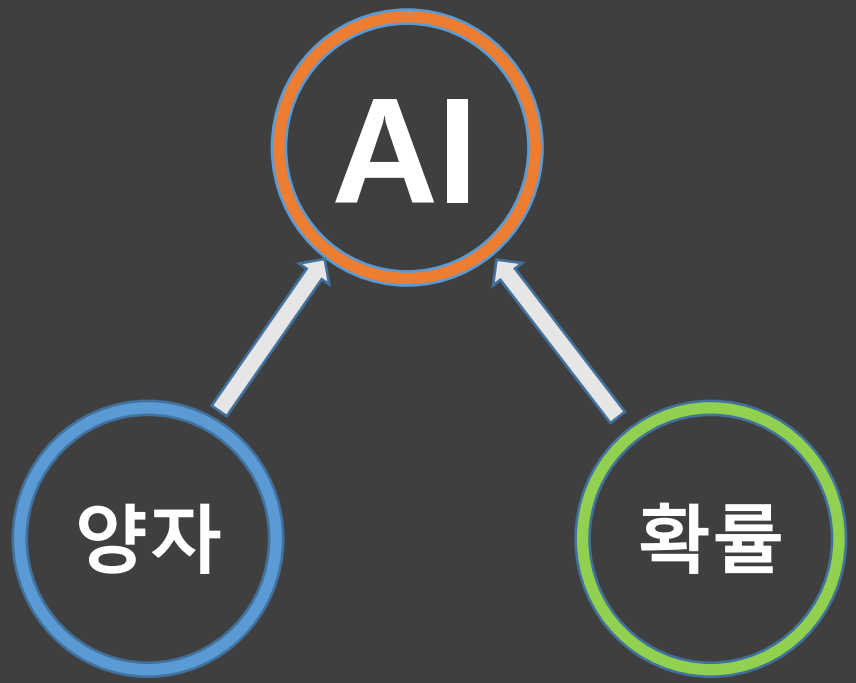
양자물리에서

인공지능으로



AI융합대학, 이 상 훈, E319, chaos21c@gmail.com

◆ 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 데이터주사위를 가지고 놀고 있다.

데이터주사위 → AI

AI

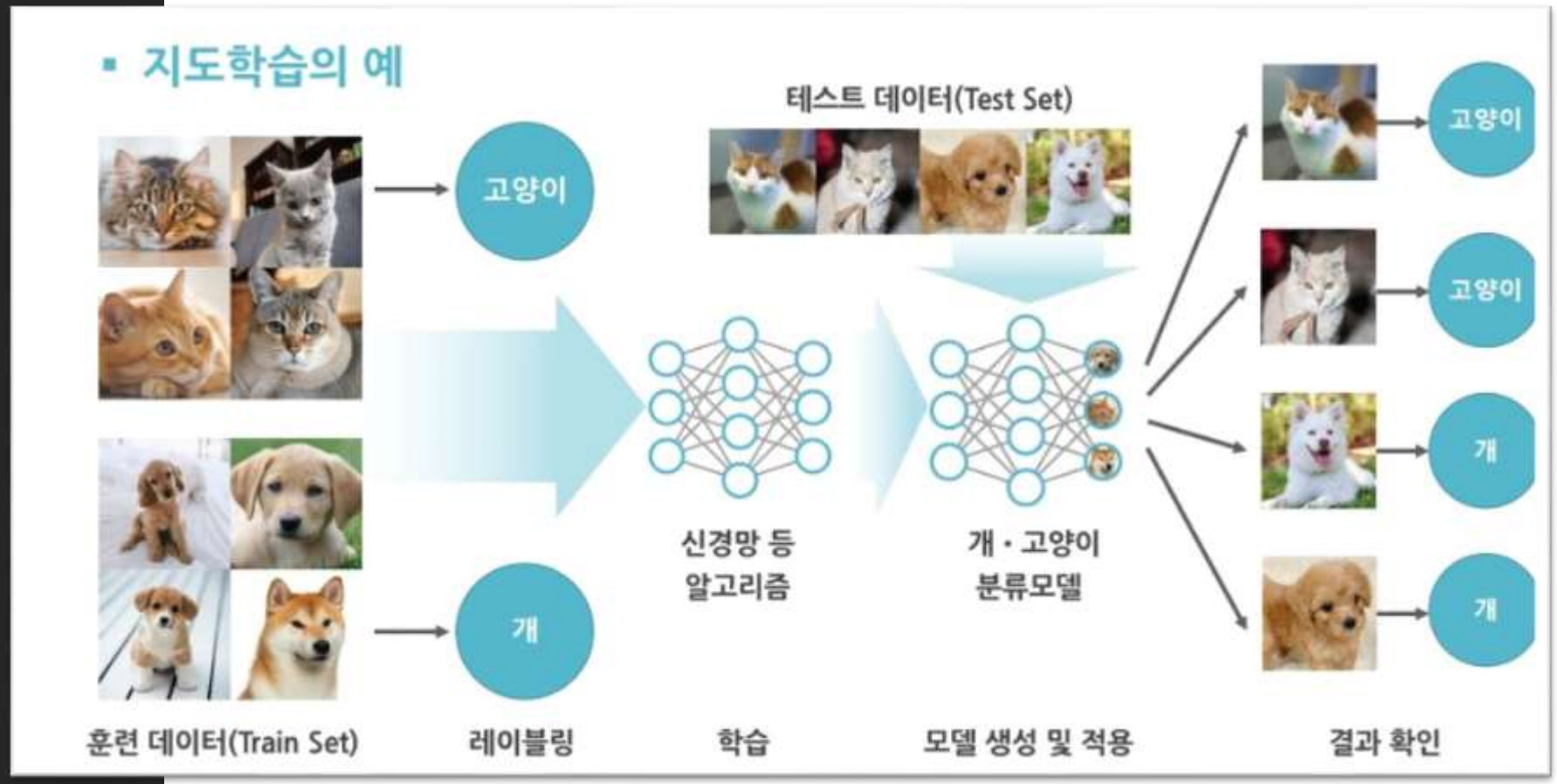
머신러닝/딥러닝

개냐? 고양이냐?

컴퓨터에게는 모든 개/고양이 사진이 개와 고양이의 중첩!

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

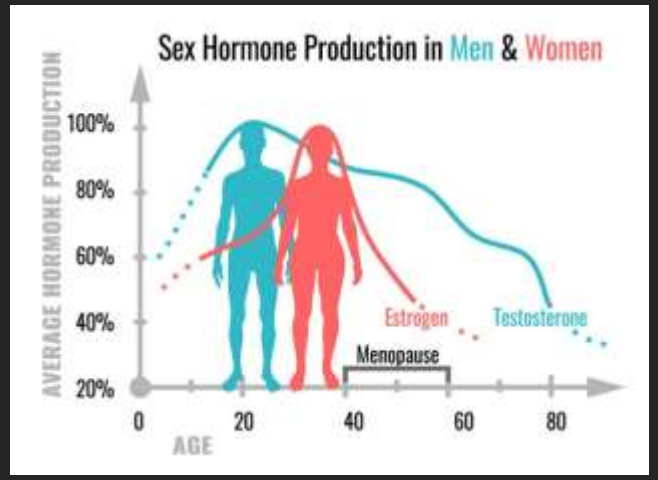
[긴급 질문]
Is Redwoods man or woman?



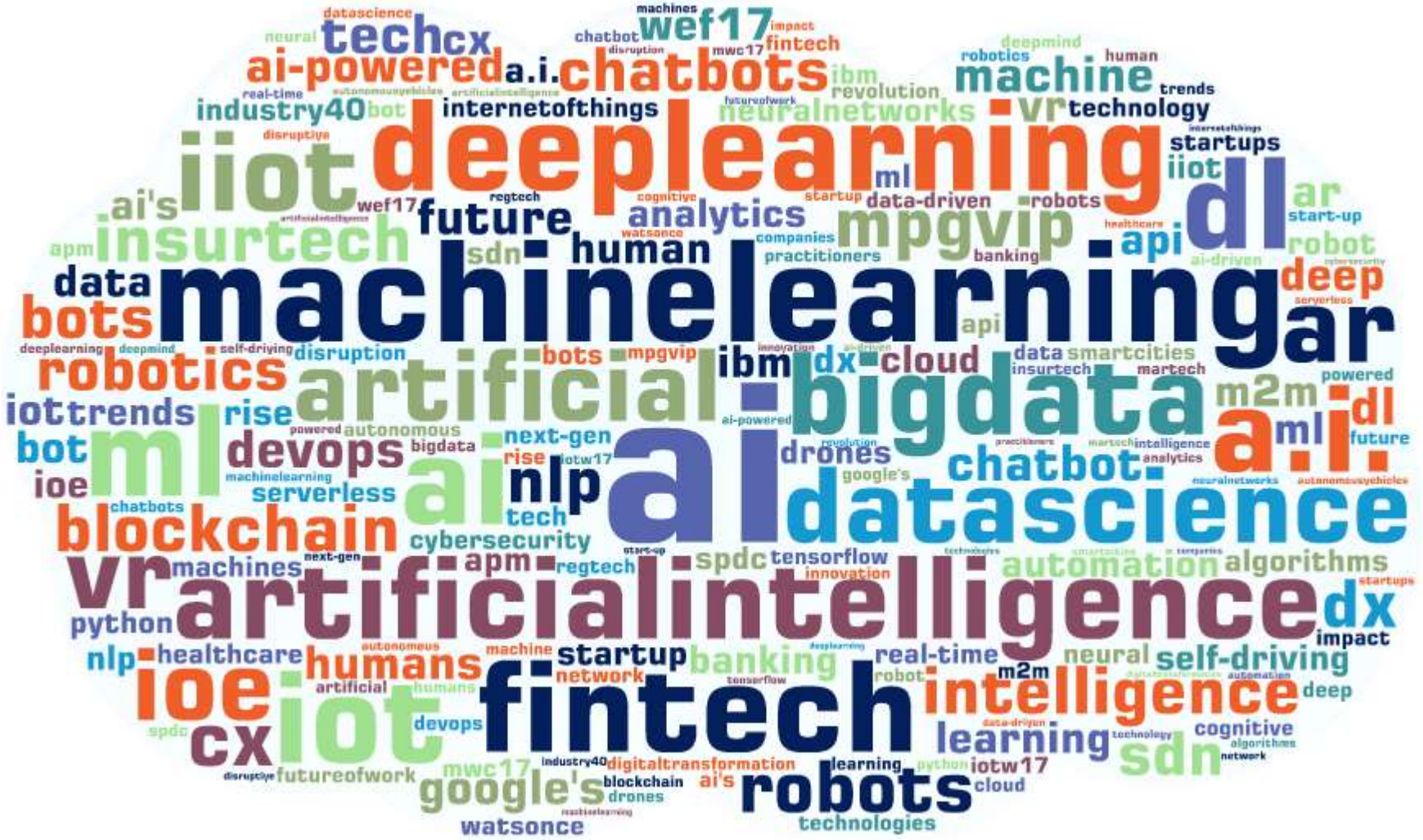
https://t1.daumcdn.net/cfile/tistory/99B9C4415B5991D516

AI

woman or man?

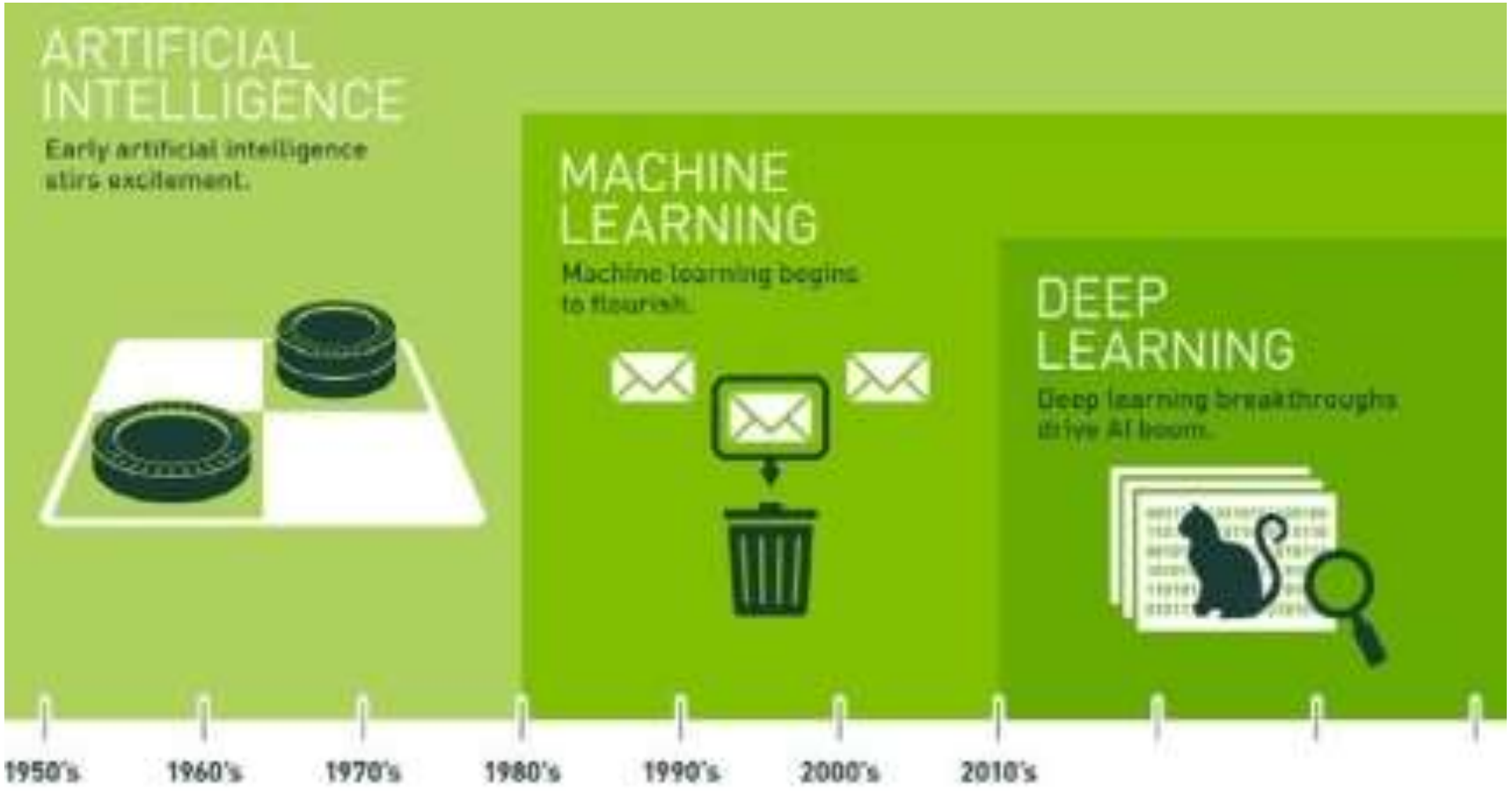


https://www.youtube.com/watch?v=st9RHcmnqwg



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

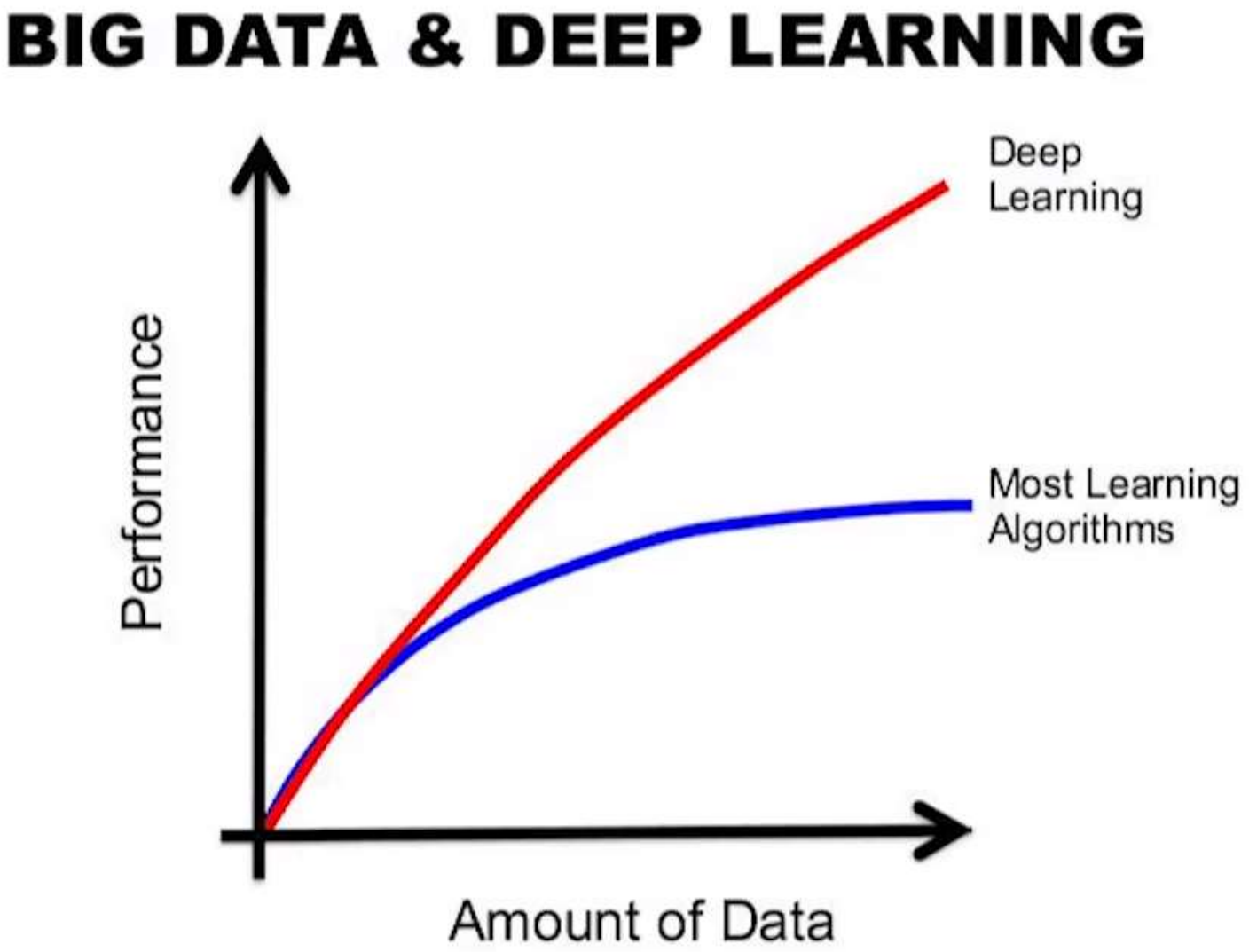
AI > ML > DL

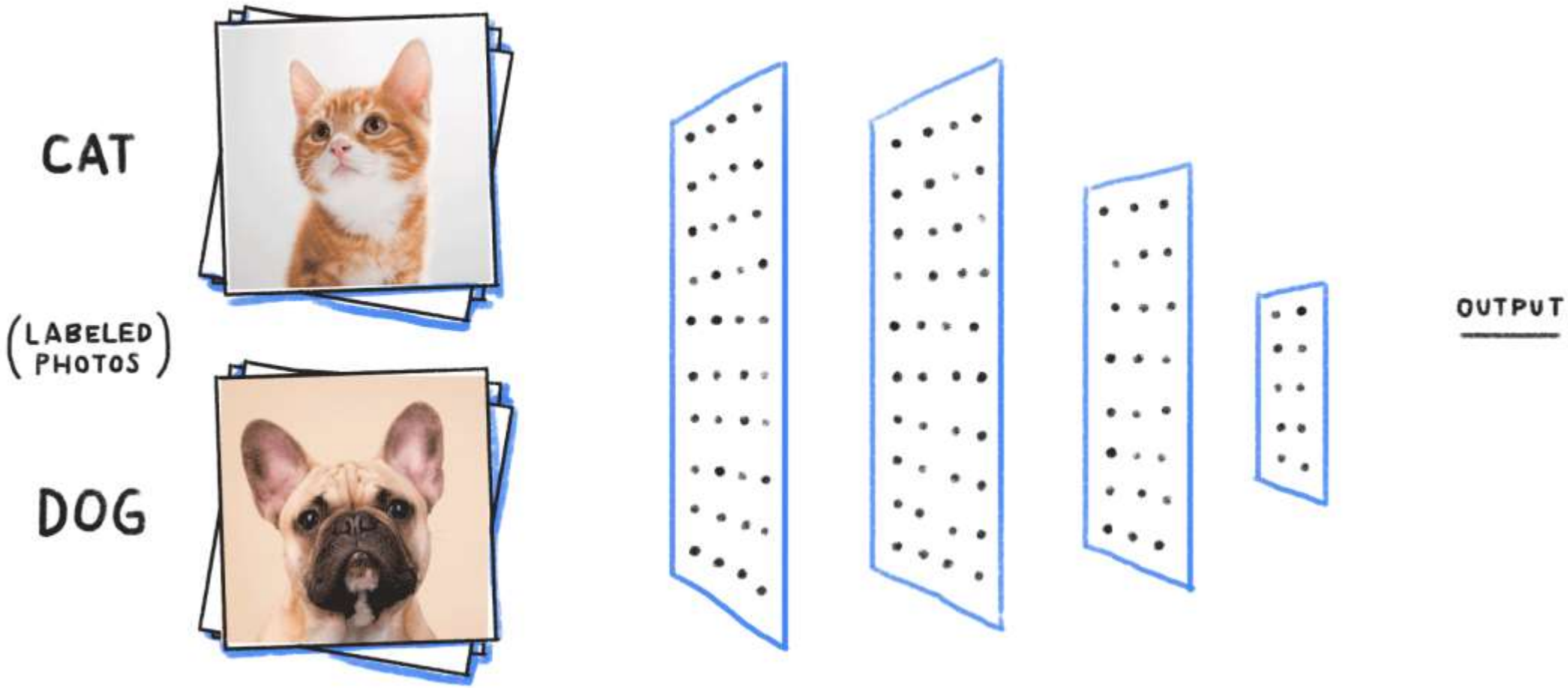


Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

http://m.news.naver.com/read.nhn?mode=LSD&mid=sec&sid1=105&oid=018&aid=0004063295

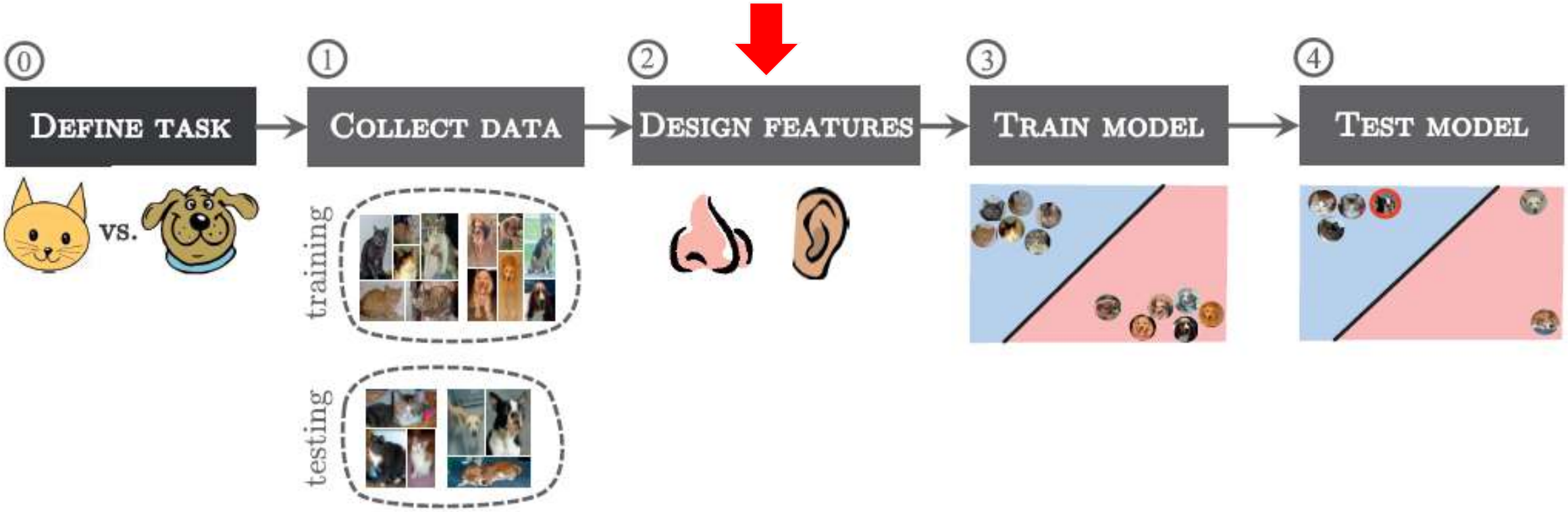
AI – ML vs. DL ← Data





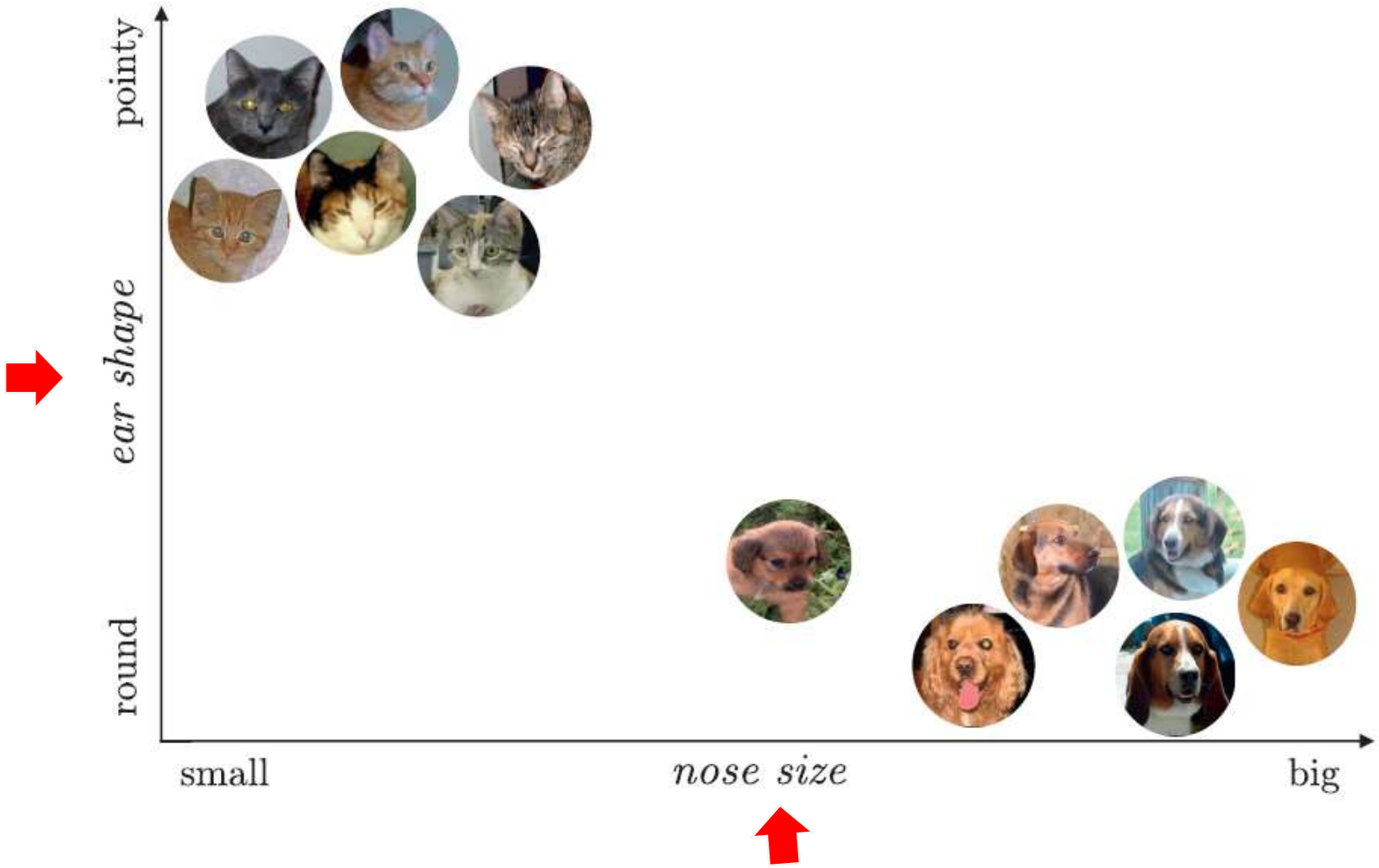
https://miro.medium.com/max/3840/1*oB3S5yHHhvougJkPXuc8og.gif

Easy ML - 0

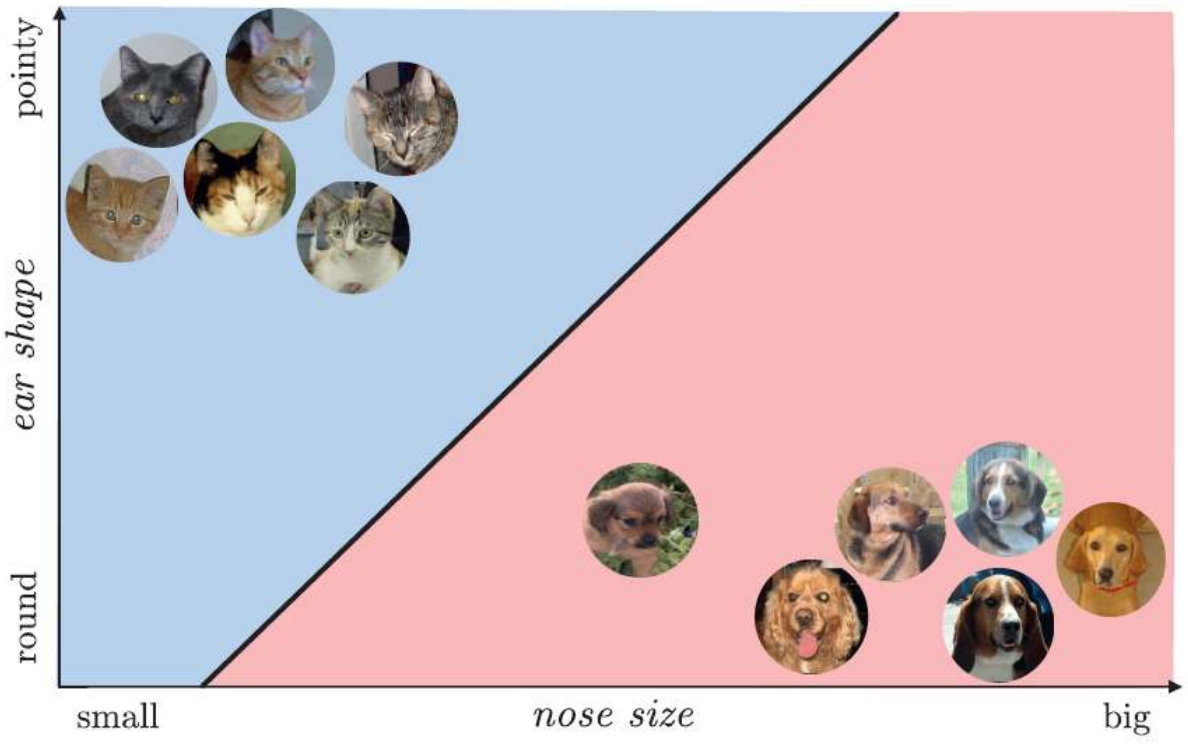

0
DEFINE TASK
vs.
1
COLLECT DATA
training
testing
2
DESIGN FEATURES
3
TRAIN MODEL
4
TEST MODEL

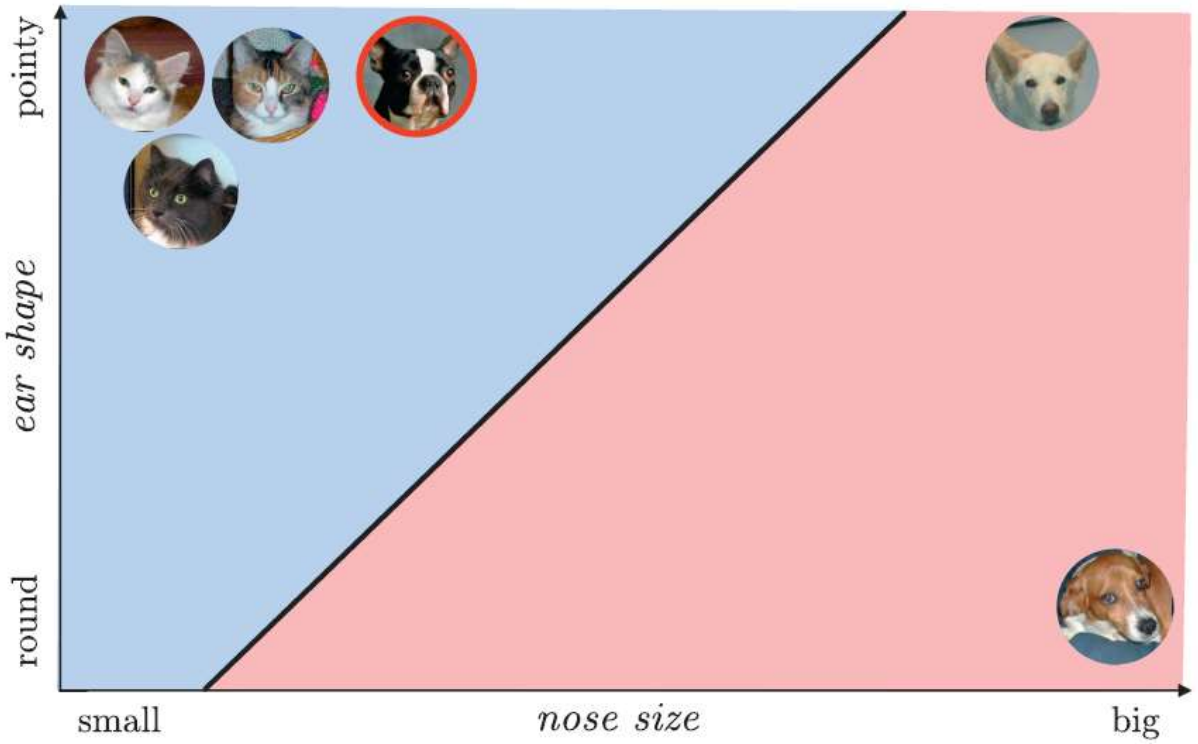
Easy ML - 1 : data

Easy ML - 2 : Training

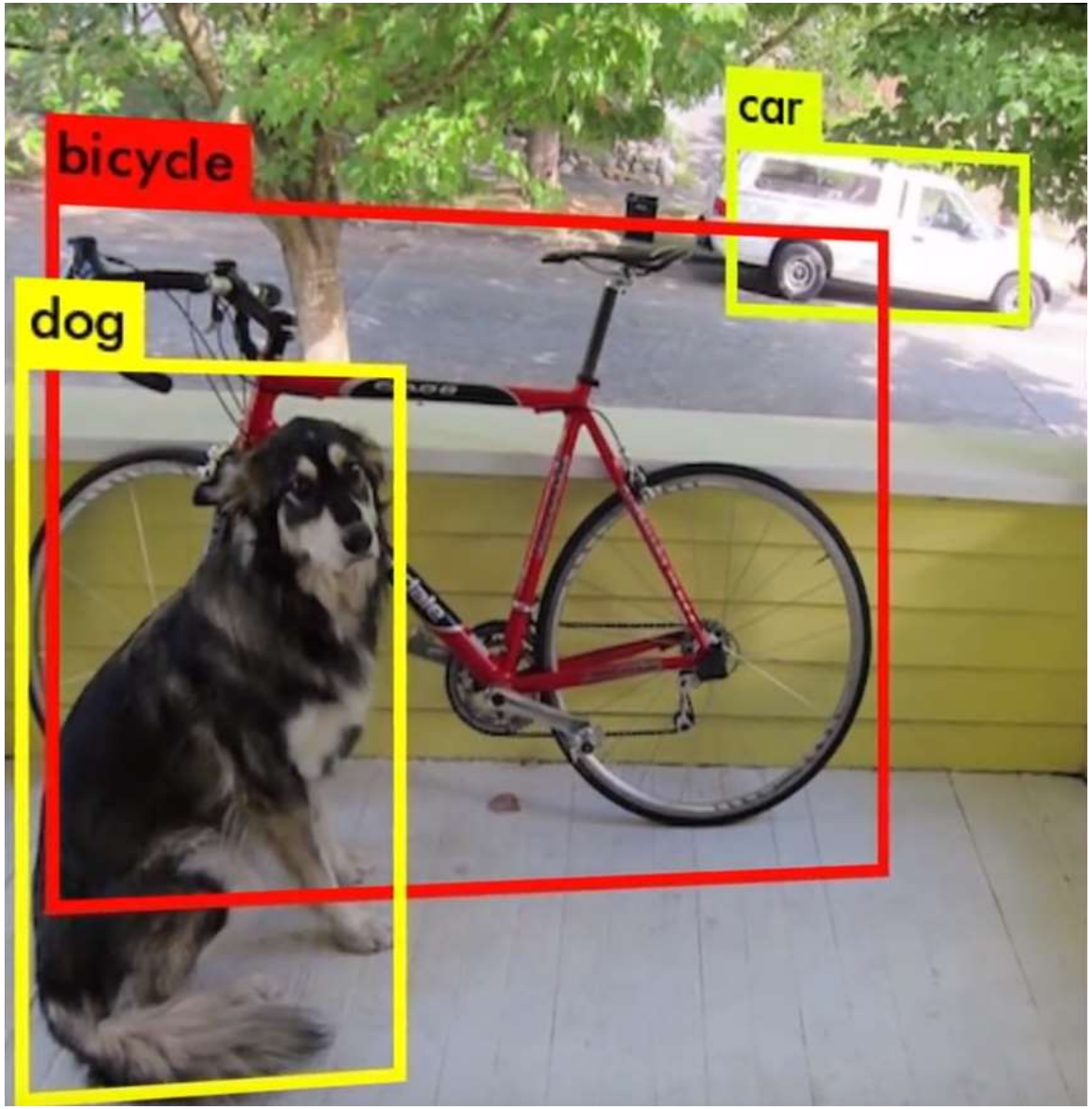


Easy ML - 3: Testing

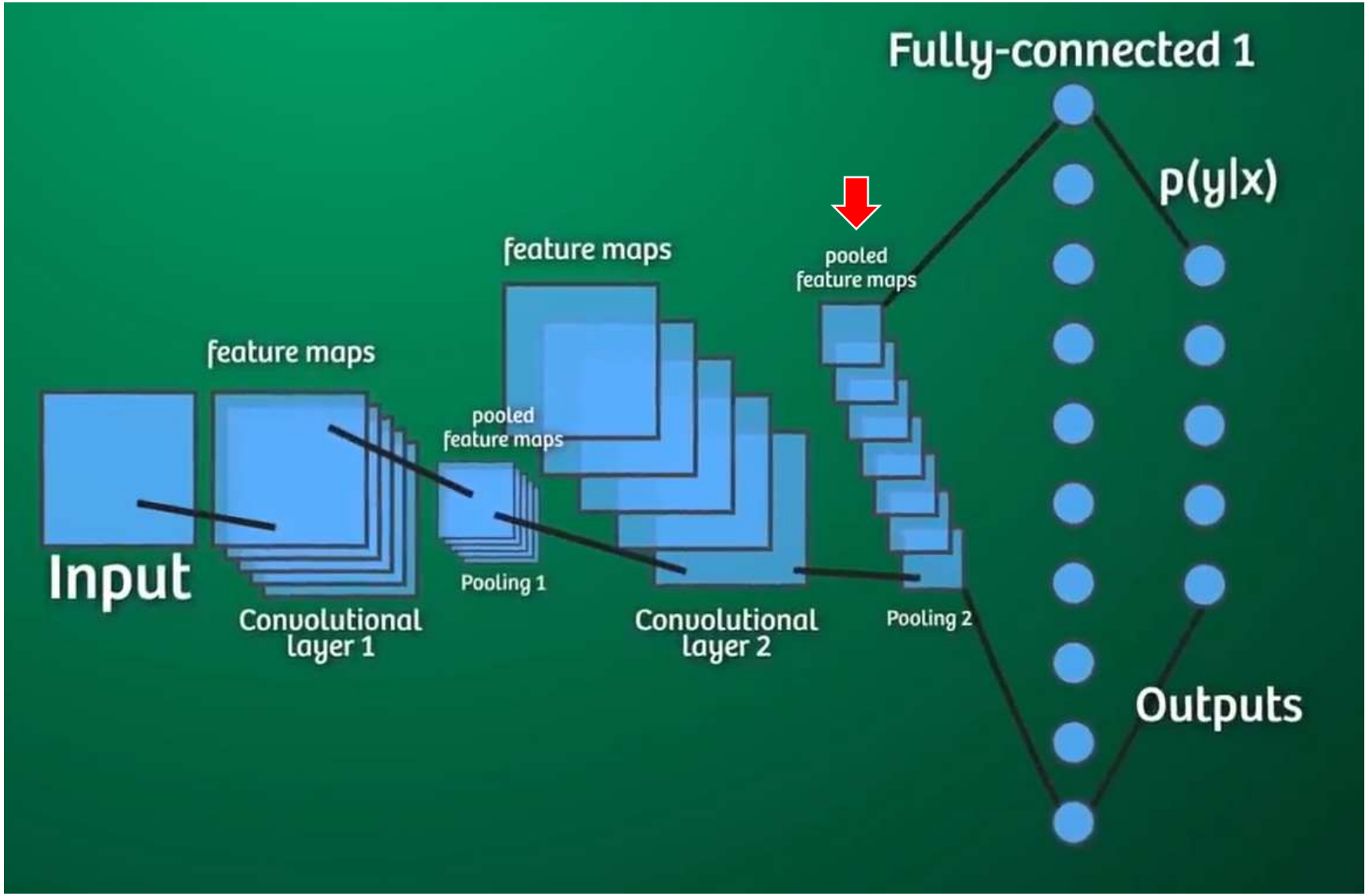




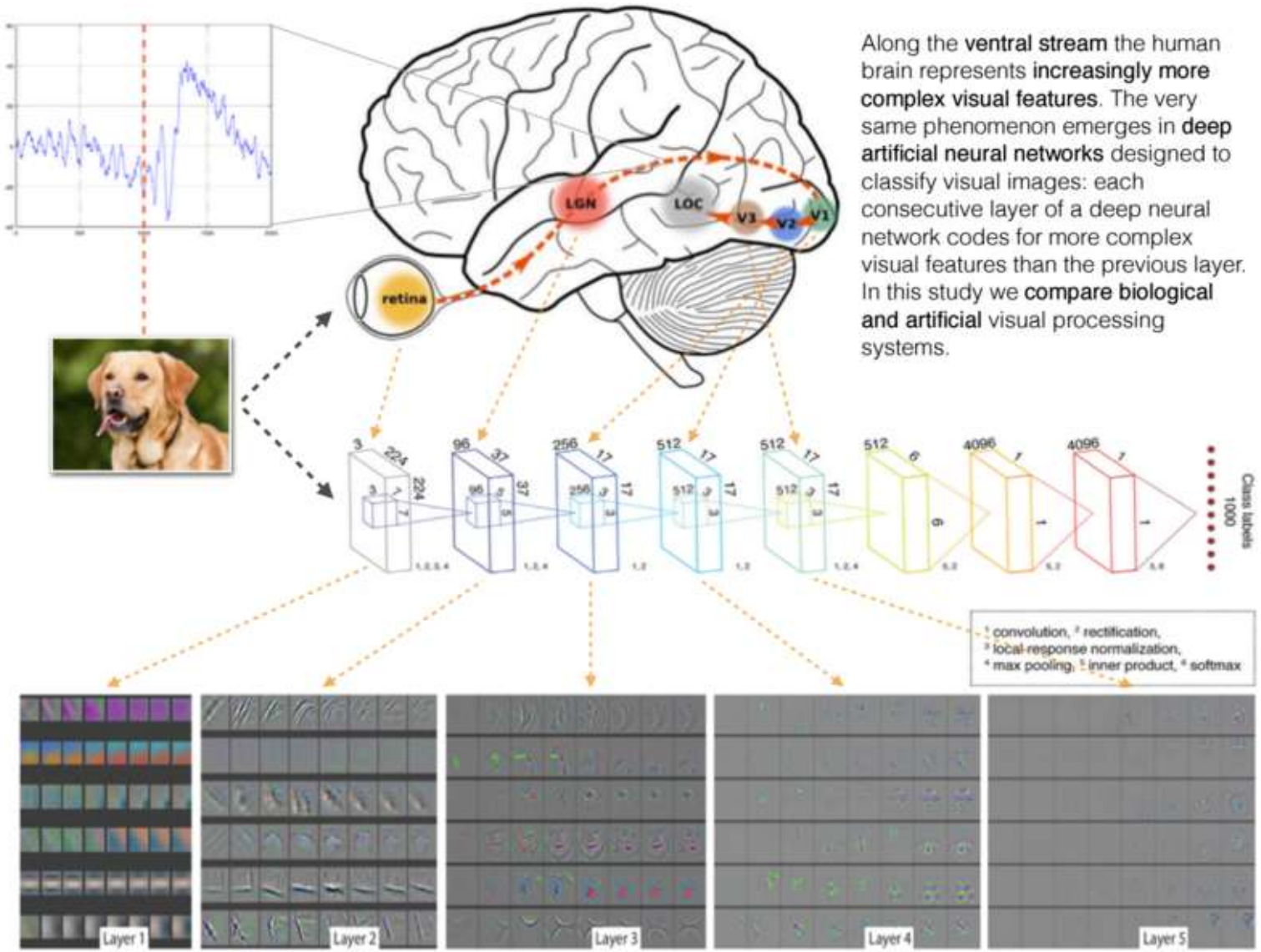
Still easy ML ? → DL, 다중 객체

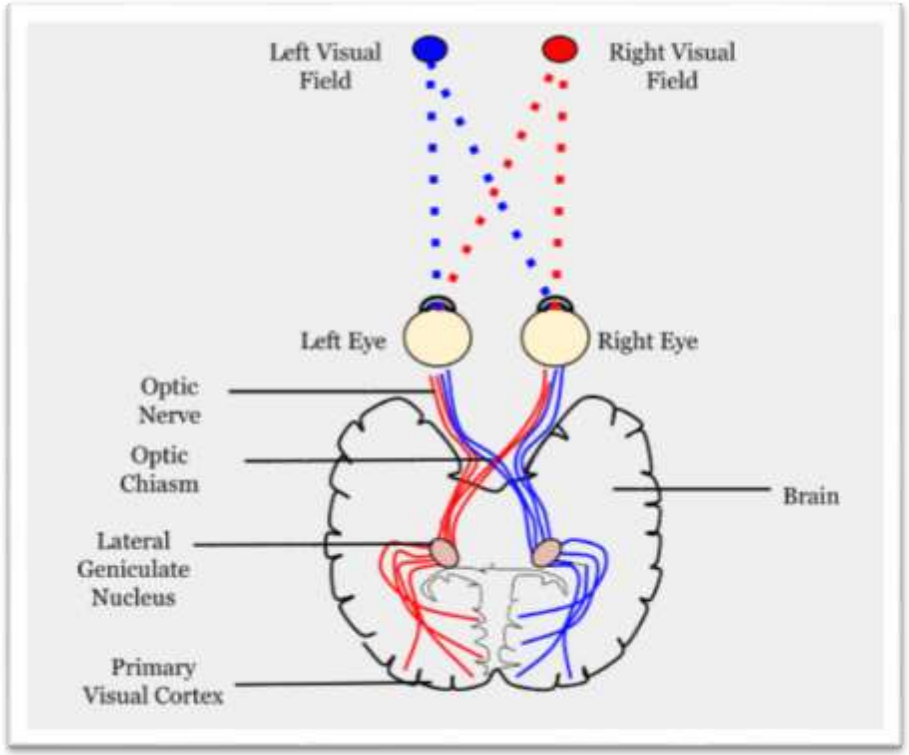


Still easy ML ? → 딥러닝



생명체의 시각과 인공 시각

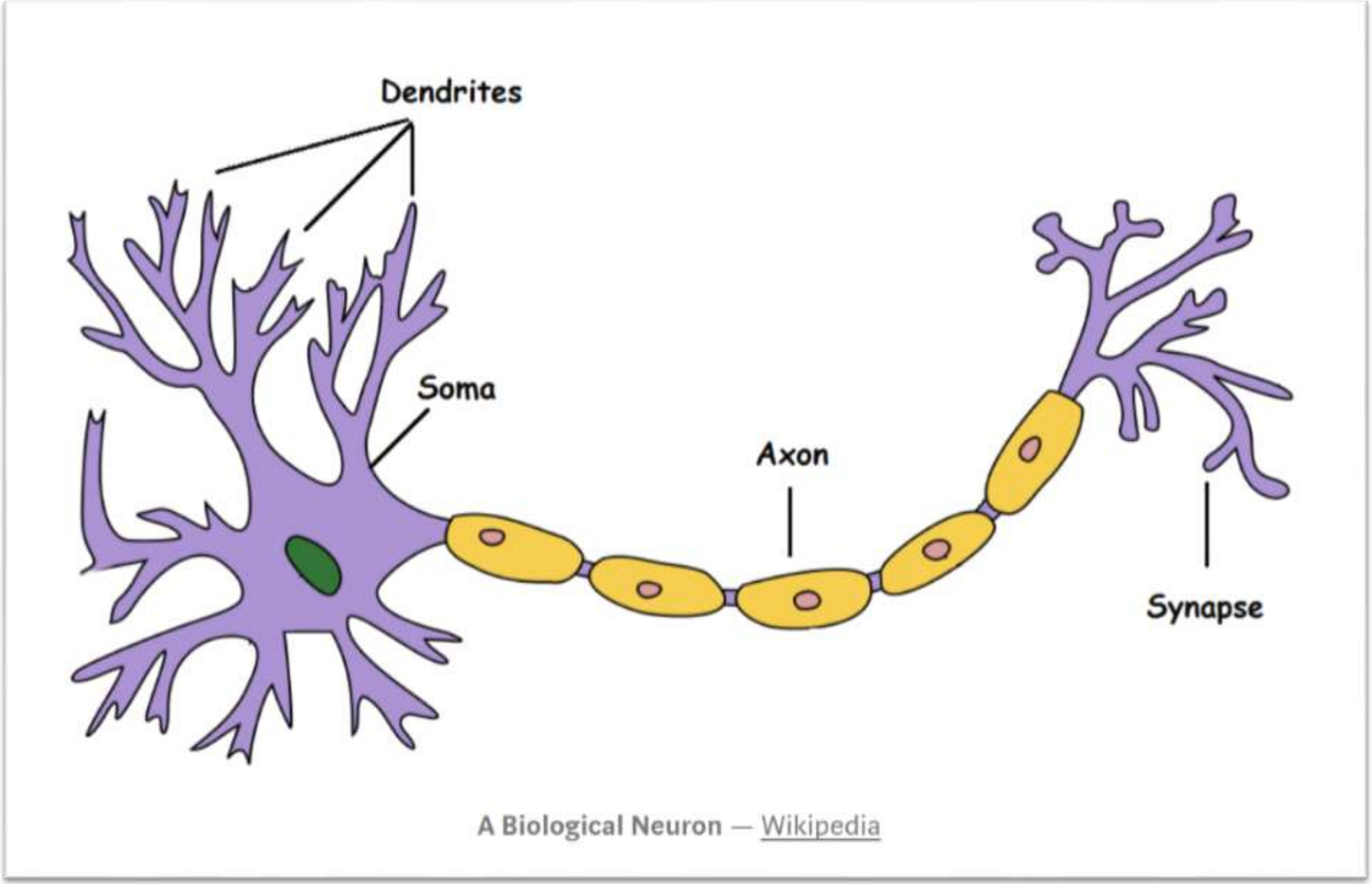




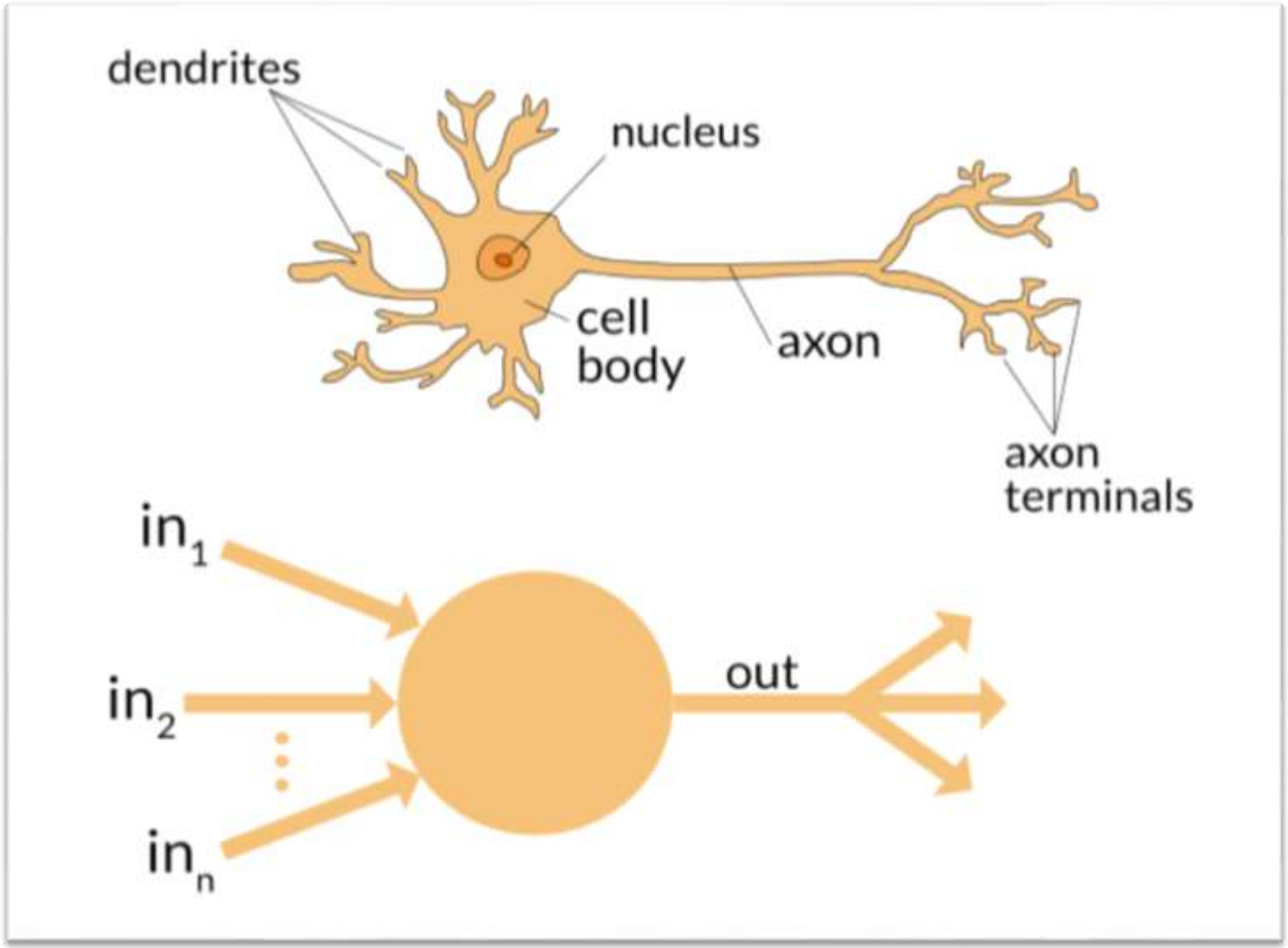
Source: Wikimedia

https://medium.com/the-school-of-ai-official/developing-an-intuition-for-better-understanding-of-convolutional-neural-networks-17812fe4722a

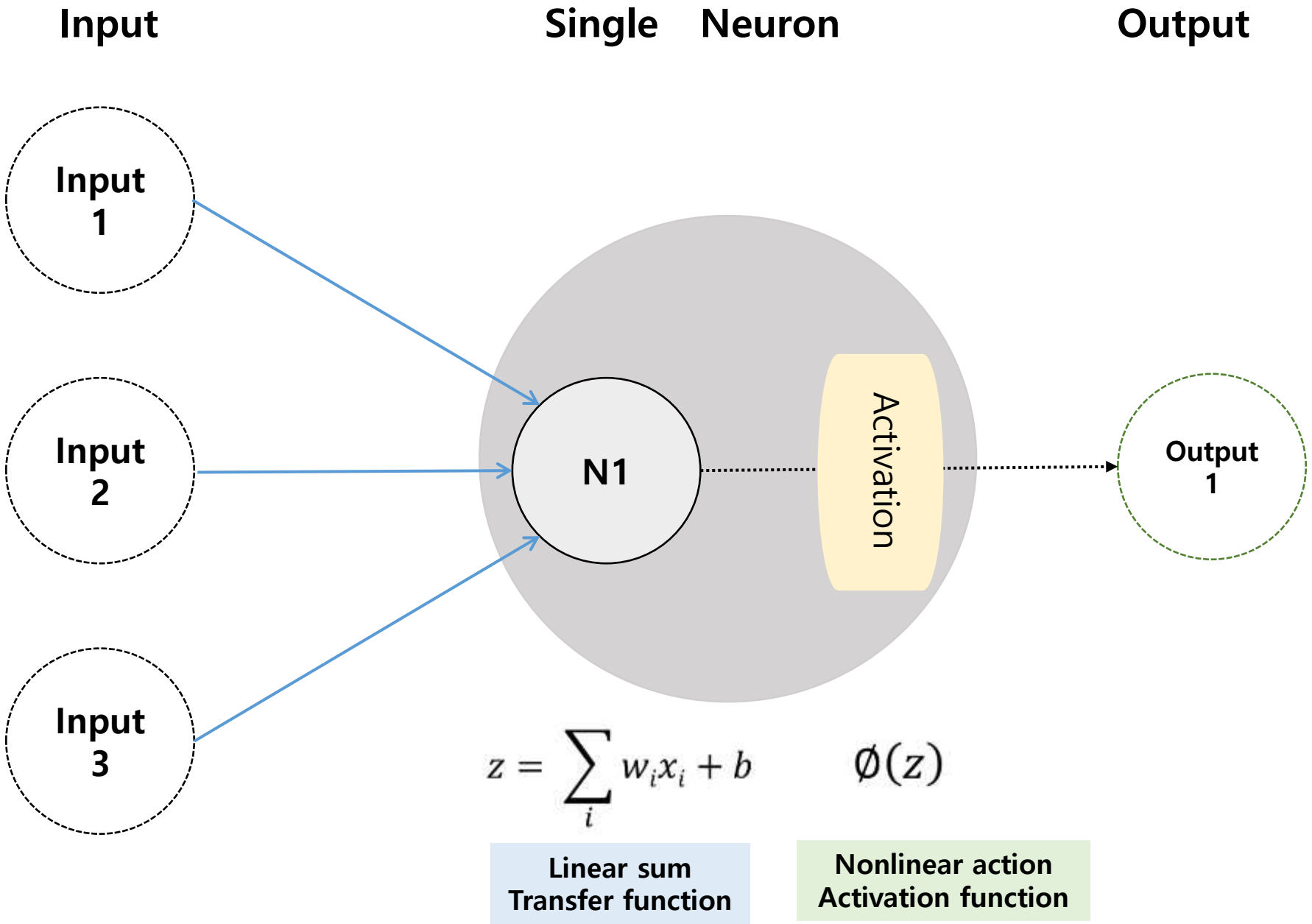
신경 세포 (Neuron)


Dendrites
Soma
Axon
Synapse
A Biological Neuron — Wikipedia

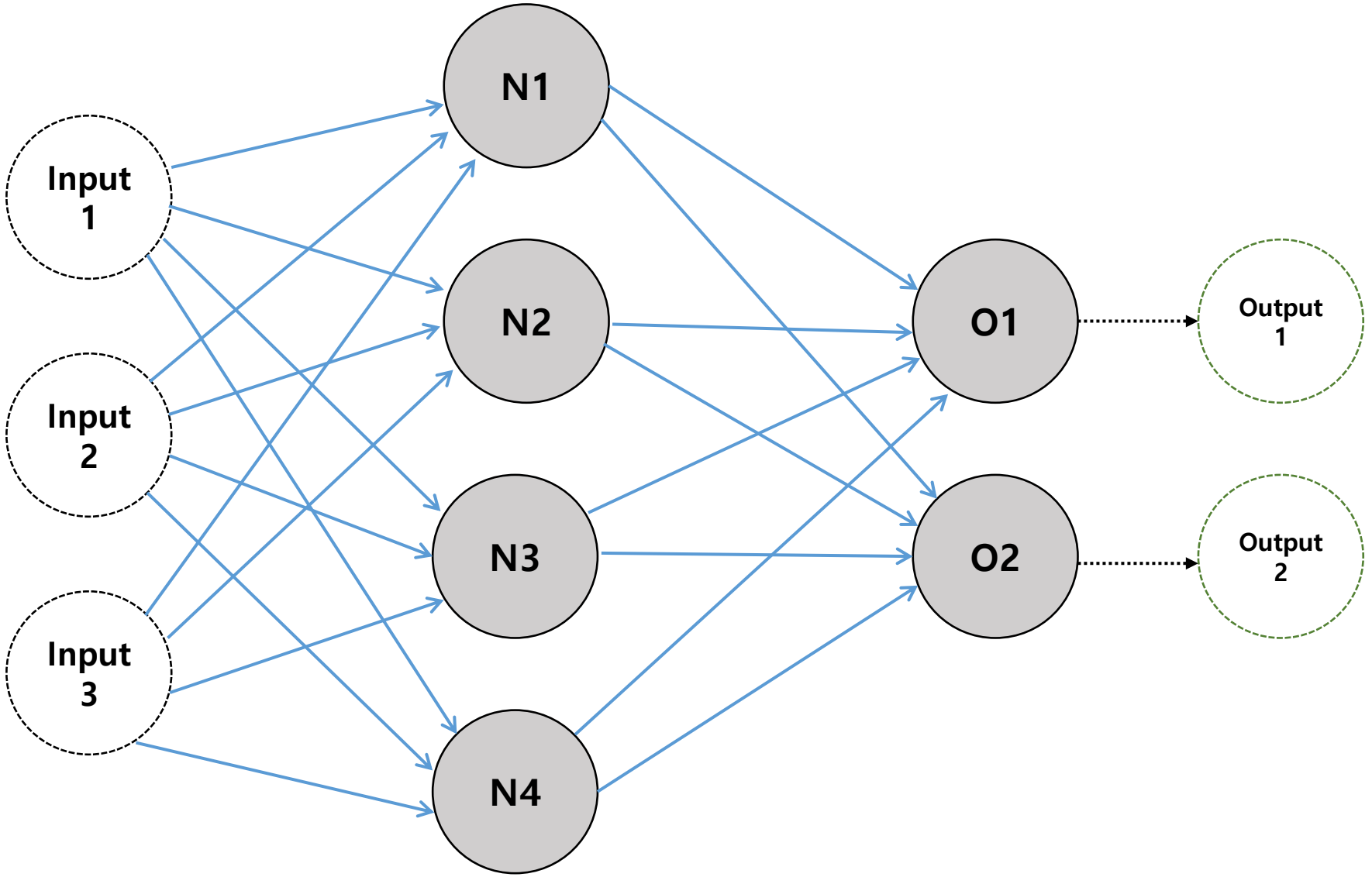
생체 신경세포와 인공신경



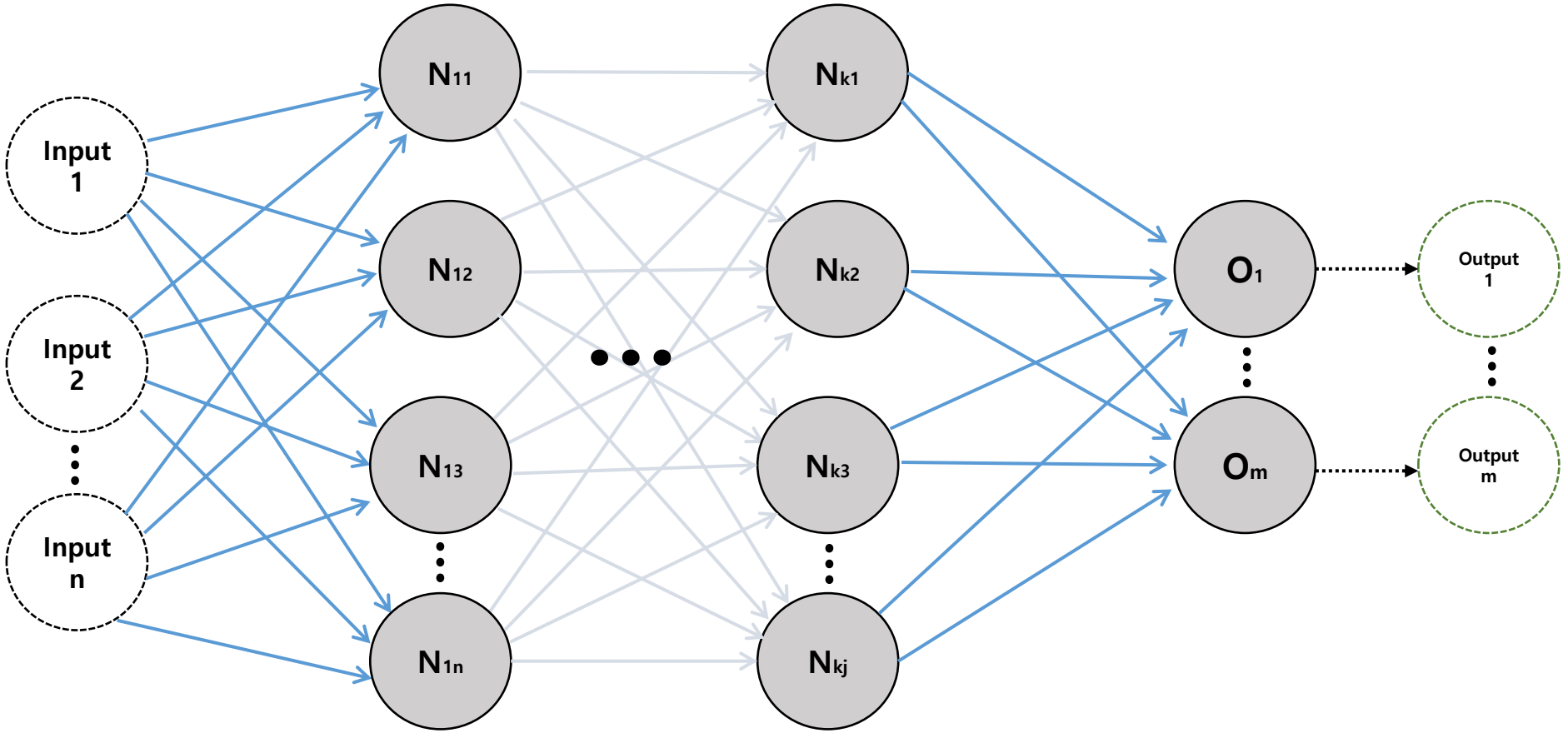
인공신경망


Input
Single Neuron
Output
Input 1
Input 2
Input 3
N1
Activation
Output 1
$z = \sum_i w_i x_i + b$
$\emptyset(z)$
Linear sum
Transfer function
Nonlinear action
Activation function

다층인공신경망 → 심층신경망



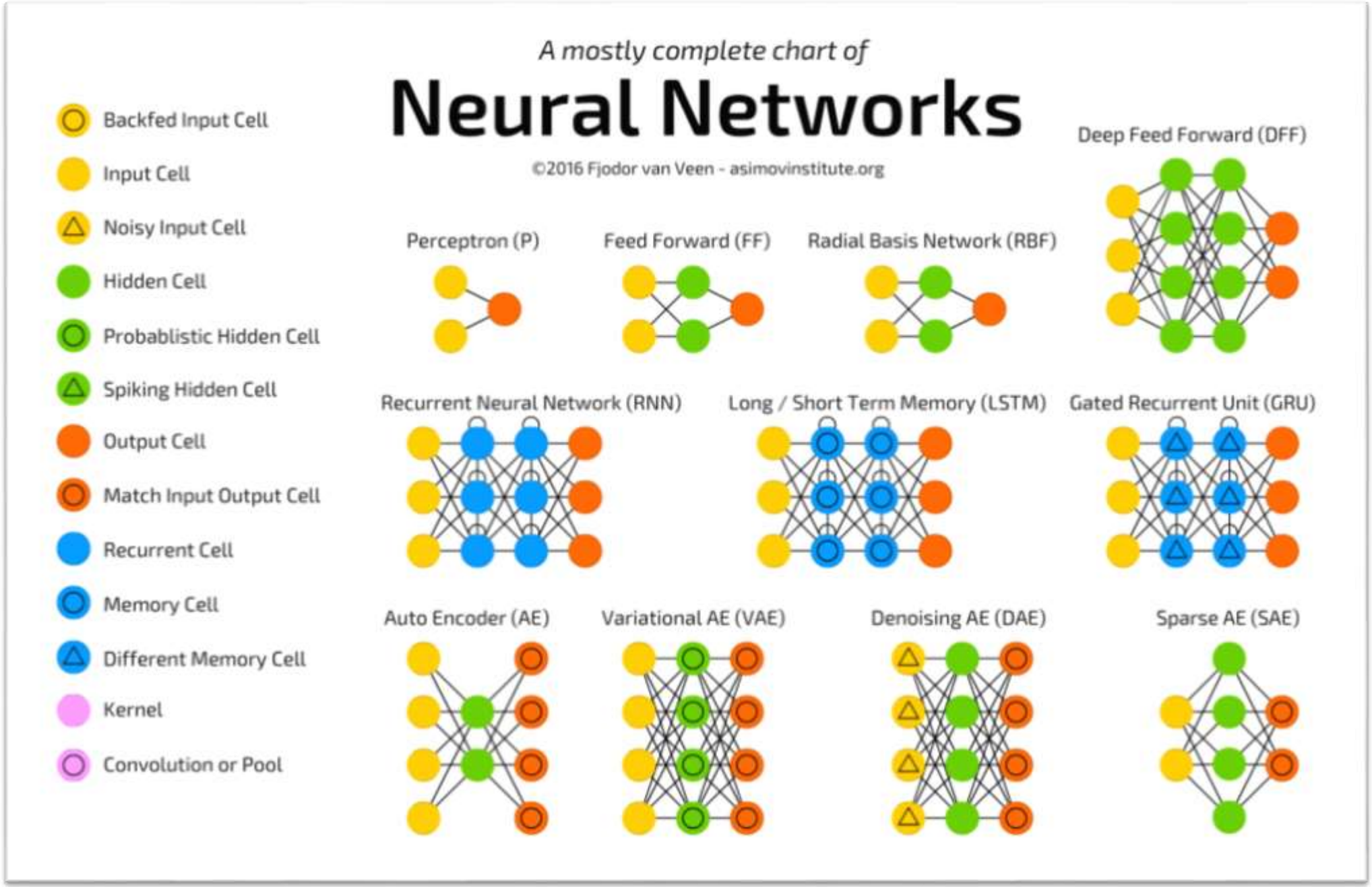
심층신경망 (Deep Neural Network → DL)



n-Input

k-Hidden layers → deep layer

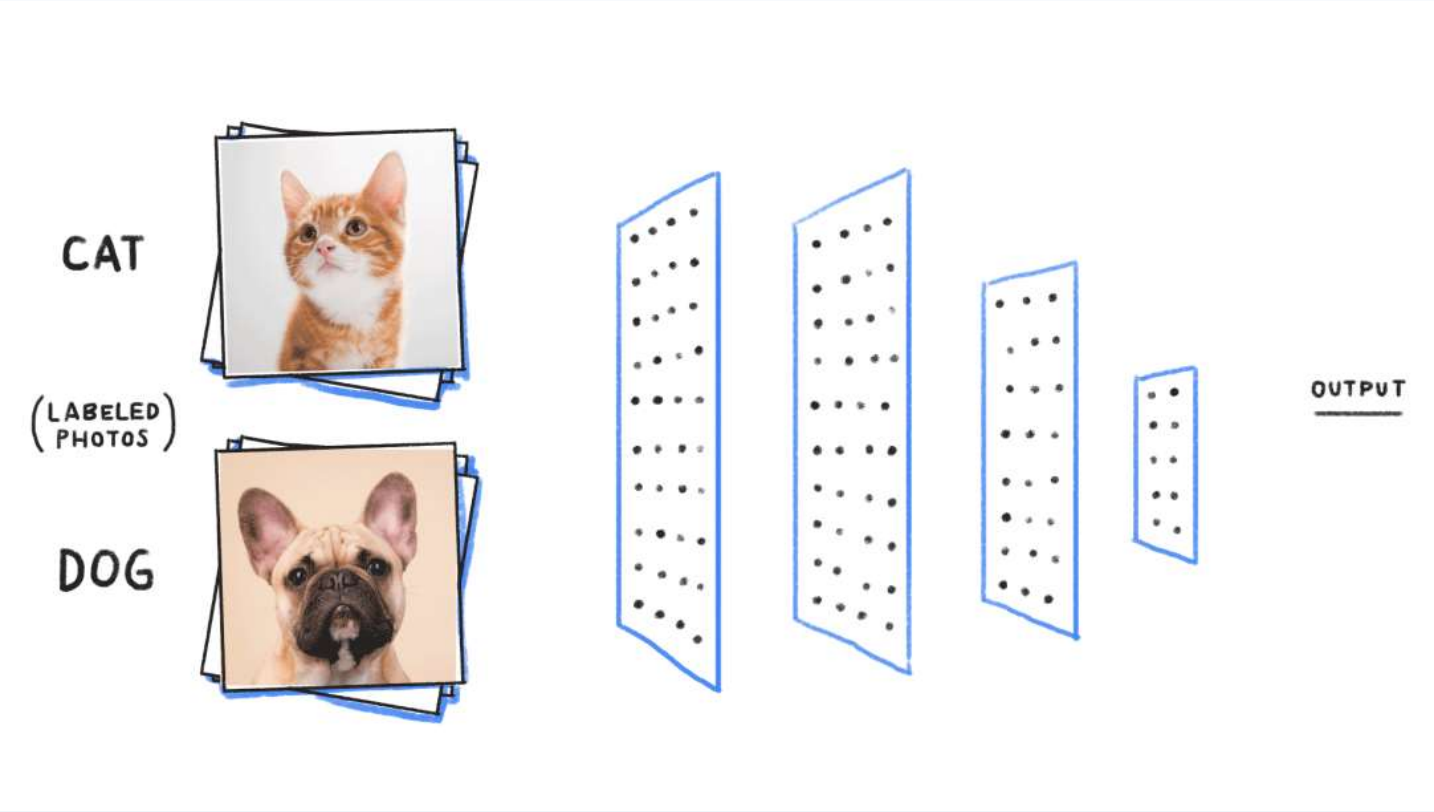
m-Output layer



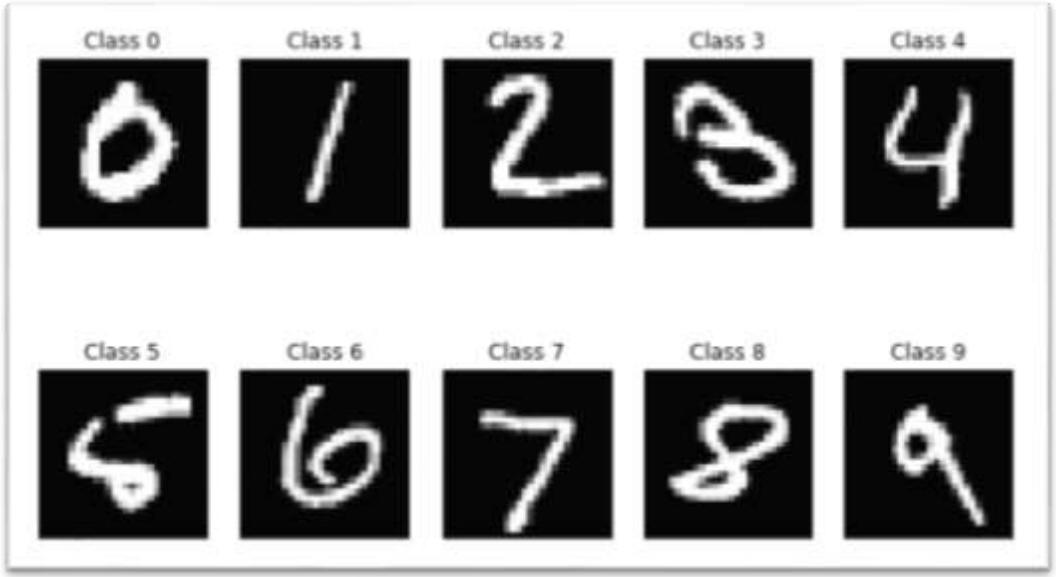
https://leonardoaraujosantos.gitbooks.io/artificial-inteligence/content/neural_networks.html

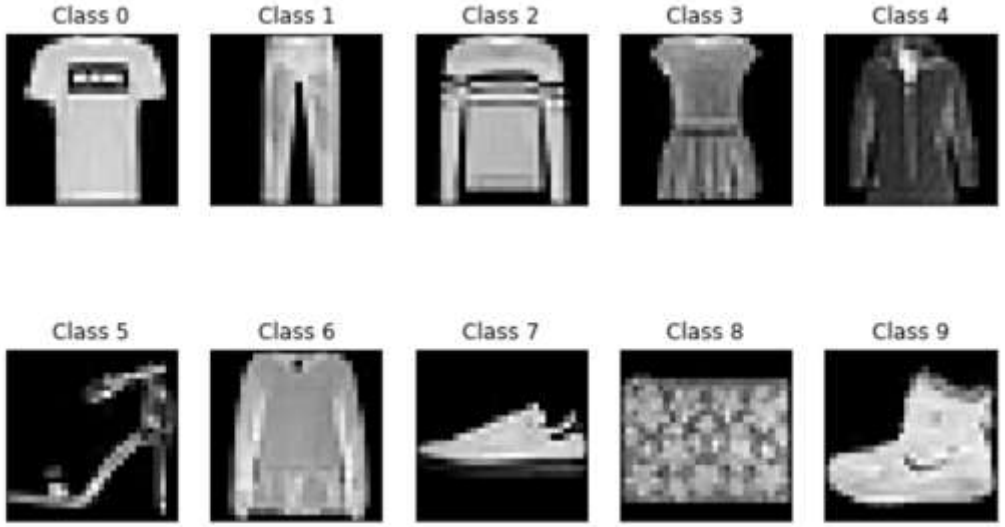
Deep Learning of Images

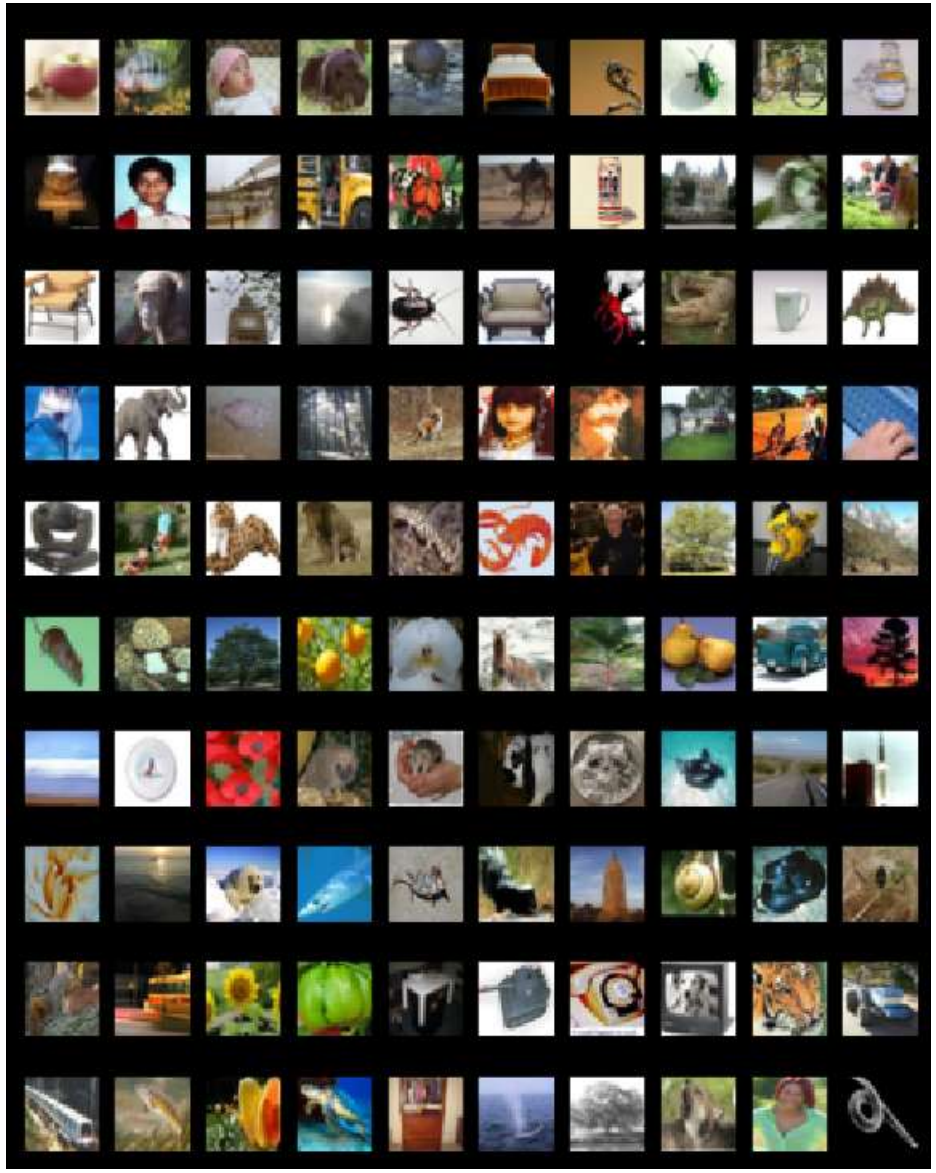
Conv2D
Pooling



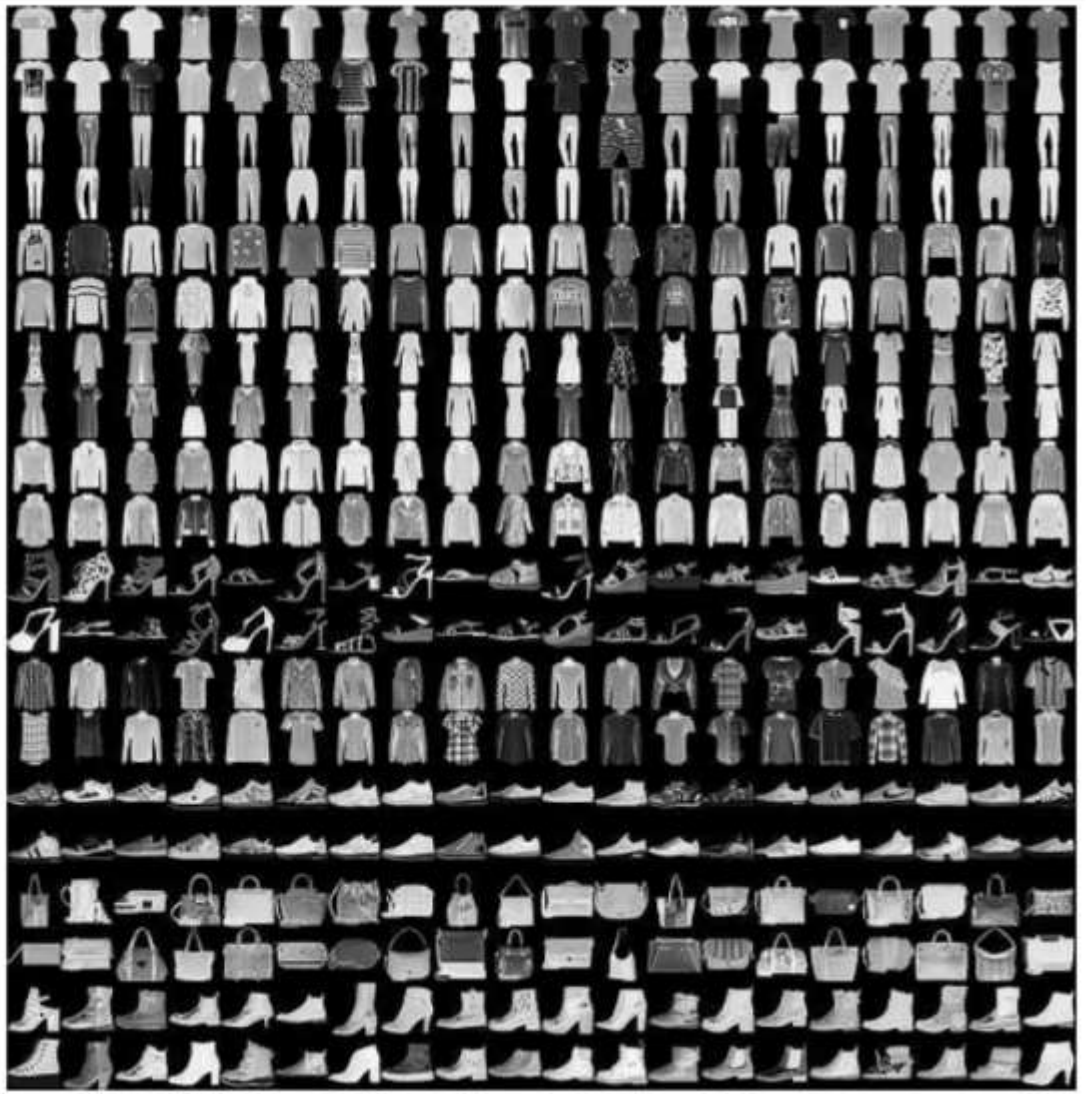
Sample data


Class 0
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
Class 8
Class 9


Class 0
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
Class 8
Class 9

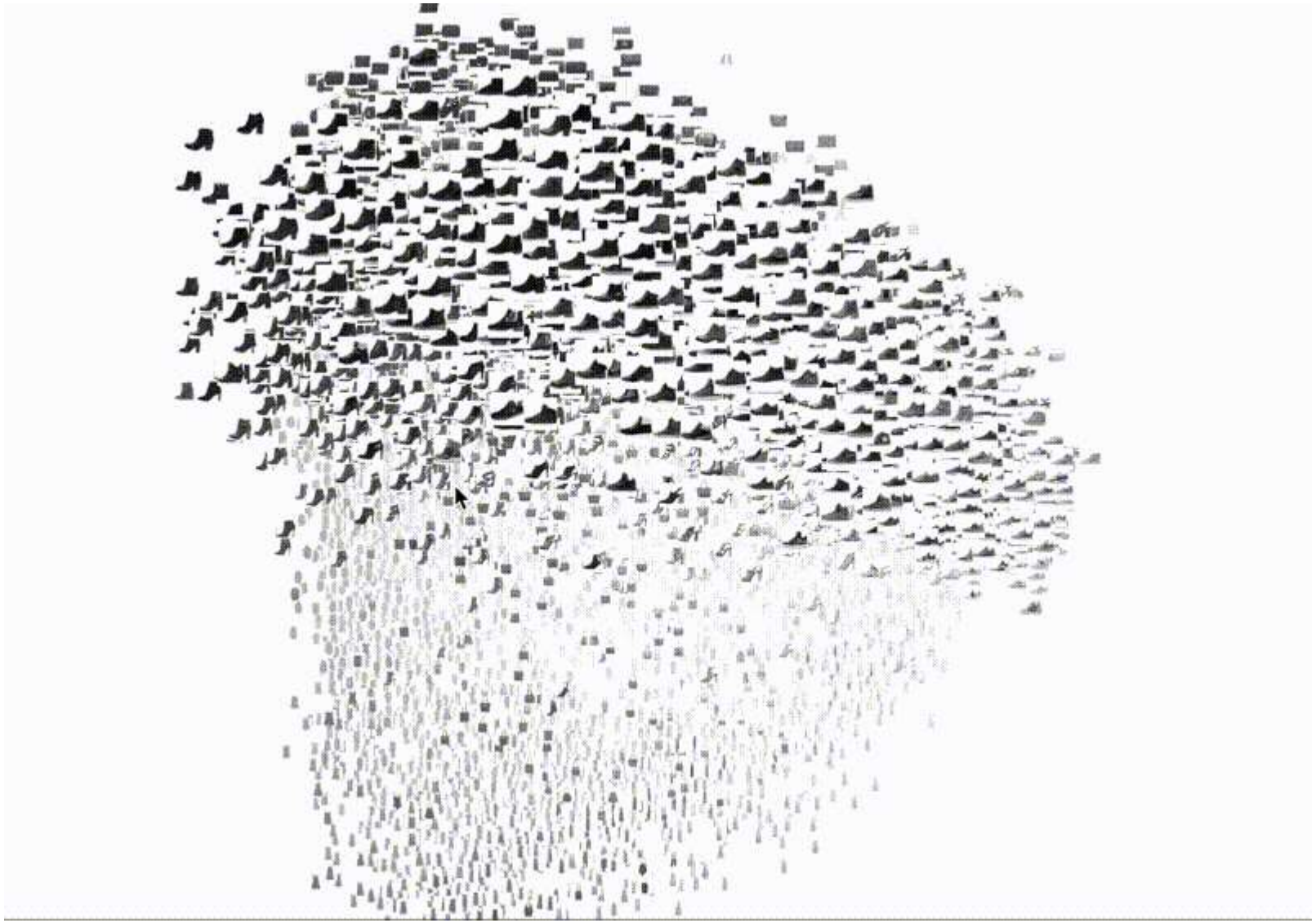


Sample data: Fashion MNIST

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	

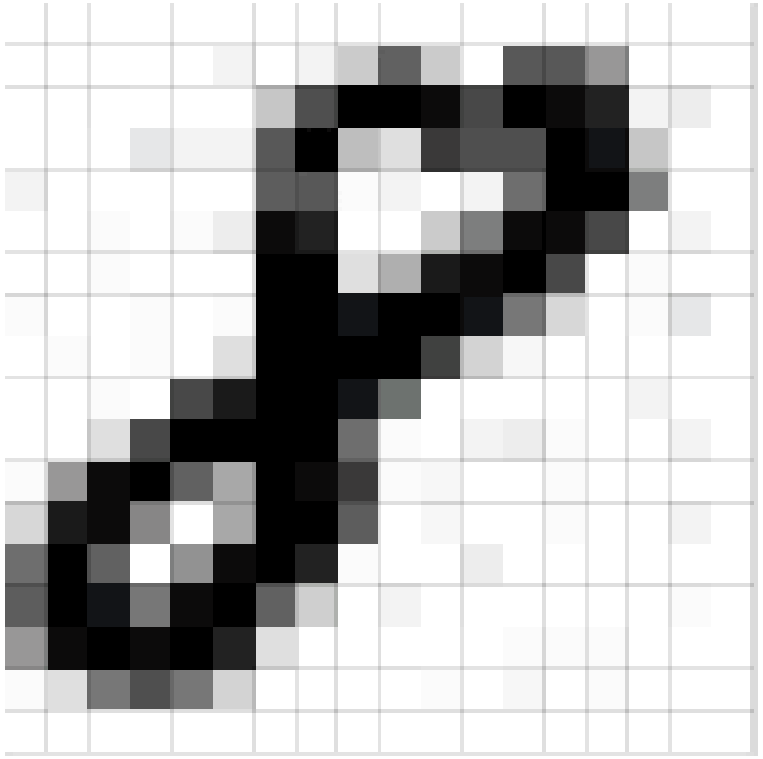
https://arxiv.org/pdf/1708.07747.pdf

Sample data: Fashion MNIST

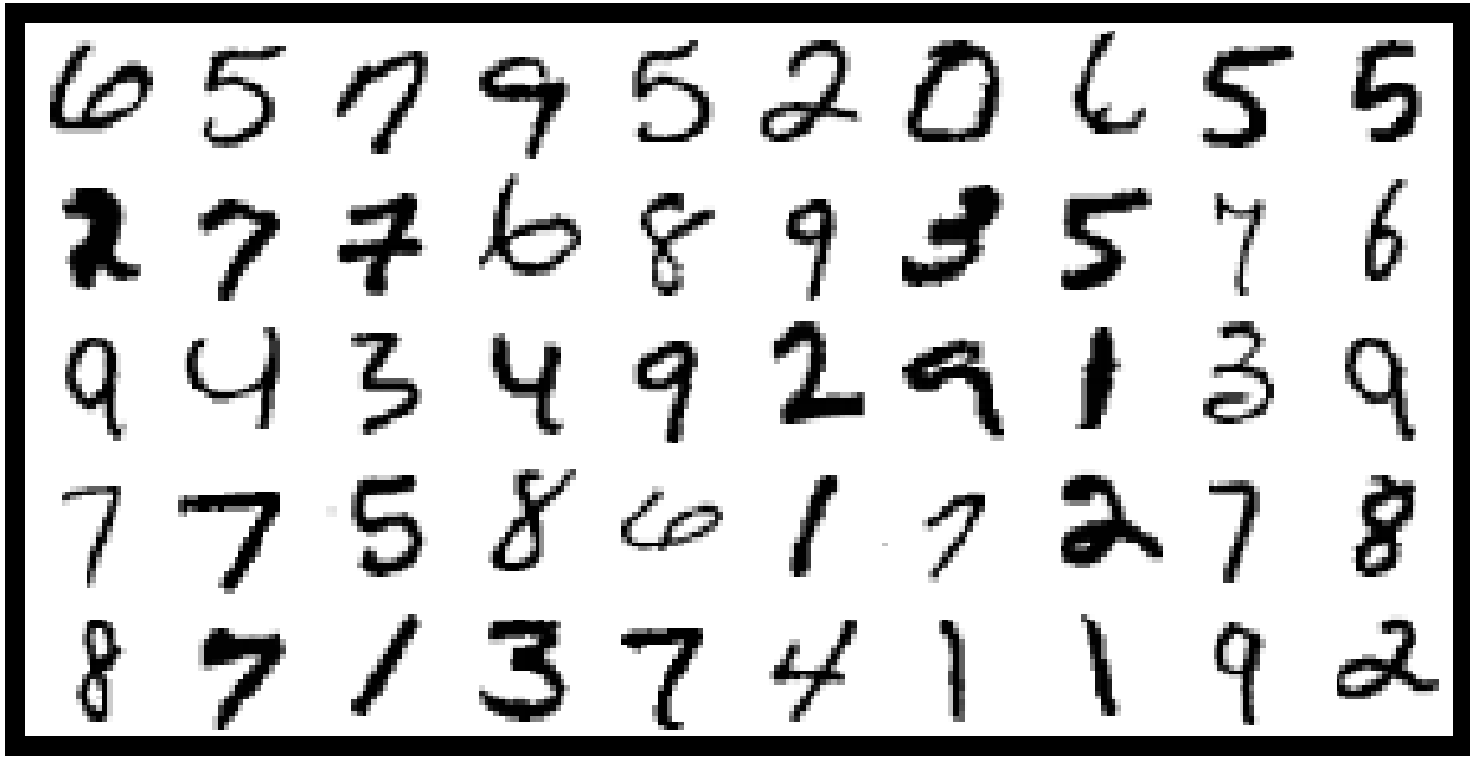


https://miro.medium.com/max/1400/1*ASBL6bFOdz1KWLAgfKwsvw.gif

MNIST

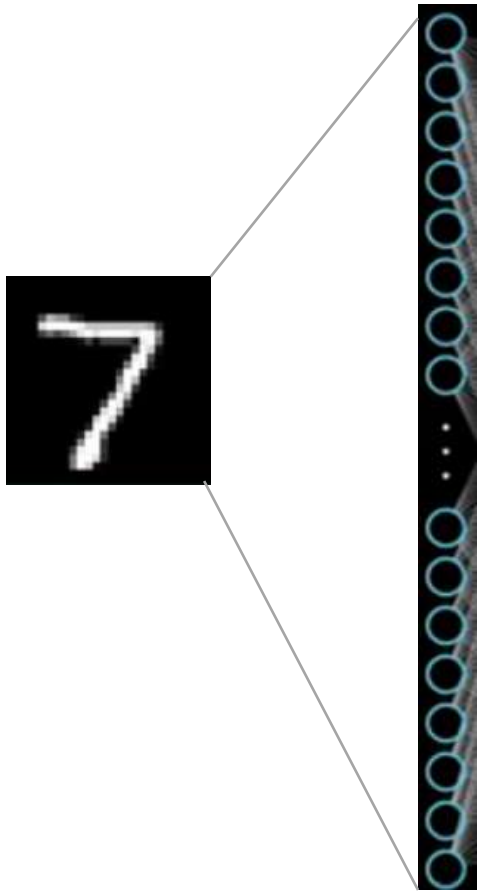


28 X 28 : 784 pixels
Gray scale [0 ~ 255]

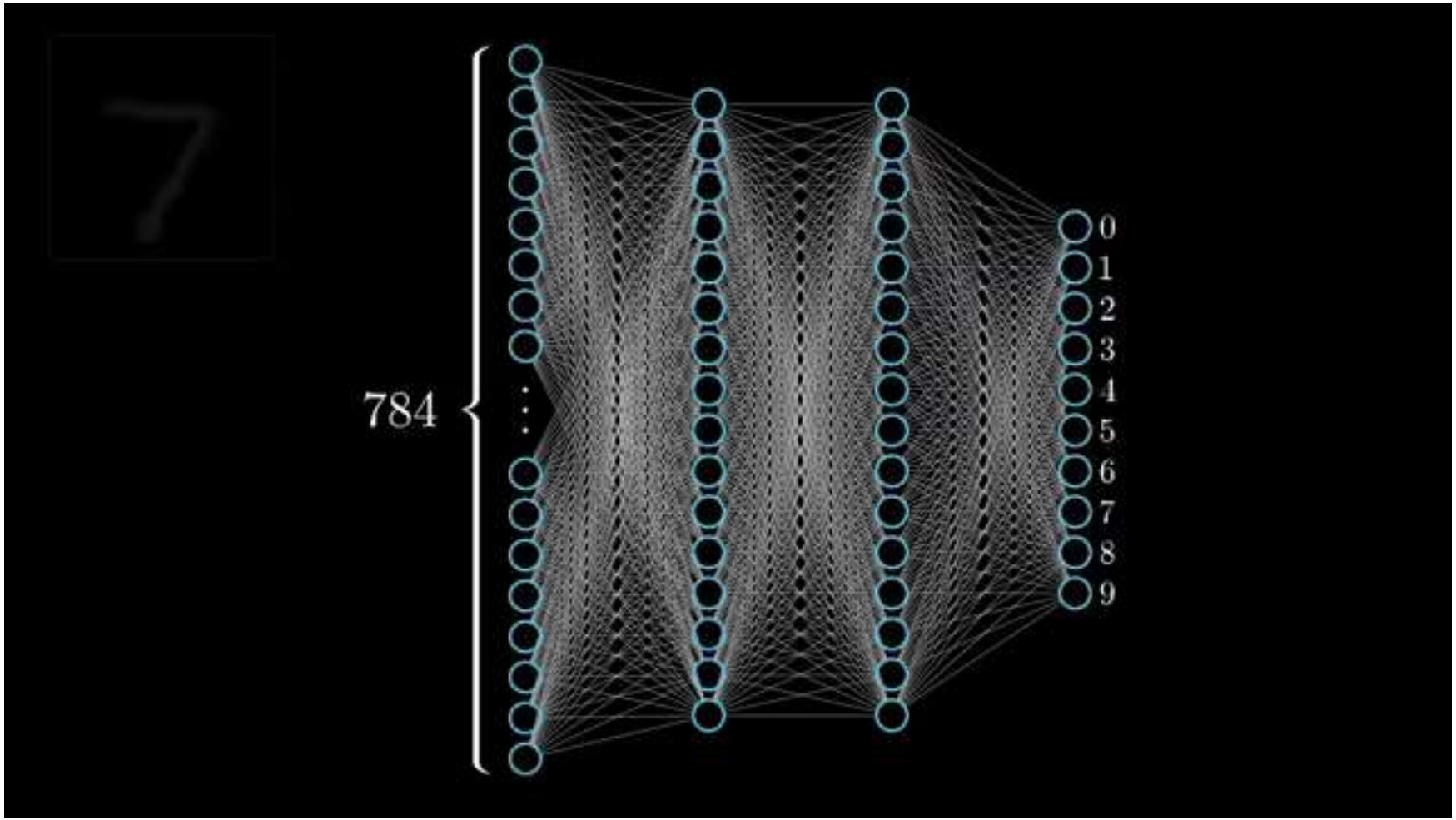


MLP: Multi-Layer Perceptron (90%)

Fully Connected Network (FCN)

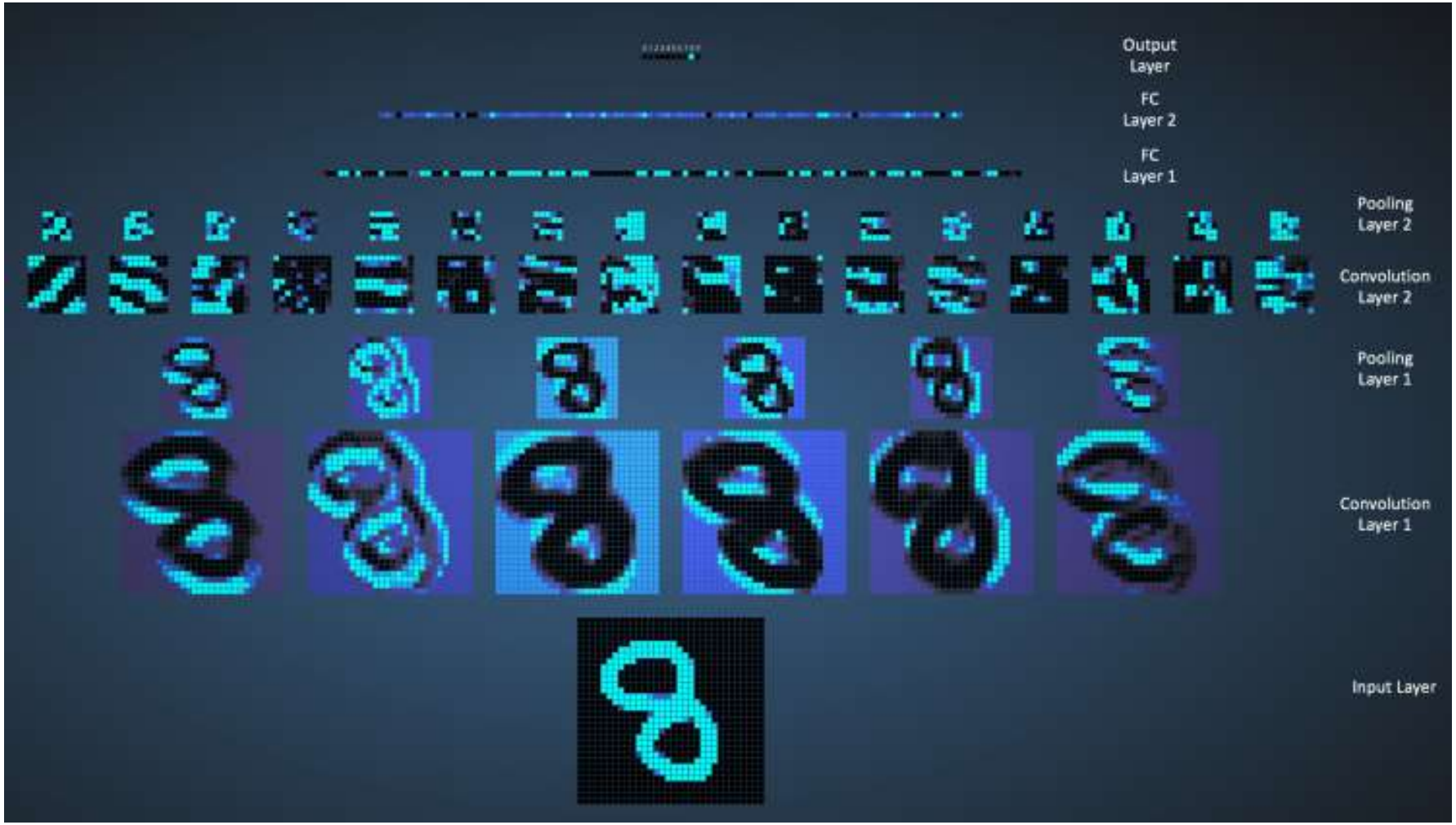


28 X 28 → 784 pixels



Source: https://gfycat.com/ko/deadlydeafeningatlanticblackgoby-three-blue-one-brown-machines-learning

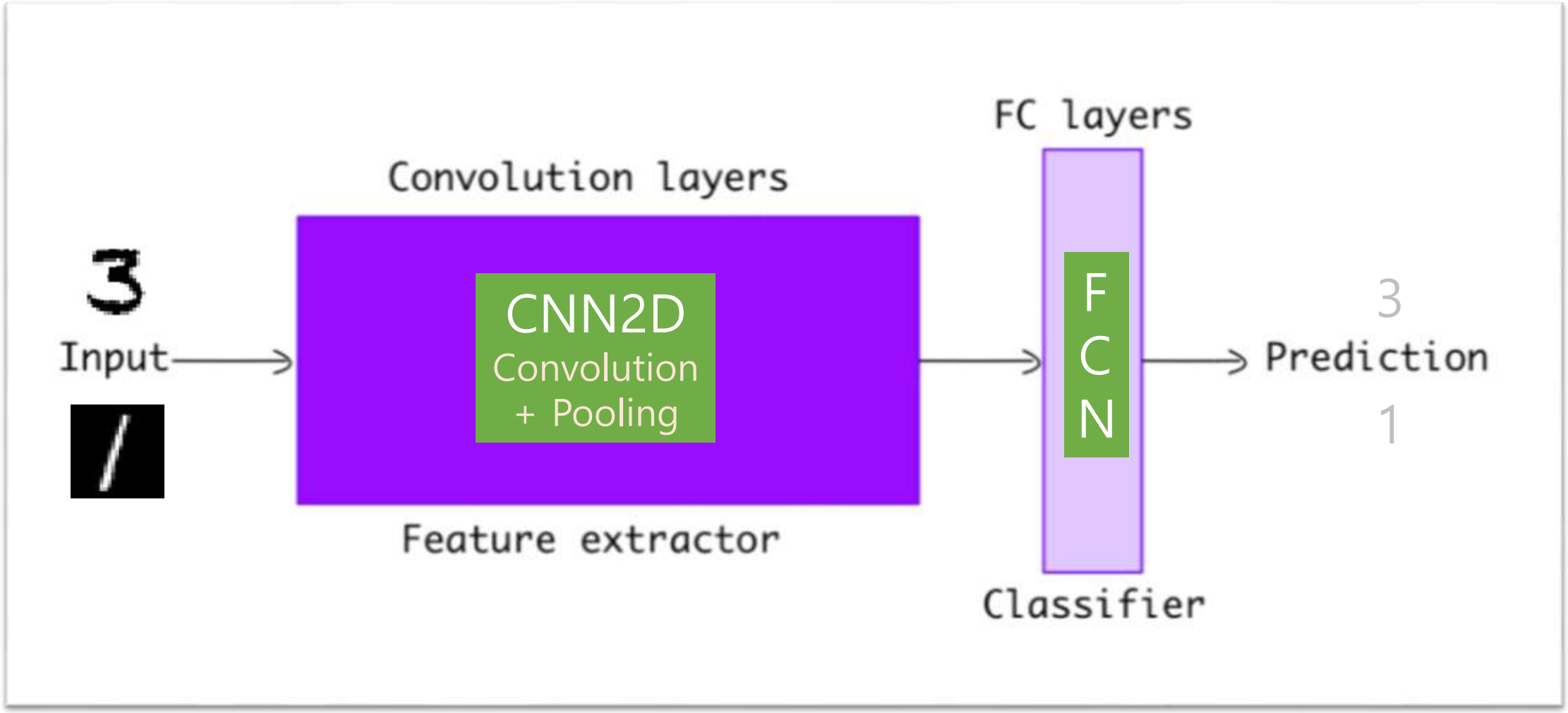
CNN2D: Convolution & Pooling (99%)



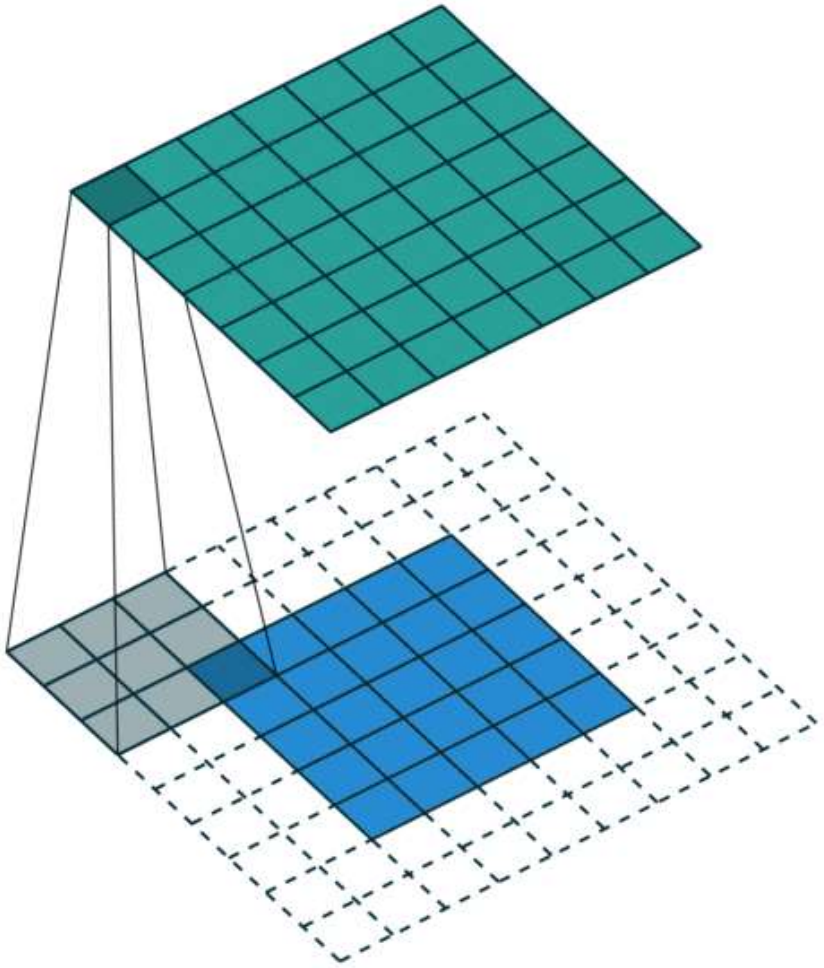
http://scs.ryerson.ca/~aharley/vis/conv/flat.html
http://chaos.inje.ac.kr:3030/cnn_vis/conv/flat.html

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

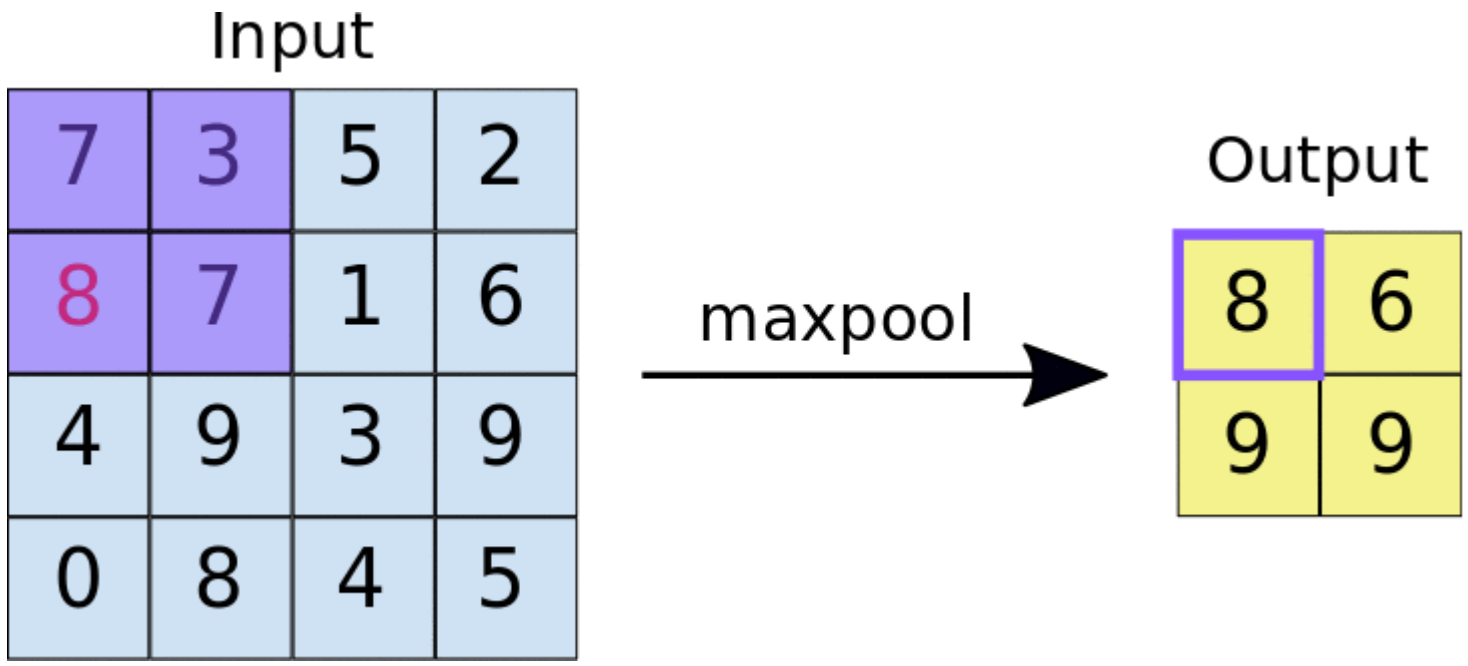
CNN2D + FCN


FC layers
Convolution layers
3
Input
CNN2D
Convolution
+ Pooling
F
C
N
3
Prediction
1
Feature extractor
Classifier

Conv2D

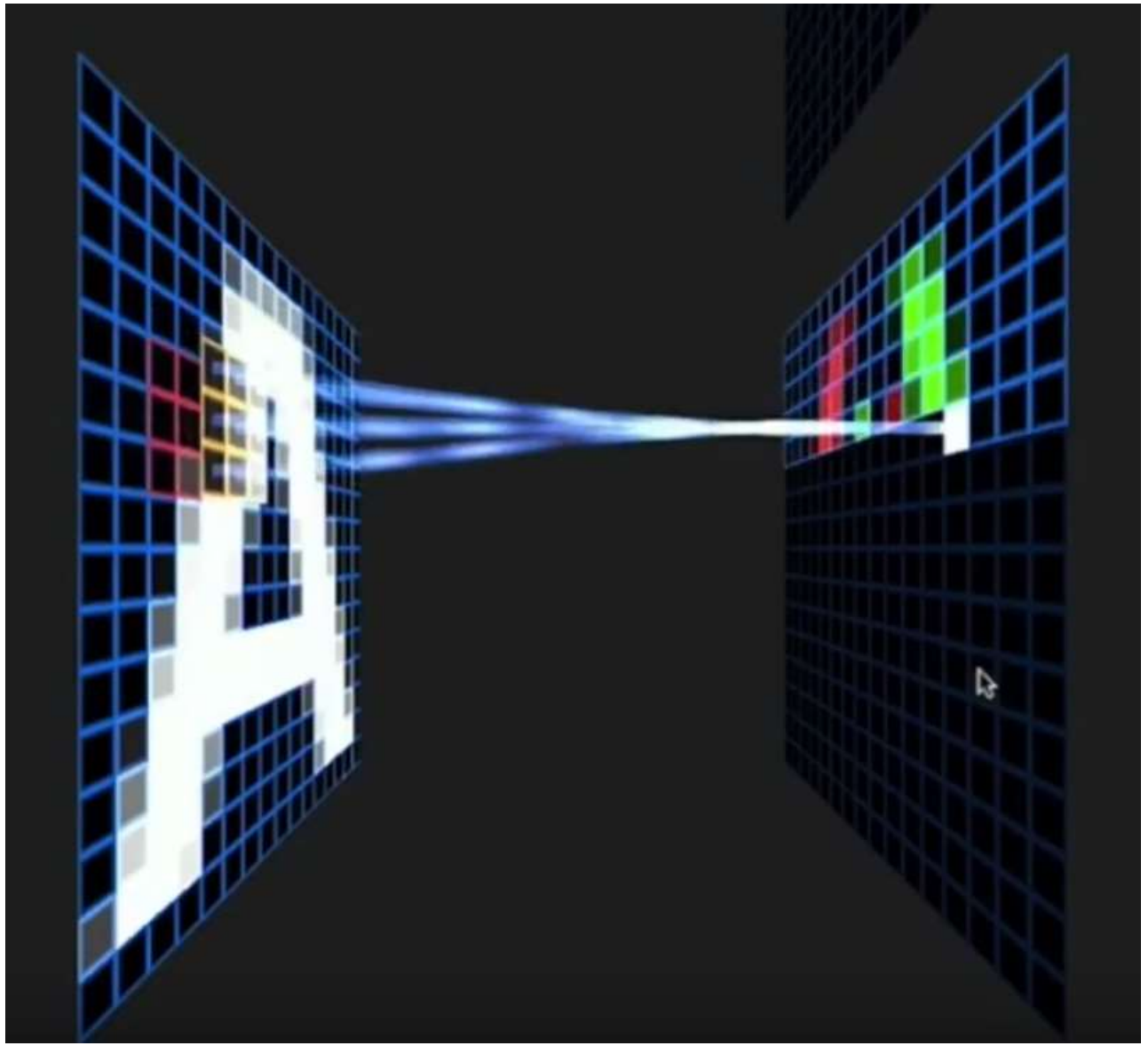


Max-Pooling



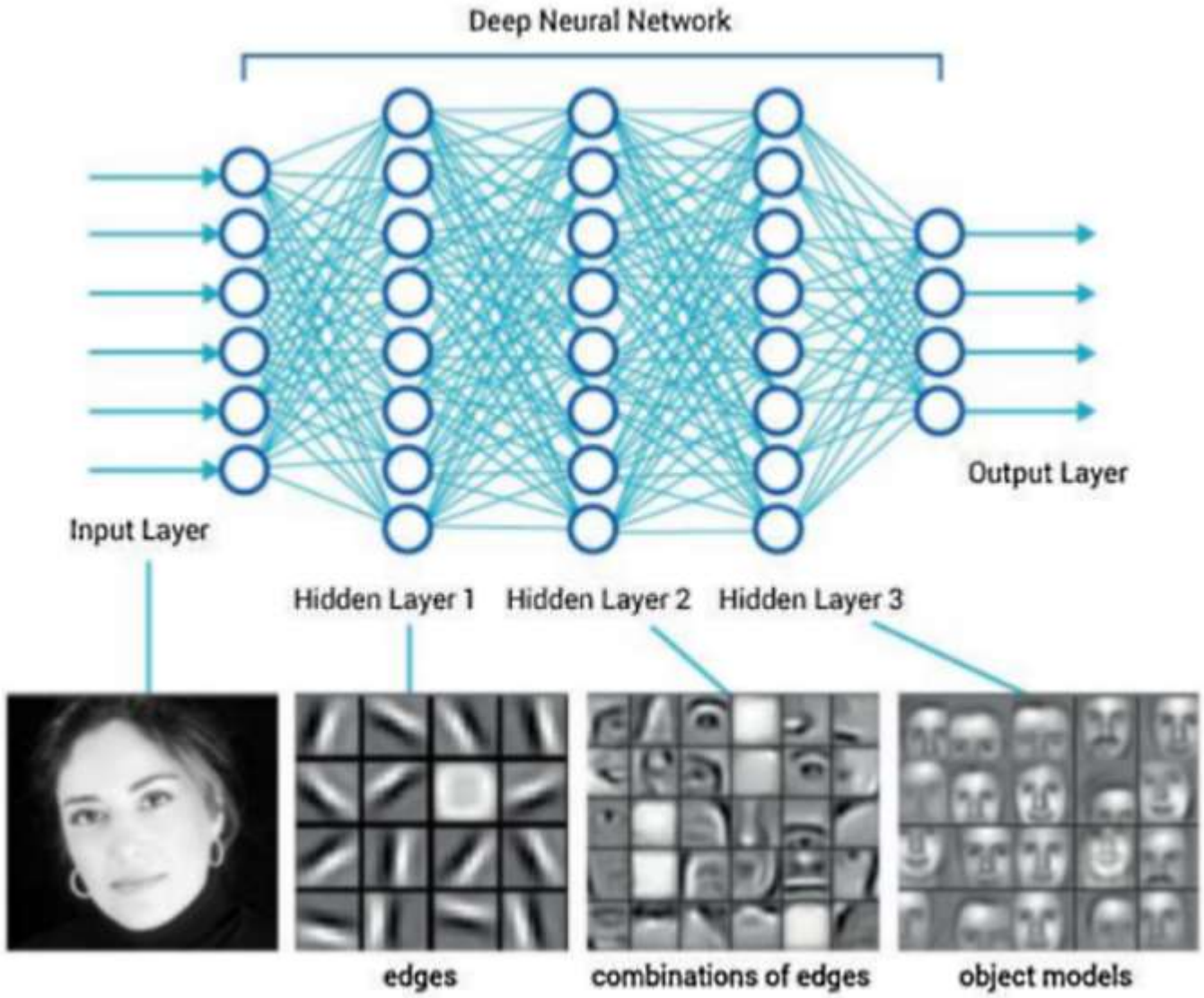
https://developers.google.com/machine-learning/practica/image-classification/convolutional-neural-networks

Convolution & Pooling



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

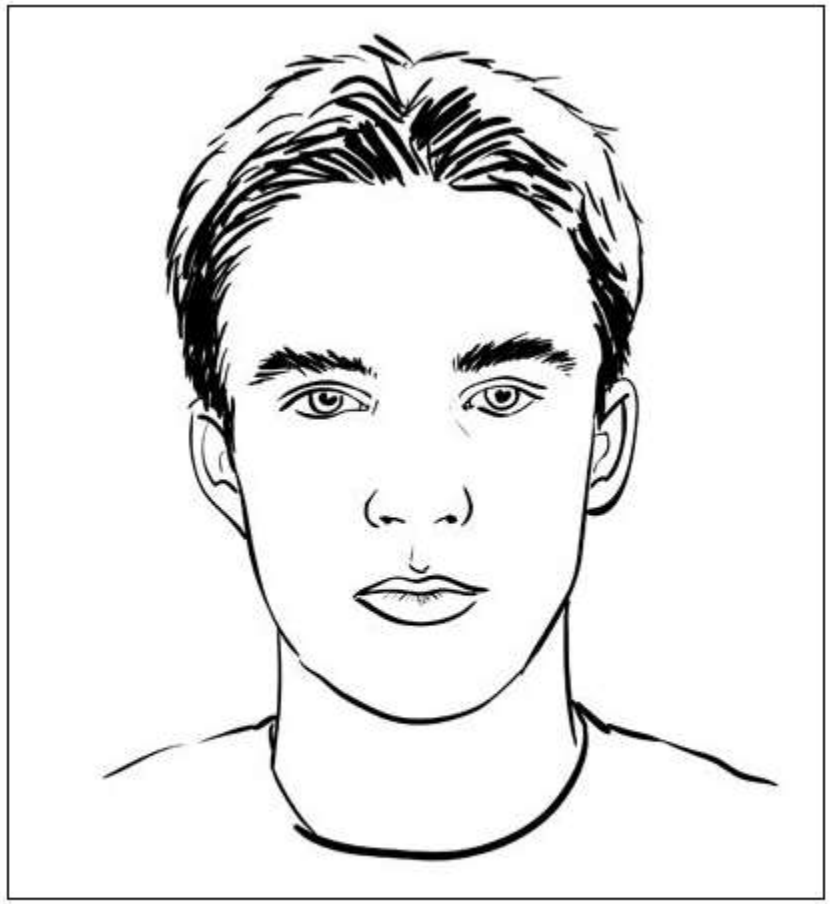
How does DL work on images?



https://miro.medium.com/max/616/1*Uhr-4VDJD0-gnteUNFzZTw.jpeg

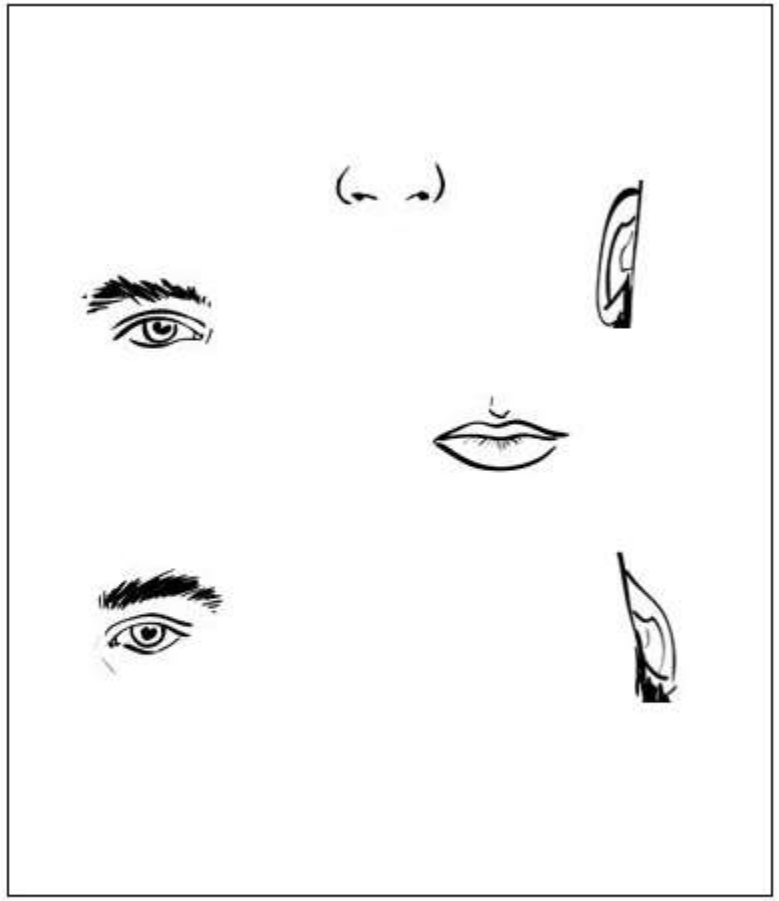
How does DL work on images?

Human



Face

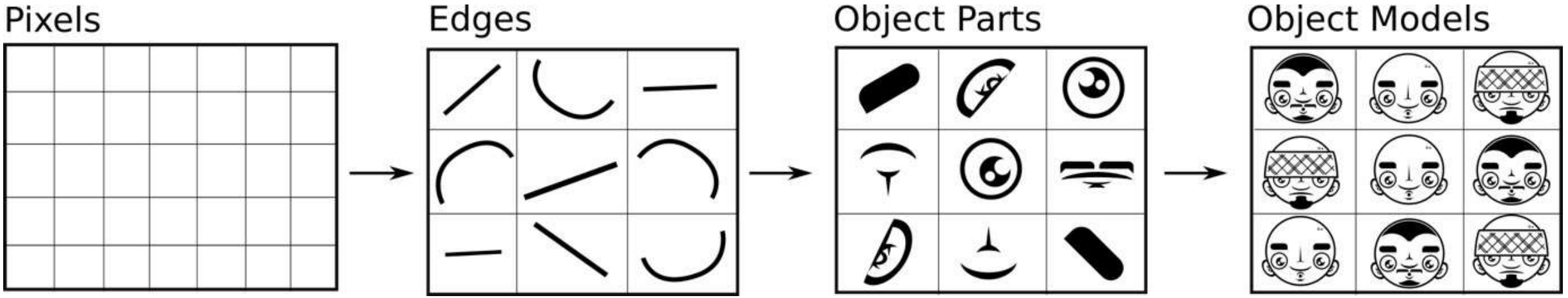
AI



Face

How does DL work on images?

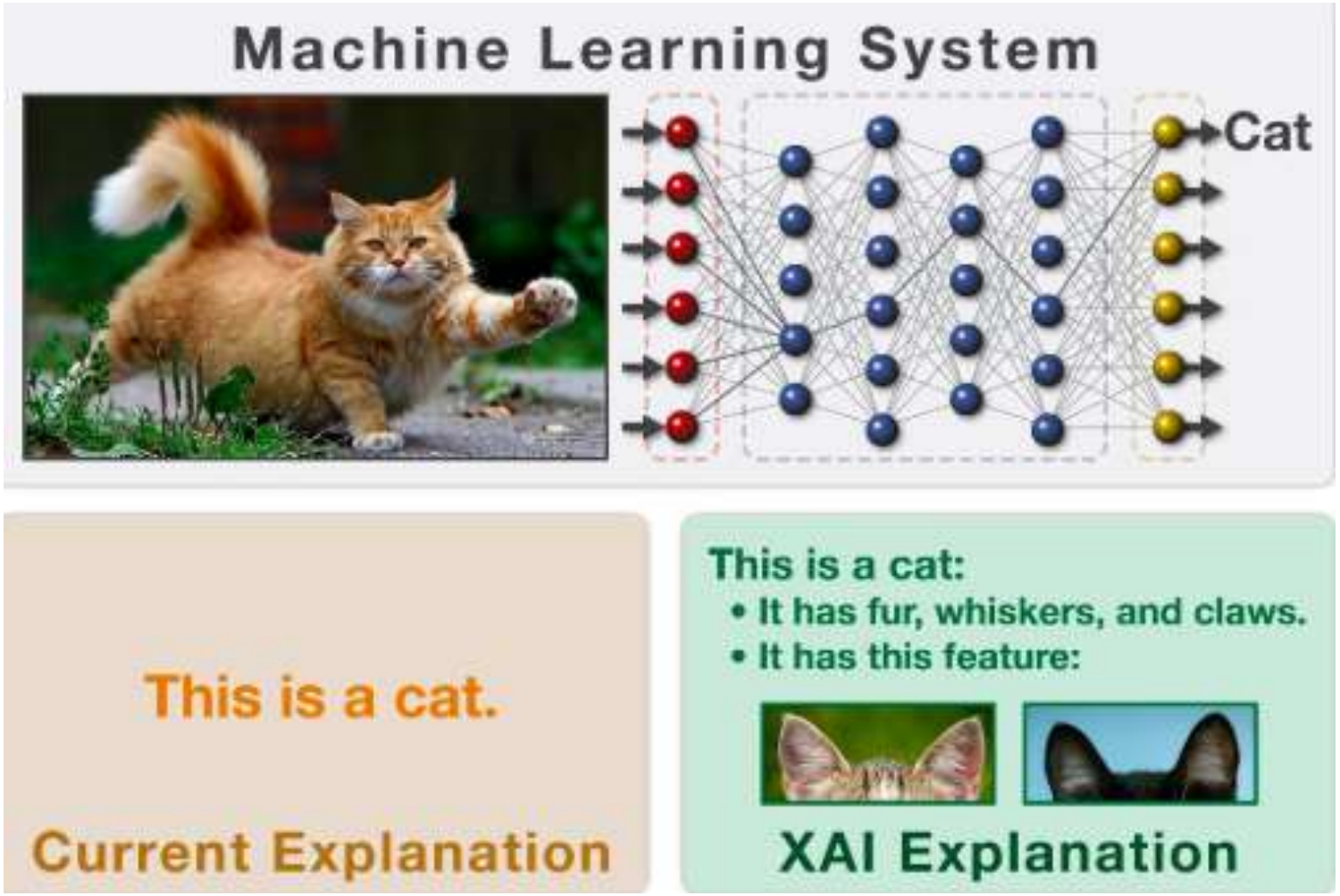
AI는 부분들의 확률을 조합해서 객체를 판단한다.



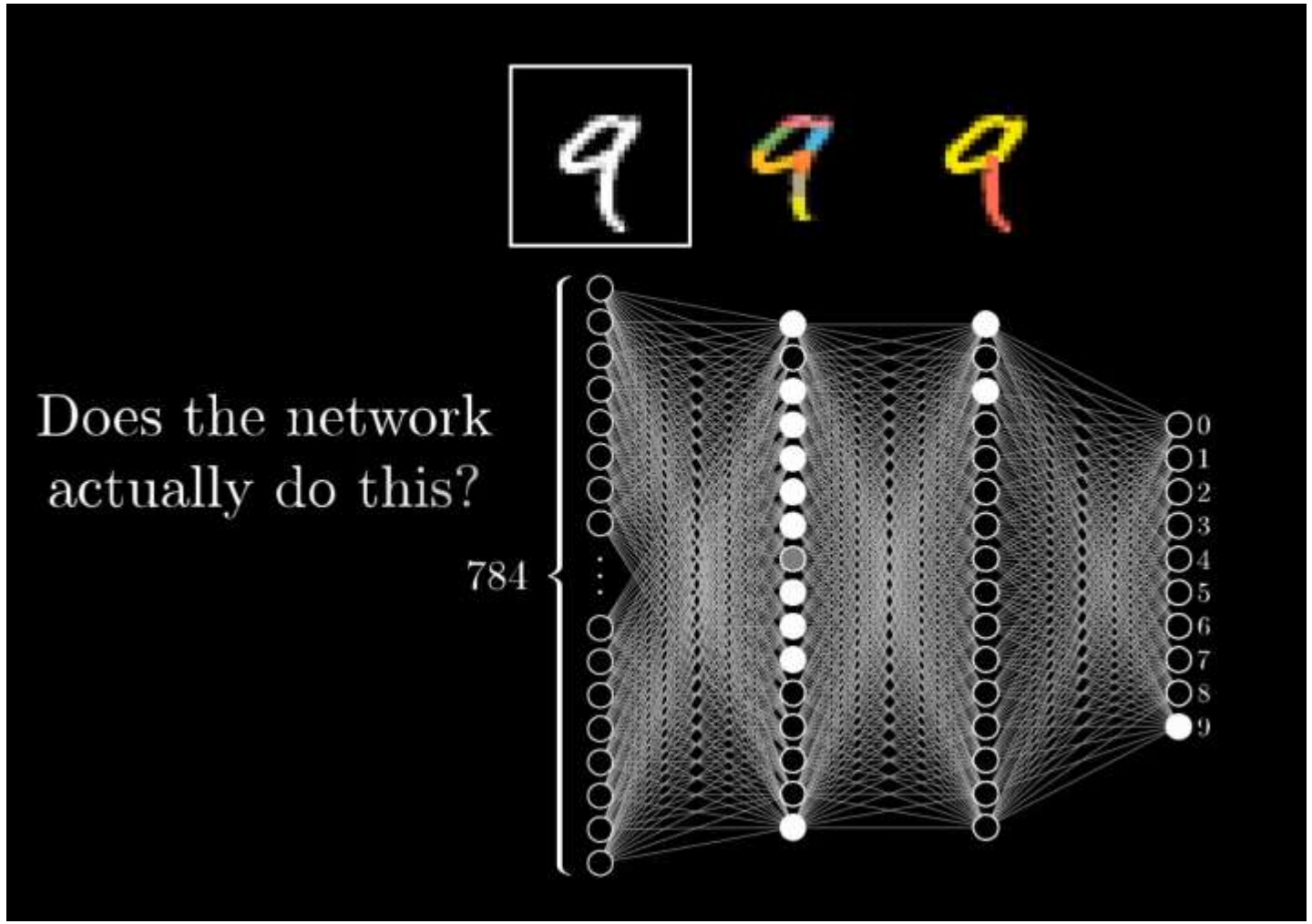
Series of higher-level representations that begin on input data.
Y. LeCun, Y. Bengio & G. Hinton. "**Deep Learning**". **Nature** 521, 436–444 (**28 May 2015**) doi:10.1038/nature14539

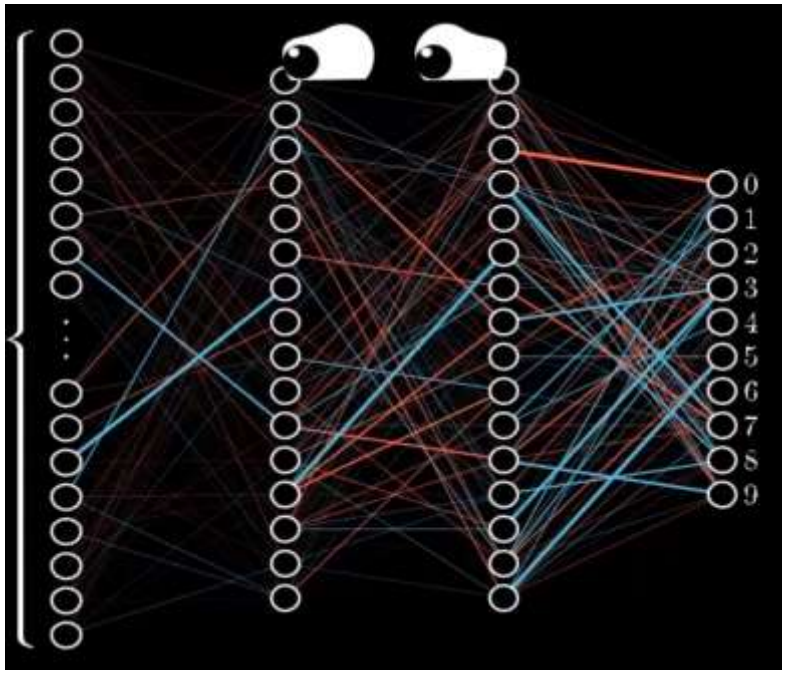
How can we understand DL works on images?

AI는 부분들의 확률을 조합해서 객체를 판단한다.



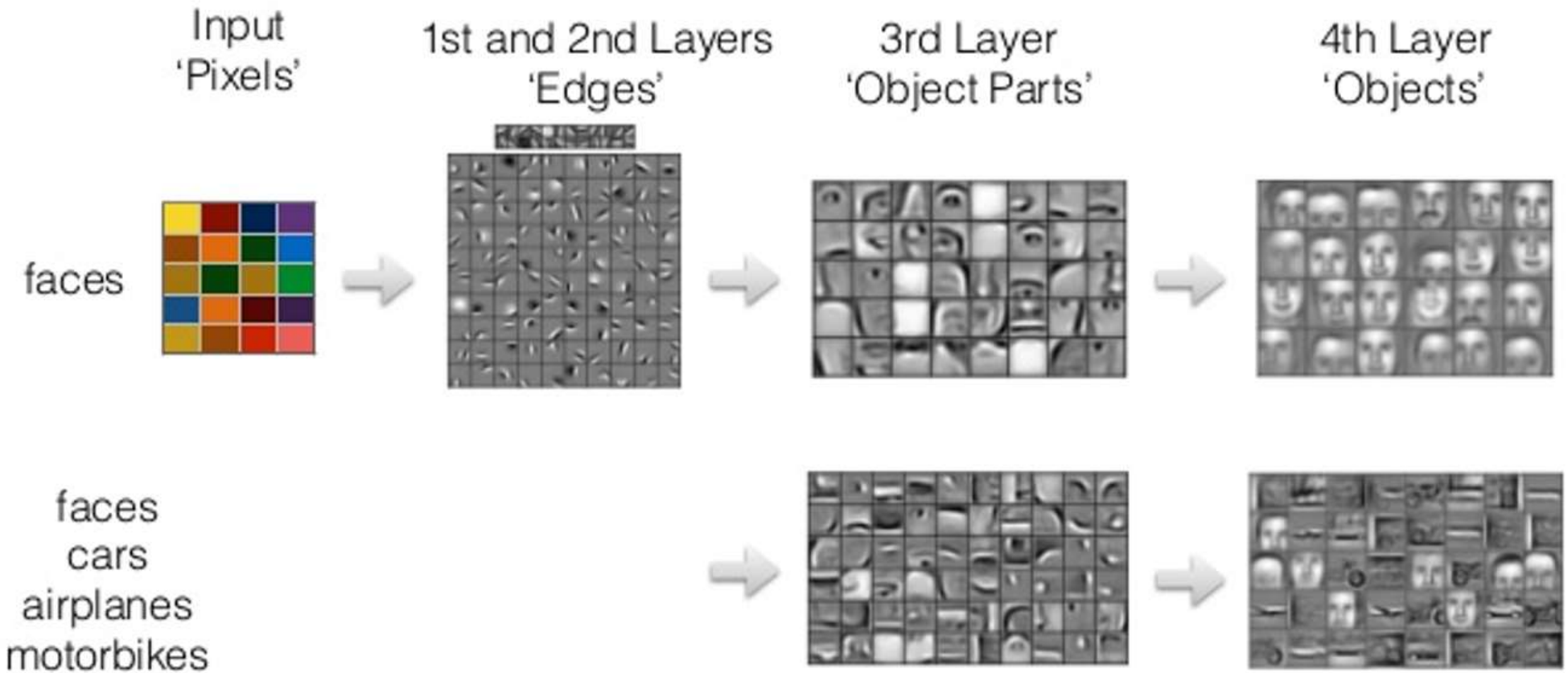
https://twitter.com/darpa/status/894989139262812166



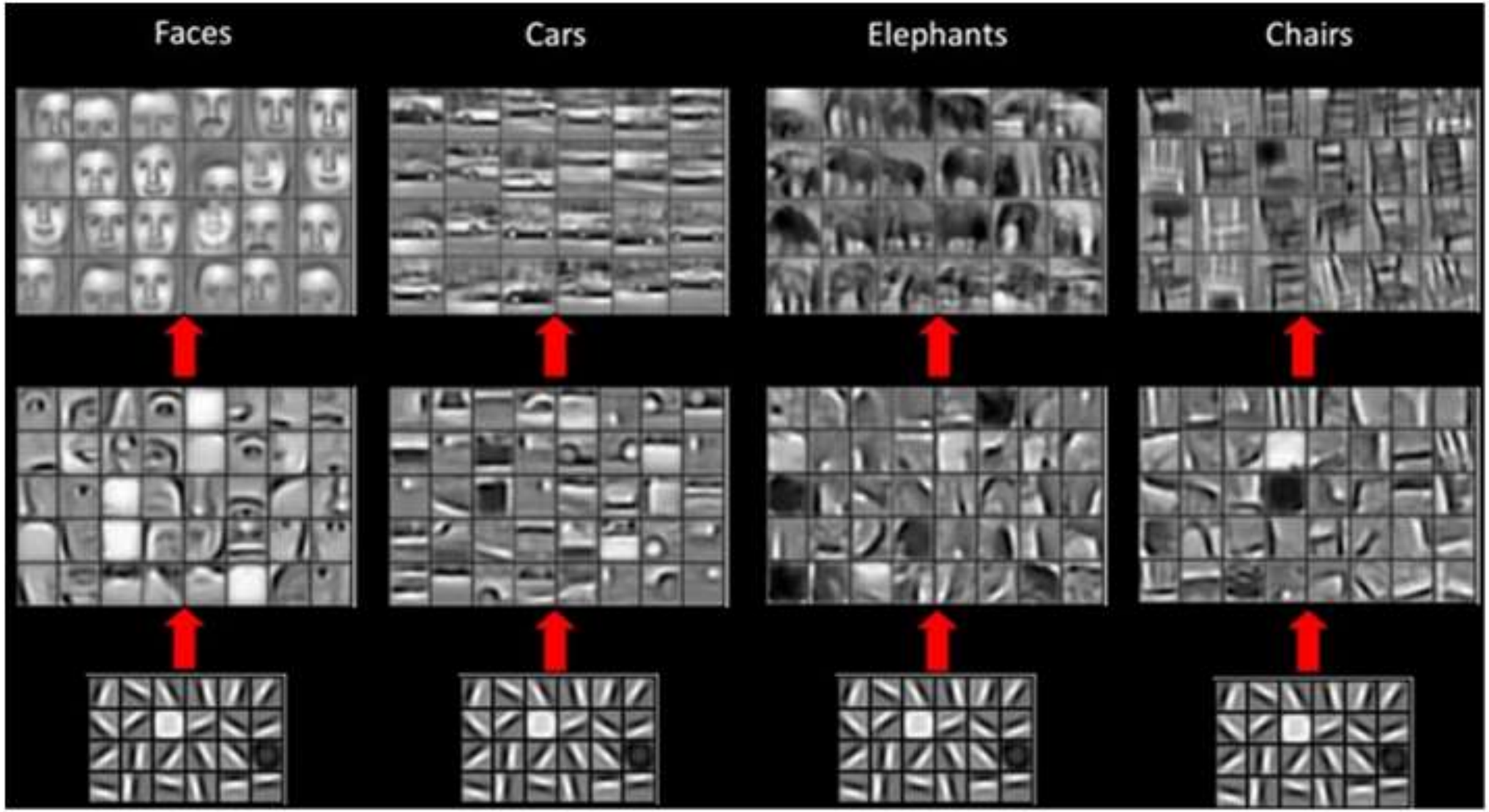


https://image.slidesharecdn.com/deeplearningincomputervision2-150711091158-lva1-app6891/95/deep-learning-in-computer-vision-9-638.jpg?cb=1436605943

Going deeper in the network

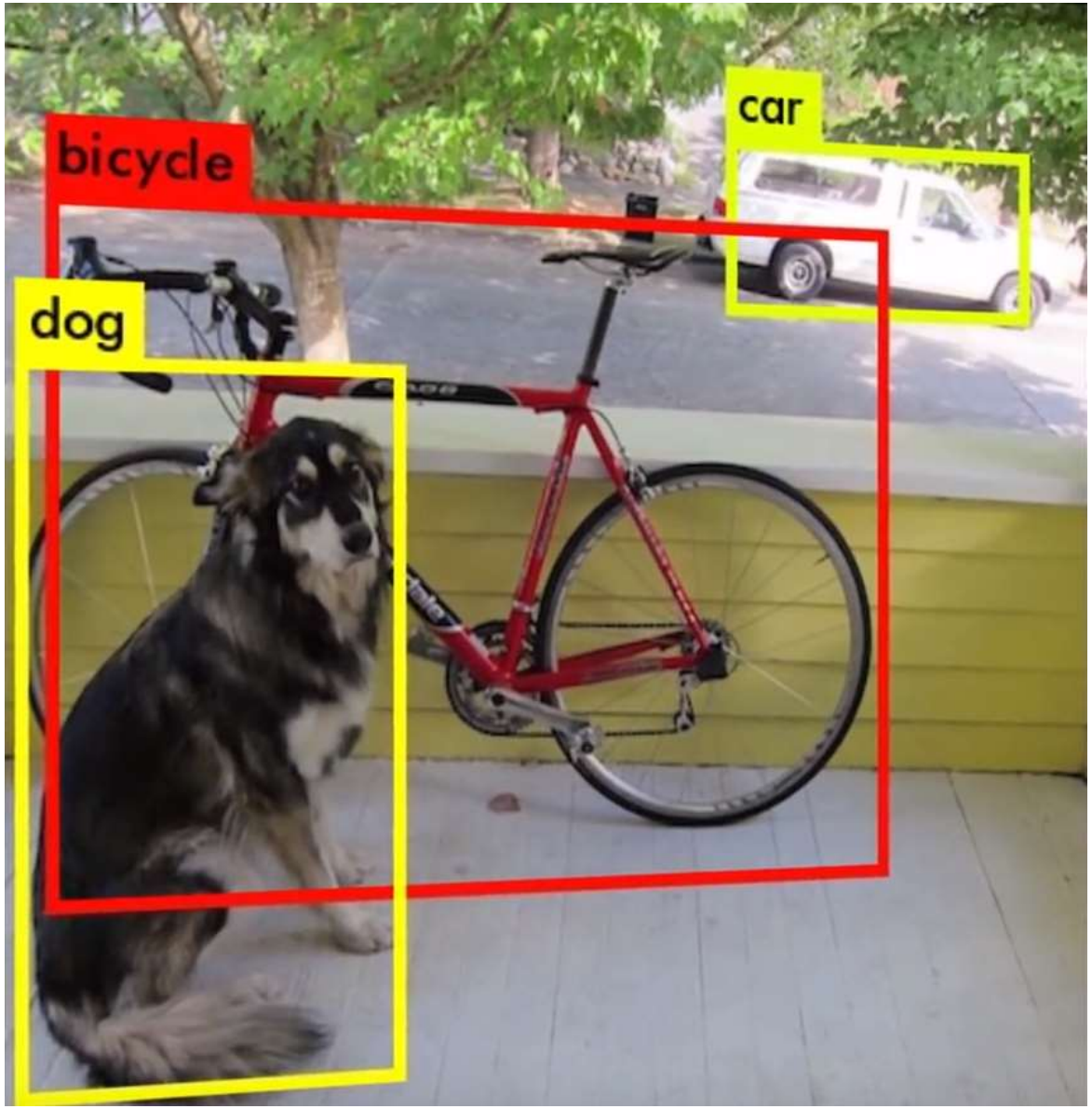


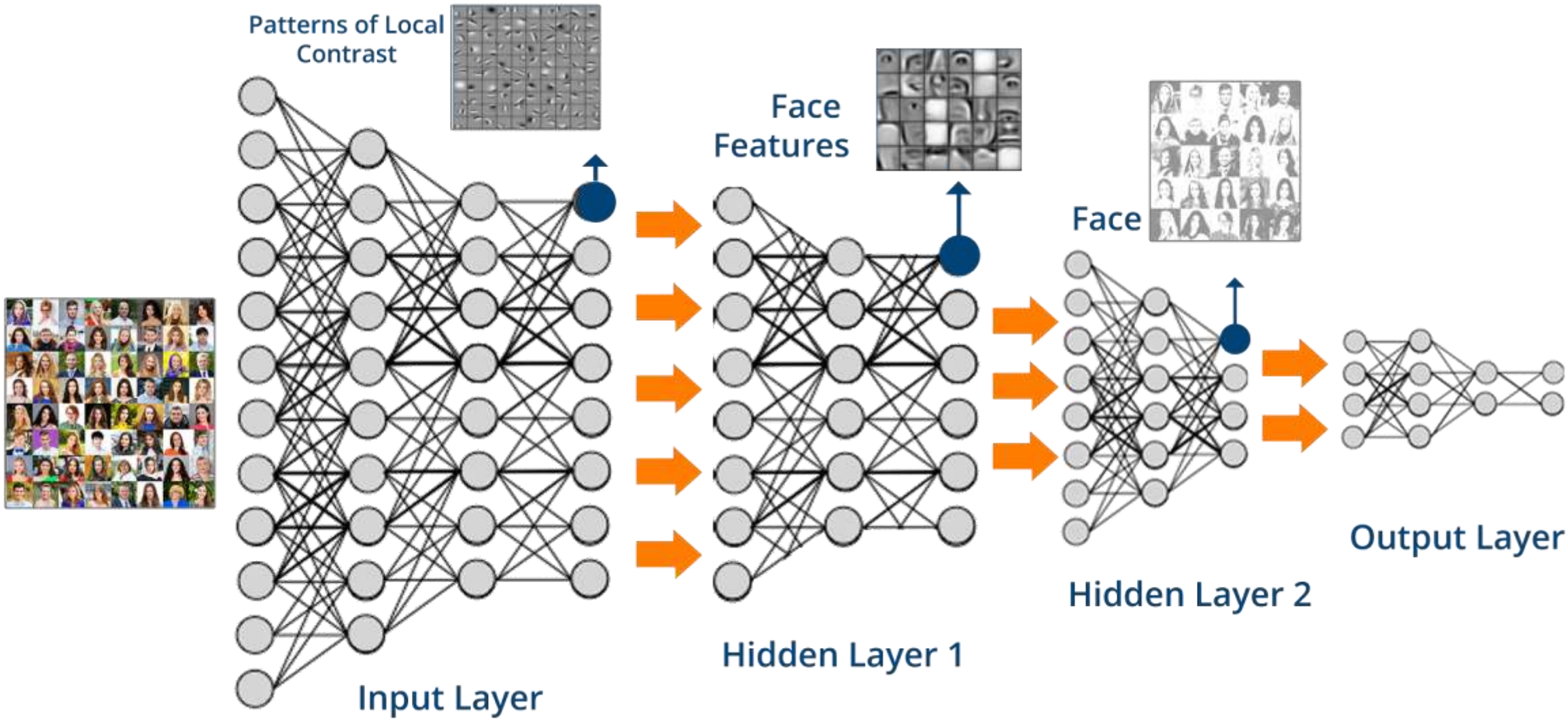
https://image.slidesharecdn.com/deeplearningincomputervision2-150711091158-lva1-app6891/95/deep-learning-in-computer-vision-9-638.jpg?cb=1436605943



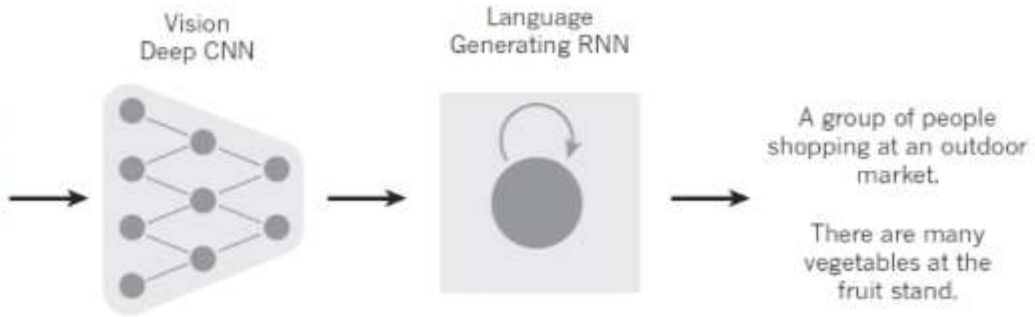
https://stats.stackexchange.com/questions/146413/why-convolutional-neural-networks-belong-to-deep-learning/146477

DL, 다중 객체 분리





https://cdn.edureka.co/blog/wp-content/uploads/2017/05/Deep-Neural-Network-What-is-Deep-Learning-Edureka.png



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

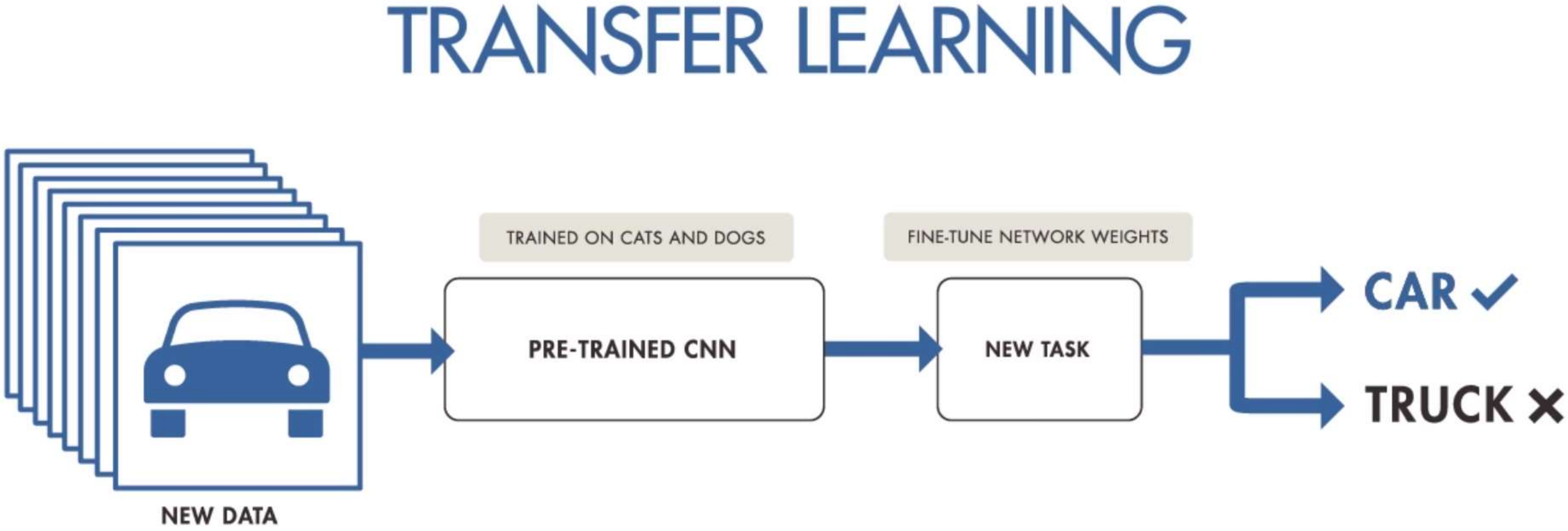
A little **girl** sitting on a bed with a teddy bear.

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

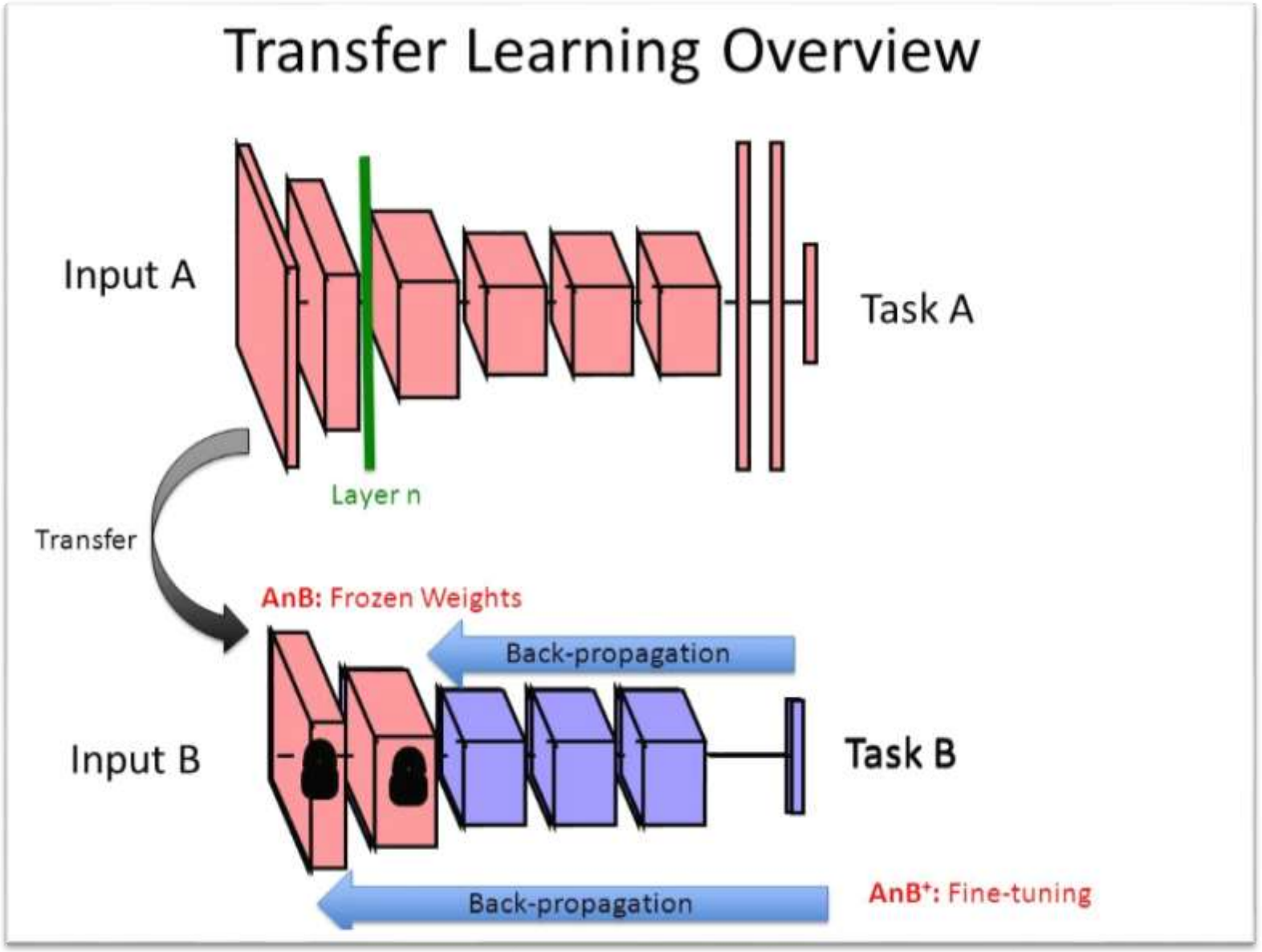
A giraffe standing in a forest with **trees** in the background.

Y. LeCun, Y. Bengio & G. Hinton. **"Deep Learning". Nature** 521, 436–444 (**28 May 2015**)

전환학습


TRANSFER LEARNING
TRAINED ON CATS AND DOGS
FINE-TUNE NETWORK WEIGHTS
PRE-TRAINED CNN
NEW TASK
CAR ✓
TRUCK ✕
NEW DATA

Transfer Learning (전환학습)



https://lisaong.github.io/mldds-courseware/03_TextImage/assets/transfer/Transfer+Learning+Overview.jpg

Transfer Learning

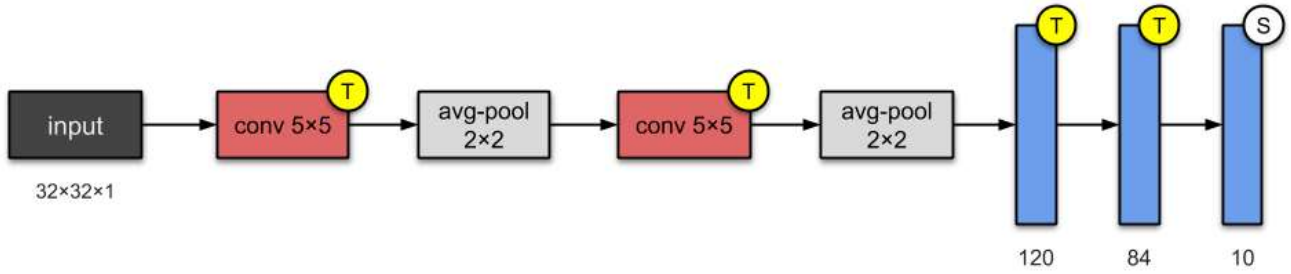
The 10 architectures that will be discussed and the year their papers were published.

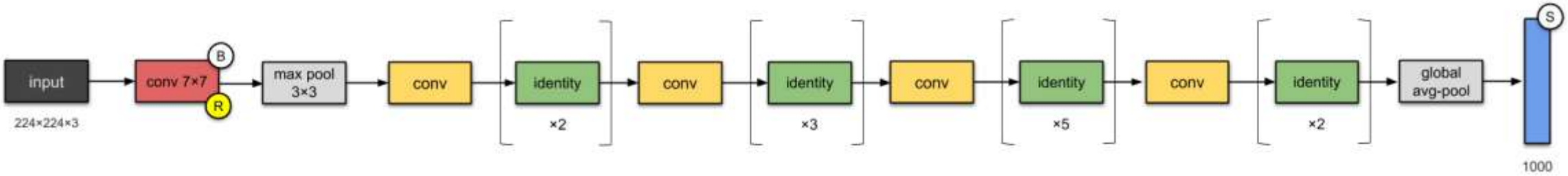
Model	Size	Top-1 Accuracy	Top-5 Accuracy	Parameters	Depth
VGG16	528 MB	0.713	0.901	138,357,544	23
InceptionV3	92 MB	0.779	0.937	23,851,784	159
ResNet50	98 MB	0.749	0.921	25,636,712	-
Xception	88 MB	0.790	0.945	22,910,480	126
InceptionResNetV2	215 MB	0.803	0.953	55,873,736	572
ResNeXt50	96 MB	0.777	0.938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

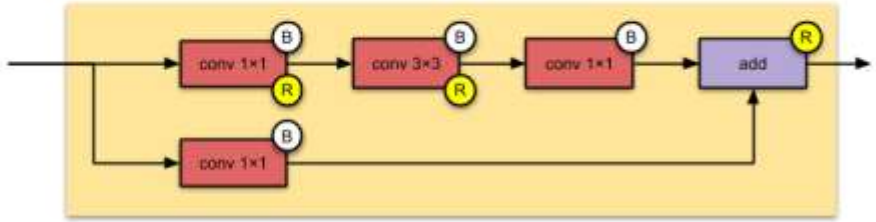
The top-1 and top-5 accuracy refers to the model's performance on the ImageNet validation dataset.

https://towardsdatascience.com/illustrated-10-cnn-architectures-95d78ace614d

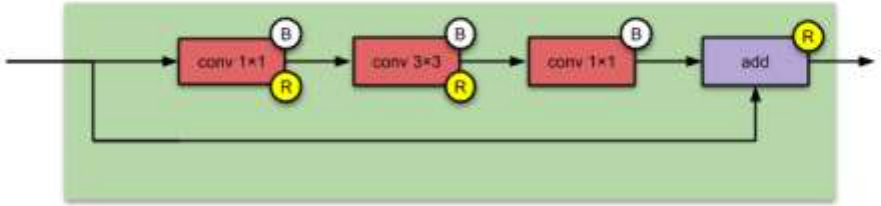
Transfer Learning: LeNet(1999), ResNet(2015)





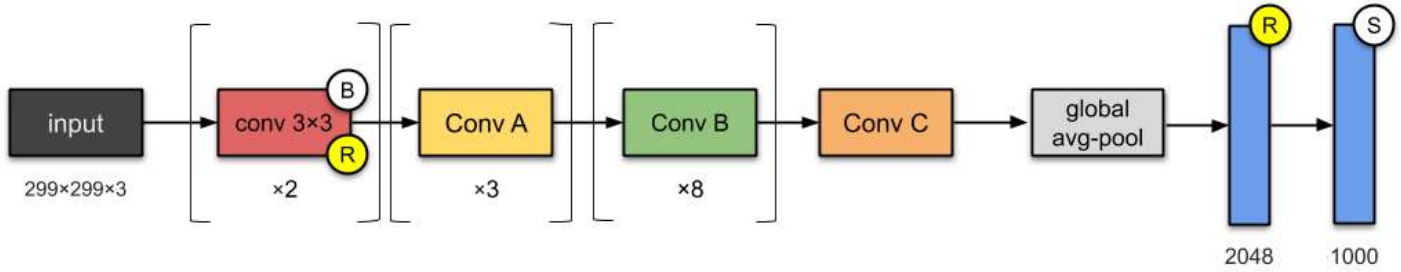


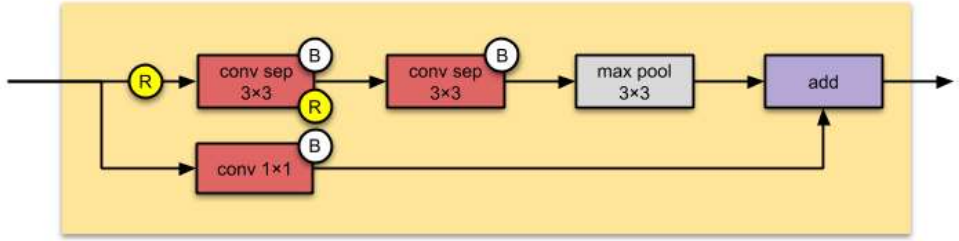
Conv block



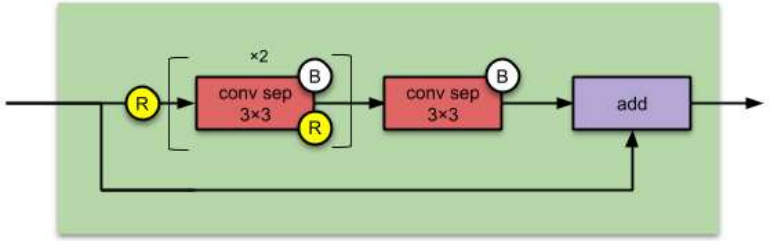
Identity block

Transfer Learning: Xception(2016)

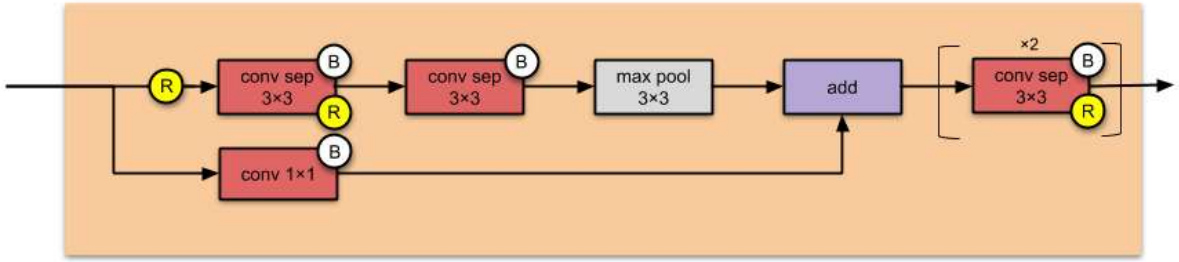




Conv A



Conv B



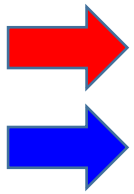
Conv C

https://towardsdatascience.com/illustrated-10-cnn-architectures-95d78ace614d

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%	



http://karpathy.github.io/2014/09/02/what-i-learned-from-competing-against-a-convnet-on-imagenet/

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

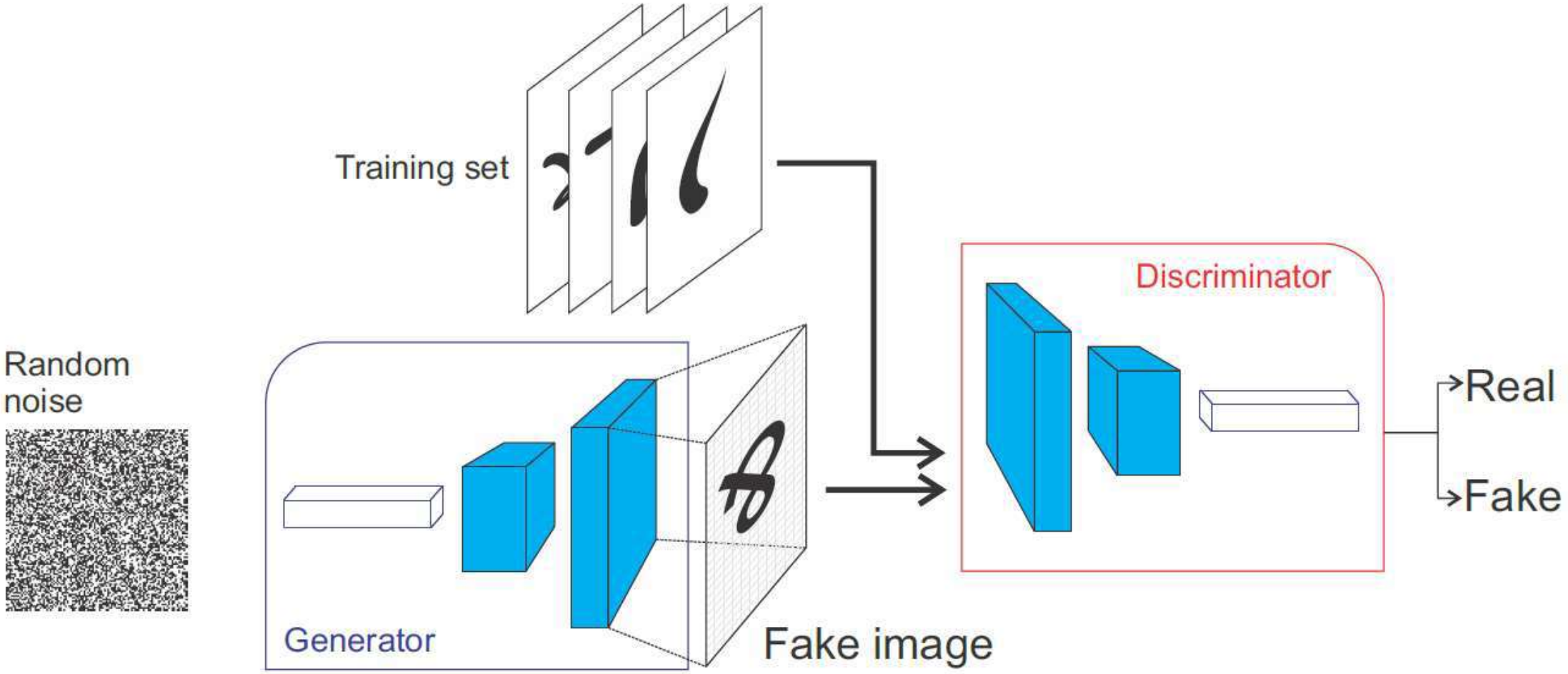
https://towardsdatascience.com/illustrated-10-cnn-architectures-95d78ace614d

GAN (적대적생성망)

GANs 구조 (cont'd)

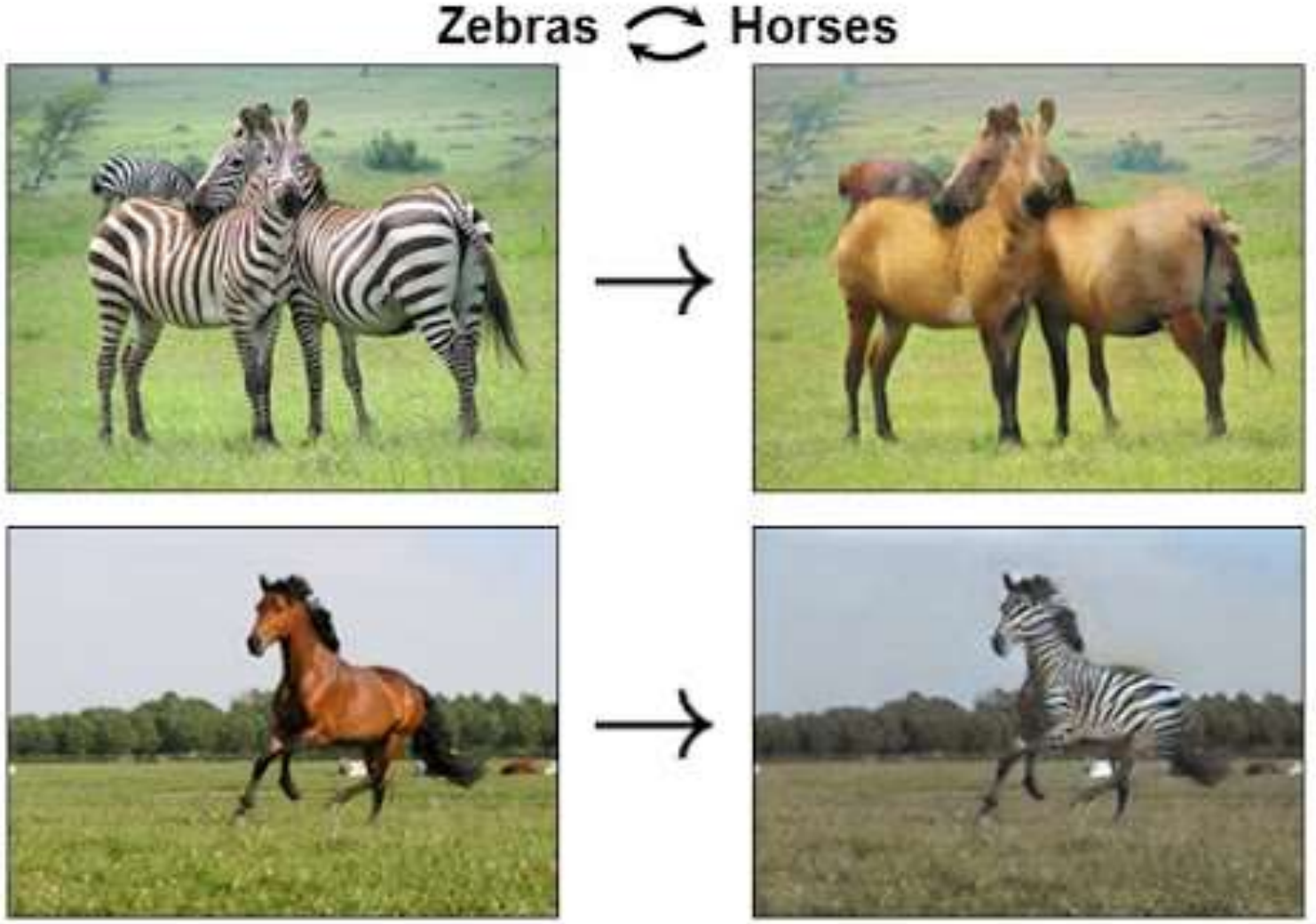
Source: https://image.slidesharecdn.com/gan-170630071203/95/gan-6-638.jpg?cb=1498806769

GAN



Source: Hands-On Deep Learning for IoT - Packt

GAN – Painting I



Source: https://lh3.googleusercontent.com/proxy/2CWdIpWTpvWwwWQ2nafWWW22dX3MuEom13kBoBIqQjj4eP-IL4gJ0hPhKiBBc0EEMAB9DwFUoWaPvnLXyNvX23zsEXxIvQ_kG989RA

GAN – Painting II

Style transfer

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

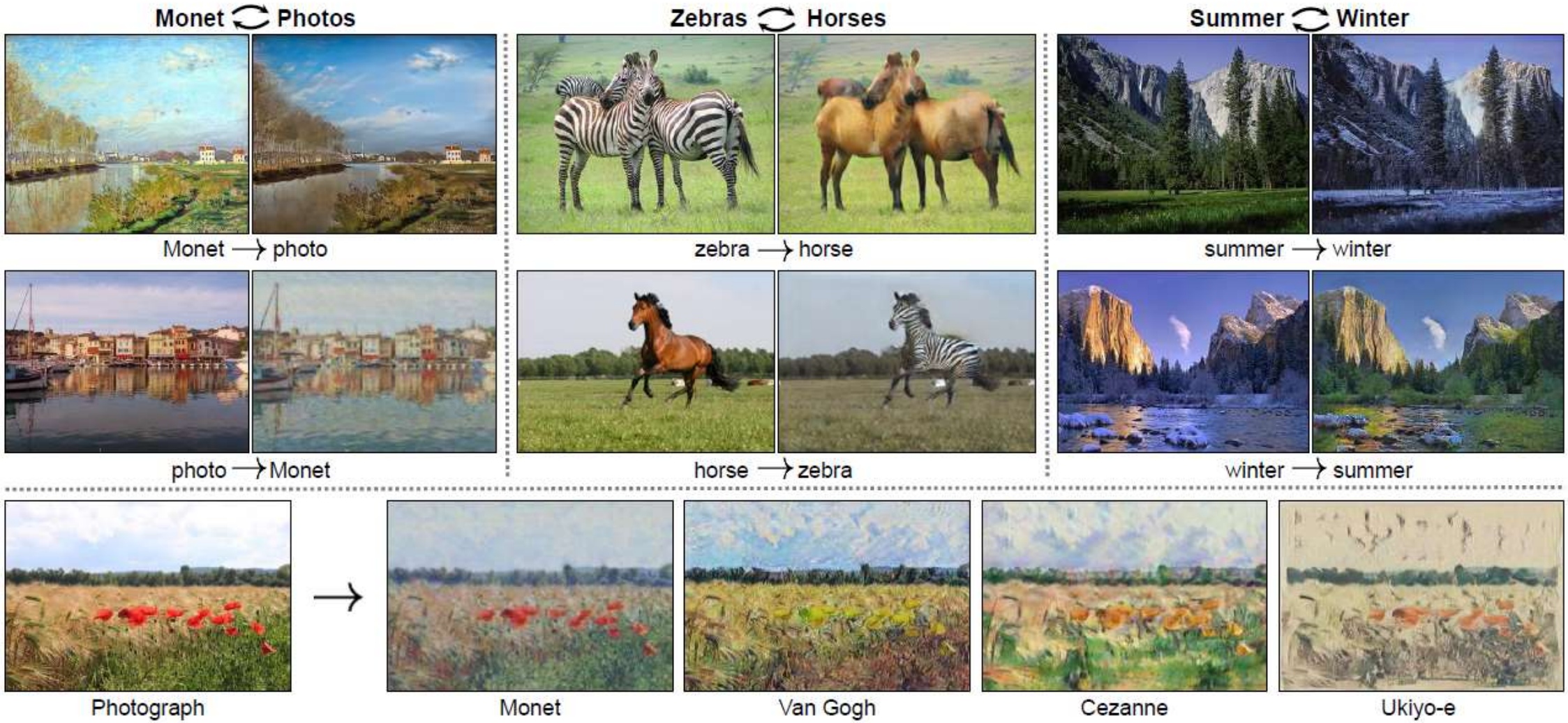
GAN – Painting II

Style transfer

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

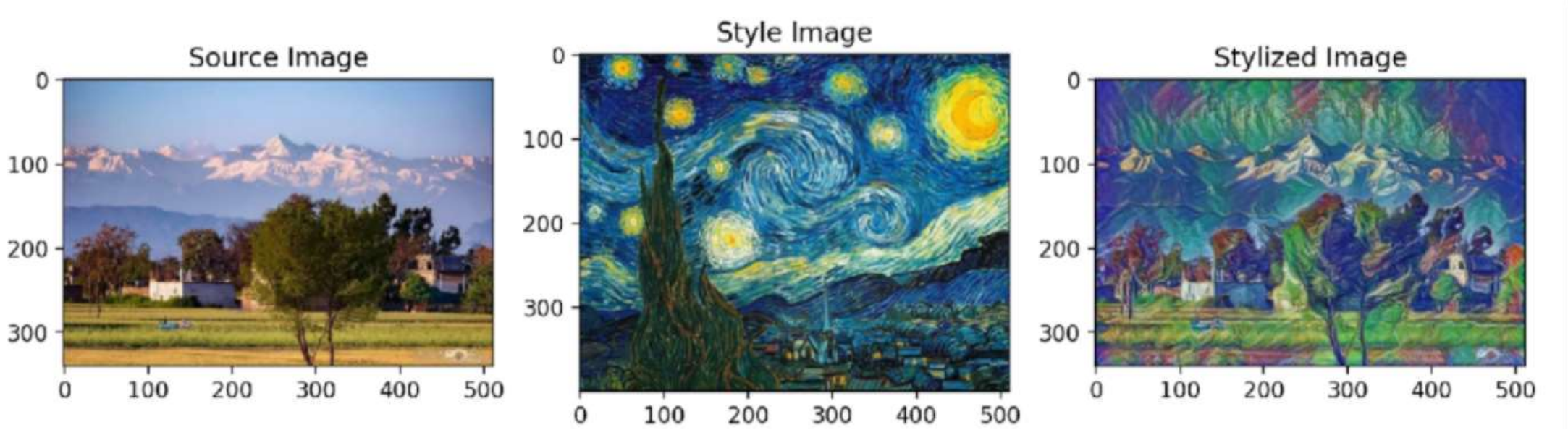
Source: https://www.researchgate.net/profile/Alexander_Ecker/publication/281312423/figure/fig1/AS:391530486485004@1470359550795/Images-that-combine-the-content-of-a-photograph-with-the-style-of-several-

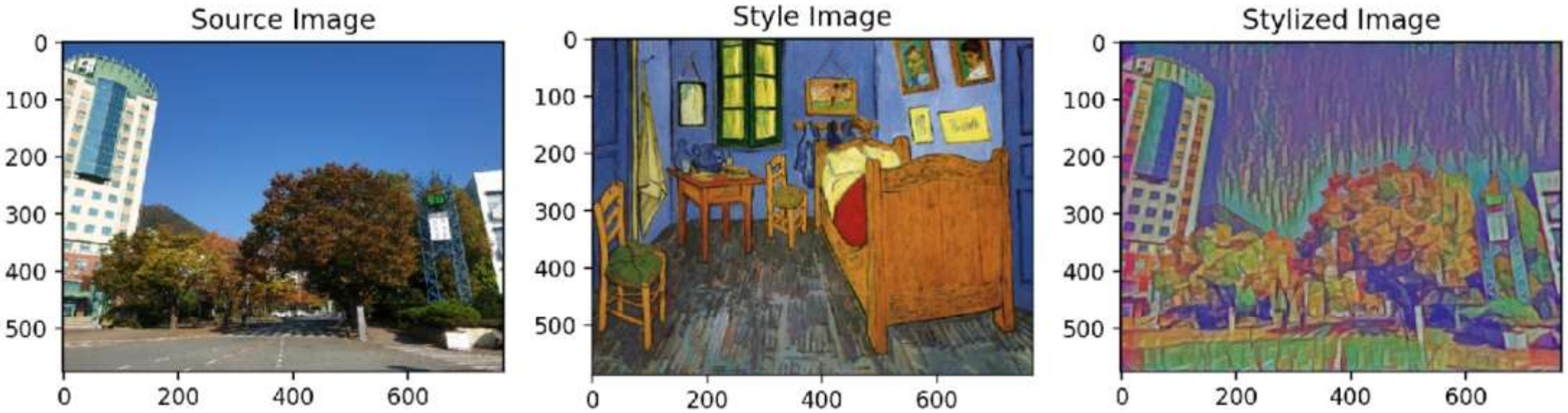
GAN – Painting III



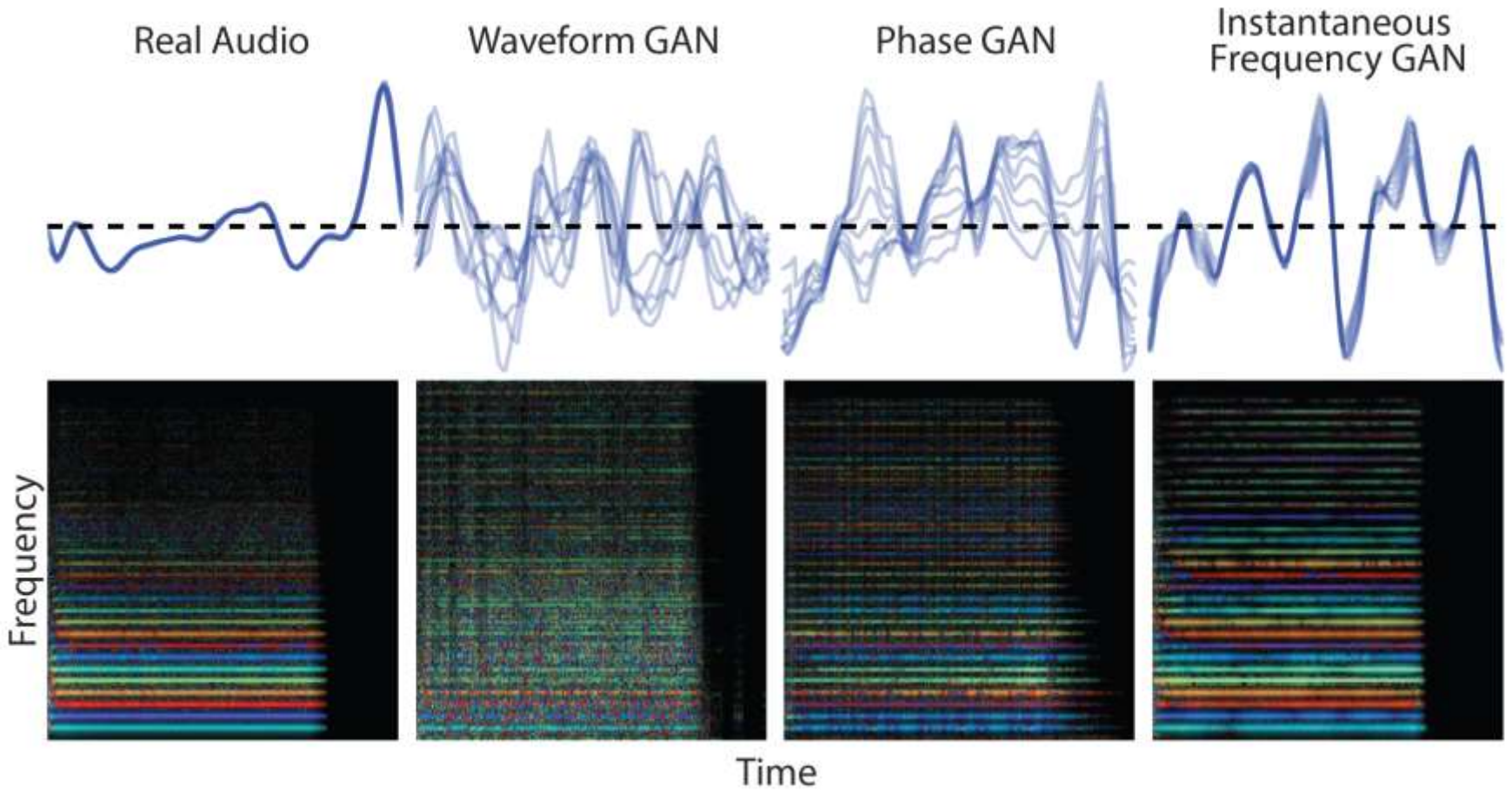
Source: arXiv:1703.10593v6

GAN – Painting IV : NTS → streamlit webapp





GAN – Music



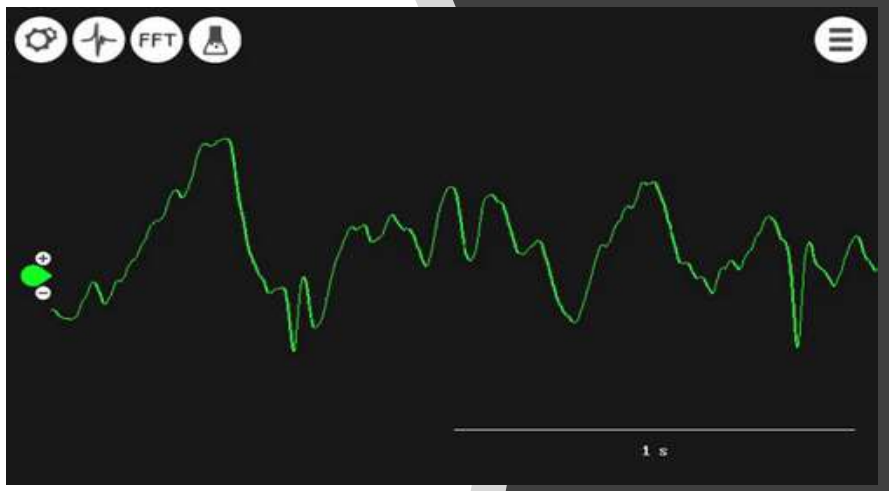
Source: https://magenta.tensorflow.org/assets/gansynth/coherence.png

GAN – Fake news

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

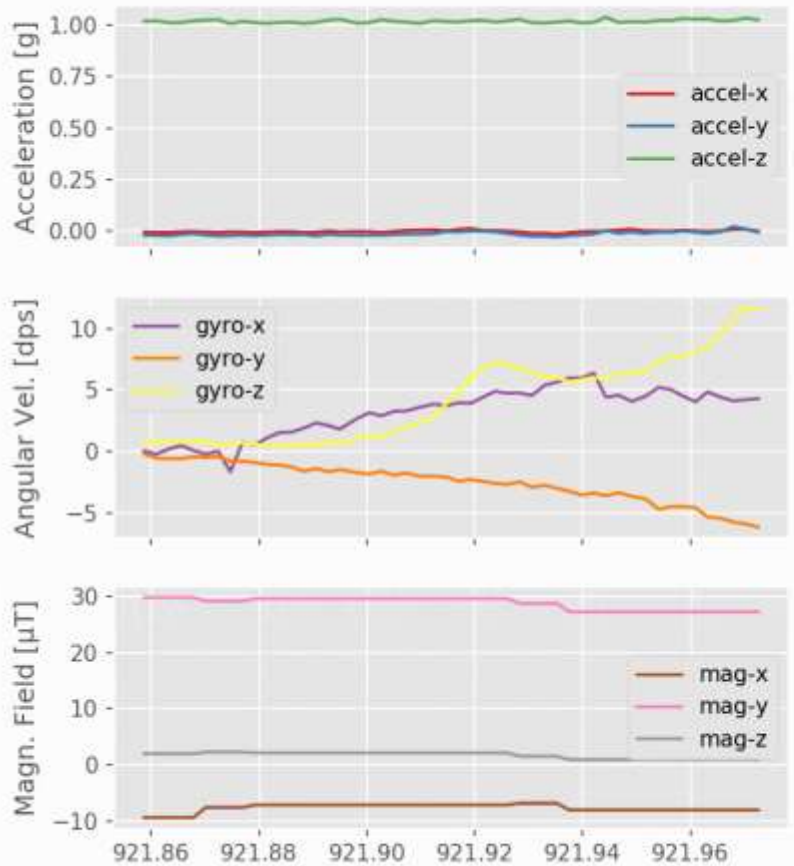
Source: https://i.ytimg.com/vi/dkoi7sZvWiU/maxresdefault.jpg

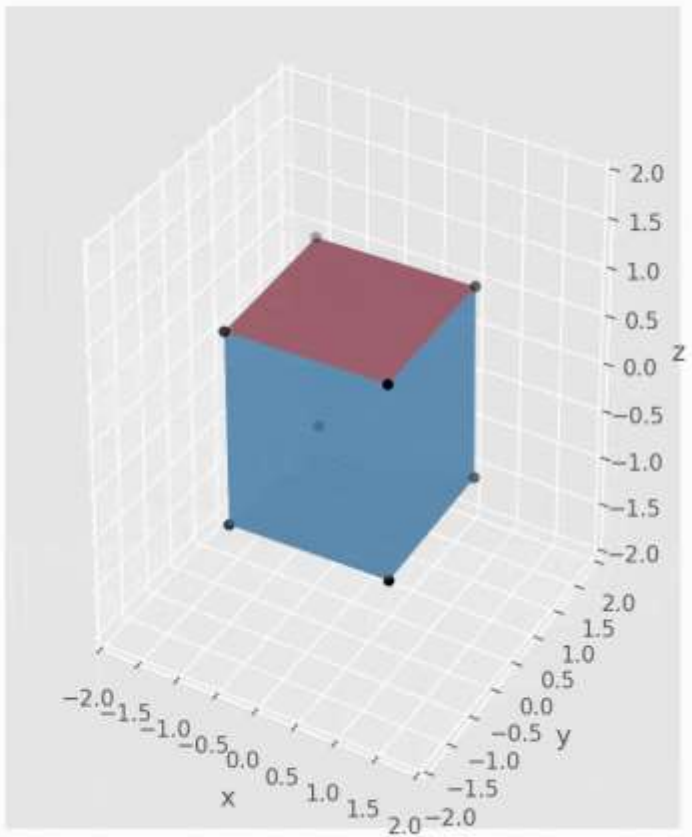
Deep Learning of Signals



Conv1D
Pooling

일상활동 인식(3축 가속도)





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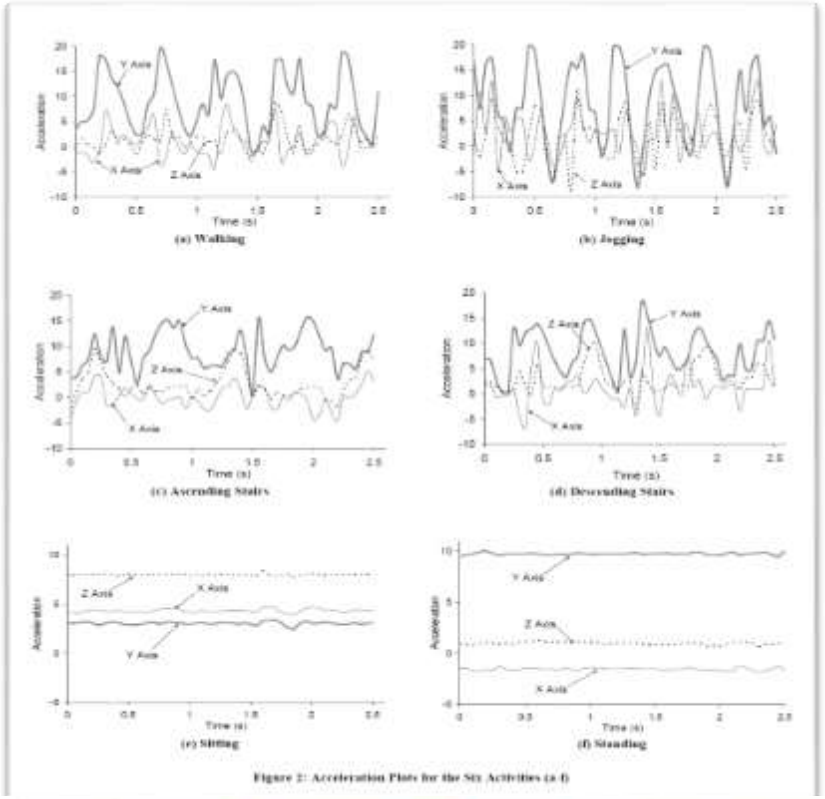
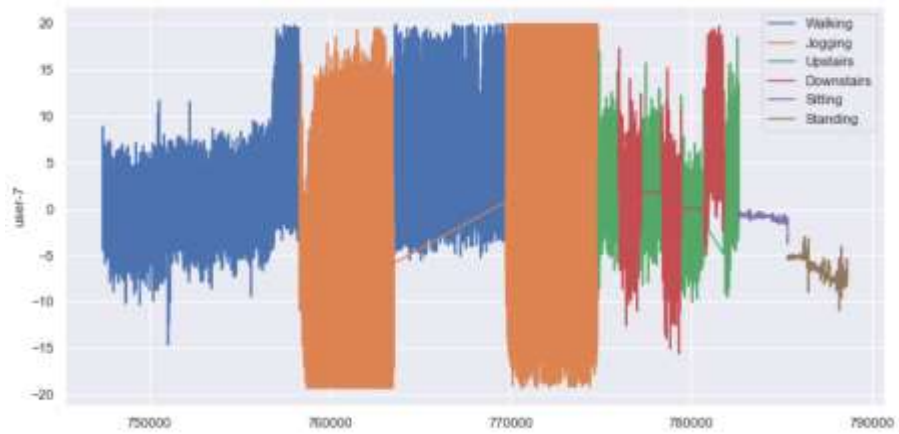
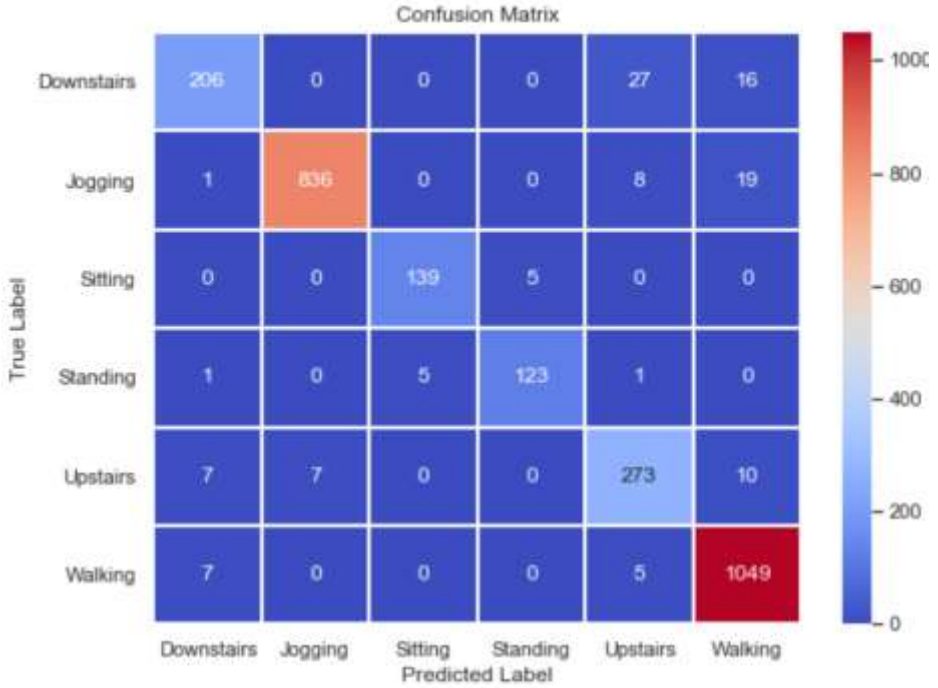
일상활동 인식(3축 가속도)

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







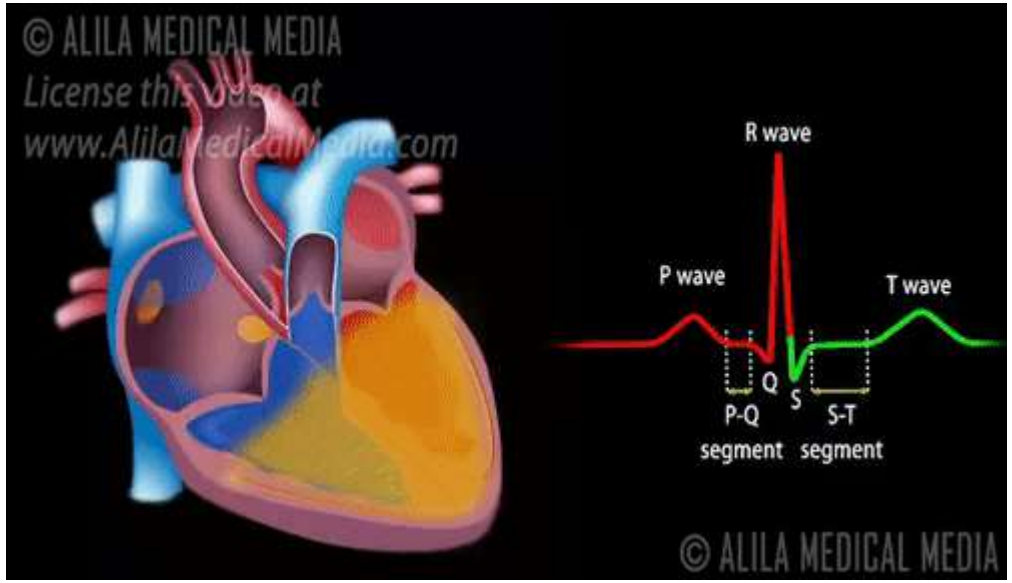

```
--- ACC_XYZ, 4s: classification report for test data ---

              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)



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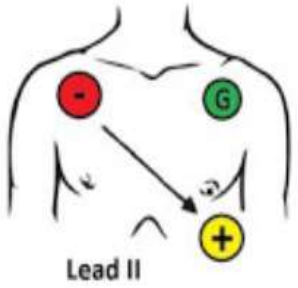
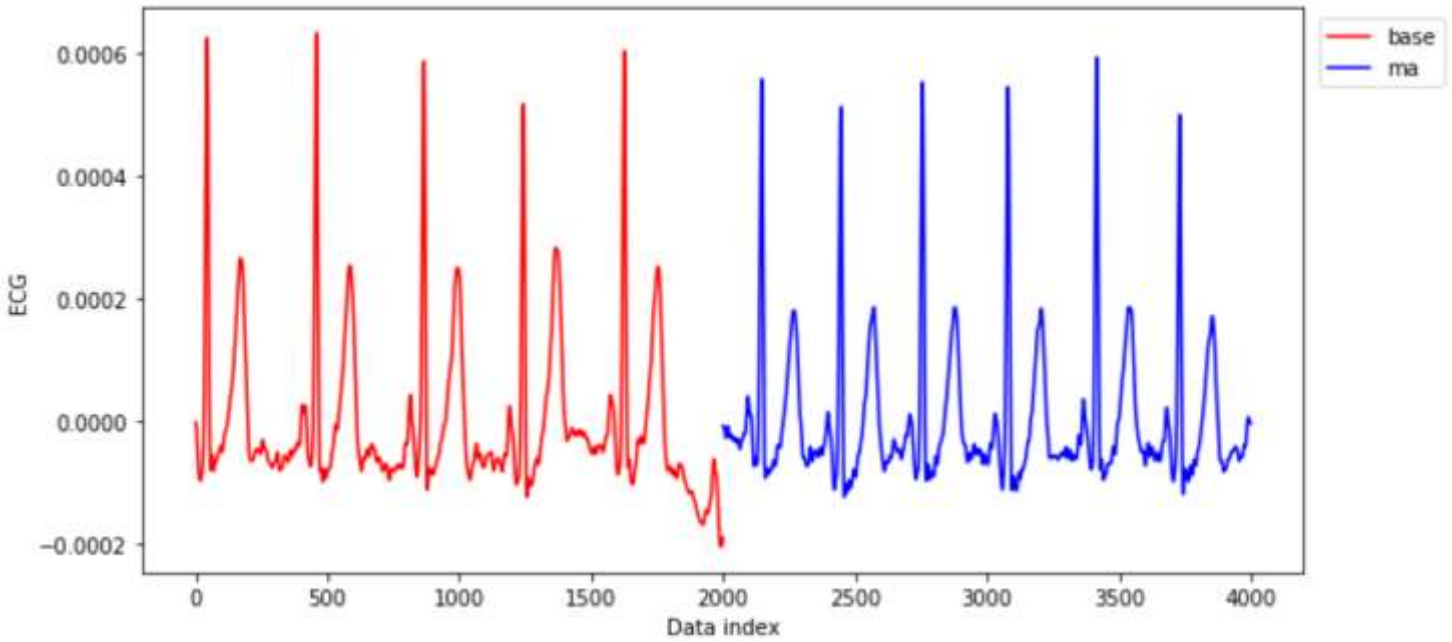
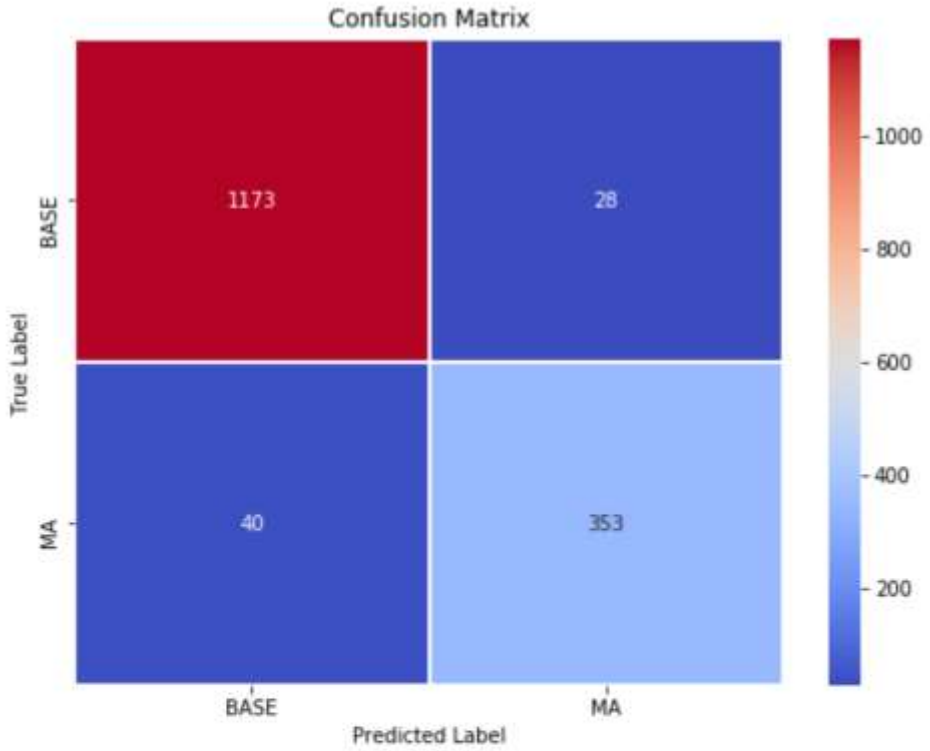
https://thumbs.gfycat.com/CorruptShoddyAmazontreeboa-size_restricted.gif



심전도(ECG, heart rhythm)

ECG Raw : Base(안정) vs. MA(암산)

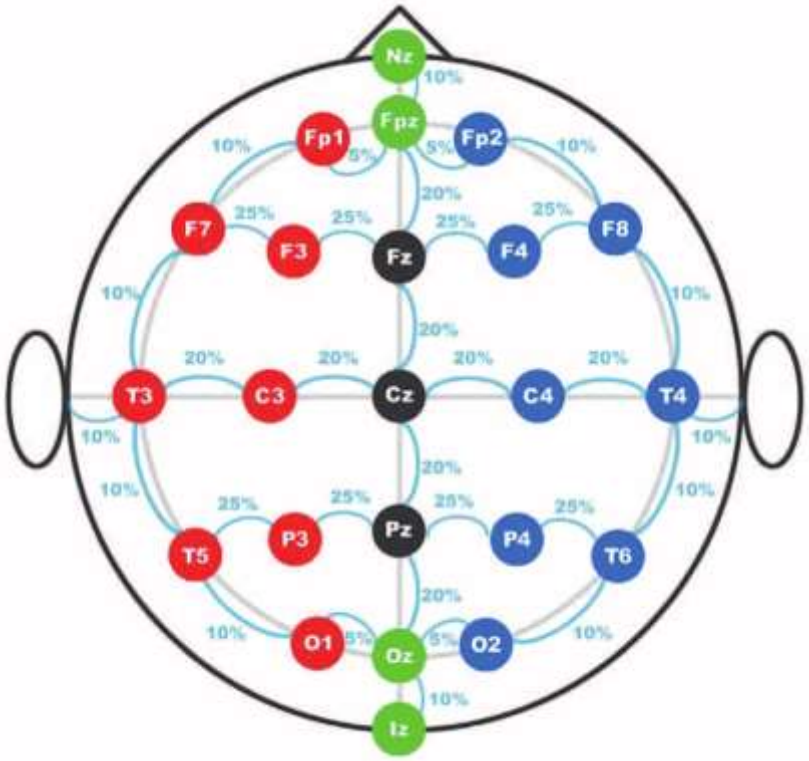




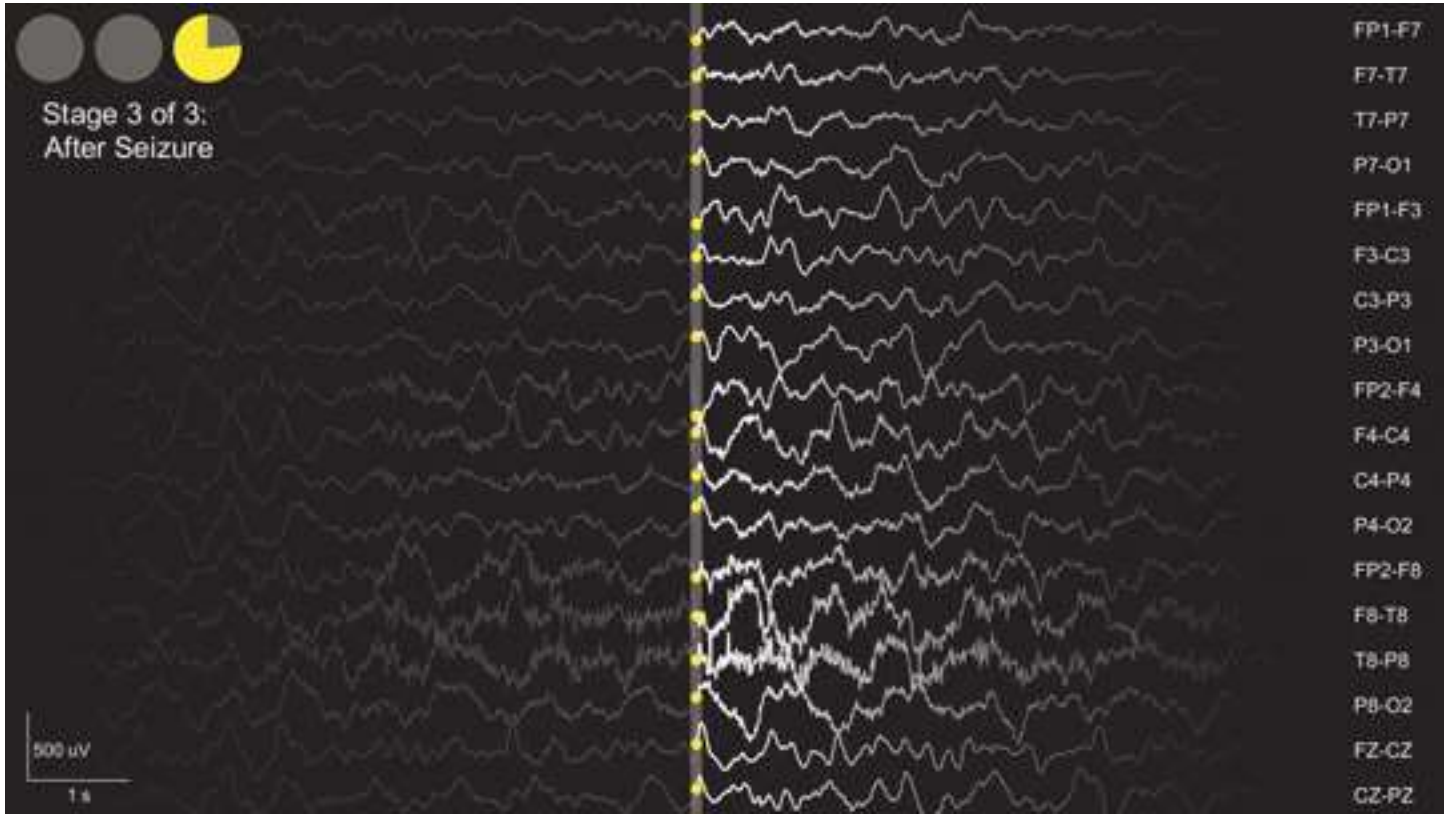
--- ECG 1-s rescaled: classification report for test data ---

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

뇌파 (EEG, brain waves)

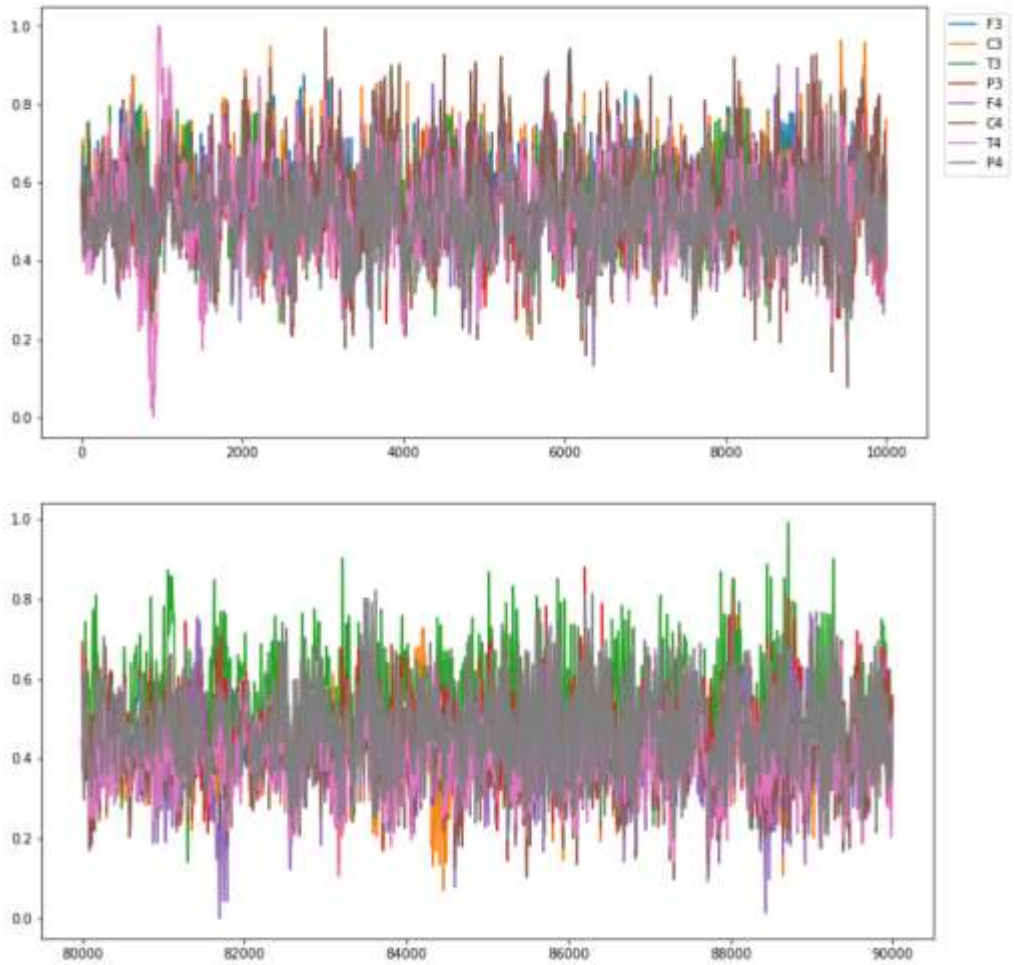


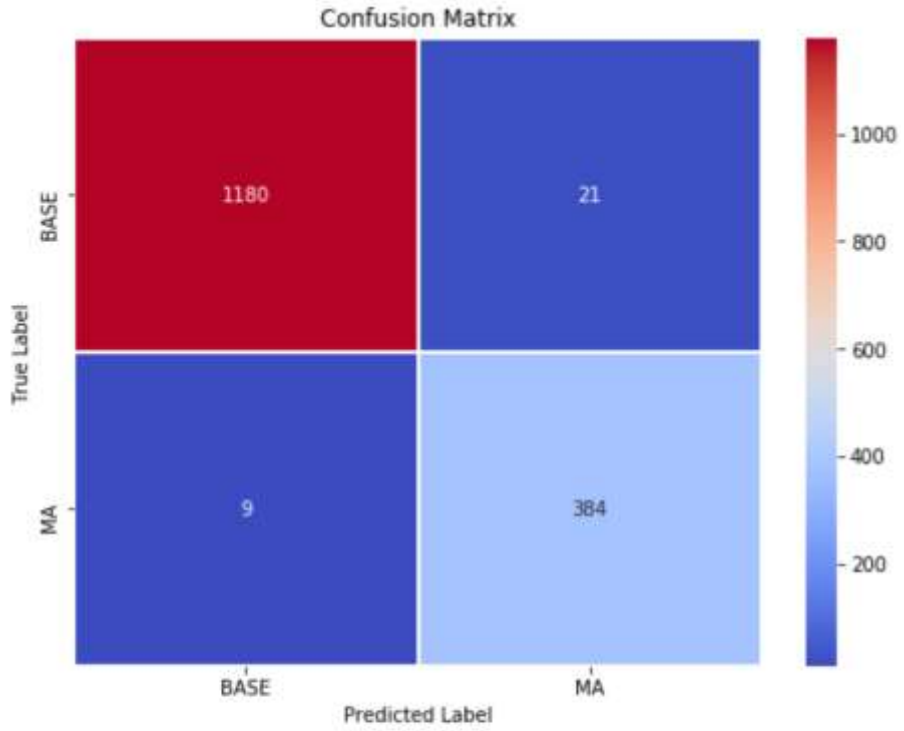
https://www.researchgate.net/profile/Daisuke_Hamada2/publication/282153913/figure/fig1/AS:706073979797505@1545352563235/The-international-10-20-scalp-positioning-system-showing-the-locations-of-scalp.ppm



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

뇌파 (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      1594
   macro avg       0.97      0.98      0.97      1594
weighted avg       0.98      0.98      0.98      1594
```

도전!!!

정상 뇌파

?

멘붕 뇌파

4792 - 31

- 31

- 31

- 31

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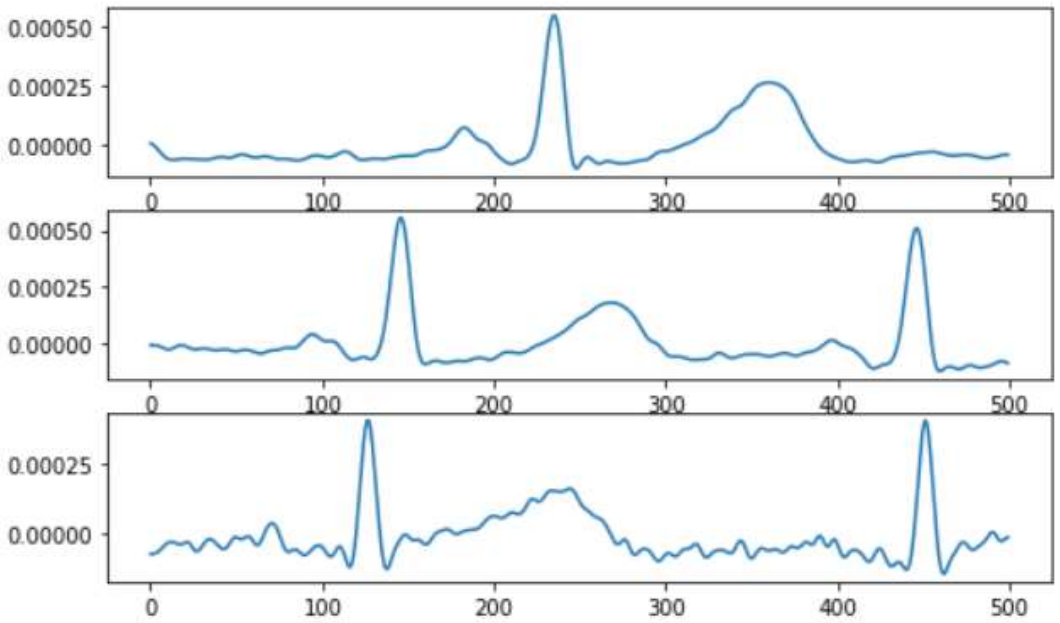
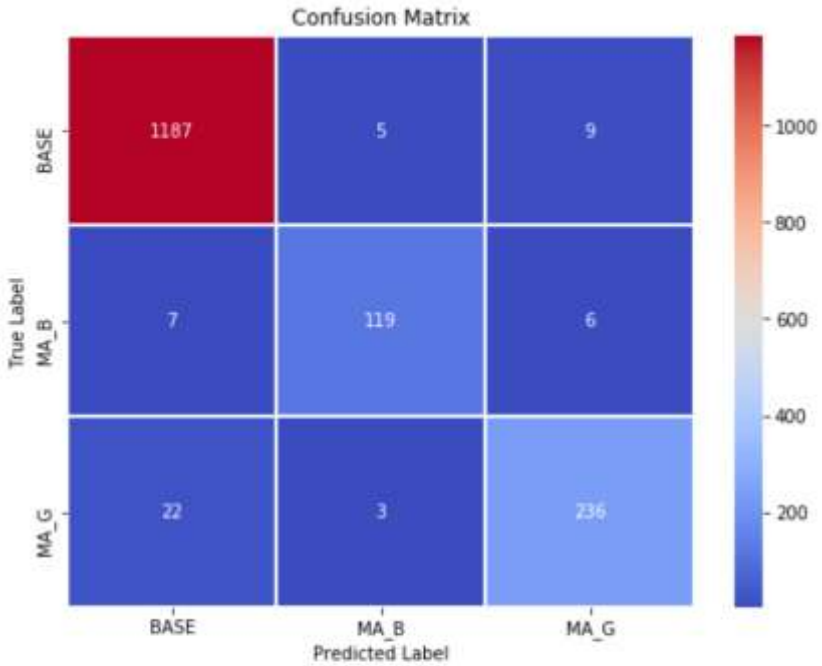
1분 동안
암산 실시!

심전도 [안정, 암산, 멘붕]

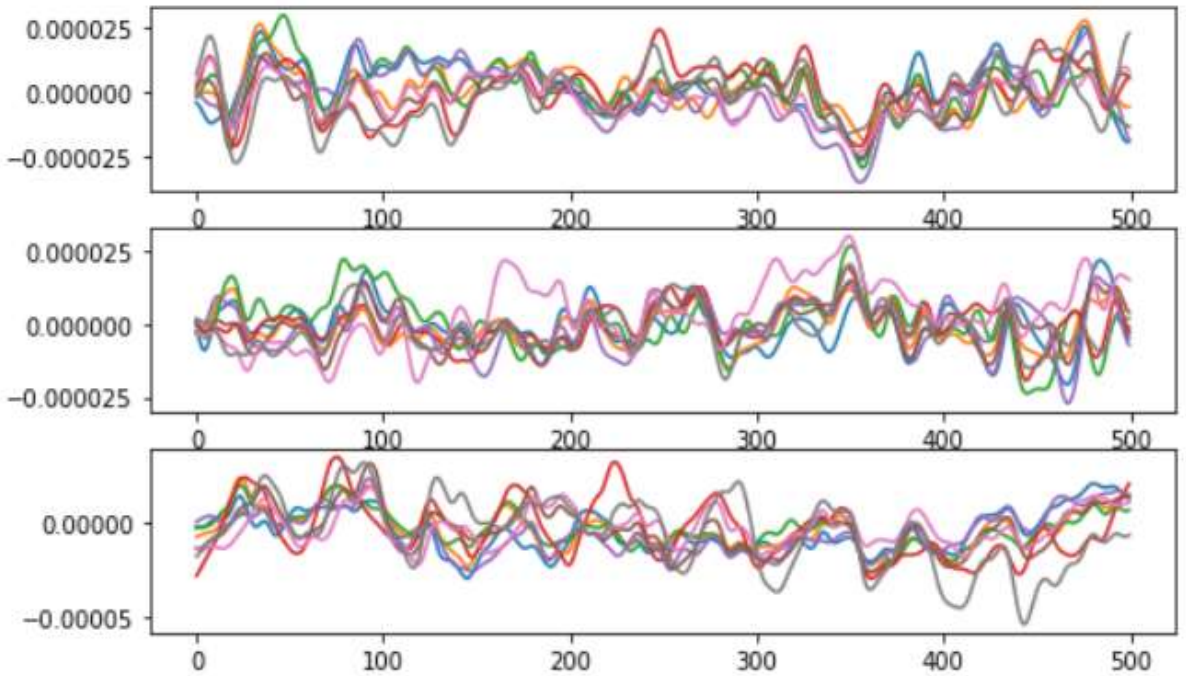




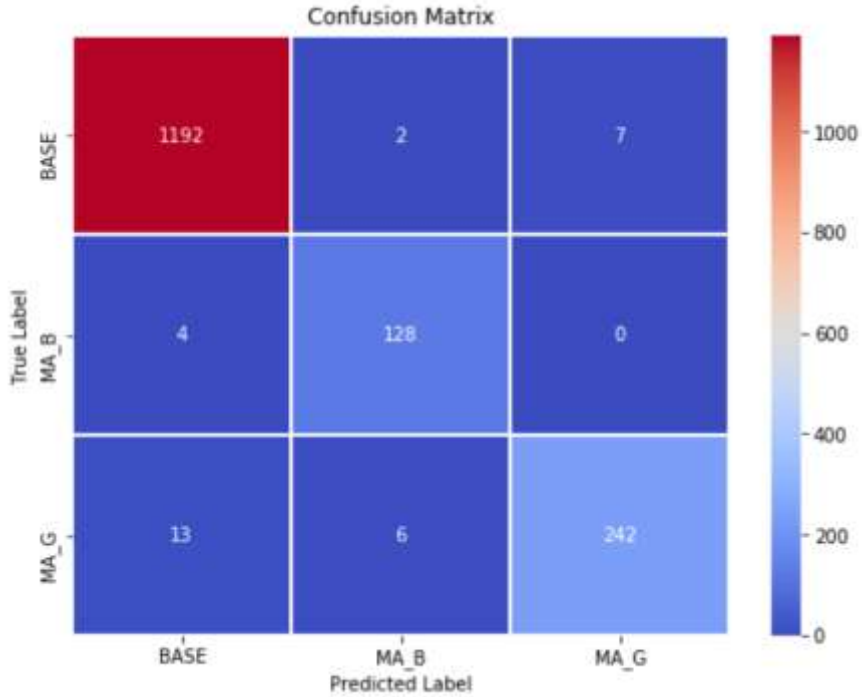
--- ECG scaled 1s: CV1D, MA_B vs. MA_G ---

	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]

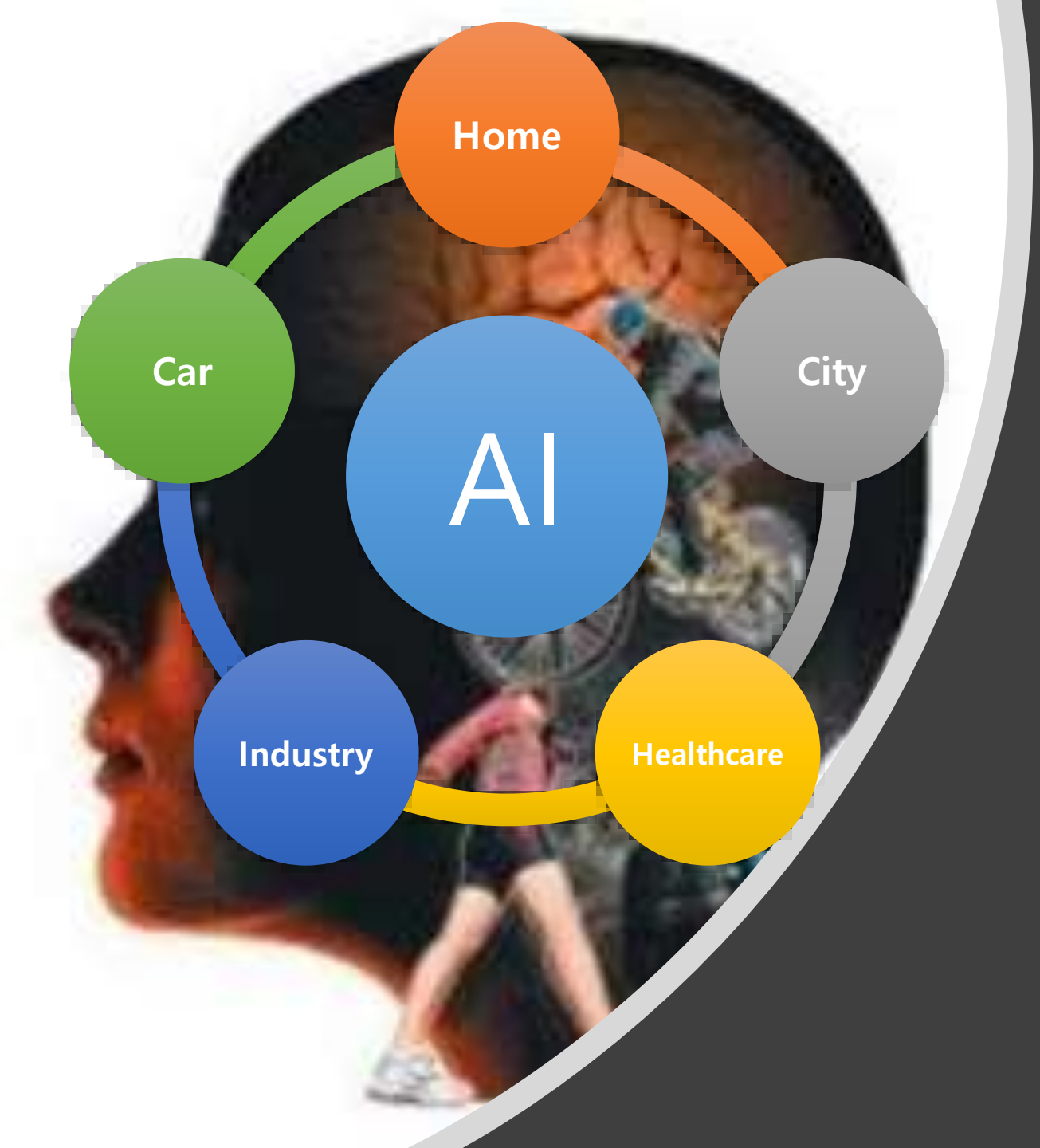


뇌파 (EEG, 8-채널)



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

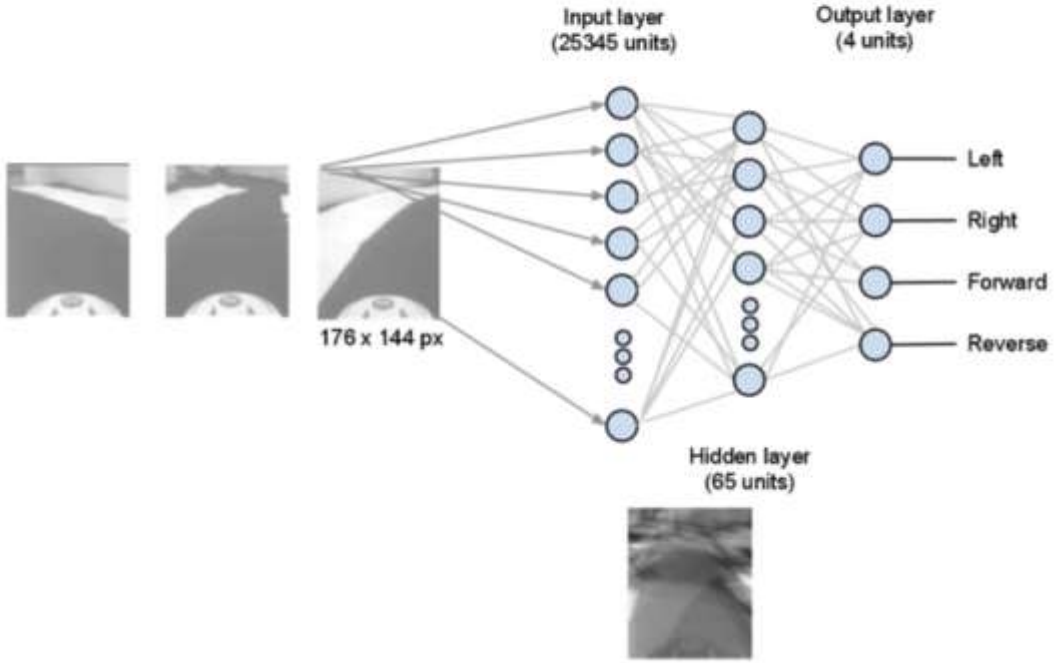
	precision	recall	f1-score	support
0	0.99	0.99	0.99	1201
1	0.94	0.97	0.96	132
2	0.97	0.93	0.95	261
accuracy			0.98	1594
macro avg	0.97	0.96	0.96	1594
weighted avg	0.98	0.98	0.98	1594



AI Everywhere!

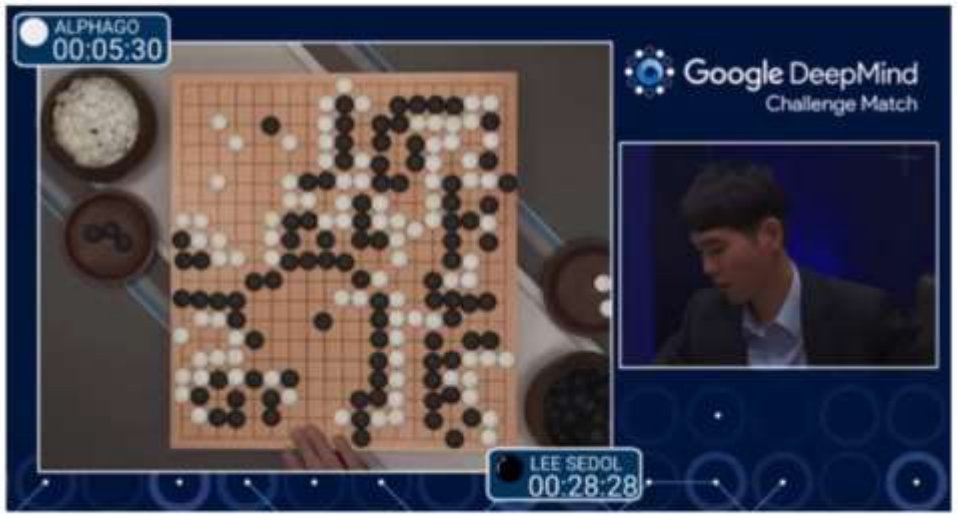
AI Everywhere!

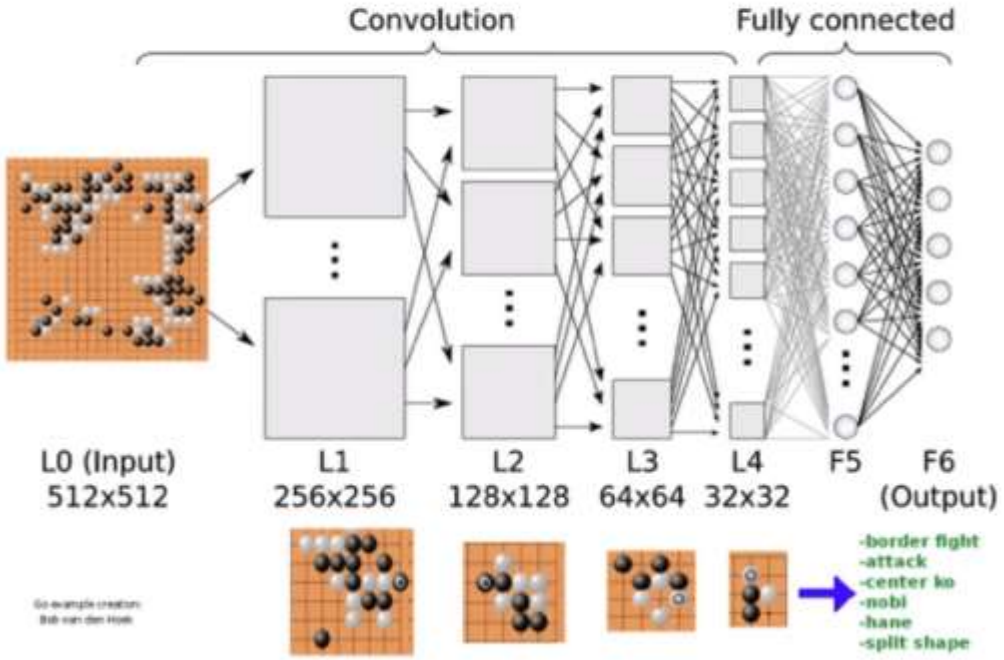
Self Driving Car



AI Everywhere!

Playing Go





AI Everywhere!

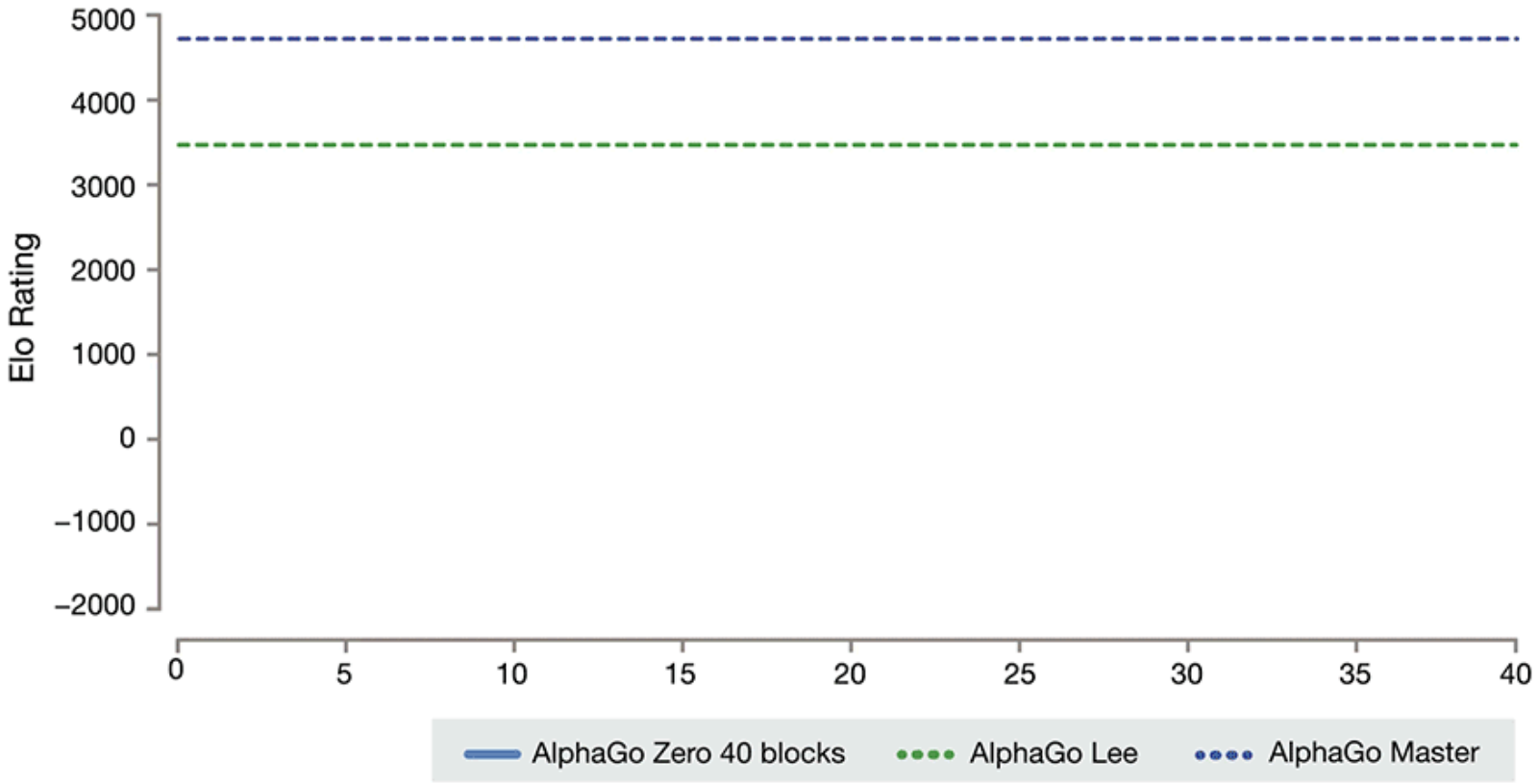
Self-learning AlphaGo Zero (강화학습)

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

환경 센서

생체 센서

Photos

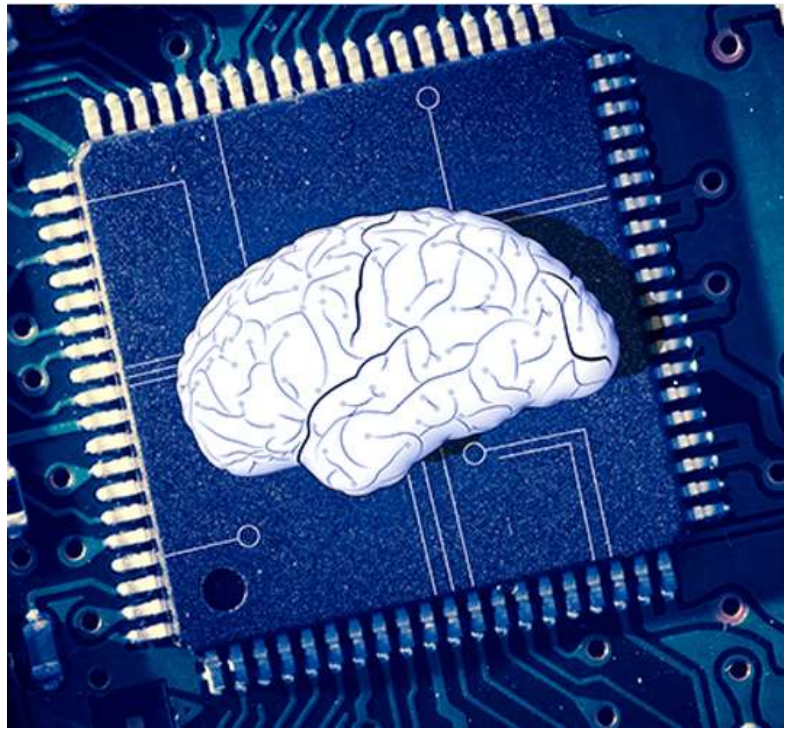
Videos

CAR

드론

SNS

EHR



Smart IoT

Smart Life

Well being

https://www.codeproject.com/Articles/1166257/Learning-Machine-Learning-Part-An-Introduction

The END

Thank for focusing…

양자물리에서

인공지능으로