Introduction of ML and DL

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Find differences between two images

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

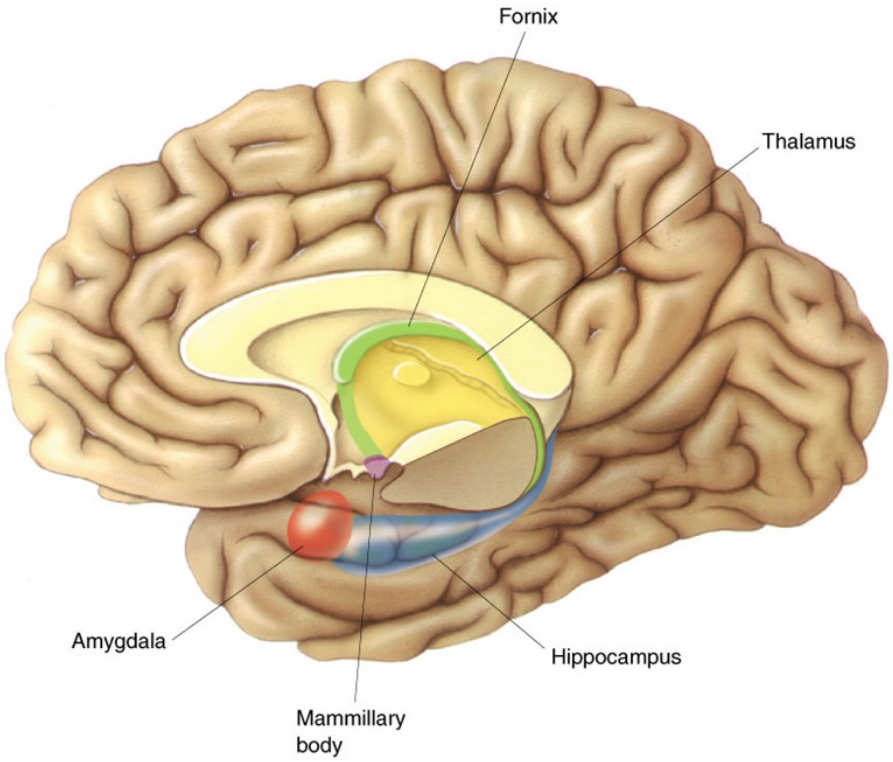
The differences between two images found by machine

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:

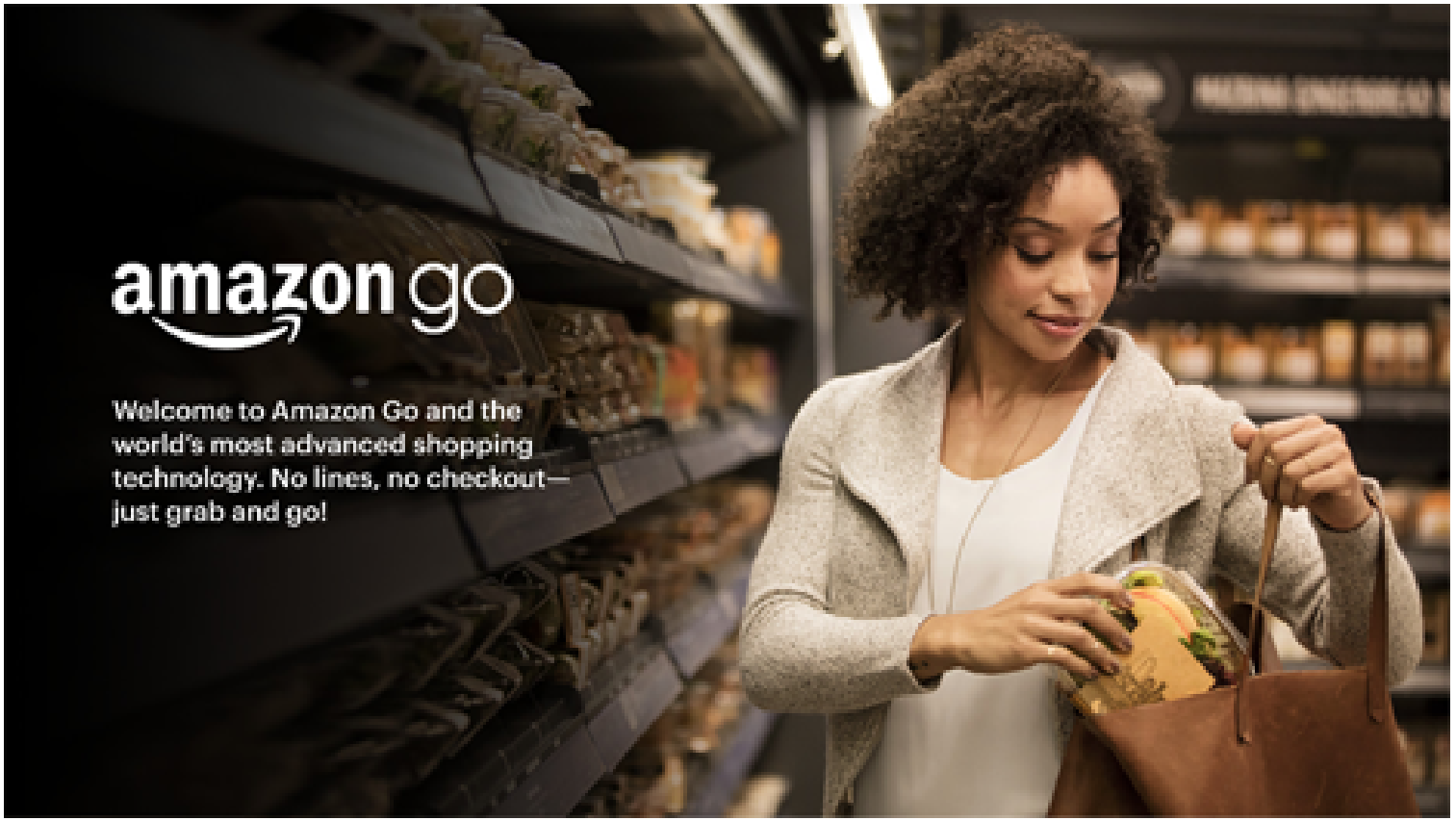
Extracting features and recognizing pattern

Application of DL

AMAZONGO

Automobile

AMAZONGO

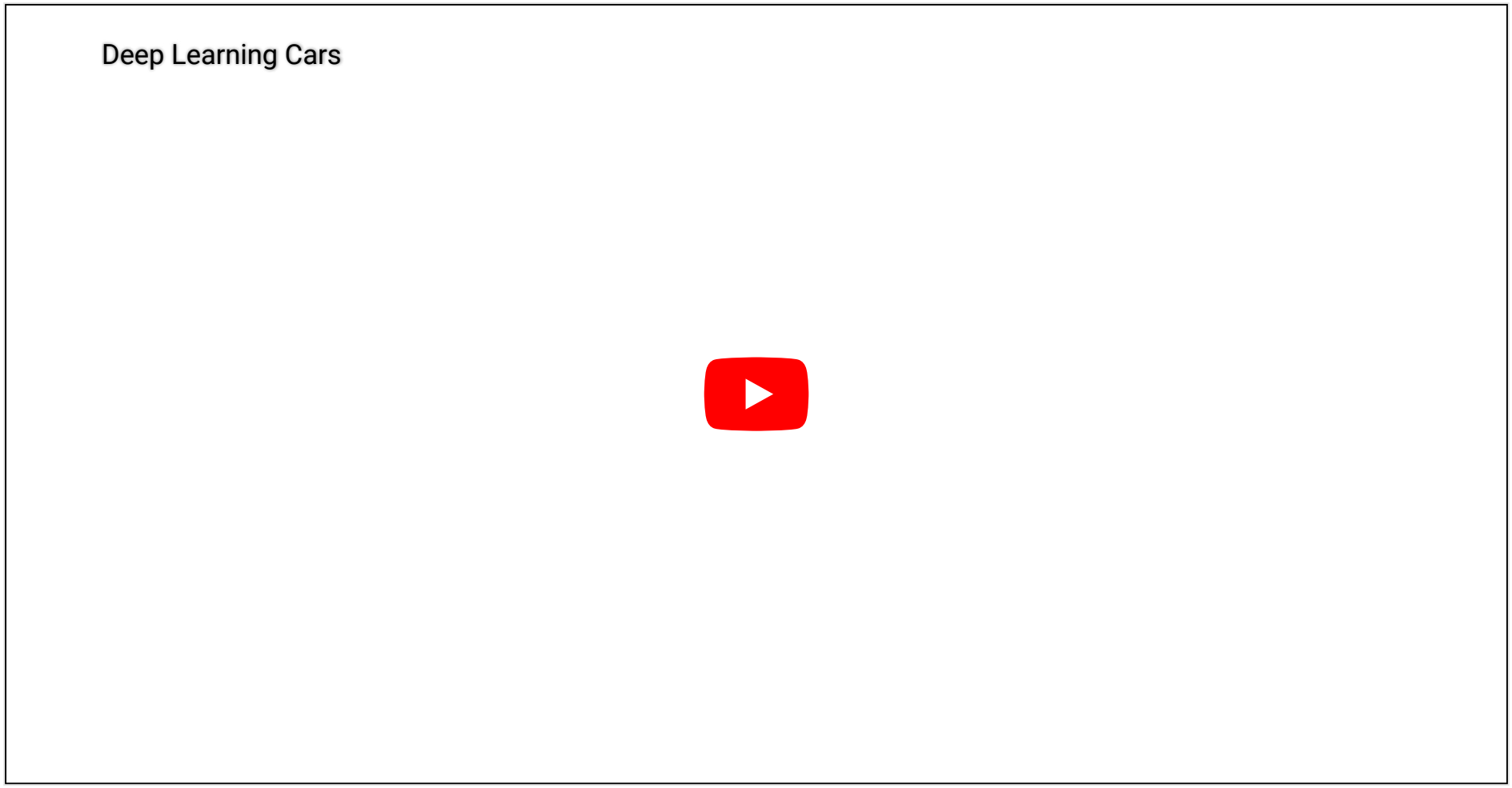


https://youtu.be/NrmMk1Myrxc

Automobile

https://youtu.be/tlThdr3O5Qo

Deep learning of automobile

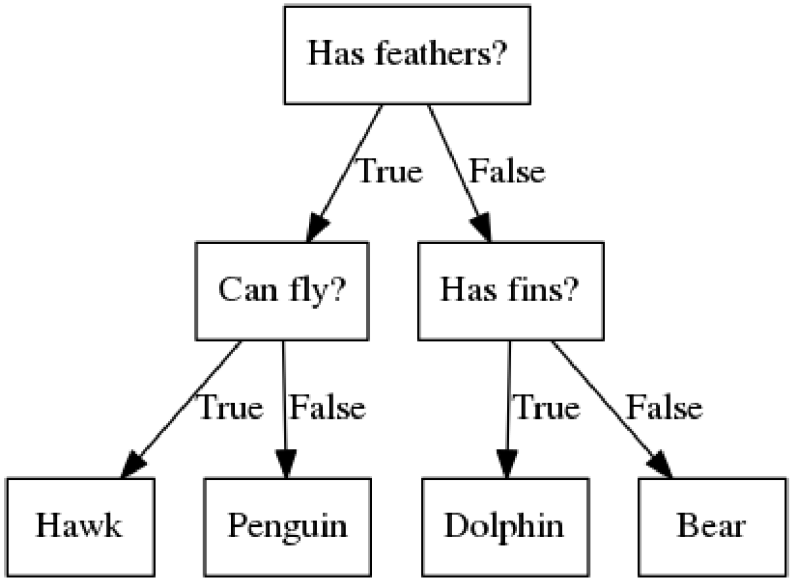


What is AI, Machine learning, and deep learning

AI (1950 ~ 1980)

사람처럼 학습하고 추론할 수 있는 지능을 가진 컴퓨터 시스템을 만드는 기술

모든 규칙을 사람이 프로그래밍



https://kolikim.tistory.com/22

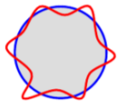
Machine learning (1980 ~ 2010)

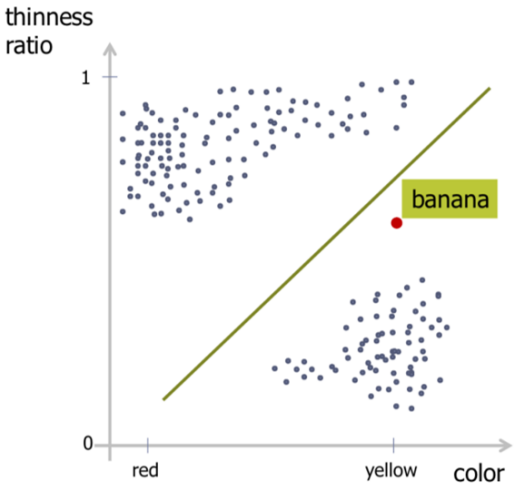
규칙을 일일이 프로그래밍하지 않아도 자동으로 데이터에서 규칙을 학습하는 통계적알고리즘

학습에 사용되는 feature를 사람이 정해 줘야함

$$T = 4\pi\left(\frac{A}{P^2}\right)$$

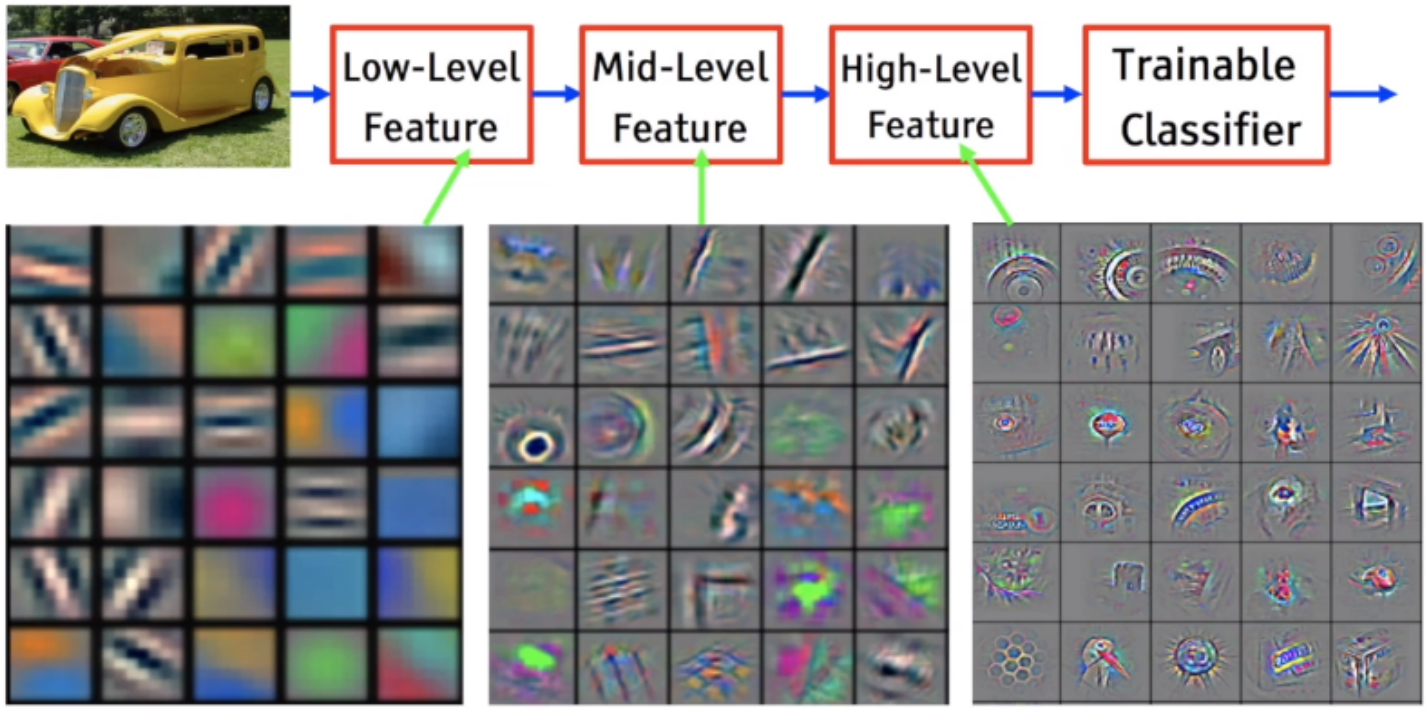
$$4\pi\left(\frac{\pi r^2}{(2\pi r)^2}\right) = 1$$





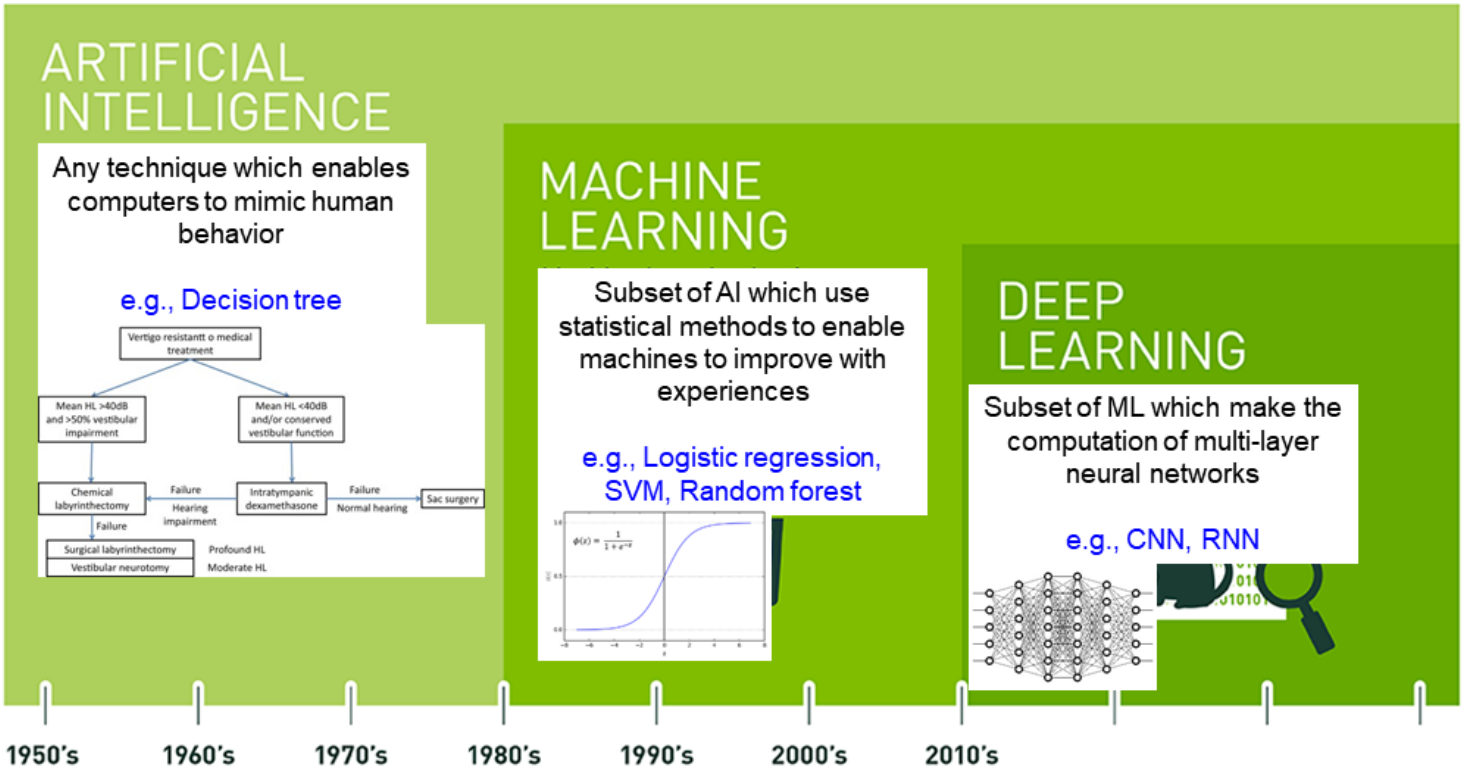
Deep learning (2010 ~)

학습에 사용되는 feature도 인공지능이 결정



https://medium.com/analytics-vidhya/the-world-through-the-eyes-of-cnn-5a52c034dbeb

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

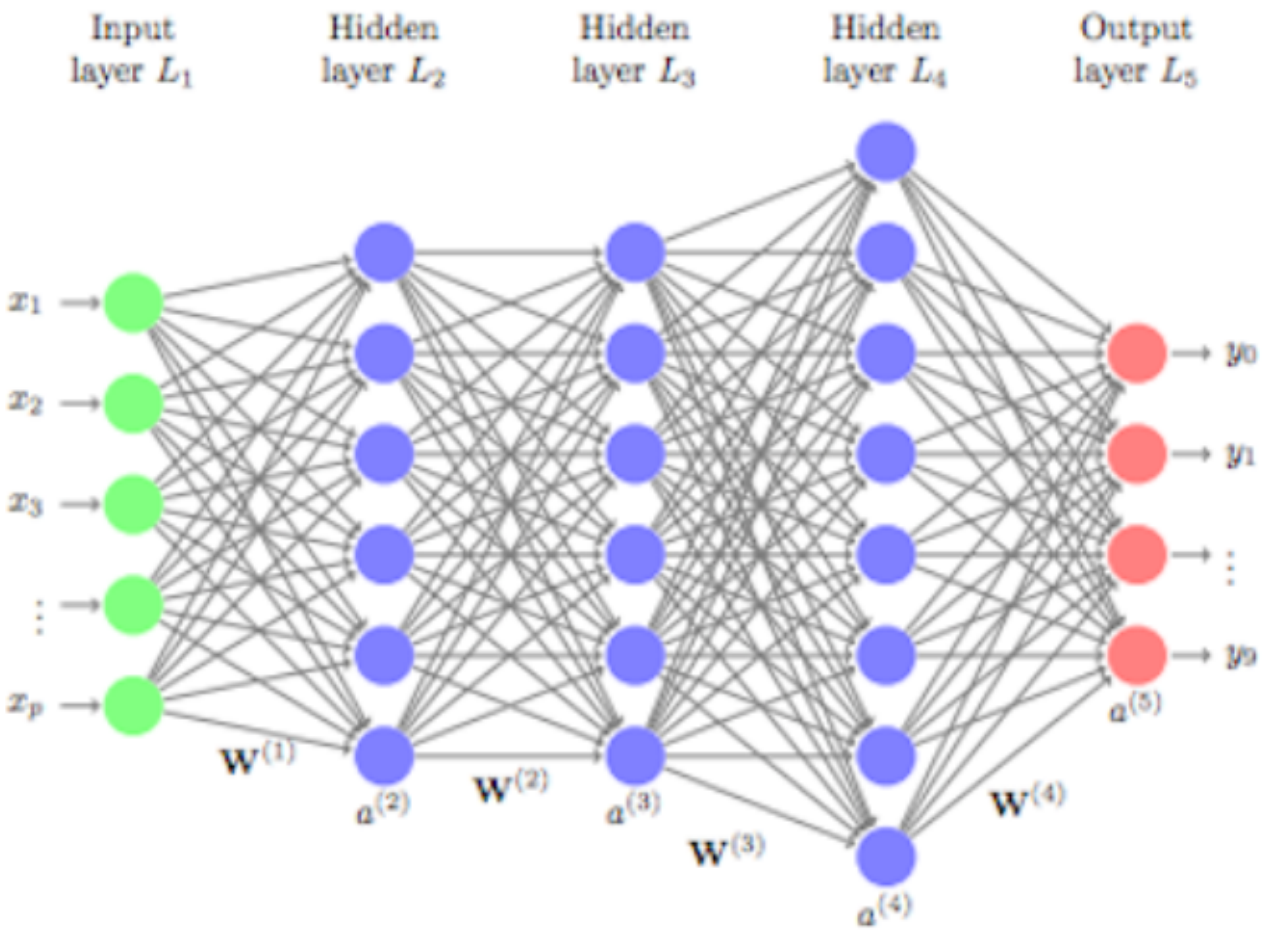
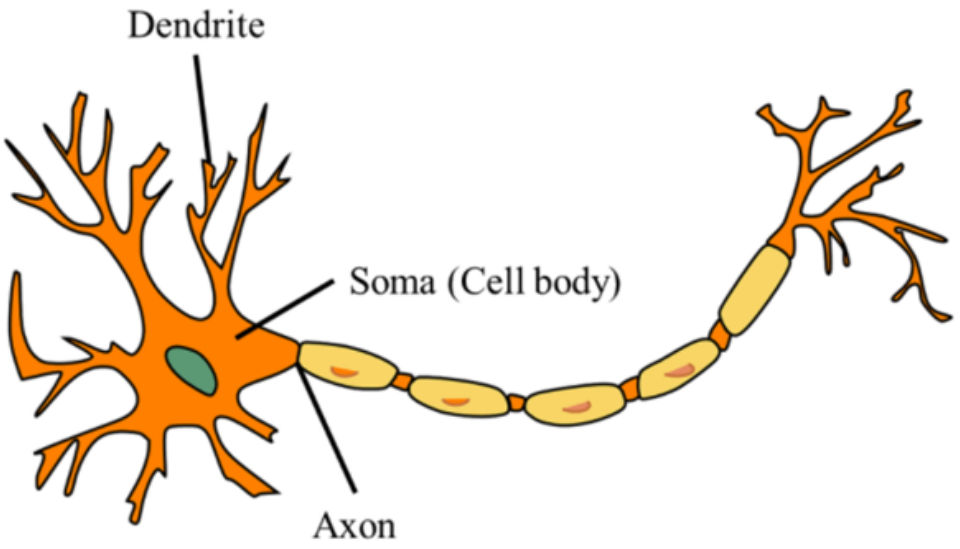
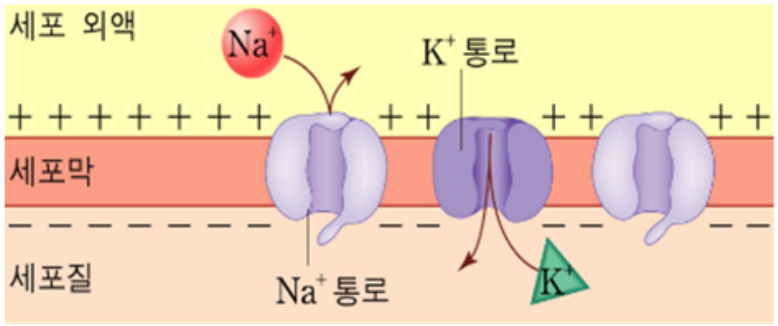
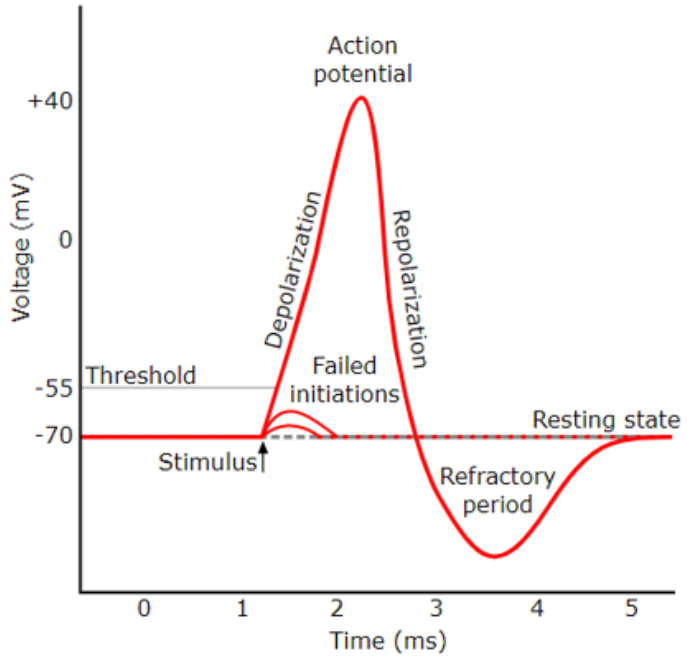


Figure 13.3: Representation of a deep feedforward neural network.

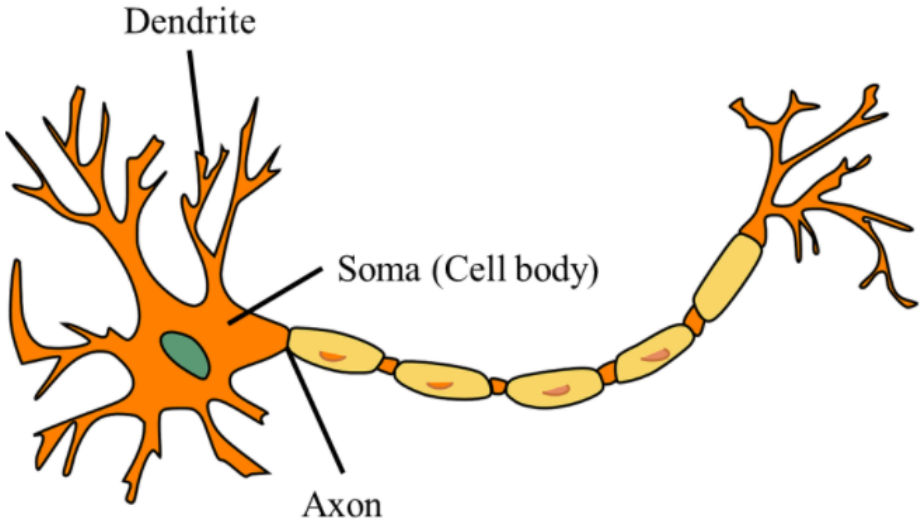
why they are called “Neural network” (인공신경망)?

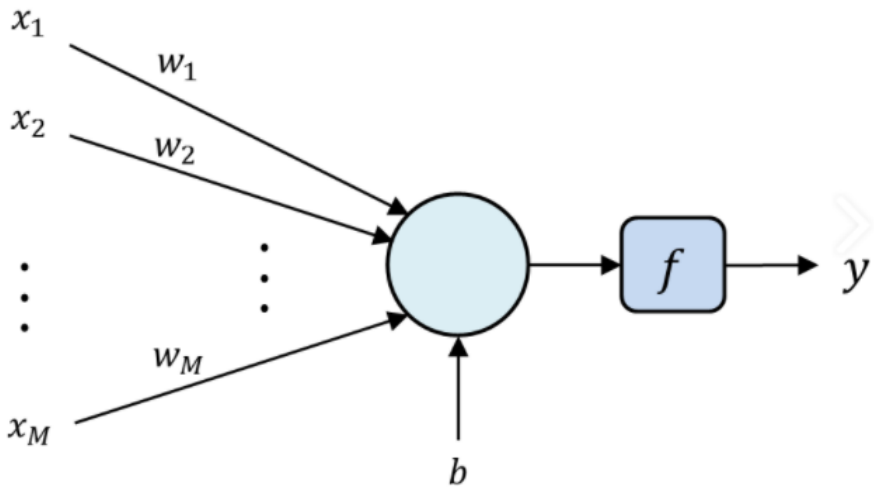






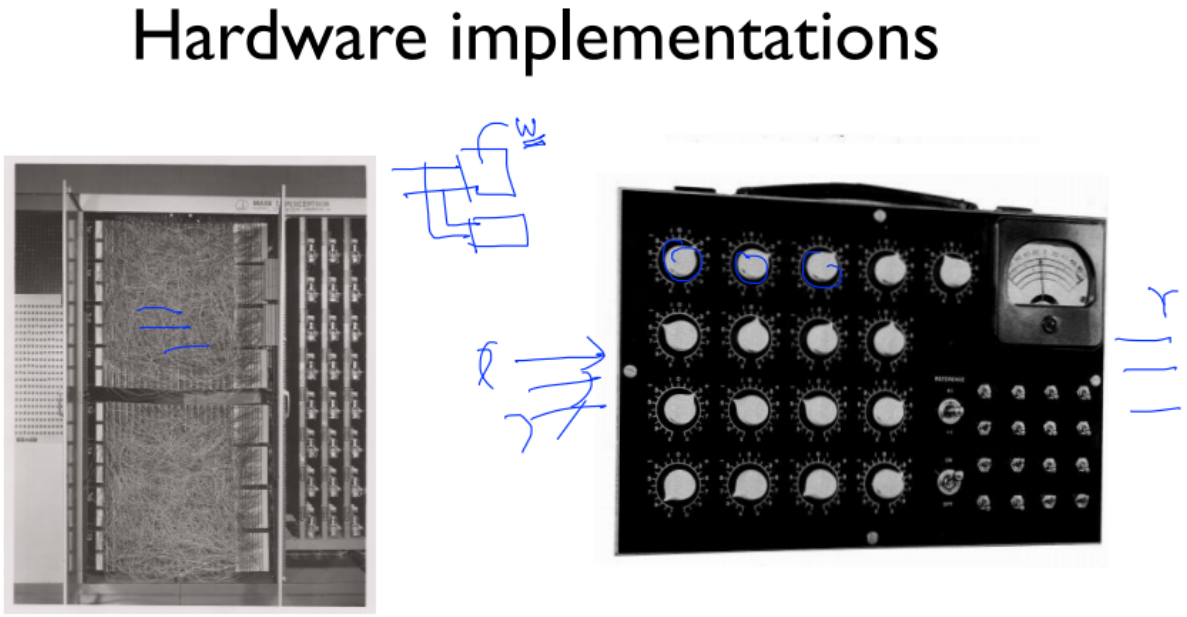
why they are called “Neural network” (인공신경망)?





Hardware implementations

https://hunkim.github.io/ml (모두를 위한 머신러닝과 딥러닝)



https://hunkim.github.io/ml/lec8.pdf

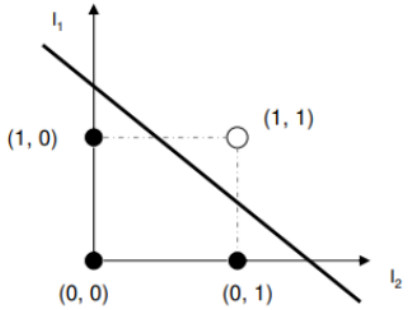
How promising perceptron networks initially

The New York Times has reported in 1958 that "the Navy [has] revealed the embryo of an electronic computer today that it expects will be able to **walk, talk, see, write, reproduce itself and be conscious of its existence.**"

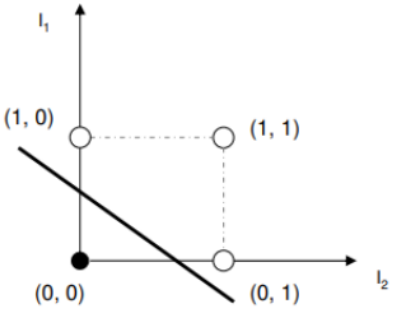
However, its shortcomings were quickly realized, as a single layer of perceptrons alone is **unable to solve non-linear classification problems** (such as learning a simple XOR function)

XOR problem

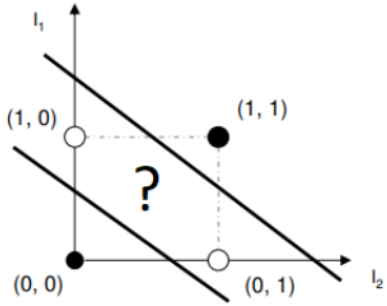
AND		
I_1	I_2	out
0	0	0
0	1	0
1	0	0
1	1	1



OR		
I_1	I_2	out
0	0	0
0	1	1
1	0	1
1	1	1

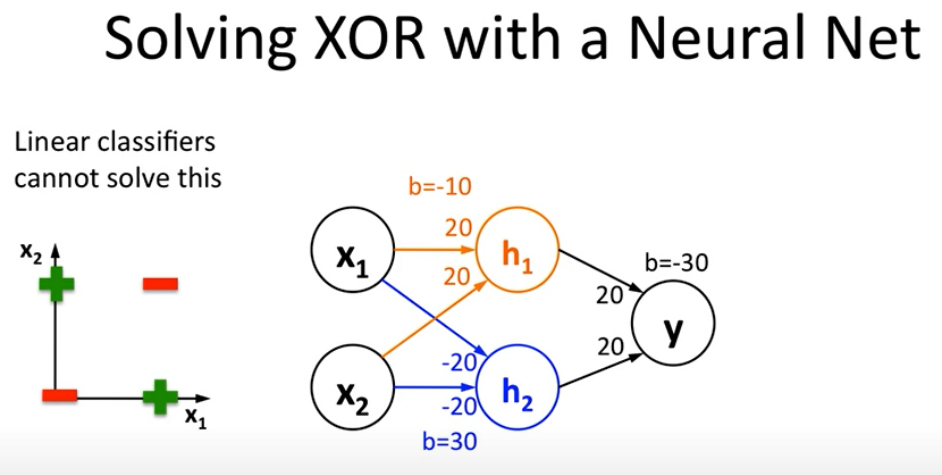


XOR		
I_1	I_2	out
0	0	0
0	1	1
1	0	1
1	1	0



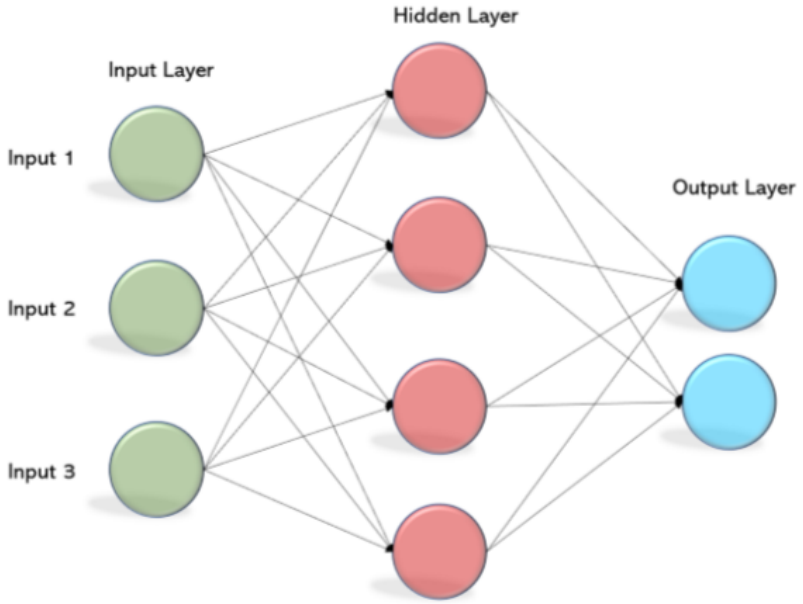
http://www.cs.stir.ac.uk/courses/ITNP4B/lectures/kms/2-Perceptrons.pdf

Multi-layer neuronal network (perceptron)



http://www.cs.stir.ac.uk/courses/ITNP4B/lectures/kms/2-Perceptrons.pdf

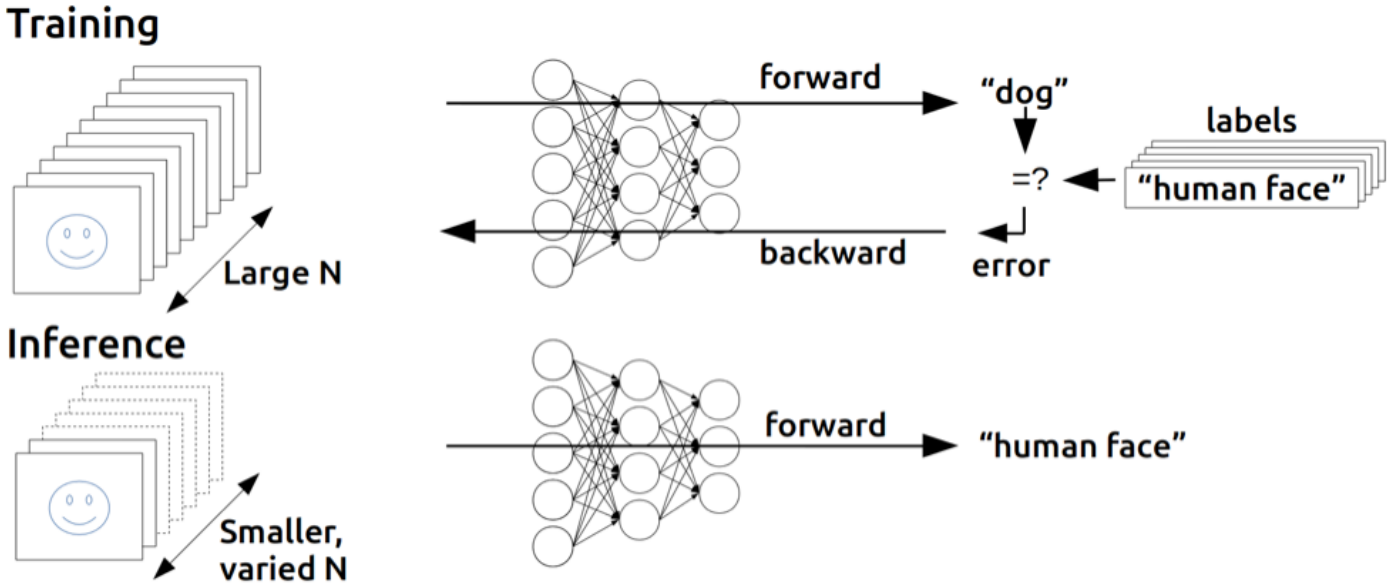
Learning problem of multi-layer NN



http://www.cs.stir.ac.uk/courses/ITNP4B/lectures/kms/2-Perceptrons.pdf

Solving the problem by Backpropagation

1974, 1982 by Paul Werbos, 1986 by Hinton



https://developer.nvidia.com/blog/inference-next-step-gpu-accelerated-deep-learning/

Derivatives of cost function of logistic regression

Let's see the cases of cost function of logistic regression
This equation does not have a closed-form solution

$$J(\theta) = -\frac{1}{m}\sum_{i=1}^{m}[y_i log(h_\theta(x_i)) + (1-y_i) log(1-h_\theta(x_i))$$

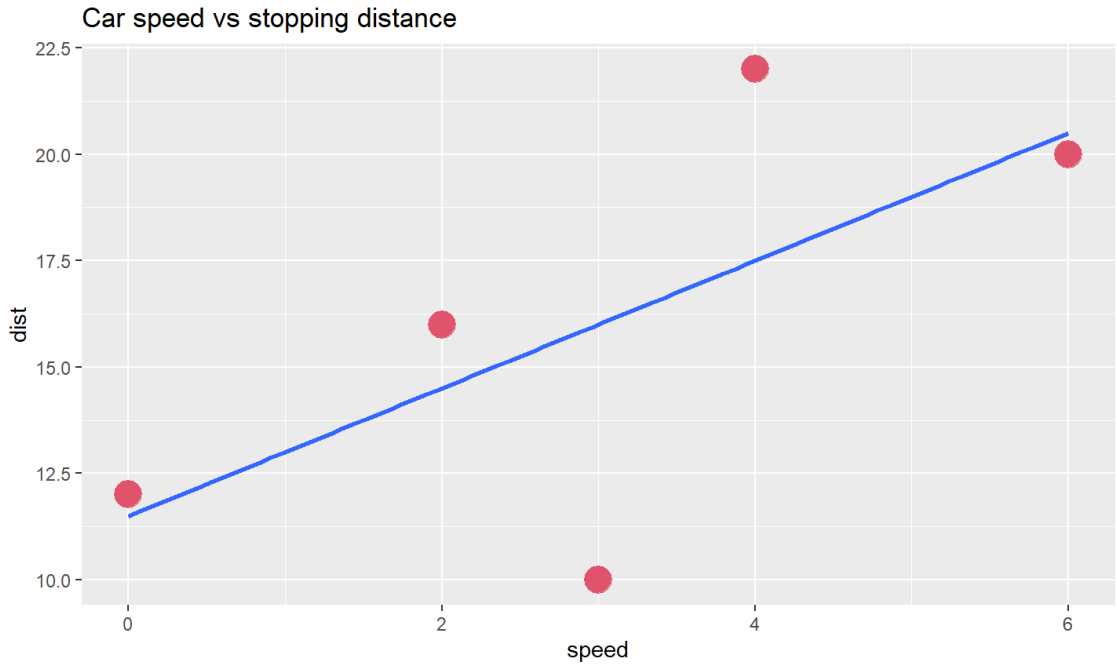
where, $h_\theta(x_i) = \frac{1}{1+e^{-\theta x}}, \quad y \in 0, 1$

The concept of gradient descent (GD) algorithm

```
# A tibble: 5 x 2
  speed  dist
  <dbl> <dbl>
1     0    12
2     2    16
3     3    10
4     6    20
5     4    22
```

```
(Intercept)       speed
       11.5         1.5
```

```
[1] "Sum of squard error =  59"
```



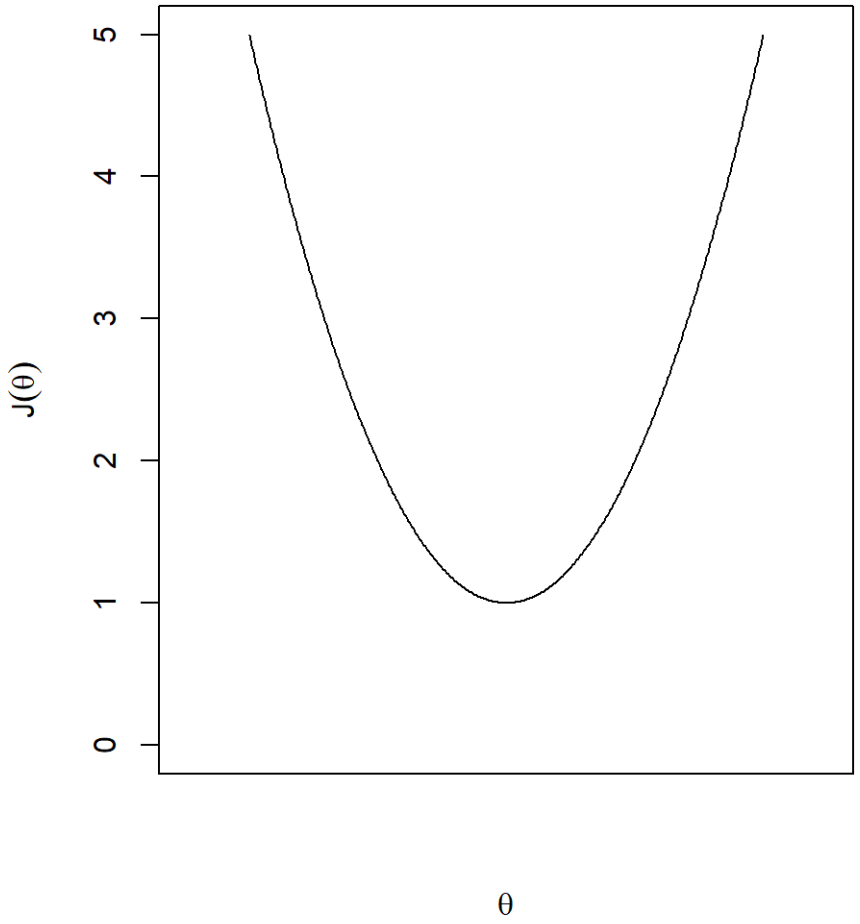
Gradient descent (GD) algorithm

Objective (cost) function =
$J(\theta) = \frac{1}{2m} \sum_{i=1}^{m} (h_\theta(x_i) - y_i)^2$
$= \frac{1}{2m} \sum_{i=1}^{m} (y_i - h_\theta(x_i))^2$

Parameter update :
Repeat until convergence {

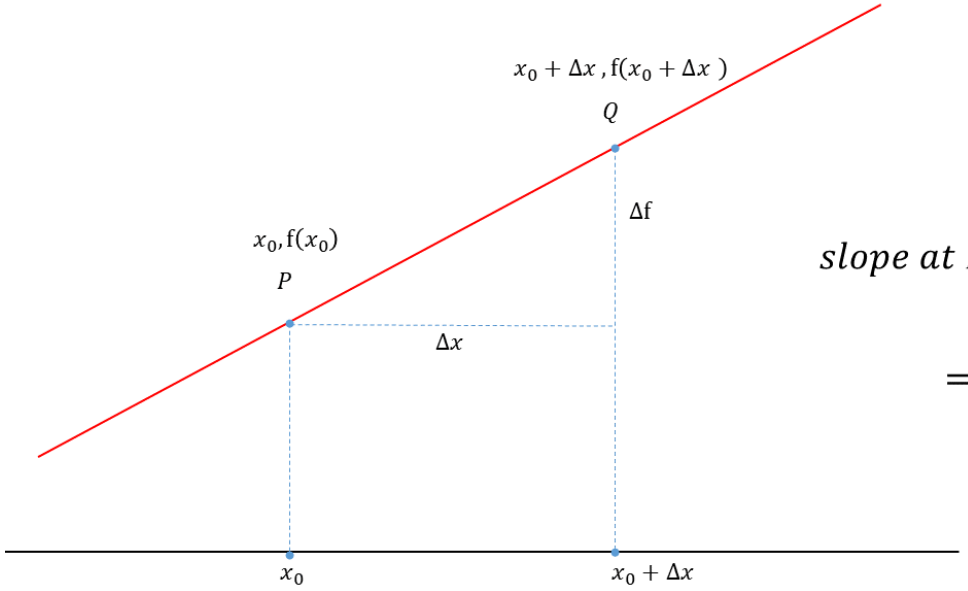
$\theta_j^{(n+1)} = \theta_j^{(n)} - \gamma \frac{\partial}{\partial \theta_j} J(\theta^{(n)})$

}



What is a derivative?

Geometric interpretation



$$slope\ at\ P = \lim_{\Delta x \to 0} \frac{\Delta f}{\Delta x} ,$$

$$= \lim_{\Delta x \to 0} \frac{f(x_0+\Delta x)-f(x_0)}{\Delta x}$$

$$f'(x) = \frac{\partial f}{\partial x} = \frac{\partial y}{\partial x} = \frac{\partial}{\partial x} f = \frac{\partial}{\partial x} y$$

Derivative of 1/x

$$\frac{\partial}{\partial x}\frac{1}{x} = -\frac{1}{x^2}$$

$$e.g., \frac{\partial}{\partial x}\frac{6}{x} = ?$$

Derivative of x^n

$$\frac{\partial}{\partial x} x^n = n x^{n-1}$$

$$e.g., f(x) = 6x^3 - 4x + \pi, \quad \frac{\partial}{\partial x} f(x) =$$

Composition rule of derivatives

$$\frac{\partial y}{\partial t} = \frac{\partial y}{\partial x}\frac{\partial x}{\partial t}$$

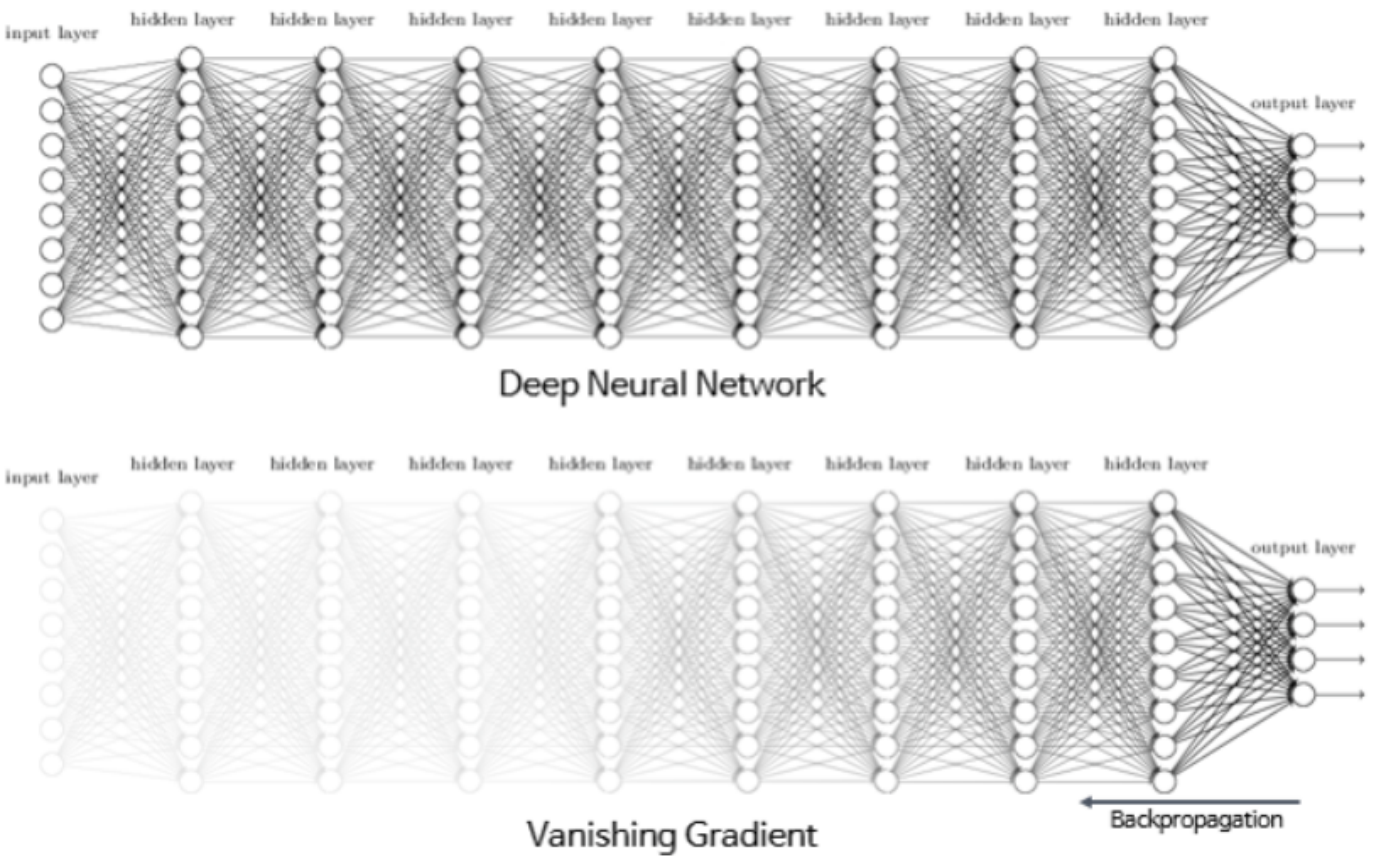
where, y is a function of x and x is a function of t

Derivatives of sigmoid function

$$\frac{\partial}{\partial x} \frac{1}{1+\exp^{-x}}$$

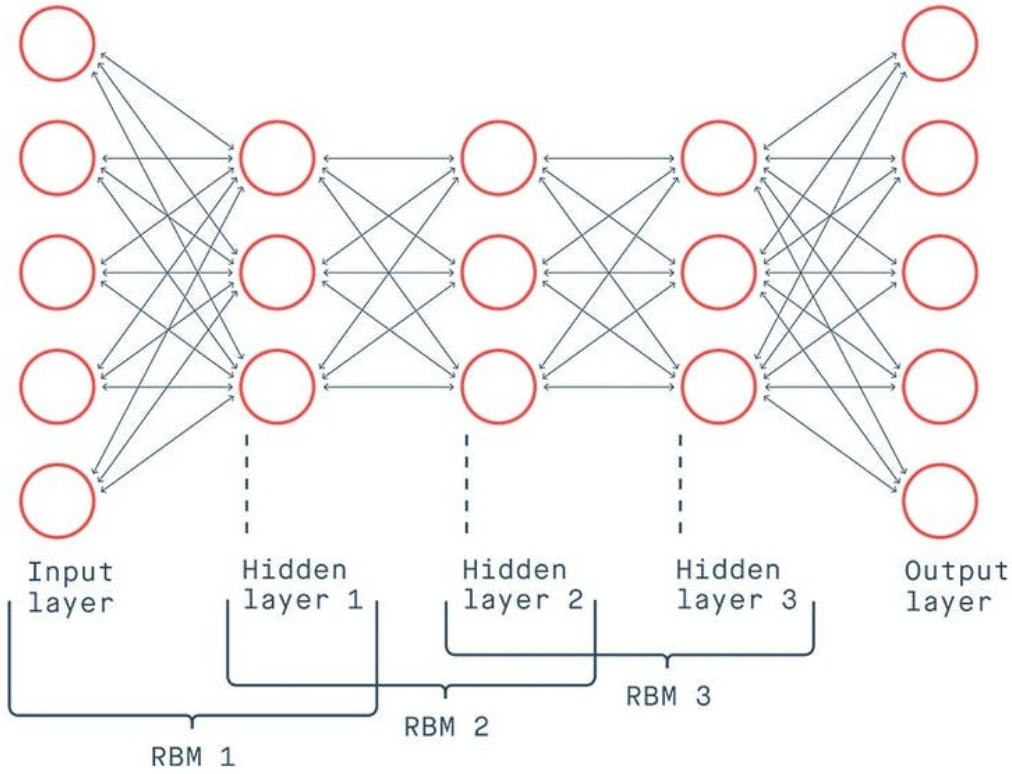
Backpropagation algorithm

Vanishing gradient



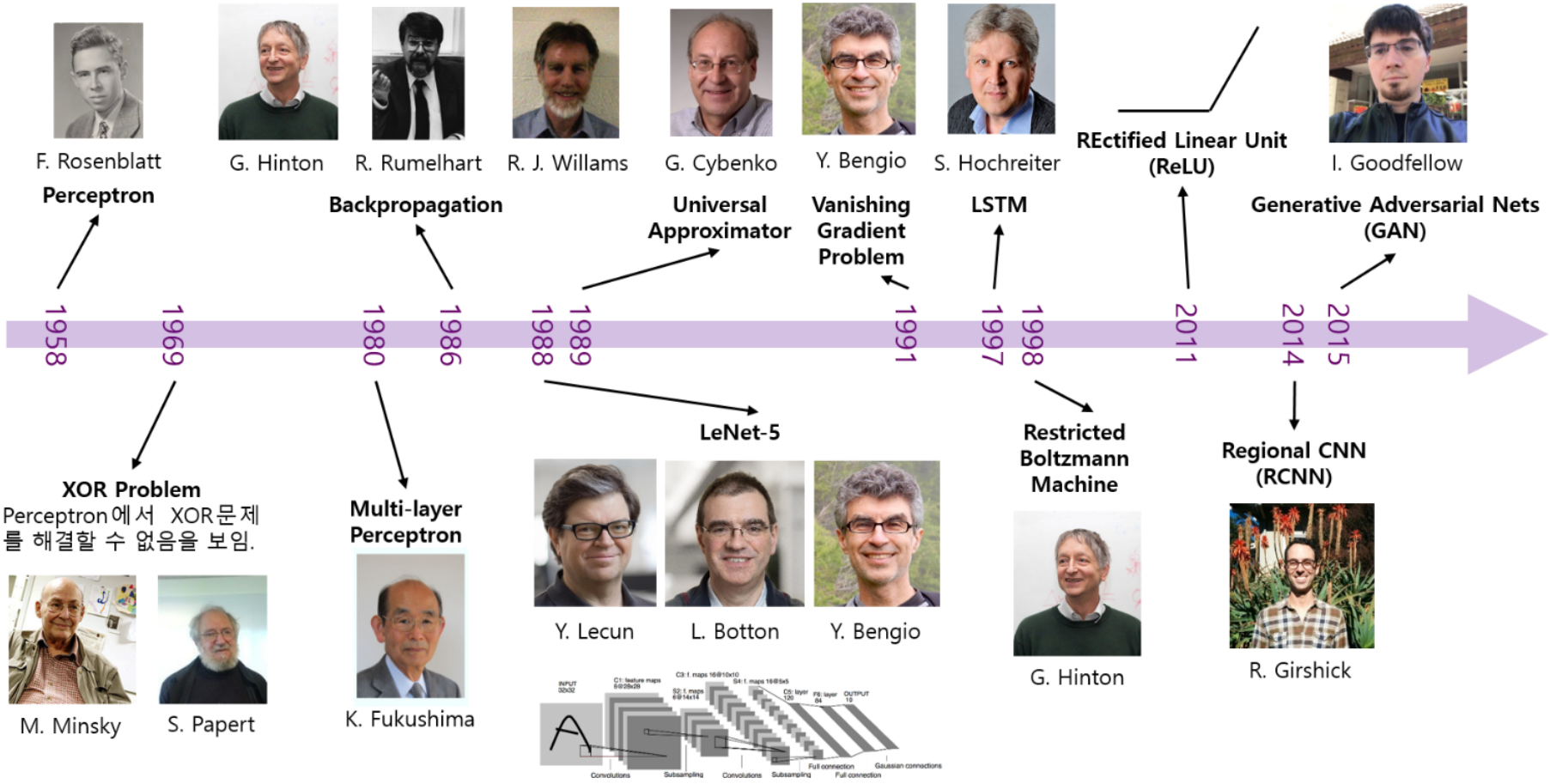
https://trendy00develope.tistory.com/37

Deep belief nets (G. Hinton, 2006)



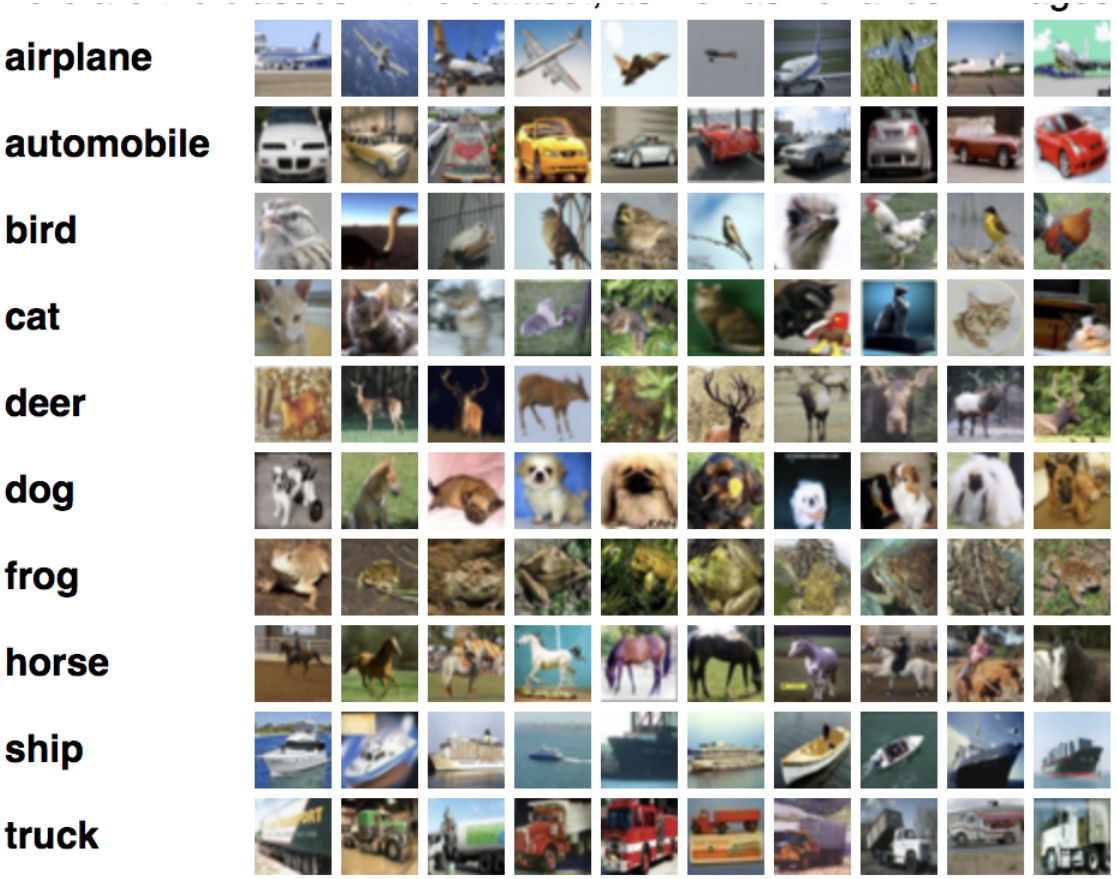
https://www.analyticsvidhya.com/blog/2022/03/an-overview-of-deep-belief-network-dbn-in-deep-learning/

Deep Learning history



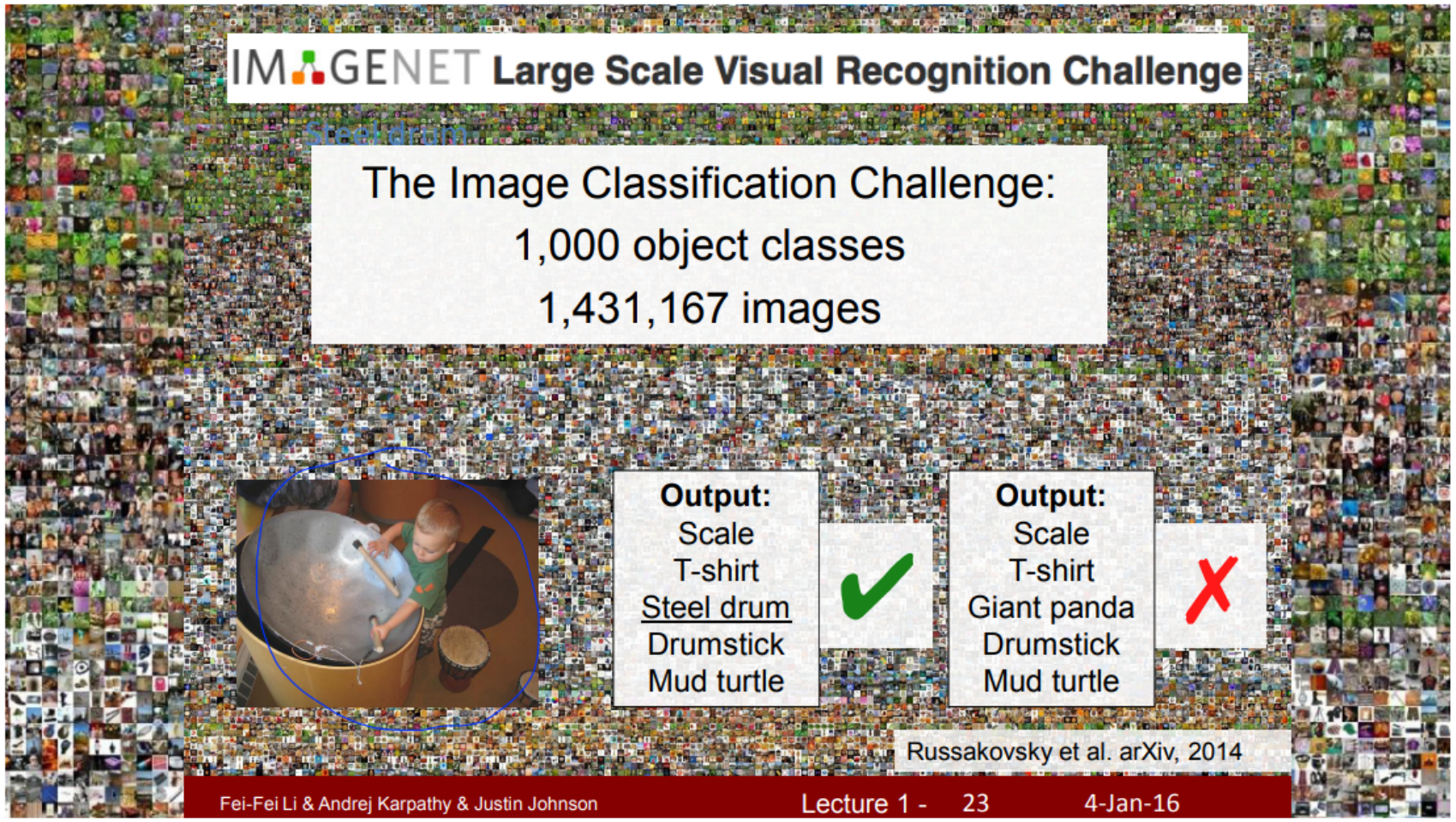
https://yjjo.tistory.com/4

Image classification



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

Image classification



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

Image classification

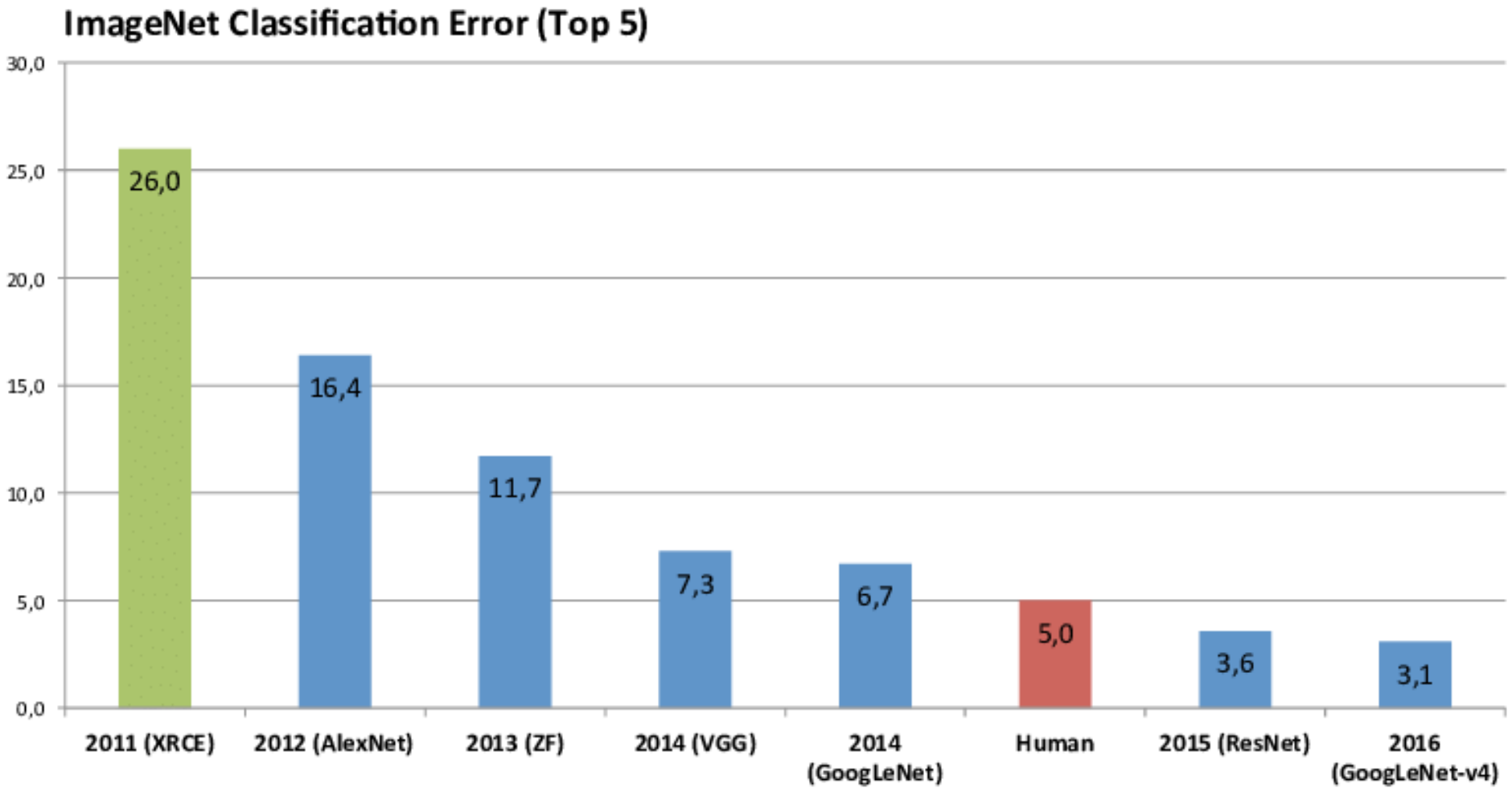
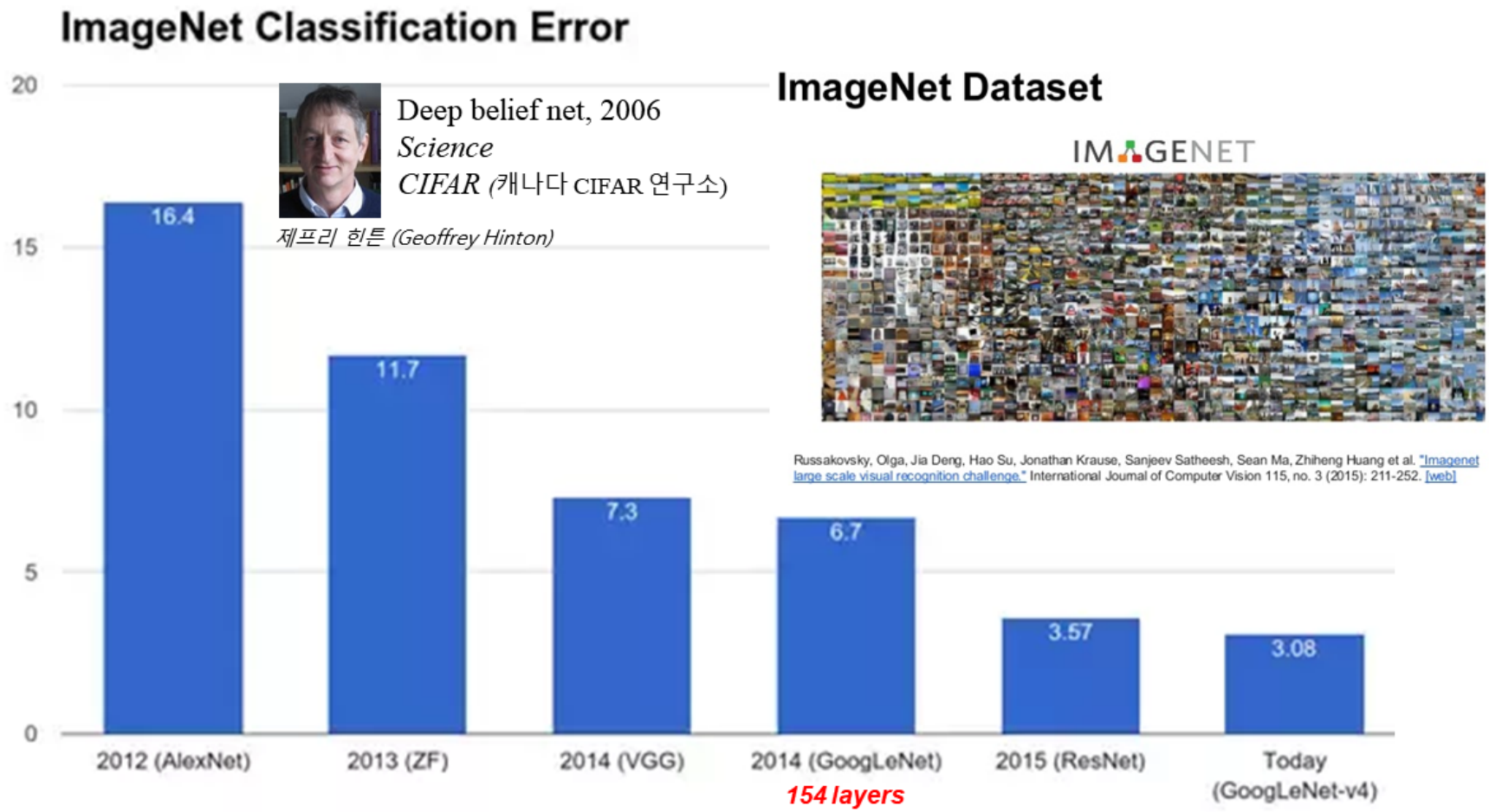
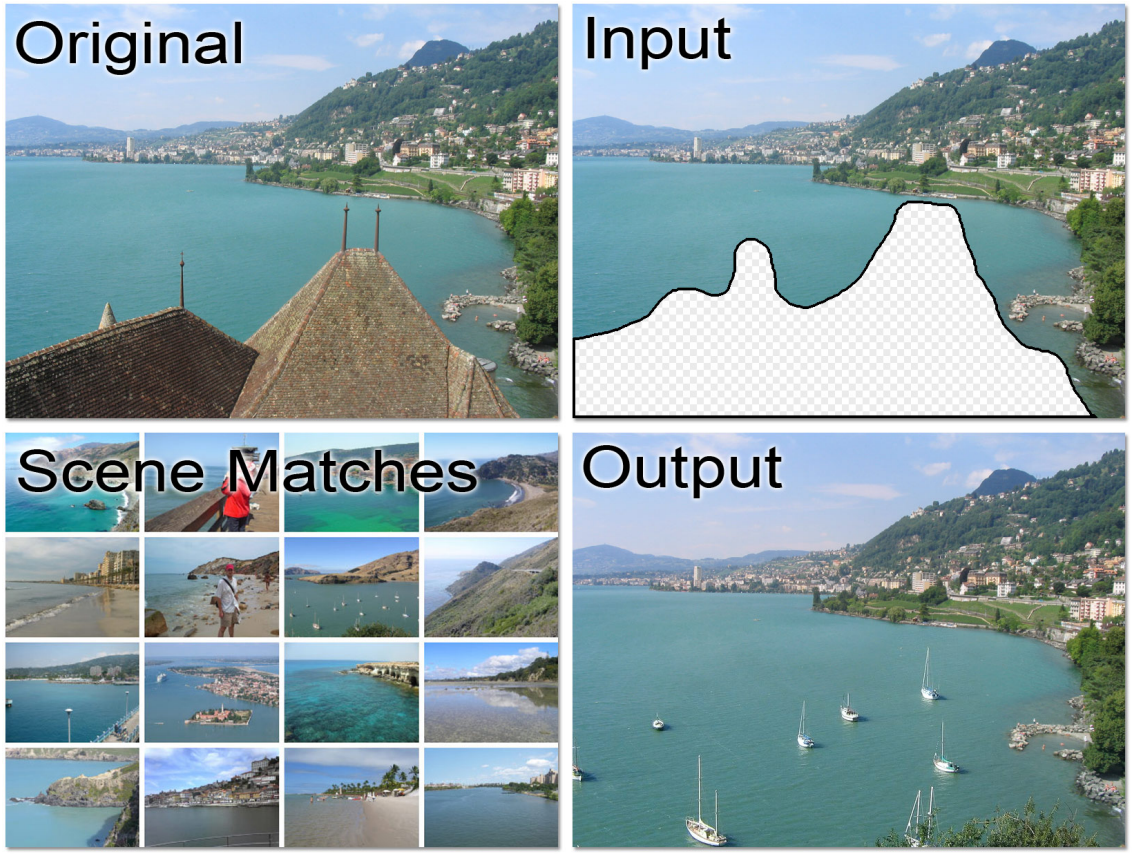


Image classification



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.

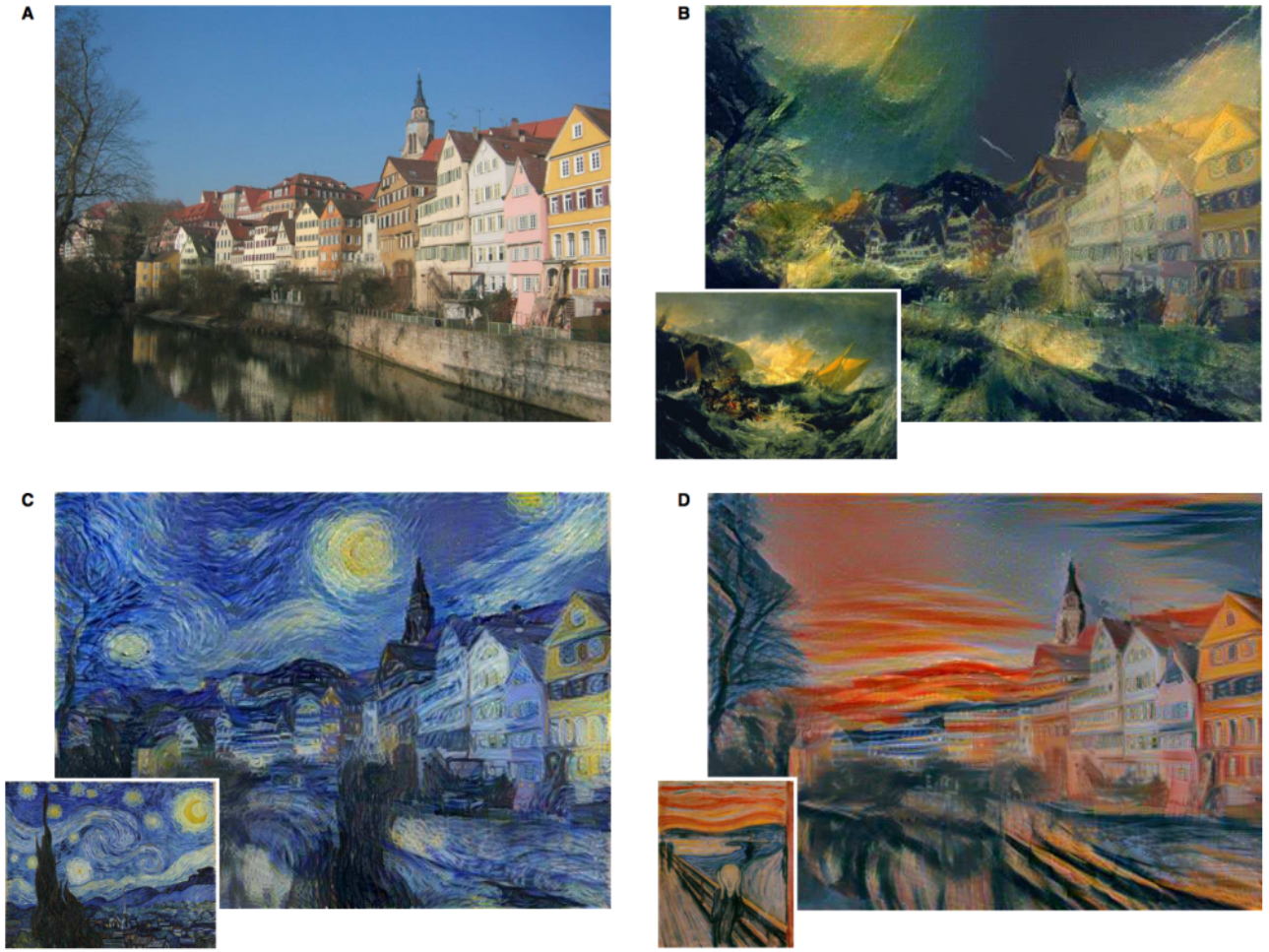
Motion tracking

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

Deep fake

전 미대통령 버락 오바마(Barack Obama)

Style Transfer

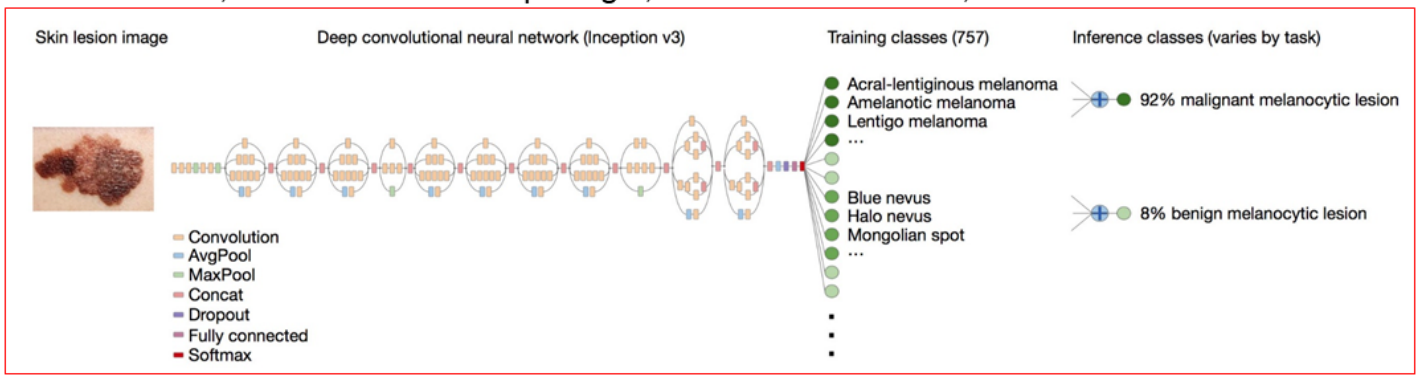


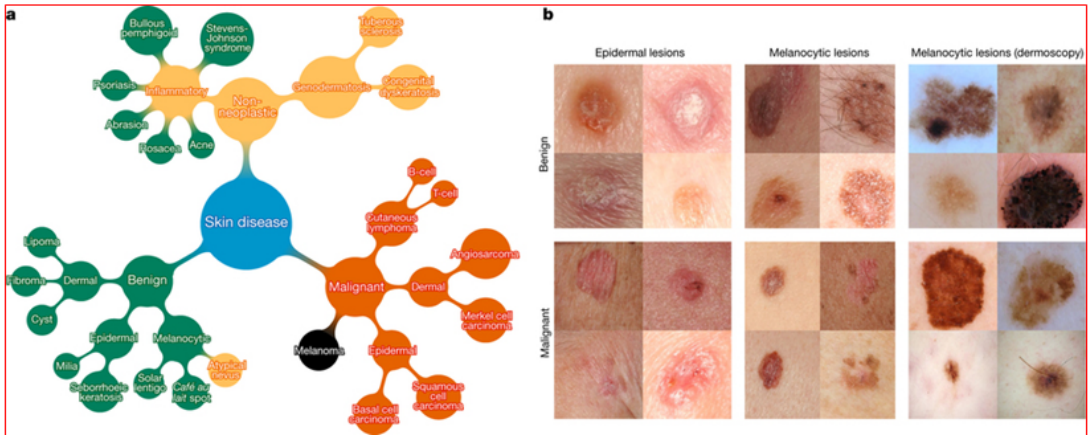
https://sunniesuhyoung.github.io/DST-page/

Skin cancer diagnosis

Dermatologist-level classification of skin cancer

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

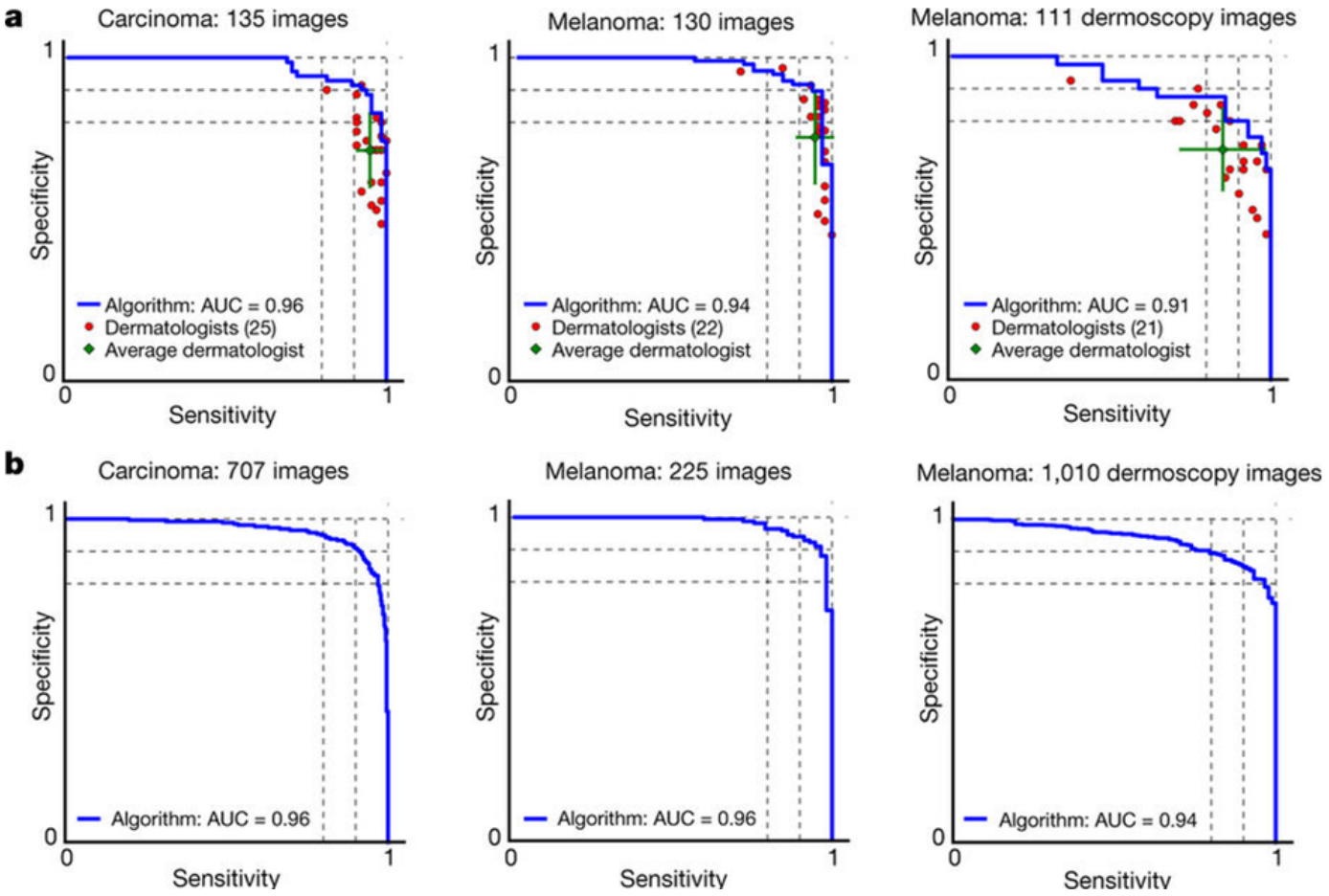




Esteva et al., Nature, 2017

Skin cancer diagnosis

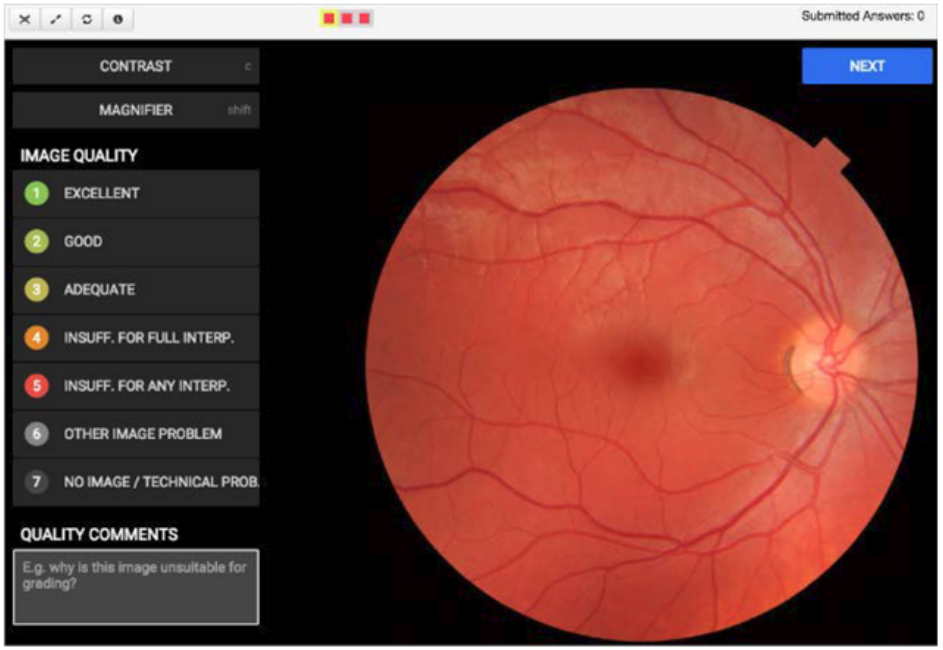
The deep learning CNN outperforms the average of the dermatologists at skin cancer classification



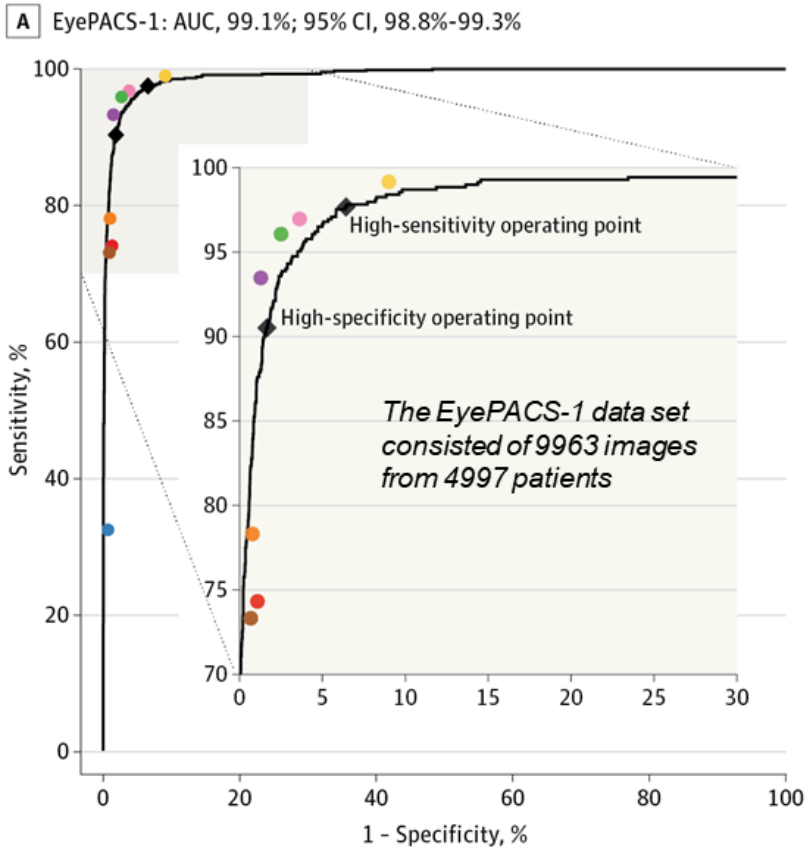
Esteva et al., Nature, 2017

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

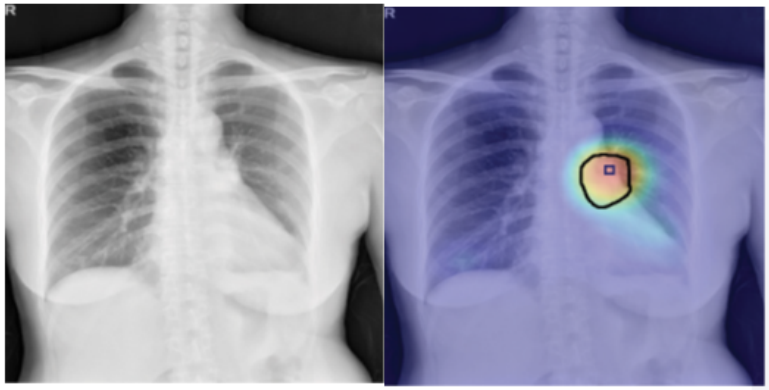


Gulshan et al., *JAMA*, 2016

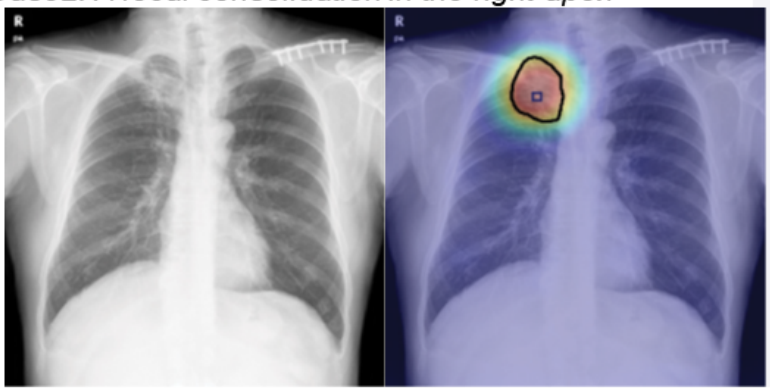
가슴 x-ray diagnosis

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

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



Case2. A focal consolidation in the right apex



SEOUL NATIONAL UNIVERSITY HOSPITAL, APRIL 2017

THE ACCURACY OF OUR ALGORITHM IS HIGH

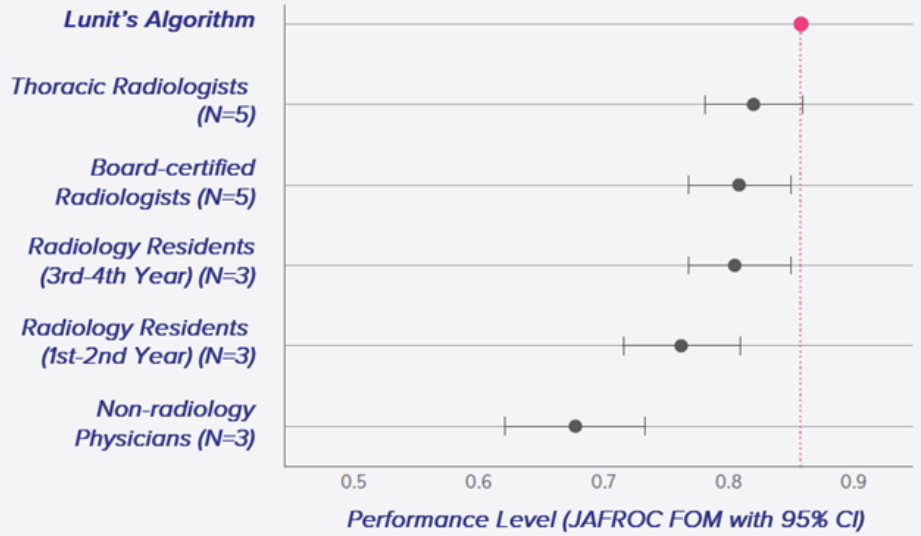


FIGURE 1. The accuracy of our algorithm was shown to be very high, comparable to that of thoracic radiologists (or likely even higher).

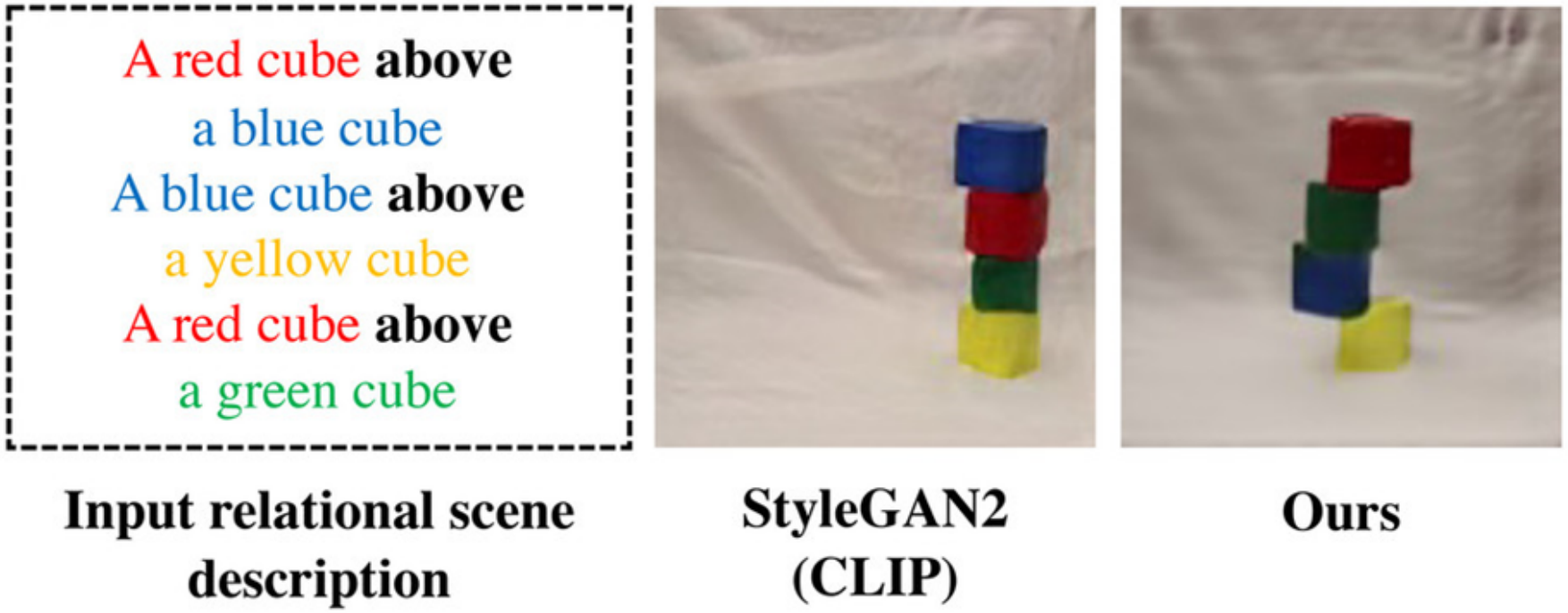
https://insight.lunit.io

Nvidia 고해상도 영상생성

-美타임이 선정한 '2021생활 방식을 바꾸는 100가지 혁신'에 선정된 '5가지 인공지능' 솔루션

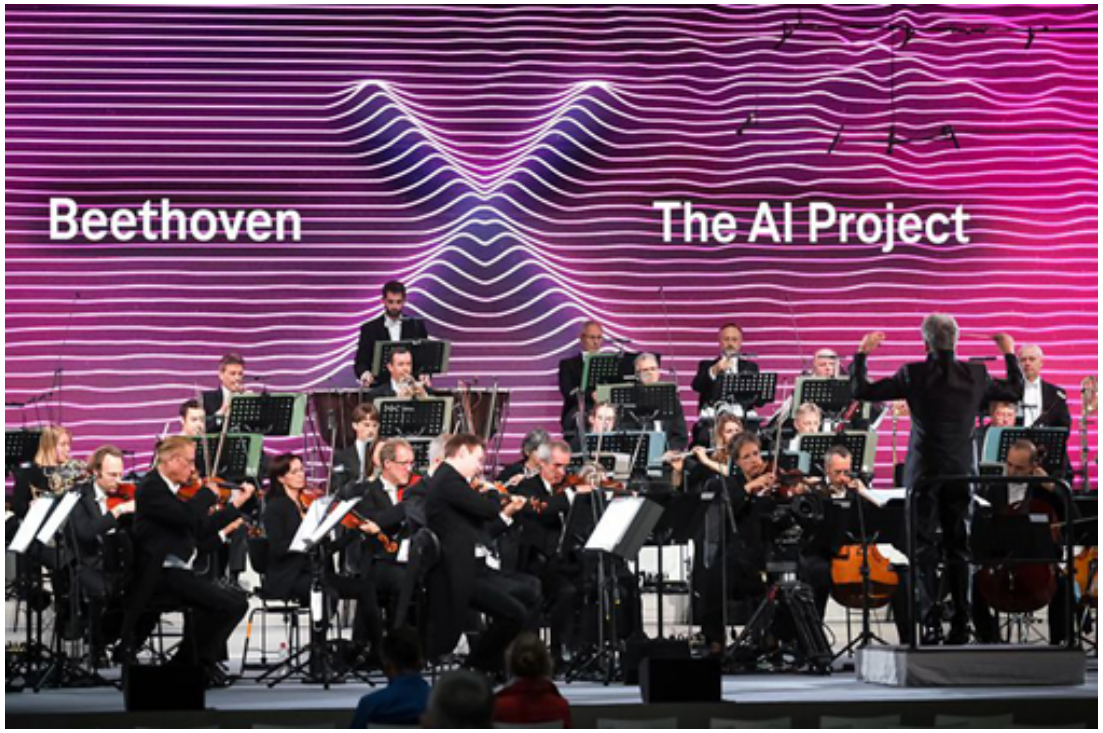
사람처럼 객체 관계를 이해하는 인공지능 개발

예를 들어, 부엌에서 누군가를 돕기 위해 설계된 서비스 로봇은 “스토브 왼쪽에 있는 주걱을 들어 도마 위에 올려놓으십시오!”와 같은 명령을 따르는 데 객체 간 관계에 대한 이해부족으로 작업을 진행할 수 없다.



창작과 예술의 경지에 오른 인공지능. 베토벤 미완의 **10**번 교향곡 완성

불행히도 루트비히 판 베토벤(Ludwig van Beethoven. 1770~1827) 그의 10번째 교향곡을 완성할 수 없었다. 그가 운명할 당시에는 교향곡과 관련된 몇 가지 음표와 악보 스케치만 남았을 뿐이다.



DALL·E 2 is a new AI system that can create realistic images and art from a description in natural language.

https://openai.com/dall-e-2/

입력 제시어로 빠르게 고품질 이미지 만드는 'AI 아티스트'

카카오브레인, '칼로 1.0' 오픈소스로 공개

GPT-3 예제

GPT-3 예시: 상식 Q&A

Q. '파우스트'는 누가 썼죠?

A. 요한 볼프강 폰 괴테가 '파우스트'를 썼습니다.

Q. 파이널판타지6의 마지막 보스가 누구죠?

A. Kefka Palazzo가 파이널판타지6의 마지막 보스입니다.

Q. "Fernweh"가 무슨 뜻이죠?

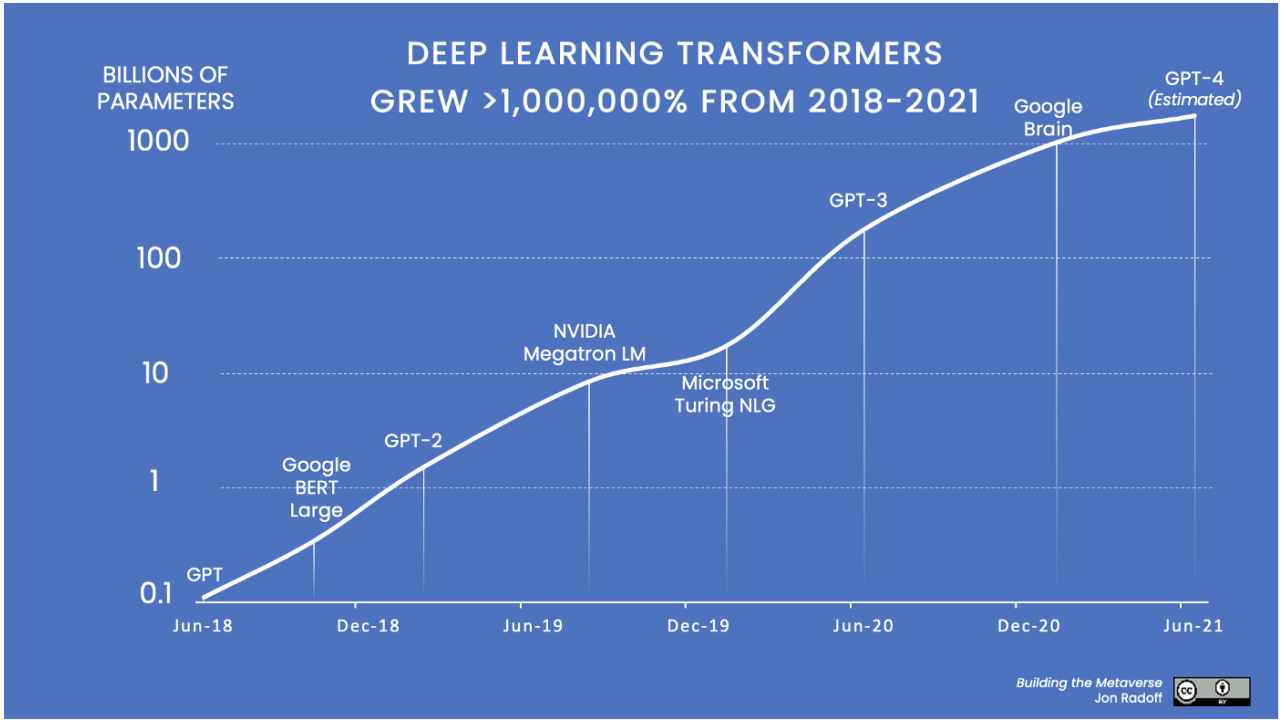
A. "Fernweh"는 아직 가보지 못한 멀리 떨어진 장소를 그리워하는 향수병을 뜻하는 독일어 단어입니다.

* 가는 텍스트는 주어진 컨텍스트이며, 볼드는 GPT-3의 생성 결과입니다.

2023년 AI 업계의 최대 관심사는 ‘GPT-4 (Generative Pre-trained Transformer)’.

‘인간과 구분할 수 없다’. GPT-4가 튜링테스트를 통과

GPT3: 1750억 개 파라메터, GPT-4: 100조 개 파라메터



Computer vision Deep learning

Object detection

Semantic segmentation

Pose estimation

Style transfer

Colorization

Person identification

Text recognition

Depth estimation

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

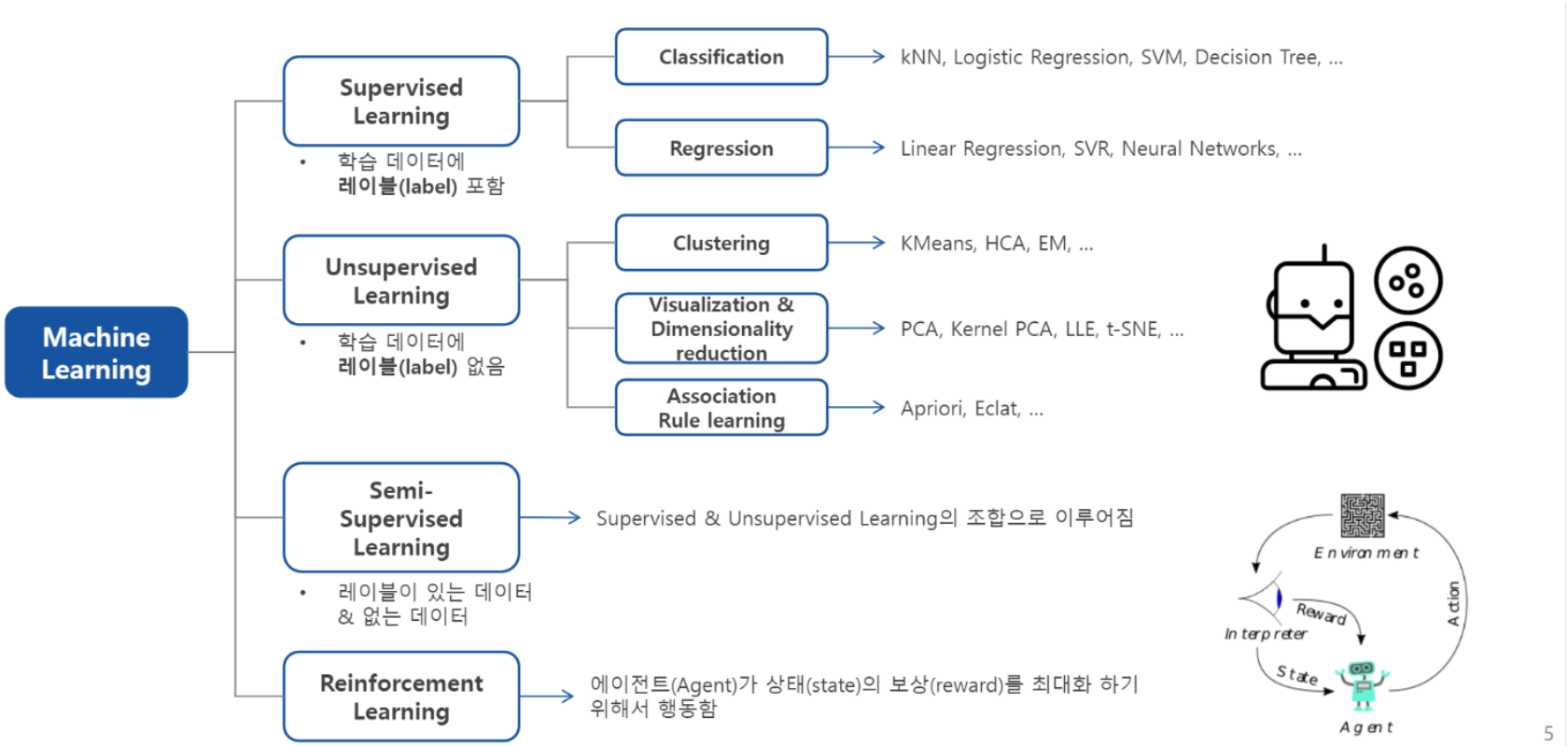
  인공지능 로봇: 청소 로봇, 교육용 로봇, 동반자 로봇, 운송 로봇

  이미지 인식: 페이스북, 구글, 마이크로소프트, 네이버

  개인화 추천: 넷플릭스,구글, 페이스북

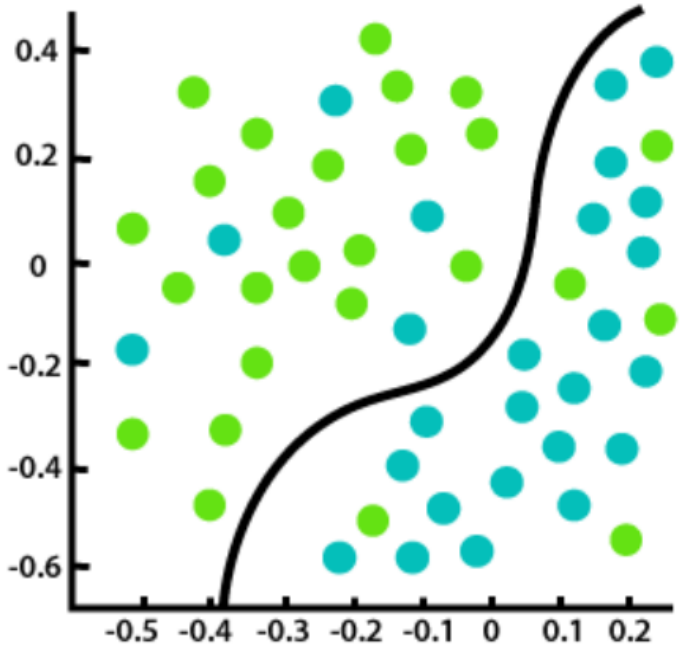
  기계 번역: 구글, 네이버 파파고

학습방법에 따른 분류

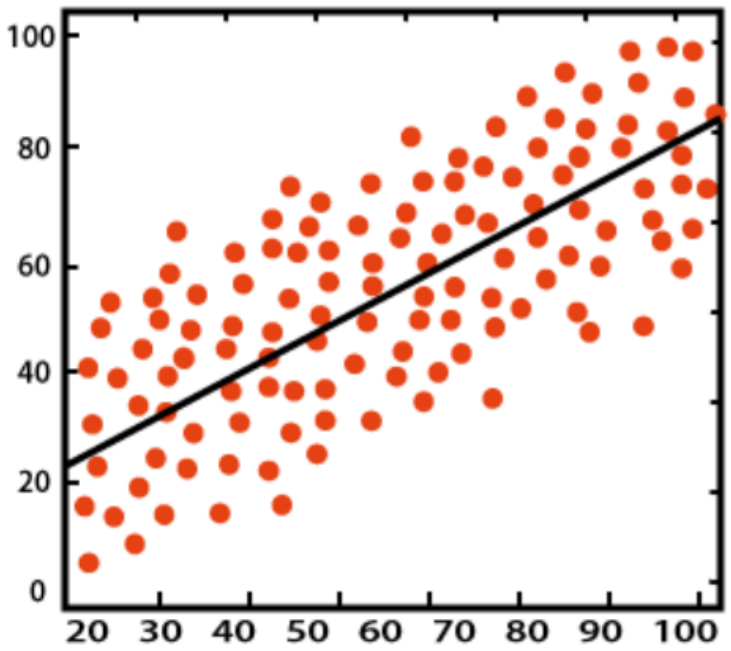


https://github.com/ExcelsiorCJH/Hands-On-ML/blob/master/Chap01-The_Machine_Learning_Landscape

목적변수에 따른 분류



Classification



Regression

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

참고 자료

[Coursera 기계학습] https://www.coursera.org/learn/machine-learning

[Andrew Ng] https://online.stanford.edu/courses/xcs229i-machine-learning

[UBC by Nando de lectures] https://www.cs.ubc.ca/~nando/340-2012/lectures.php

[모두를 위한 머신러닝/딥러닝 강의] http://hunkim.github.io/ml/

혼자서 공부하는 머신러닝 + 딥러닝 (Python code)

딥러닝작업환경 만들기

구글 Colab 구동하기

Anaconda 설치하기