Apply to Machine Learning

Machine Learning

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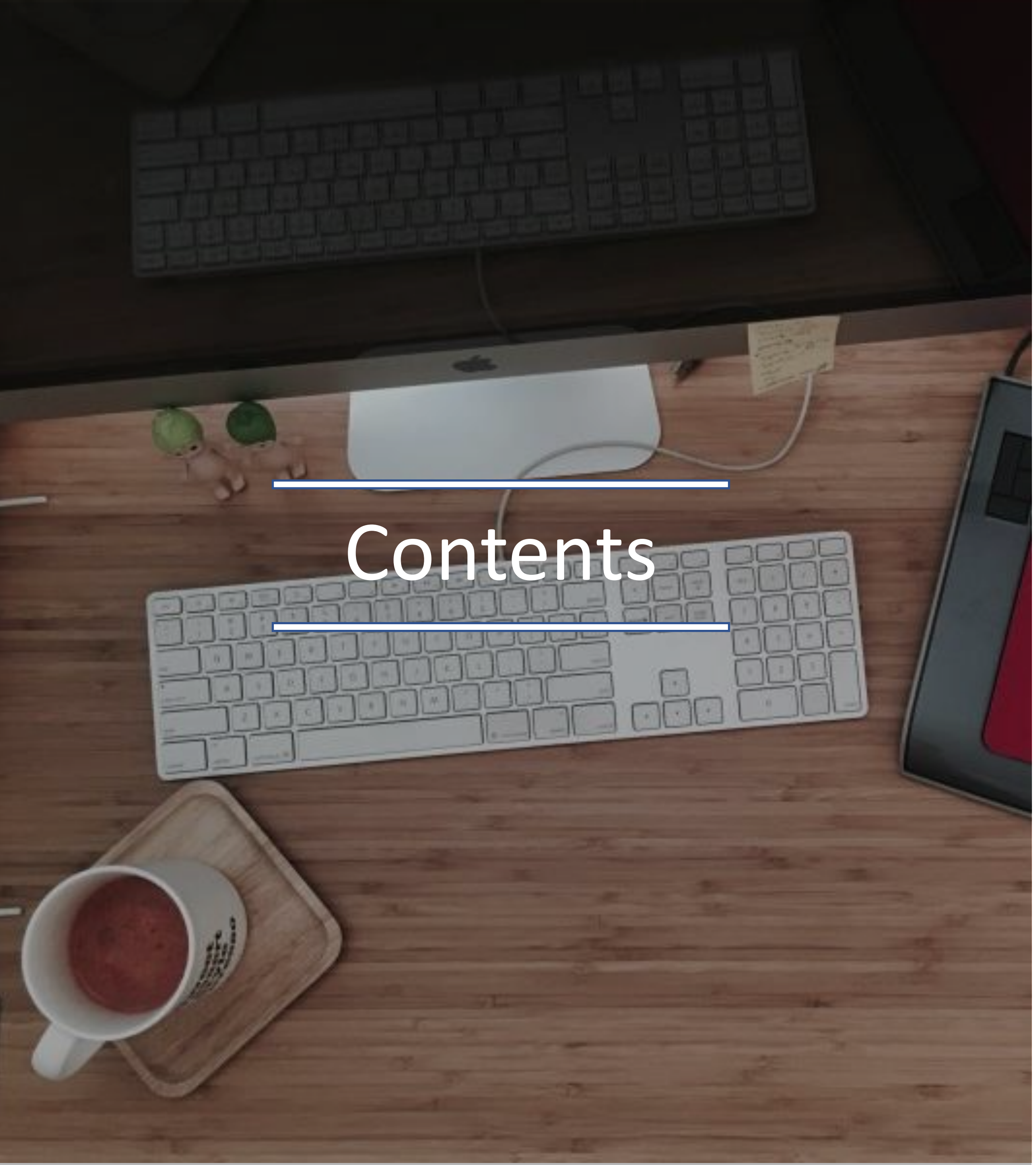
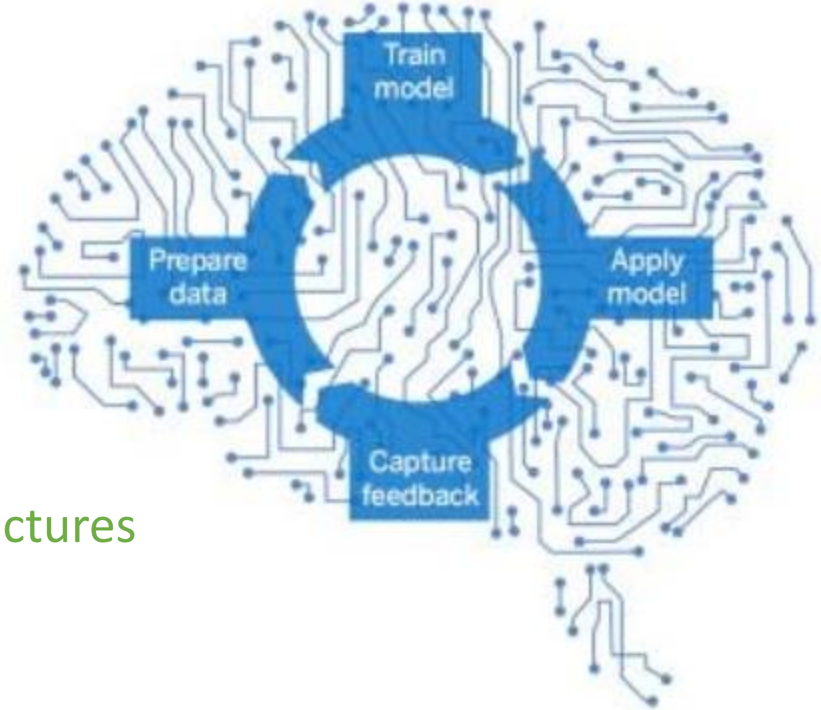


Contents

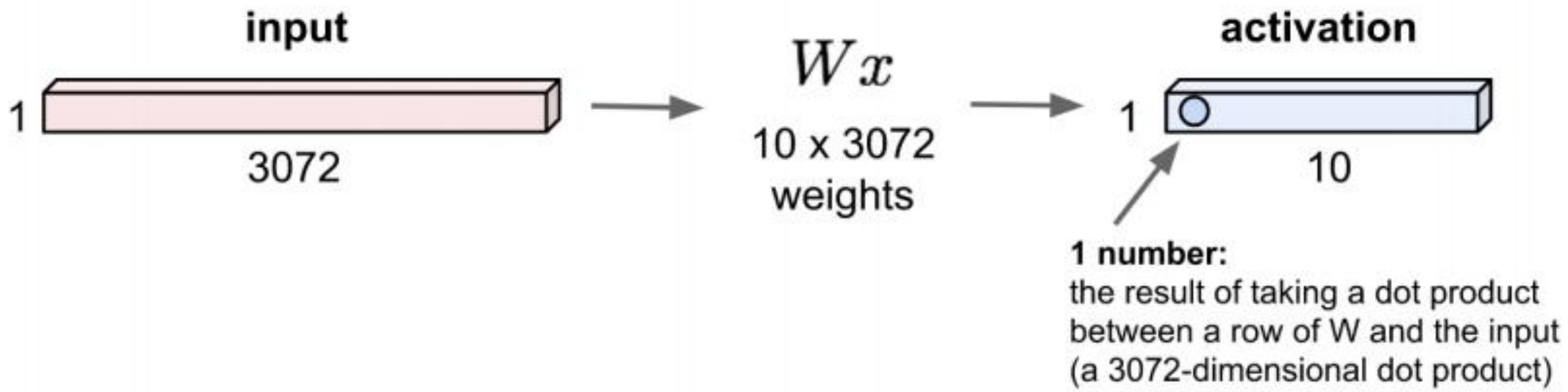


1 Review

CNN(Convolution Neural Network)

Fully Connected Layer

32x32x3 image -> stretch to 3072 x 1



CNN(Convolution Neural Network)

그림 7-4 합성곱 연산의 계산 순서

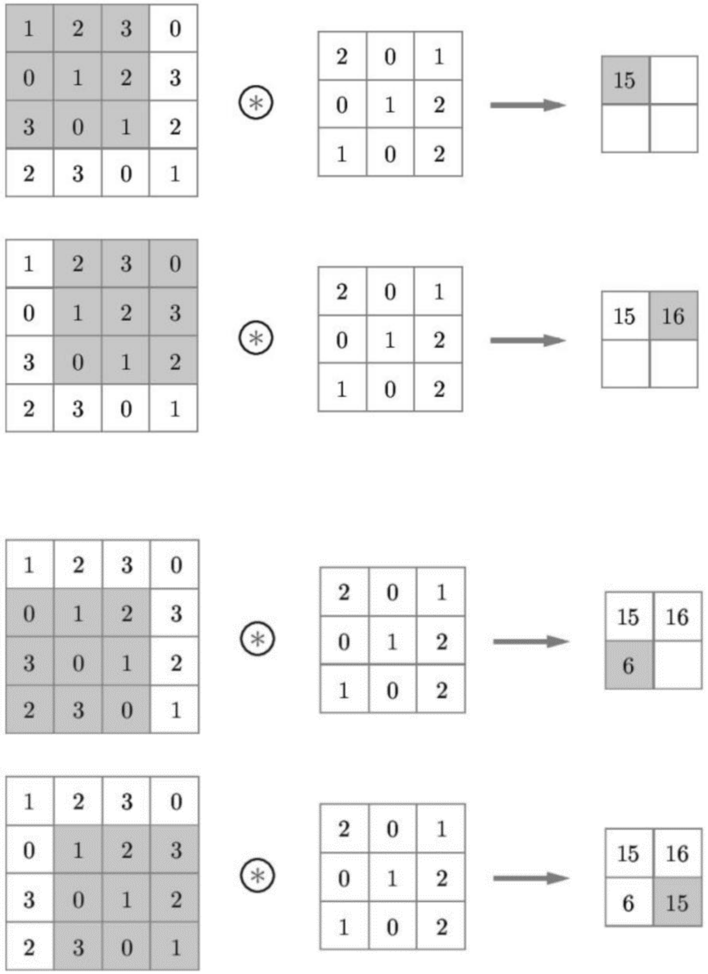
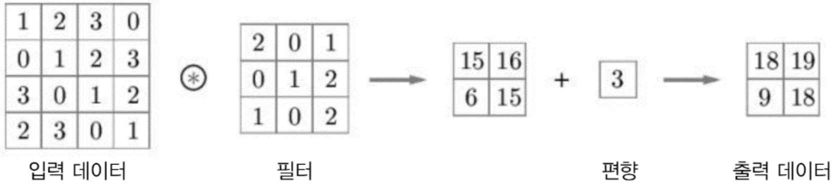
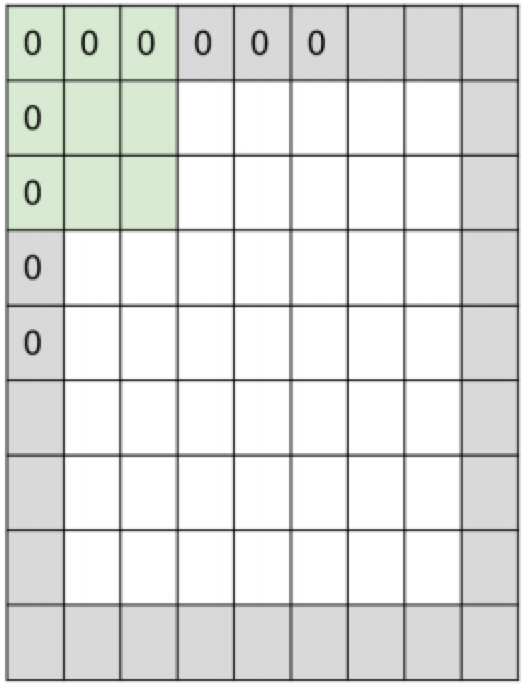


그림 7-5 합성곱 연산의 편향 : 필터를 적용한 원소에 고정값(편향)을 더한다.



CNN(Convolution Neural Network)

In practice: Common to zero pad the border



e.g. input 7x7
3x3 filter, applied with **stride 1**
pad with 1 pixel border => what is the output?

7x7 output!

(recall:)
(N + 2P - F) / stride + 1

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CNN(Convolution Neural Network)

$$(OH, OW) = \left(\frac{H + 2P - FH}{S} + 1\ , \frac{W + 2P - FW}{S} + 1\right)$$

- $(H,\ W)$: 입력크기
- $(FH,\ FW)$: 필터크기
- $(OH,\ OW)$: 출력크기

- P : 패딩
- S : 스트라이드

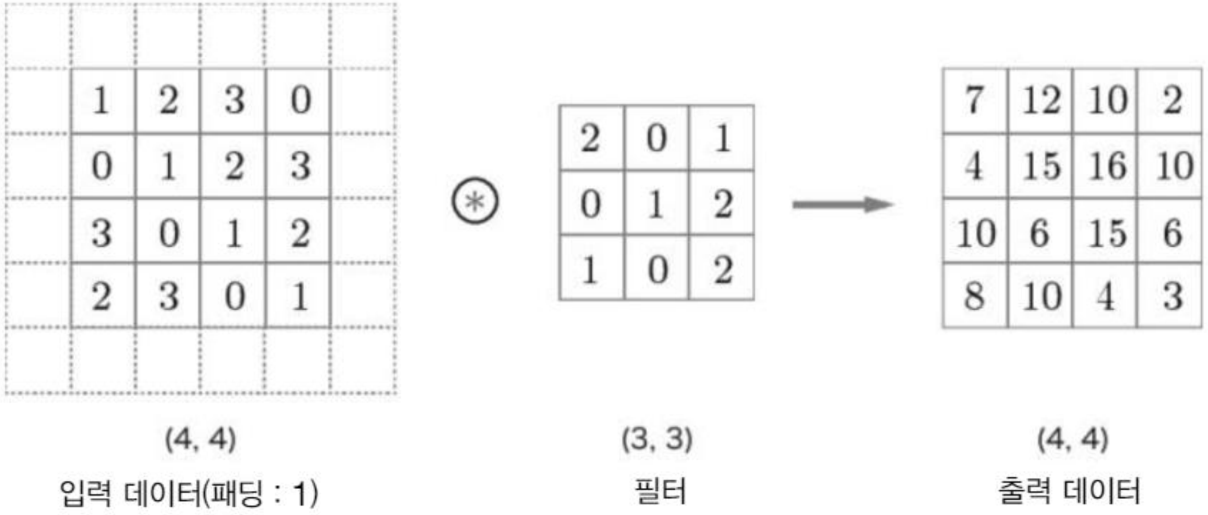
패딩(P) : 1,
스트라이드(S) : 1

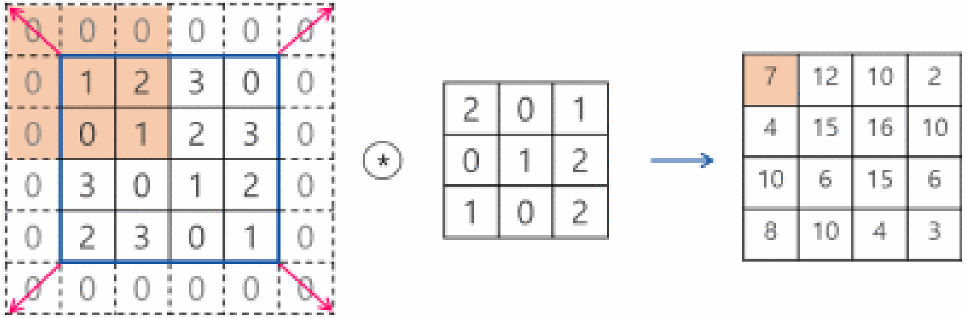
$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 2 & 3 & 0 & 0 \\ 0 & 0 & 1 & 2 & 3 & 0 \\ 0 & 3 & 0 & 1 & 2 & 0 \\ 0 & 2 & 3 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \circledast \begin{bmatrix} 2 & 0 & 1 \\ 0 & 1 & 2 \\ 1 & 0 & 2 \end{bmatrix} \rightarrow \begin{bmatrix} 7 & 12 & 10 & 2 \\ 4 & 15 & 16 & 10 \\ 10 & 6 & 15 & 6 \\ 8 & 10 & 4 & 3 \end{bmatrix}$$

$$(OH, OW) = \left(\frac{4 + 2 * 1 - 3}{1} + 1\ , \frac{4 + 2 * 1 - 3}{1} + 1\right) = (4, 4)$$

CNN(Convolution Neural Network)

그림 7-6 합성곱 연산의 패딩 처리 : 입력 데이터 주위에 0을 채운다(패딩은 점선으로 표시했으며 그 안의 값 '0'은 생략했다).



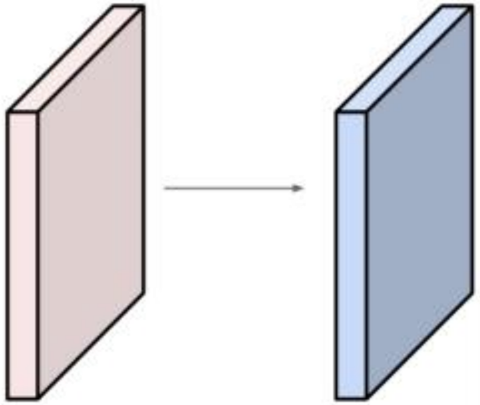


CNN(Convolution Neural Network)

Examples time:

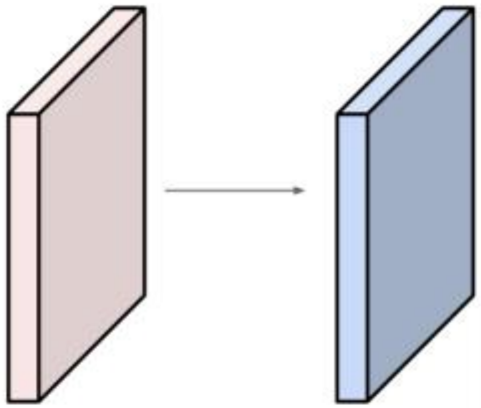
Input volume: **32x32x3**
10 5x5 filters with stride 1, pad 2

Output volume size:
(32+2*2-5)/1+1 = 32 spatially, so
32x32x10



CNN(Convolution Neural Network)

Examples time:



Input volume: **32x32x3**

10 5x5 filters with stride 1, pad 2

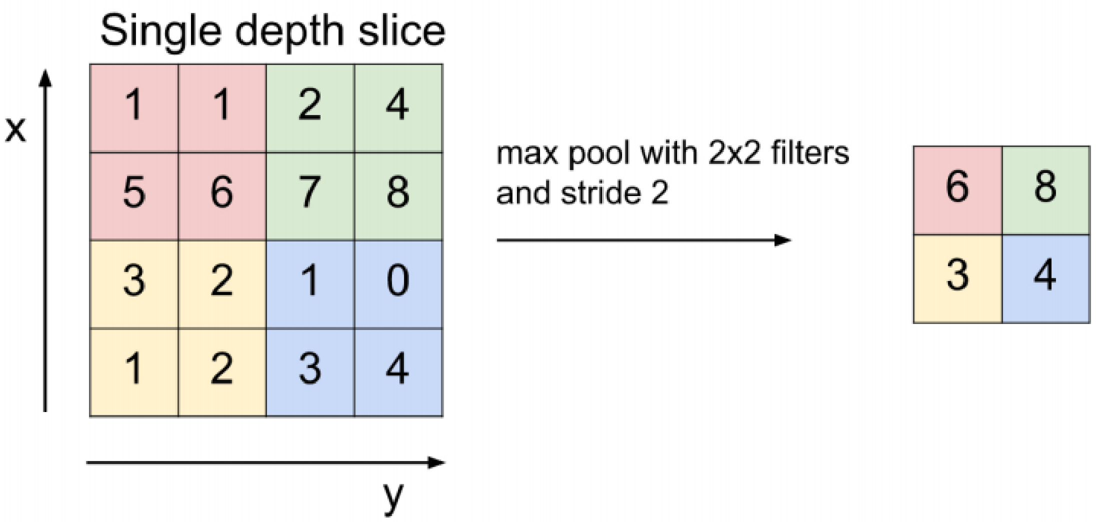
Number of parameters in this layer?

each filter has 5*5*3 + 1 = 76 params (+1 for bias)

=> 76*10 = **760**

CNN(Convolution Neural Network)

MAX POOLING



Pooling layer: summary

Let's assume input is $W_1 \times H_1 \times C$
Conv layer needs 2 hyperparameters:

- The spatial extent **F**
- The stride **S**

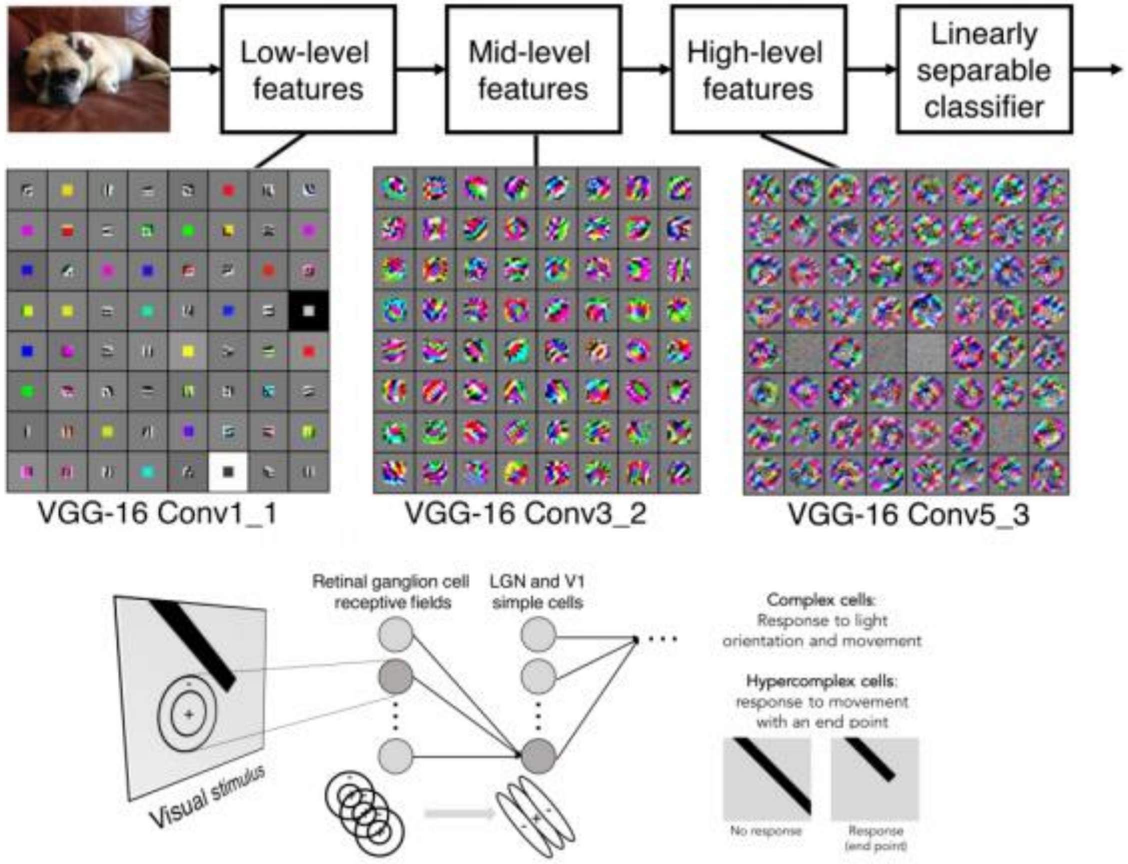
This will produce an output of $W_2 \times H_2 \times C$ where:

- $W_2 = (W_1 - F)/S + 1$
- $H_2 = (H_1 - F)/S + 1$

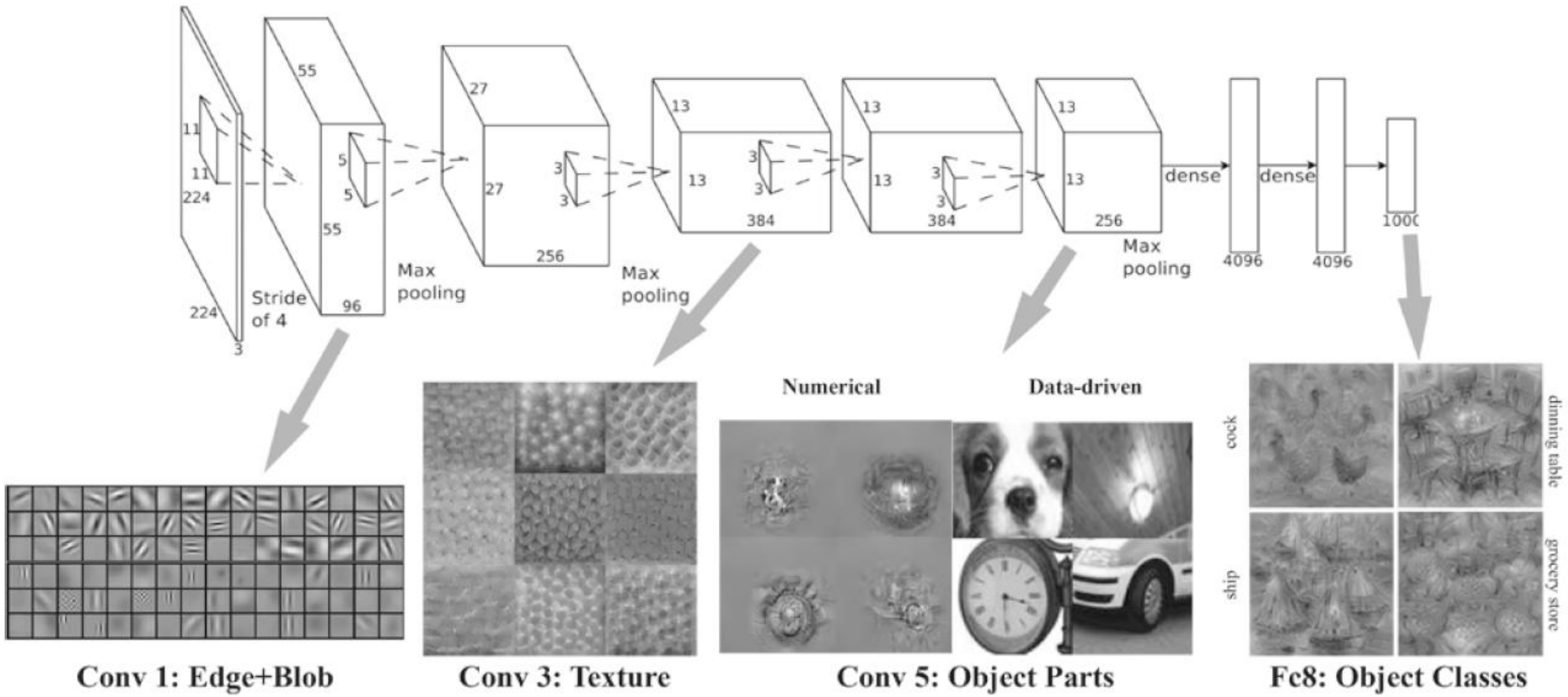
Number of parameters: 0

CNN(Convolution Neural Network)

Preview



CNN(Convolution Neural Network)



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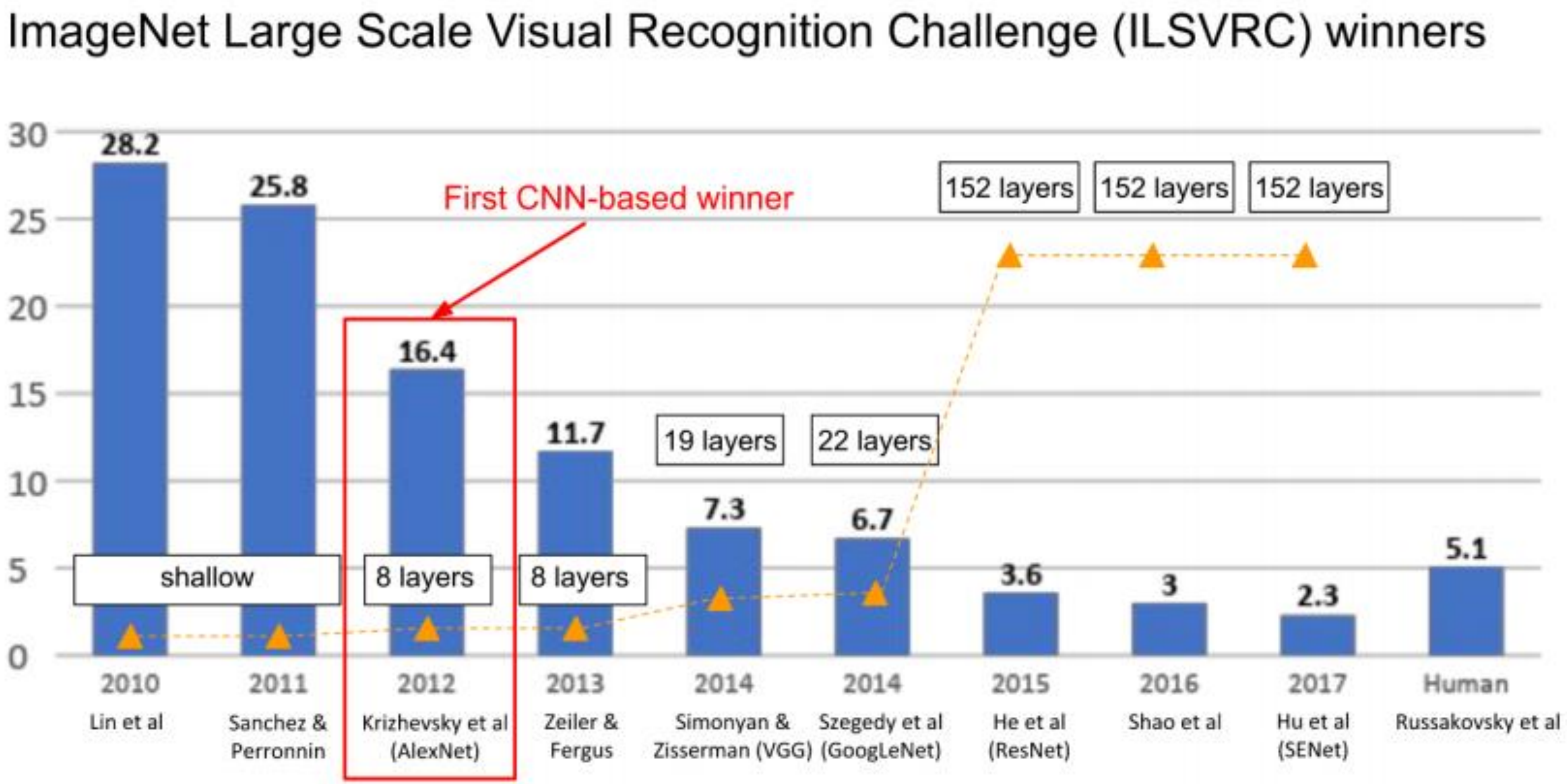
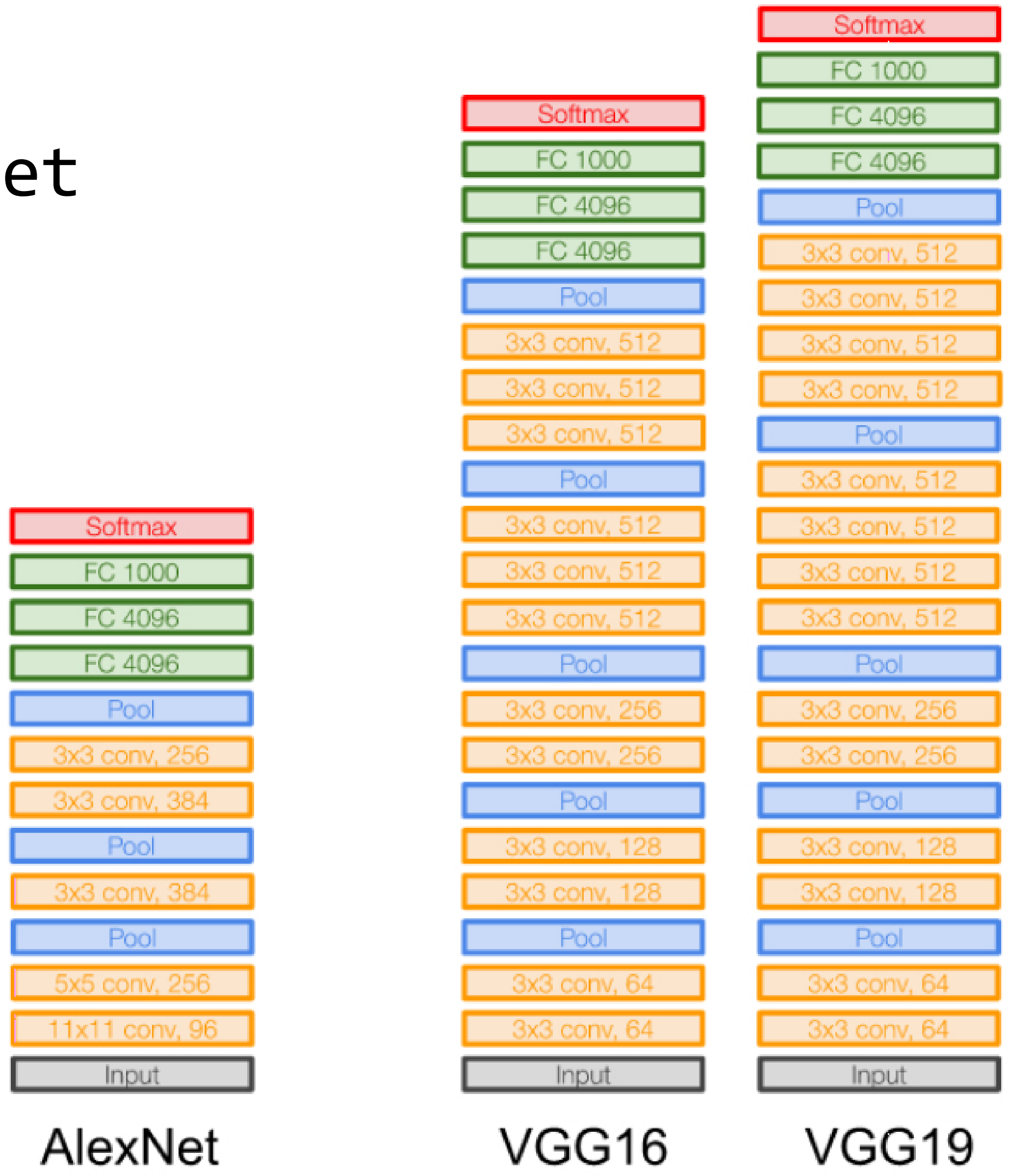
2 CNN Architectures

CNN Architectures



CNN Architectures

Case Study: AlexNet, VGGNet

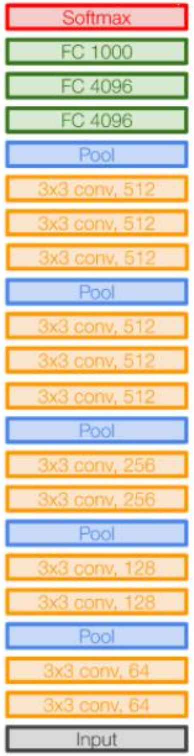


CNN Architectures

(not counting biases)

INPUT: [224x224x3] memory: 224*224*3=150K params: 0
CONV3-64: [224x224x64] memory: 224*224*64=3.2M params: (3*3*3)*64 = 1,728
CONV3-64: [224x224x64] memory: 224*224*64=3.2M params: (3*3*64)*64 = 36,864
POOL2: [112x112x64] memory: 112*112*64=800K params: 0
CONV3-128: [112x112x128] memory: 112*112*128=1.6M params: (3*3*64)*128 = 73,728
CONV3-128: [112x112x128] memory: 112*112*128=1.6M params: (3*3*128)*128 = 147,456
POOL2: [56x56x128] memory: 56*56*128=400K params: 0
CONV3-256: [56x56x256] memory: 56*56*256=800K params: (3*3*128)*256 = 294,912
CONV3-256: [56x56x256] memory: 56*56*256=800K params: (3*3*256)*256 = 589,824
CONV3-256: [56x56x256] memory: 56*56*256=800K params: (3*3*256)*256 = 589,824
POOL2: [28x28x256] memory: 28*28*256=200K params: 0
CONV3-512: [28x28x512] memory: 28*28*512=400K params: (3*3*256)*512 = 1,179,648
CONV3-512: [28x28x512] memory: 28*28*512=400K params: (3*3*512)*512 = 2,359,296
CONV3-512: [28x28x512] memory: 28*28*512=400K params: (3*3*512)*512 = 2,359,296
POOL2: [14x14x512] memory: 14*14*512=100K params: 0
CONV3-512: [14x14x512] memory: 14*14*512=100K params: (3*3*512)*512 = 2,359,296
CONV3-512: [14x14x512] memory: 14*14*512=100K params: (3*3*512)*512 = 2,359,296
CONV3-512: [14x14x512] memory: 14*14*512=100K params: (3*3*512)*512 = 2,359,296
POOL2: [7x7x512] memory: 7*7*512=25K params: 0
FC: [1x1x4096] memory: 4096 params: 7*7*512*4096 = 102,760,448
FC: [1x1x4096] memory: 4096 params: 4096*4096 = 16,777,216
FC: [1x1x1000] memory: 1000 params: 4096*1000 = 4,096,000

TOTAL memory: 24M * 4 bytes ~= 96MB / image (for a forward pass)
TOTAL params: 138M parameters



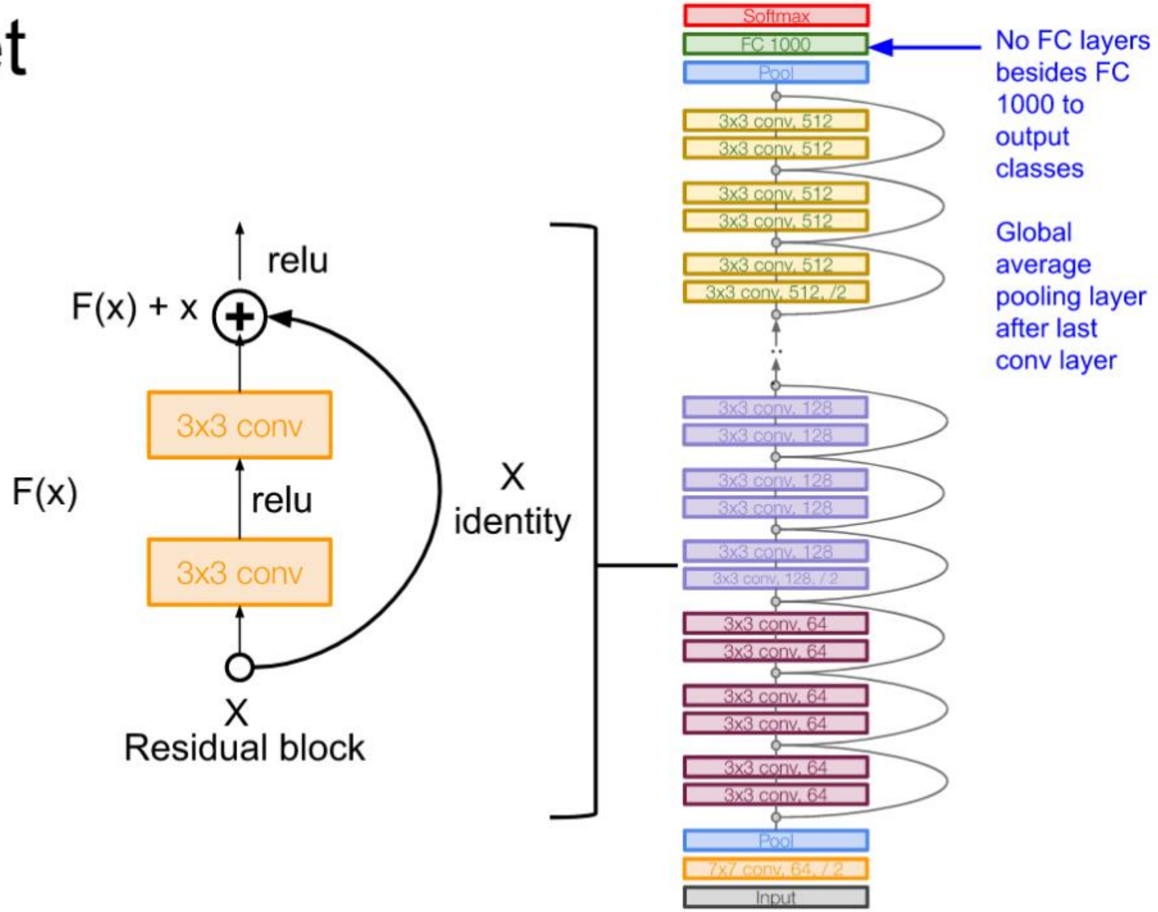
VGG16

CNN Architectures

Case Study: ResNet

[He et al., 2015]

Full ResNet architecture:
- Stack residual blocks
- Every residual block has two 3x3 conv layers
- Periodically, double # of filters and downsample spatially using stride 2 (/2 in each dimension)
- Additional conv layer at the beginning (stem)
- No FC layers at the end (only FC 1000 to output classes)
- (In theory, you can train a ResNet with input image of variable sizes)



CNN Architectures

- https://pytorch.org/docs/stable/torchvision/models.html

TORCHVISION.MODELS

The models subpackage contains definitions of models for addressing different tasks, including: image classification, pixelwise semantic segmentation, object detection, instance segmentation, person keypoint detection and video classification.

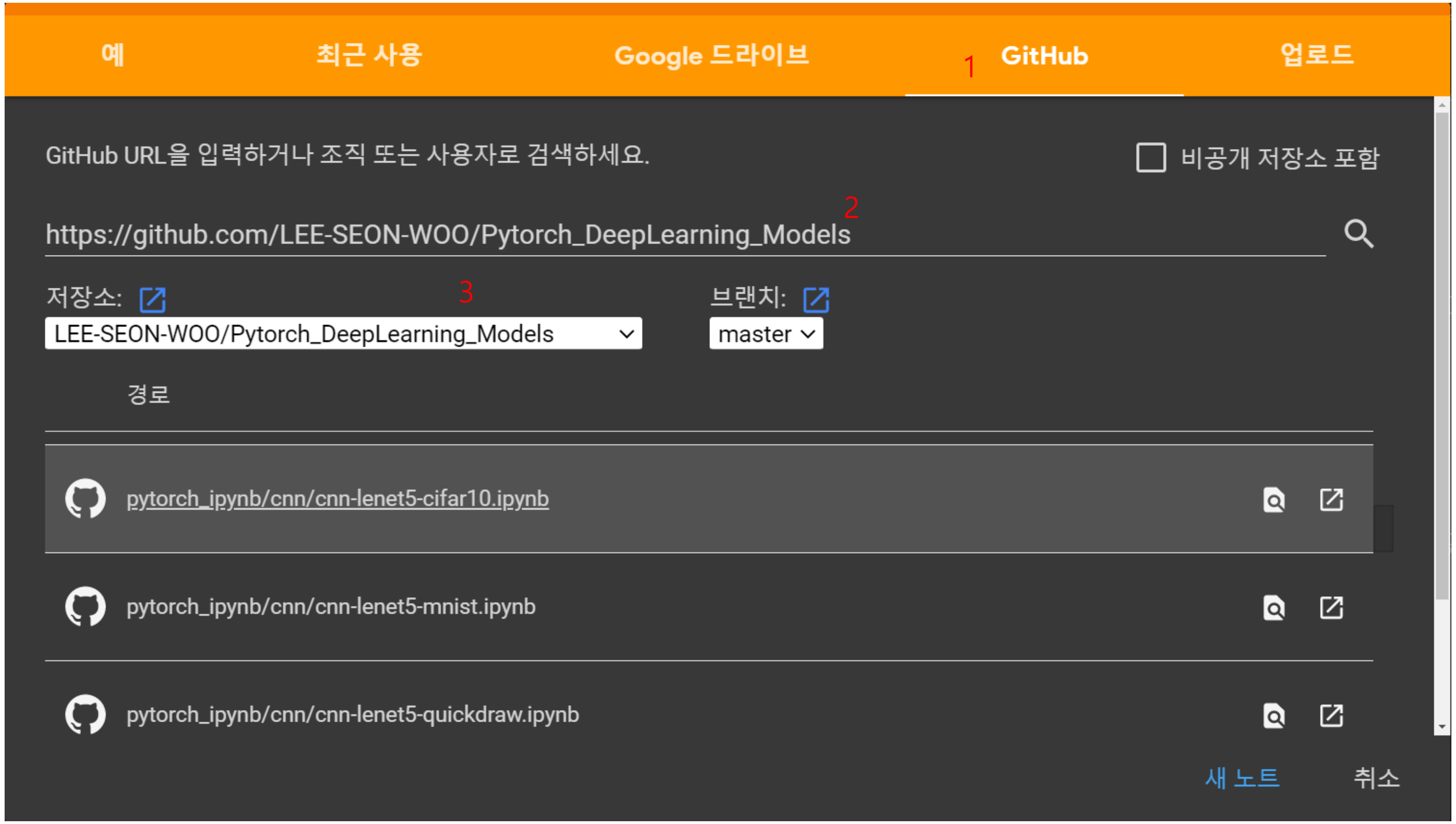
```
import torchvision.models as models
resnet18 = models.resnet18()
alexnet = models.alexnet()
vgg16 = models.vgg16()
squeezenet = models.squeezenet1_0()
densenet = models.densenet161()
inception = models.inception_v3()
googlenet = models.googlenet()
shufflenet = models.shufflenet_v2_x1_0()
mobilenet = models.mobilenet_v2()
resnext50_32x4d = models.resnext50_32x4d()
wide_resnet50_2 = models.wide_resnet50_2()
mnasnet = models.mnasnet1_0()
```

```
import torchvision.models as models
resnet18 = models.resnet18(pretrained=True)
alexnet = models.alexnet(pretrained=True)
squeezenet = models.squeezenet1_0(pretrained=True)
vgg16 = models.vgg16(pretrained=True)
densenet = models.densenet161(pretrained=True)
inception = models.inception_v3(pretrained=True)
googlenet = models.googlenet(pretrained=True)
shufflenet = models.shufflenet_v2_x1_0(pretrained=True)
mobilenet = models.mobilenet_v2(pretrained=True)
resnext50_32x4d = models.resnext50_32x4d(pretrained=True)
wide_resnet50_2 = models.wide_resnet50_2(pretrained=True)
mnasnet = models.mnasnet1_0(pretrained=True)
```

3 Practice

CNN Tutorials

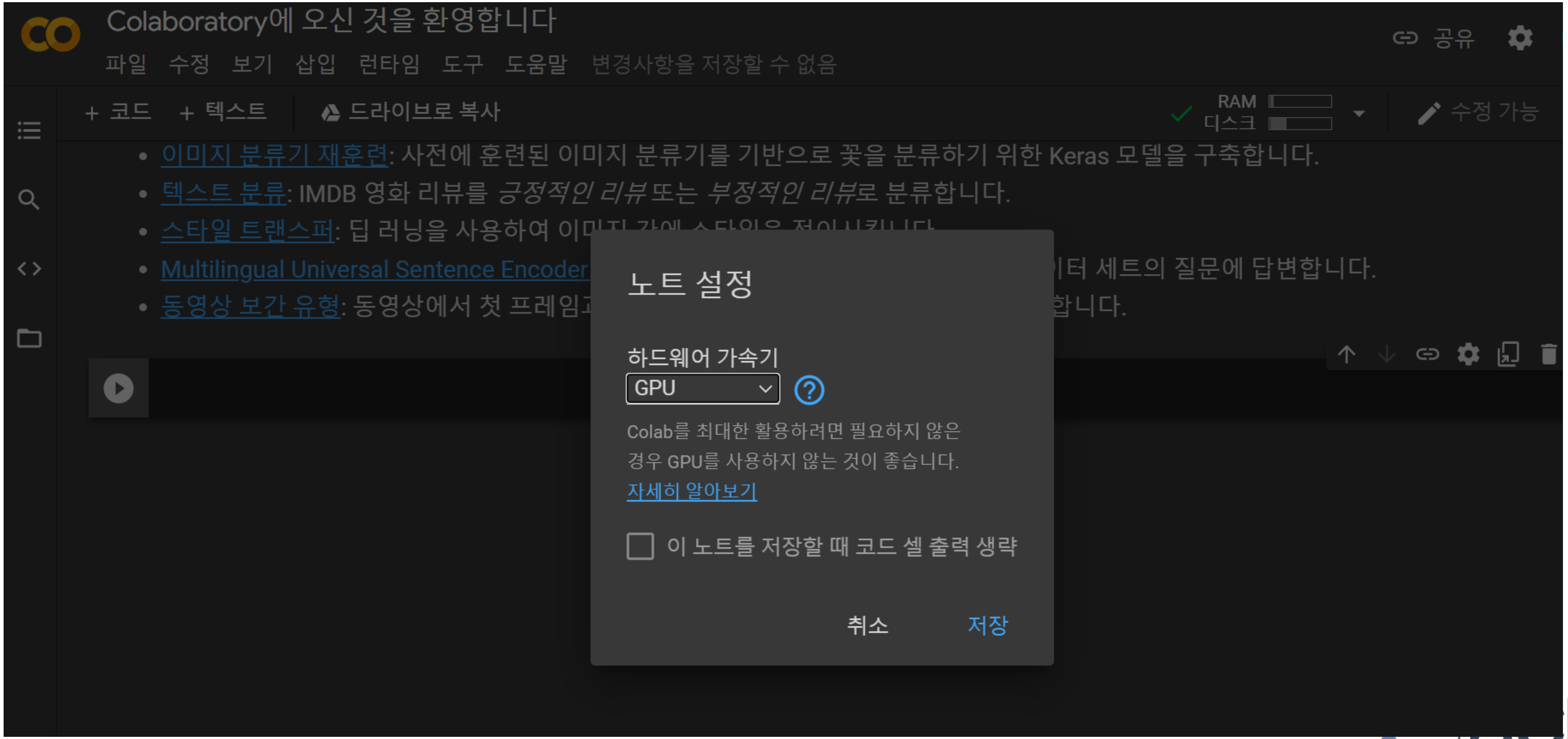
https://colab.research.google.com/



https://github.com/LEE-SEON-WOO/Pytorch_DeepLearning_Models

CNN Tutorials

https://colab.research.google.com/

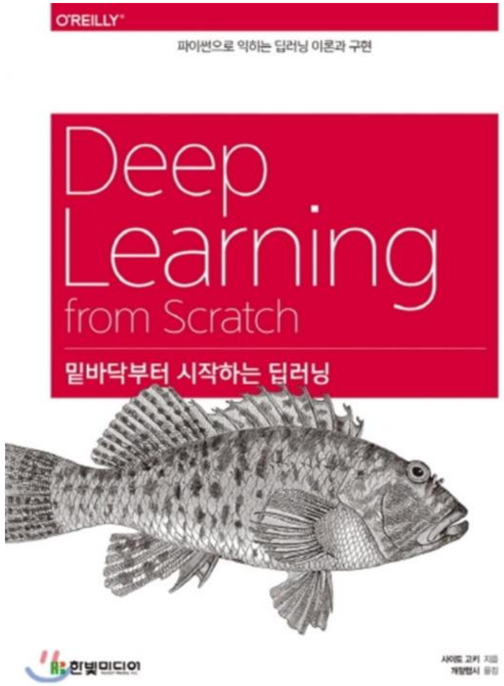


Book

주교재

밑바닥부터 시작하는 딥러닝 1, 사이토 고키 지음, 개앞맨시 옮김 .

(Deep Learning from Scratch의 번역서입니다 .)



부교재

Pytorch로 시작하는 딥러닝, 비슈누 수브라마니안 지음 김태완 옮김 .

(Deep Learning with PYTORCH 의 번역서입니다 .)