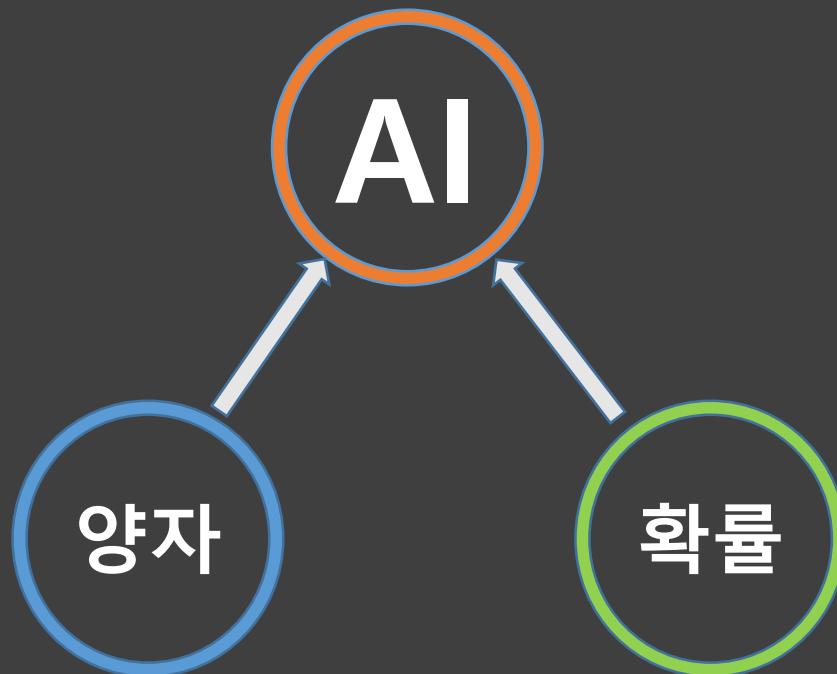




양자물리에서 인공지능으로



◆ 양자론적 세계관?

- 양자화
- 파동-입자 이중성
- 물질파
- 양자역학과 불확정성원리
- 양자 계산과 양자 컴퓨터

● 확률론적 세계관

→ AI

확률론적 세상

신은 주사위 놀이를 하지
않는데,

인간은 요즘 **데이터주사위**
를 가지고 놀고 있다.



데이터주사위 → AI

AI

머신러닝/딥러닝

개냐? 고양이냐?

컴퓨터에게는 모든 개/고양이 사진
이 개와 고양이의 중첩!

개 또는 고양이의 세부 특징의
조합에 대한 확률을 계산해서
개/고양이 결정

[긴급 질문]

Is Redwoods man or woman?

▪ 지도학습의 예



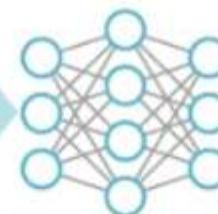
훈련 데이터(Train Set)

고양이

개

학습

테스트 데이터(Test Set)



신경망 등
알고리즘



개 · 고양이
분류모델



모델 생성 및 적용

고양이

고양이

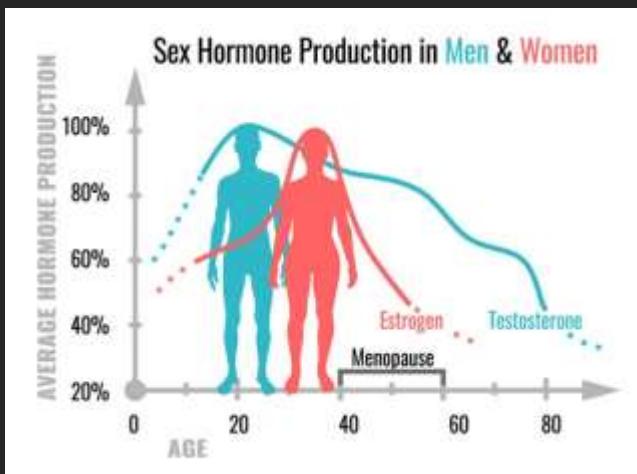
개

개

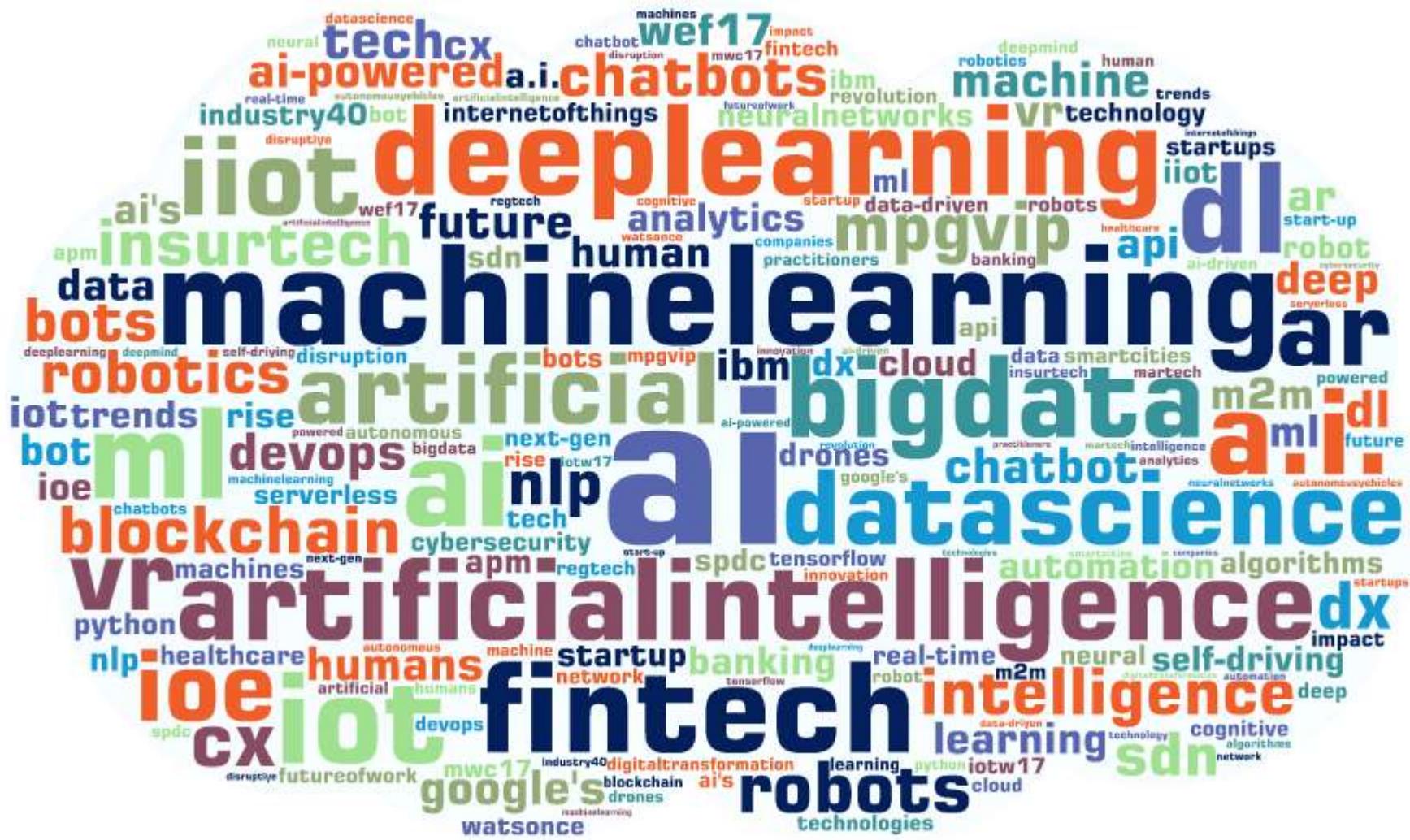
결과 확인

AI

woman
or
man?

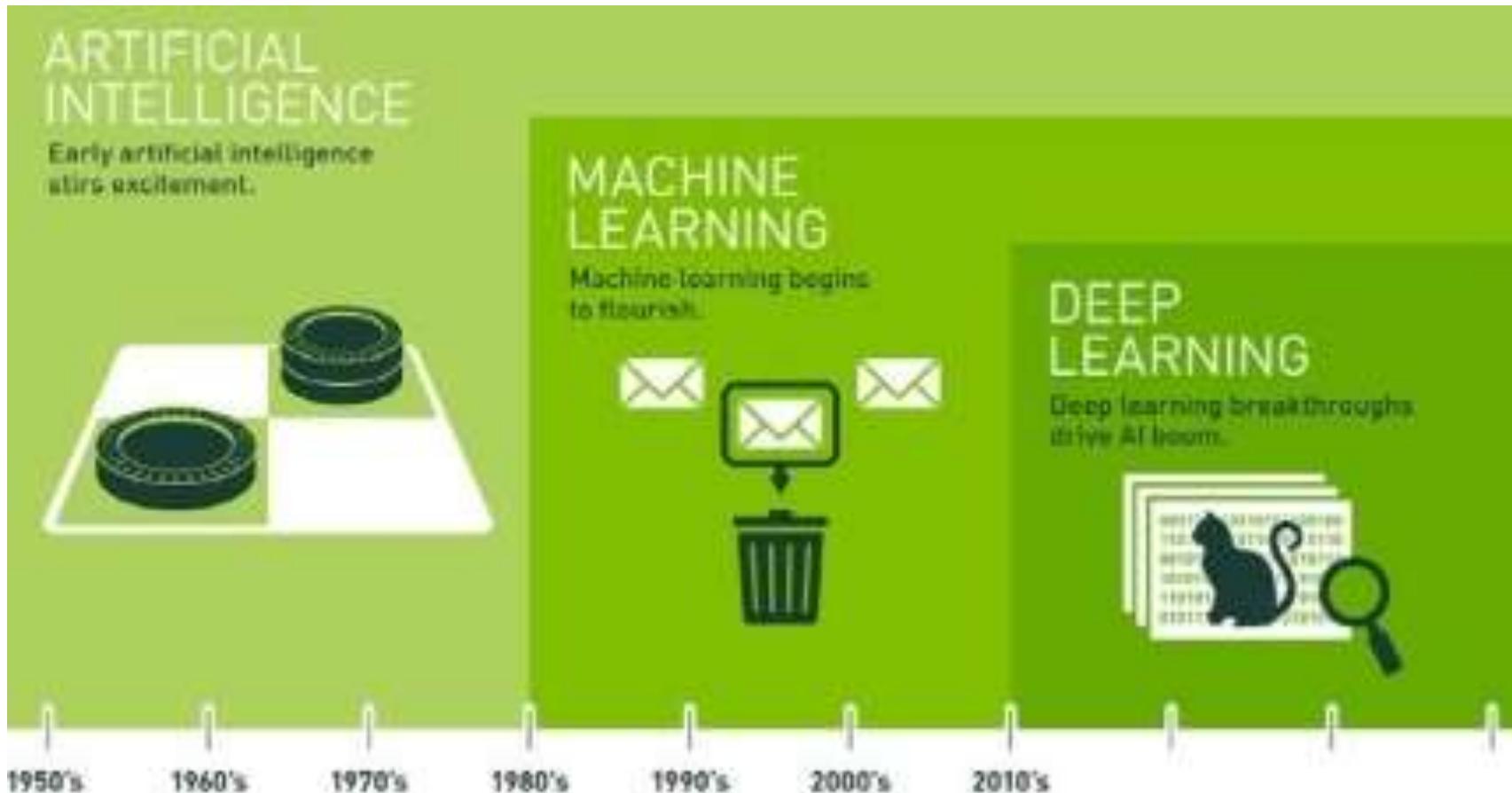


<https://www.youtube.com/watch?v=st9RHcmnqwg>



<https://i.pinimg.com/originals/35/40/96/3540963f968365cb9e34dc993ac146ad.png>

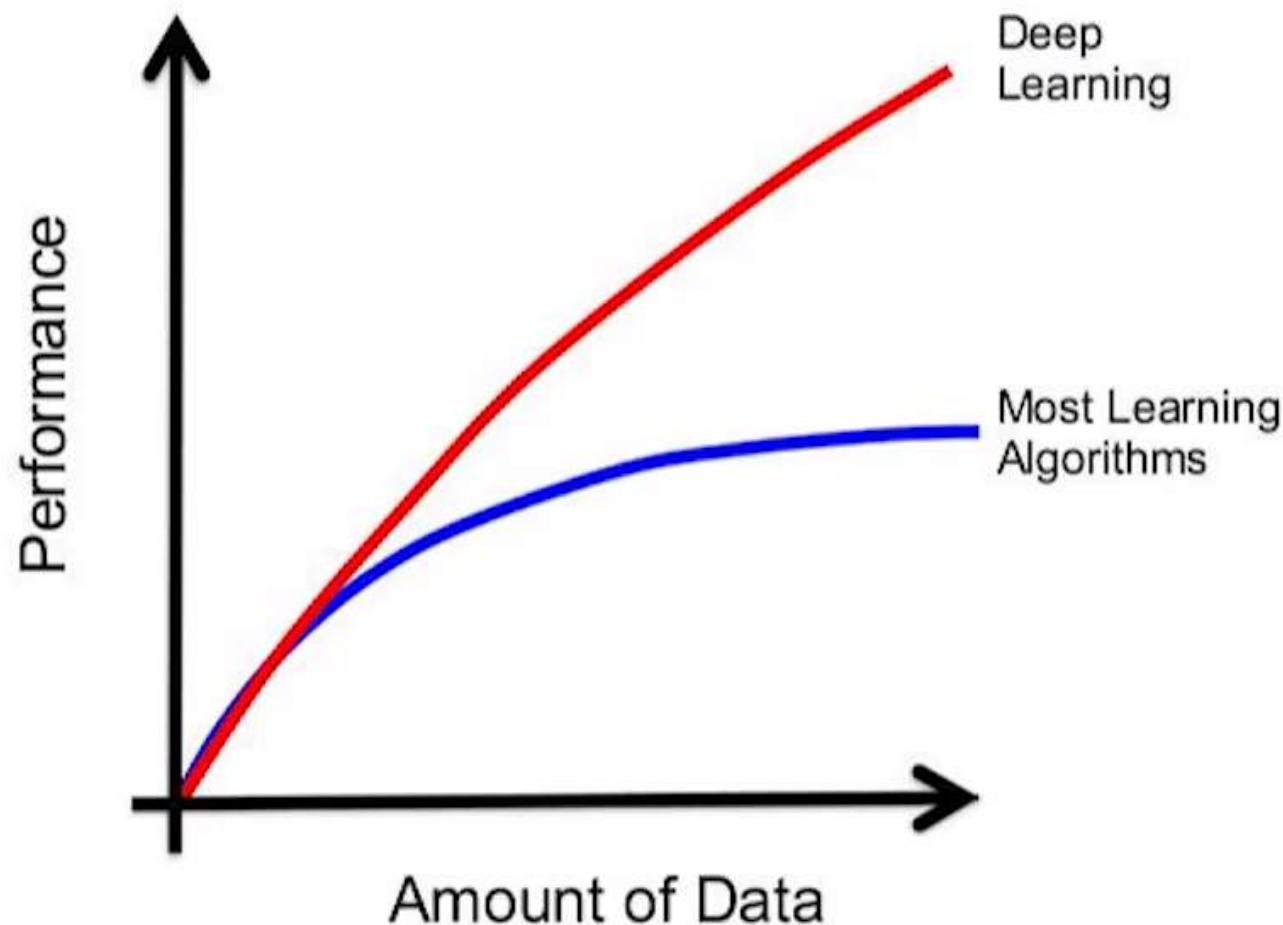
AI > ML > DL



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

AI – ML vs. DL ← Data

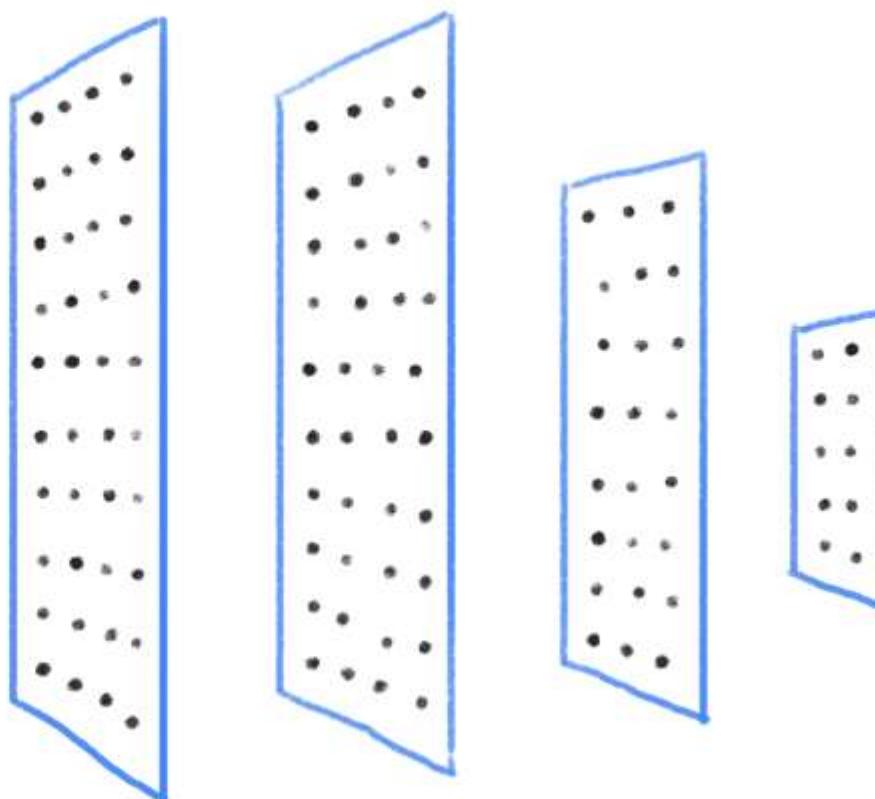
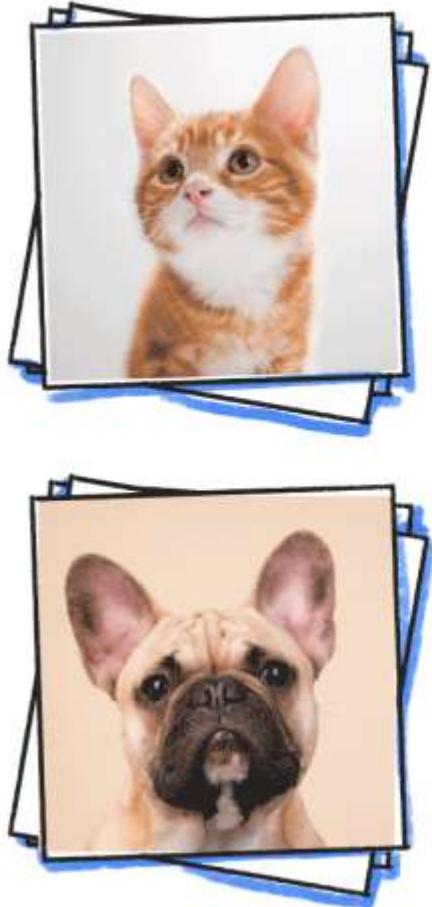
BIG DATA & DEEP LEARNING



CAT

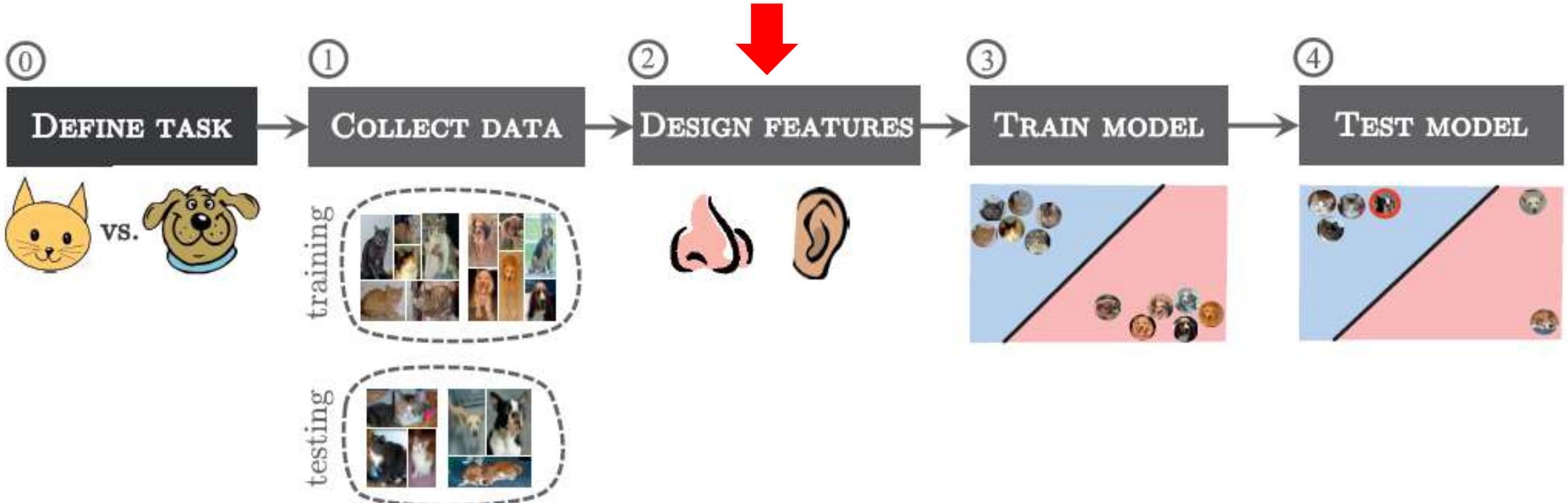
(LABLED
PHOTOS)

DOG



https://miro.medium.com/max/3840/1*oB3S5yHHvougJkPXuc8og.gif

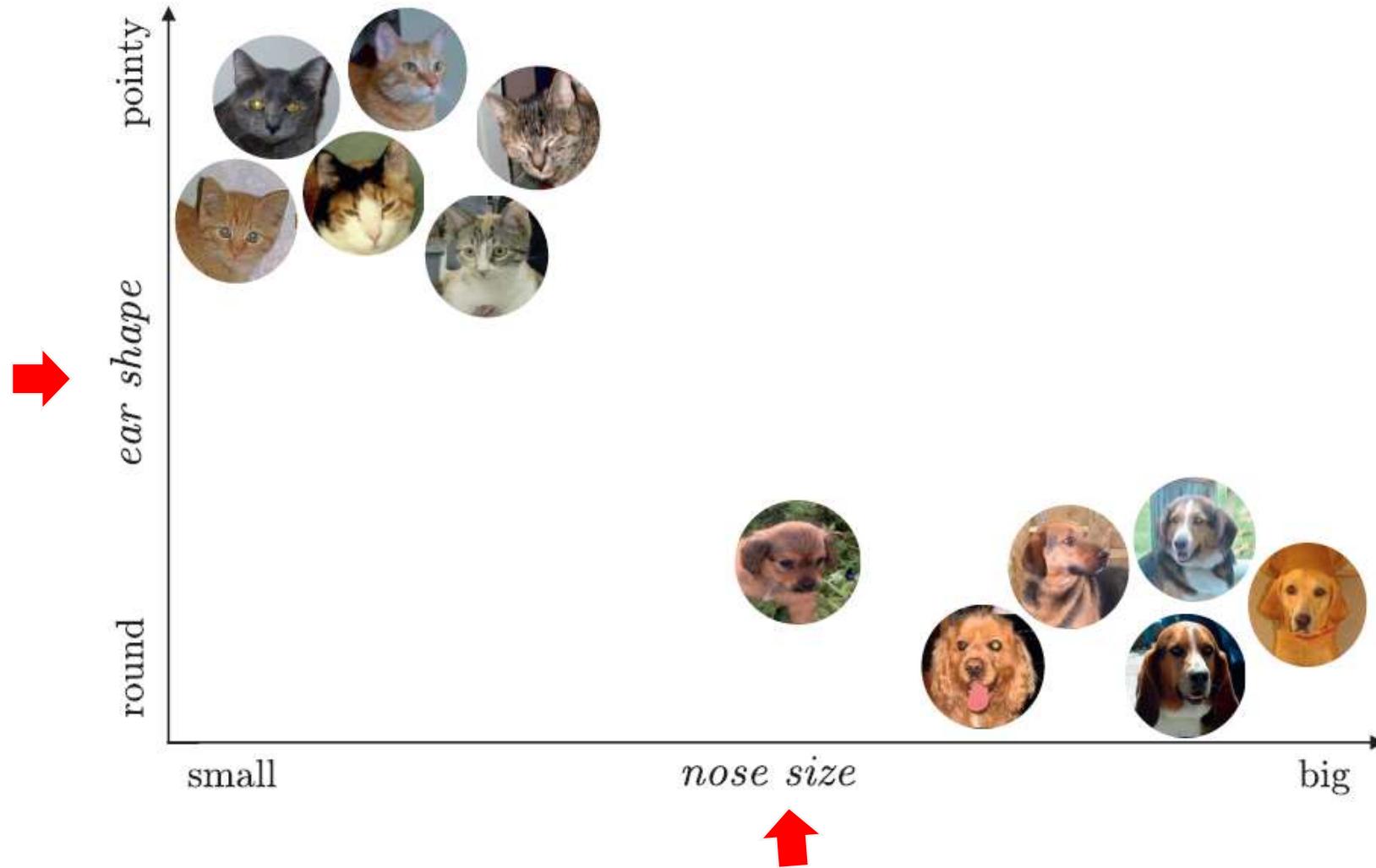
Easy ML - 0



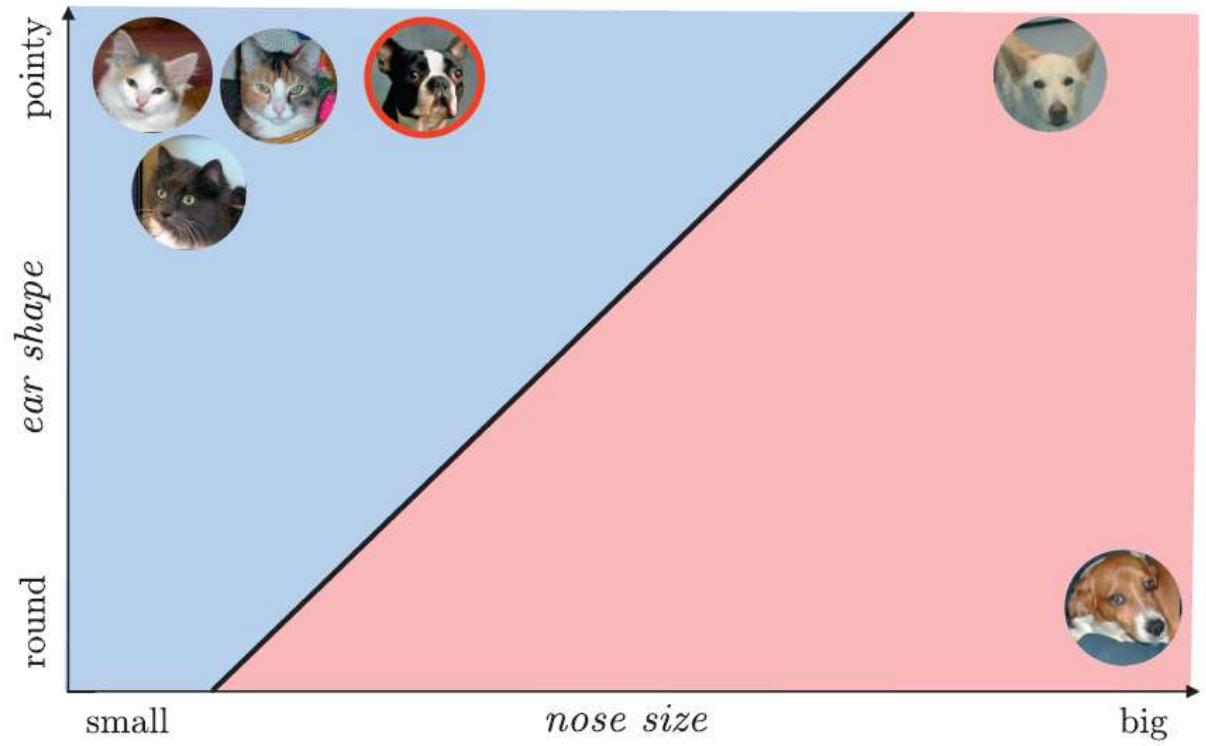
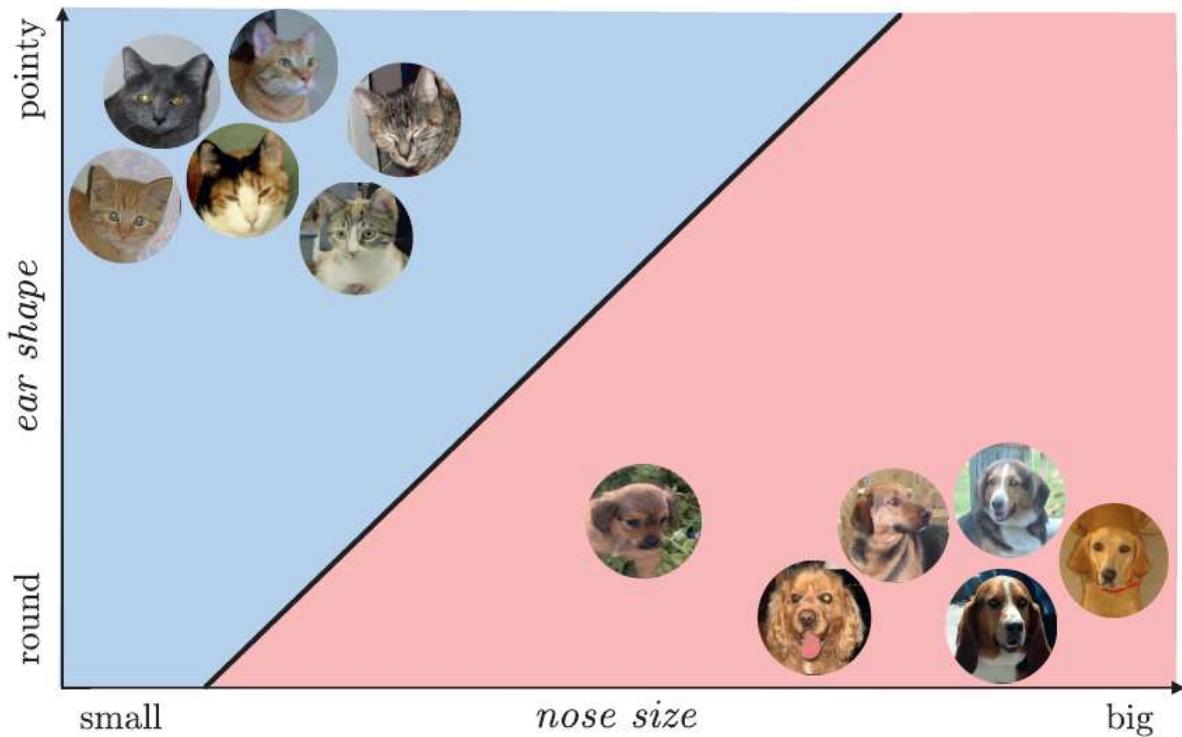
Easy ML - 1 : data



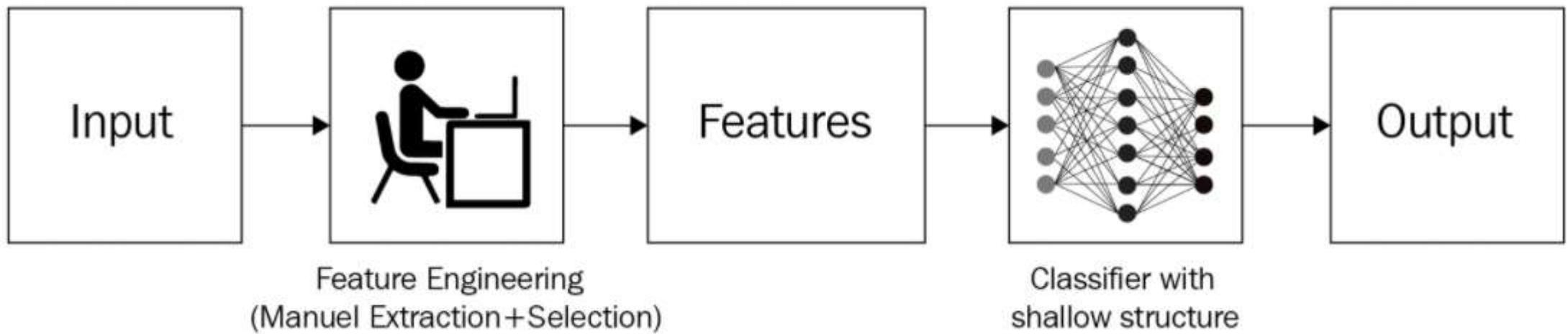
Easy ML - 2 : Training



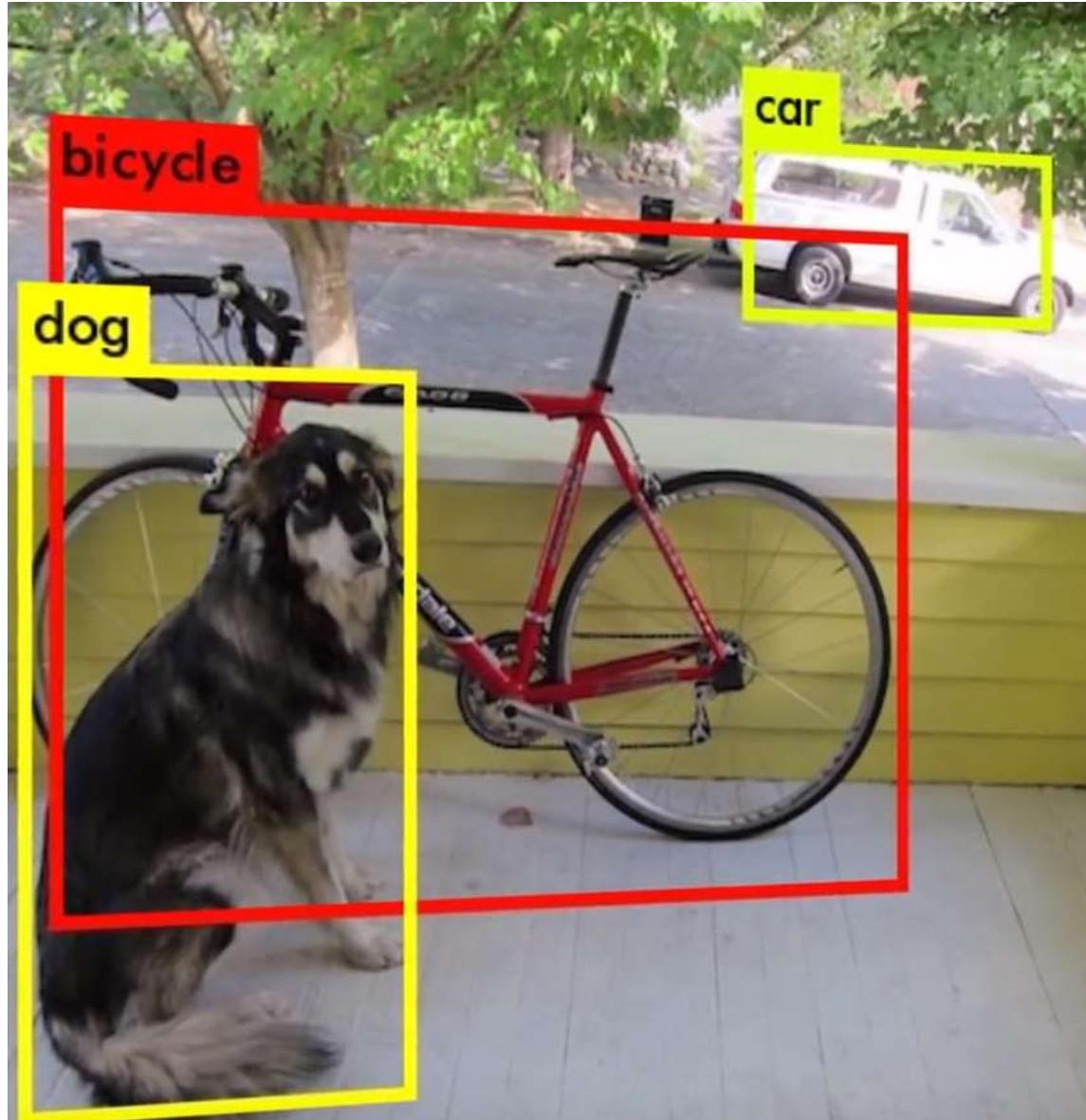
Easy ML - 3: Testing



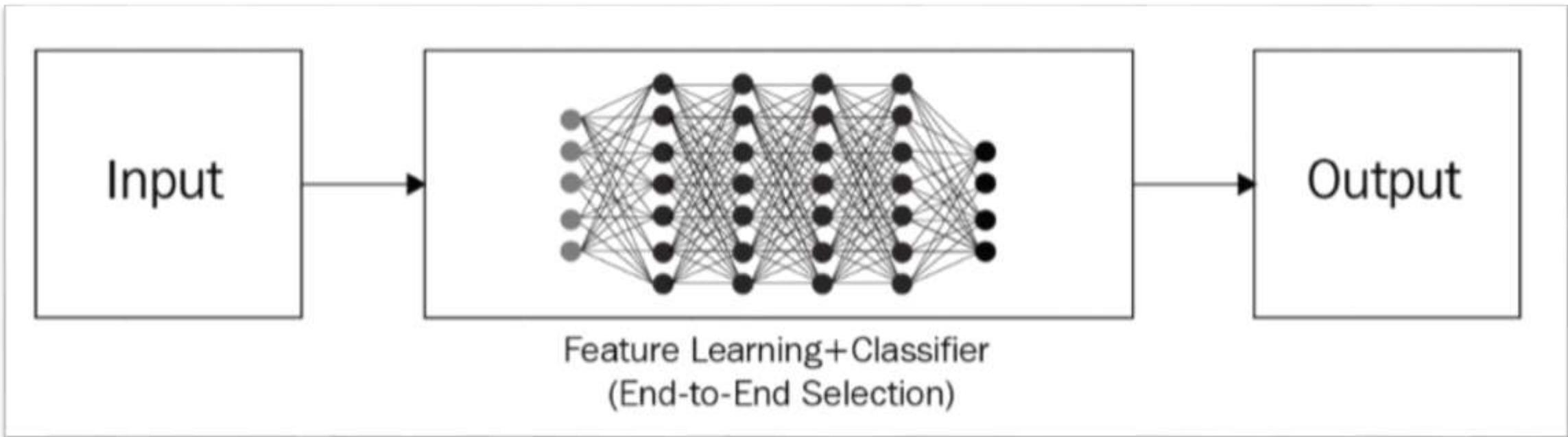
Easy ML - Processes



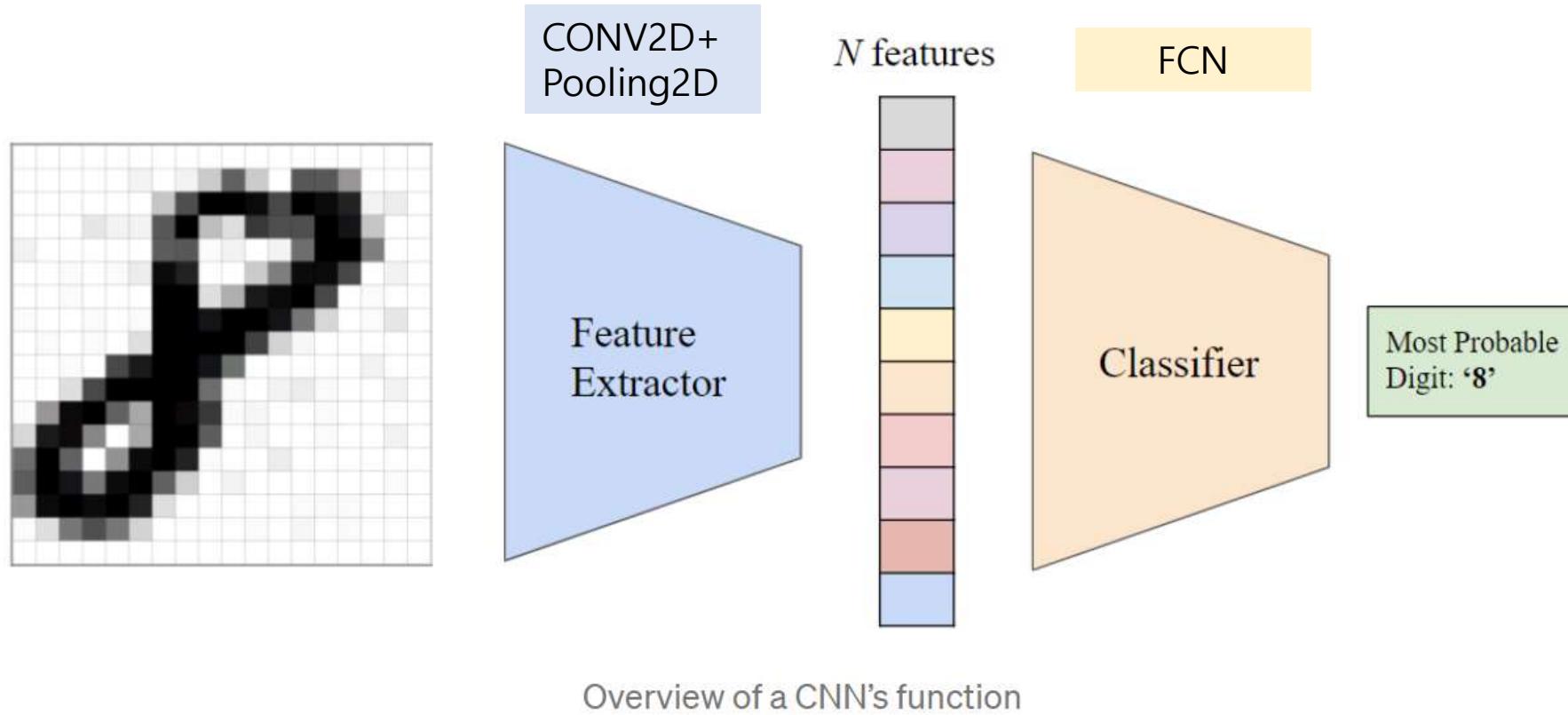
Still easy ML ? → DL, 다중 객체



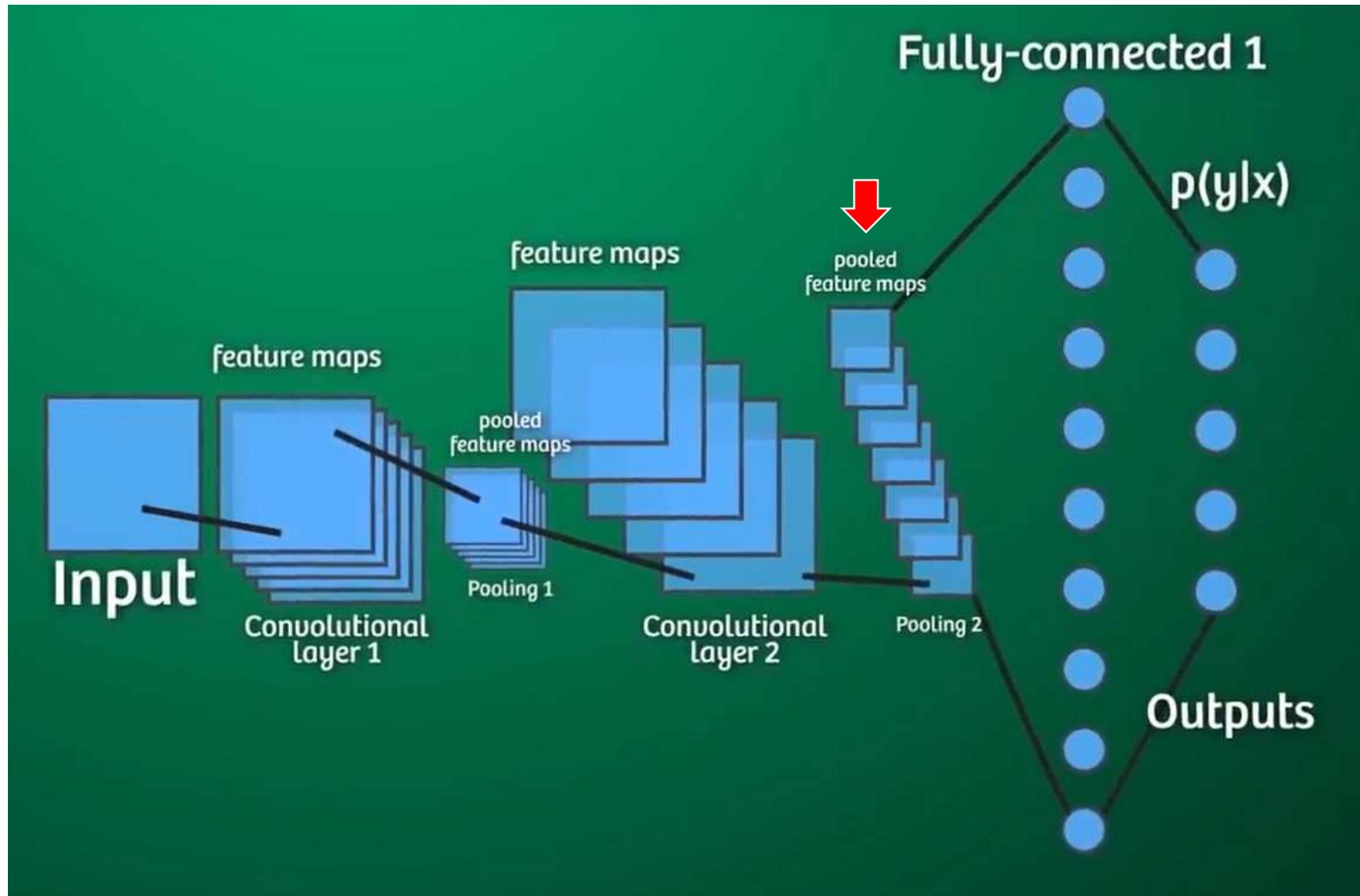
Easy DL - Processes



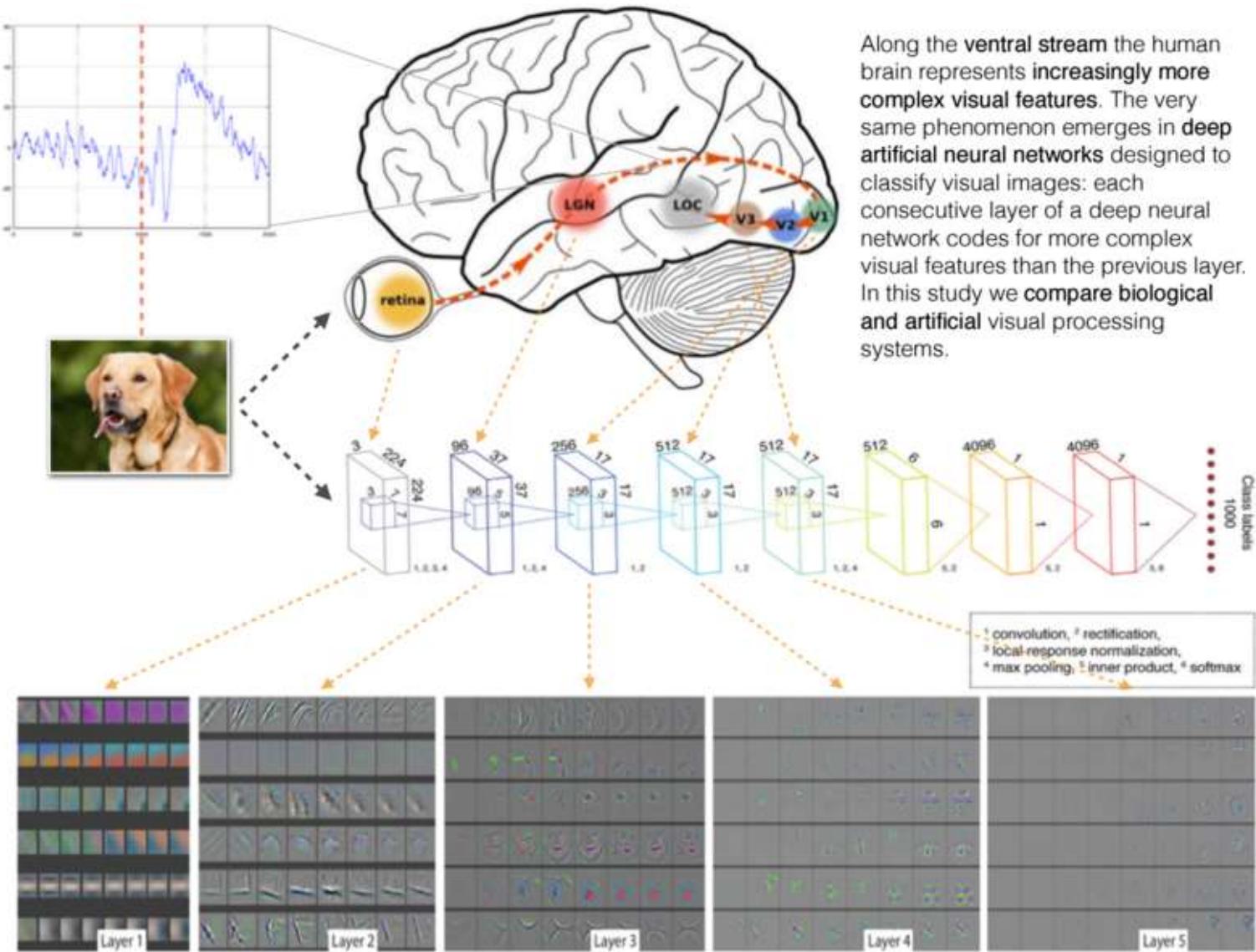
Easy DL - Processes



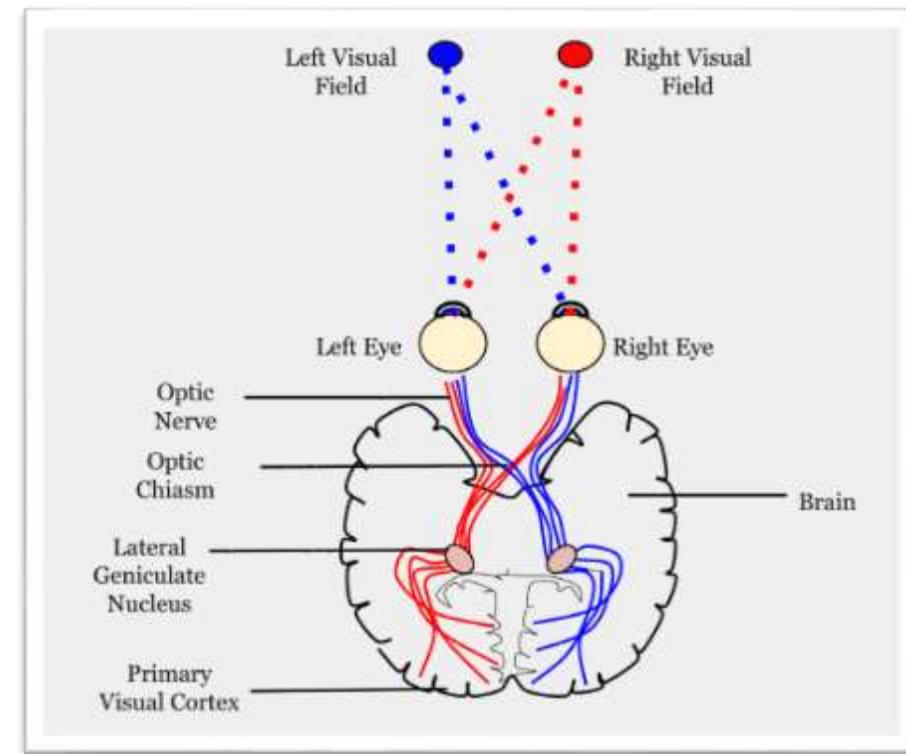
Still easy ML ? → 딥러닝



생명체의 시각과 인공 시각

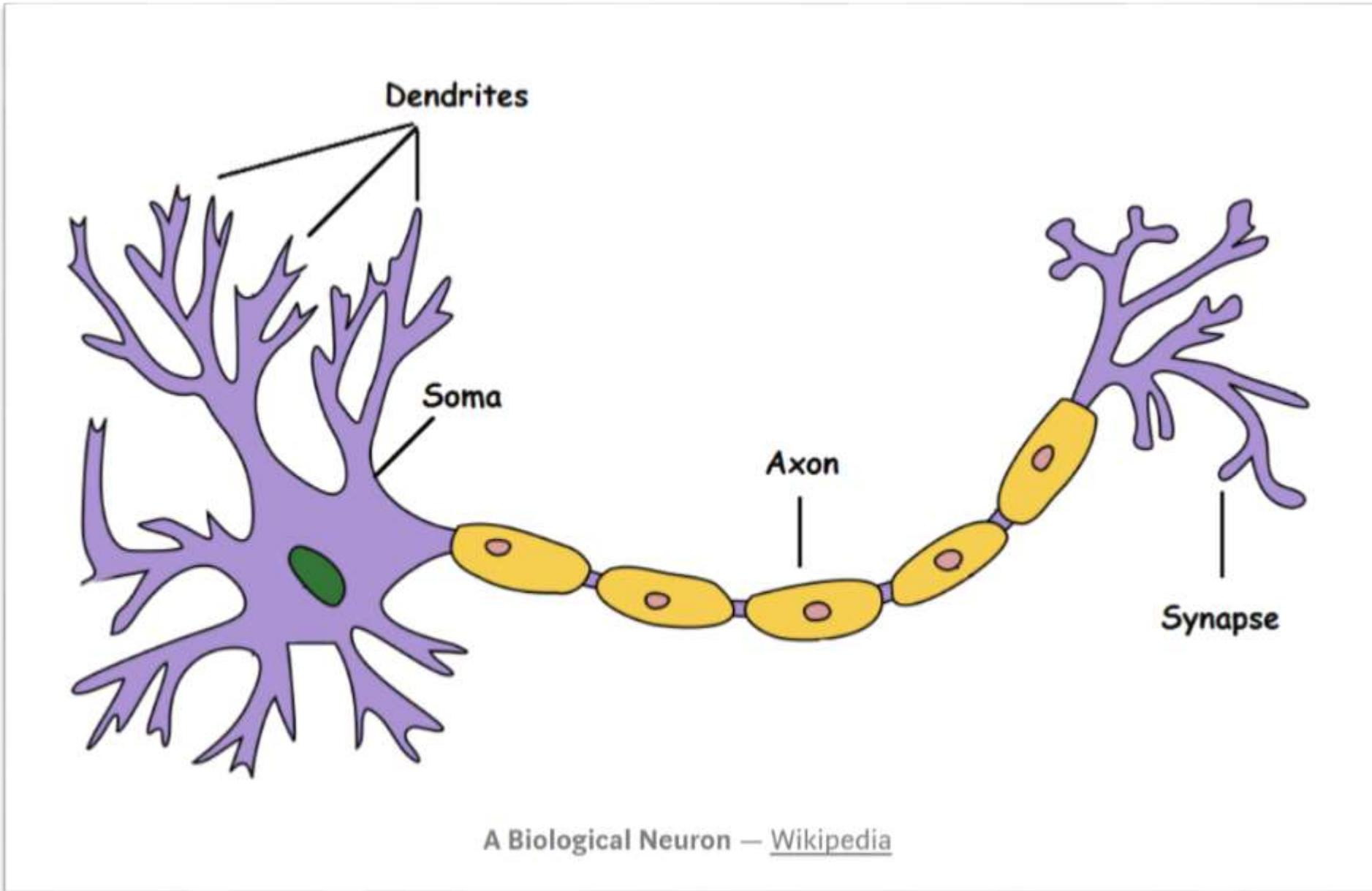


Along the **ventral stream** the human brain represents increasingly more complex visual features. The very same phenomenon emerges in **deep artificial neural networks** designed to classify visual images: each consecutive layer of a deep neural network codes for more complex visual features than the previous layer. In this study we compare **biological** and **artificial** visual processing systems.

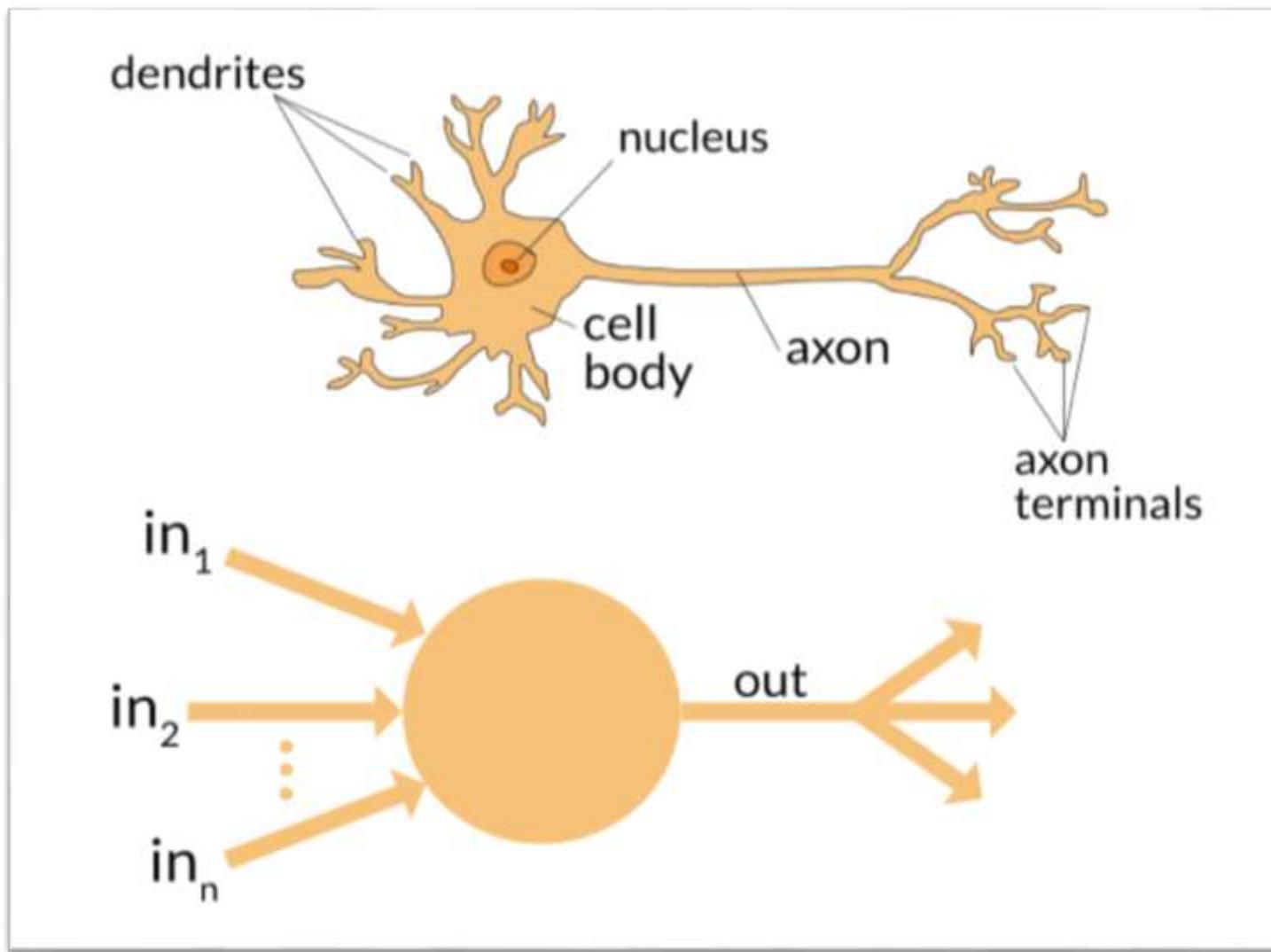


Source: Wikimedia

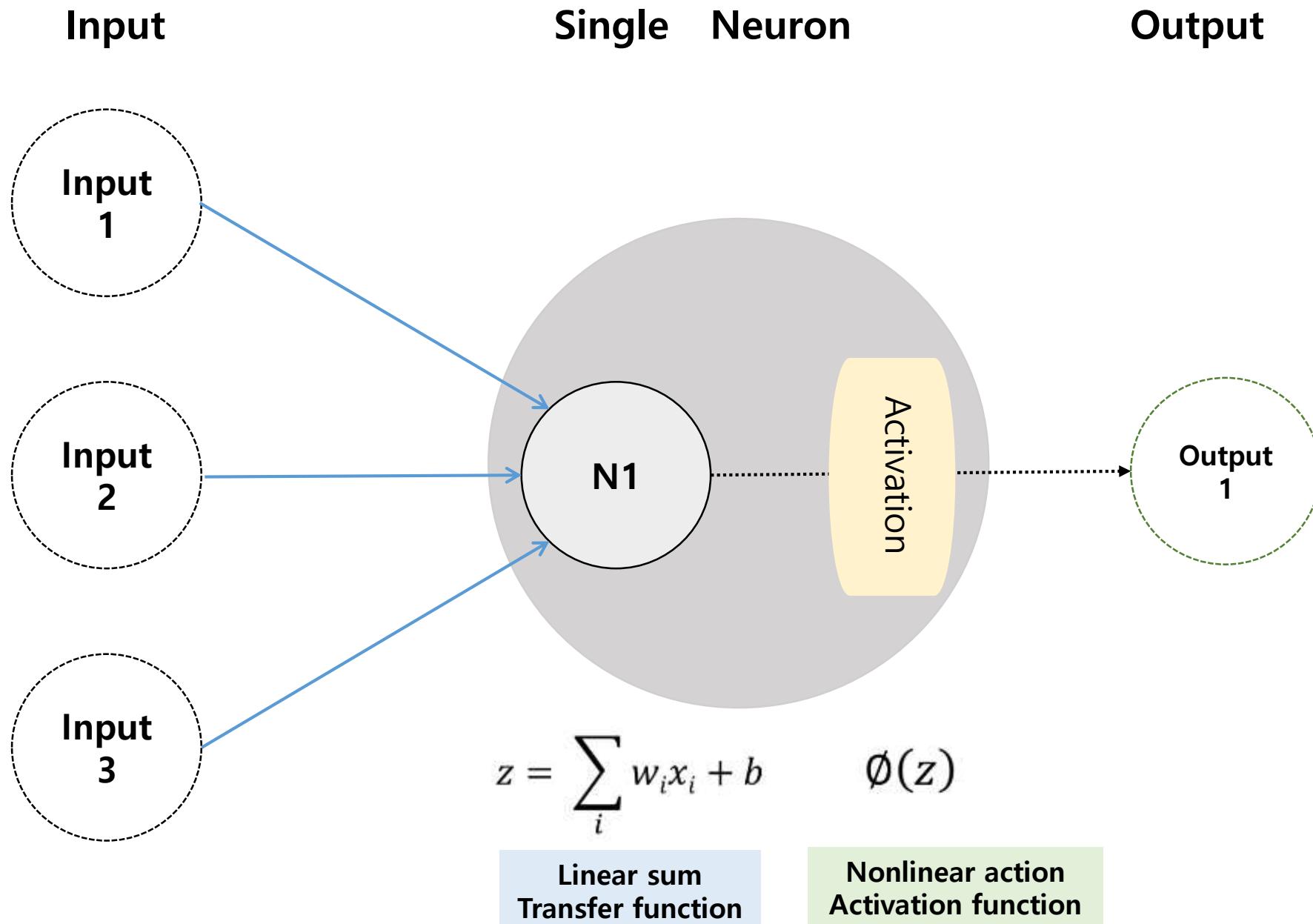
신경 세포 (Neuron)



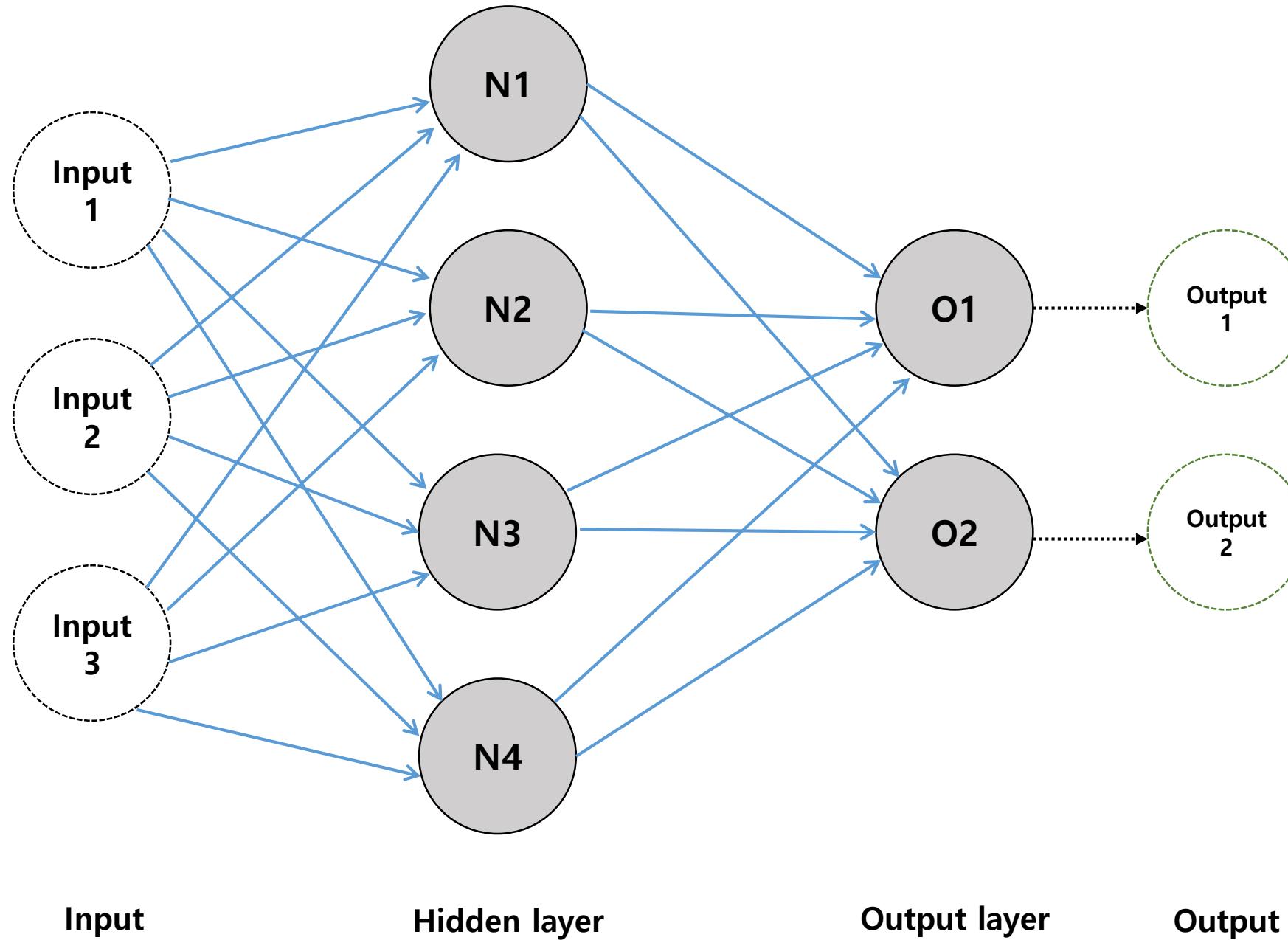
생체 신경세포와 인공신경



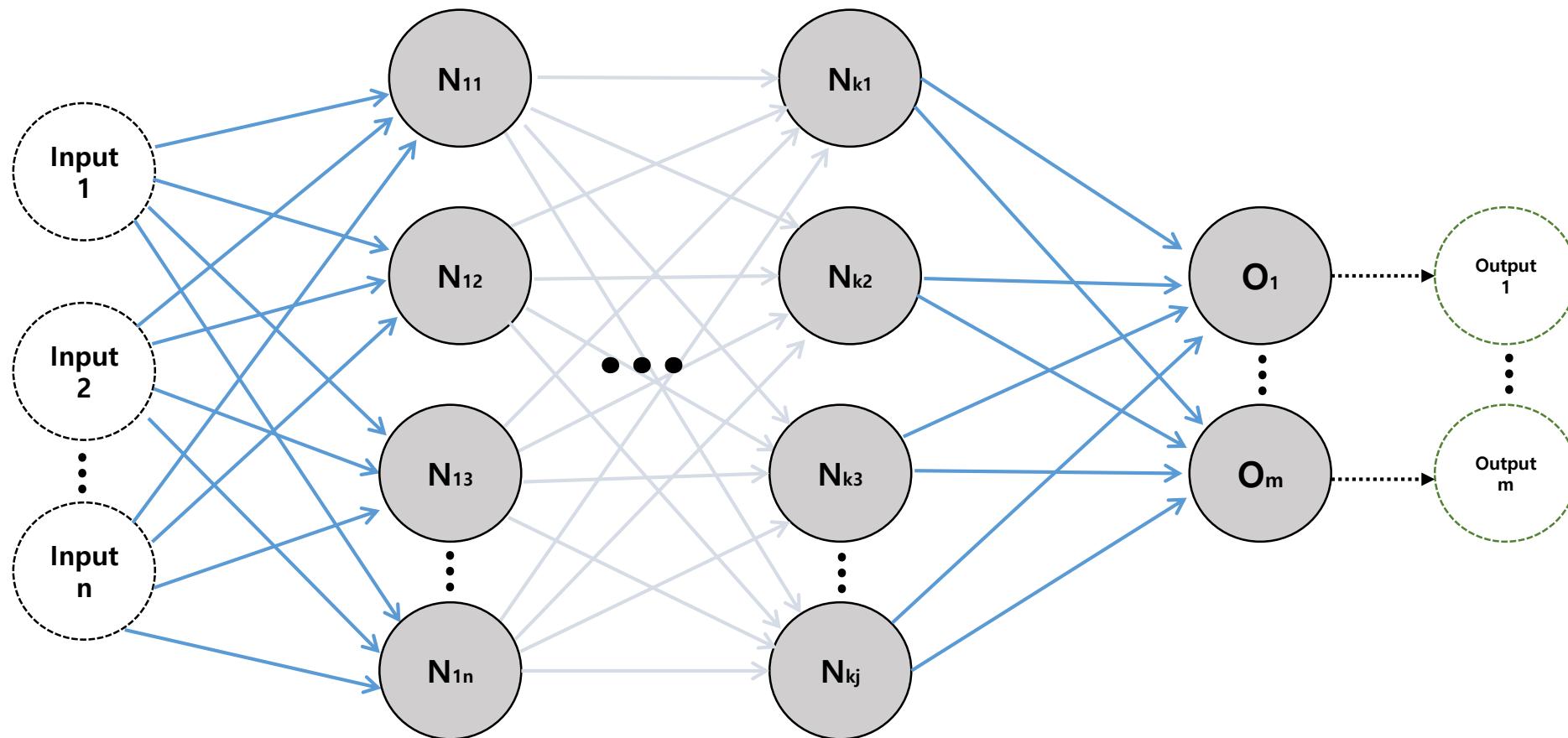
인공신경망



다층인공신경망 → 심층신경망



심층신경망 (Deep Neural Network → DL)



n-Input

k-Hidden layers → deep layer

m-Output layer

A mostly complete chart of

Neural Networks

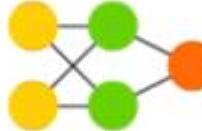
©2016 Fjodor van Veen - asimovinstitute.org

- (○) Backfed Input Cell
- (○) Input Cell
- (△) Noisy Input Cell
- (●) Hidden Cell
- (○) Probabilistic Hidden Cell
- (△) Spiking Hidden Cell
- (●) Output Cell
- (○) Match Input Output Cell
- (●) Recurrent Cell
- (○) Memory Cell
- (△) Different Memory Cell
- (●) Kernel
- (○) Convolution or Pool

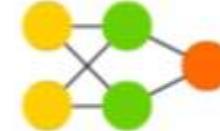
Perceptron (P)



Feed Forward (FF)



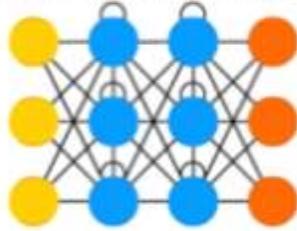
Radial Basis Network (RBF)



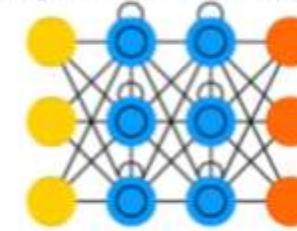
Deep Feed Forward (DFF)



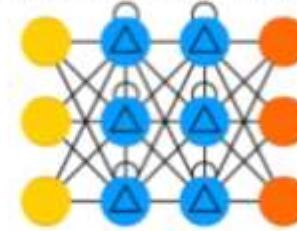
Recurrent Neural Network (RNN)



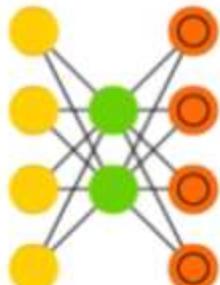
Long / Short Term Memory (LSTM)



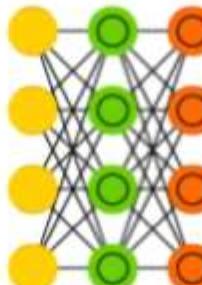
Gated Recurrent Unit (GRU)



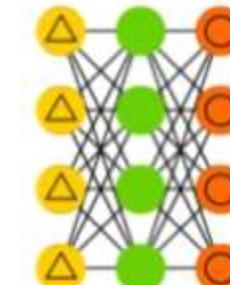
Auto Encoder (AE)



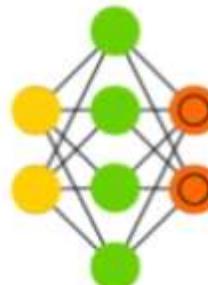
Variational AE (VAE)



Denoising AE (DAE)

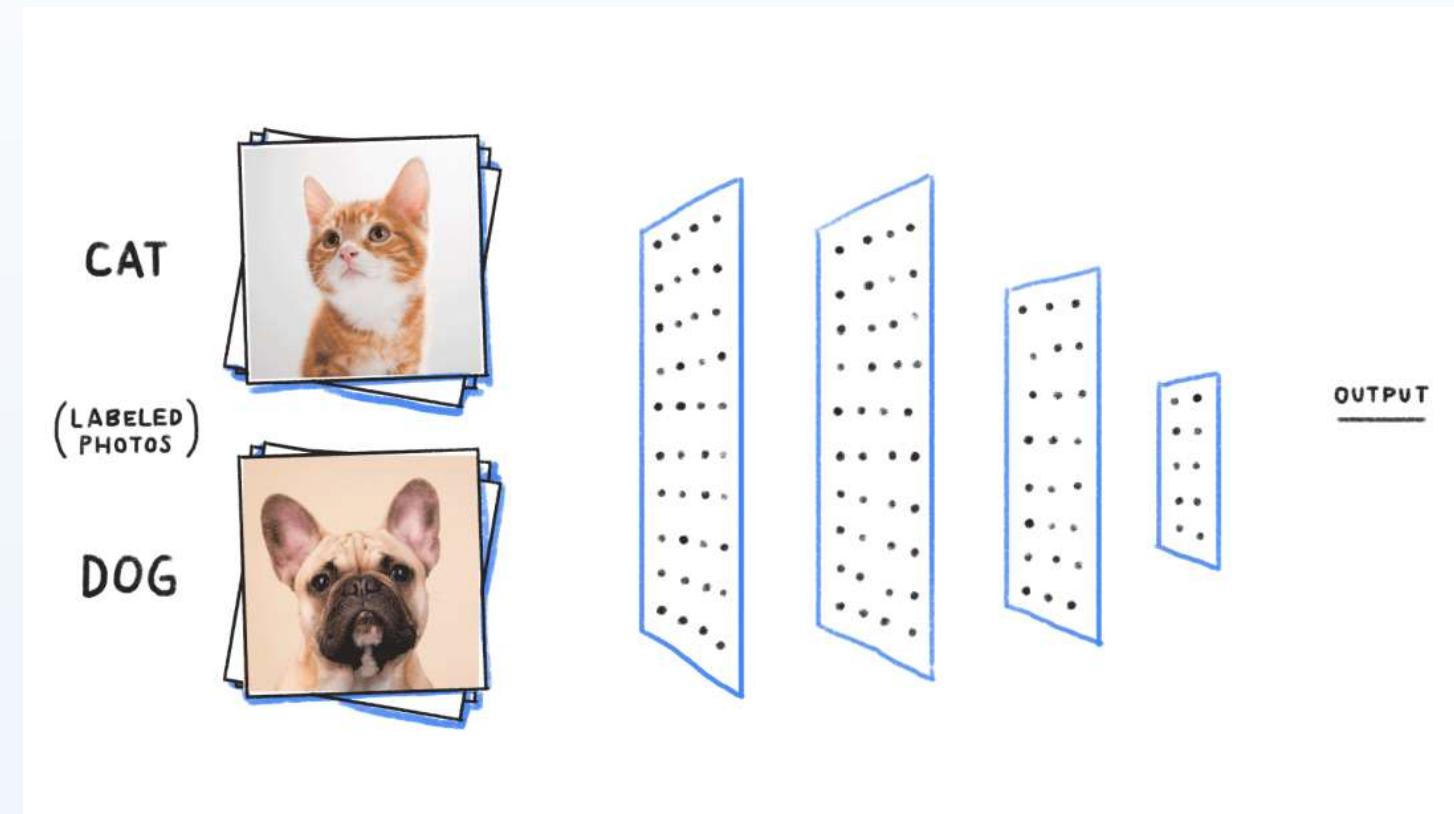


Sparse AE (SAE)

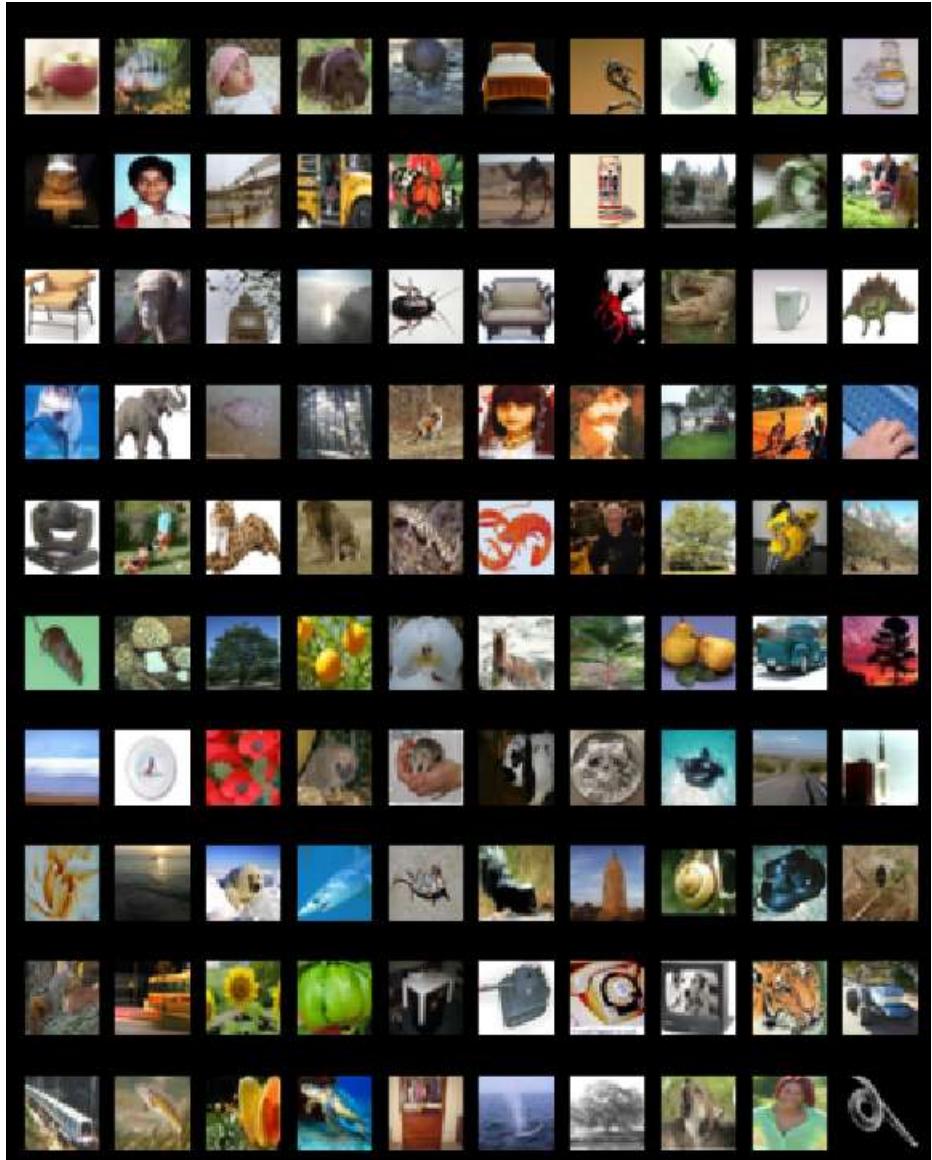
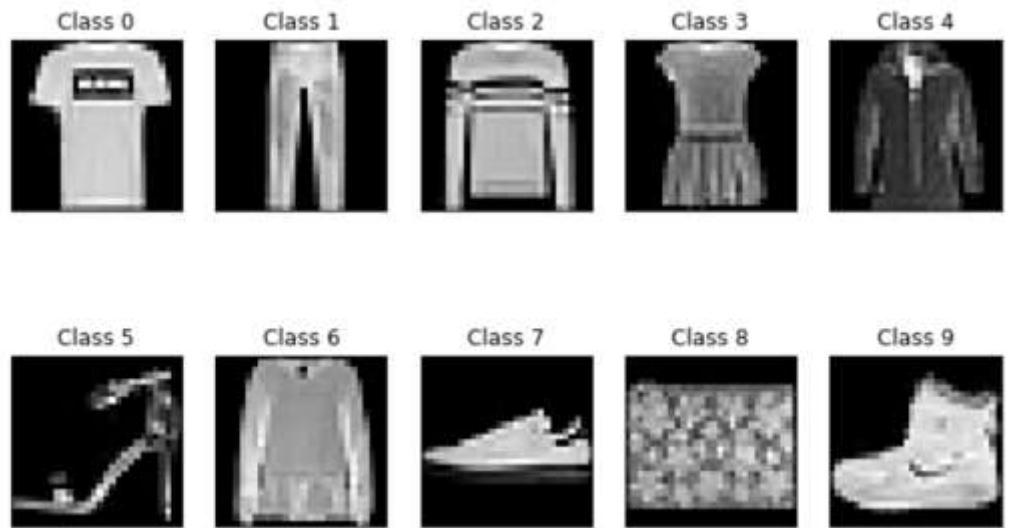
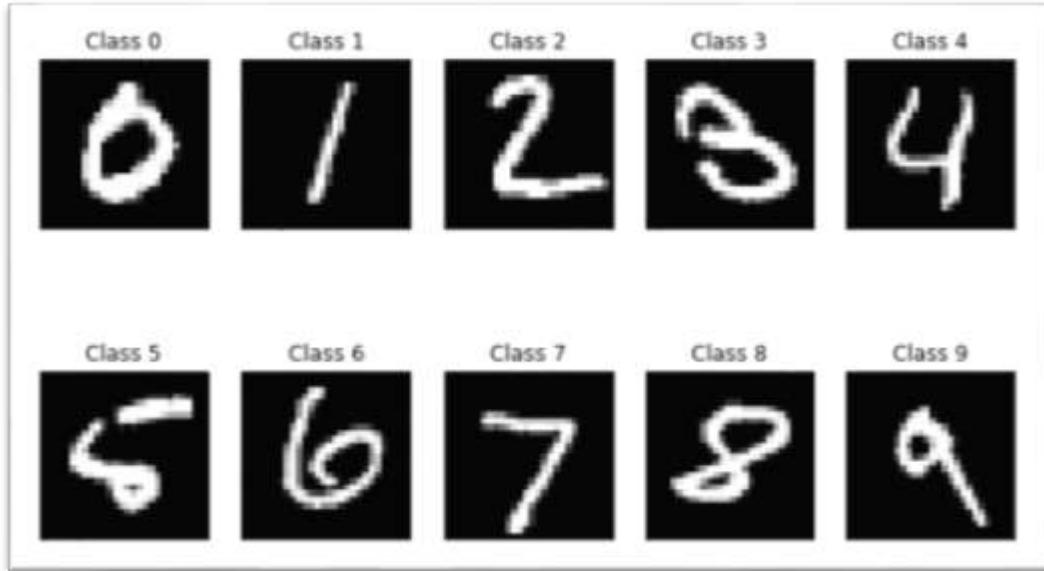


Deep Learning of Images

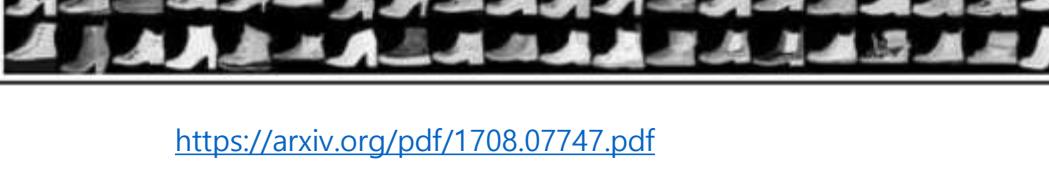
Conv2D Pooling



Sample data



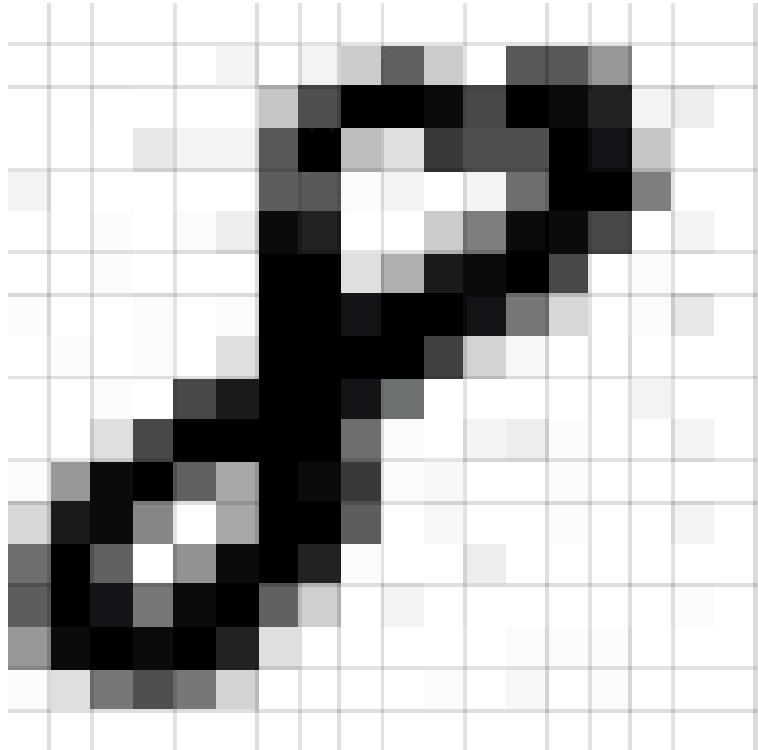
Sample data: Fashion MNIST

Label	Description	Examples
0	T-Shirt/Top	
1	Trouser	
2	Pullover	
3	Dress	
4	Coat	
5	Sandals	
6	Shirt	
7	Sneaker	
8	Bag	
9	Ankle boots	

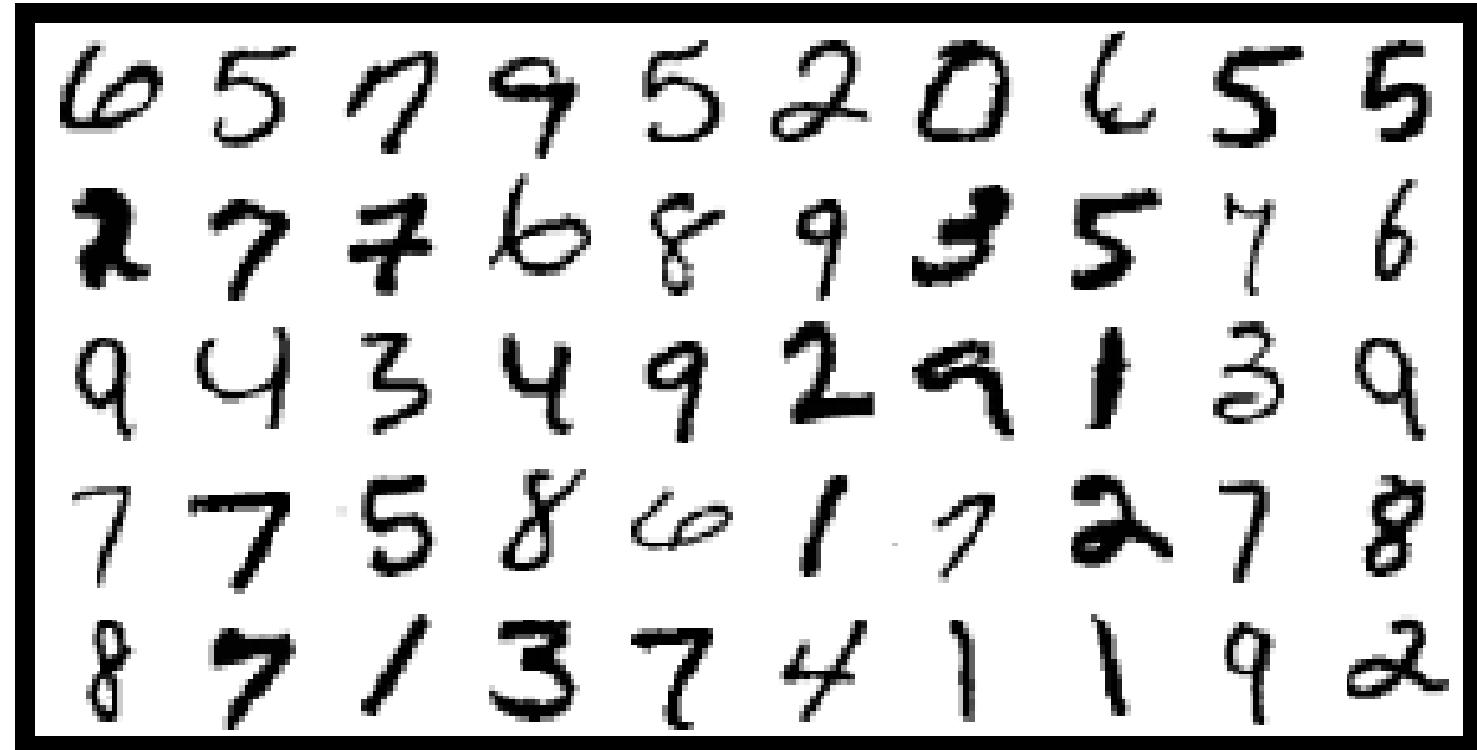
Sample data: Fashion MNIST



MNIST

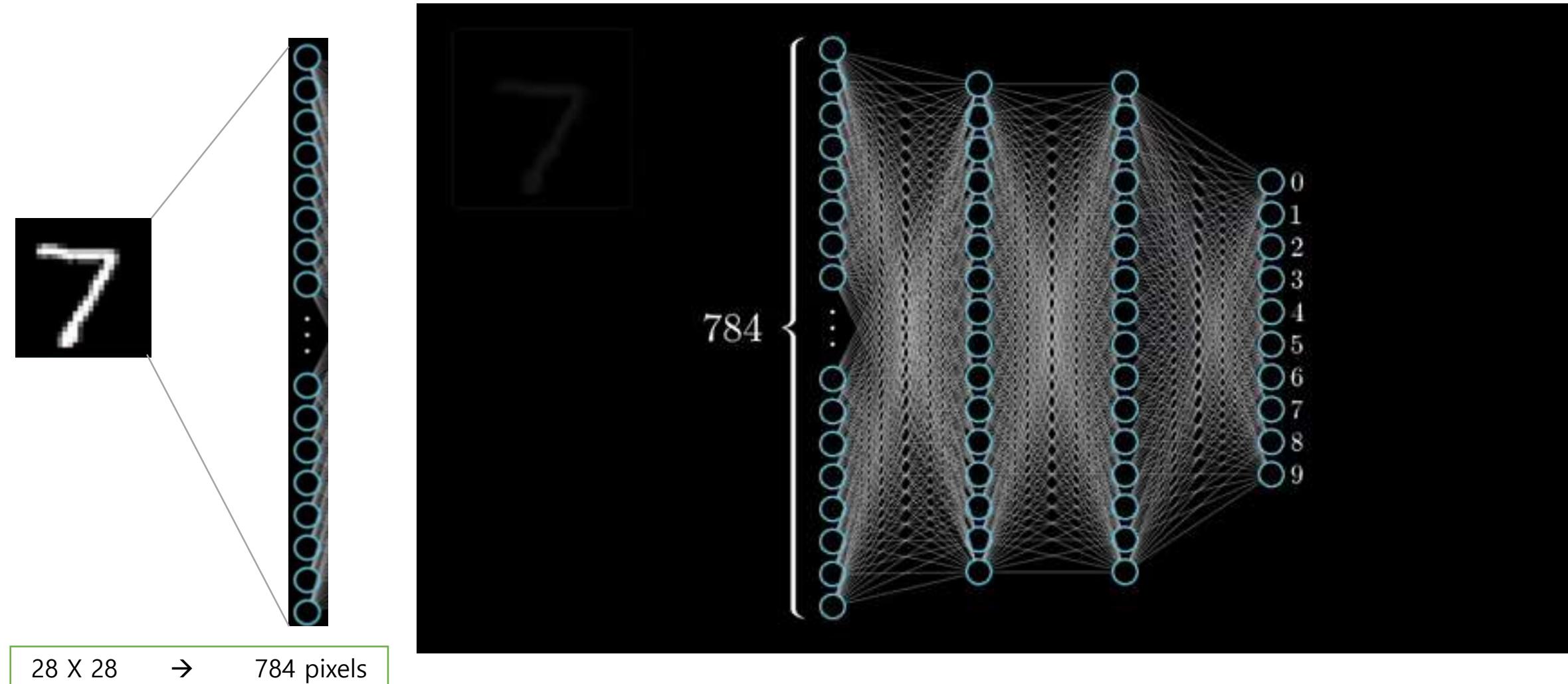


28 X 28 : 784 pixels
Gray scale [0 ~ 255]

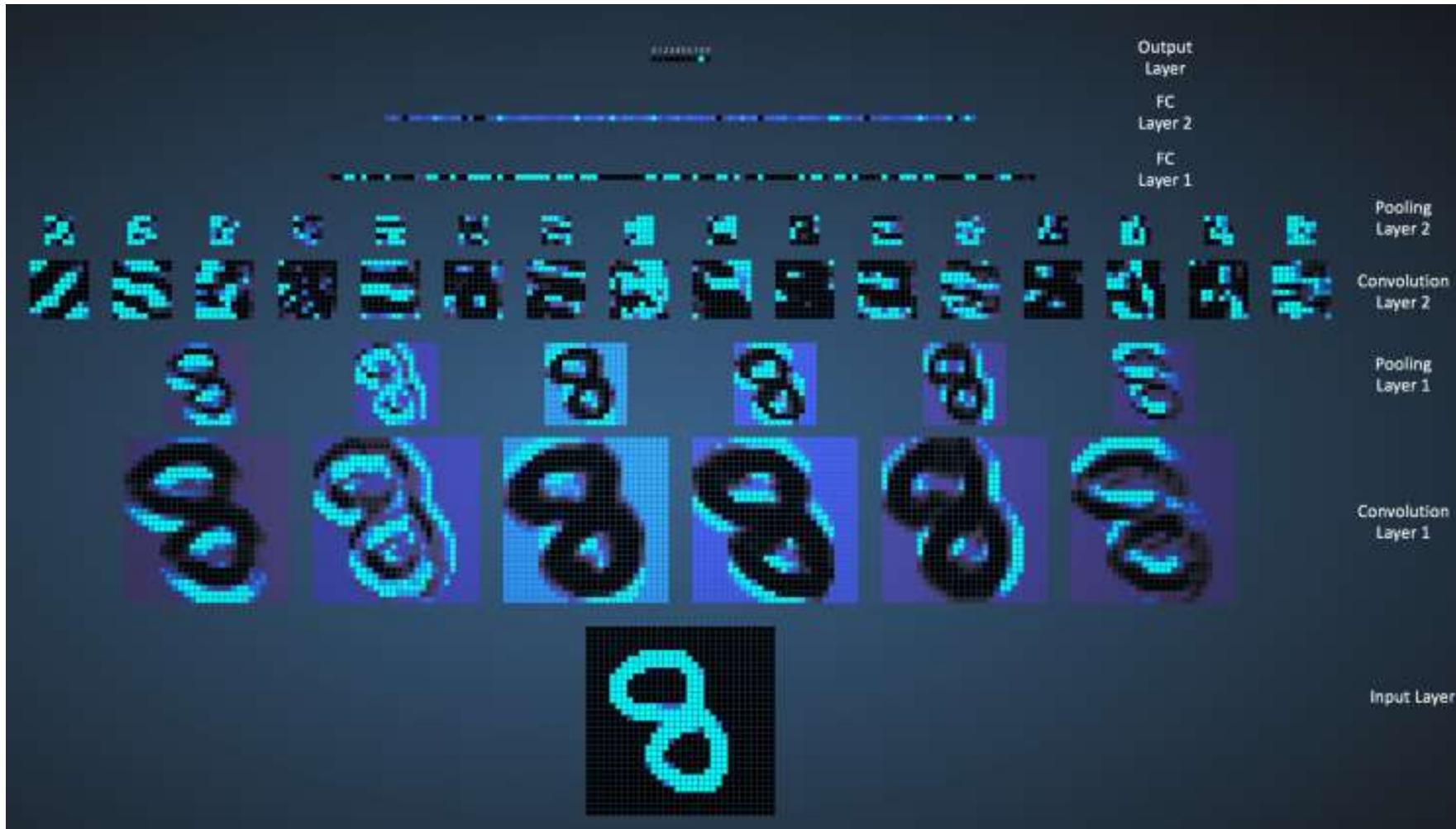


MLP: Multi-Layer Perceptron (90%)

Fully Connected Network (FCN)



CNN2D: Convolution & Pooling (99%)

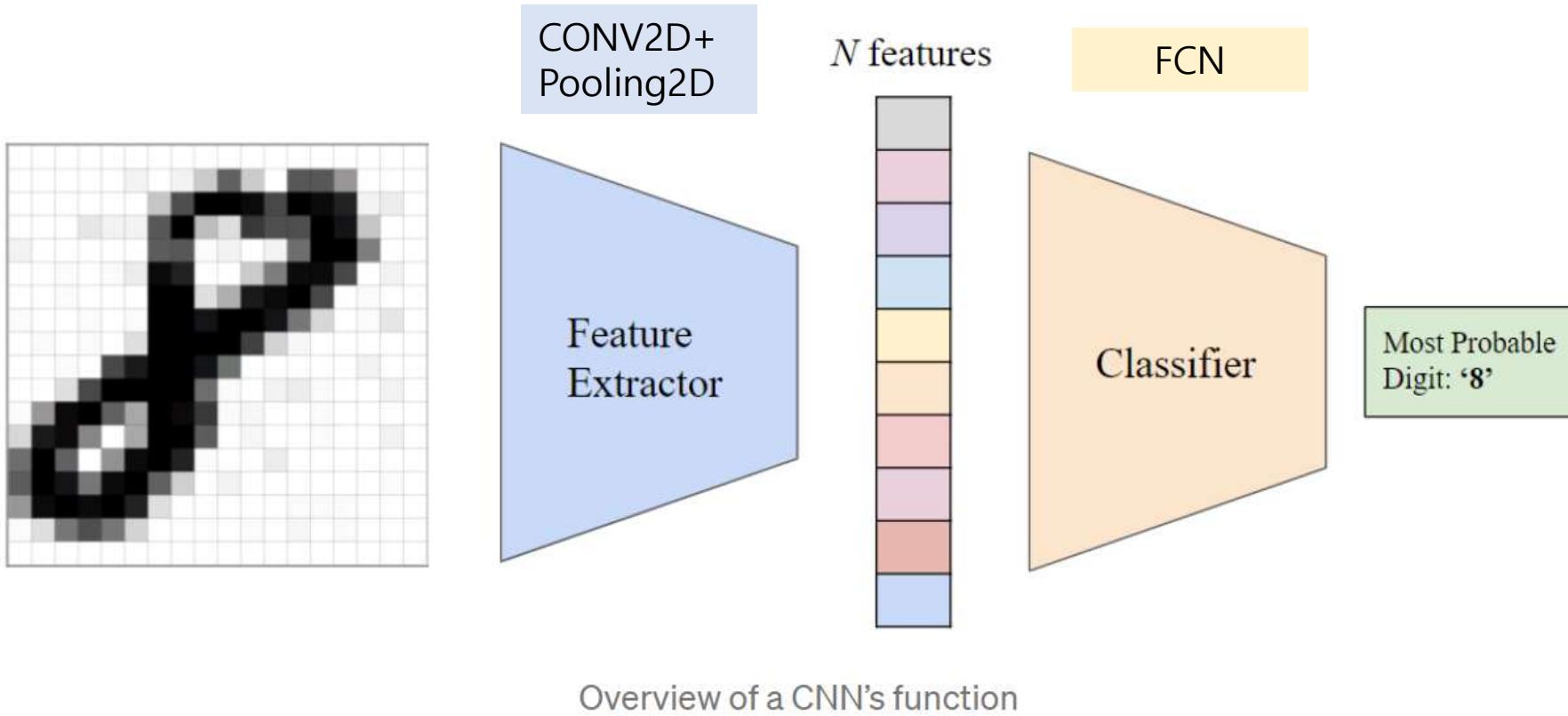


<http://scs.ryerson.ca/~aharley/vis/conv/flat.html>

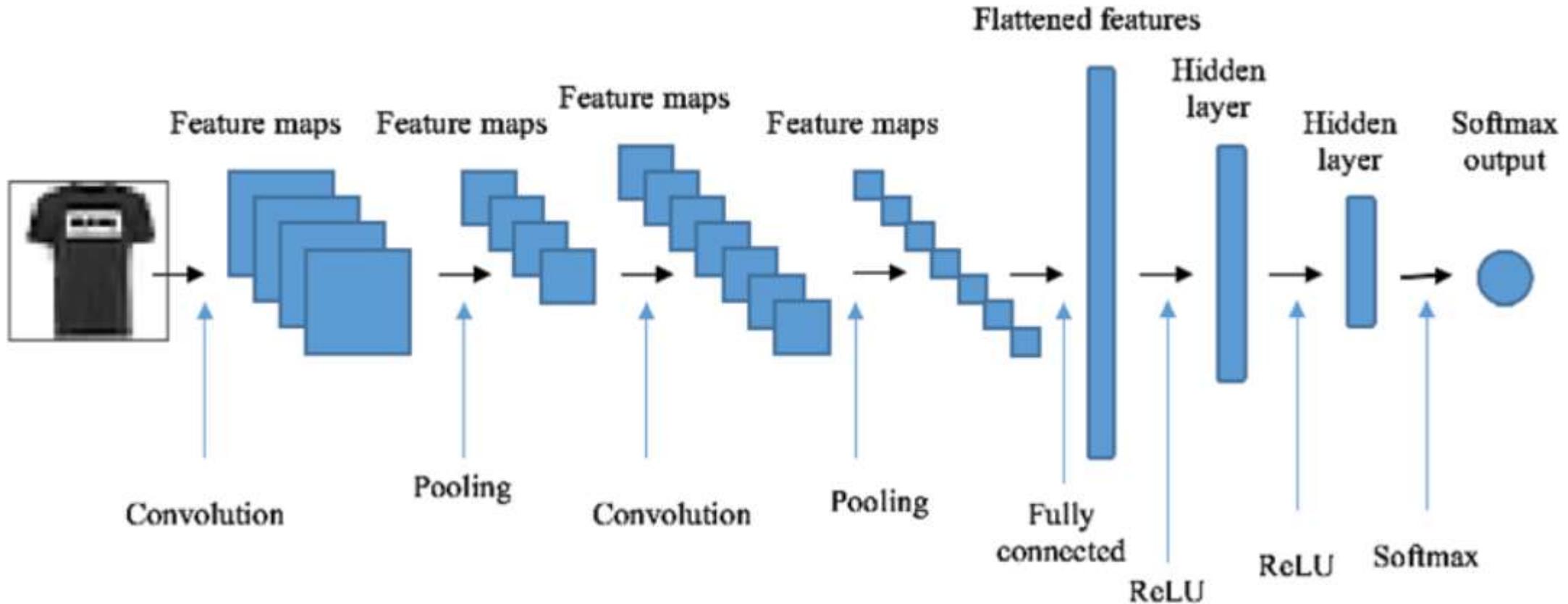
http://chaos.inje.ac.kr:3030/cnn_vis/conv/flat.html

https://link.springer.com/chapter/10.1007%2F978-3-319-27857-5_77

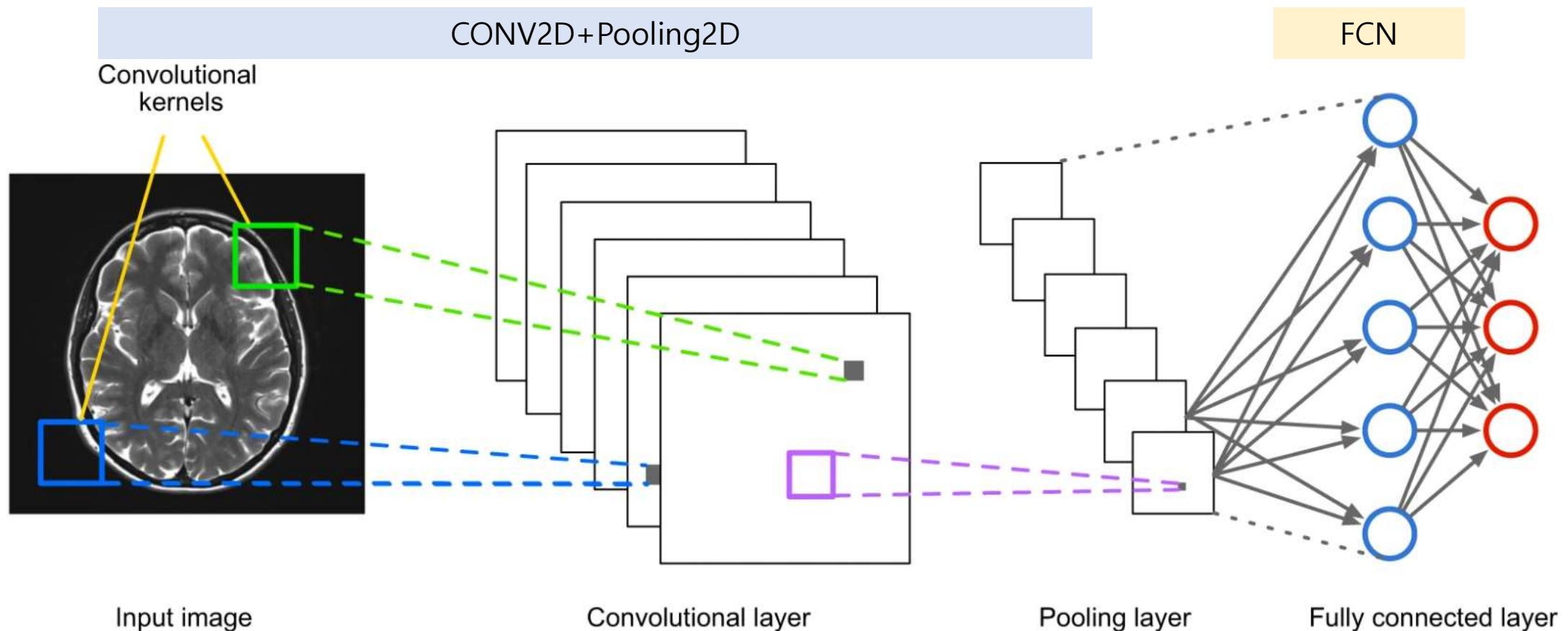
Easy DL - CNN



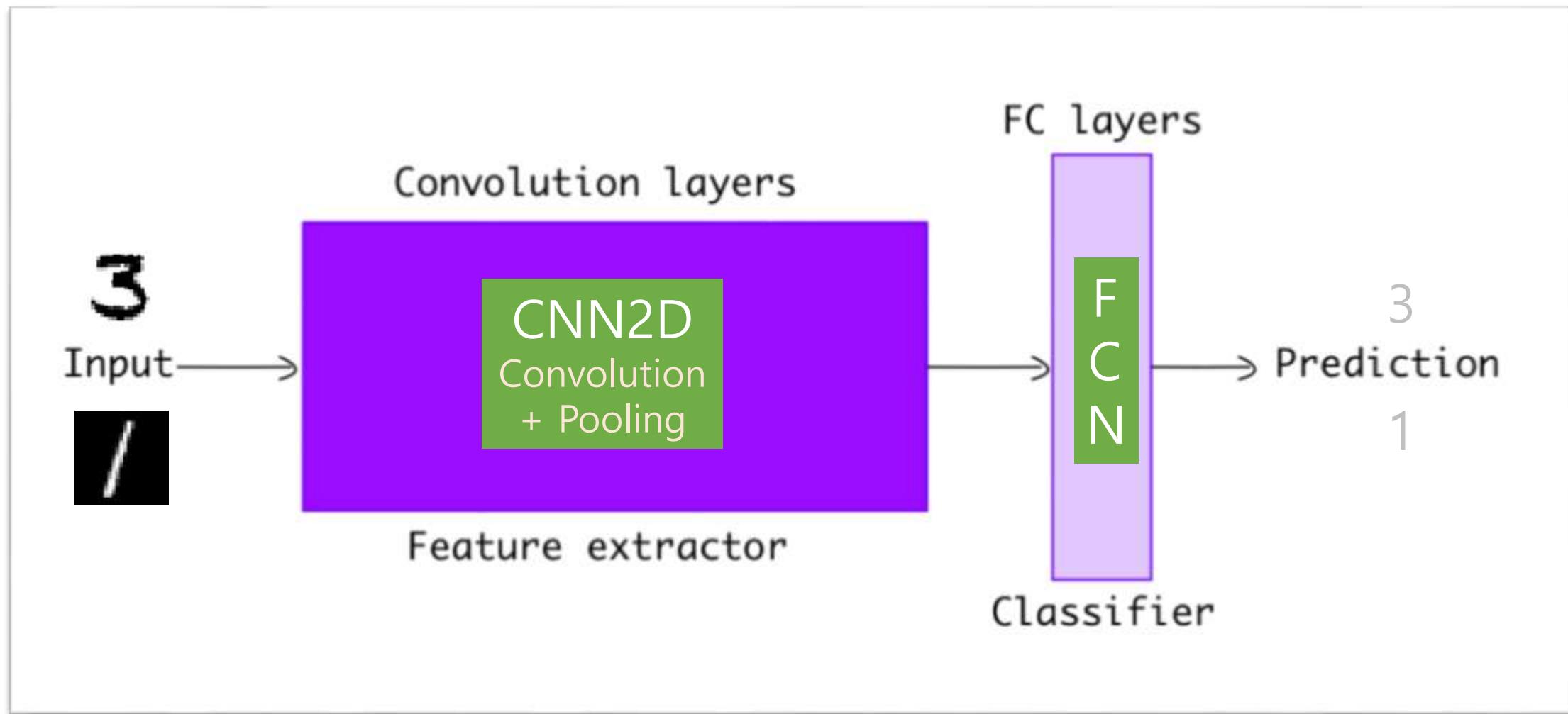
Basic DL - CNN



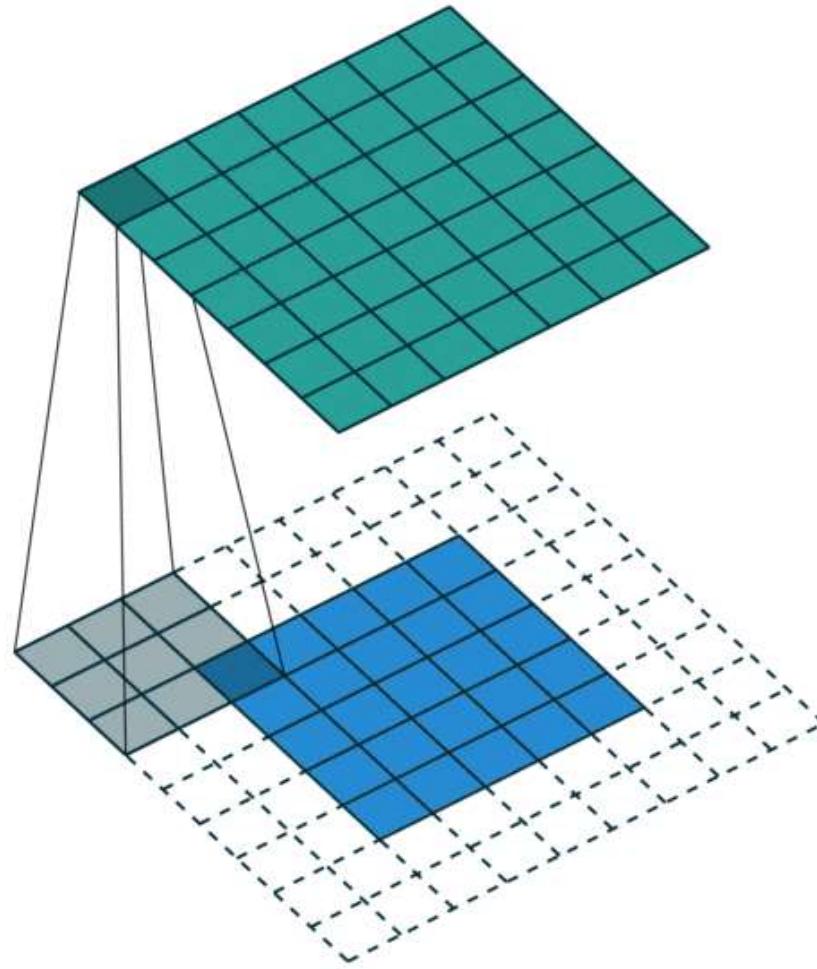
Applied DL - CNN



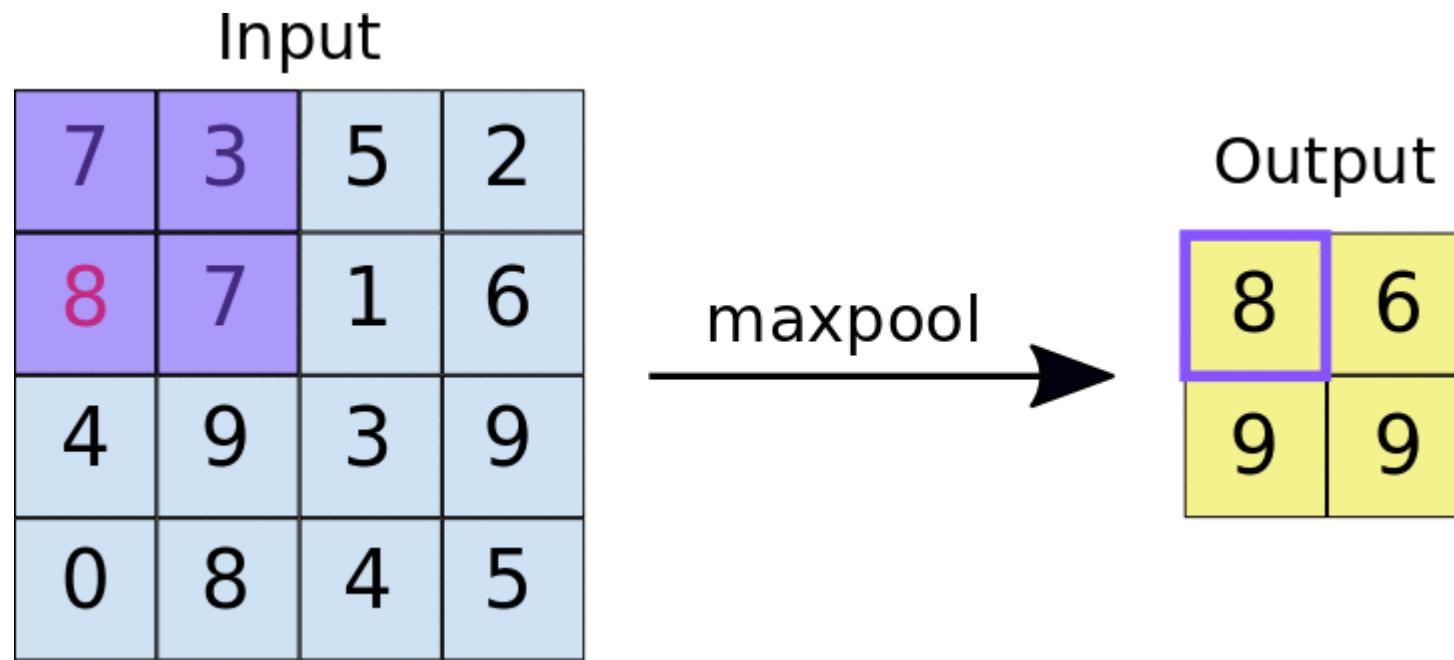
CNN2D + FCN



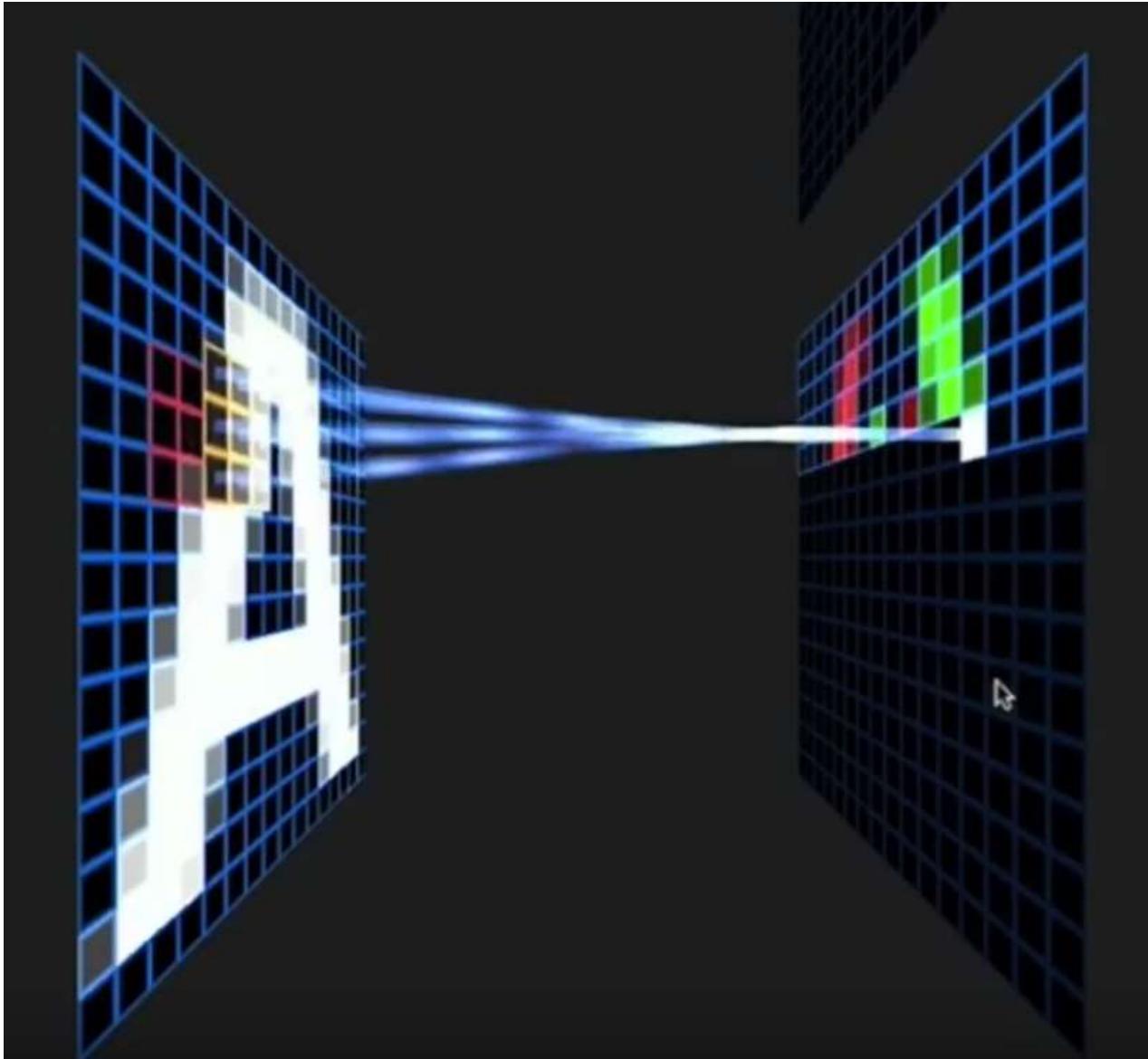
Conv2D



Max-Pooling

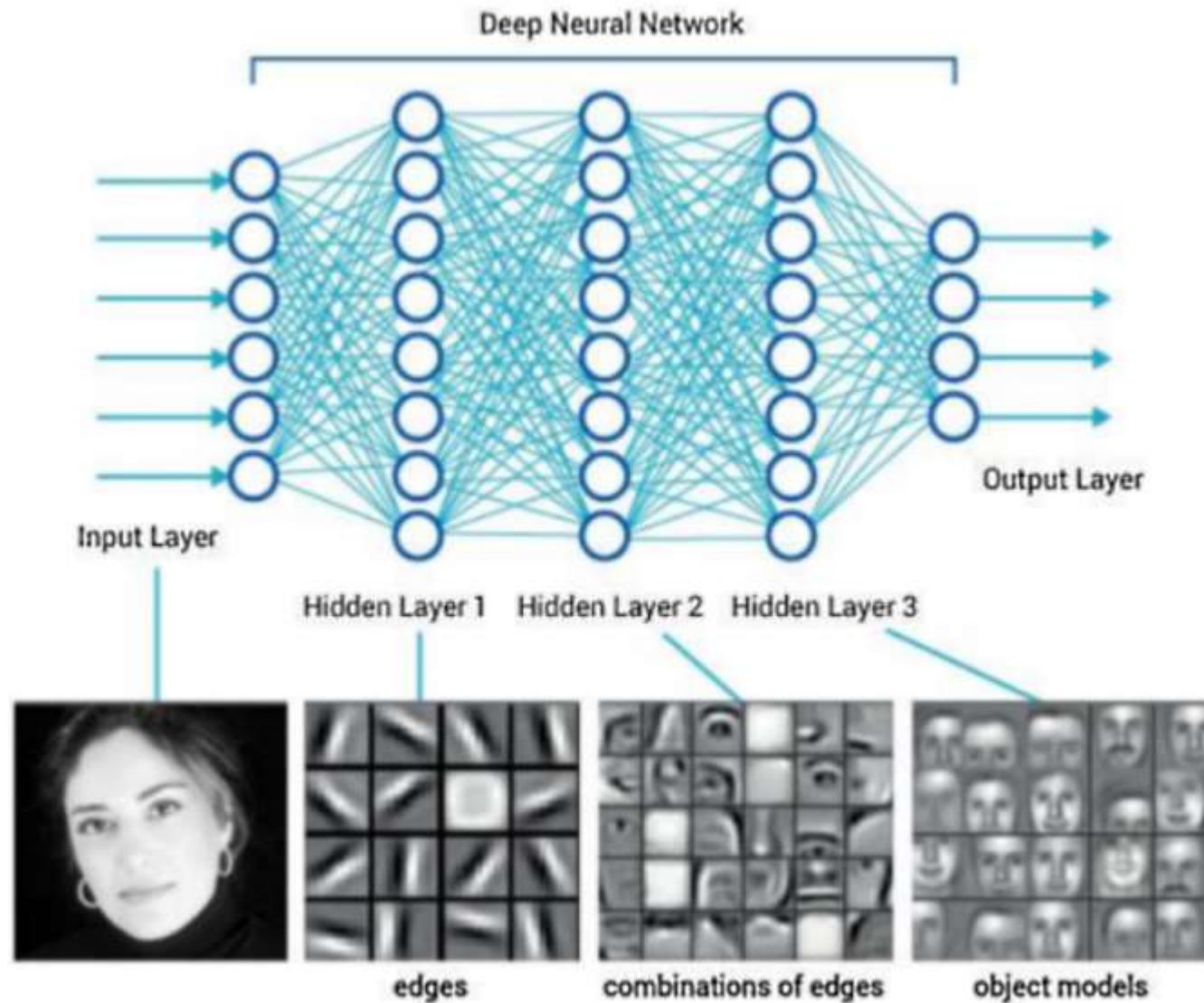


Convolution & Pooling



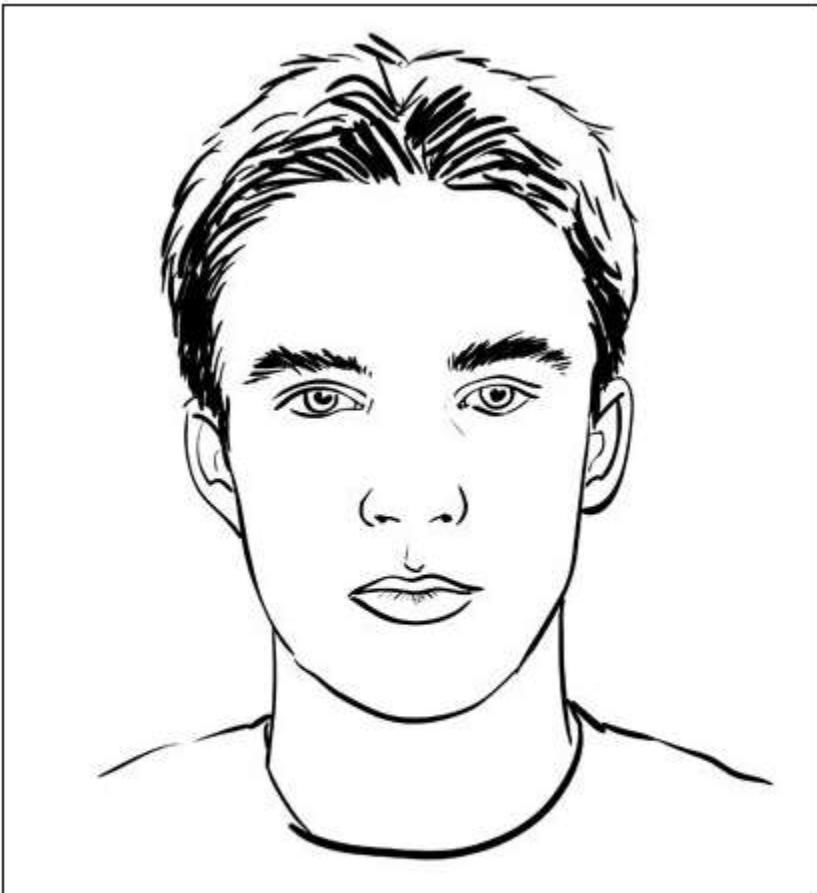
<https://www.youtube.com/watch?v=f0t-OCG79-U>

How does DL work on images?

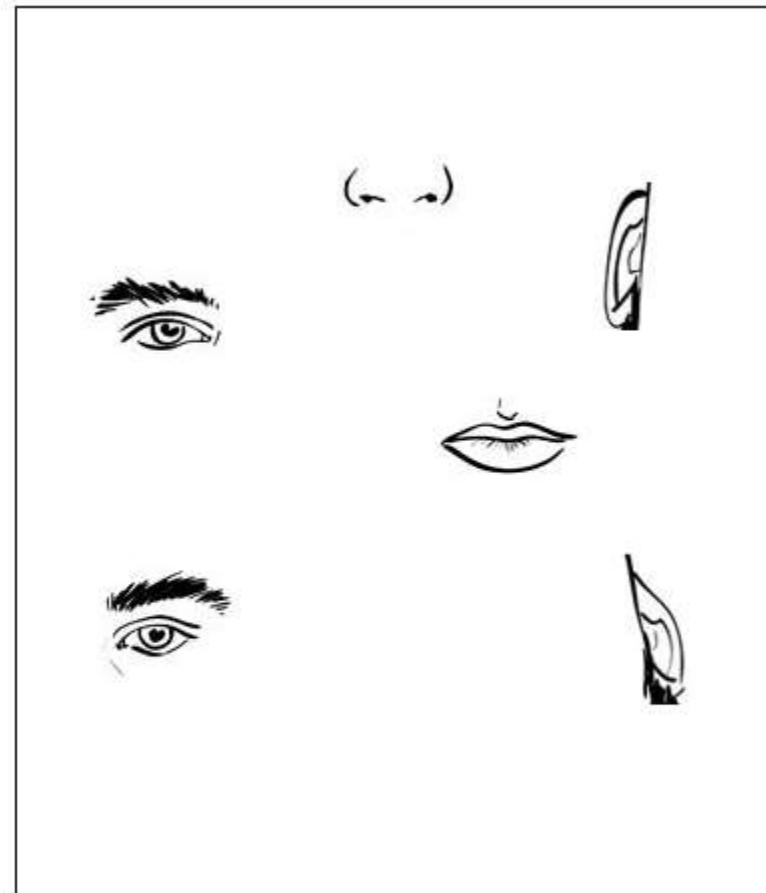


How does DL work on images?

Human



AI

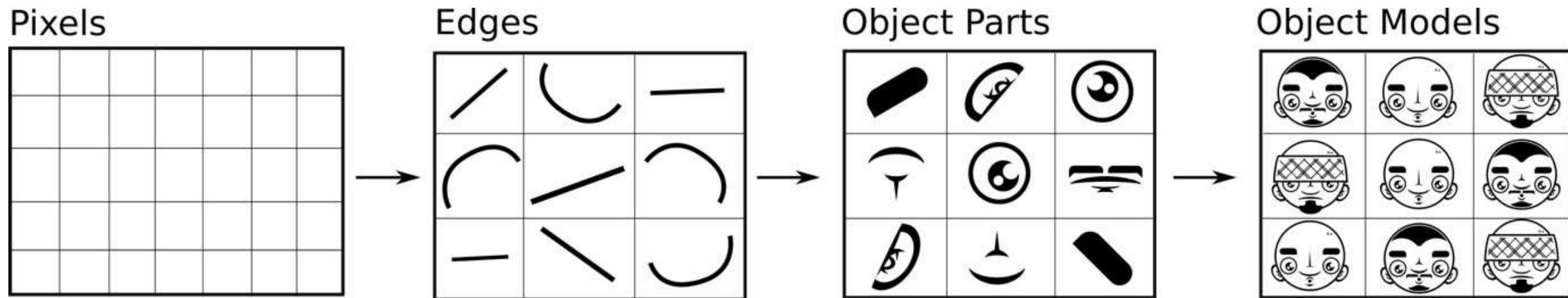


Face

Face

How does DL work on images?

AI는 부분들의 확률을 조합해서 객체를 판단한다.

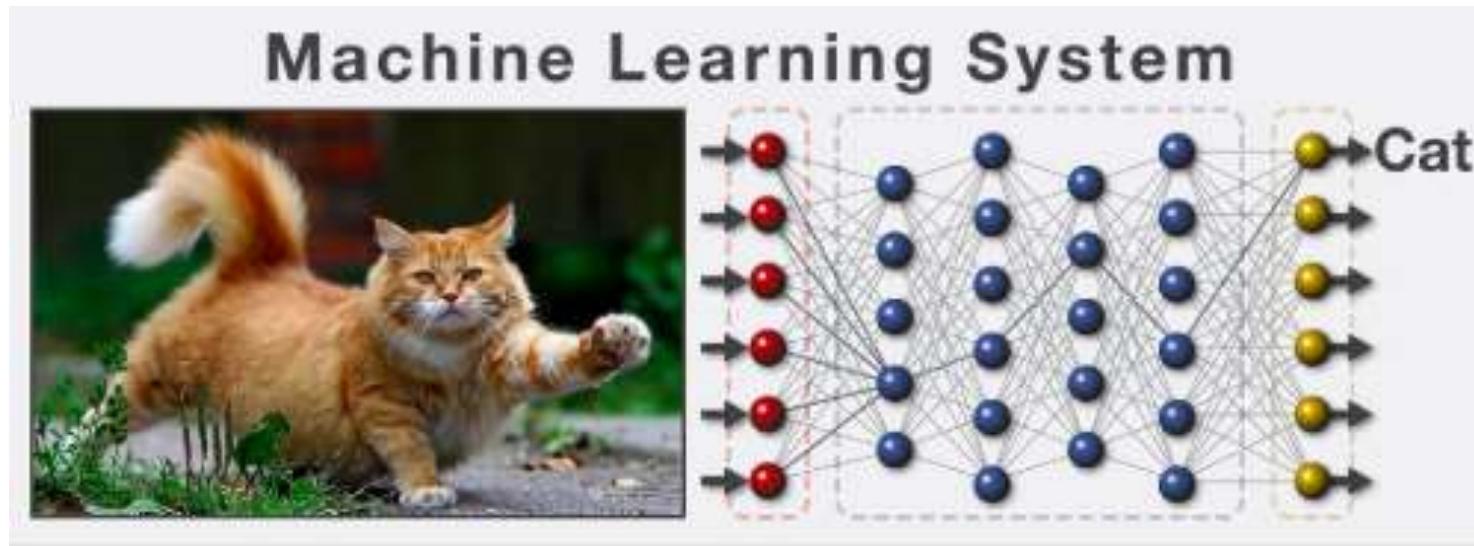


Series of higher-level representations that begin on input data.

Y. LeCun, Y. Bengio & G. Hinton. "Deep Learning". Nature 521,
436–444 (28 May 2015) doi:10.1038/nature14539

How can we understand DL works on images?

AI는 부분들의 확률을 조합해서 객체를 판단한다.



This is a cat.

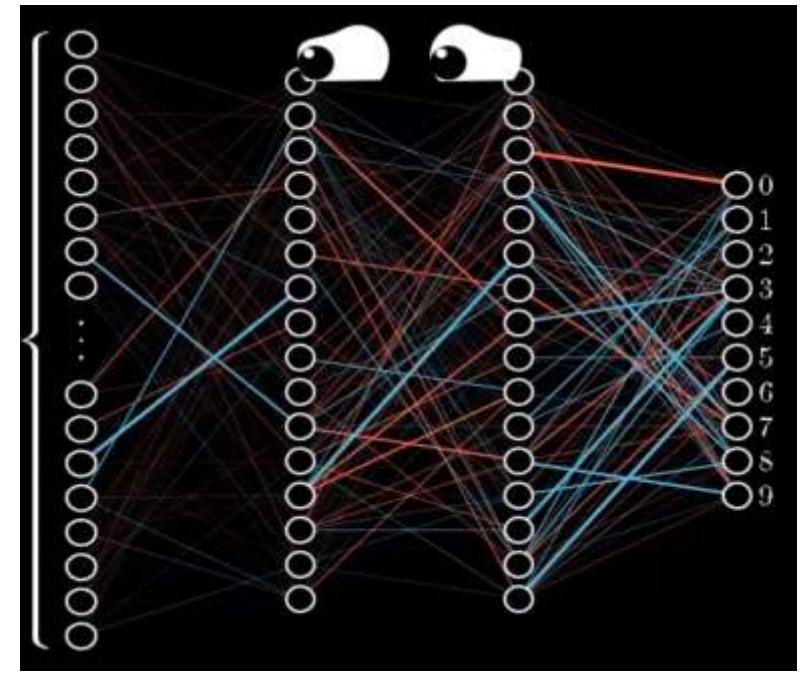
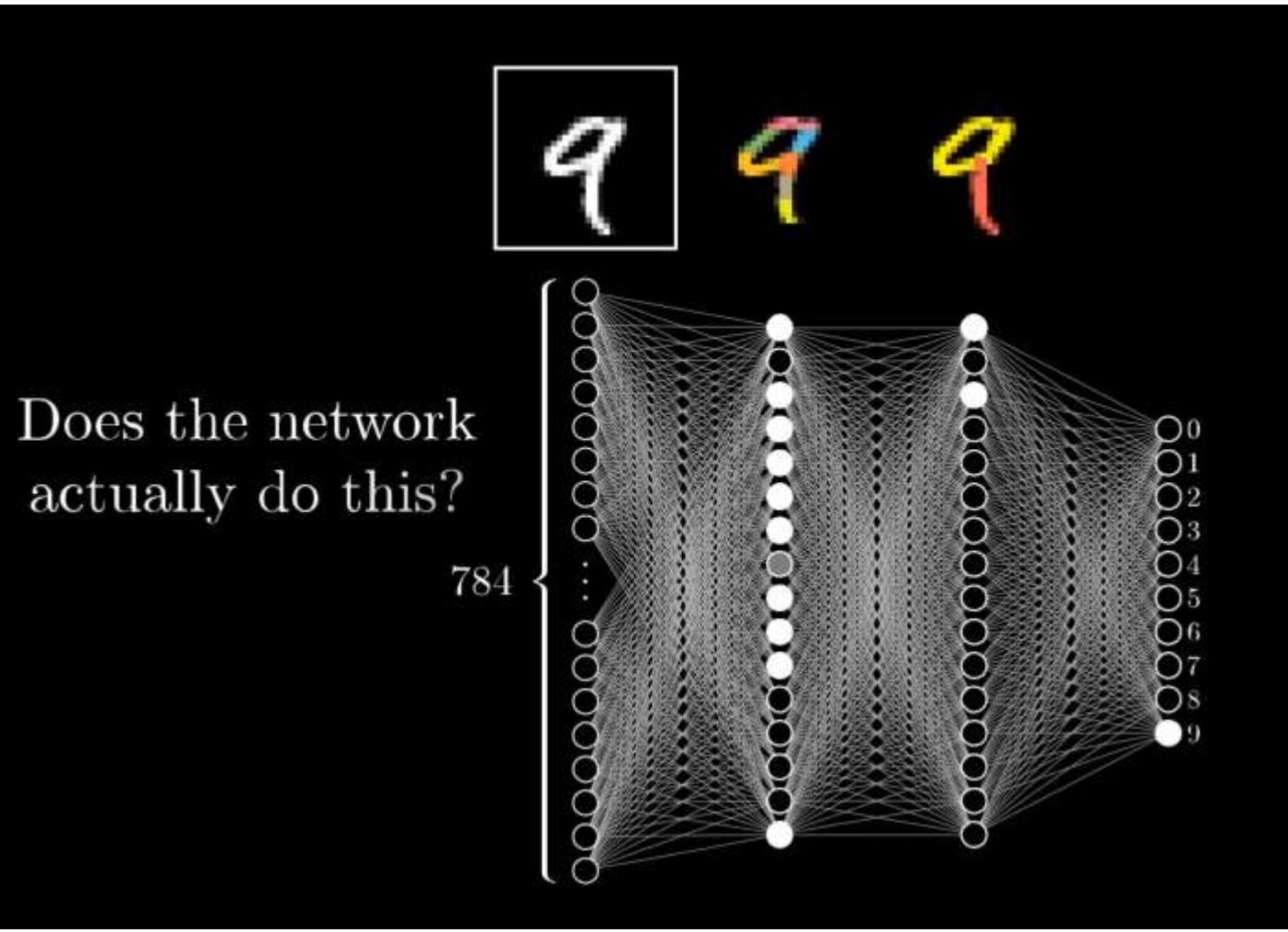
Current Explanation

This is a cat:

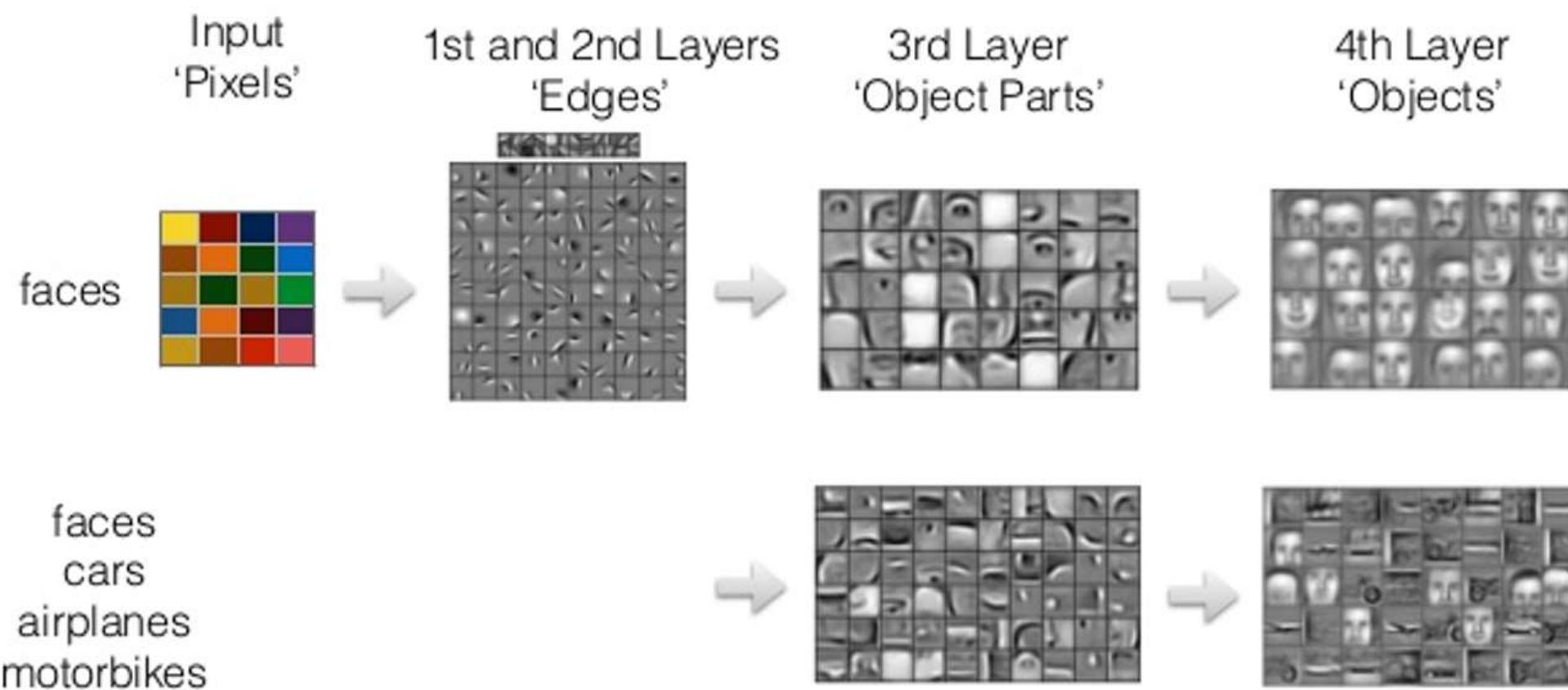
- It has fur, whiskers, and claws.
- It has this feature:

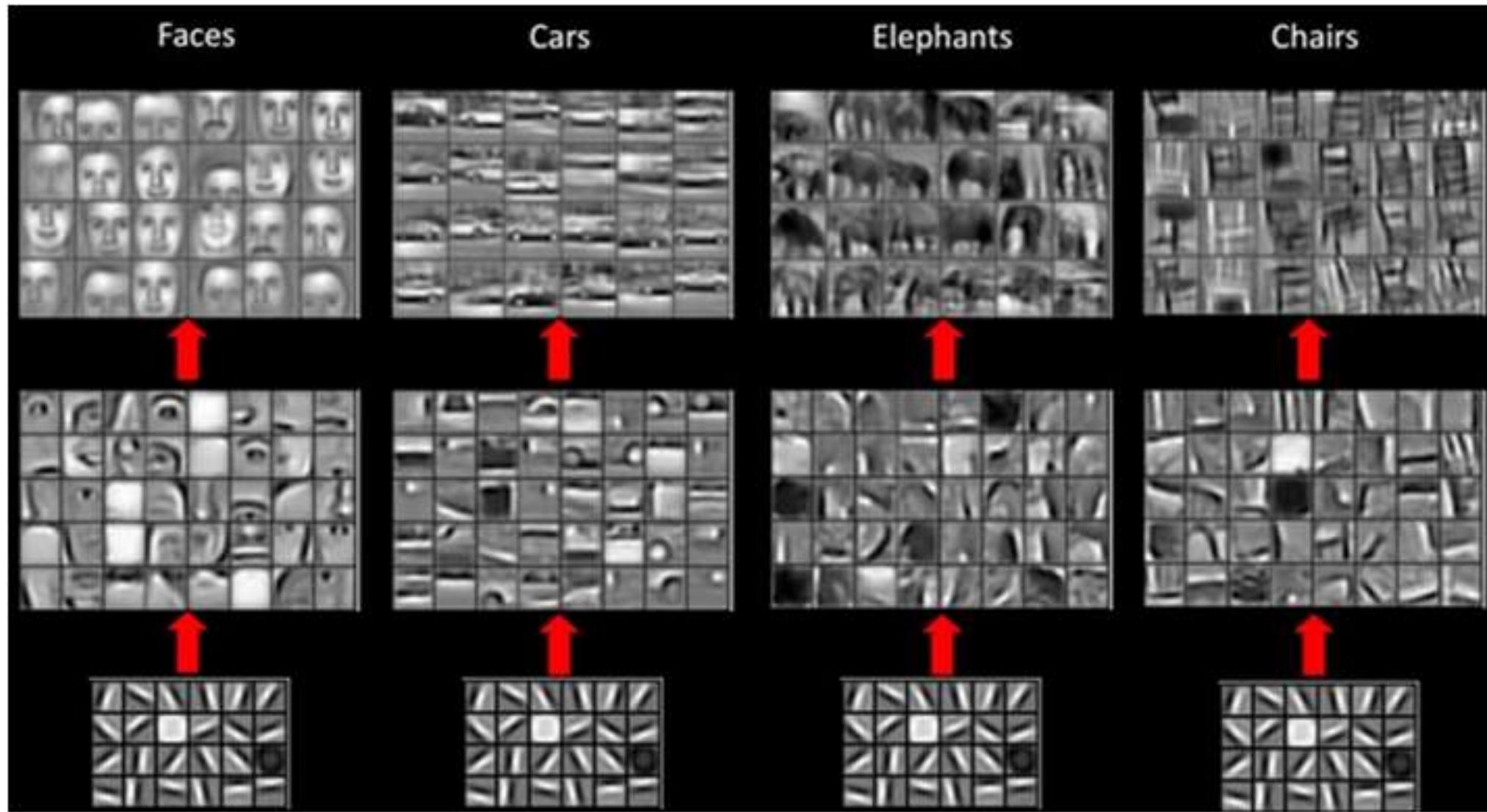


XAI Explanation

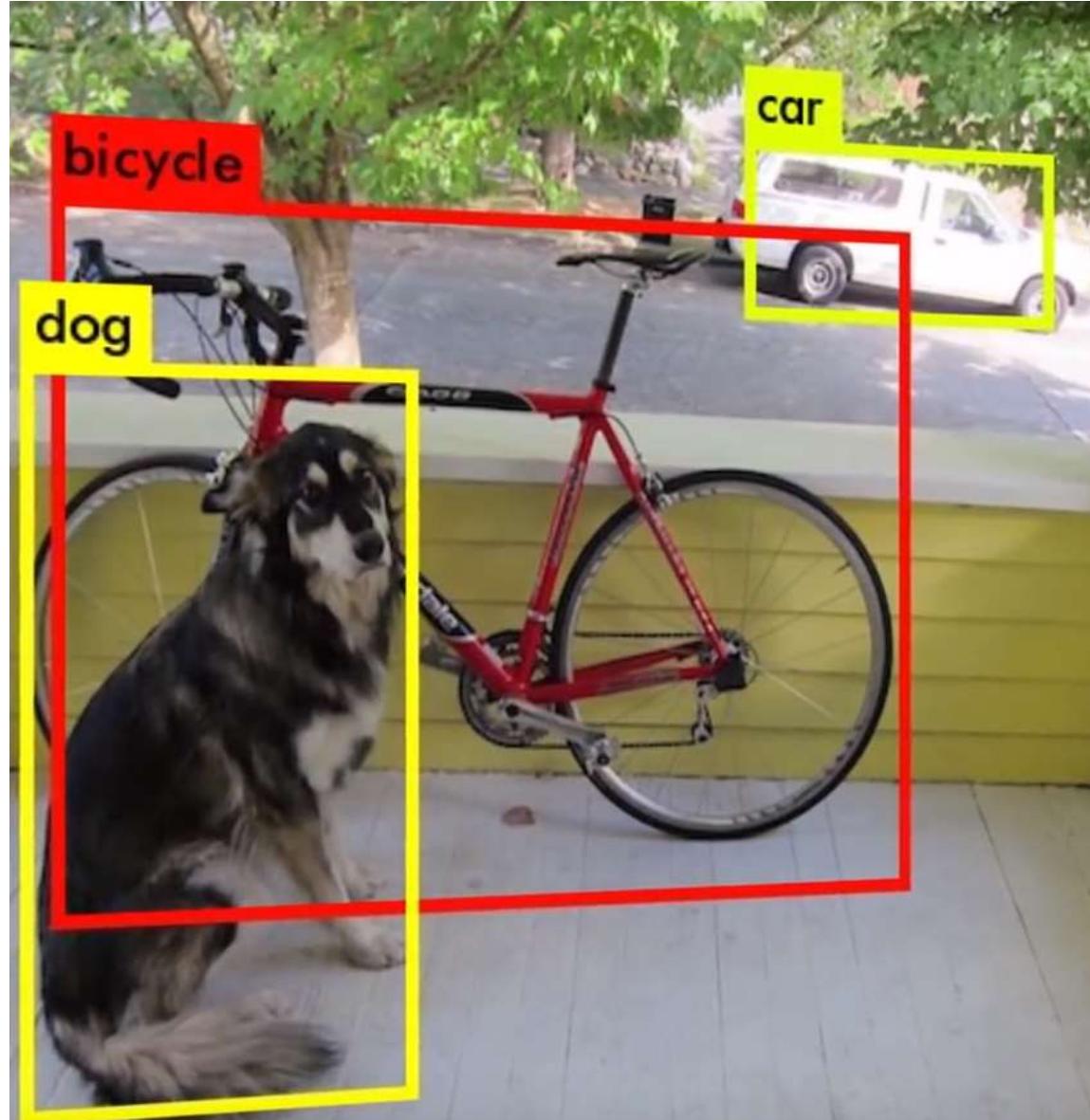


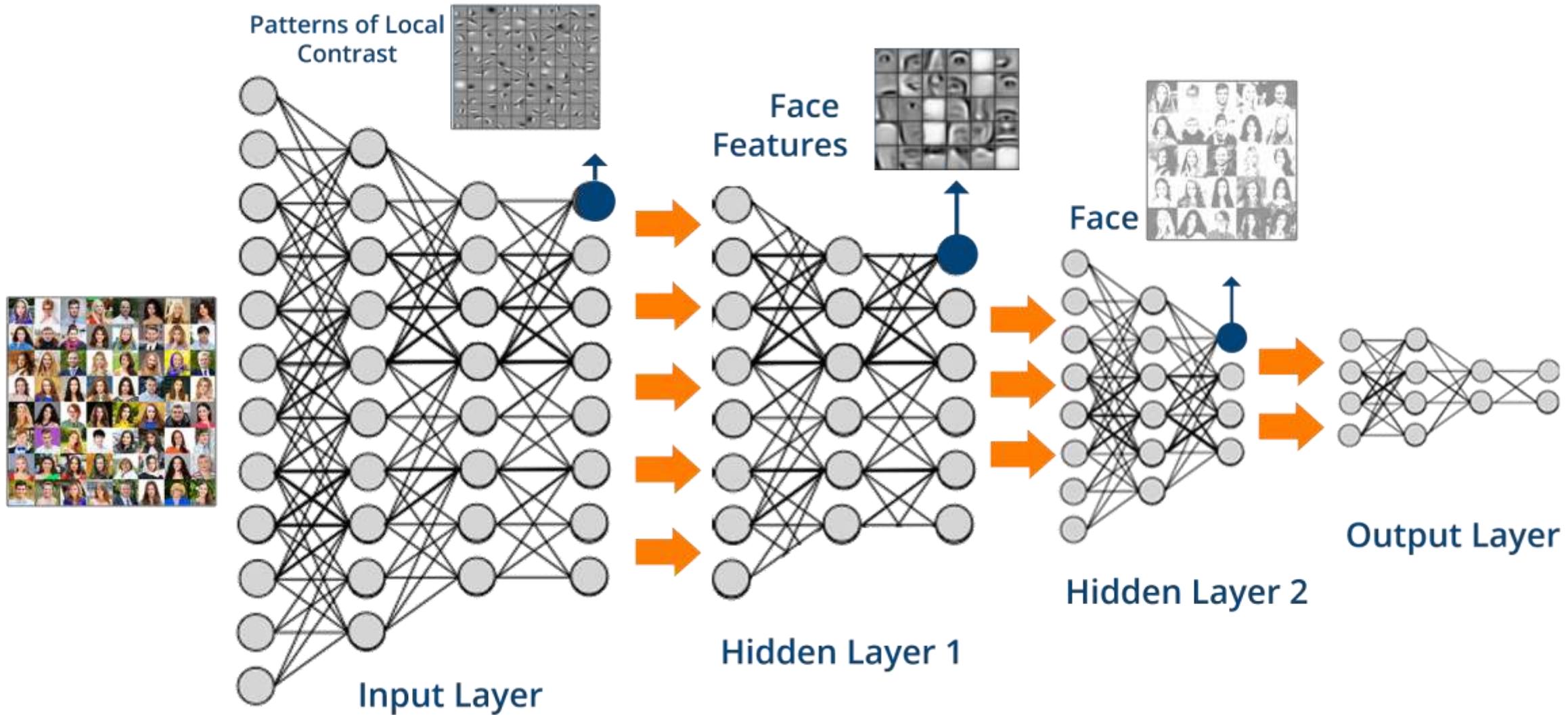
Going deeper in the network

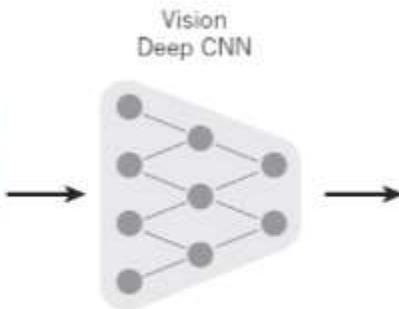




DL, 다중 객체 분리







A group of people shopping at an outdoor market.
There are many vegetables at the fruit stand.

AI가 그림을 분석해서 만든 캡션 (CNN, RNN)



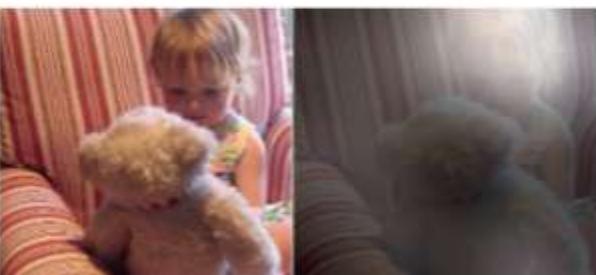
A woman is throwing a **frisbee** in a park.



A dog is standing on a hardwood floor.



A **stop** sign is on a road with a mountain in the background



A little **girl** sitting on a bed with a teddy bear.



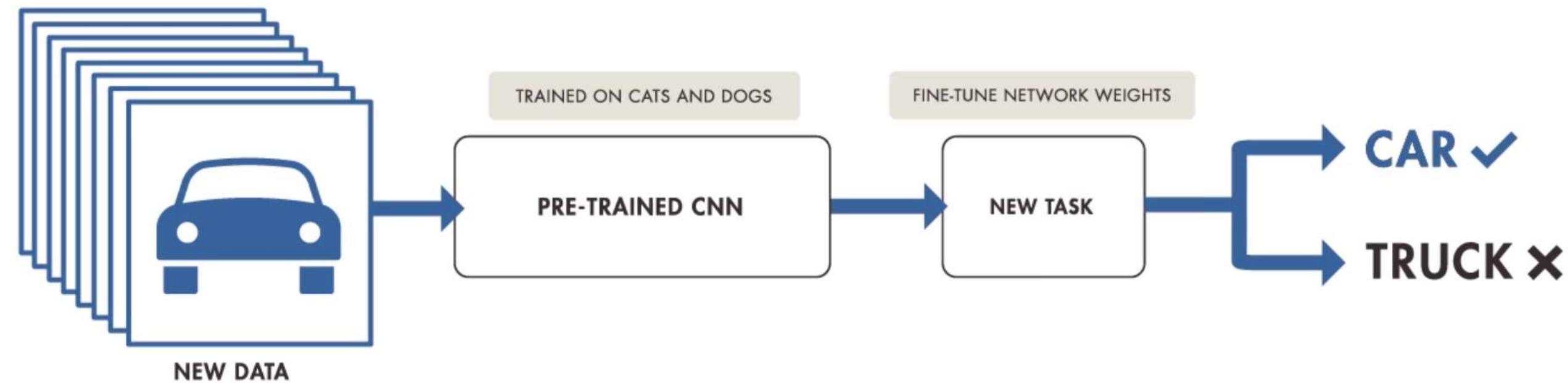
A group of **people** sitting on a boat in the water.



A **giraffe** standing in a forest with **trees** in the background.

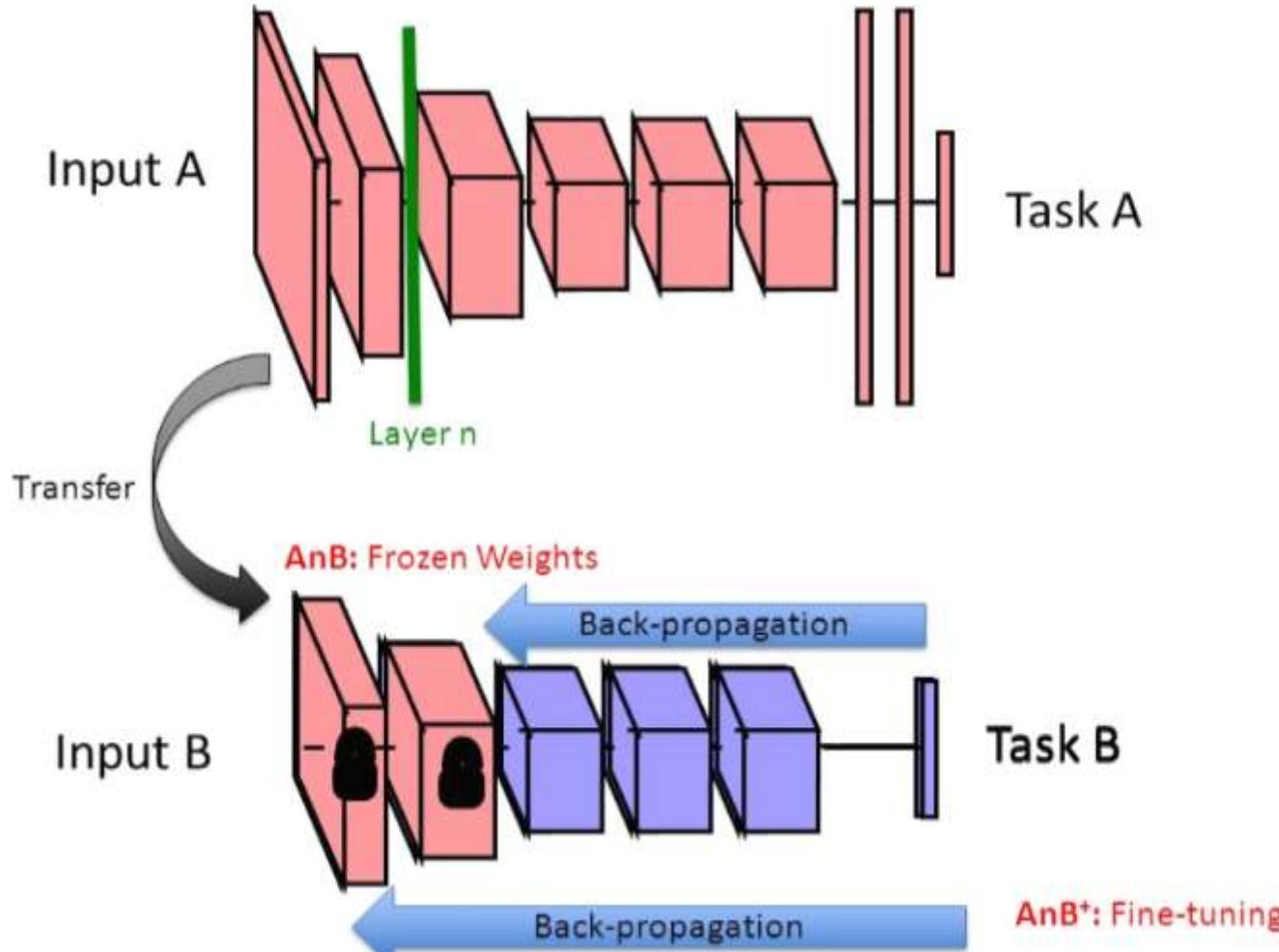
전환학습

TRANSFER LEARNING

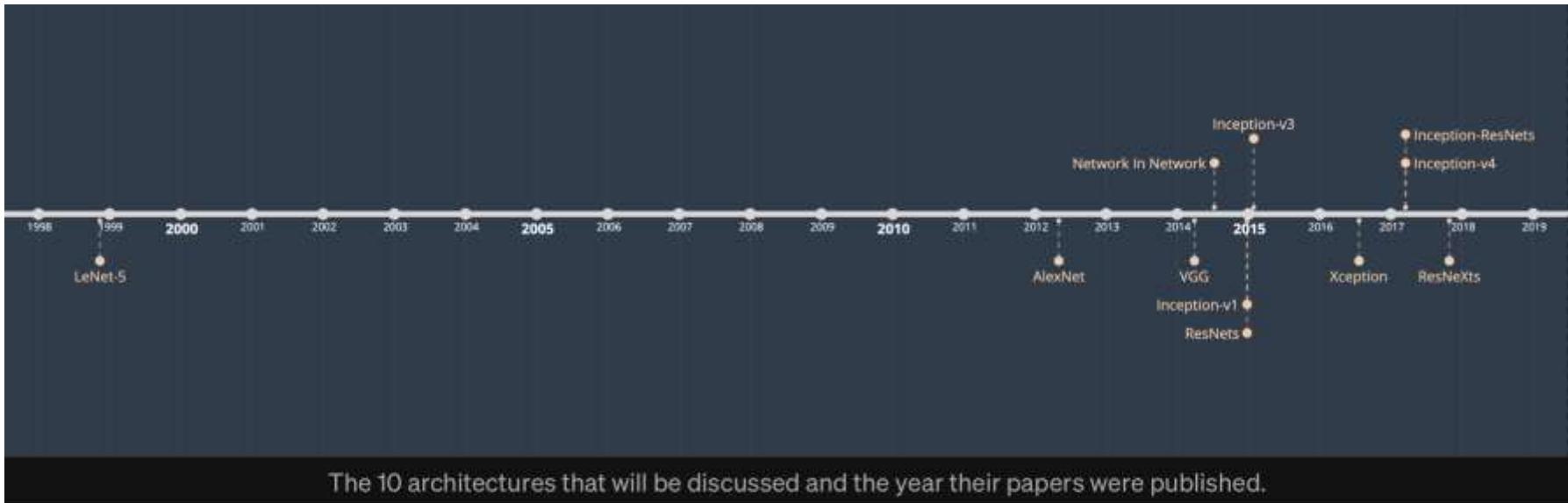


Transfer Learning (전환학습)

Transfer Learning Overview



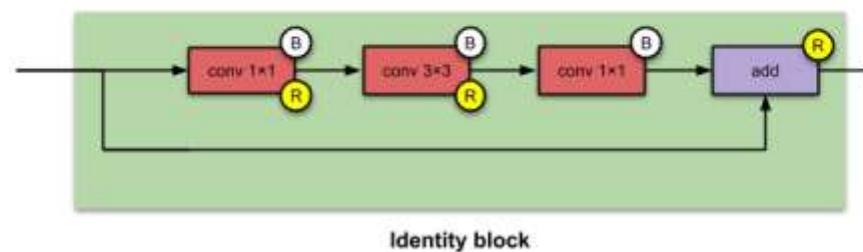
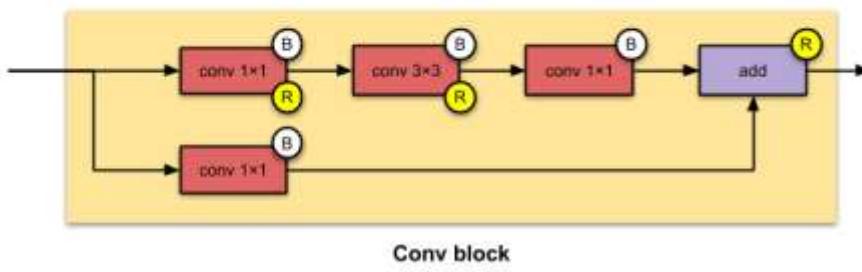
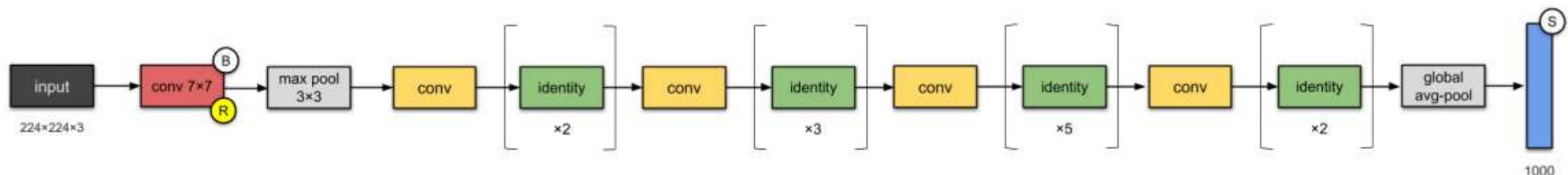
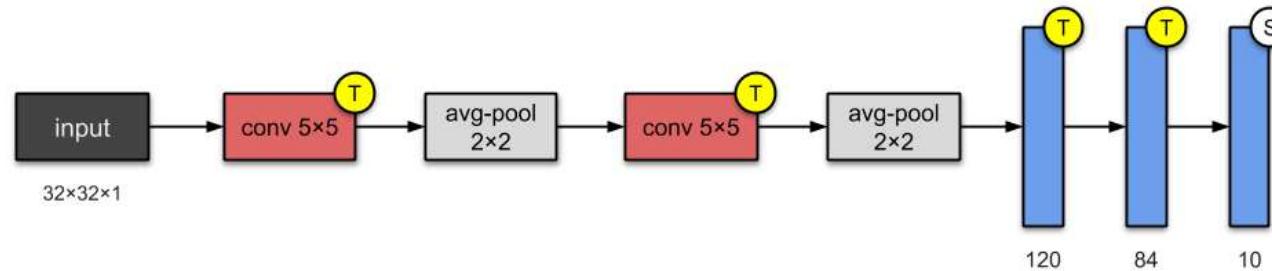
Transfer Learning



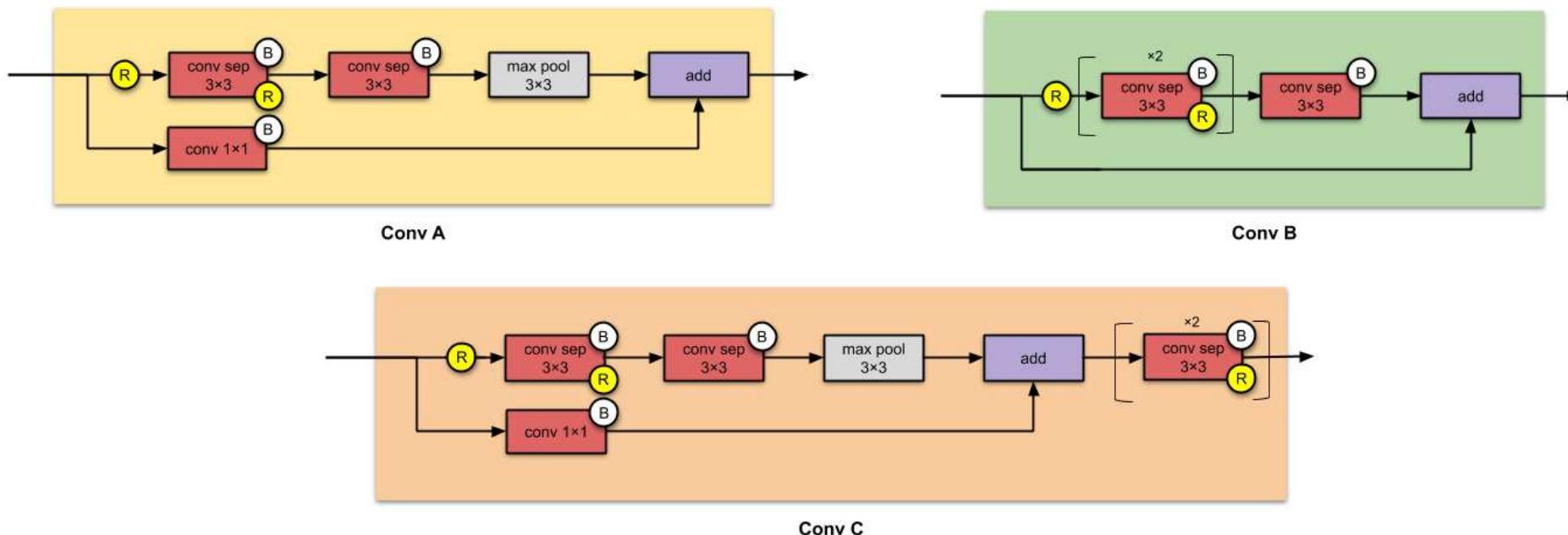
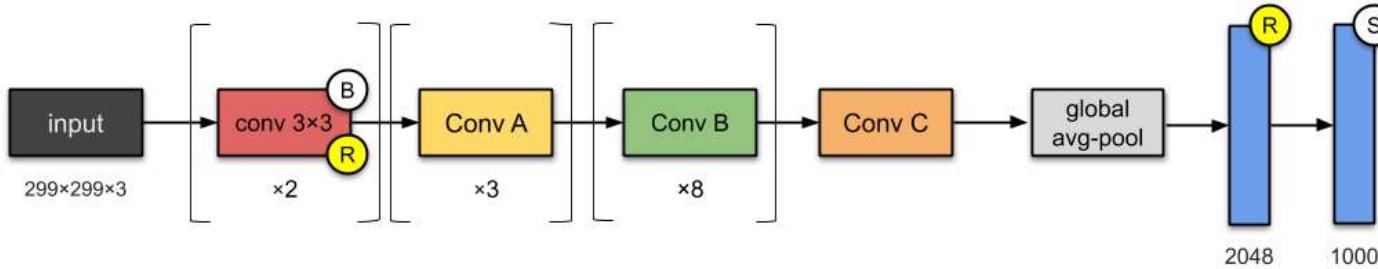
Model	Size	Top-1 Accuracy	Top-5 Accuracy	Parameters	Depth
VGG16	528 MB	0.713	0.901	138,357,544	23
InceptionV3	92 MB	0.779	0.937	23,851,784	159
ResNet50	98 MB	0.749	0.921	25,636,712	-
Xception	88 MB	0.790	0.945	22,910,480	126
InceptionResNetV2	215 MB	0.803	0.953	55,873,736	572
ResNeXt50	96 MB	0.777	0.938	25,097,128	-

The top-1 and top-5 accuracy refers to the model's performance on the ImageNet validation dataset.

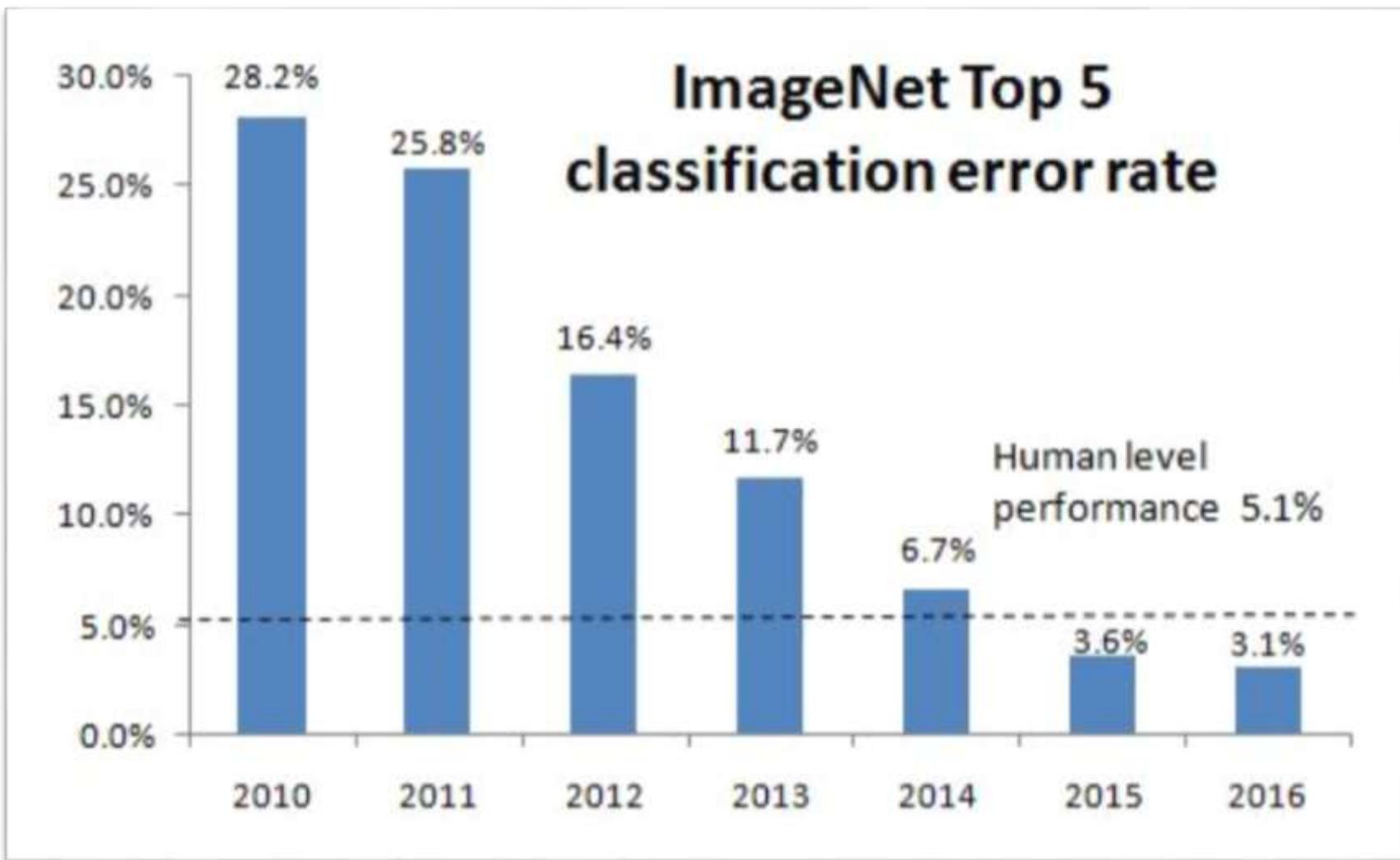
Transfer Learning: LeNet(1999), ResNet(2015)



Transfer Learning: Xception(2016)



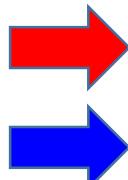
Transfer Learning: ref.s



Transfer Learning: ref.s

Summary: ILSVRC 2012-2015

Team	Year	Place	Error (top-5)	External data
SuperVision – Toronto (AlexNet, 7 layers)	2012	-	16.4%	no
SuperVision	2012	1st	15.3%	ImageNet 22k
Clarifai – NYU (7 layers)	2013	-	11.7%	no
Clarifai	2013	1st	11.2%	ImageNet 22k
VGG – Oxford (16 layers)	2014	2nd	7.32%	no
GoogLeNet (19 layers)	2014	1st	6.67%	no
ResNet (152 layers)	2015	1st	3.57%	
Human expert*			5.1%	



Transfer Learning: ref.s

Reading list

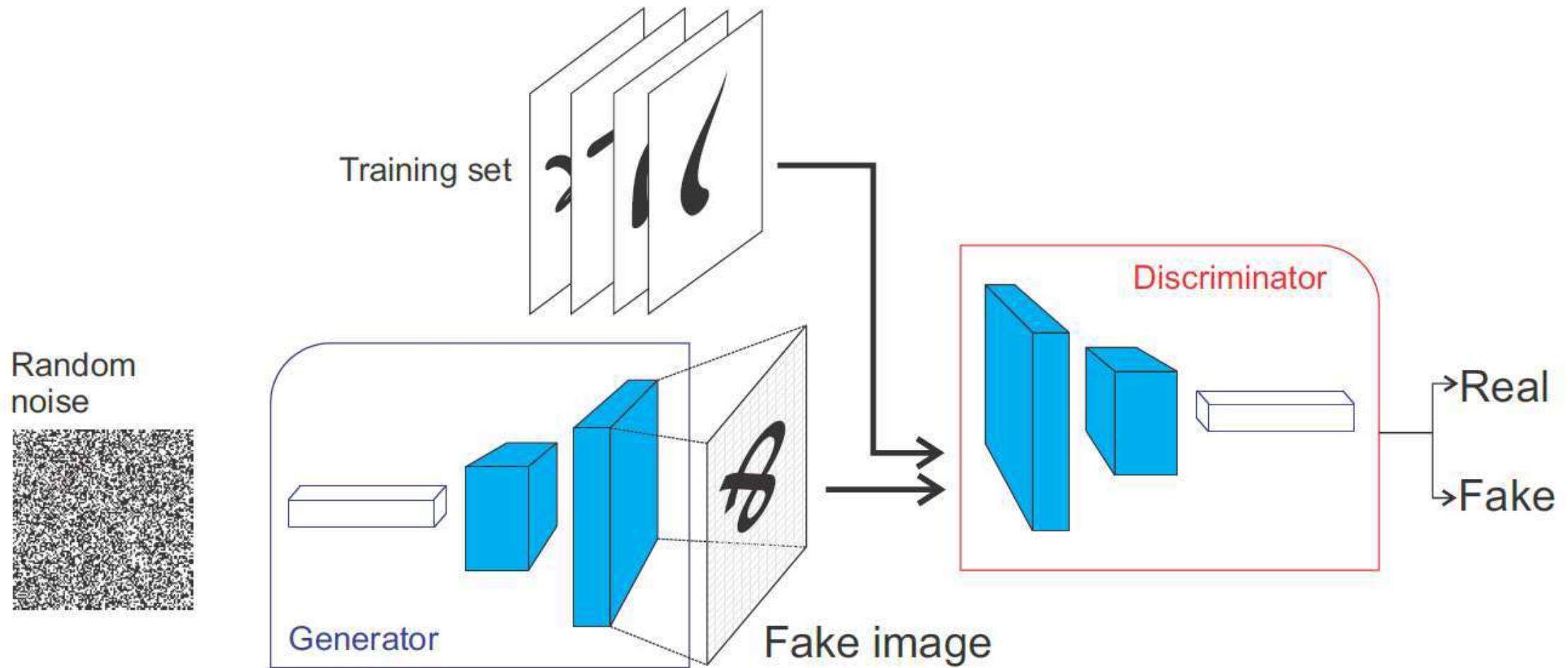
- <https://culurciello.github.io/tech/2016/06/04/nets.html>
- Y. LeCun, L. Bottou, Y. Bengio, and P. Haffner,
[Gradient-based learning applied to document recognition](#), Proc. IEEE 86(11):
2278–2324, 1998.
- A. Krizhevsky, I. Sutskever, and G. Hinton,
[ImageNet Classification with Deep Convolutional Neural Networks](#), NIPS 2012
- M. Zeiler and R. Fergus, [Visualizing and Understanding Convolutional Networks](#),
ECCV 2014
- K. Simonyan and A. Zisserman,
[Very Deep Convolutional Networks for Large-Scale Image Recognition](#), ICLR 2015
- M. Lin, Q. Chen, and S. Yan, [Network in network](#), ICLR 2014
- C. Szegedy et al., [Going deeper with convolutions](#), CVPR 2015
- C. Szegedy et al., [Rethinking the inception architecture for computer vision](#),
CVPR 2016
- K. He, X. Zhang, S. Ren, and J. Sun,
[Deep Residual Learning for Image Recognition](#), CVPR 2016

GAN (적대적생성망)

GANs 구조 (cont'd)



GAN



GAN – Painting I

Zebras ↘ Horses



Source: https://lh3.googleusercontent.com/proxy/2CWdlpWTpvWwwWQ2nafWWW22dX3MuEom13kBoBlqQjj4eP-IL4gJ0hPhKiBBC0EEMAB9DwFUoWaPvnLXyNvX23zsEXxlvQ_kG989RA



GAN – Painting II

Style transfer

<https://www.youtube.com/watch?v=Khuj4ASldmU>



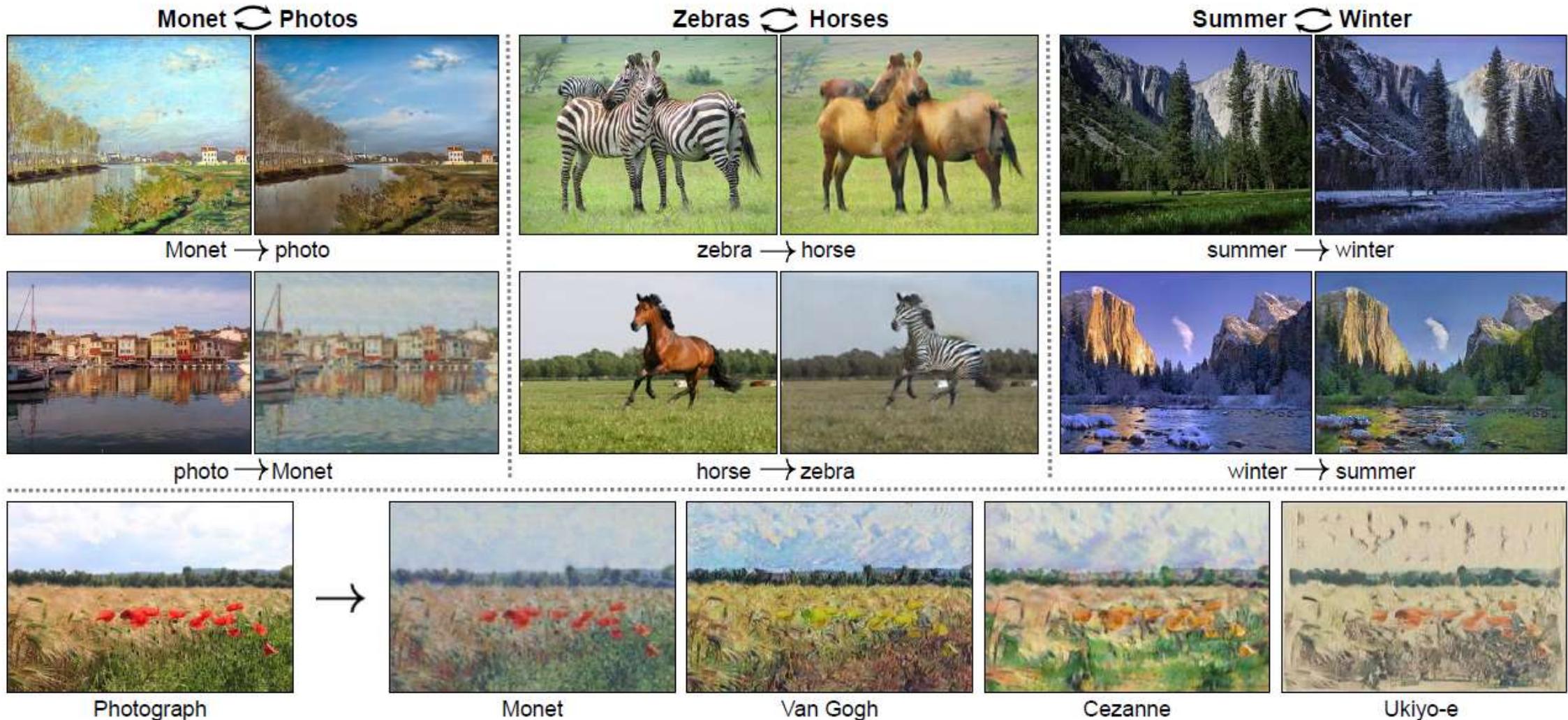
GAN – Painting II

Style transfer

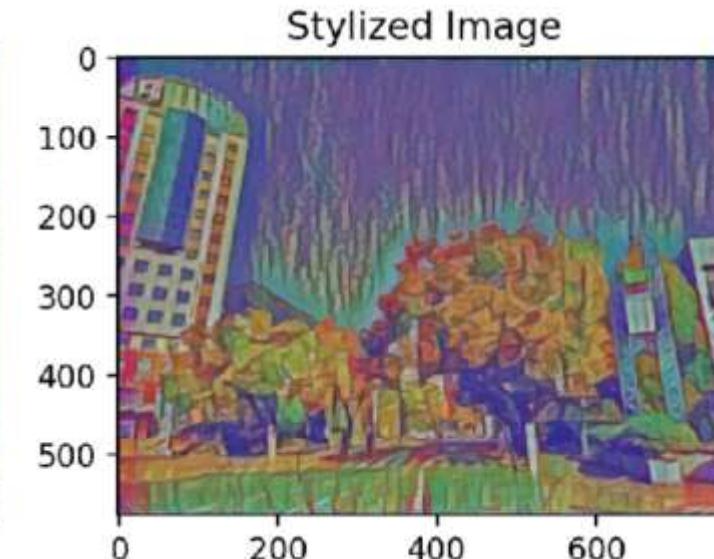
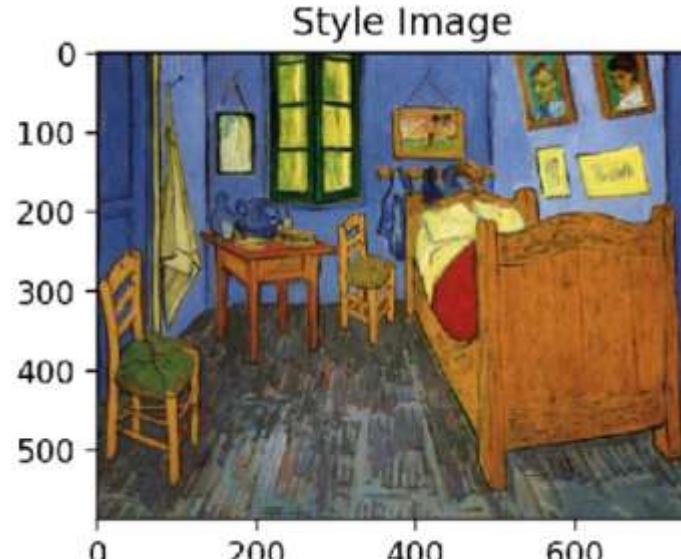
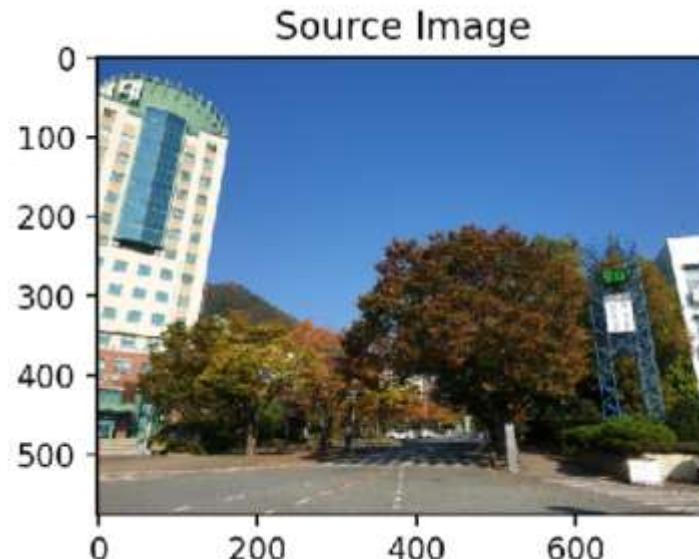
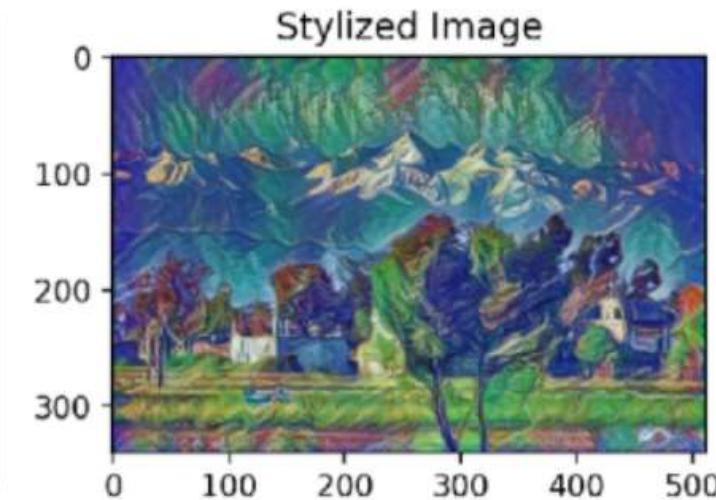
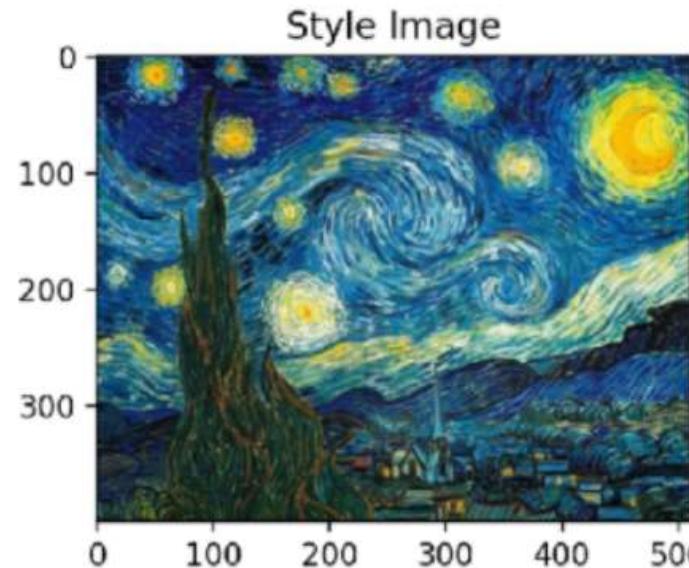
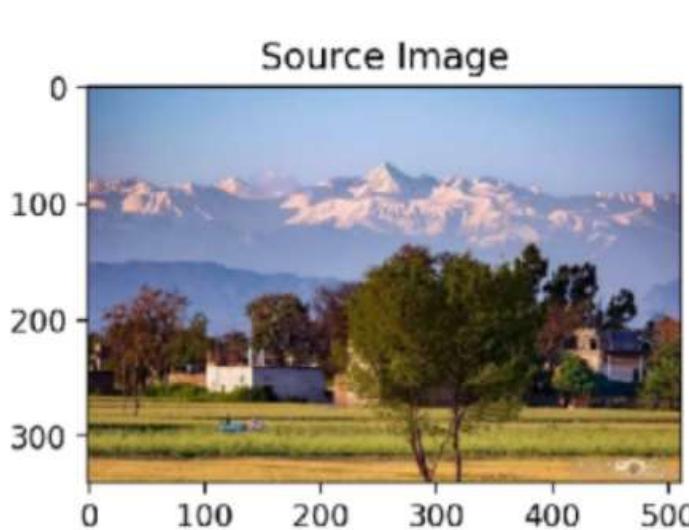
<https://www.youtube.com/watch?v=Khuj4ASldmU>

Source: https://www.researchgate.net/profile/Alexander_Ecker/publication/281312423/figure/fig1/AS:391530486485004@1470359550795/Images—that—combine—the—content—of—a—photograph—with—the—style—of—several—

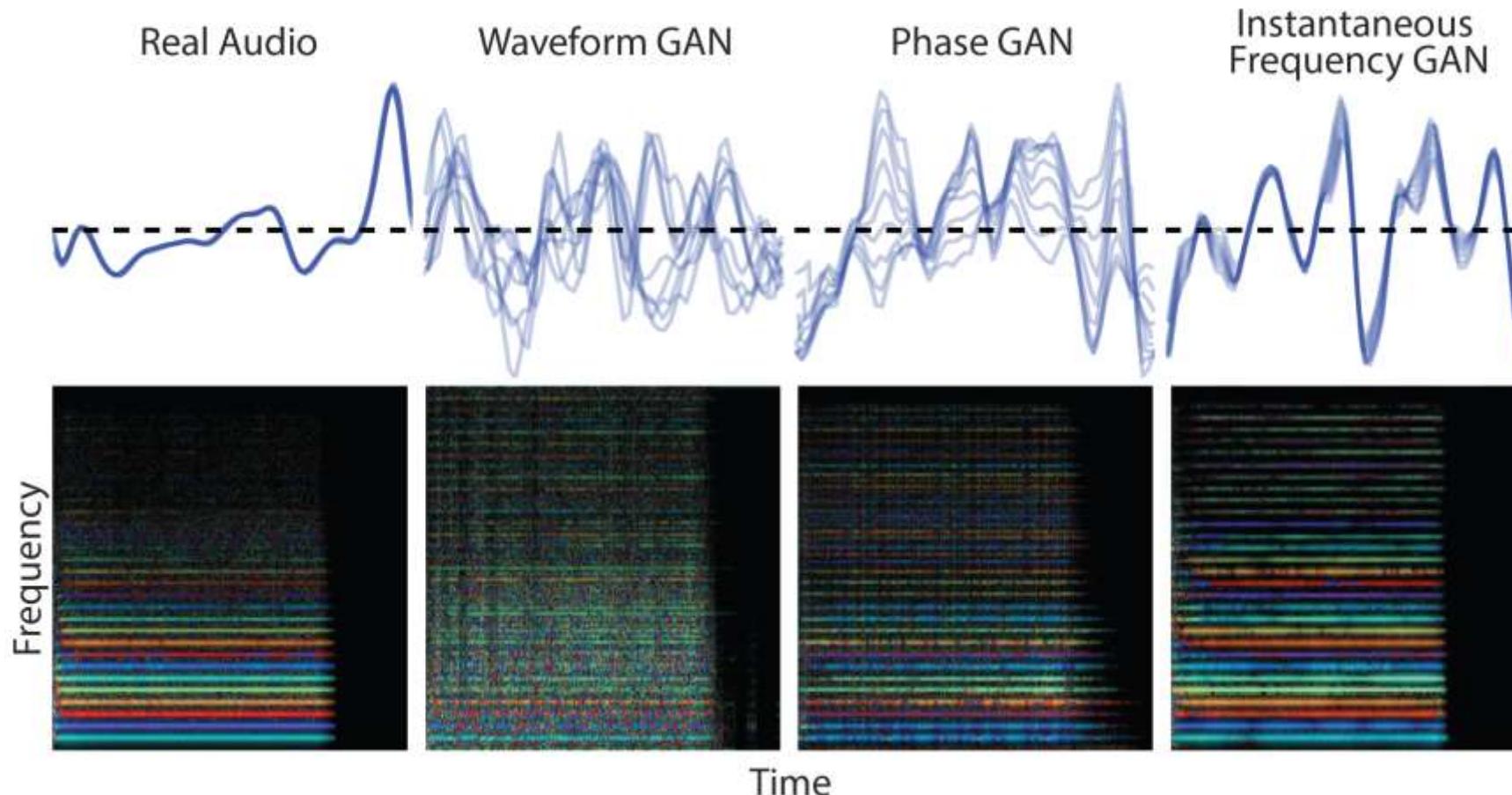
GAN – Painting III



GAN – Painting IV : NTS → streamlit webapp



GAN – Music



GAN – Fake news



<https://www.youtube.com/watch?v=dkoi7sZvWiU>

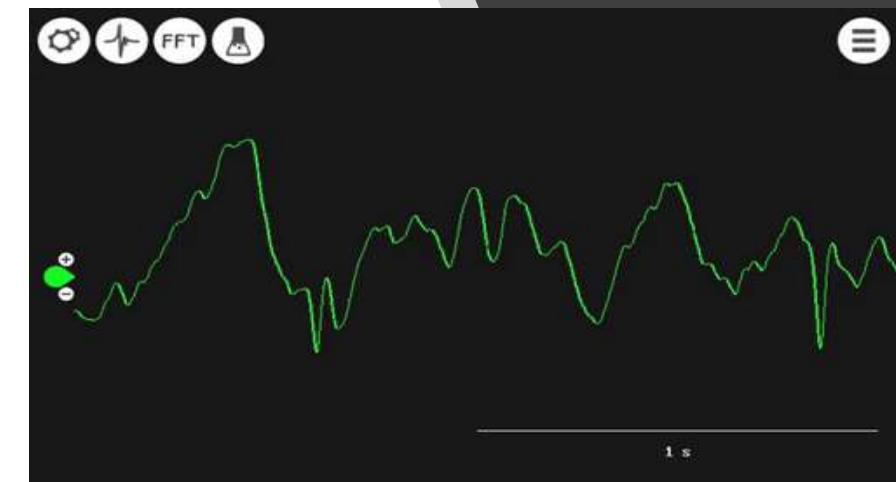
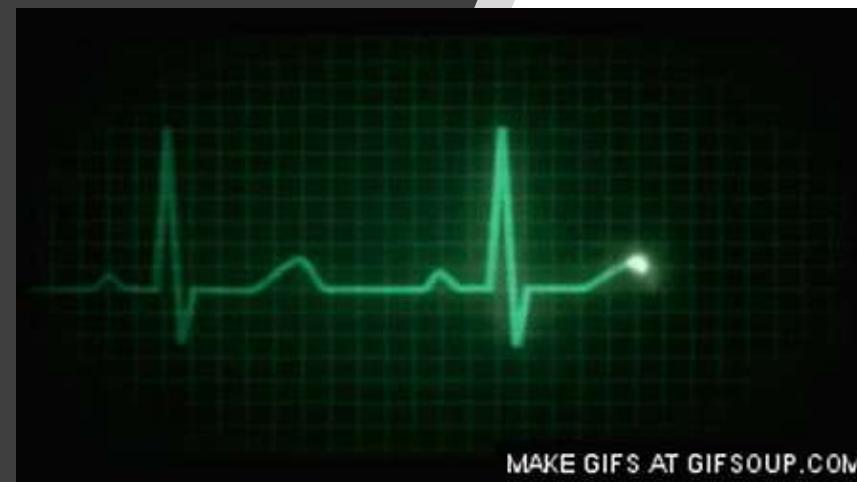
Source: <https://i.ytimg.com/vi/dkoi7sZvWiU/maxresdefault.jpg>

GPT-3

Voice and Language Driven AI

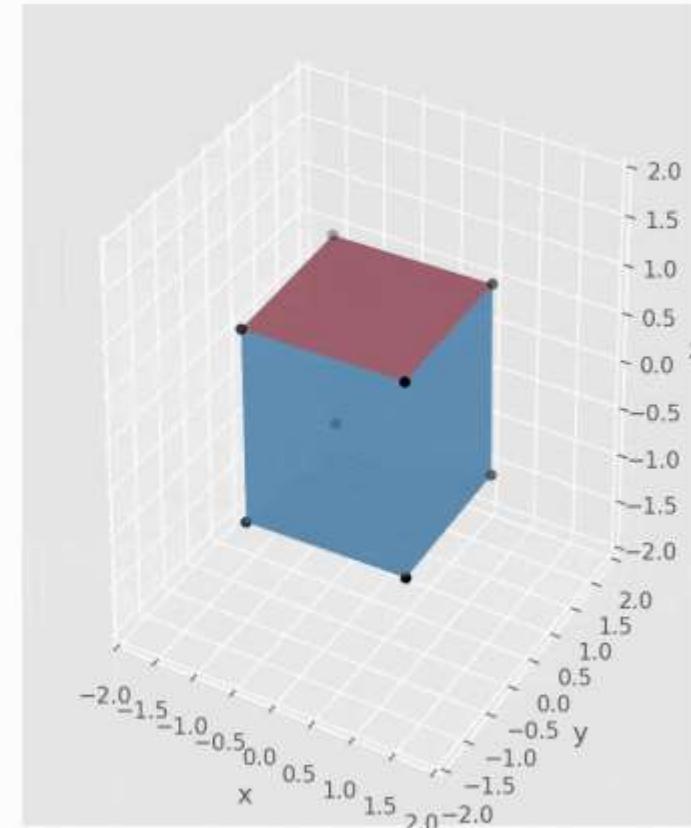
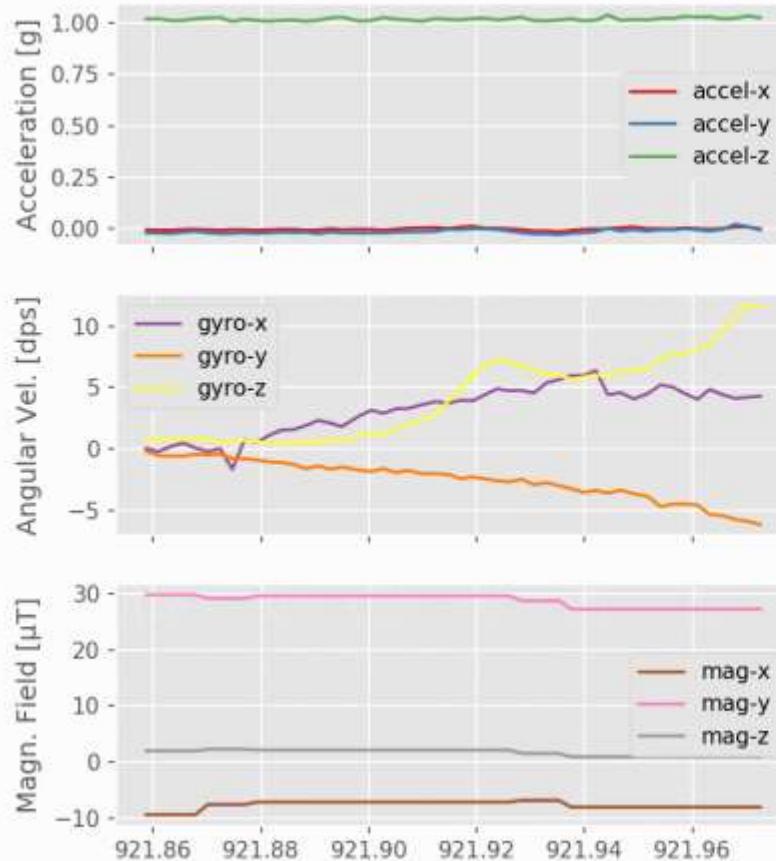


Deep Learning of Signals



Conv1D Pooling

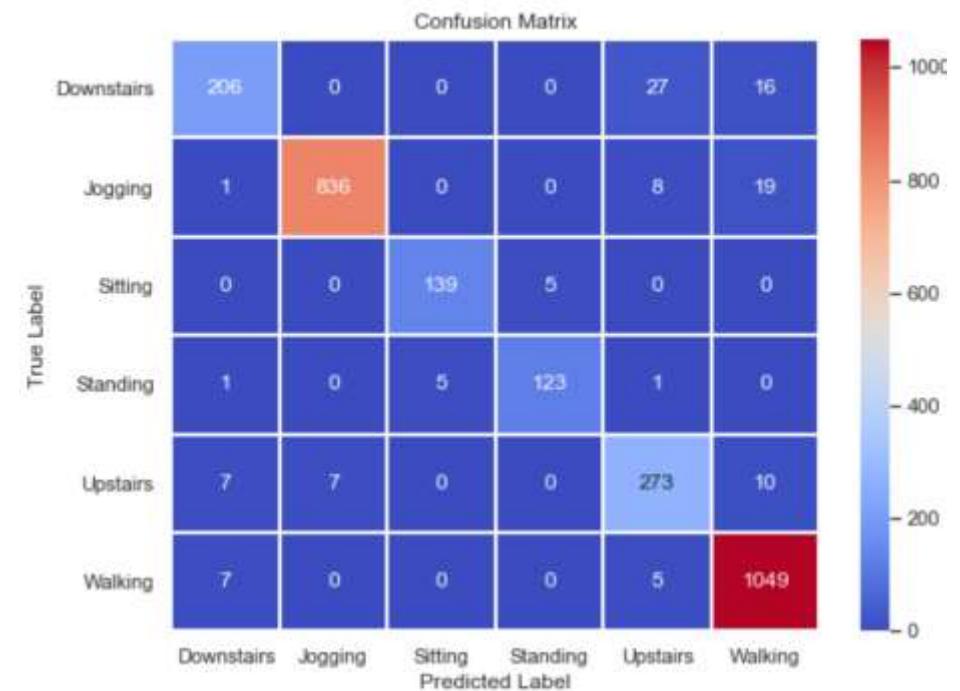
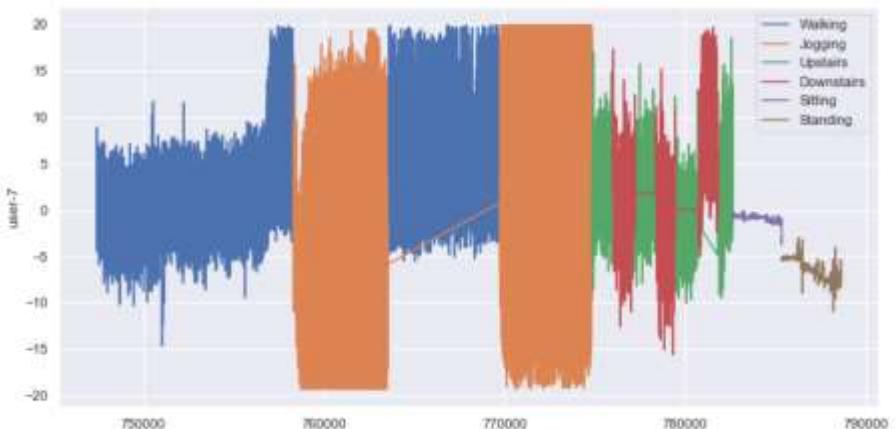
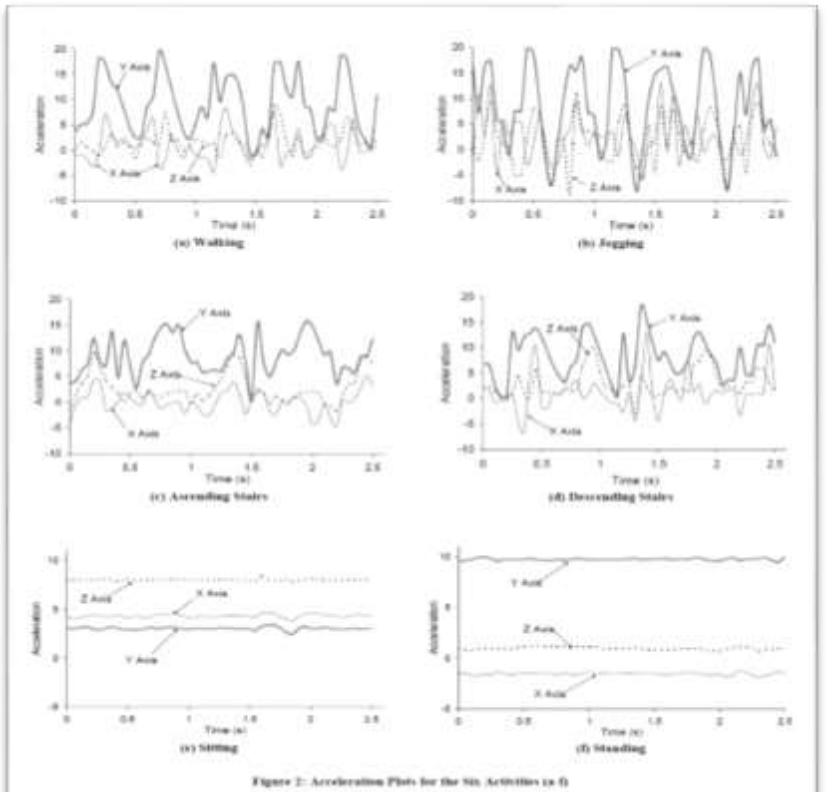
일상활동 인식(3축 가속도)



https://images.squarespace-cdn.com/content/v1/59b037304c0dbfb092fbe894/1573836927118-IS5CS61OW9XH9HSRCMA1/ke17ZwdGBToddl8pDm48kGbFogdxZzB1B7PQq3zm9xl7gQa3H78H3Y0txjaiv_0fDoOvxcdMmMKkDsyUqMSsMWxHk725yiiHCCfrh8O1z5QPOohDlaleljMHgDF5CVIOqpeNLcJ80NK65_fV7S1UQuPmlr7Z9cq9PZkRYtzEu3SbZmkCxOjksrEup4_K2kPH3bqxw7fF48mhrg5Ulrl0Hg/mpu9250_cube_rotation_compressed.gif

일상활동 인식(3축 가속도)

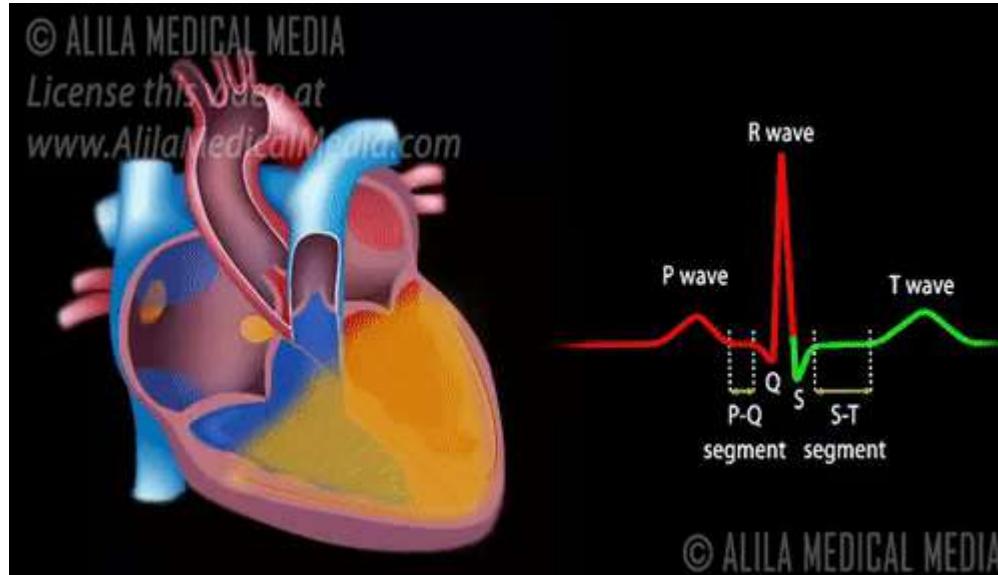
['Downstairs',
 'Jogging',
 'Sitting',
 'Standing',
 'Upstairs',
 'Walking']



--- ACC_XYZ, 4s: classification report for test data ---

	precision	recall	f1-score	support
0	0.93	0.83	0.87	249
1	0.99	0.97	0.98	864
2	0.97	0.97	0.97	144
3	0.96	0.95	0.95	130
4	0.87	0.92	0.89	297
5	0.96	0.99	0.97	1061
accuracy			0.96	2745
macro avg	0.95	0.94	0.94	2745
weighted avg	0.96	0.96	0.96	2745

심전도(ECG, heart rhythm)



https://thumbs.gfycat.com/FamiliarWatchfulBlackmamba-size_restricted.gif

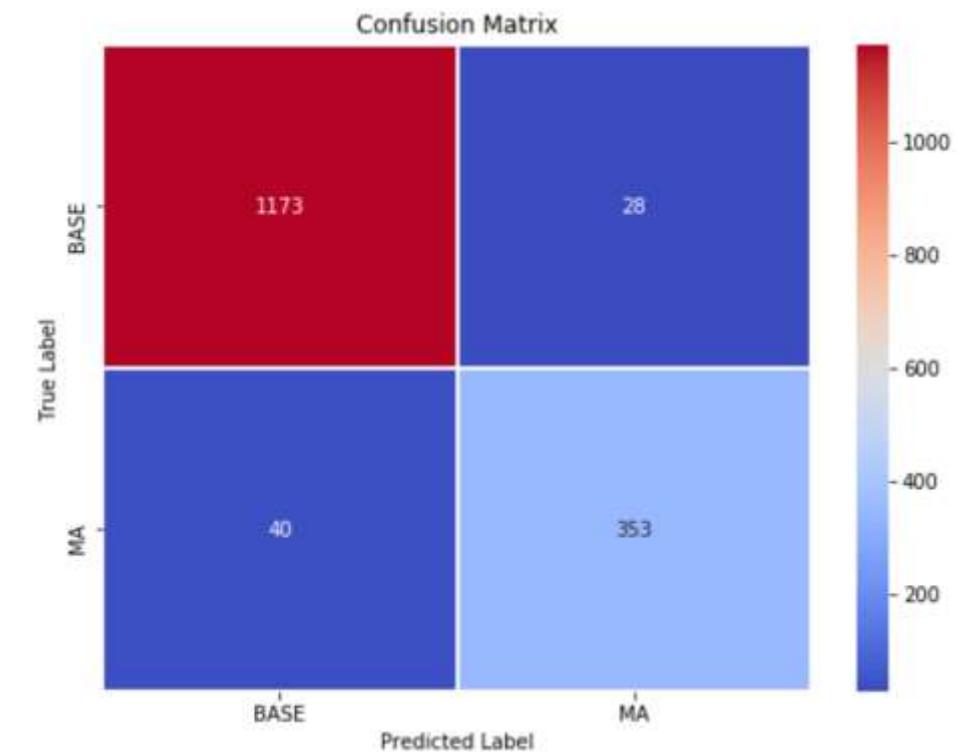
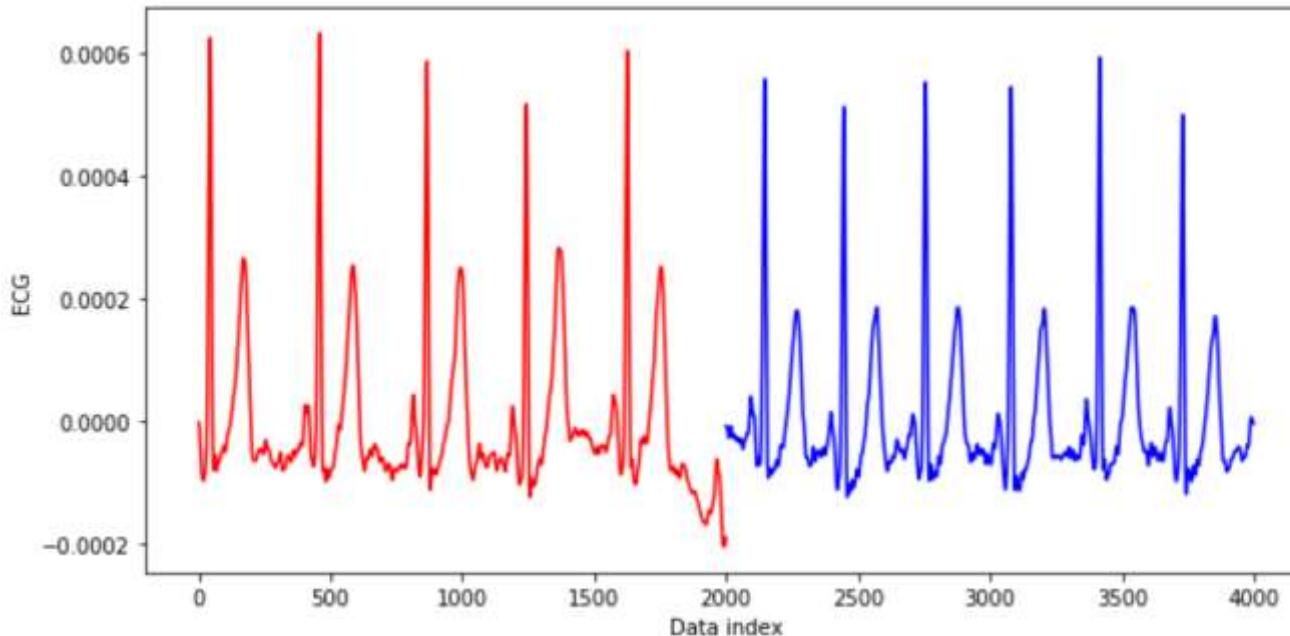


https://thumbs.gfycat.com/CorruptShoddyAmazontreeboa-size_restricted.gif



심전도(ECG, heart rhythm)

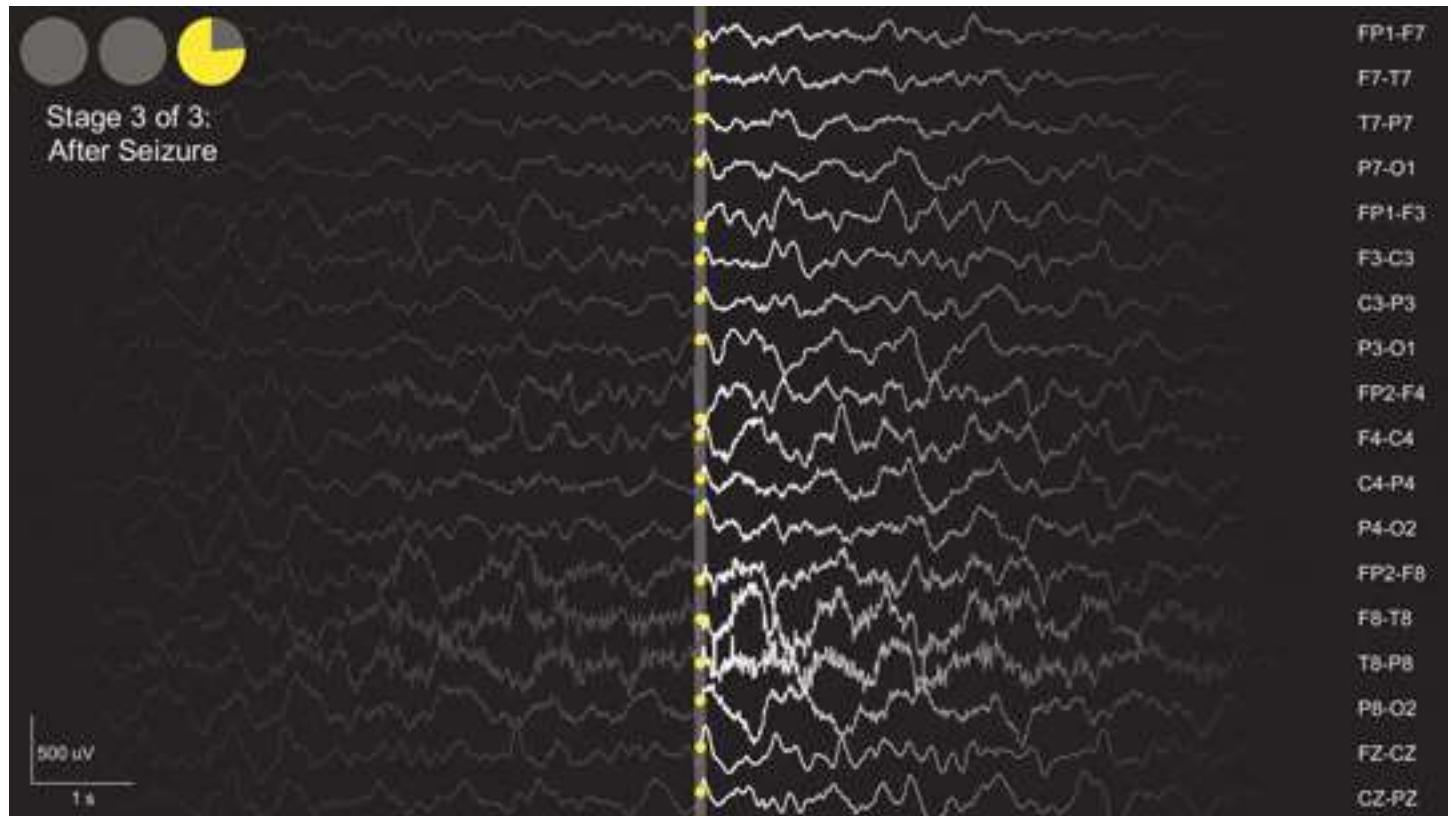
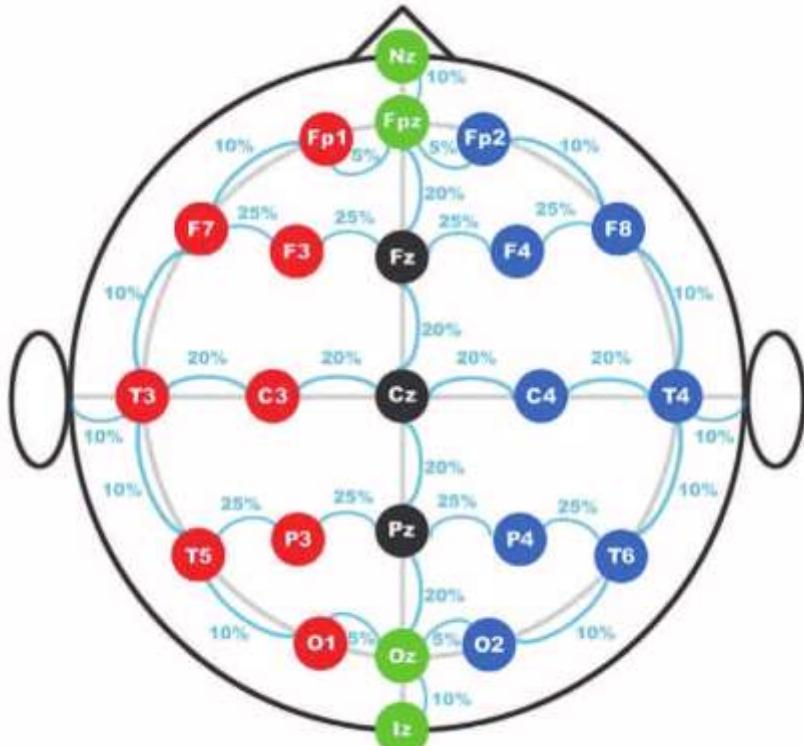
ECG Raw : Base(안정) vs. MA(암산)



--- ECG 1-s rescaled: classification report for test data ---

	precision	recall	f1-score	support
0	0.97	0.98	0.97	1201
1	0.93	0.90	0.91	393
accuracy				0.96
macro avg	0.95	0.94	0.94	1594
weighted avg	0.96	0.96	0.96	1594

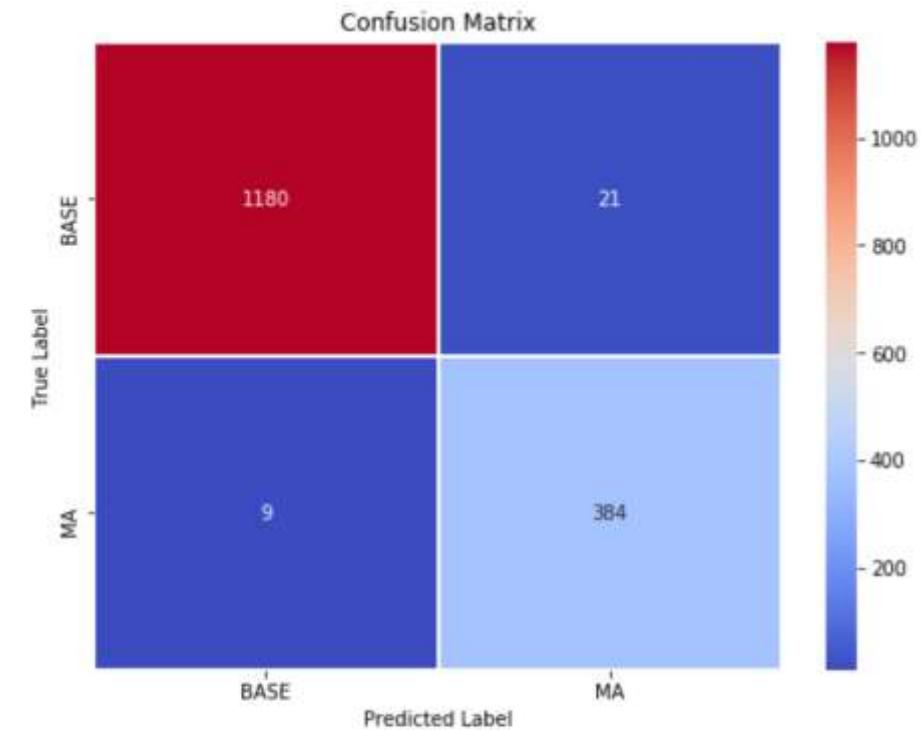
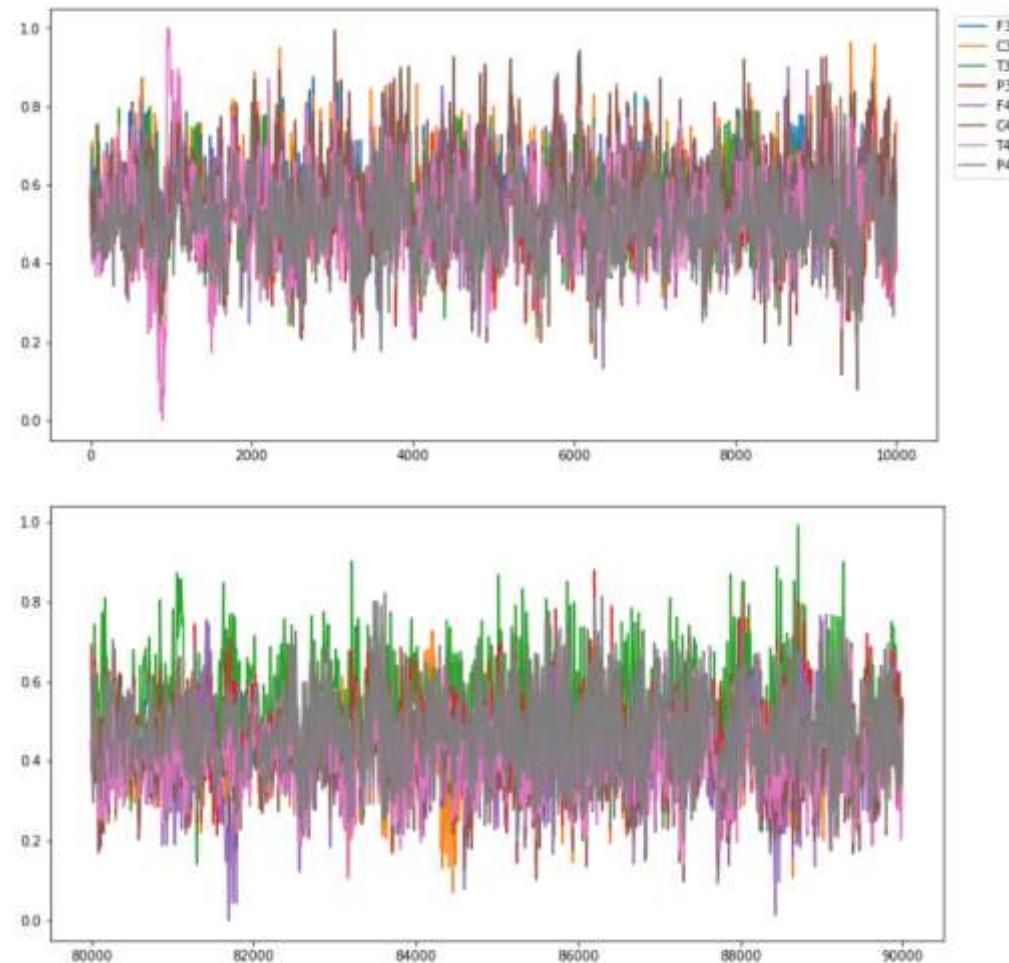
노파 (EEG, brain waves)



https://www.researchgate.net/profile/Daisuke_Hamada2/publication/282153913/figure/fig1/AS:7060739797950@1545352563235/The-international-10-20-scalp-positioning-system-showing-the-locations-of-scalp.ppm

<https://media.giphy.com/media/jAM12sDlGf3ry/giphy.gif>

노파 (EEG, 8-채널 brain waves)



--- EEG 1-s scaled: classification report for test data ---

	precision	recall	f1-score	support
0	0.99	0.98	0.99	1201
1	0.95	0.98	0.96	393
accuracy				0.98
macro avg	0.97	0.98	0.97	1594
weighted avg	0.98	0.98	0.98	1594

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- 31

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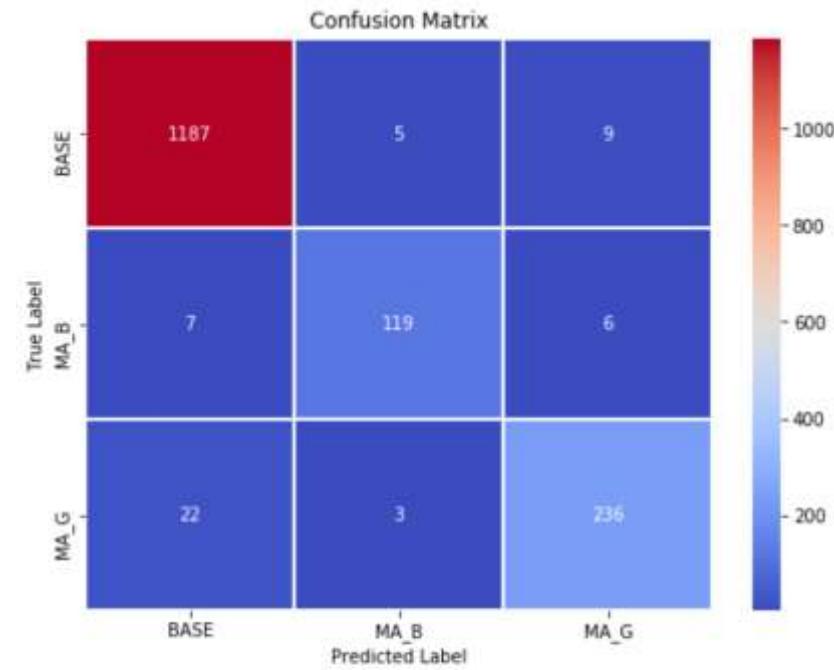
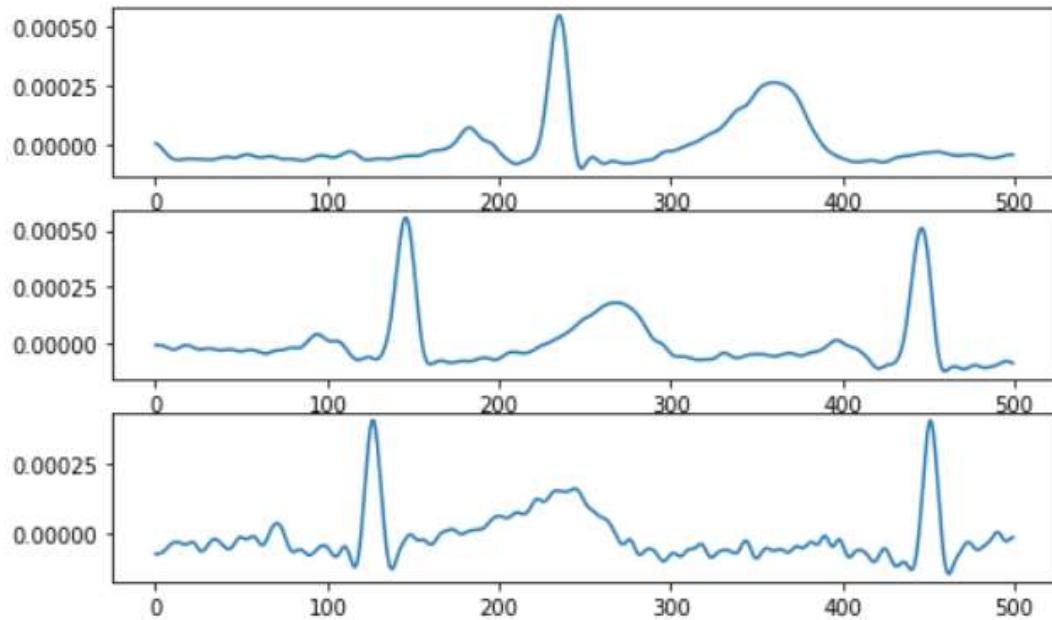
= ?

1분 동안
암산 실시!

도전!!!

정상 뇌파
멘붕 뇌파
?

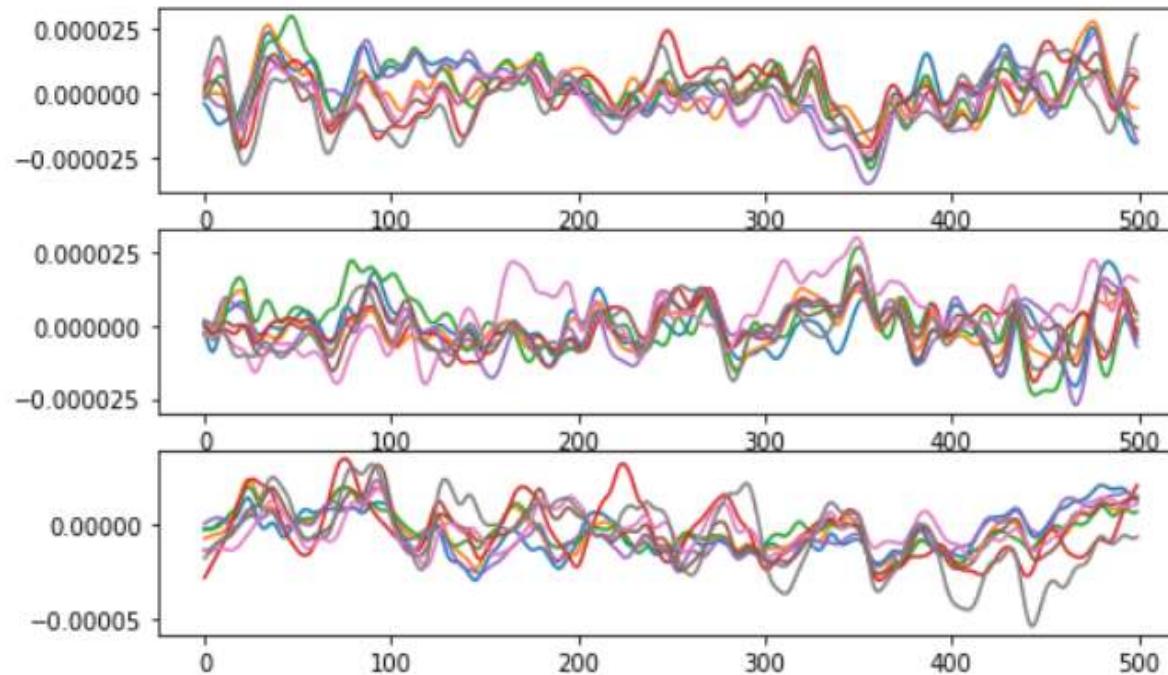
심전도 [안정, 암산, 멘붕]



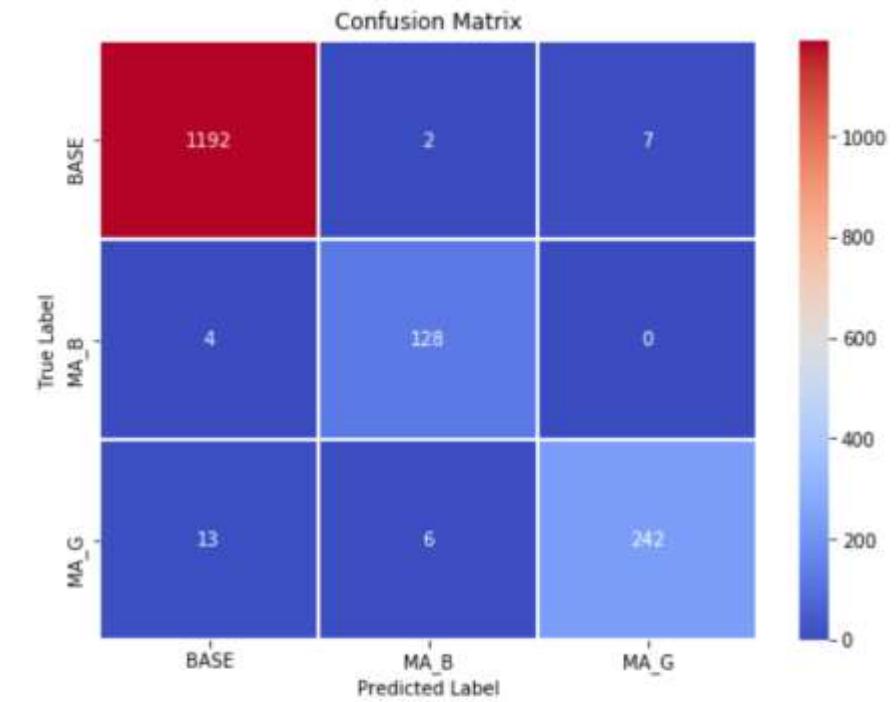
--- ECG scaled 1s: CV1D, MA_B vs. MA_G ---

	precision	recall	f1-score	support
0	0.98	0.99	0.98	1201
1	0.94	0.90	0.92	132
2	0.94	0.90	0.92	261
accuracy			0.97	1594
macro avg	0.95	0.93	0.94	1594
weighted avg	0.97	0.97	0.97	1594

뇌파 [안정, 암산, 멘붕]

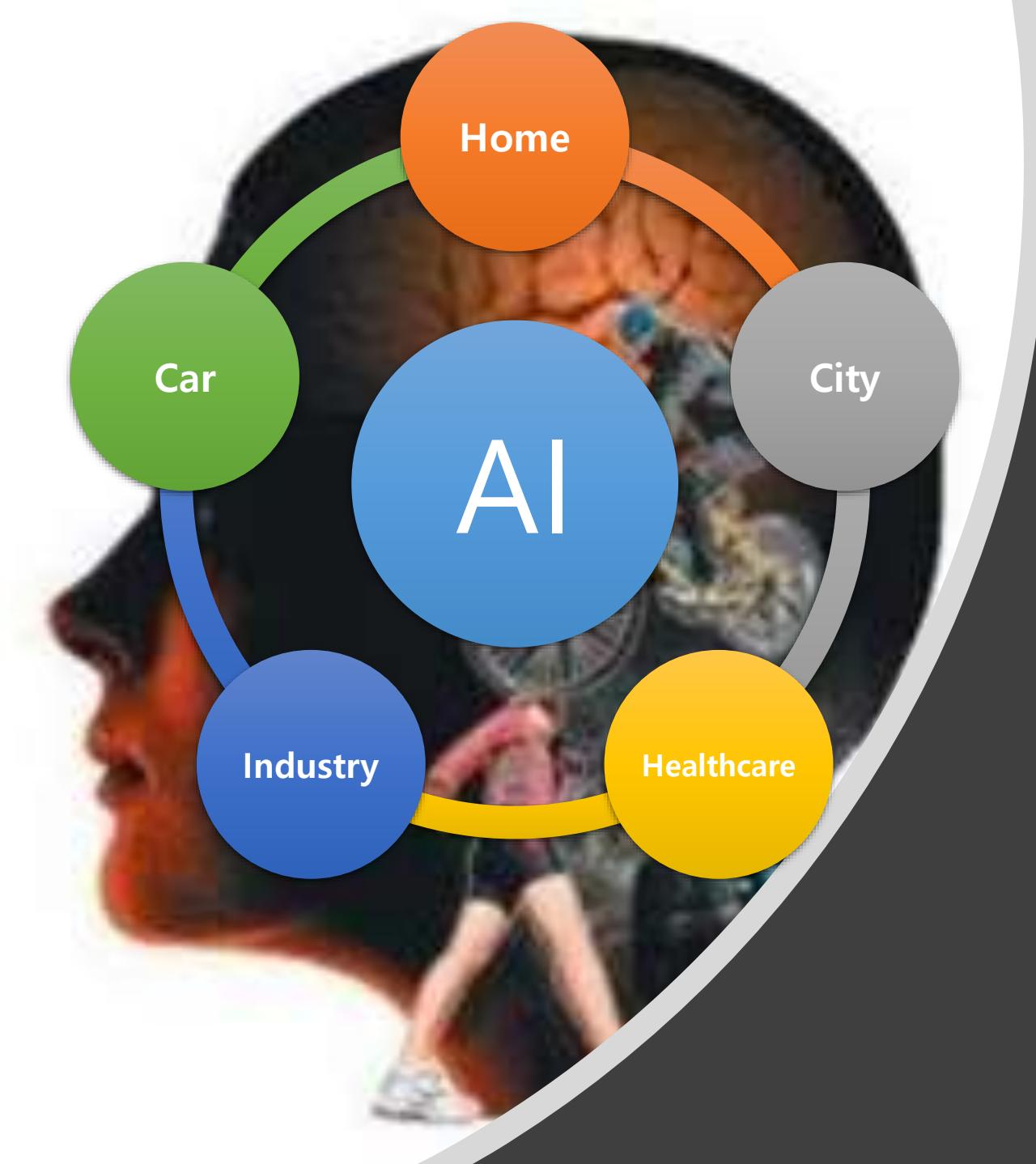


뇌파 (EEG, 8-채널)



--- EEG scaled 1s: CV1D ---

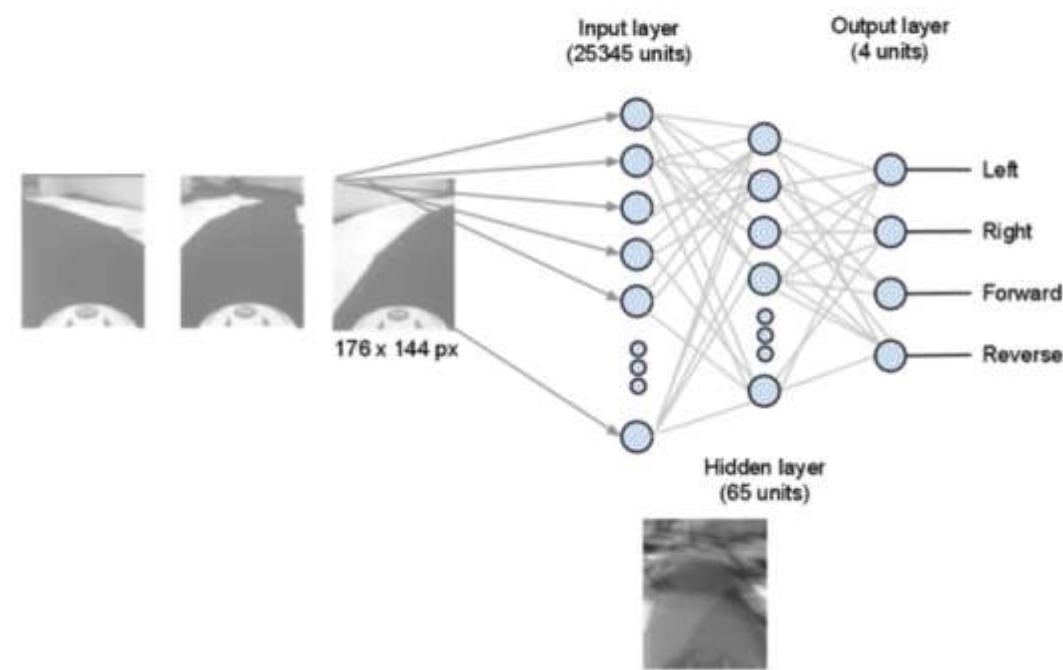
	precision	recall	f1-score	support
0	0.99	0.99	0.99	1201
1	0.94	0.97	0.96	132
2	0.97	0.93	0.95	261
accuracy			0.98	1594
macro avg	0.97	0.96	0.96	1594
weighted avg	0.98	0.98	0.98	1594



AI Everywhere!

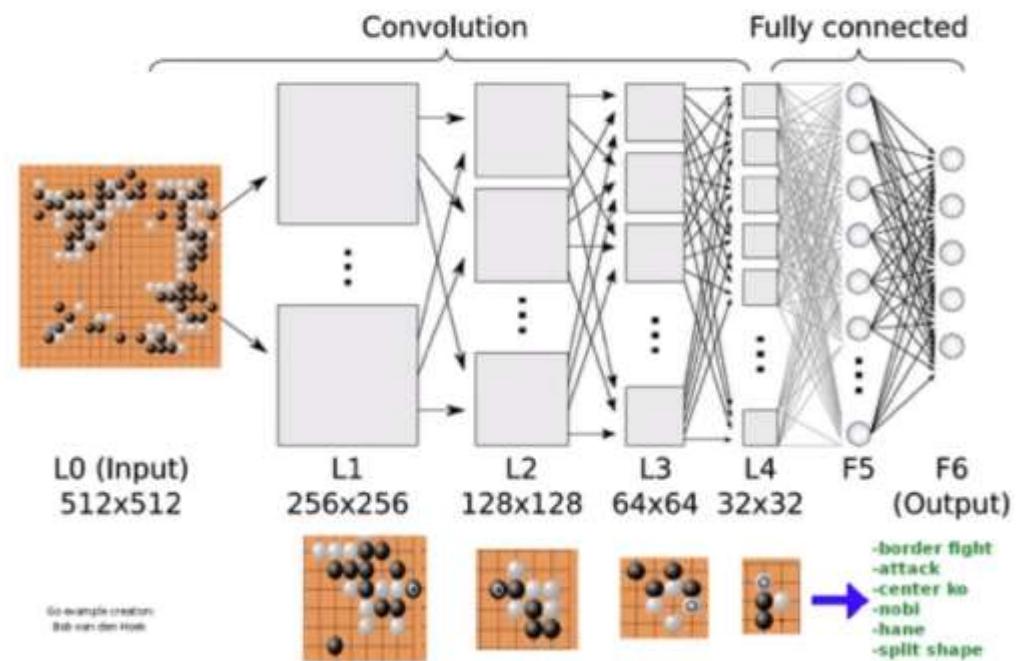
AI Everywhere!

Self Driving Car



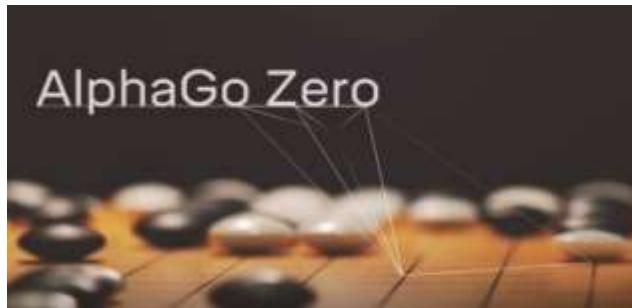
AI Everywhere!

Playing Go



AI Everywhere!

Self-learning AlphaGo Zero (강화학습)

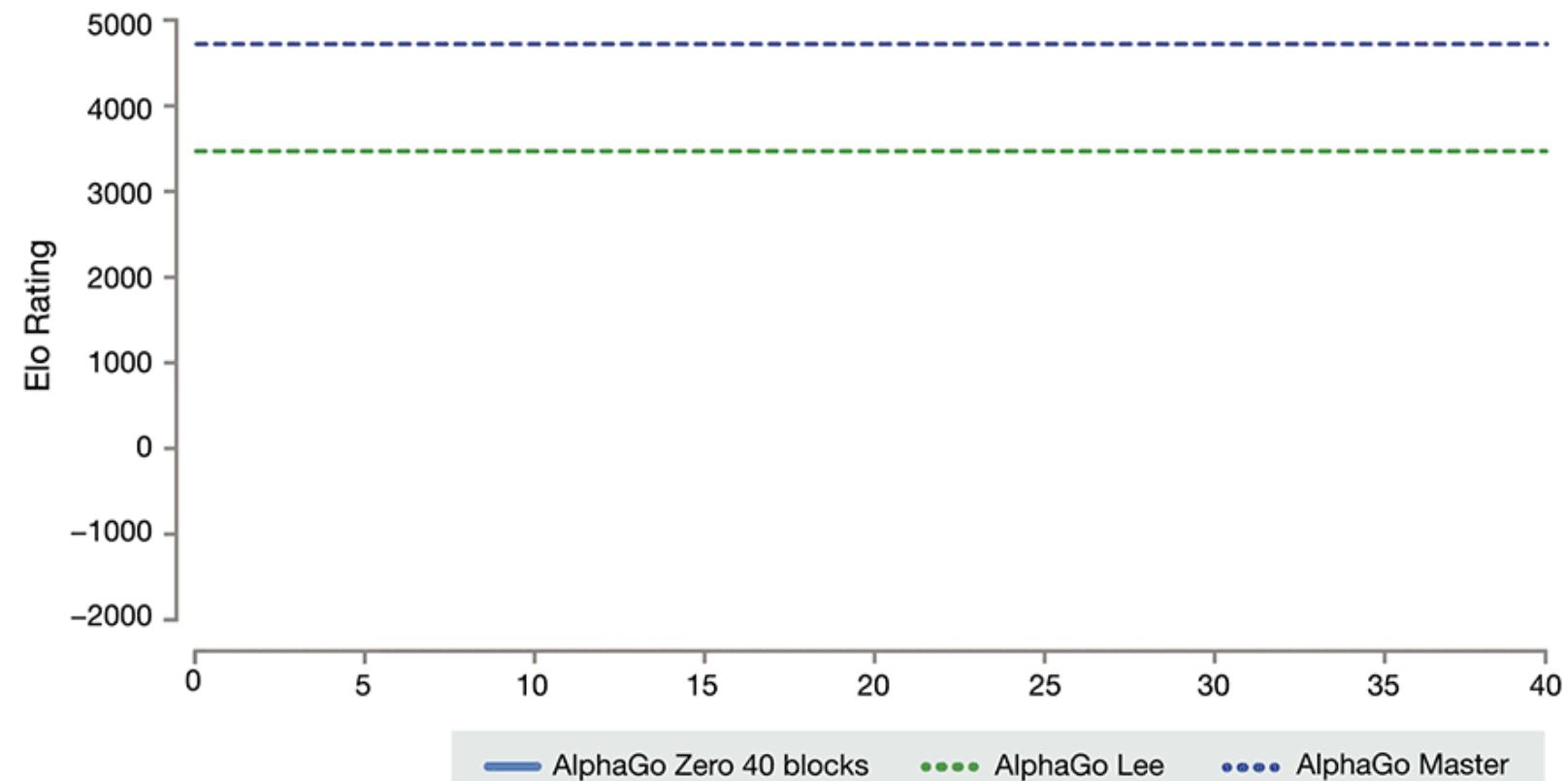


0 days

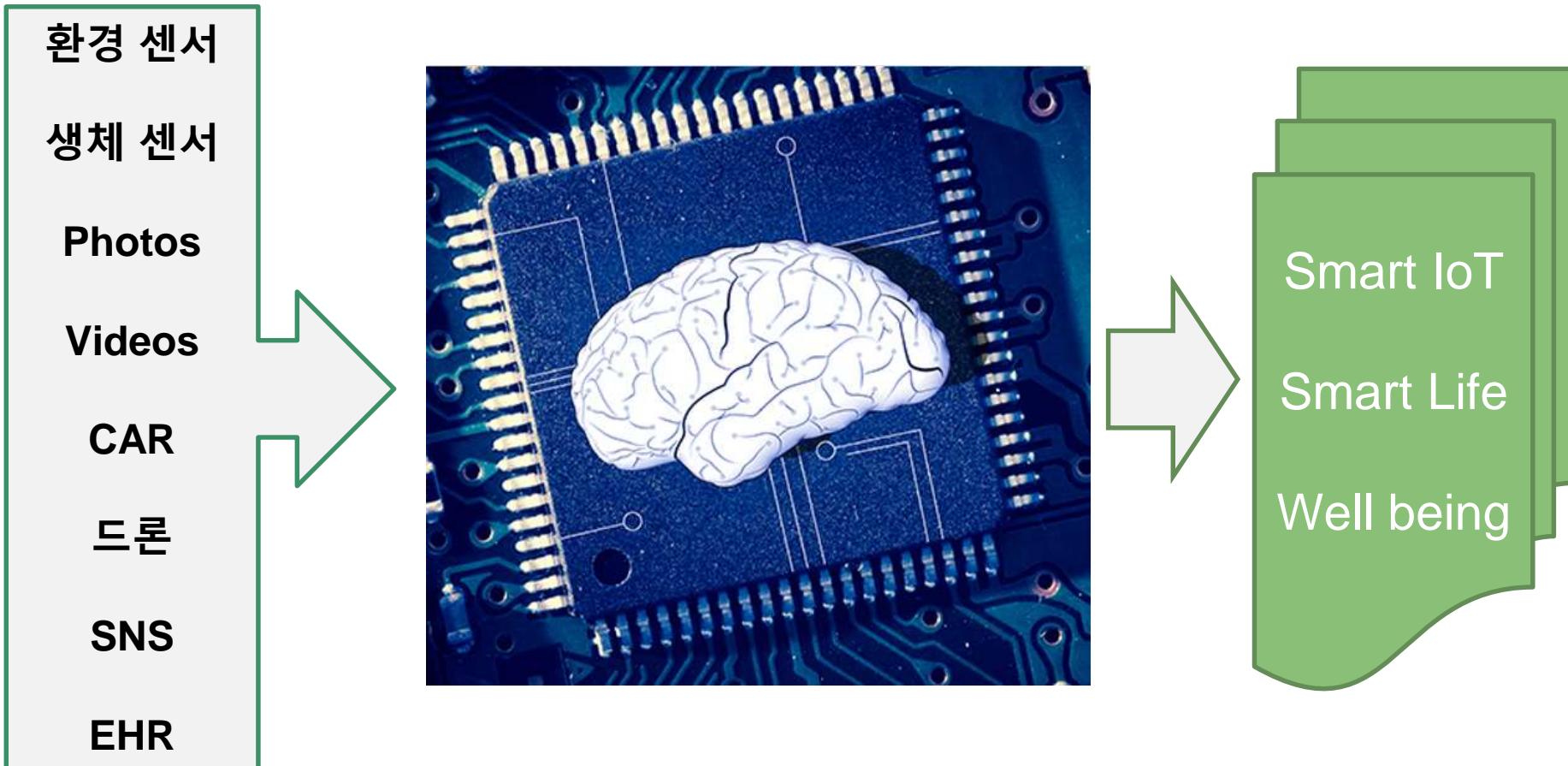
AlphaGo Zero has no prior knowledge of the game and only the basic rules as an input.

3 days

AlphaGo Zero surpasses the abilities of AlphaGo Lee, the version that beat world champion Lee Sedol in 4 out of 5 games in 2016.



Machine(Deep) learning with AI chip



Don't let a lack of math stop you.

Get good at writing code, rely on existing libraries, investigate how others solve problems, and get feedback.

ML engineers and data scientists don't do much math

The real challenge is data, not mathematics.

The END

Thank for
focusing...

양자물리에서

인공지능으로

