

Machine Learning Course

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Convolutional Neural Networks (CNN)

- ▶ **What is Convolution?**
- ▶ **What is Pooling?**
- ▶ **What are the weights?**
- ▶ **How is the architecture?**

Convolution

I(0,0)	I(1,0)	I(2,0)	I(3,0)	I(4,0)	I(5,0)	I(6,0)
I(0,1)	I(1,1)	I(2,1)	I(3,1)	I(4,1)	I(5,1)	I(6,1)
I(0,2)	I(1,2)	I(2,2)	I(3,2)	I(4,2)	I(5,2)	I(6,2)
I(0,3)	I(1,3)	I(2,3)	I(3,3)	I(4,3)	I(5,3)	I(6,3)
I(0,4)	I(1,4)	I(2,4)	I(3,4)	I(4,4)	I(5,4)	I(6,4)
I(0,5)	I(1,5)	I(2,5)	I(3,5)	I(4,5)	I(5,5)	I(6,5)
I(0,6)	I(1,6)	I(2,6)	I(3,6)	I(4,6)	I(5,6)	I(6,6)

Input image

×

H(0,0)	H(1,0)	H(2,0)
H(0,1)	H(1,1)	H(2,1)
H(0,2)	H(1,2)	H(2,2)

Filter

=

O(0,0)				

Output image

Convolution

0 ₂	0 ₀	0 ₁	0	0	0	0
0 ₁	2 ₀	2 ₀	3	3	3	0
0 ₀	0 ₁	1 ₁	3	0	3	0
0	2	3	0	1	3	0
0	3	3	2	1	2	0
0	3	3	0	2	3	0
0	0	0	0	0	0	0

1	6	5
7	10	9
7	10	8

Pooling

Max Pooling

29	15	28	184
0	100	70	38
12	12	7	2
12	12	45	6

2 x 2
pool size

100	184
12	45

Average Pooling

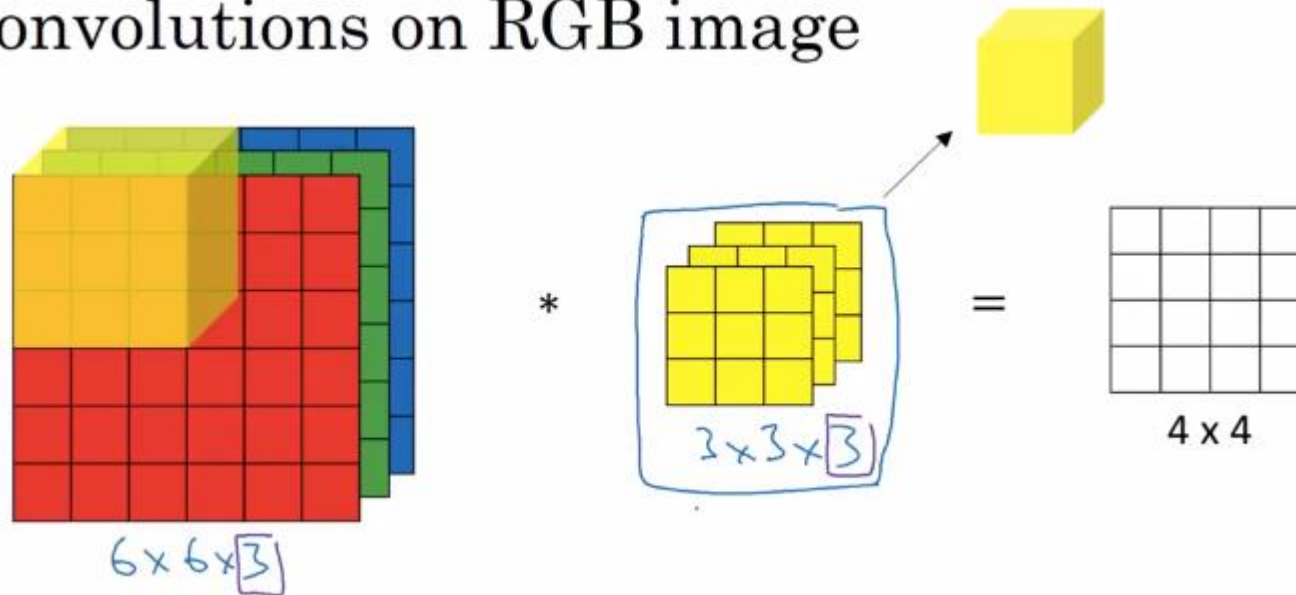
31	15	28	184
0	100	70	38
12	12	7	2
12	12	45	6

2 x 2
pool size

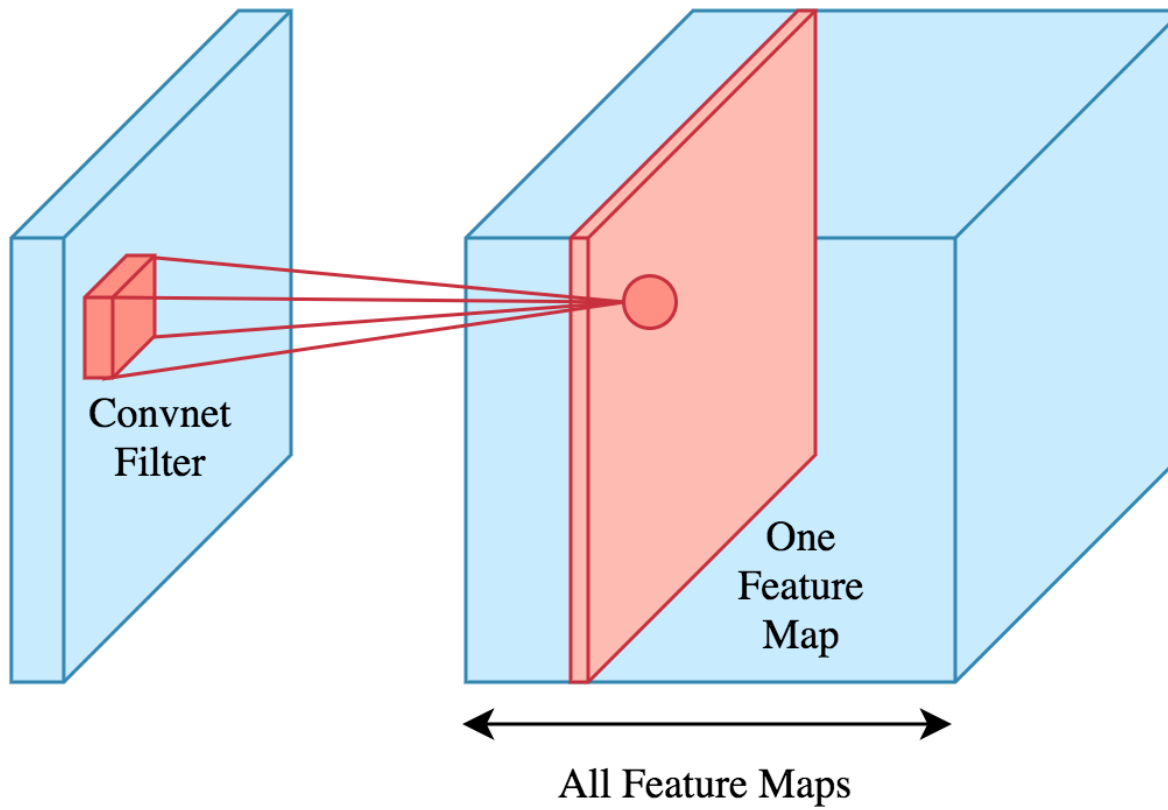
36	80
12	15

Convolution on RGB Image

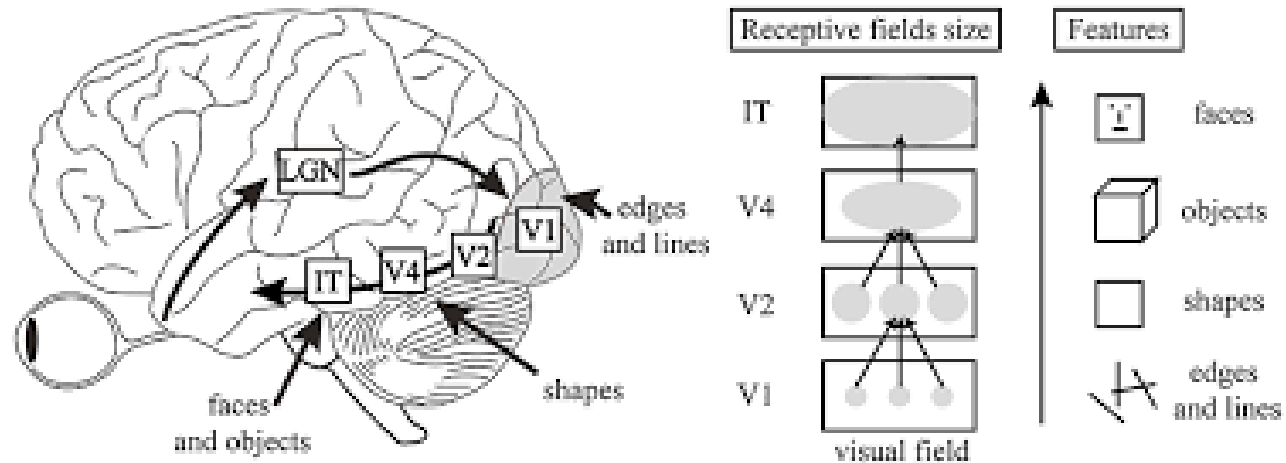
Convolutions on RGB image



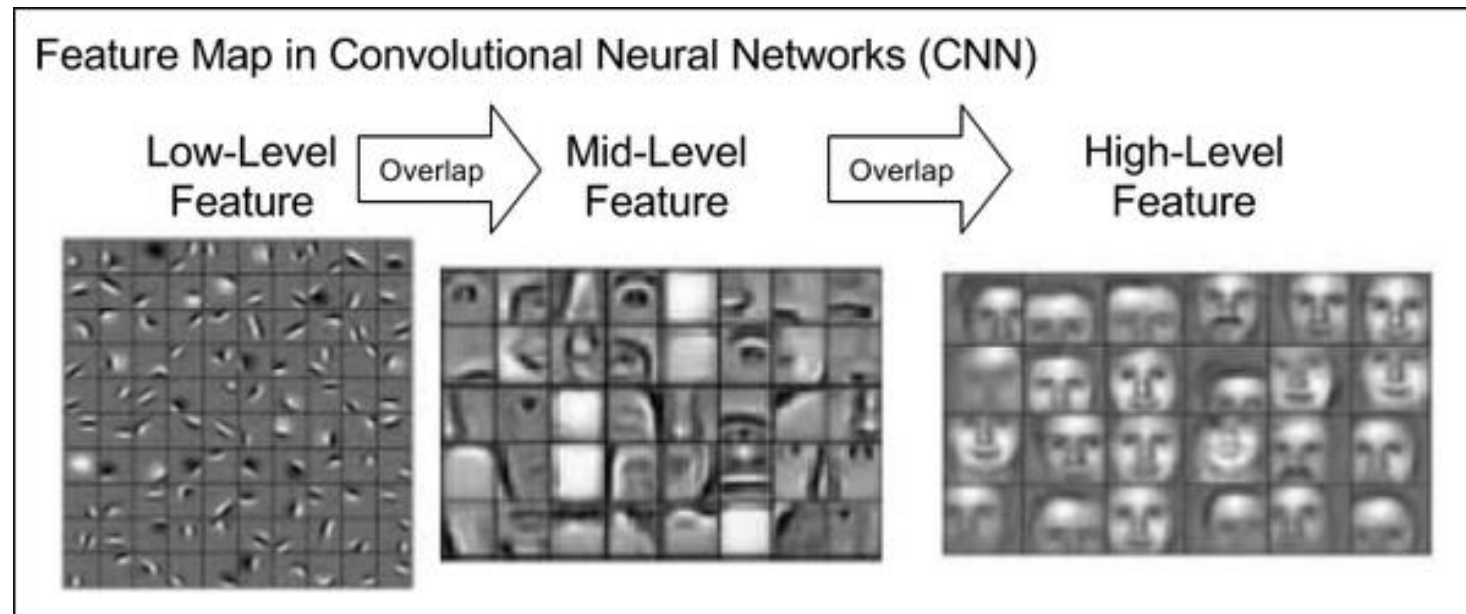
Feature Maps



Human Visual System



Convolutional Neural Networks (CNN)



Convolutional Neural Networks (CNN)

