

# Deep learning (DL)

Nambeom Kim ([nbumkim@gmail.com](mailto:nbumkim@gmail.com))

# Introduction to Deep learning

# Find differences between two images



<https://github.com/Frichetten/Image-Difference-Finder>

# The differences between two images found by machine

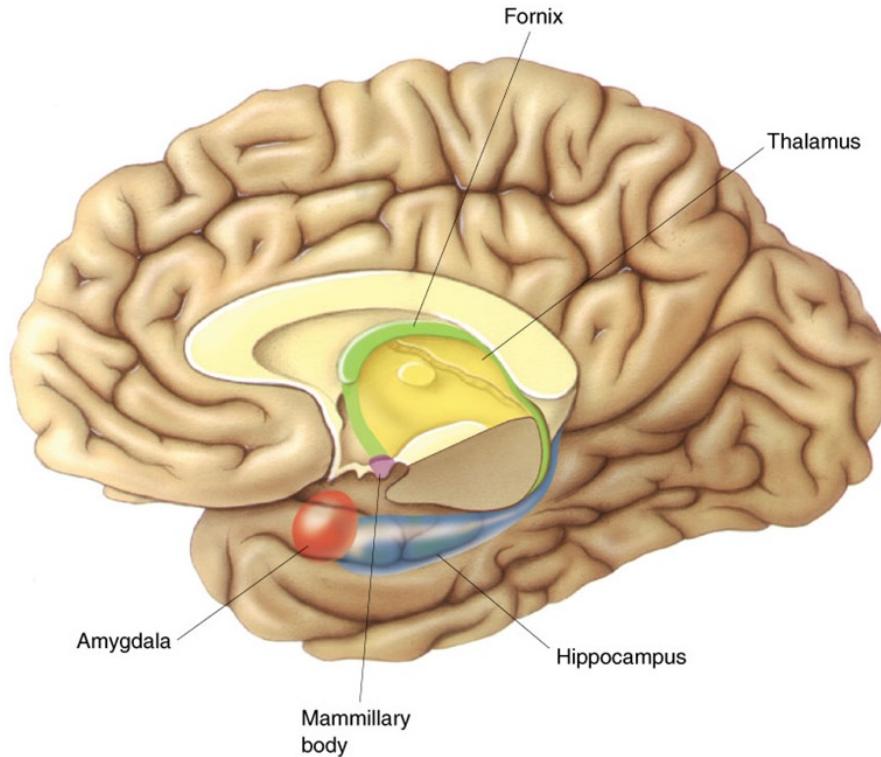


<https://github.com/Frichetten/Image-Difference-Finder>

# What is learning?

In human brain:

Figure 23.13  
Components of the diencephalon involved in memory. The thalamus and mammillary bodies receive afferents from structures in the medial temporal lobe.



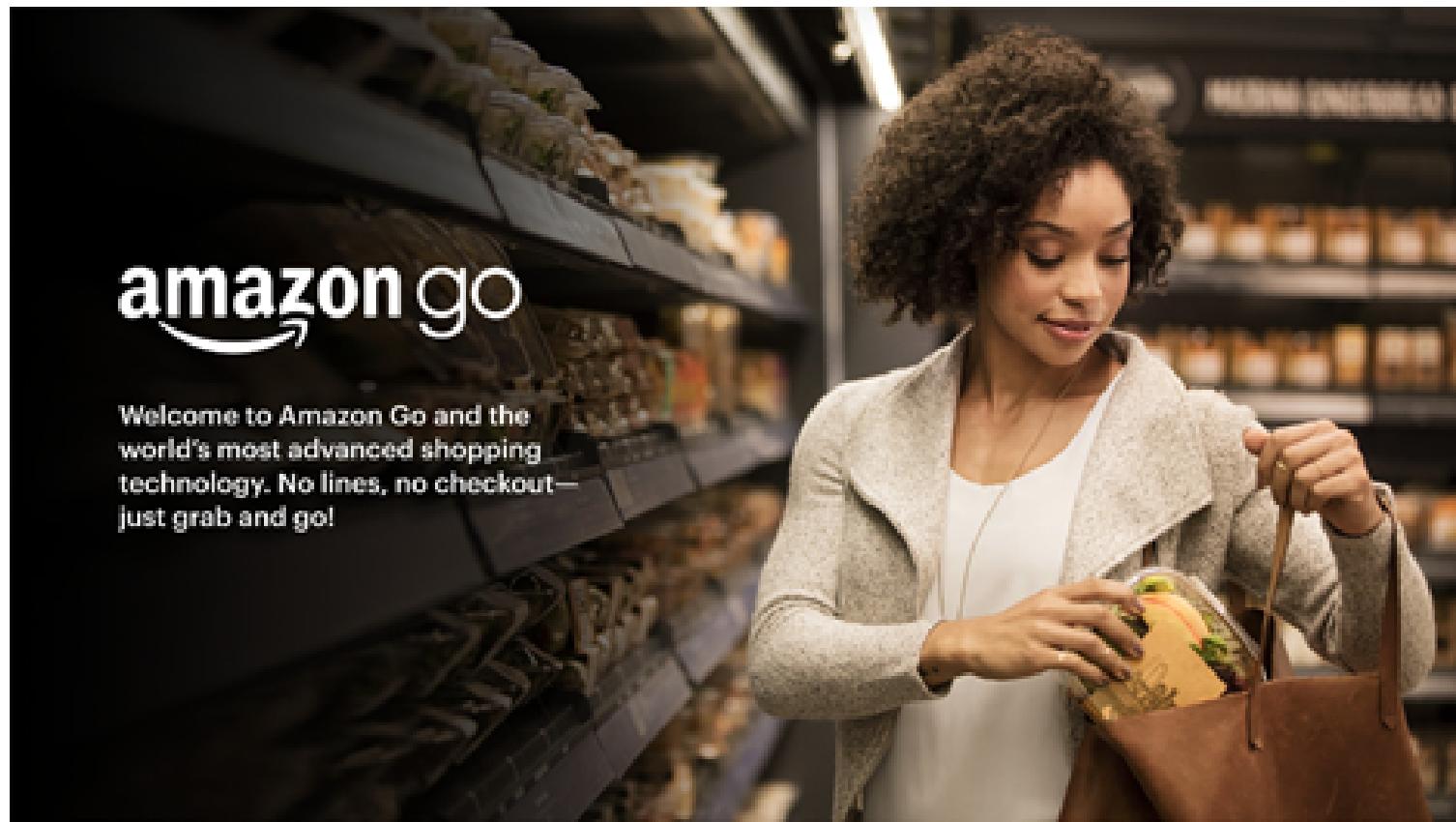
In machine:

Extracting features and recognizing pattern

# Application of DL

- AMAZONGO
- Automobile

# AMAZONGO



<https://youtu.be/NrmMk1Myrxc>

# Automobile



<https://youtu.be/tlThdr3O5Qo>

# Deep learning of automobile

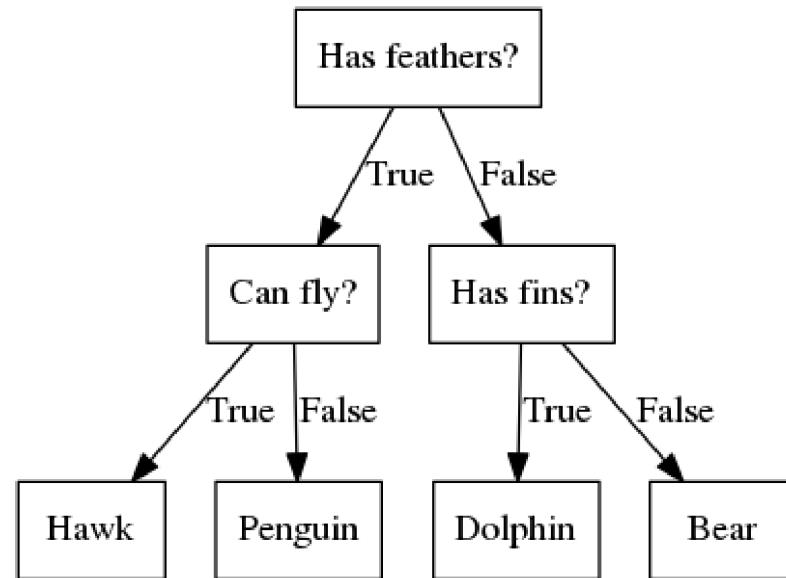
Deep Learning Cars



# What is AI, Machine learning, and deep learning

## AI (1950 ~ 1980)

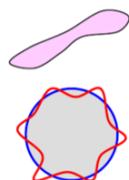
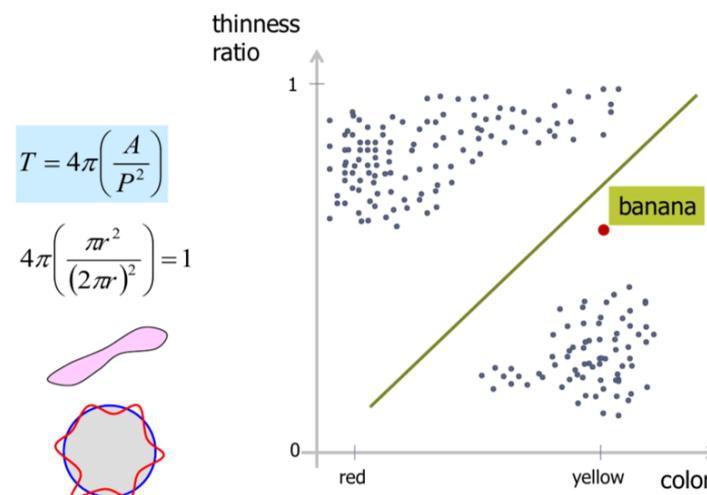
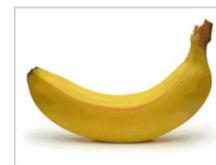
- 사람처럼 학습하고 추론할 수 있는 지능을 가진 컴퓨터 시스템을 만드는 기술
- 모든 규칙을 사람이 프로그래밍



<https://kolikim.tistory.com/22>

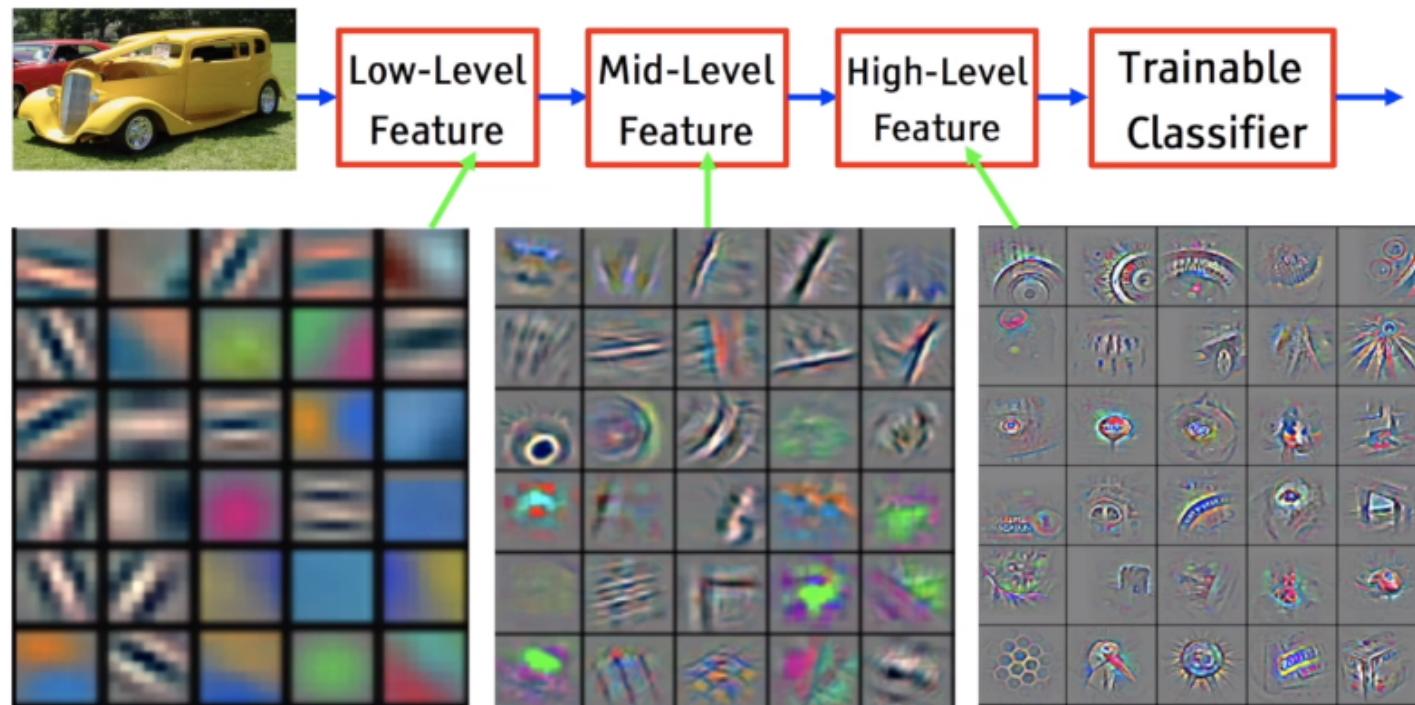
# Machine learning (1980 ~ 2010)

- 규칙을 일일이 프로그래밍하지 않아도 자동으로 데이터에서 규칙을 학습하는 통계적 알고리즘
- 학습에 사용되는 feature를 사람이 정해 줘야함

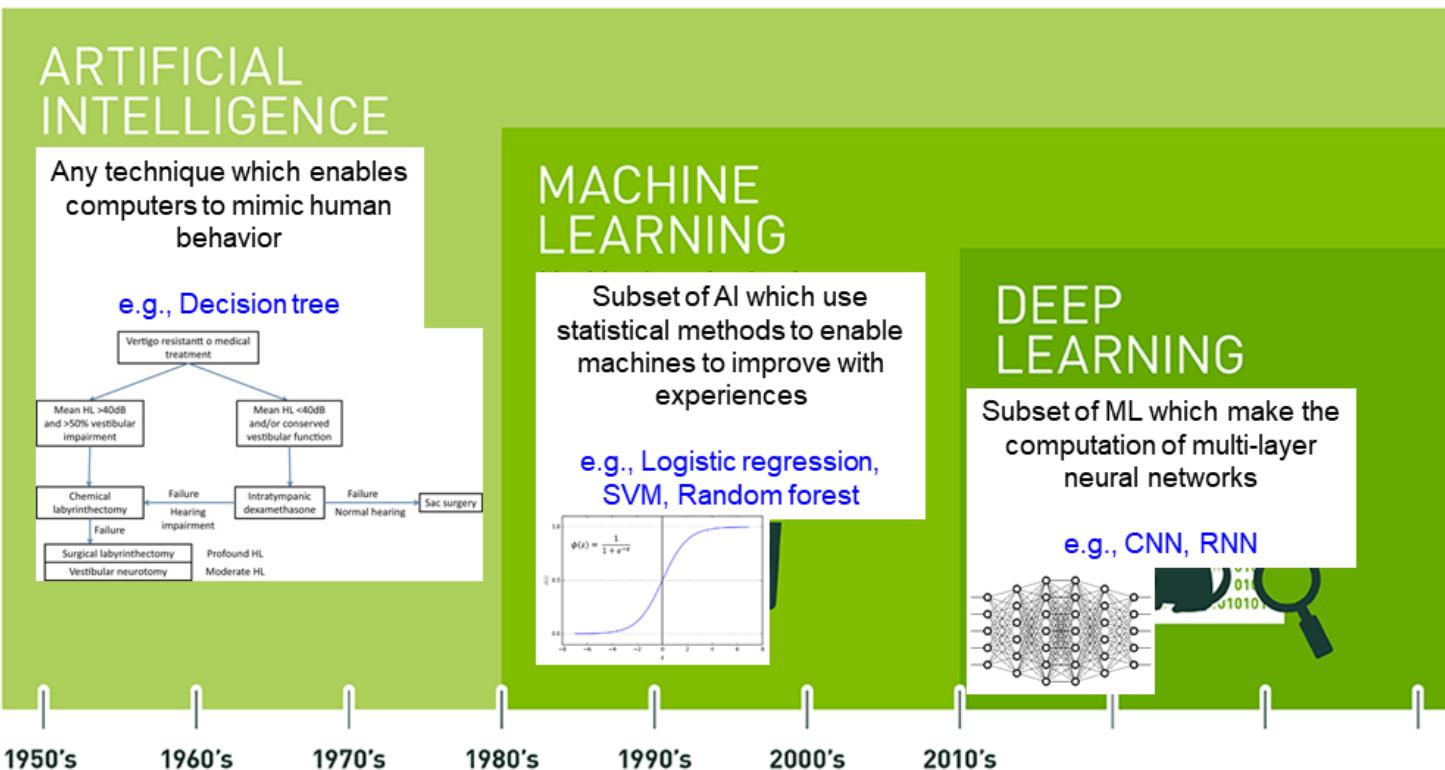


# Deep learning (2010 ~)

- 학습에 사용되는 feature도 인공지능이 결정



# Difference between Artificial intelligence, Machine learning, and Deep learning



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.

From NVIDIA, <https://blogs.nvidia.com>

# Deep learning structure

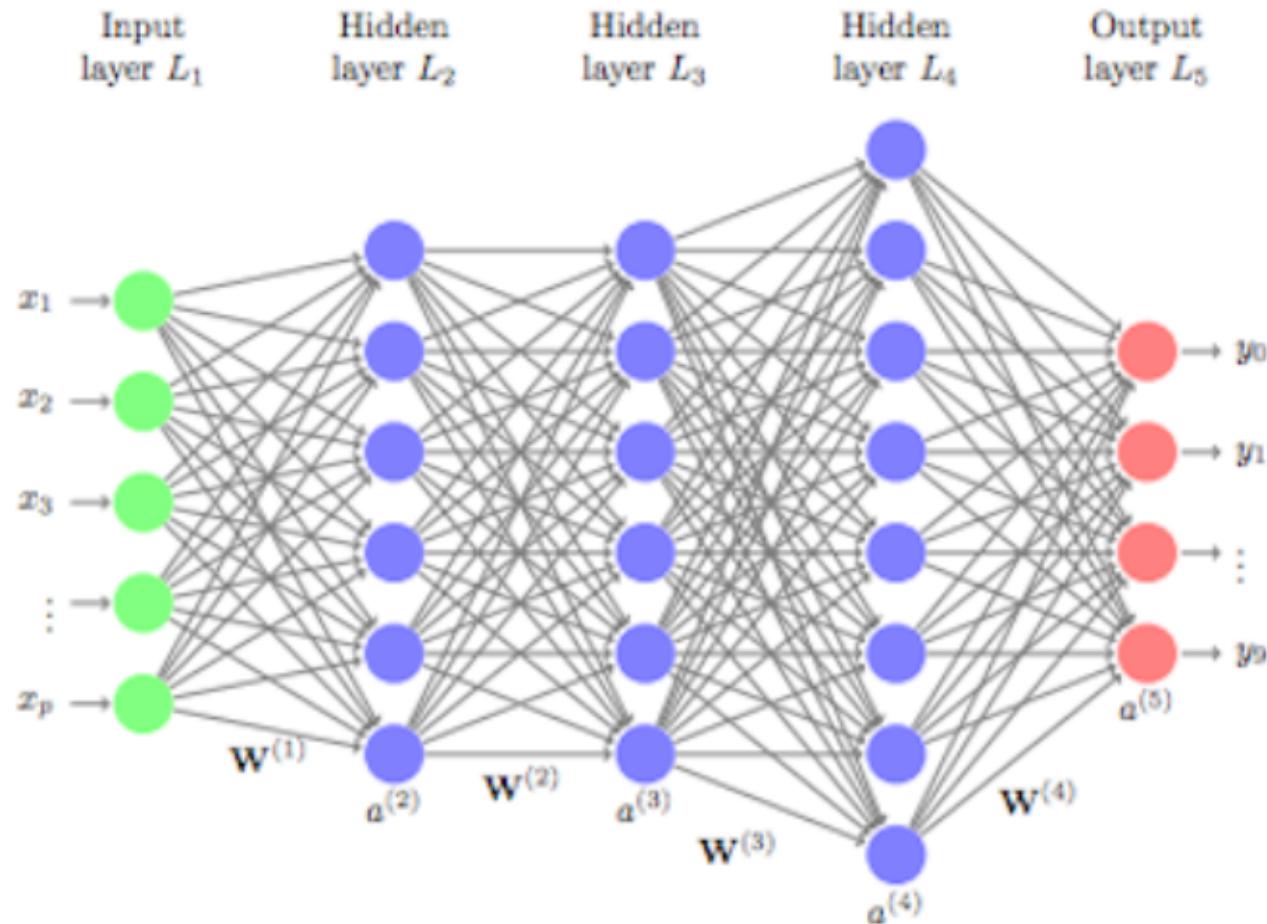
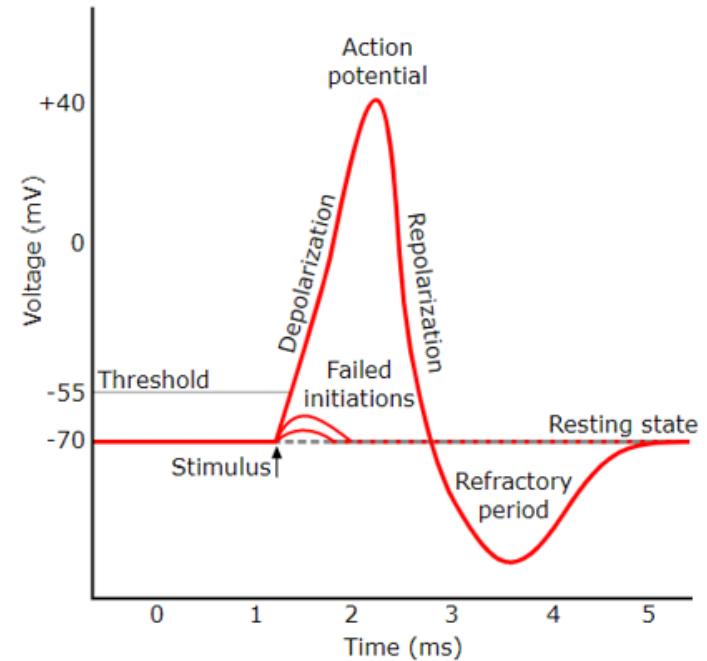
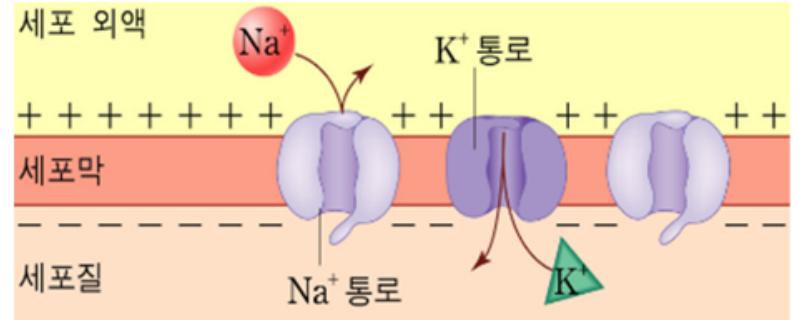
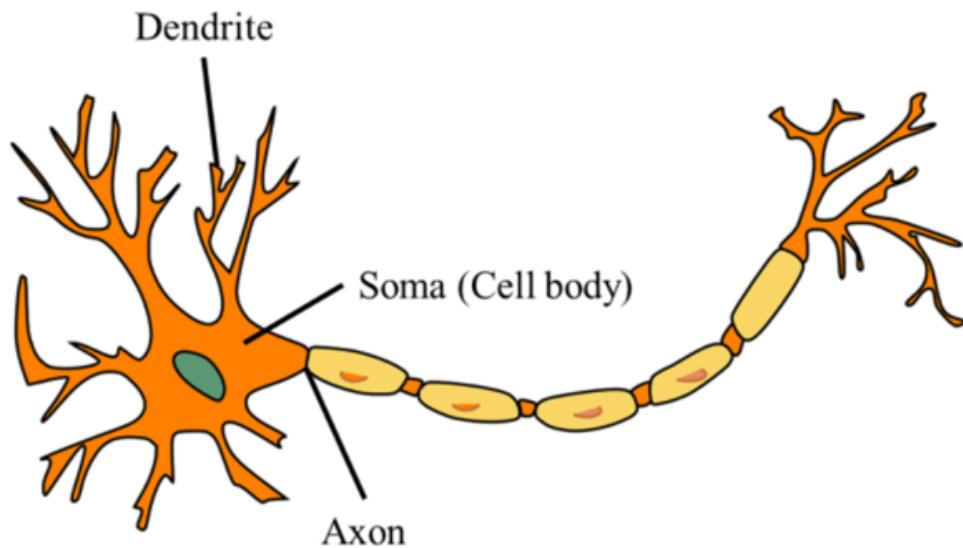
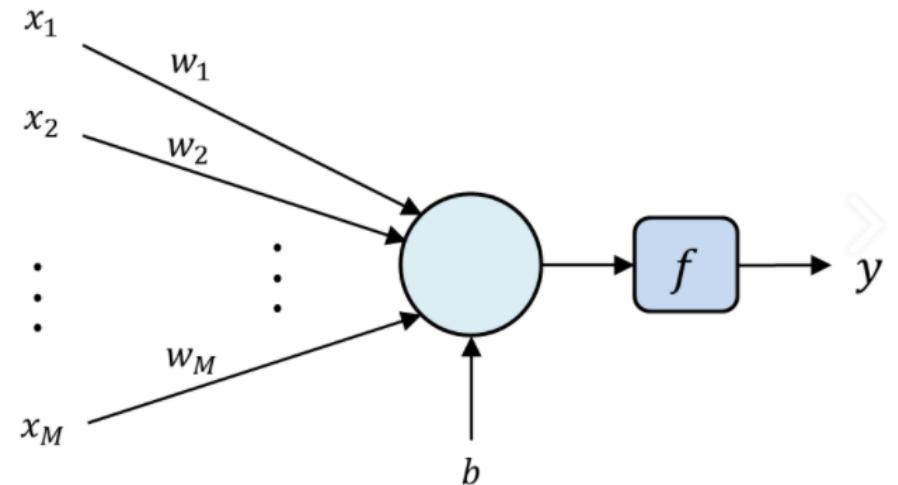
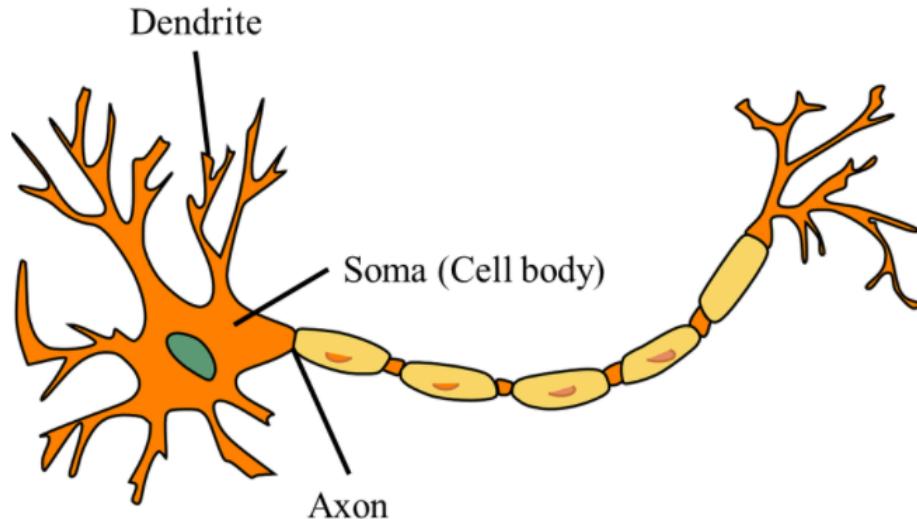


Figure 13.3: Representation of a deep feedforward neural network.

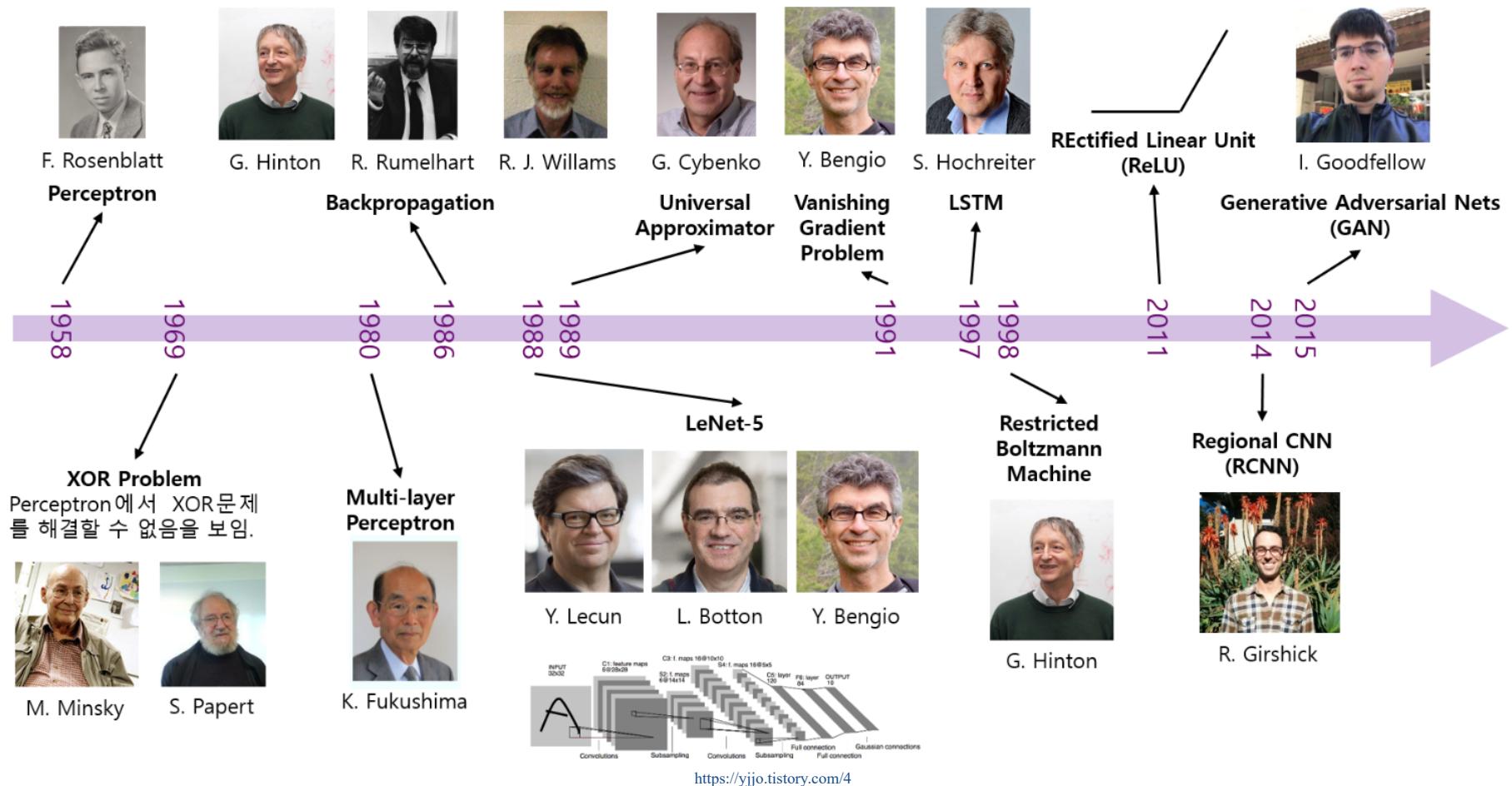
# why they are called ‘Neural network’ (인공신경망)?



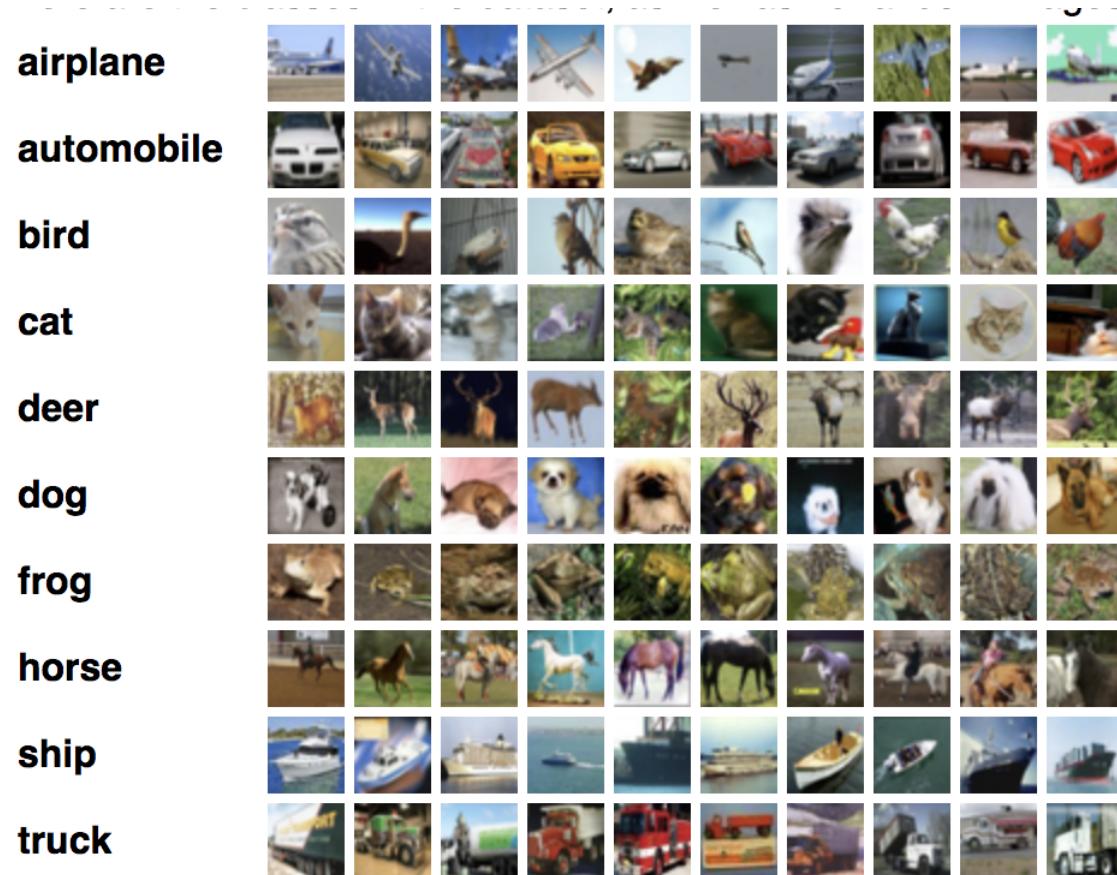
# why they are called ‘Neural network’ (인공신경망)?



# Deep Learning history



# Image classification



<http://www.image-net.org/challenges/LSVRC/>

# Image classification

IM<sup>3</sup>GENET Large Scale Visual Recognition Challenge

Steel drum

The Image Classification Challenge:  
1,000 object classes  
1,431,167 images

Output:  
Scale  
T-shirt  
Steel drum  
Drumstick  
Mud turtle

Output:  
Scale  
T-shirt  
Giant panda  
Drumstick  
Mud turtle

Russakovsky et al. arXiv, 2014

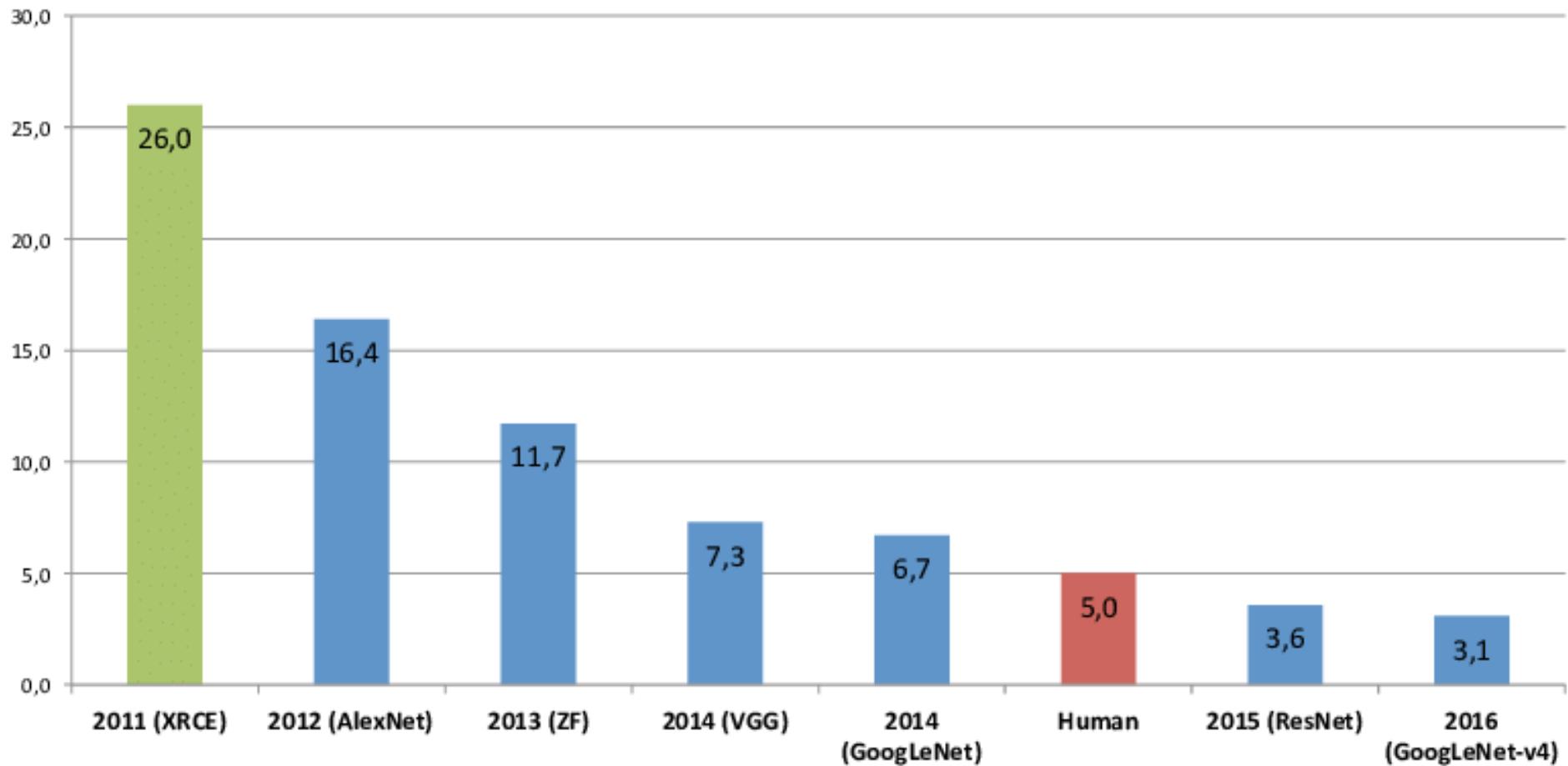
Fei-Fei Li & Andrej Karpathy & Justin Johnson

Lecture 1 - 23 4-Jan-16

<http://www.image-net.org/challenges/LSVRC/>

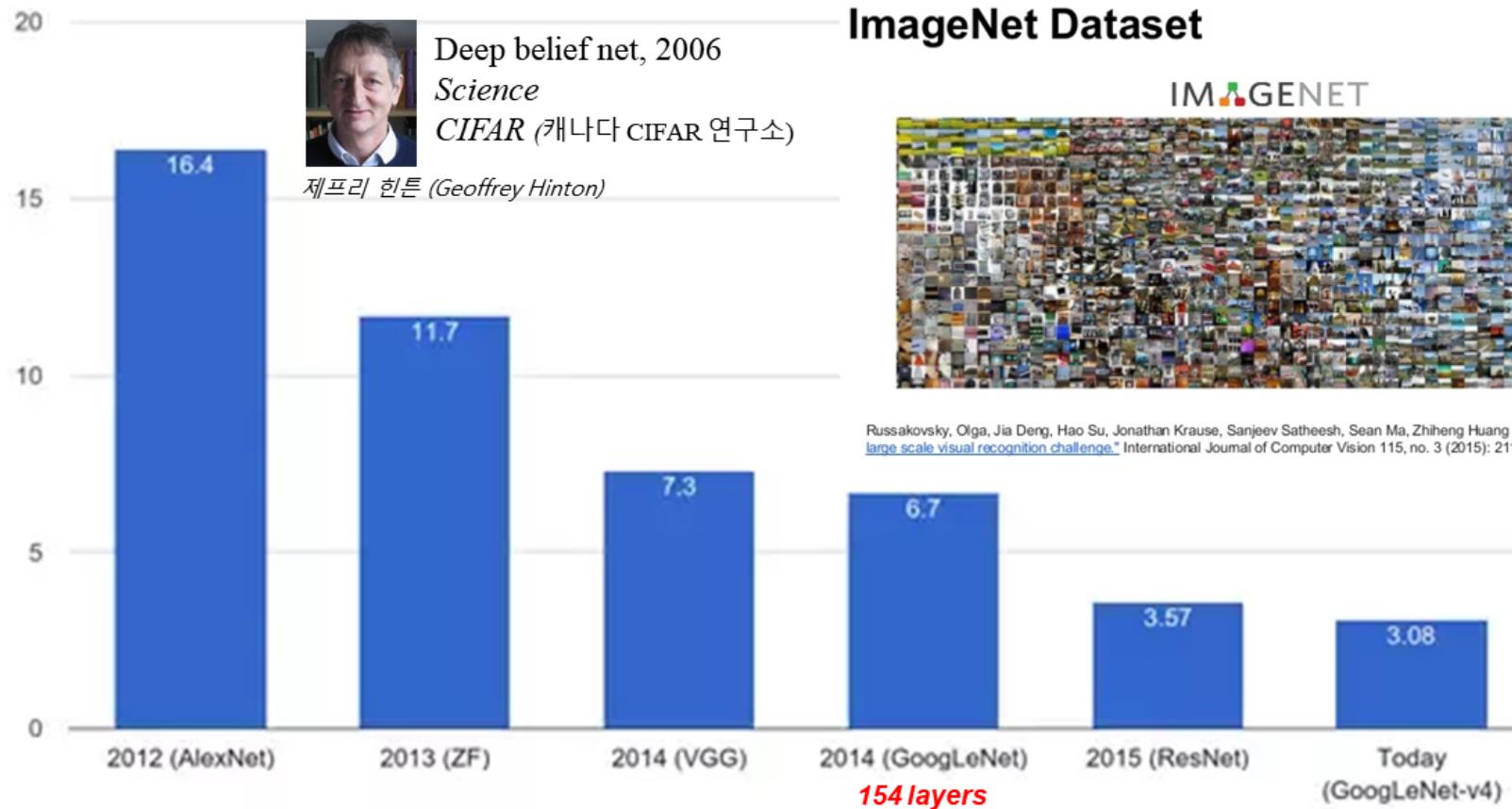
# Image classification

ImageNet Classification Error (Top 5)



# Image classification

## ImageNet Classification Error

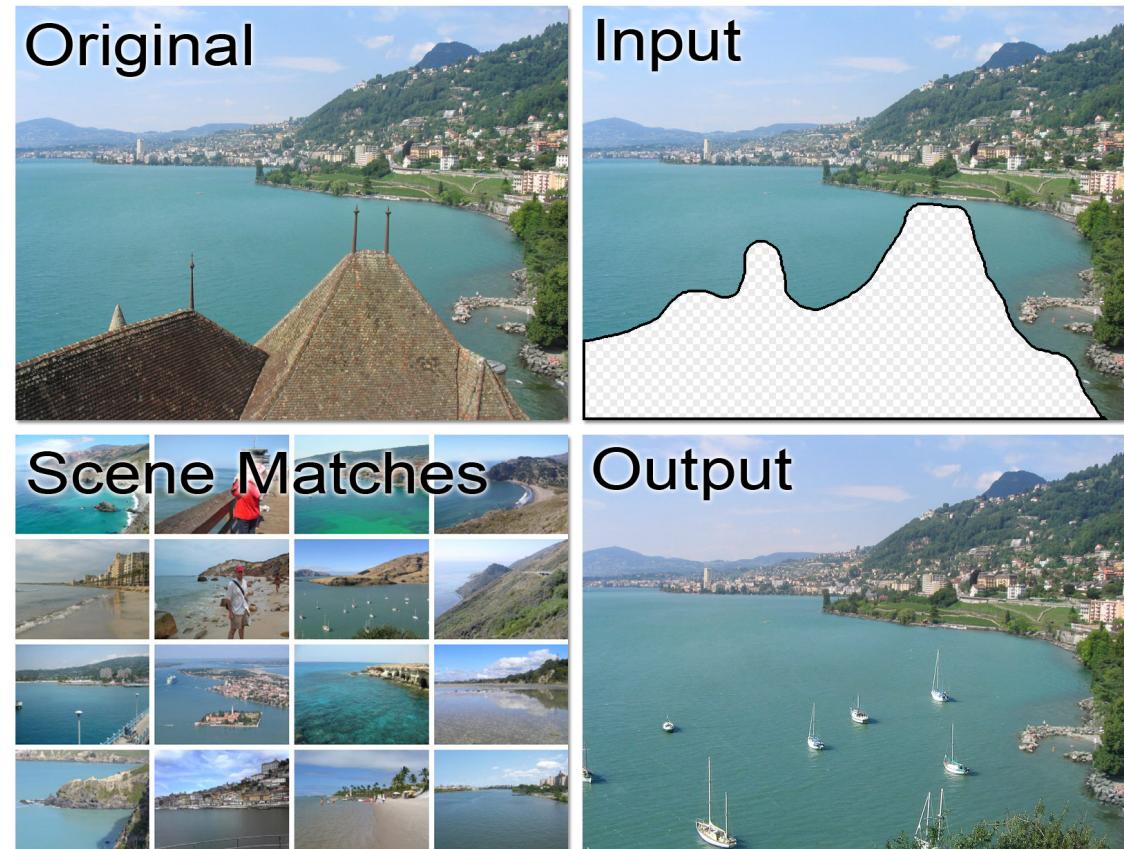


## ImageNet Dataset



Russakovsky, Olga, Jia Deng, Hao Su, Jonathan Krause, Sanjeev Satheesh, Sean Ma, Zhiheng Huang et al. "[Imagenet large scale visual recognition challenge](#)." International Journal of Computer Vision 115, no. 3 (2015): 211-252. [\[web\]](#)

# Scene filling



James Hays, Alexei A. Efros. Scene Completion Using Millions of Photographs. ACM Transactions on Graphics (SIGGRAPH 2007). August 2007, vol. 26, No. 3.

# Motion tracking

Demo of vehicle tracking and speed estimation at the 2nd AI City Challenge Workshop in CVPR 2018



# Deep fake

You Won't Believe What Obama Says In This Video! 😊



전 미대통령 버락 오바마(Barack Obama)

# Style Transfer

A



B



C



D

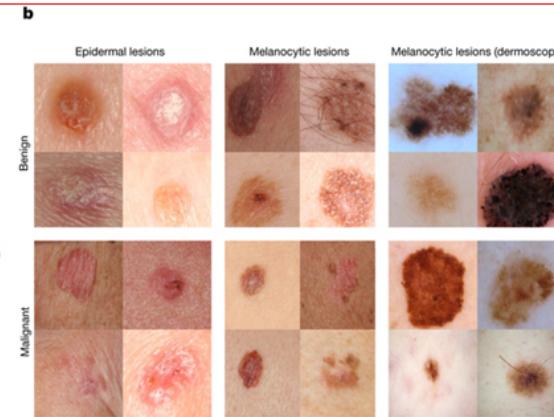
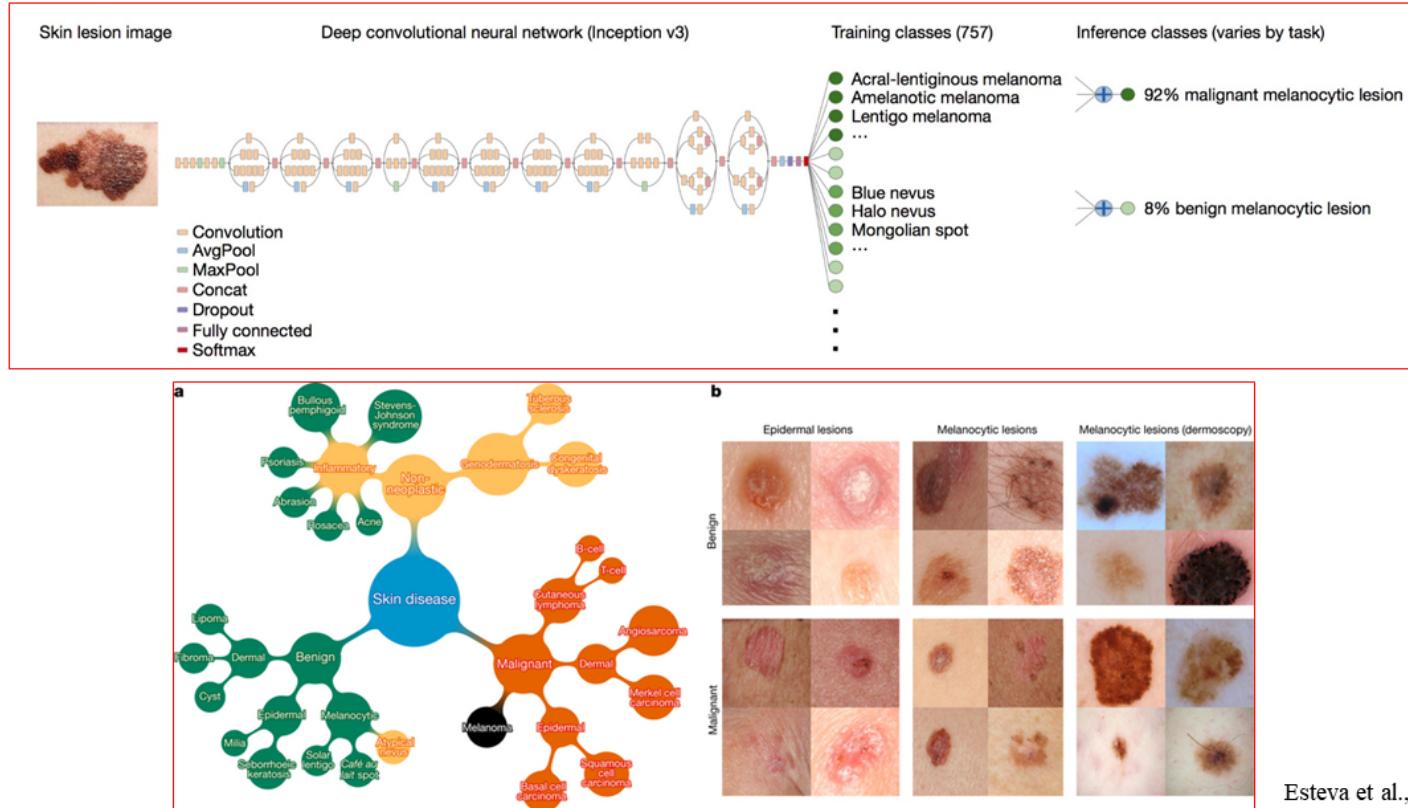


<https://sunniesuhyoung.github.io/DST-page/>

# Skin cancer diagnosis

## Dermatologist-level classification of skin cancer

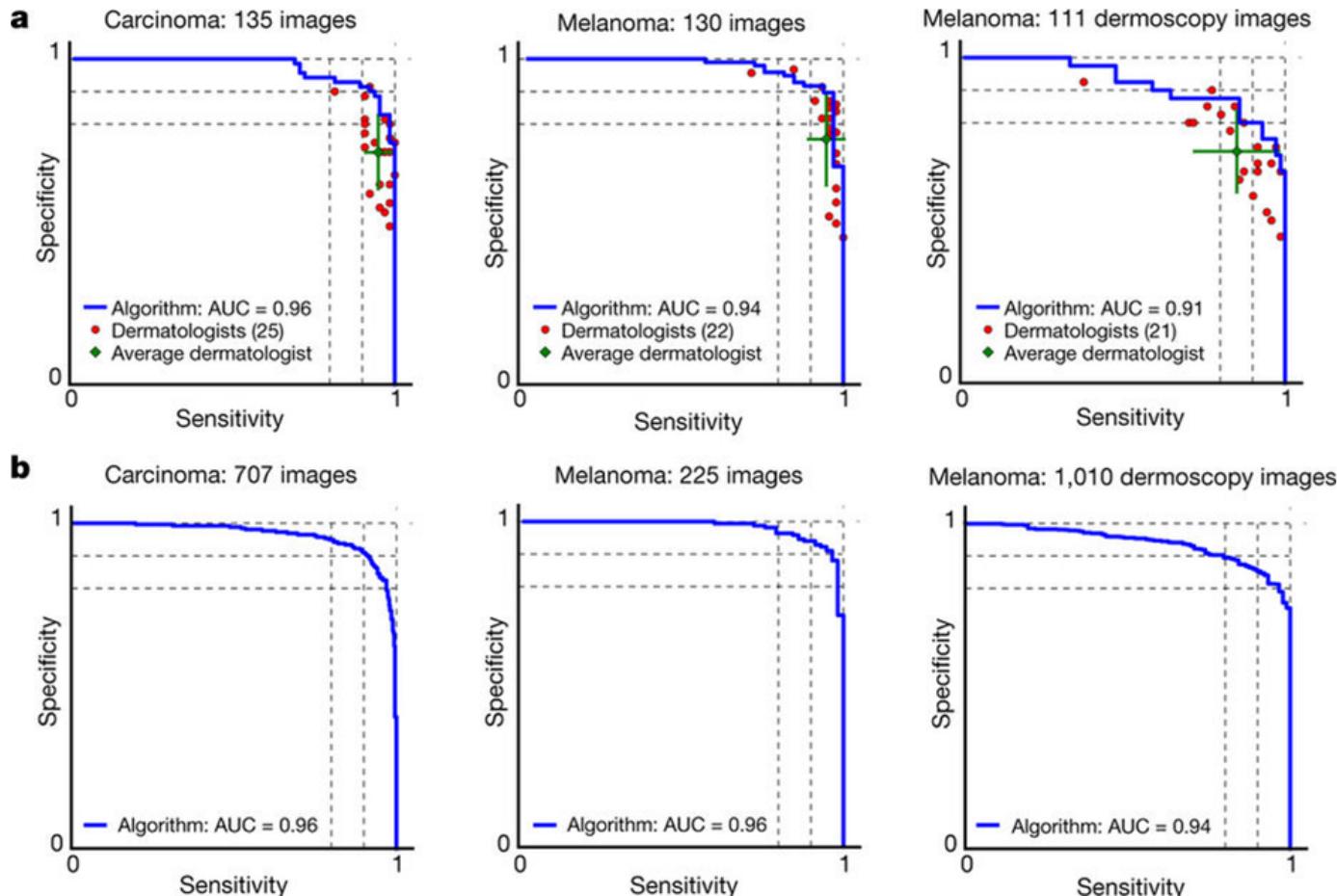
a dataset of 129,450 skin lesions comprising 2,032 different diseases,



Esteva et al., Nature, 2017

# Skin cancer diagnosis

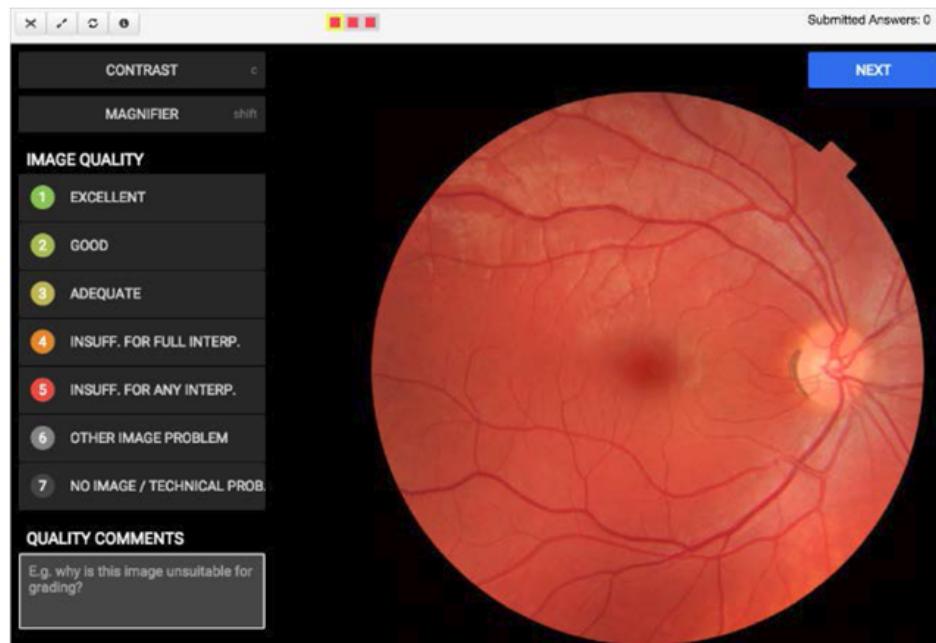
The deep learning CNN outperforms the average of the dermatologists at skin cancer classification



Esteva et al., Nature, 2017

# 당뇨병성 망막증 (Diabetic retinopathy) diagnosis

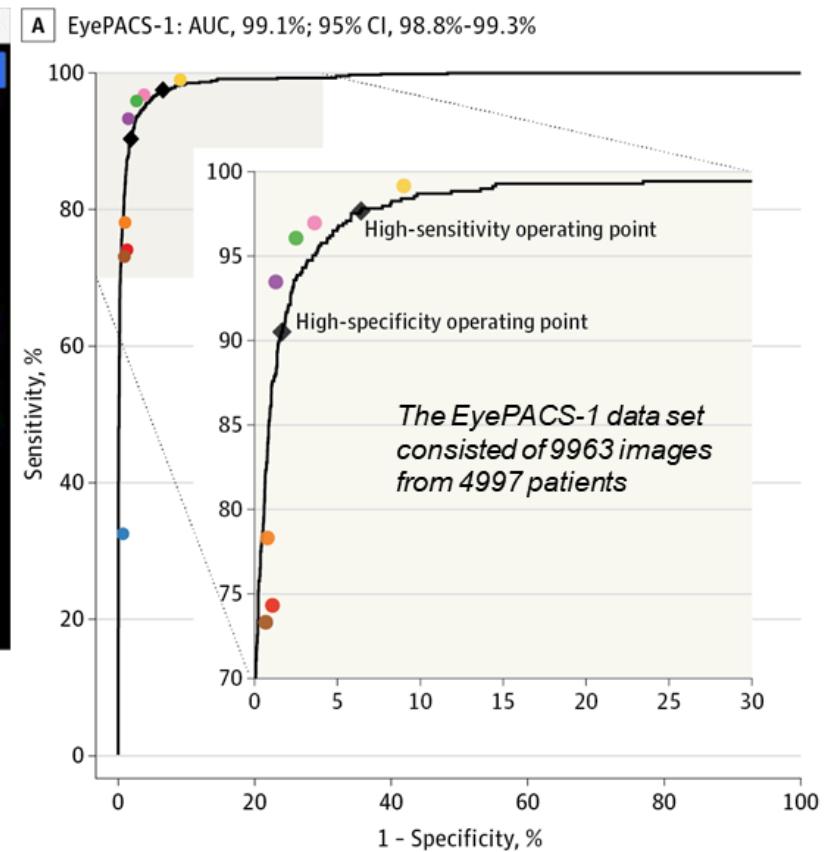
## Detection of Diabetic Retinopathy



FDA permits AI to detect diabetes-related eye problems

April 11. 2018

<https://www.fda.gov/NewsEvents>

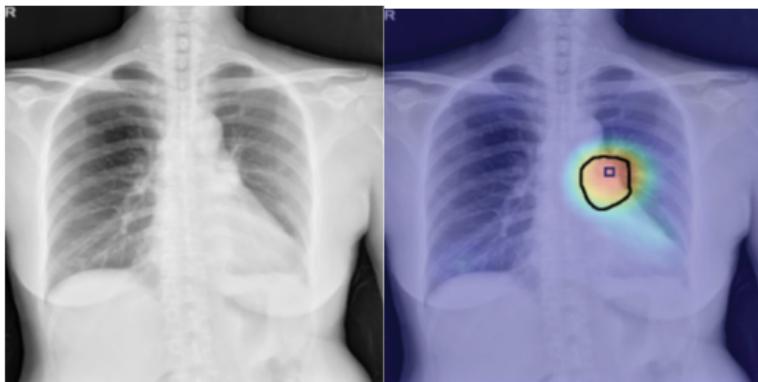


Gulshan et al., JAMA, 2016

# 가슴 x-ray diagnosis

## A new real-time imaging AI platform on the web at RSNA 2017

Case1. A lung cancer nodule located in the left hilar area



SEOUL NATIONAL UNIVERSITY HOSPITAL, APRIL 2017

THE ACCURACY OF OUR ALGORITHM IS HIGH

Lunit's Algorithm

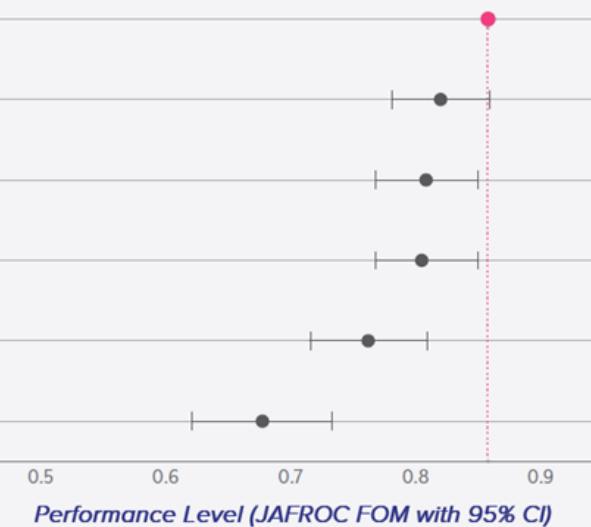
Thoracic Radiologists  
(N=5)

Board-certified  
Radiologists (N=5)

Radiology Residents  
(3rd-4th Year) (N=3)

Radiology Residents  
(1st-2nd Year) (N=3)

Non-radiology  
Physicians (N=3)



Case2. A focal consolidation in the right apex

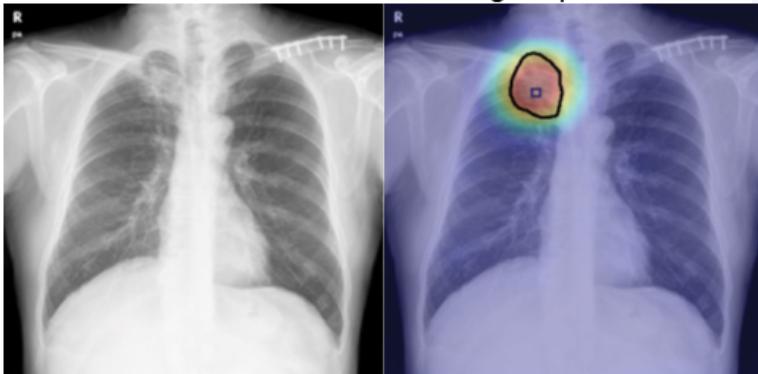


FIGURE 1. The accuracy of our algorithm was shown to be very high, comparable to that of thoracic radiologists (or likely even higher).

<https://insight.lunit.io>

# Image captioning (RNN)

input image				
generated annotation	aorta_thoracic / tortuous / mild aorta_thoracic / tortuous	opacity / lung / middle_lobe / right / aorta_thoracic / tortuous opacity / lung / base / left	calcified_granuloma / lung / middle_lobe / right / multiple calcified_granuloma / lung / hilum / right	opacity / lung / middle_lobe / right / blood_vessels calcified_granuloma / lung / middle_lobe / right
true annotation				
	airspace_disease / lung / hilum / right / lung / hilum nodule / lung / hilum / right	thoracic_vertebrae_degenerative / mild aorta_tortuous / thoracic_vertebrae_degenerative / mild	normal normal	normal normal

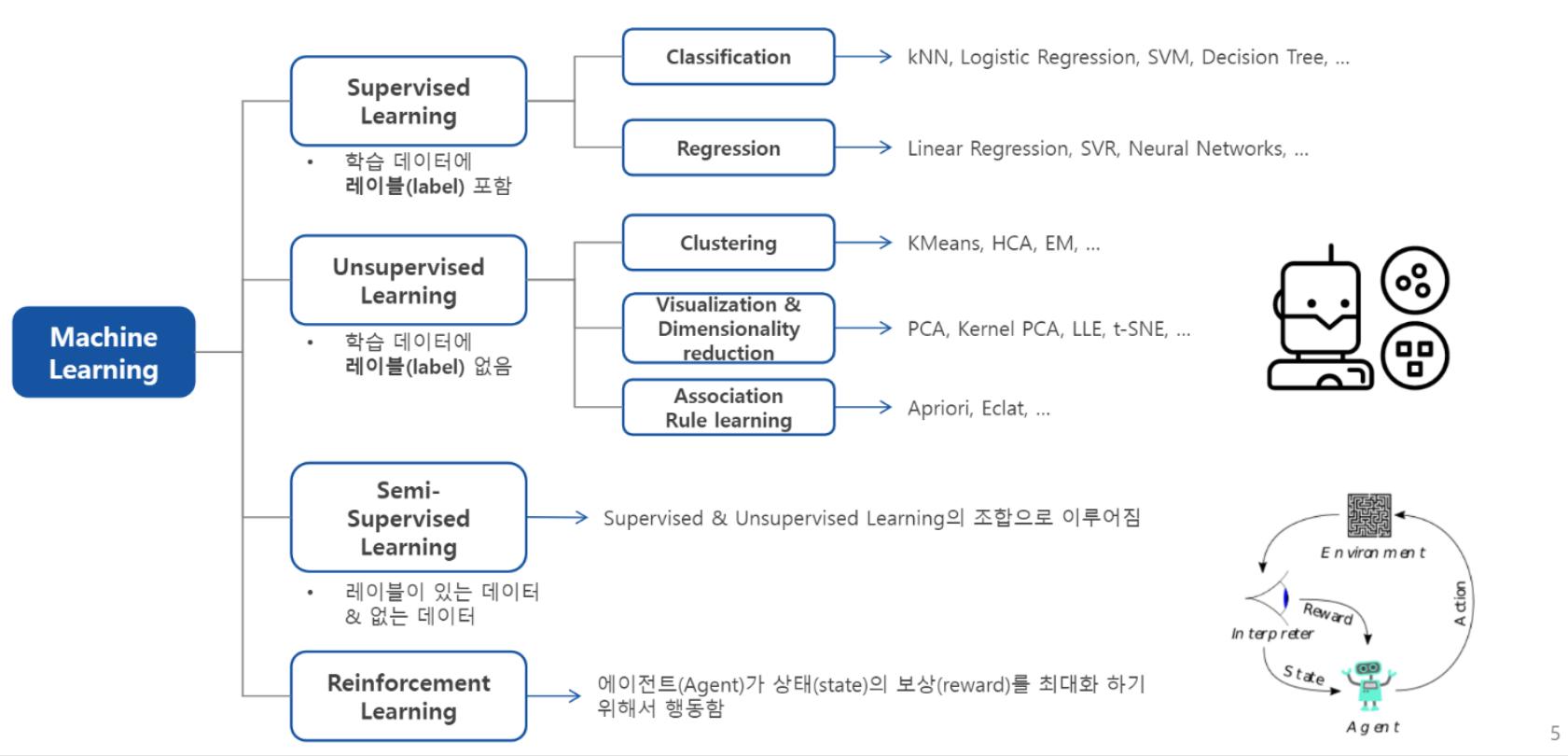
Shin et al., IEEE , 2016

# 생활 속 인공지능

(<https://hongong.hanbit.co.kr/>)

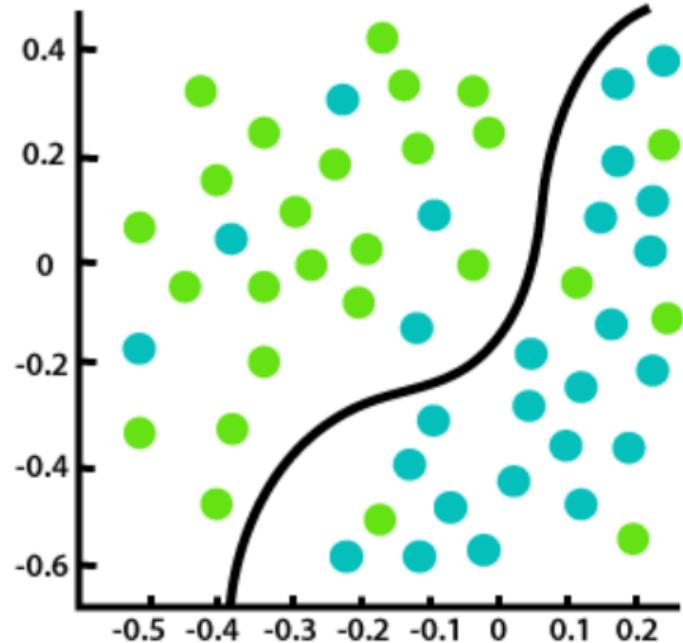
- 자율 주행 자동차: 테슬라, 구글, 현대자동차&네이버
- 스마트 스피커(AI 비서): 아마존, 구글, 바이두, 알리바바, 샤오미, KT, SK 텔레콤, 네이버, 카카오, 삼성전자 등
- 챗봇: 카카오 상담톡, 네이버 톡톡, 라인, 채널톡 등
- 인공지능 로봇: 청소 로봇, 교육용 로봇, 동반자 로봇, 운송 로봇
- 이미지 인식: 페이스북, 구글, 마이크로소프트, 네이버
- 개인화 추천: 넷플릭스, 구글, 페이스북
- 기계 번역: 구글, 네이버 파파고

# 기계학습의 분류

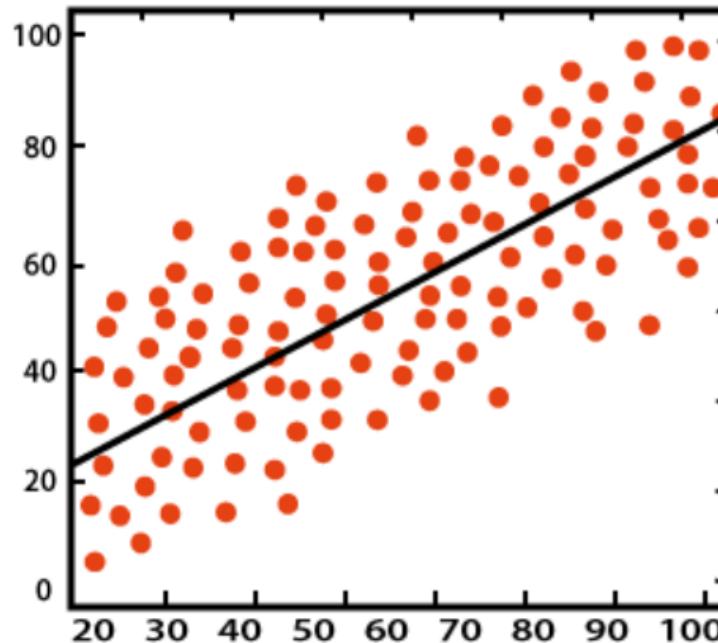


[https://github.com/ExcelsiorCJH/Hands-On-ML/blob/master/Chap01-The\\_Machine\\_Learning\\_Landscape](https://github.com/ExcelsiorCJH/Hands-On-ML/blob/master/Chap01-The_Machine_Learning_Landscape)

# 목적변수에 따른 분류



Classification



Regression

<https://www.javatpoint/regression-vs-classification-in-machine-learning>

# 딥러닝작업환경 만들기

- 구글 Colab 구동하기
- Anaconda 설치하기