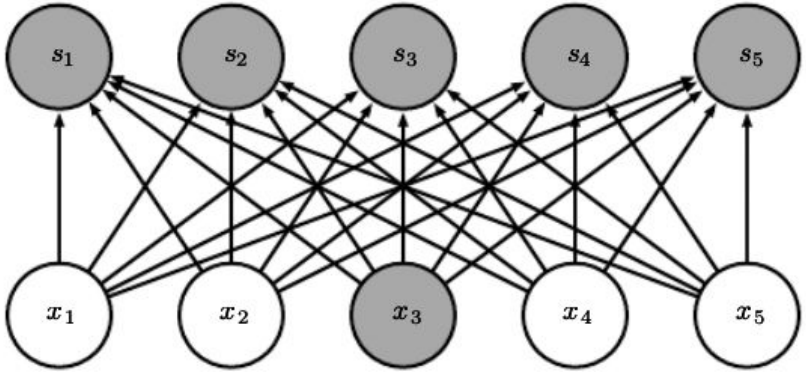
$$S(i,j) = (I * K)(i,j) = \sum_{m}\sum_{n} I(m,n)K(i-m, j-n)$$

The Convolution Operation

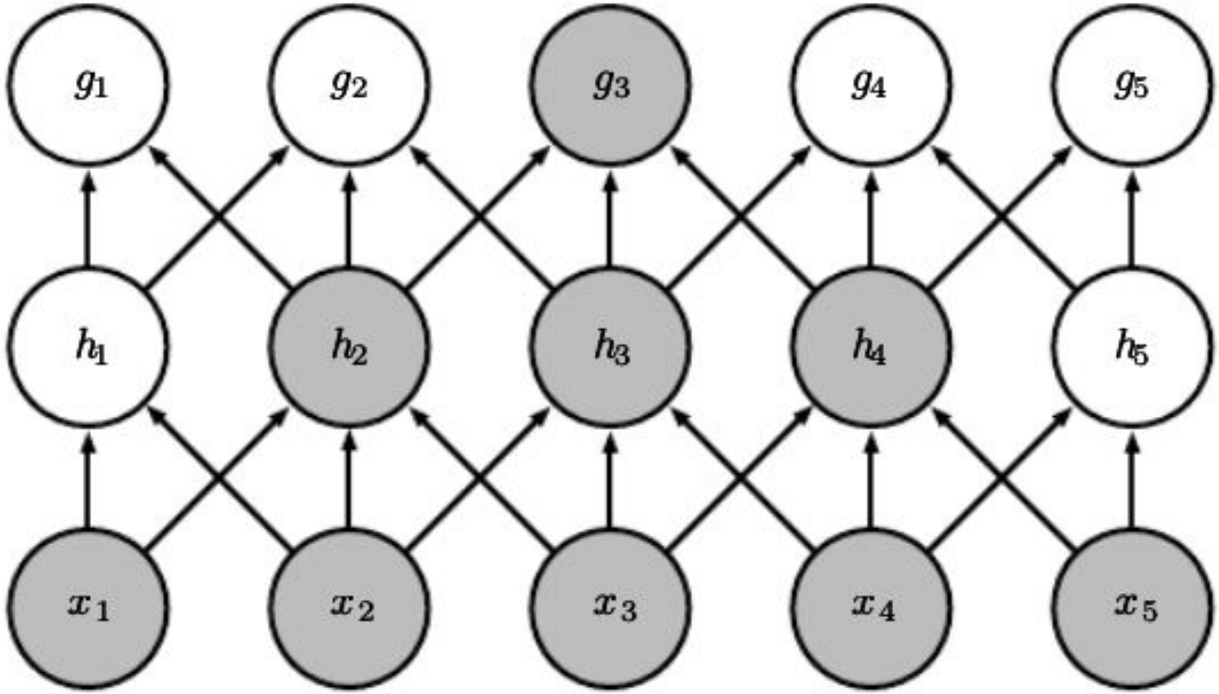


Sparse connectivity

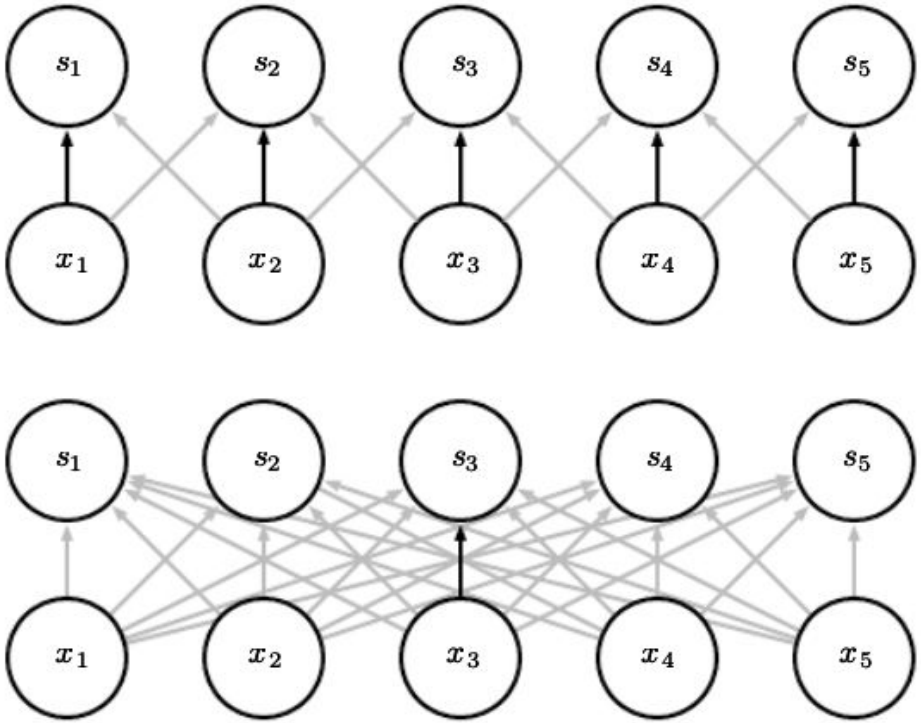




Sparse connectivity



Parameter sharing



Edge detection

10	10	10	0	0	0
10	10	10	0	0	0
10	10	10	0	0	0
10	10	10	0	0	0
10	10	10	0	0	0
10	10	10	0	0	0

$*$

1	0	-1
1	0	-1
1	0	-1

Edge detection

10	10	10	0	0	0
10	10	10	0	0	0
10	10	10	0	0	0
10	10	10	0	0	0
10	10	10	0	0	0
10	10	10	0	0	0

$*$

1	0	-1
1	0	-1
1	0	-1

$=$

0	30	30	0
0	30	30	0
0	30	30	0
0	30	30	0

Edge detection

vertical edges