2018.10.13

NEURAL NETWORK (2)

3기 천용희

Growth Hackers

CONTENTS

Chapter 1

머신러닝 복습 및 딥러닝 이해

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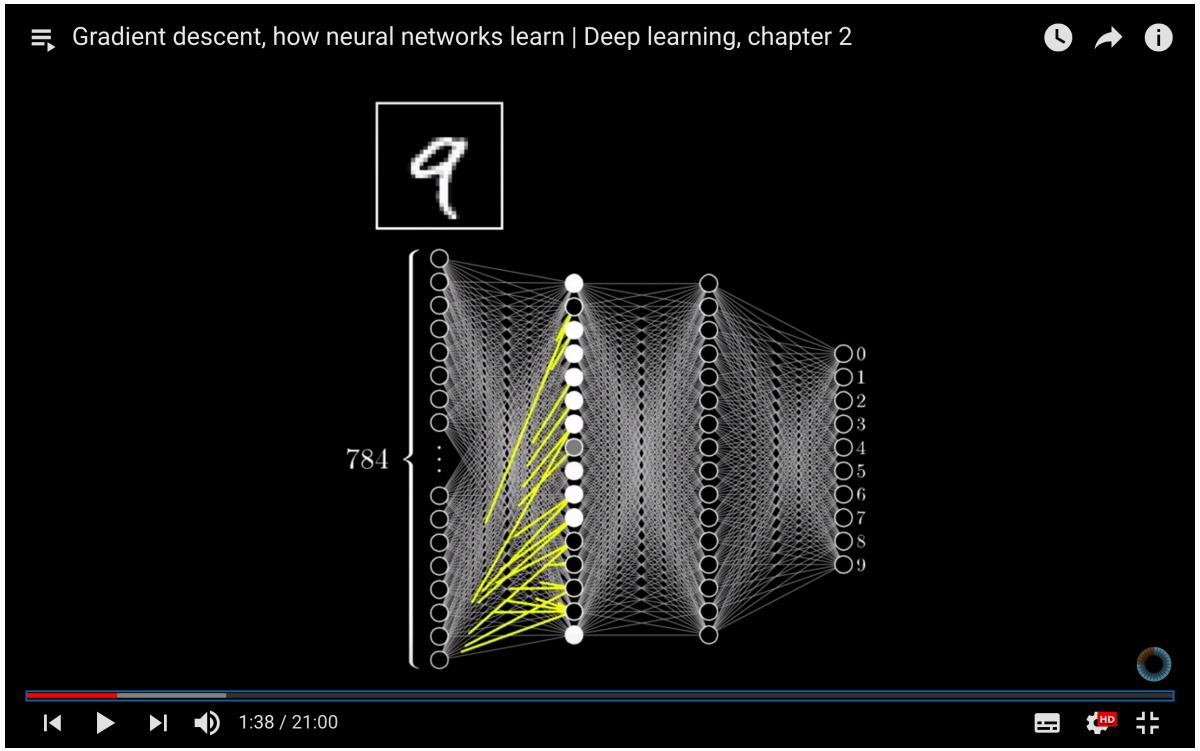
Chapter 1.1 I What is a Neural Network?

3Blue1Brown Video



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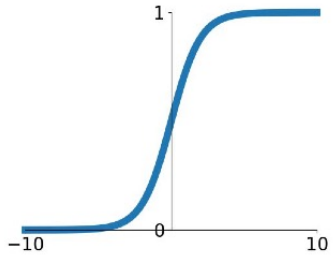
Chapter 1.2 I 활성화 함수의 종류

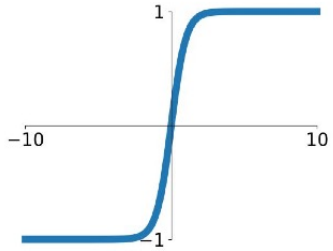
Sigmoid

$$\sigma(x) = \frac{1}{1+e^{-x}}$$



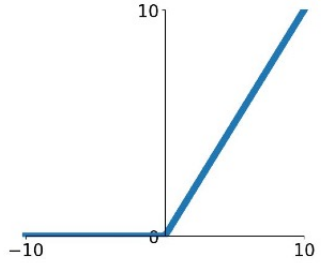
tanh

$$\tanh(x)$$



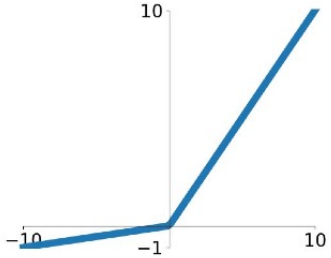
ReLU

$$\max(0, x)$$



Leaky ReLU

$$\max(0.1x, x)$$

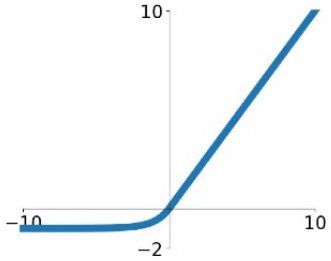


Maxout

$$\max(w_1^T x + b_1, w_2^T x + b_2)$$

ELU

$$\begin{cases} x & x \geq 0 \\ \alpha(e^x - 1) & x < 0 \end{cases}$$



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Chapter 2

합성곱 신경망
Convolutional Neural Networks

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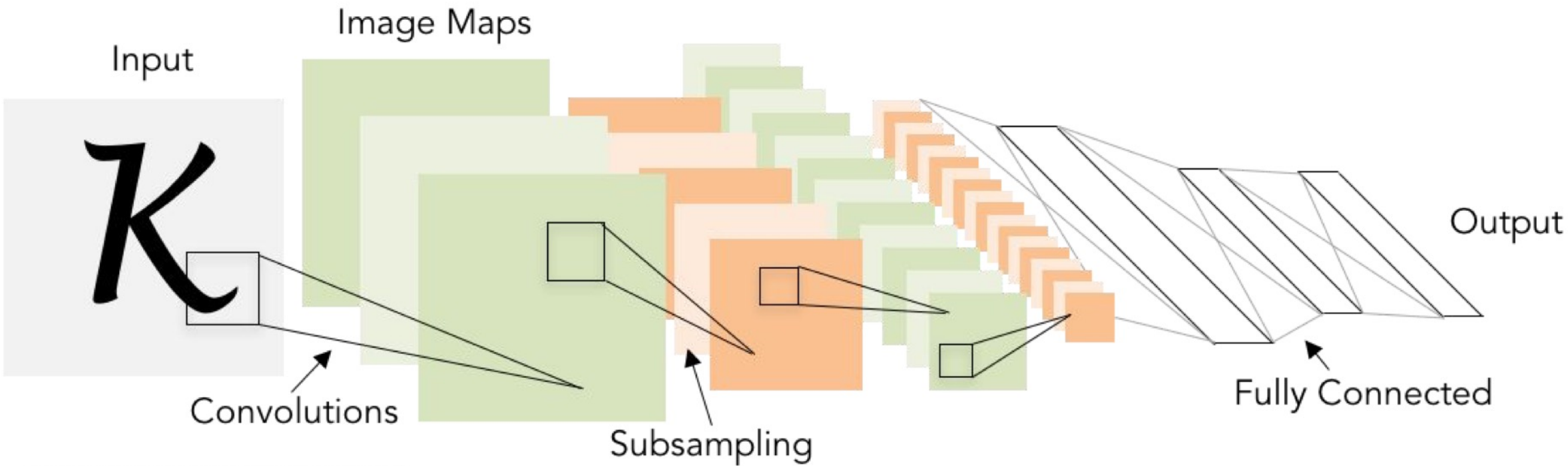
Chapter 2.1 I CNN의 아키텍쳐



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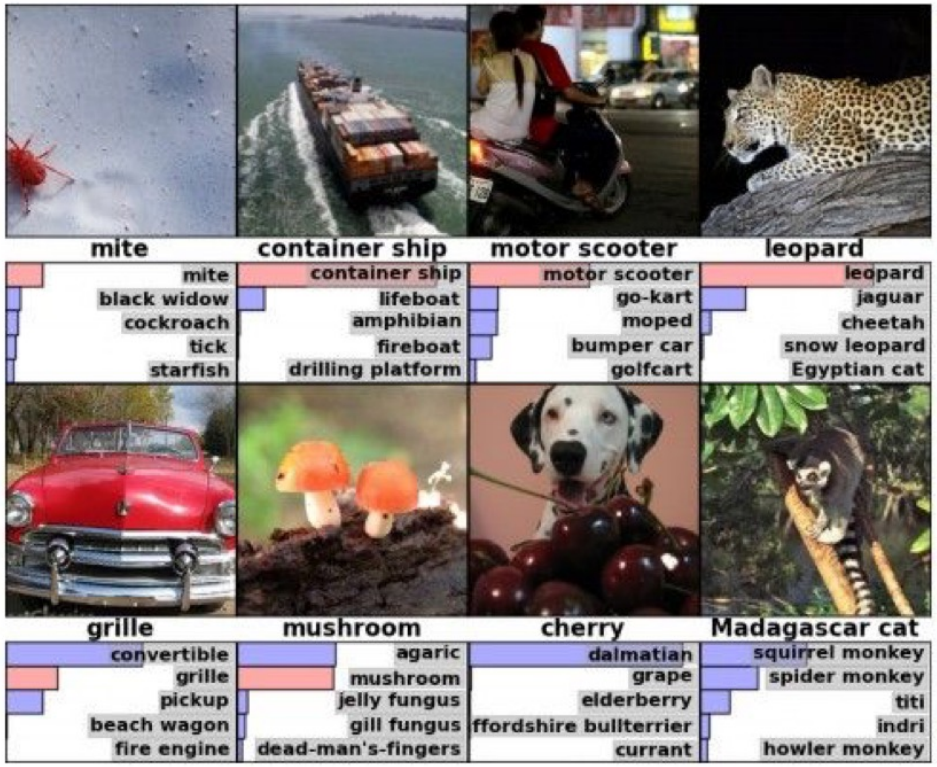
Chapter 2.2 I CNN 활용 예시

Classification



Clustering

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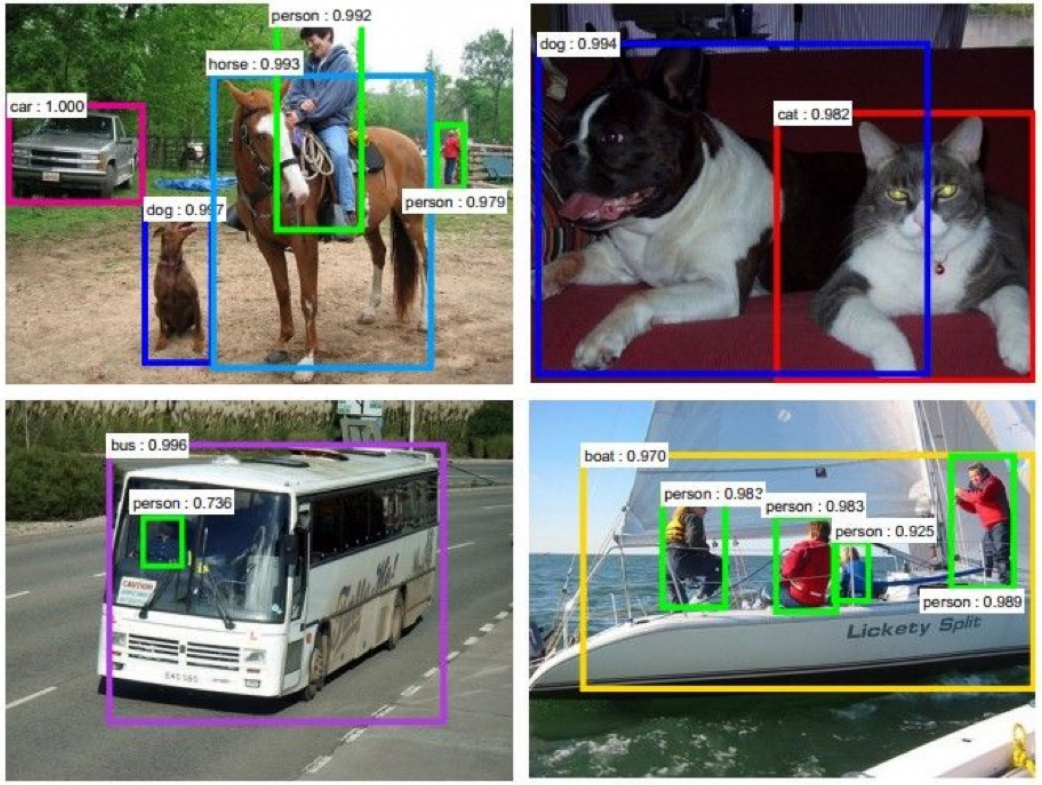
Chapter 2.2 I CNN 활용 예시

Detection



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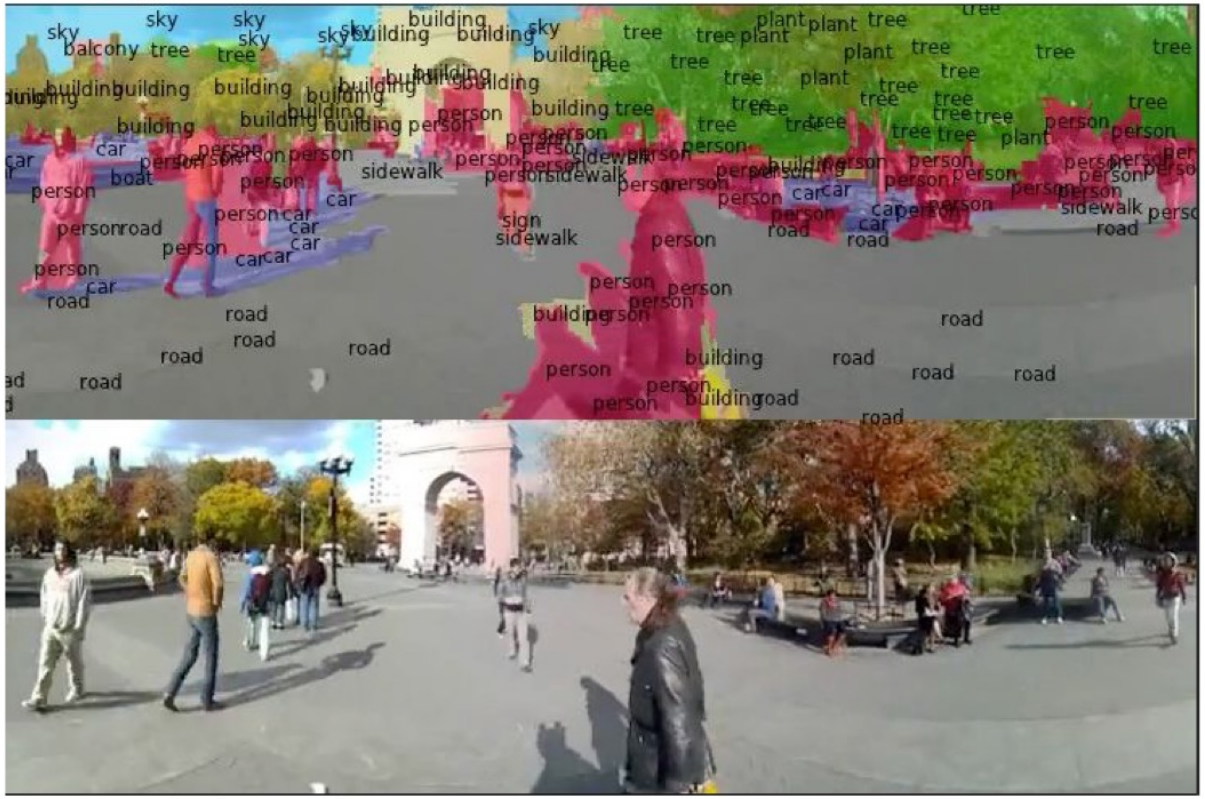
[Faster R-CNN: Ren, He, Girshick, Sun 2015]

Segmentation



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[Farabet et al., 2012]

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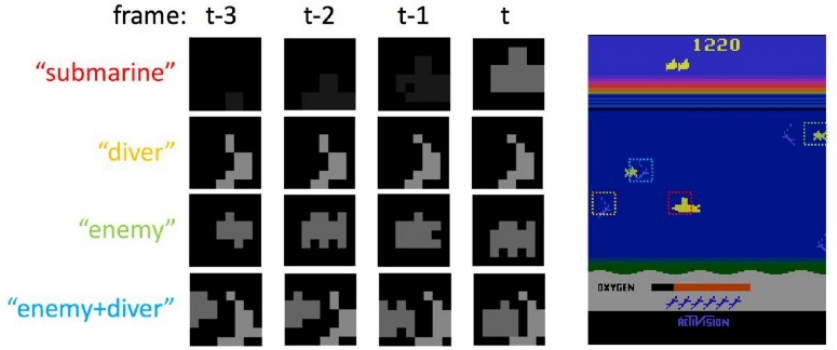
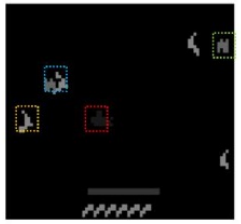
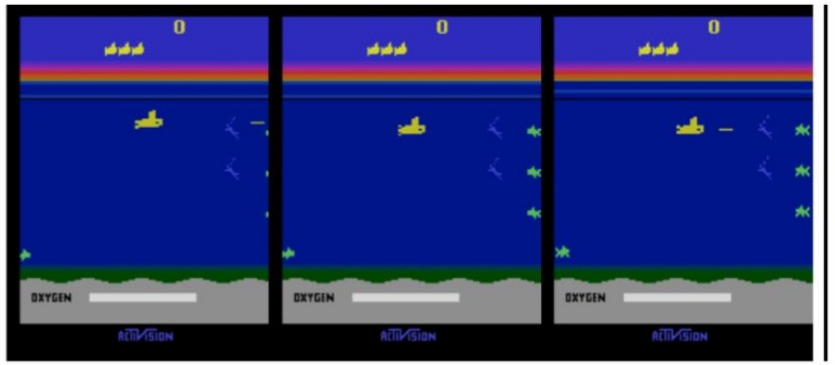
Chapter 2.2 I CNN 활용 예시

Images are examples of pose estimation, not actually from Toshev & Szegedy 2014. Copyright Lane McIntosh.

[Toshev, Szegedy 2014]







[Guo et al. 2014]

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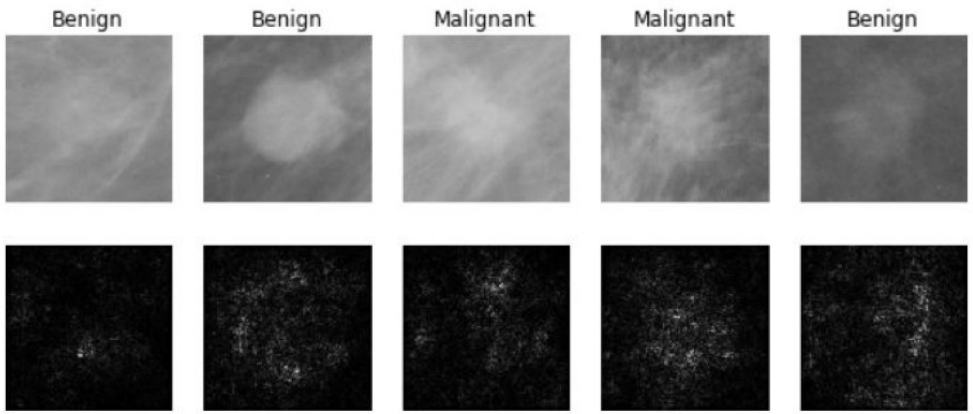
Chapter 2.2 I CNN 활용 예시



[Levy et al. 2016]

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[Dieleman et al. 2014]

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[Sermanet et al. 2011]
[Ciresan et al.]

Photos by Lane McIntosh.
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Chapter 2.2 I CNN 활용 예시

This image by Christin Khan is in the public domain and originally came from the U.S. NOAA.

Whale recognition, Kaggle Challenge

Photo and figure by Lane McIntosh; not actual example from Mnih and Hinton, 2010 paper.

Mnih and Hinton, 2010

Chapter 2.2 I CNN 활용 예시

No errors

A white teddy bear sitting in the grass

Minor errors

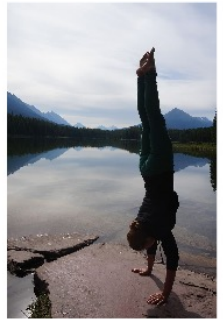
A man in a baseball uniform throwing a ball

Somewhat related

A woman is holding a cat in her hand

A man riding a wave on top of a surfboard

A cat sitting on a suitcase on the floor



A woman standing on a beach holding a surfboard

Image Captioning

[Vinyals et al., 2015]
[Karpathy and Fei-Fei, 2015]

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Captions generated by Justin Johnson using Neuraltalk2

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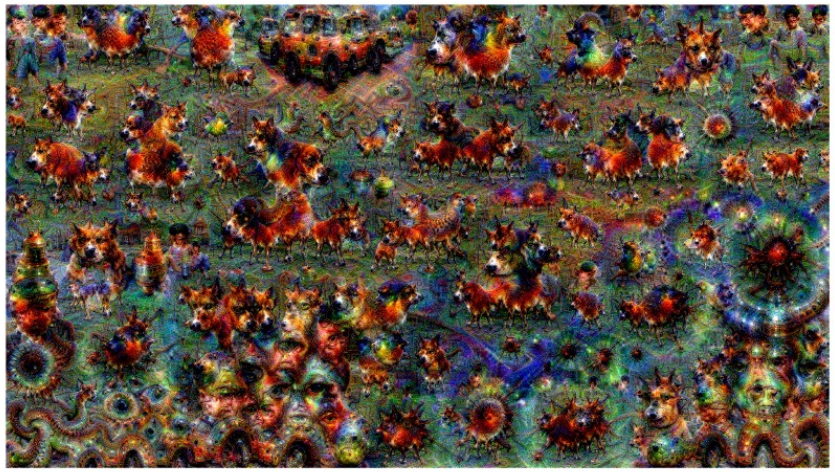
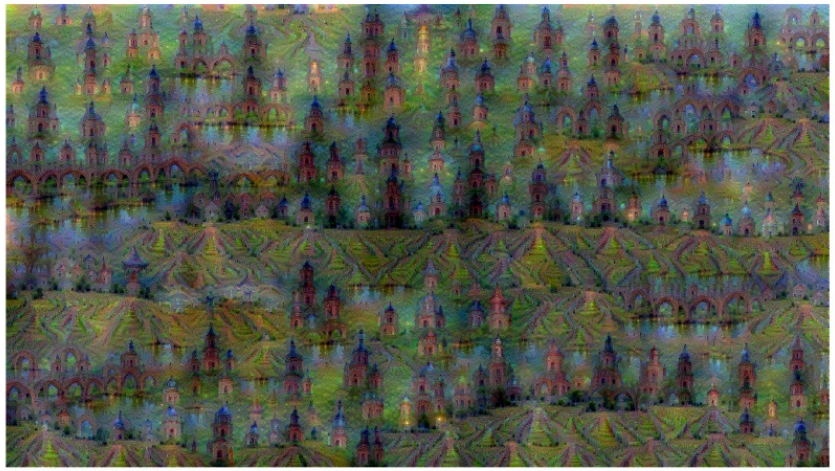
Chapter 2.2 I CNN 활용 예시





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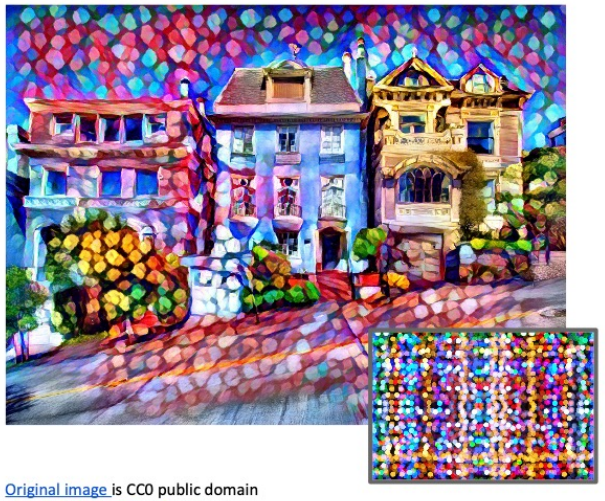

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Gatys et al, "Image Style Transfer using Convolutional Neural Networks", CVPR 2016
Gatys et al, "Controlling Perceptual Factors in Neural Style Transfer", CVPR 2017

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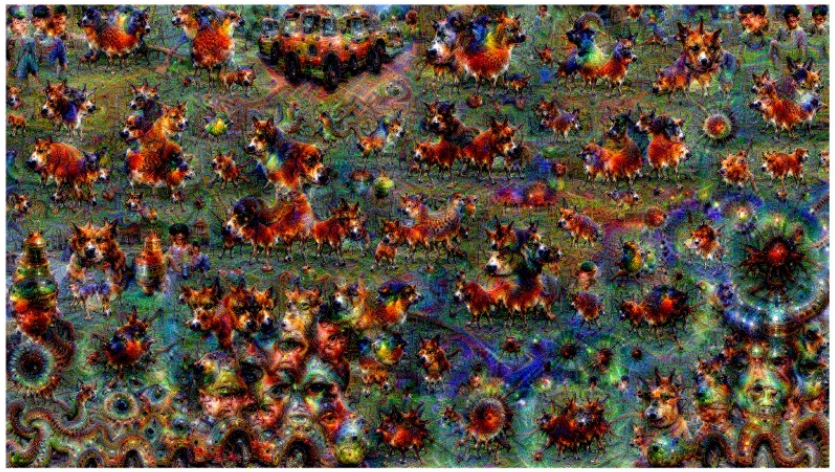
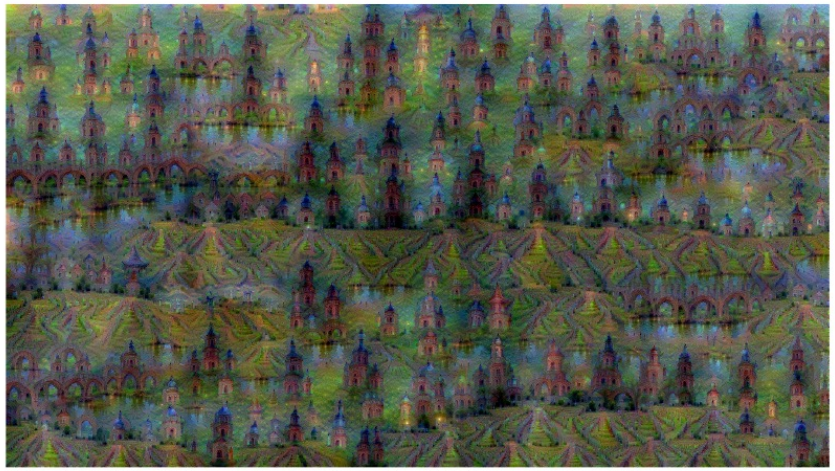
Chapter 2.2 I CNN 활용 예시





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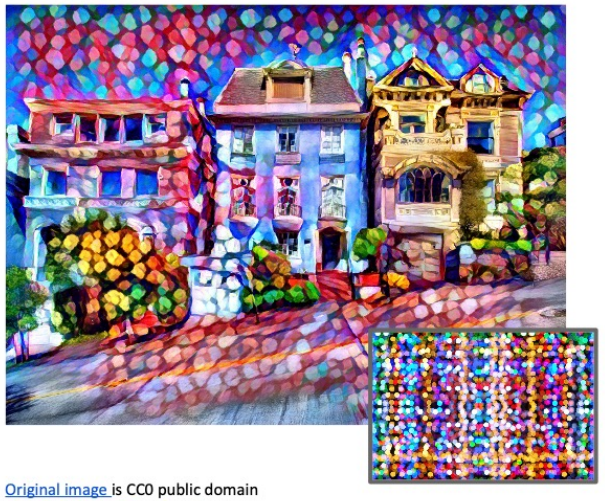

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Gatys et al, "Controlling Perceptual Factors in Neural Style Transfer", CVPR 2017

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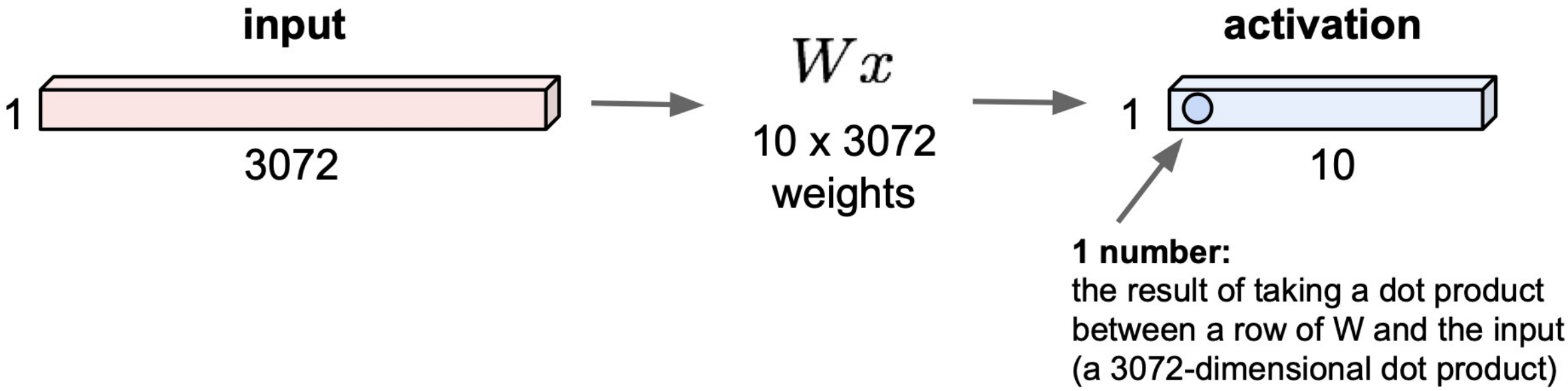
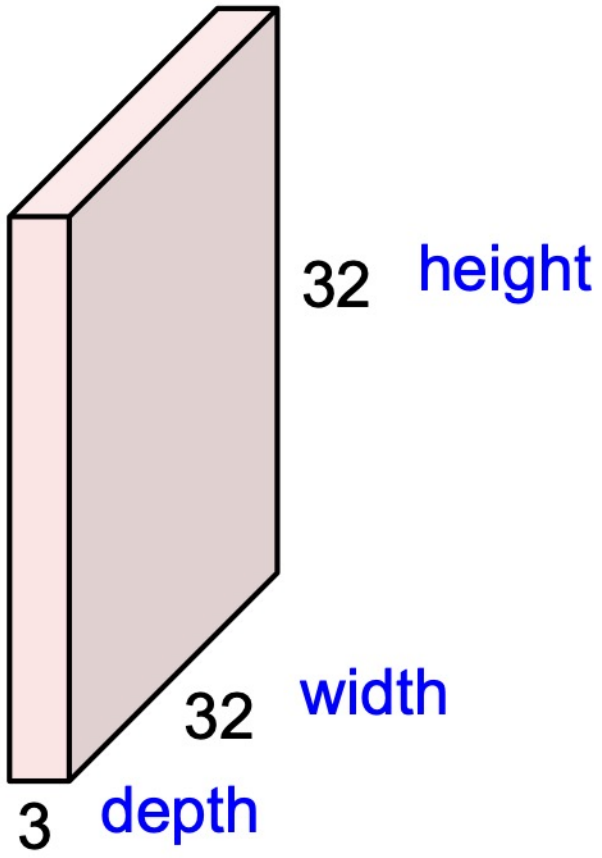
Chapter 2.3.1 l Fully Connected Layer

32x32x3 image -> stretch to 3072 x 1



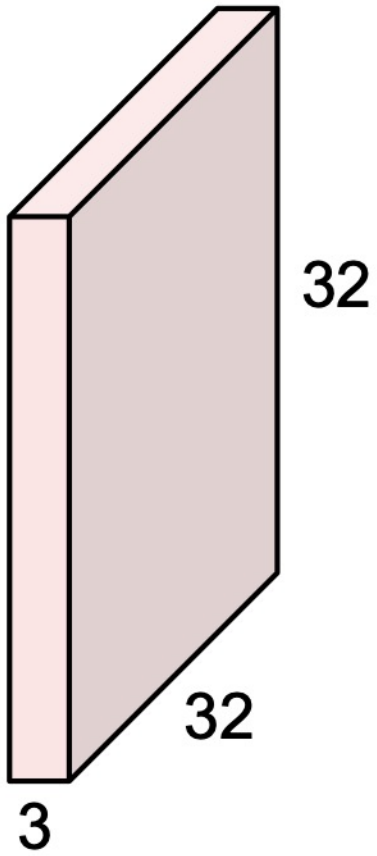
Chapter 2.3.2 l Convolutional Layer

32x32x3 image -> preserve spatial structure

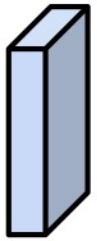


Chapter 2.3.2 l Convolutional Layer

32x32x3 image

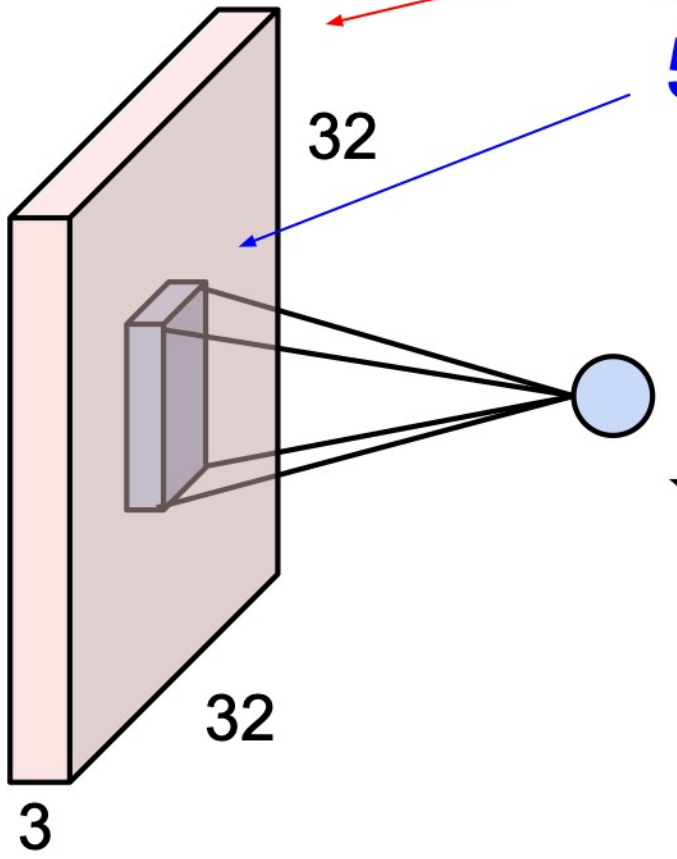


5x5x3 filter



Convolve the filter with the image
i.e. “slide over the image spatially,
computing dot products”

Chapter 2.3.2 l Convolutional Layer



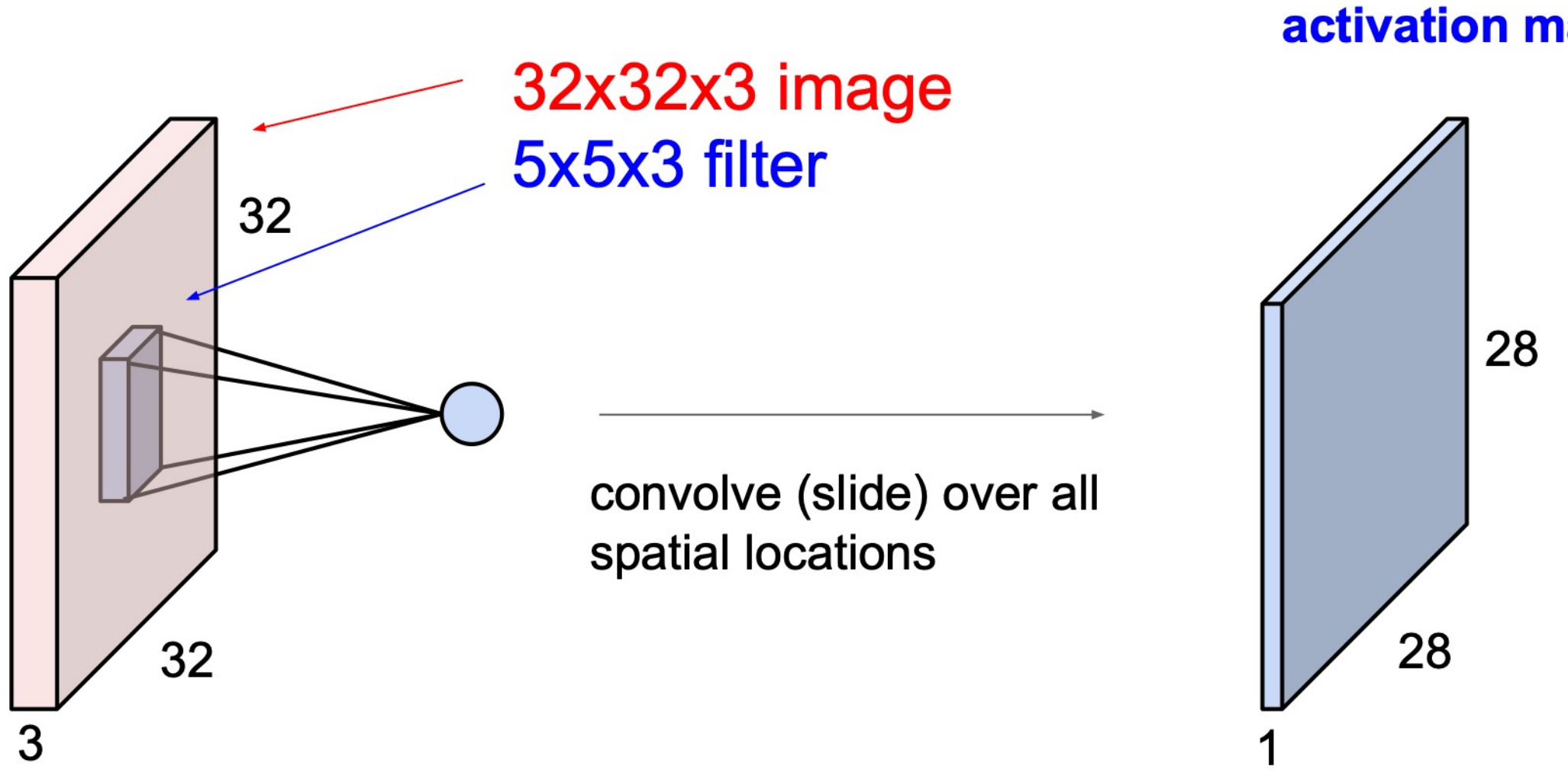
32x32x3 image

5x5x3 filter w

1 number:
the result of taking a dot product between the filter and a small 5x5x3 chunk of the image
(i.e. 5*5*3 = 75-dimensional dot product + bias)

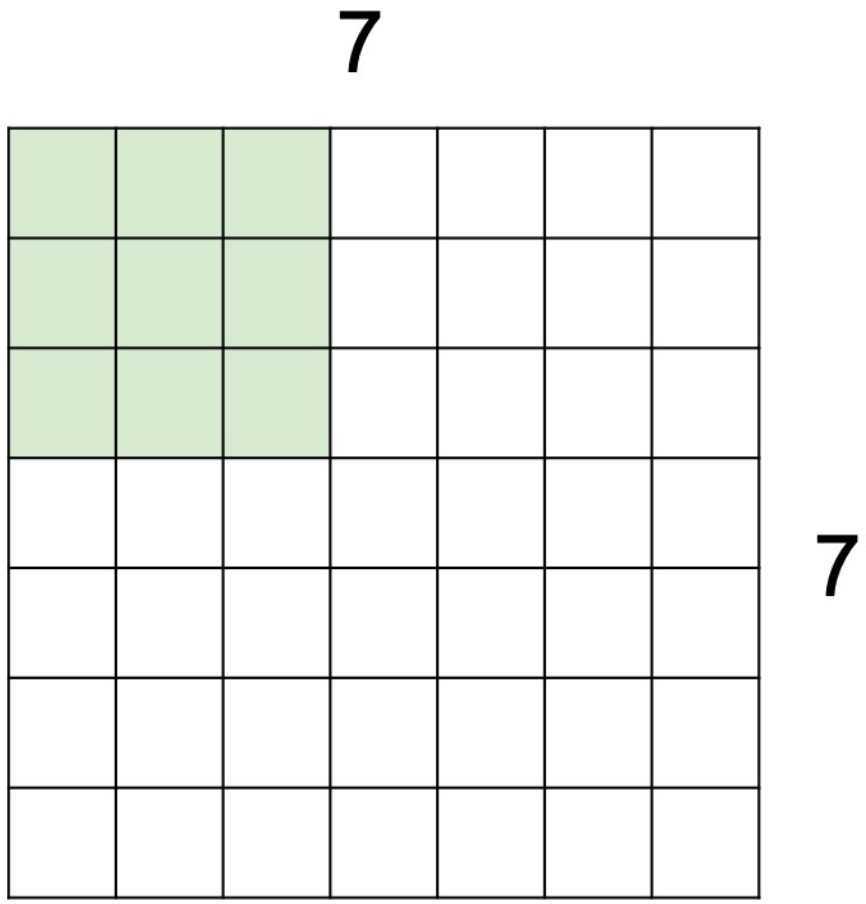
$$w^T x + b$$

Chapter 2.3.3 l Activation Map



Chapter 2.3.3.1 l Activation Map in Toy Example

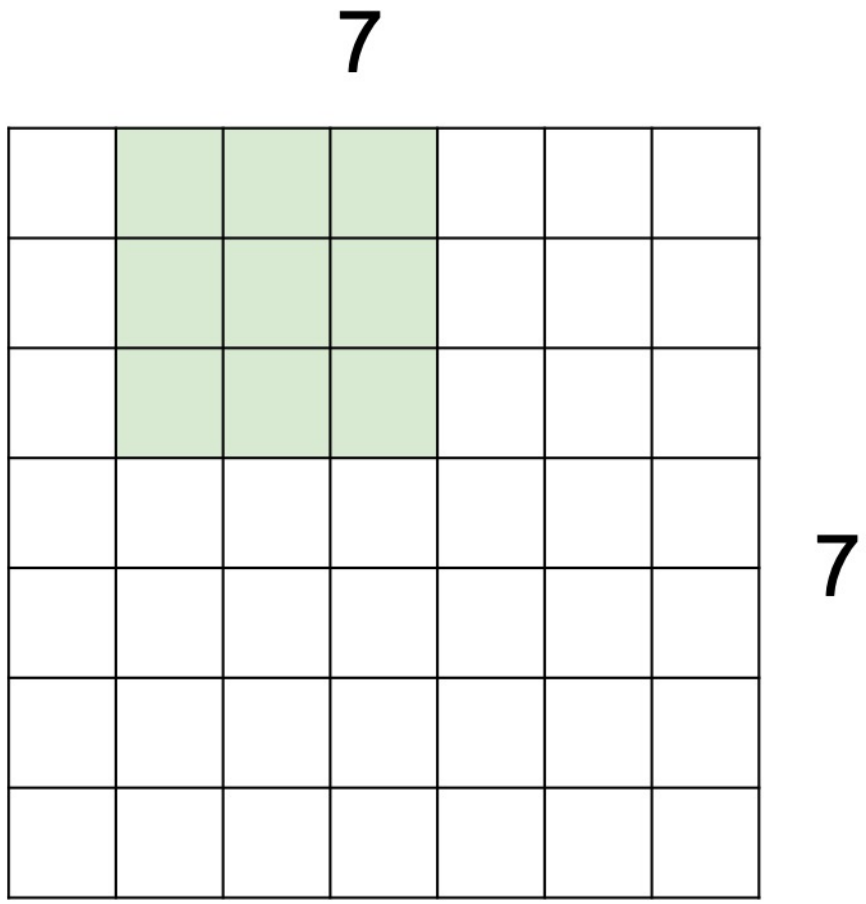
A closer look at spatial dimensions:



7x7 input (spatially)
assume 3x3 filter

Chapter 2.3.3.1 l Activation Map in Toy Example

A closer look at spatial dimensions:



7x7 input (spatially)
assume 3x3 filter

Chapter 2.3.3.1 l Activation Map in Toy Example

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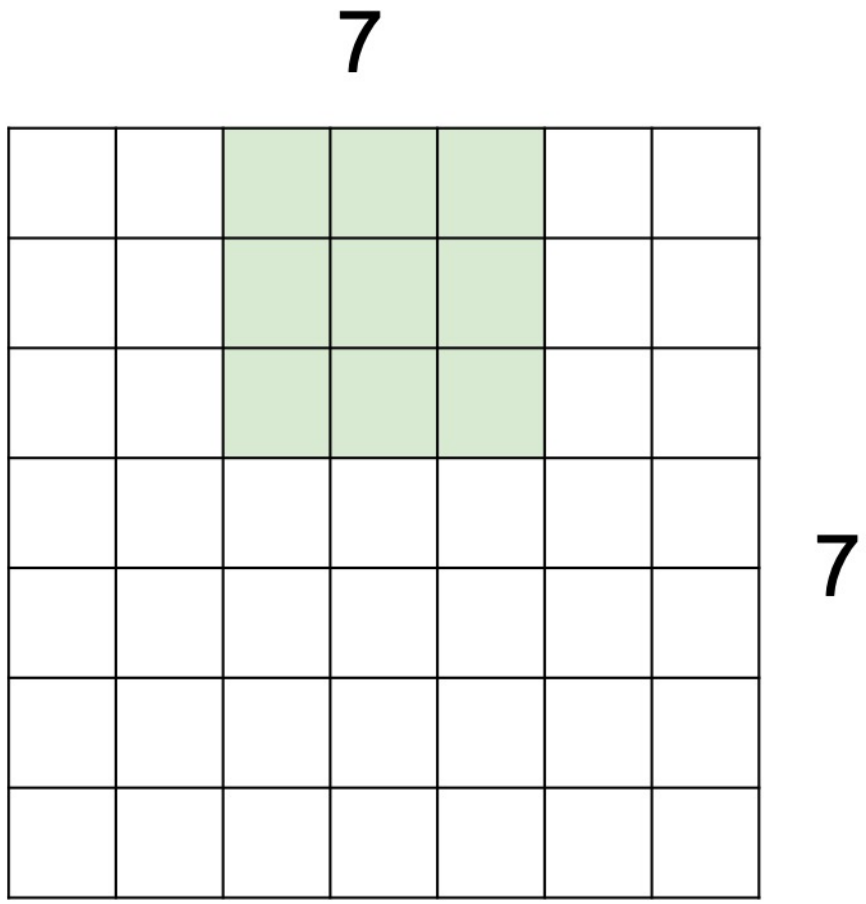

7x7 input (spatially)
assume 3x3 filter

Chapter 2.3.3.1 l Activation Map in Toy Example

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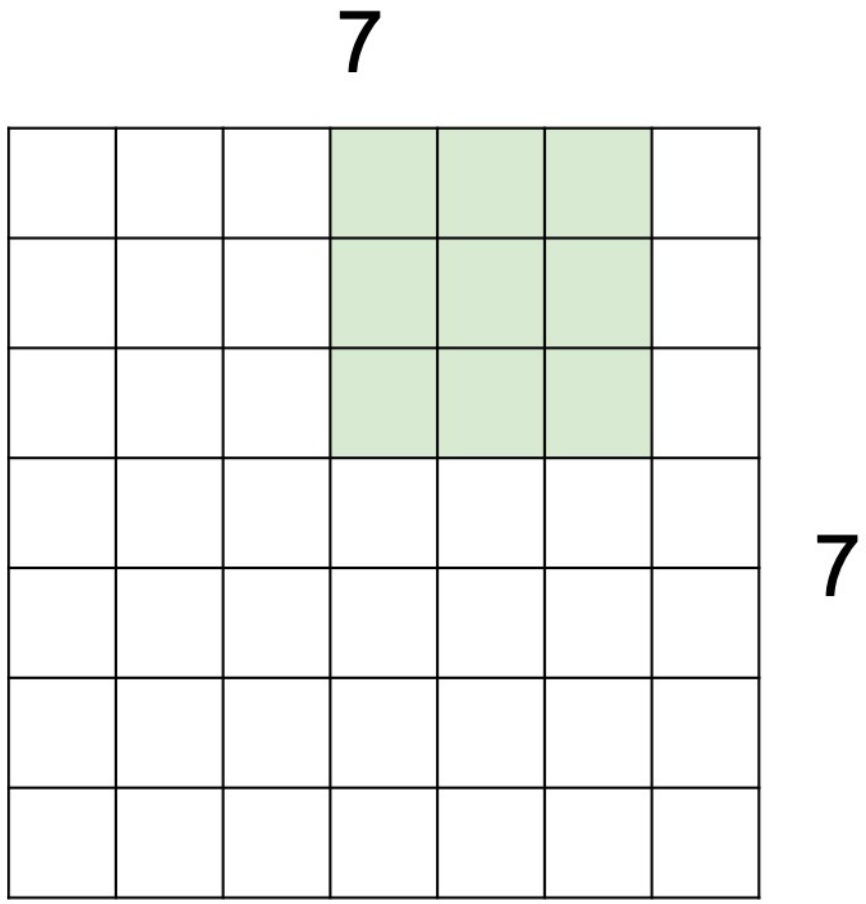
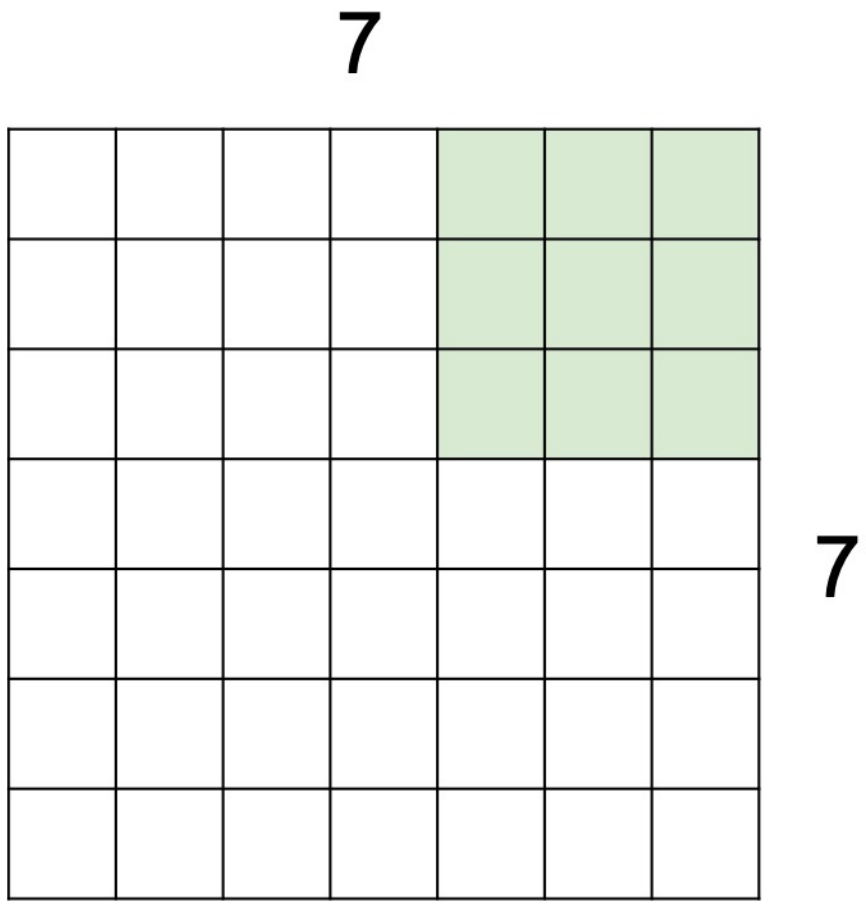


7x7 input (spatially)
assume 3x3 filter

Chapter 2.3.3.1 | Activation Map in Toy Example

A closer look at spatial dimensions:

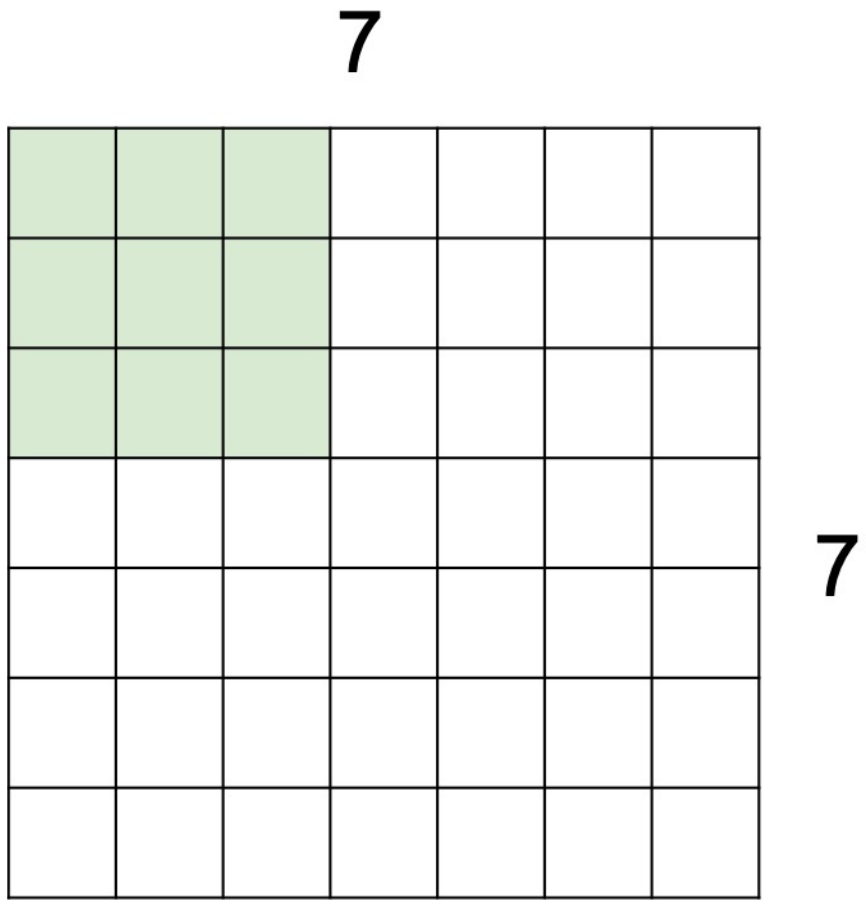


7x7 input (spatially)
assume 3x3 filter

=> 5x5 output

Chapter 2.3.3.1 l Activation Map in Toy Example

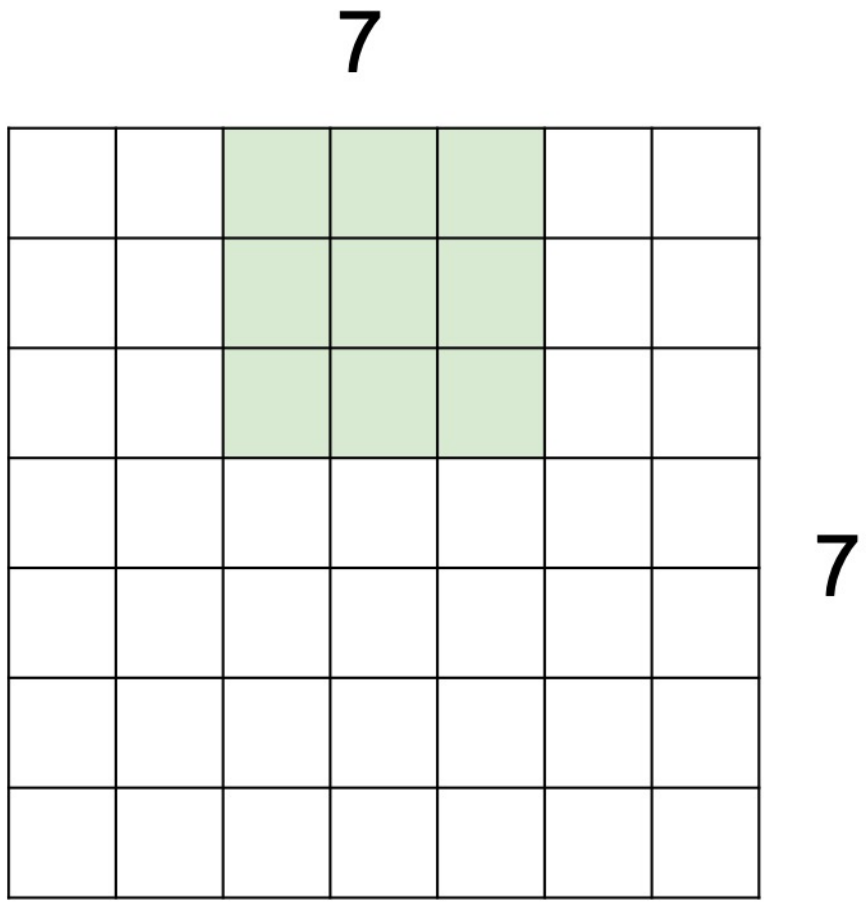
A closer look at spatial dimensions:



7x7 input (spatially)
assume 3x3 filter
applied **with stride 2**

Chapter 2.3.3.1 l Activation Map in Toy Example

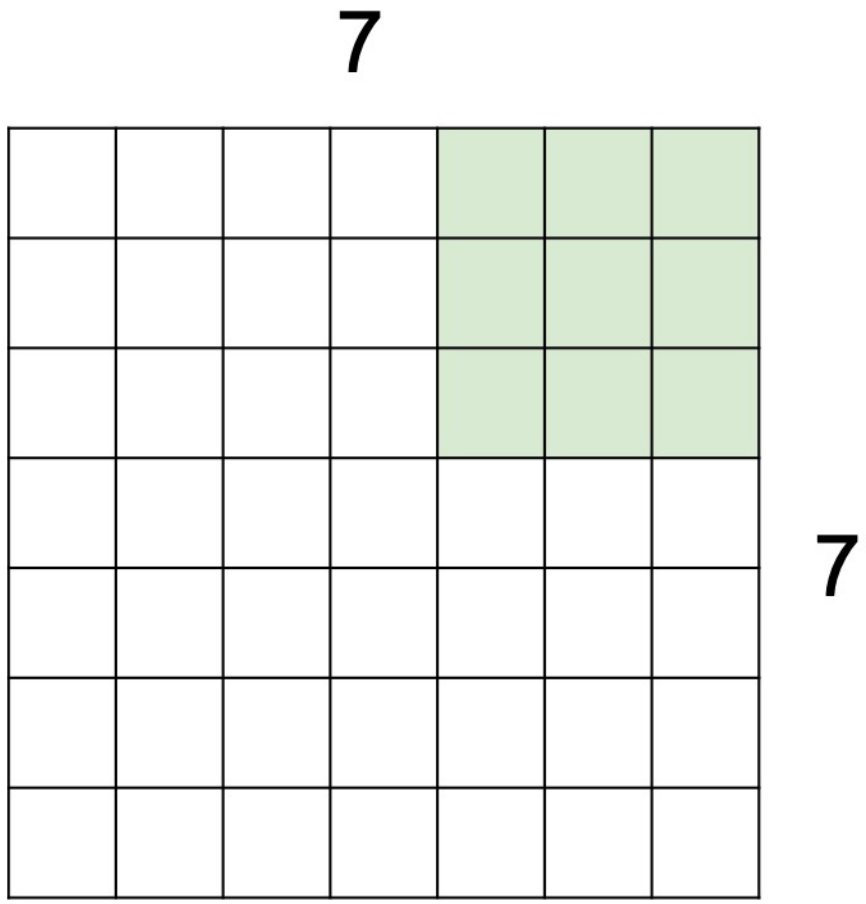
A closer look at spatial dimensions:



7x7 input (spatially)
assume 3x3 filter
applied **with stride 2**

Chapter 2.3.3.1 | Activation Map in Toy Example

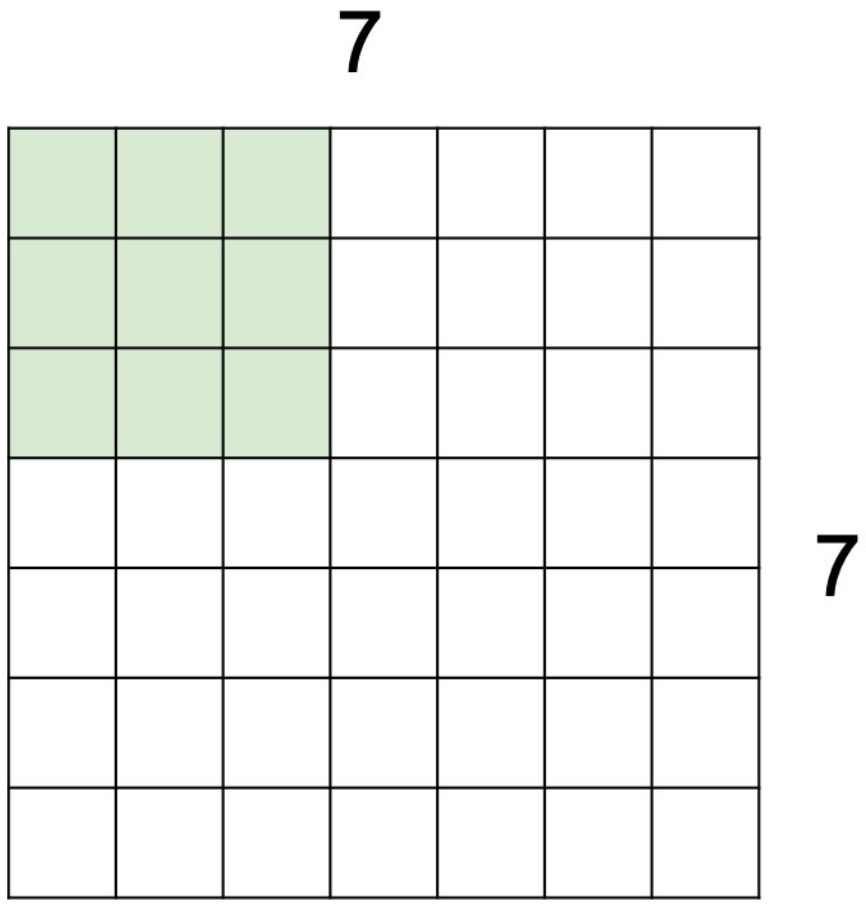
A closer look at spatial dimensions:



7x7 input (spatially)
assume 3x3 filter
applied **with stride 2**
=> 3x3 output!

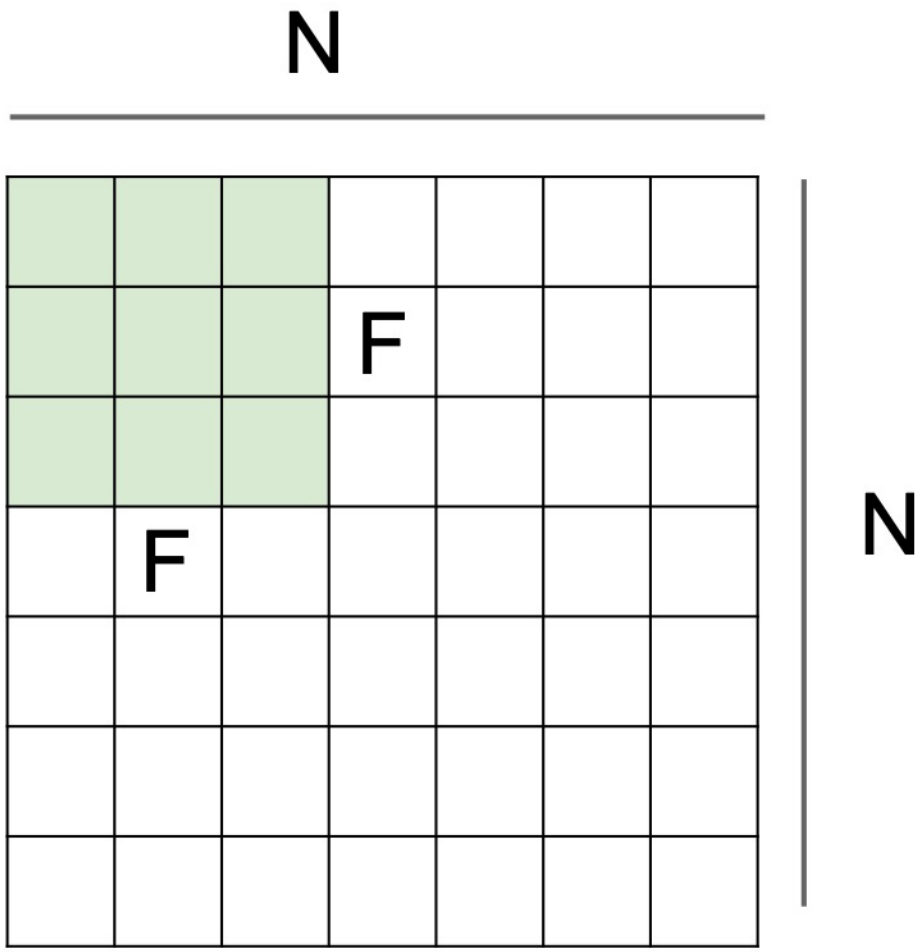
Chapter 2.3.3.1 l Activation Map in Toy Example

A closer look at spatial dimensions:



7x7 input (spatially)
assume 3x3 filter
applied **with stride 3?**

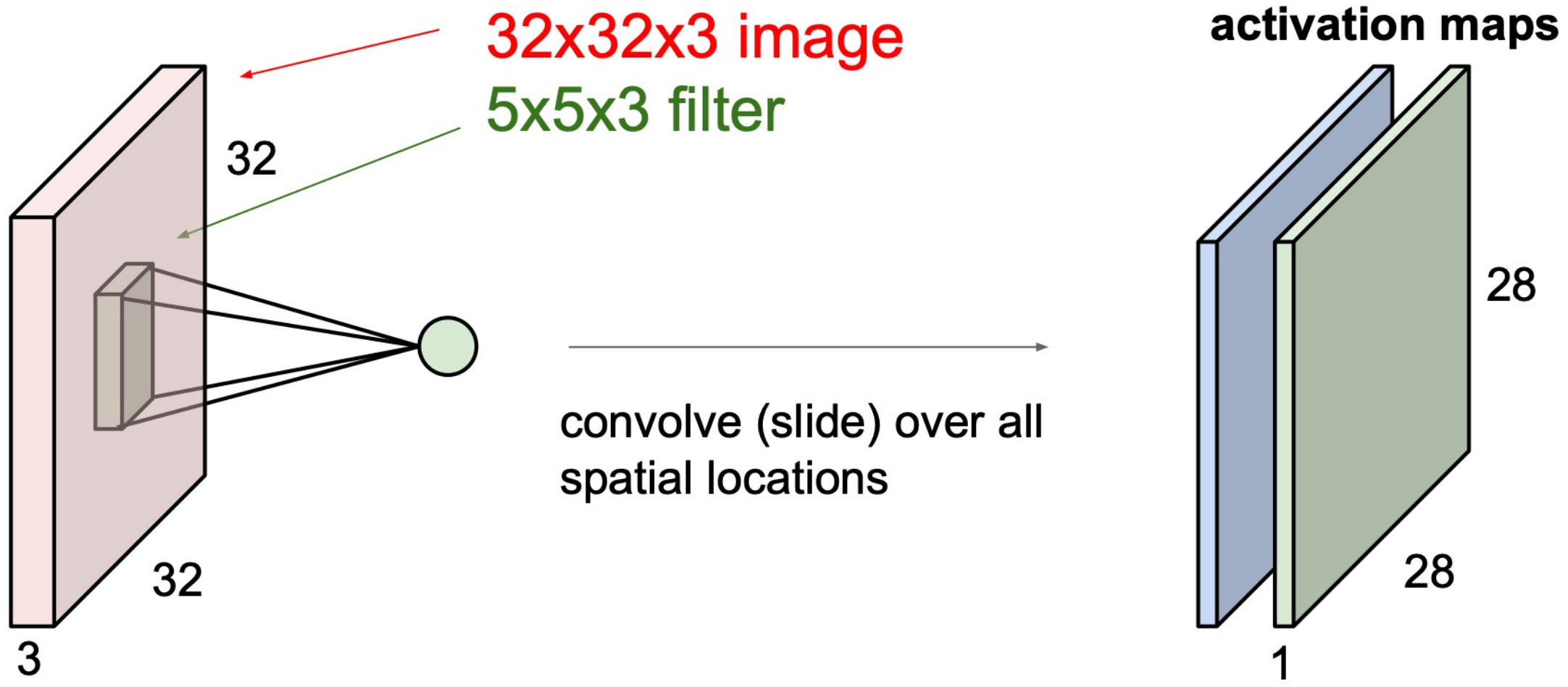
Chapter 2.3.3.1 I Activation Map in Toy Example



Output size:
(N - F) / stride + 1

e.g. N = 7, F = 3:
stride 1 => (7 - 3)/1 + 1 = 5
stride 2 => (7 - 3)/2 + 1 = 3
stride 3 => (7 - 3)/3 + 1 = 2.33 :\

Chapter 2.3.3 l Activation Map



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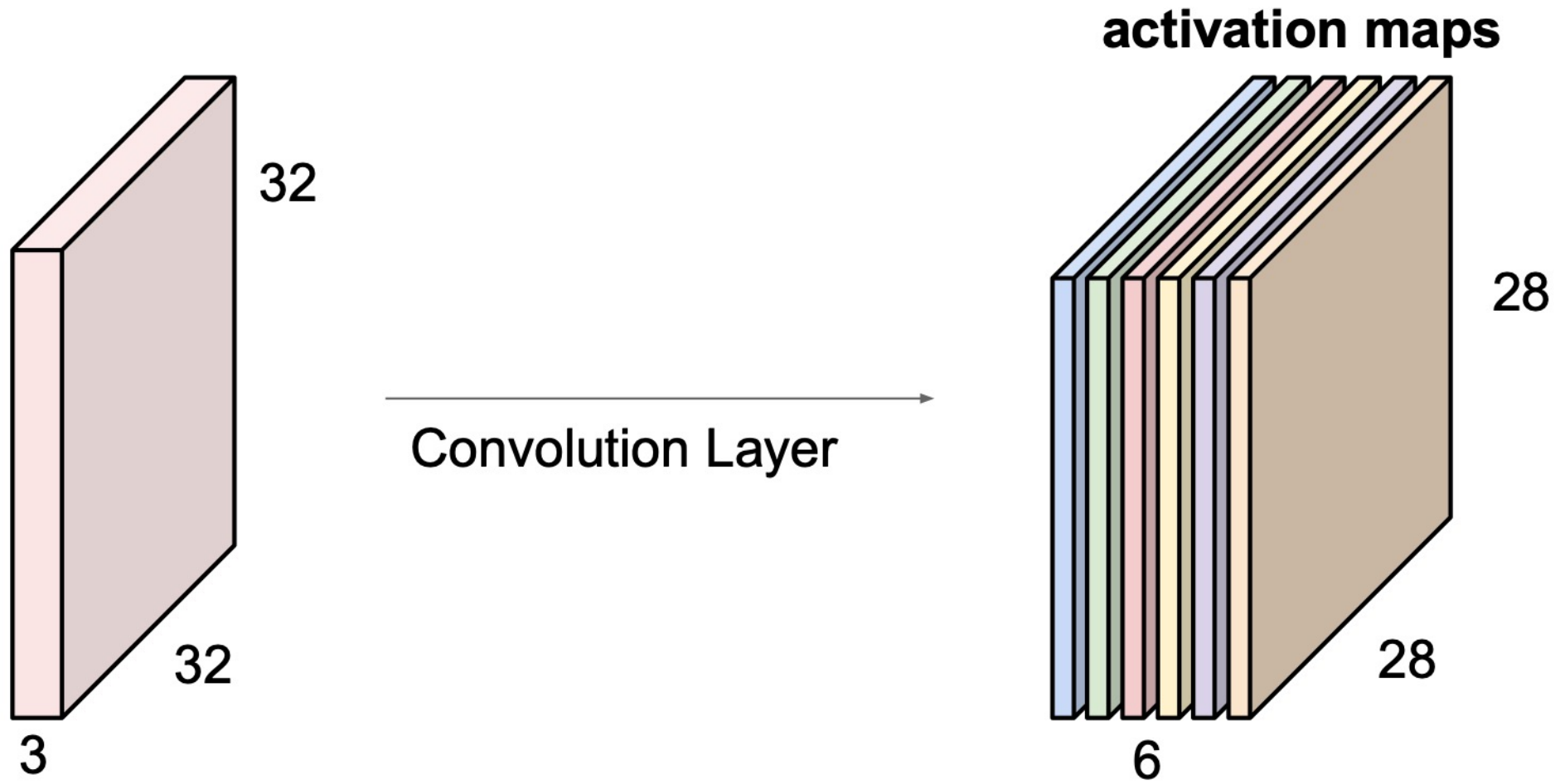
Chapter 2.3.3 l Activation Map



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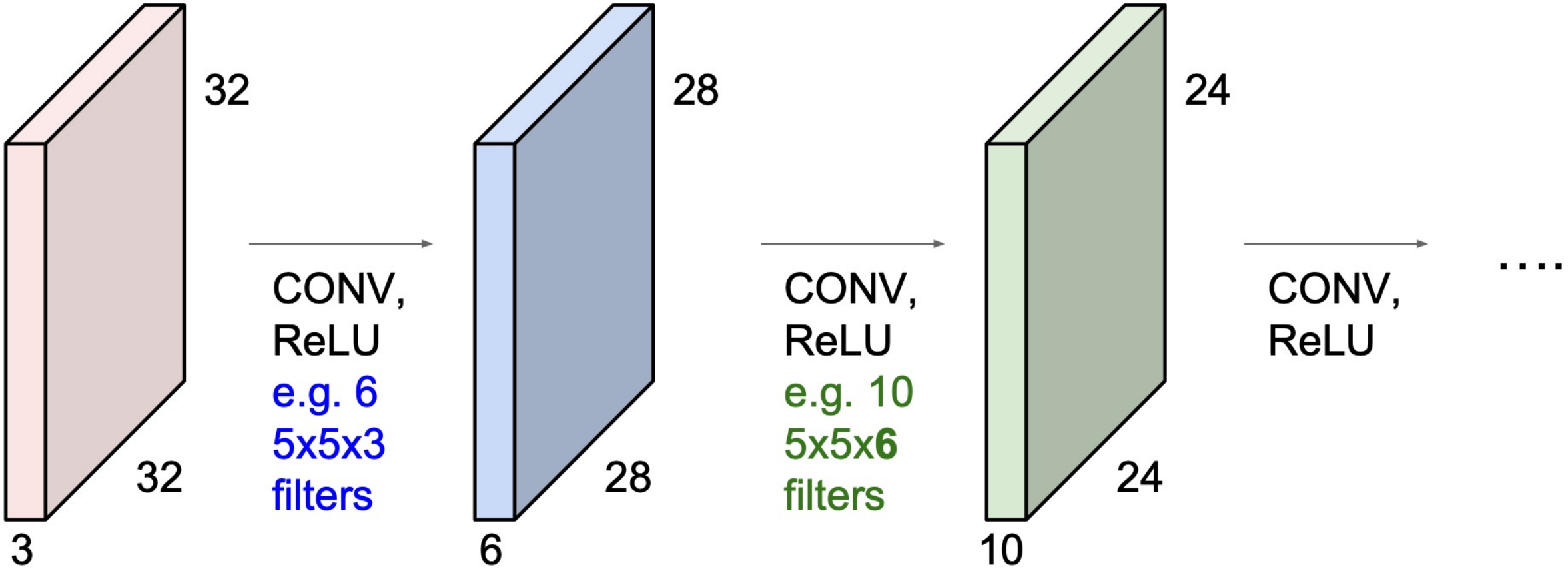
Chapter 2.4 I Convnet 구조



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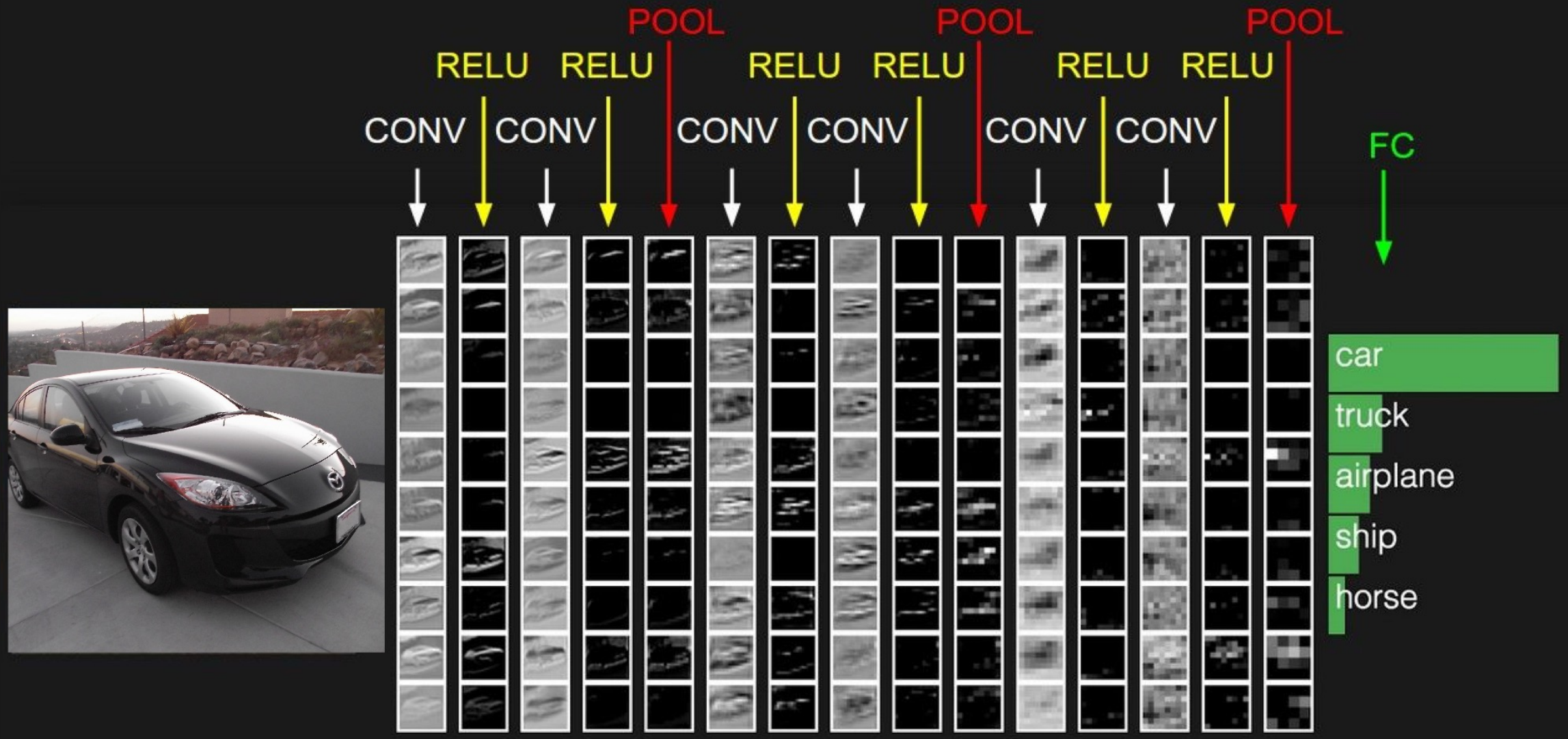
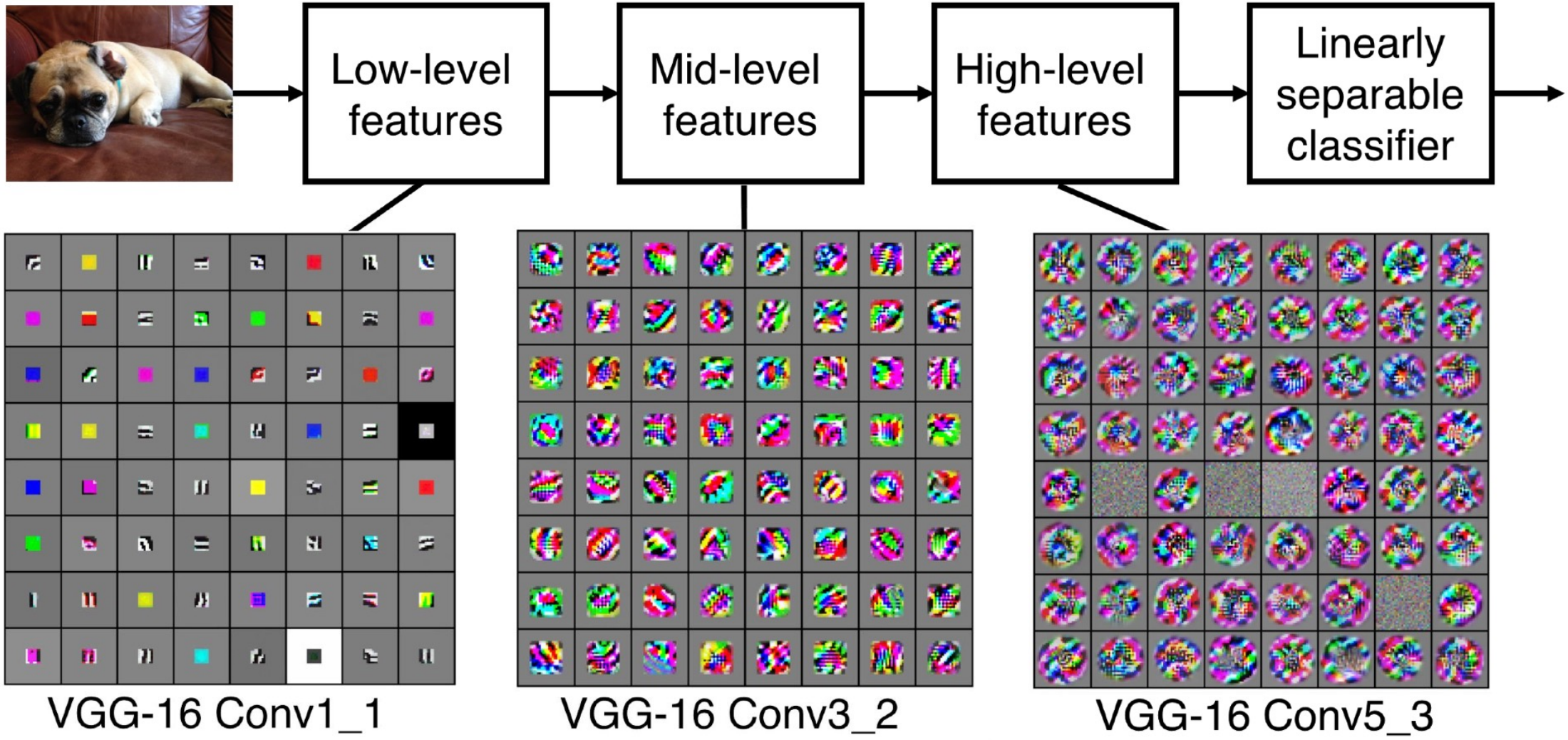
Chapter 2.4 I Convnet 구조



Chapter 2.4 I Convnet 구조



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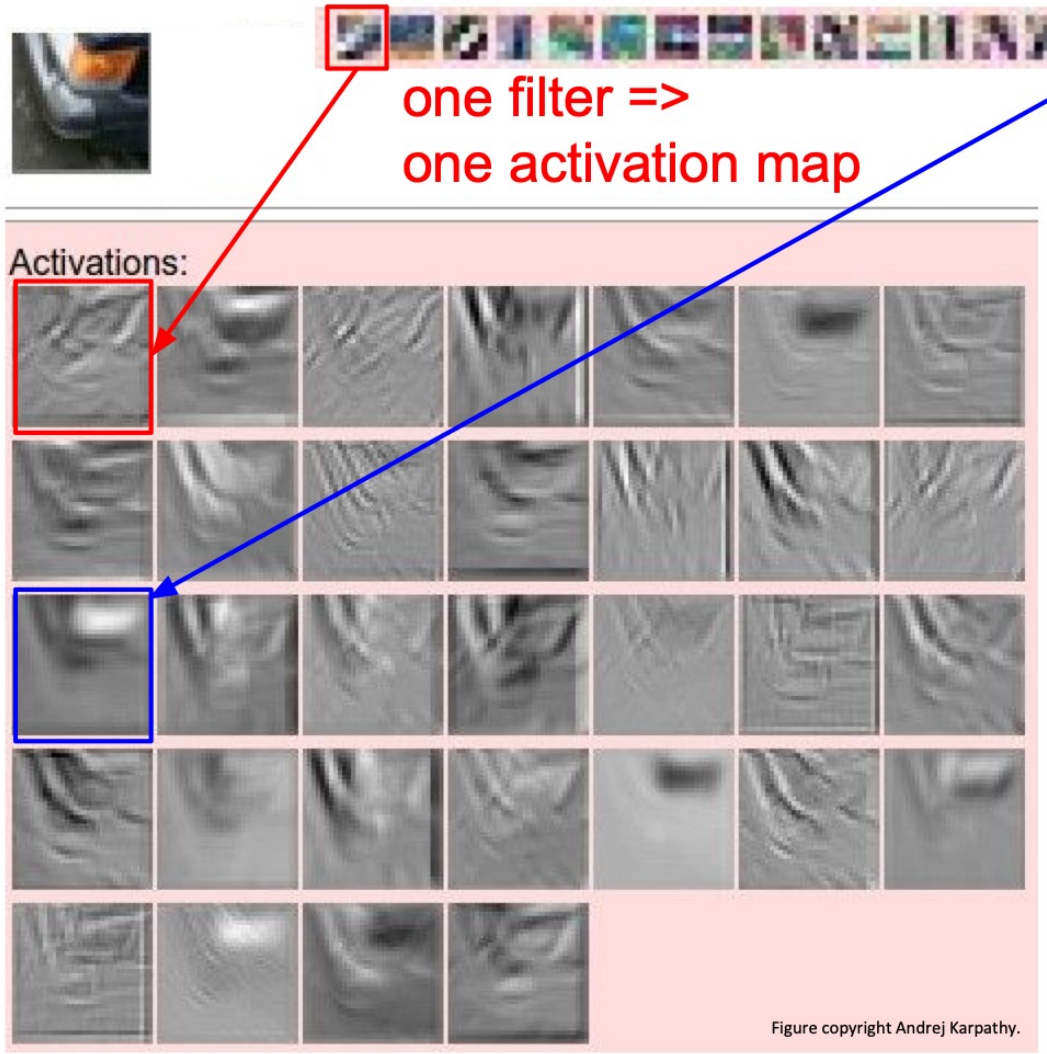
Chapter 2.5 I Activation Preview



example 5x5 filters
(32 total)

We call the layer convolutional because it is related to convolution of two signals:

$$f[x,y] * g[x,y] = \sum_{n_1=-\infty}^{\infty} \sum_{n_2=-\infty}^{\infty} f[n_1,n_2] \cdot g[x-n_1, y-n_2]$$

elementwise multiplication and sum of a filter and the signal (image)

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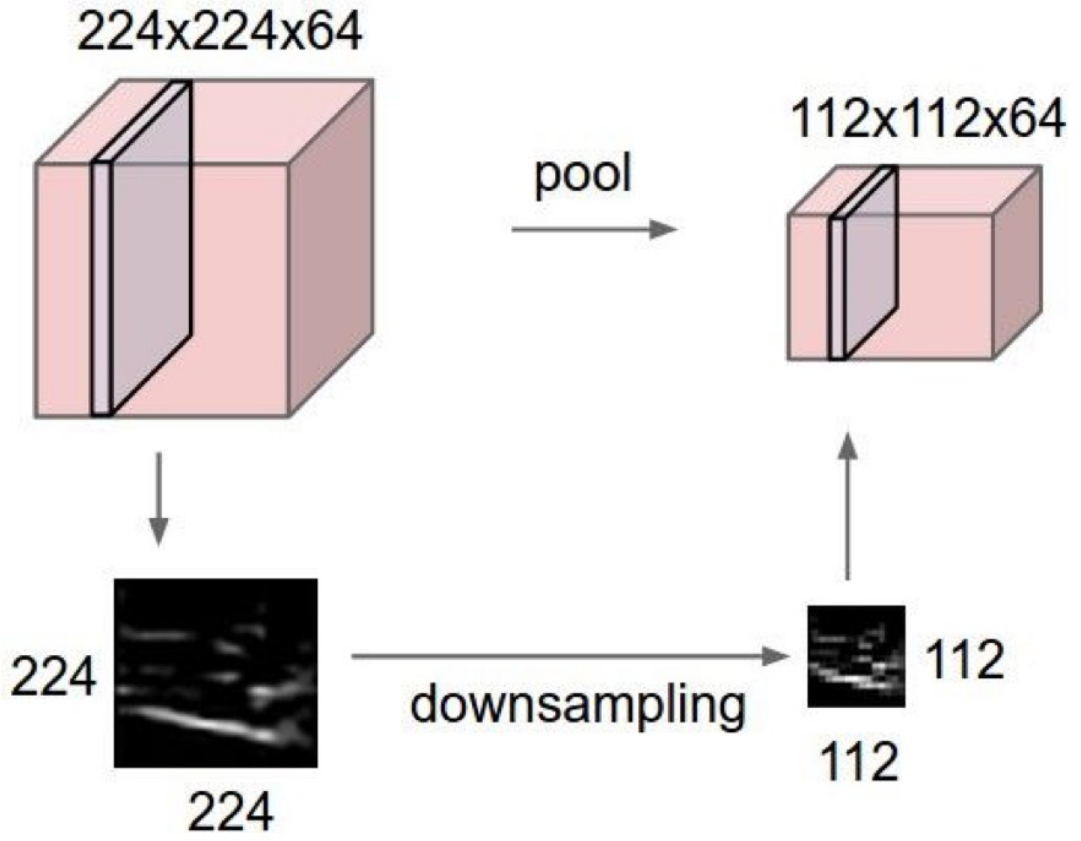
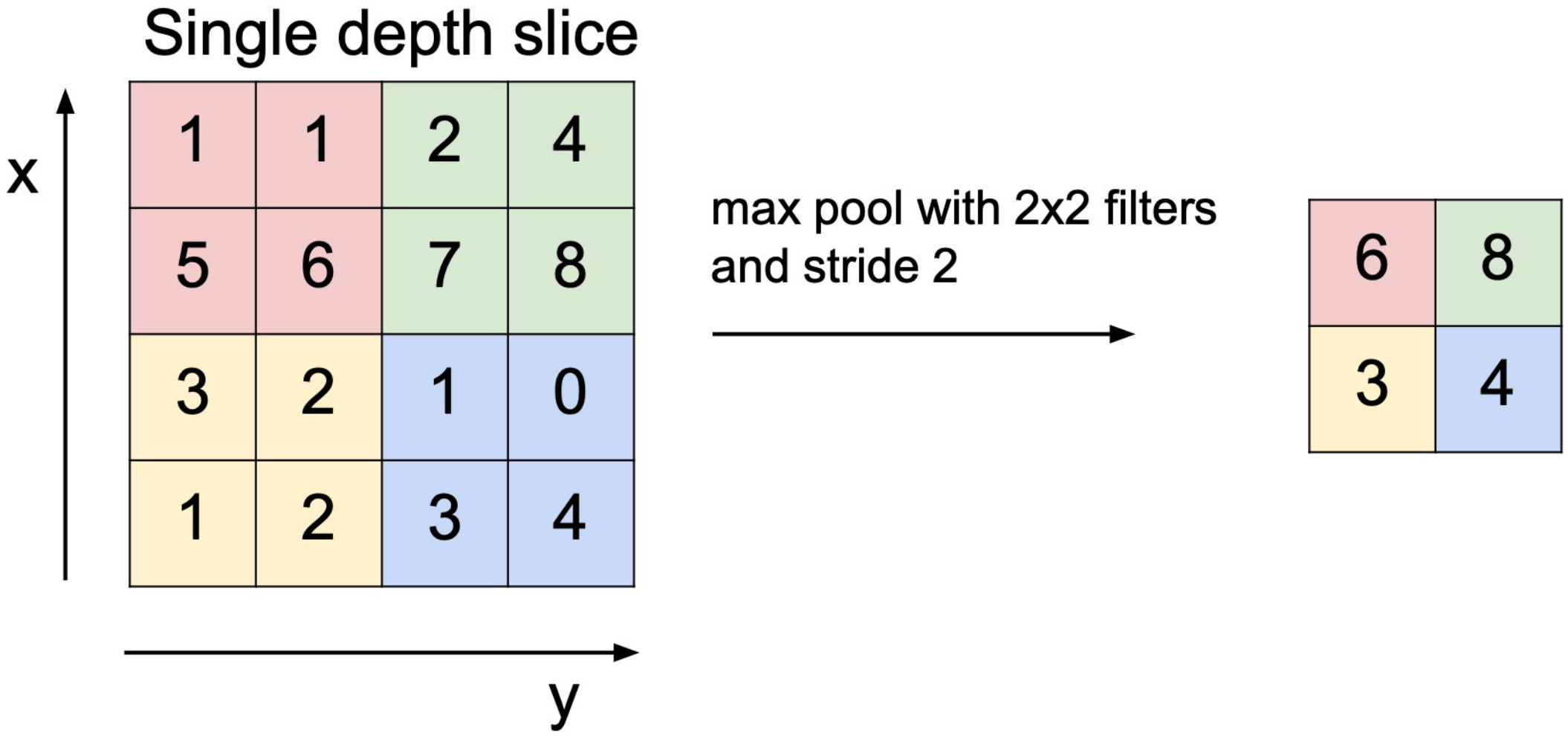
Chapter 2.6.1 l Pooling

- makes the representations smaller and more manageable
- operates over each activation map independently:



Chapter 2.6.2 l Max Pooling



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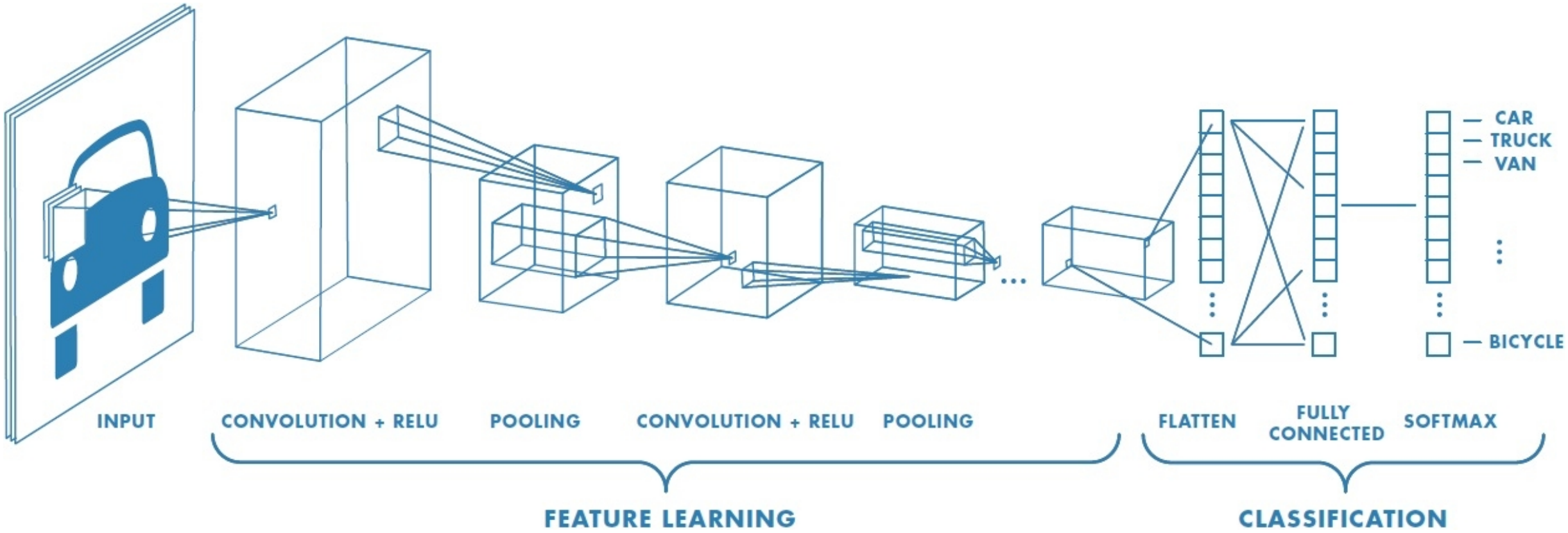
Chapter 2.7 I Convnet 전체 과정



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Chapter 3

실전 툴

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Chapter 3.1 I 딥러닝 툴 발전 개요 (2016)

Caffe
(UC Berkeley)

Torch
(NYU / Facebook)

Theano
(U Montreal)

TensorFlow
(Google)

Chapter 3.1 I 딥러닝 툴 발전 개요 (2018)

Caffe
(UC Berkeley)

Caffe2
(Facebook)

Torch
(NYU / Facebook)

PyTorch
(Facebook)

Theano
(U Montreal)

TensorFlow
(Google)

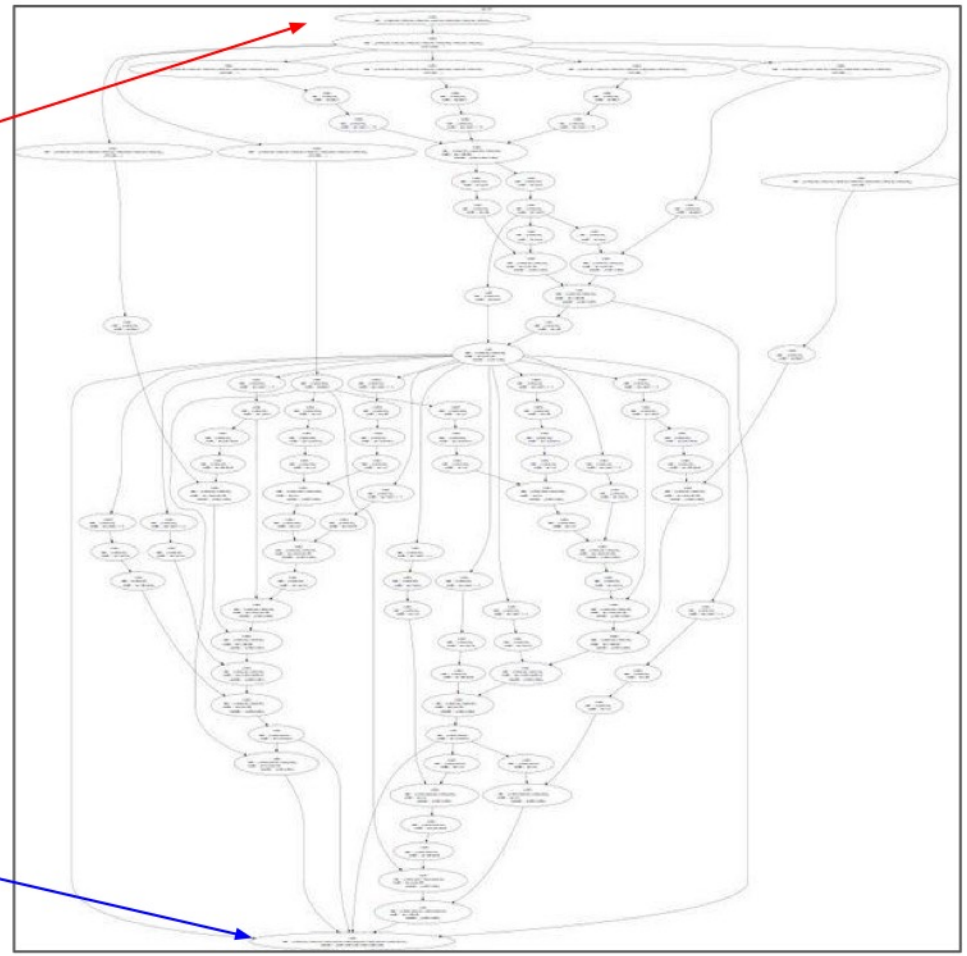
CNTK
(Microsoft)

MXNet
(Amazon)
Developed by U Washington, CMU, MIT, Hong Kong U, etc but main framework of choice at AWS

Chapter 3.2 I Computational Graph 표현

input image

loss



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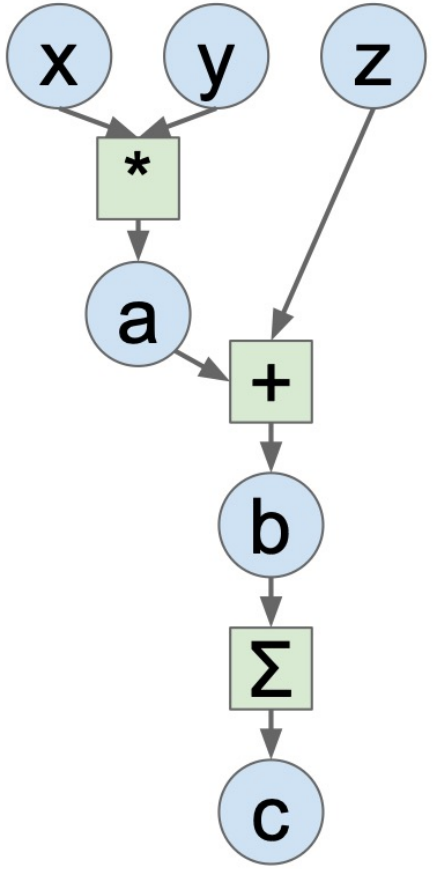
Chapter 3.3 I Numpy

Numpy

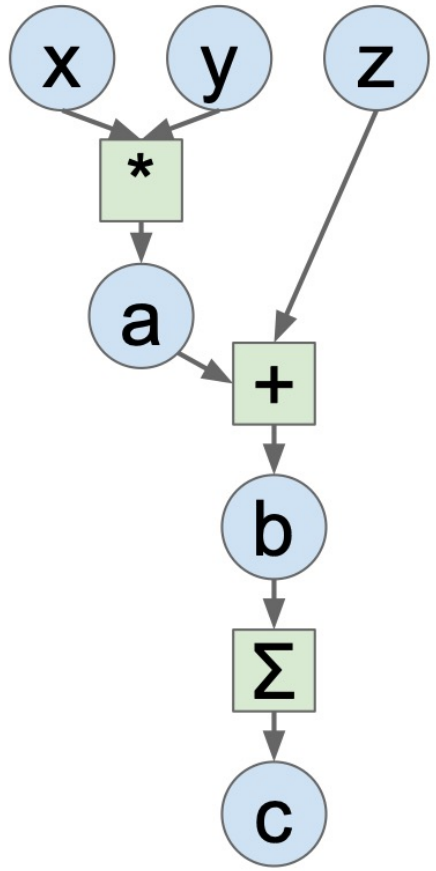
```
import numpy as np
np.random.seed(0)

N, D = 3, 4

x = np.random.randn(N, D)
y = np.random.randn(N, D)
z = np.random.randn(N, D)

a = x * y
b = a + z
c = np.sum(b)

grad_c = 1.0
grad_b = grad_c * np.ones((N, D))
grad_a = grad_b.copy()
grad_z = grad_b.copy()
grad_x = grad_a * y
grad_y = grad_a * x
```



Chapter 3.3 I Numpy

Numpy

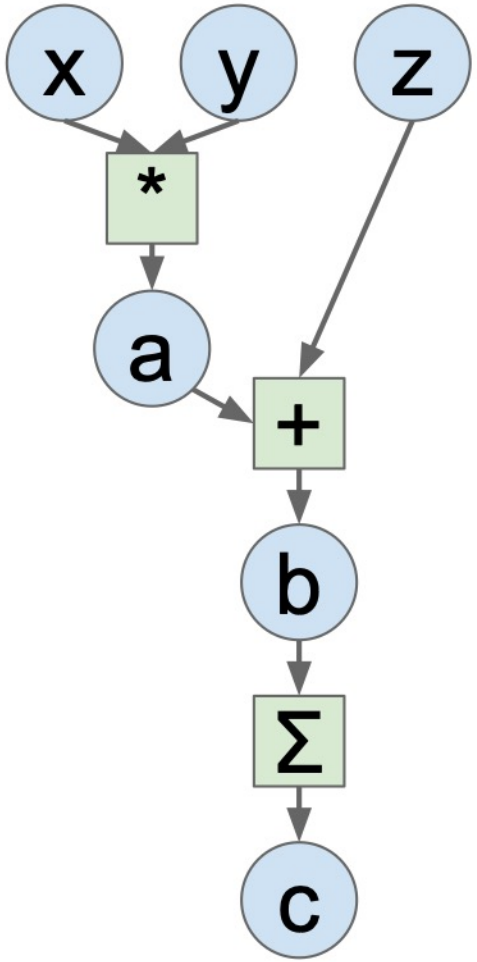
```
import numpy as np
np.random.seed(0)

N, D = 3, 4

x = np.random.randn(N, D)
y = np.random.randn(N, D)
z = np.random.randn(N, D)

a = x * y
b = a + z
c = np.sum(b)

grad_c = 1.0
grad_b = grad_c * np.ones((N, D))
grad_a = grad_b.copy()
grad_z = grad_b.copy()
grad_x = grad_a * y
grad_y = grad_a * x
```



Problems:

- Can't run on GPU
- Have to compute our own gradients

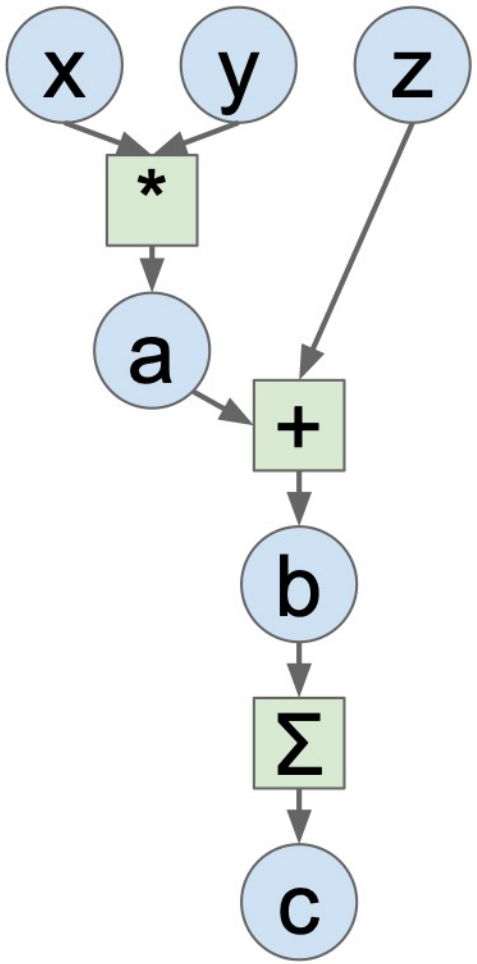
Chapter 3.4 I PyTorch



Define **Variables** to start building a computational graph

```
import torch
from torch.autograd import Variable

N, D = 3, 4

x = Variable(torch.randn(N, D),
             requires_grad=True)
y = Variable(torch.randn(N, D),
             requires_grad=True)
z = Variable(torch.randn(N, D),
             requires_grad=True)

a = x * y
b = a + z
c = torch.sum(b)

c.backward()

print(x.grad.data)
print(y.grad.data)
print(z.grad.data)
```

Chapter 3.4 I PyTorch



Forward pass looks just like numpy

```
import torch
from torch.autograd import Variable

N, D = 3, 4

x = Variable(torch.randn(N, D),
             requires_grad=True)
y = Variable(torch.randn(N, D),
             requires_grad=True)
z = Variable(torch.randn(N, D),
             requires_grad=True)

a = x * y
b = a + z
c = torch.sum(b)

c.backward()

print(x.grad.data)
print(y.grad.data)
print(z.grad.data)
```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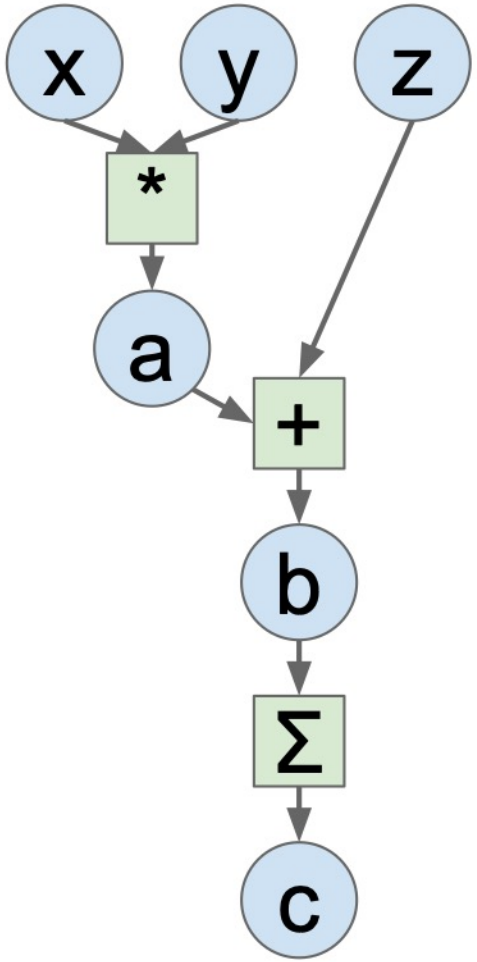
Chapter 3.4 I PyTorch



Calling c.backward() computes all gradients

```
import torch
from torch.autograd import Variable

N, D = 3, 4

x = Variable(torch.randn(N, D),
             requires_grad=True)
y = Variable(torch.randn(N, D),
             requires_grad=True)
z = Variable(torch.randn(N, D),
             requires_grad=True)

a = x * y
b = a + z
c = torch.sum(b)

c.backward()

print(x.grad.data)
print(y.grad.data)
print(z.grad.data)
```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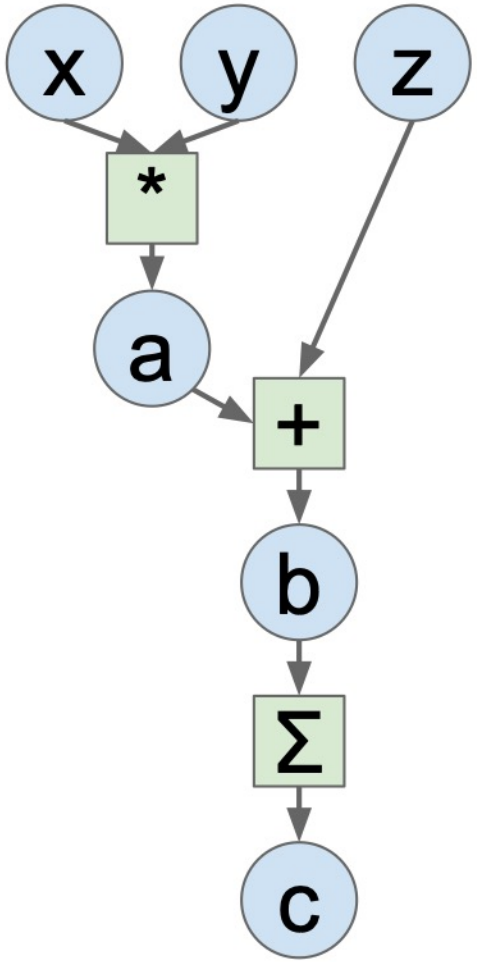
Chapter 3.4 I PyTorch



Run on GPU by casting to .cuda()

```
import torch
from torch.autograd import Variable

N, D = 3, 4

x = Variable(torch.randn(N, D).cuda(),
             requires_grad=True)
y = Variable(torch.randn(N, D).cuda(),
             requires_grad=True)
z = Variable(torch.randn(N, D).cuda(),
             requires_grad=True)

a = x * y
b = a + z
c = torch.sum(b)

c.backward()

print(x.grad.data)
print(y.grad.data)
print(z.grad.data)
```

Chapter 4

코딩 (ipynb 활용)

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E.O.D

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