



4차 산업혁명과 AI

-Machine Learning and Deep Learning -

김현민

한국원자력연구원 원자력 ICT 연구부
2018.05.16

Table of Contents

1. Introduction
2. Deep Learning
3. Application of Deep Learning
4. Deep learning in NPPs



KBS '제조업의 귀환, 4차 산업혁명 시대를 연다' (17.04.30)

사물인터넷, 인공지능, 자율주행 등 다양한 4차 산업 기술이 우리의 삶에 성큼 다가왔다.
이에 세계 각국은 4차 산업혁명에 대응하기 위해 만반의 준비를 갖추고 있다.

특히 **독일의 인더스트리4.0**, **미국의 리쇼어링**, **일본의 2016산업재흥계획**, **중국의 제조2025**는
자국 경제성장의 원동력을 제조업에서 찾고 생산성을 높이는 시스템을 구축하고 있다.

국내에서도 산업통상자원부가 2025년까지 스마트팩토리를 3만개 구축하겠다는 계획을 발표했다...

INDUSTRIAL REVOLUTION

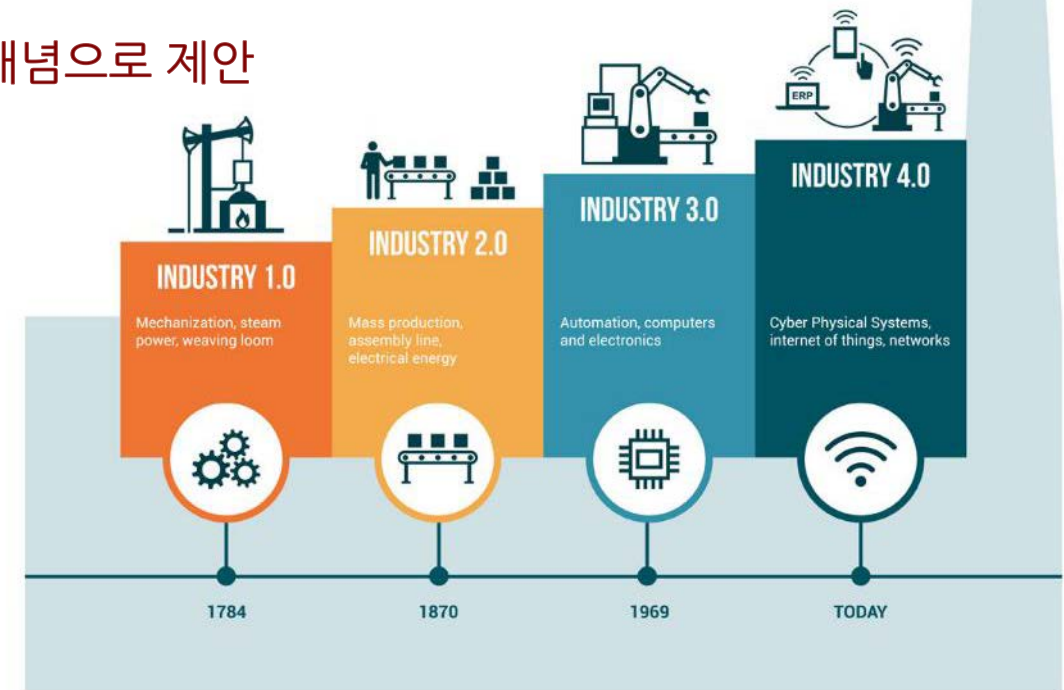
TRANSFORMING INDUSTRIES AND INNOVATION

■ Industry 4.0

- 2010년 독일에서 개념을 제안, **제조업에 집중**
 - 가상 물리 시스템, 지능형 로봇과 기계, 빅데이터, 연결성, 에너지 효율성과 분산화

■ 4th Industrial Revolution

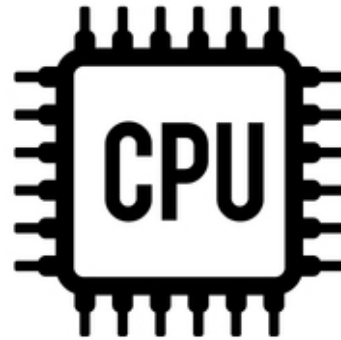
- 2016년 다보스 포럼에서 Industry 4.0 보다 좀 더 **포괄적인 개념으로 제안**
 - 유전자 염기서열분석, 나노기술, 재생가능 에너지, 쿼텀 컴퓨팅



Artificial Intelligence



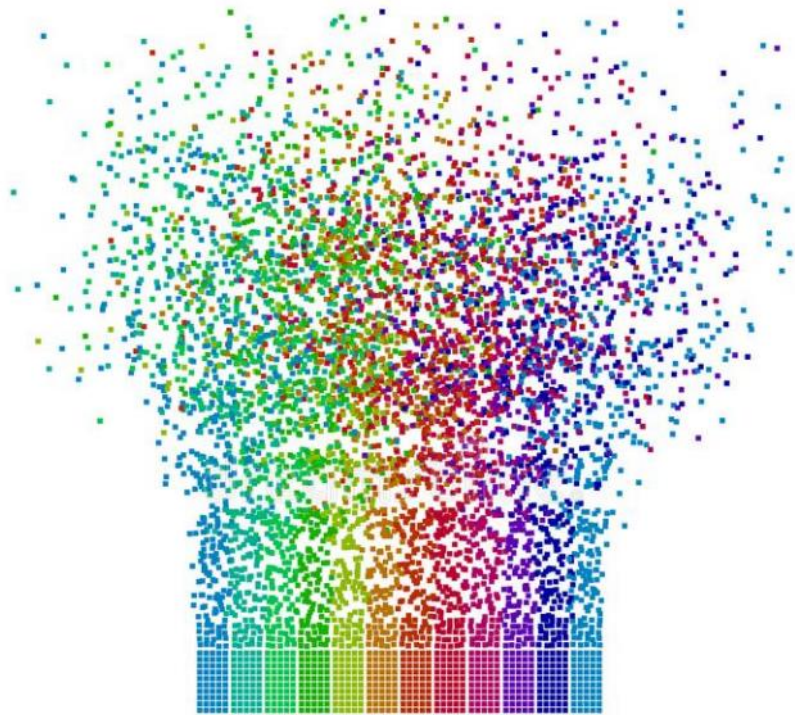
Data



Computing
Power

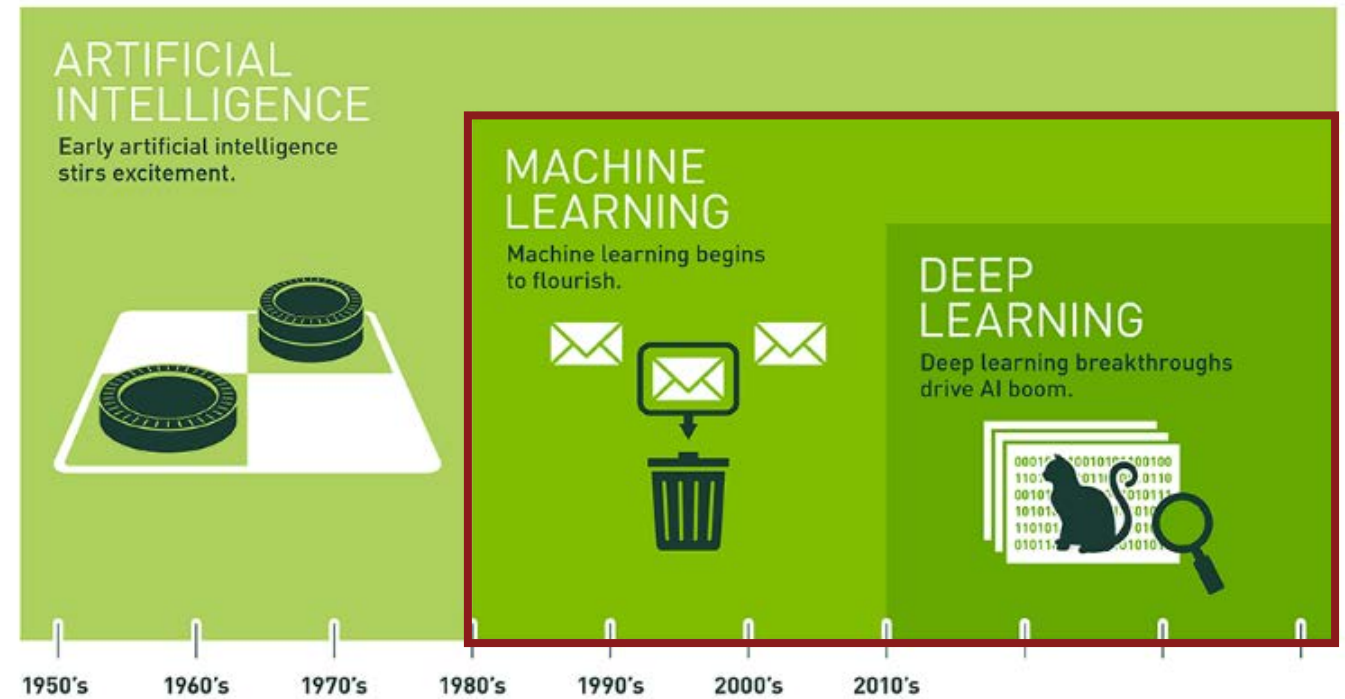


Artificial
Intelligence



BIG DATA

Machine Learning Algorithms



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.

Machine Learning

A large, hollow triangle with a black outline, representing supervised learning.

지도학습

A large, hollow triangle with a black outline, representing unsupervised learning.

비지도학습

A large, hollow triangle with a black outline, representing reinforcement learning.

강화학습

지도학습 Classification



강아지



? → 강아지

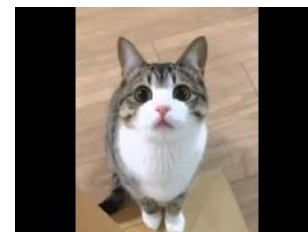
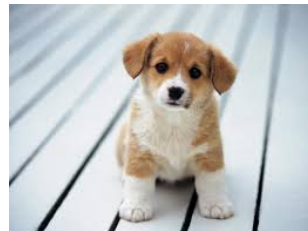


고양이

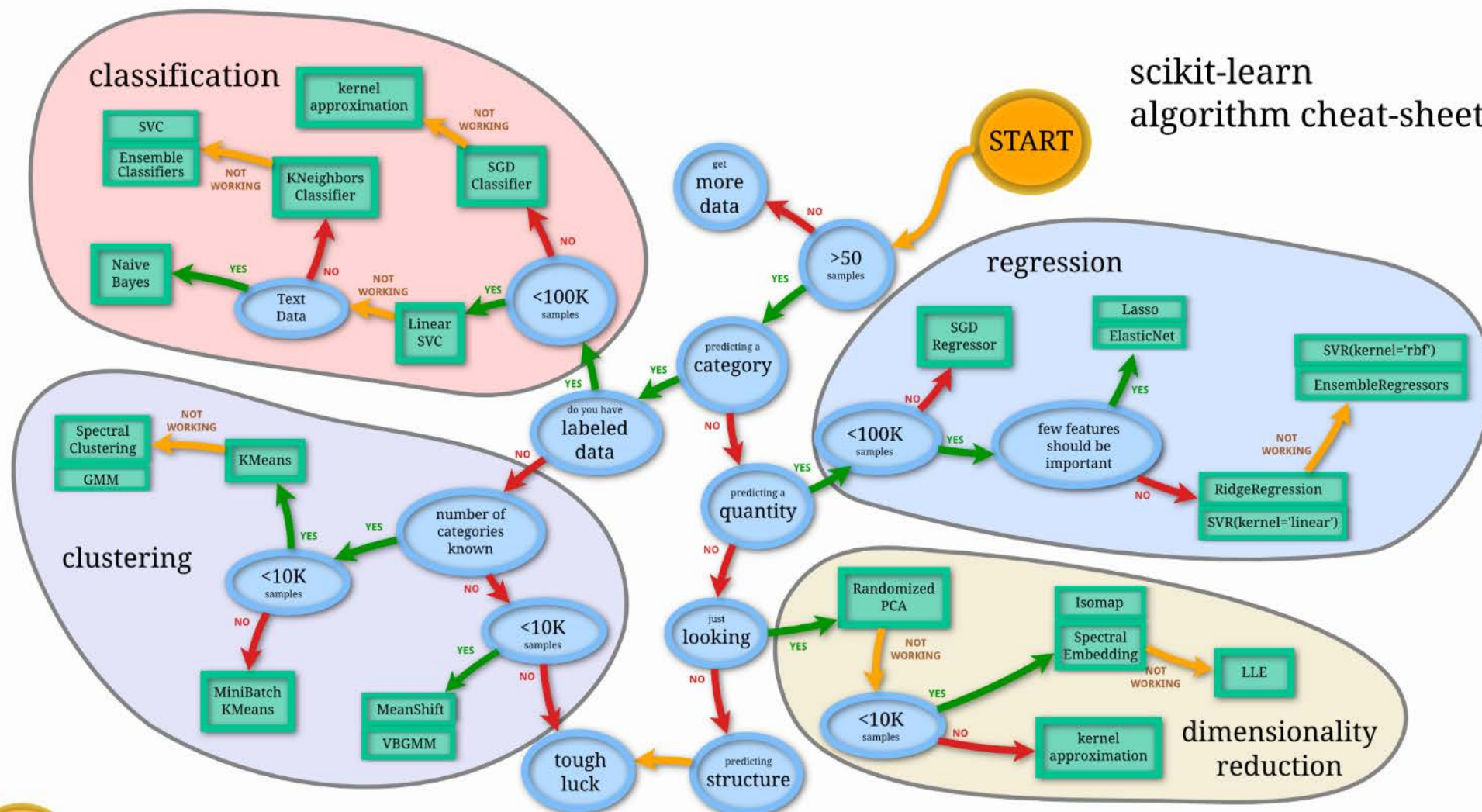


? → 고양이

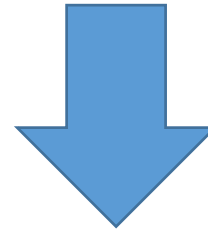
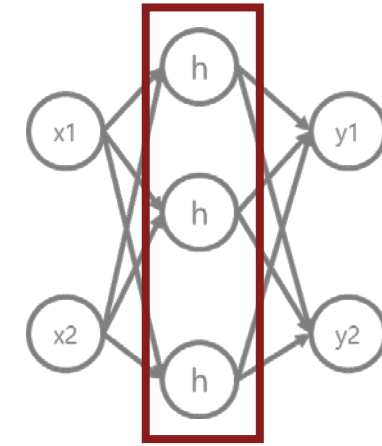
비지도학습 Clustering



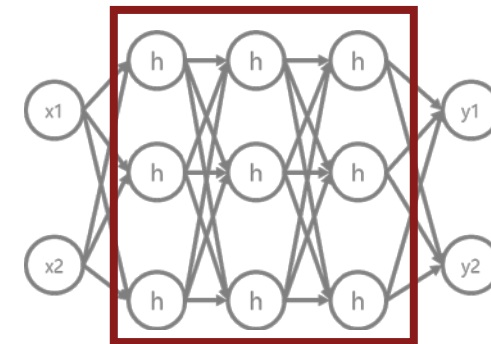
scikit-learn algorithm cheat-sheet



Artificial Neural Network

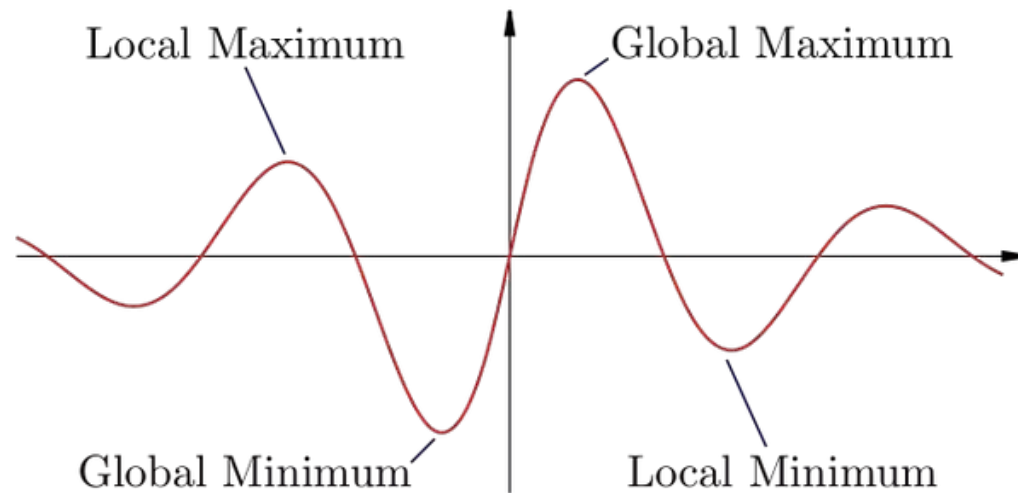


Deep Learning (Large Neural Network)



• ANN의 한계 및 암흑기

- Our labeled datasets were thousands of times too small
- Our computers were millions of times too slow
- We initialized the weights in a stupid way
- We used the wrong type of non-linearity



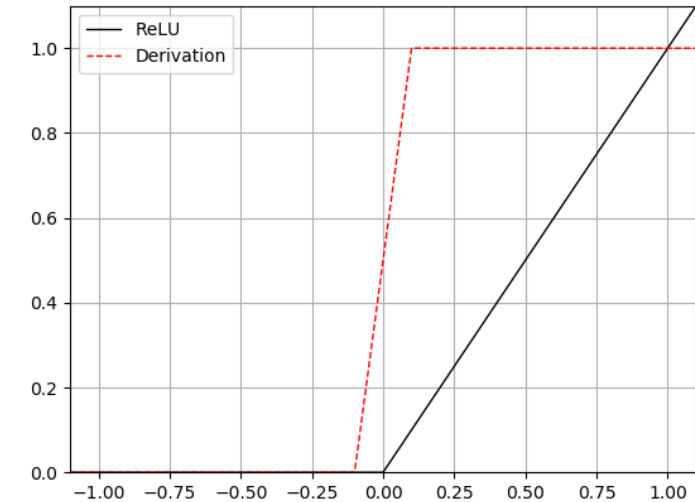
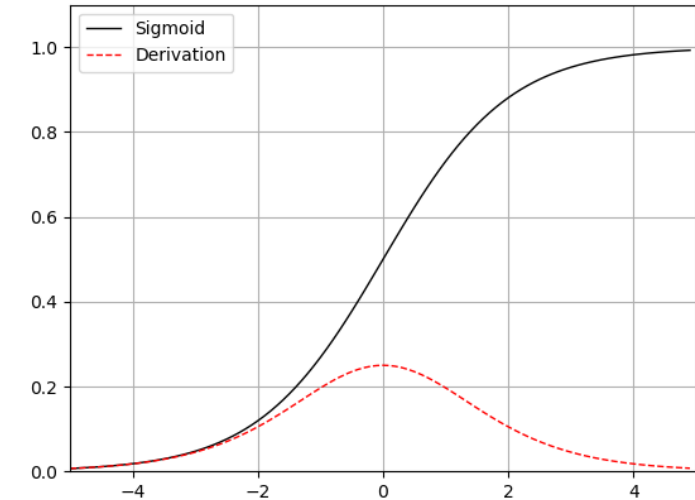
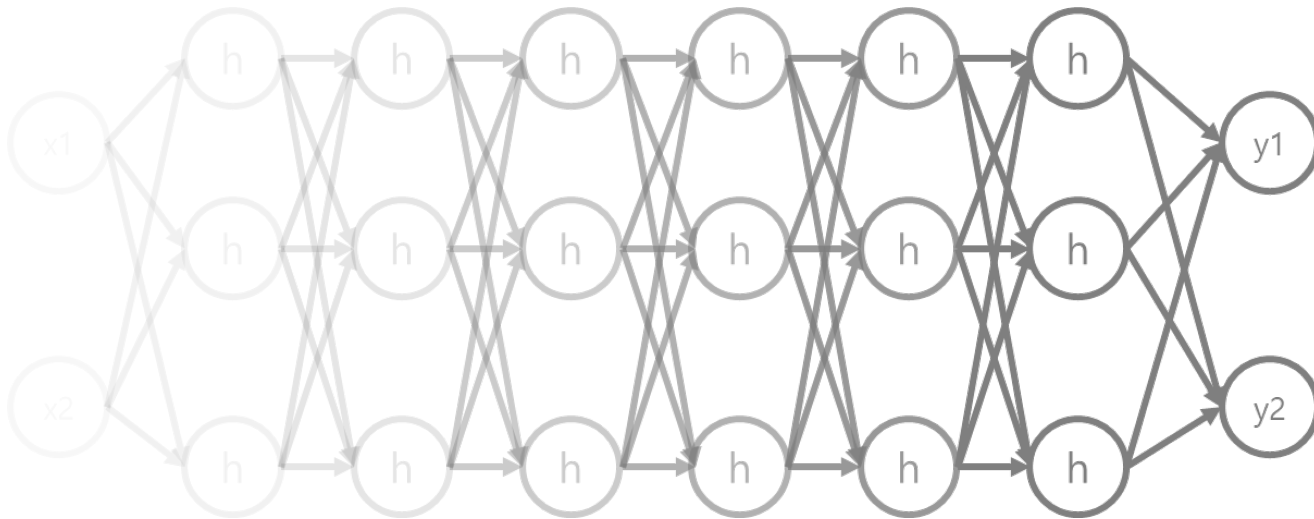
[“Deep learning-Royal Society”, Geoffrey hinton, 2016]

[“정석으로 배우는 딥러닝”, 스고모리 유우스케, 2017]

[“쉽게 풀어 쓴 딥 러닝의 거의 모든 것 (<http://slownews.kr/41461>)”, Terry, 2015]

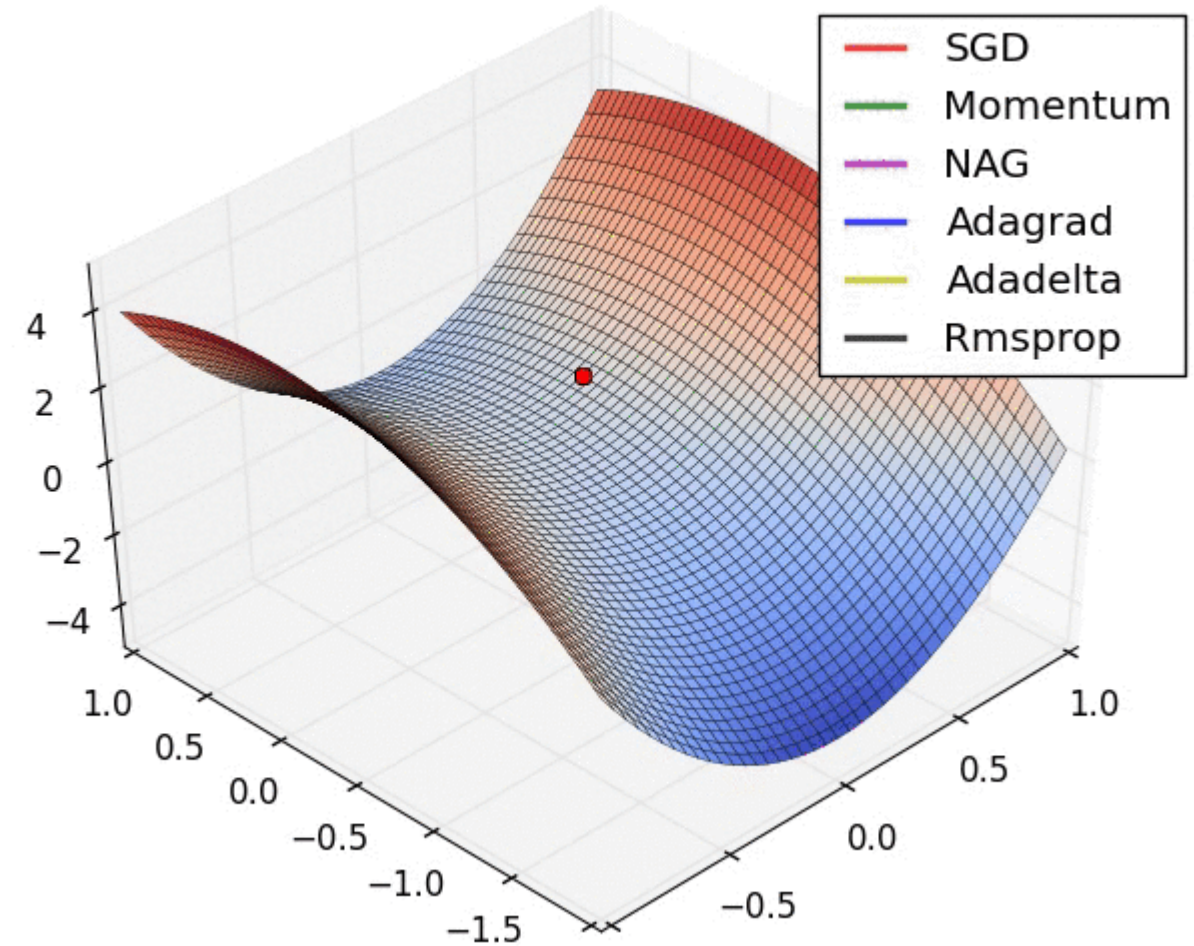
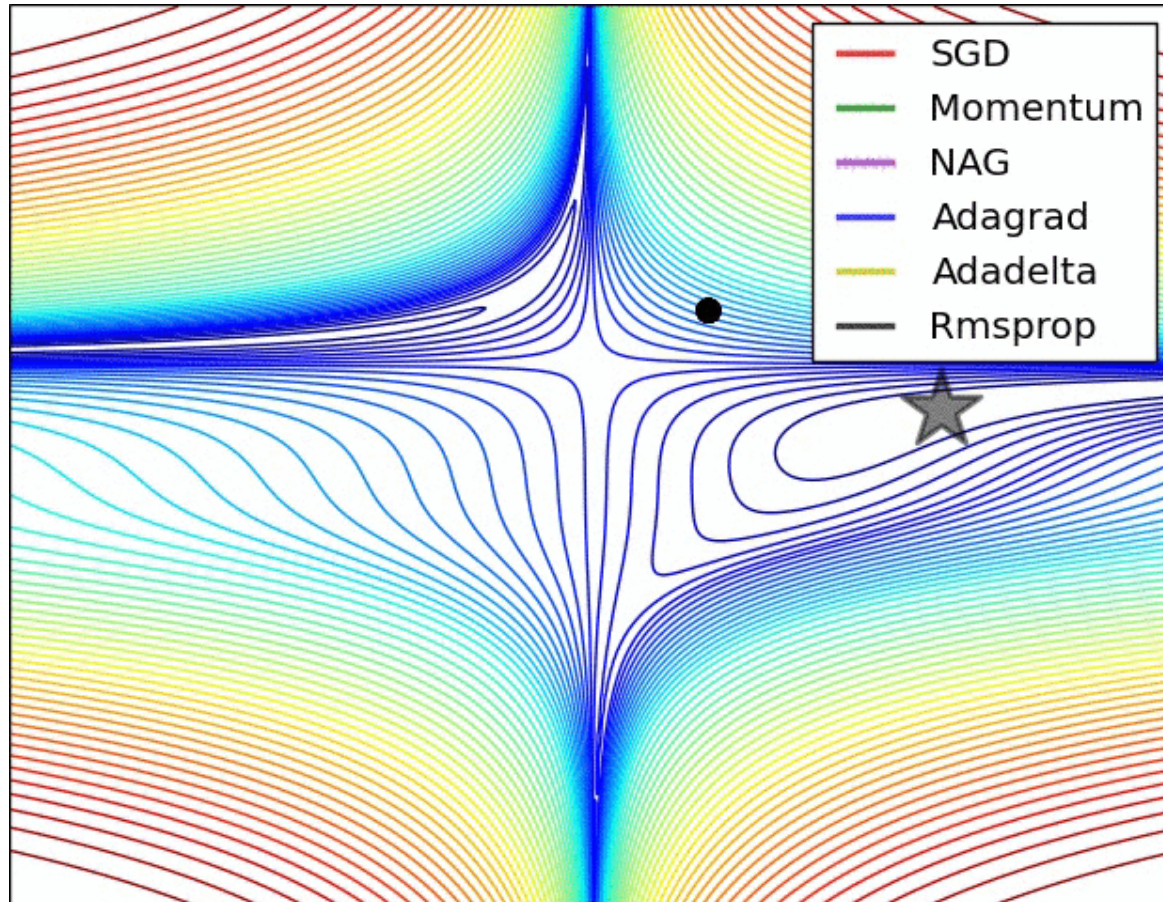
• Gradient Vanishing Problem

- Activation Function



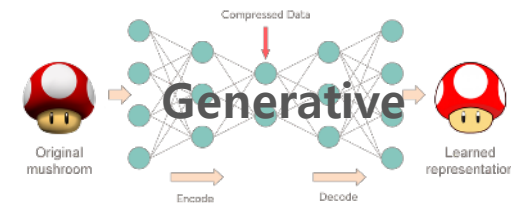
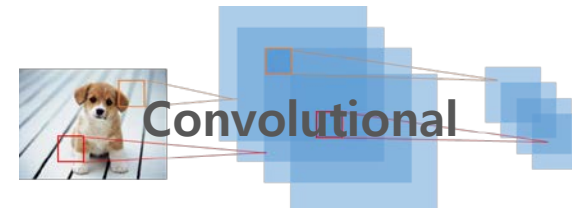
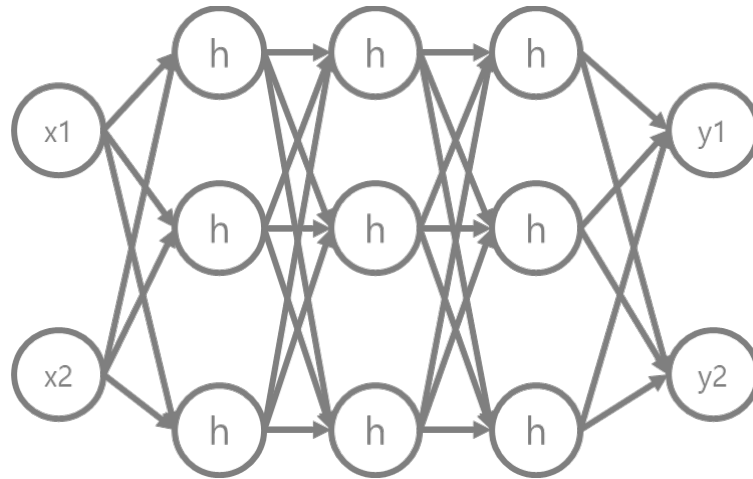
• Local Minima

- Optimization method



Deep Learning

(Large Neural Network)





Image



Convolutional
NN



Speech/Text



Recurrent
NN

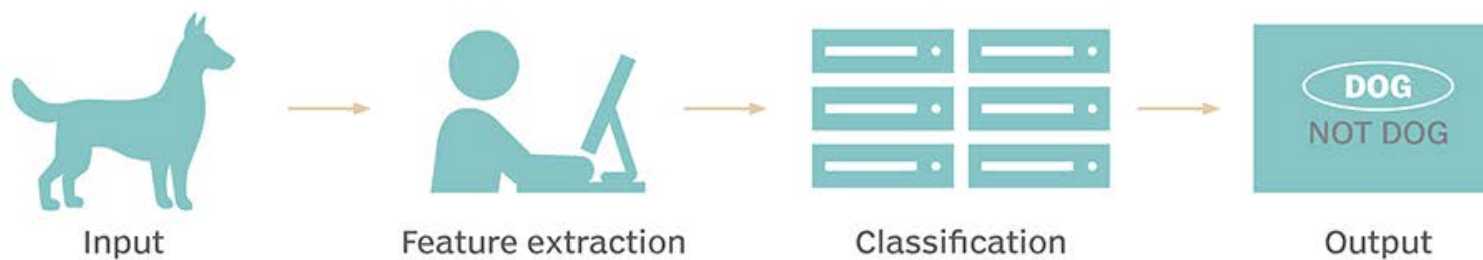


Data



Generative
Adversarial
Network

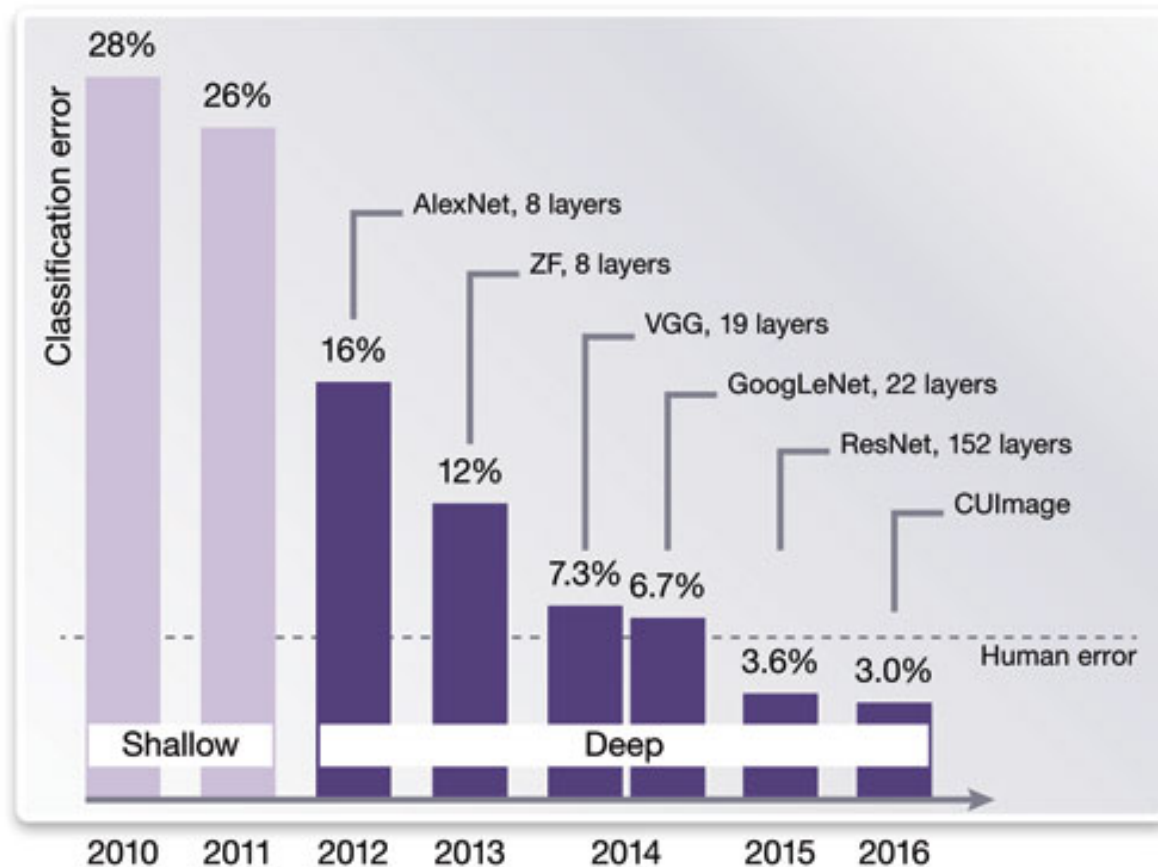
TRADITIONAL MACHINE LEARNING



DEEP LEARNING



CNN



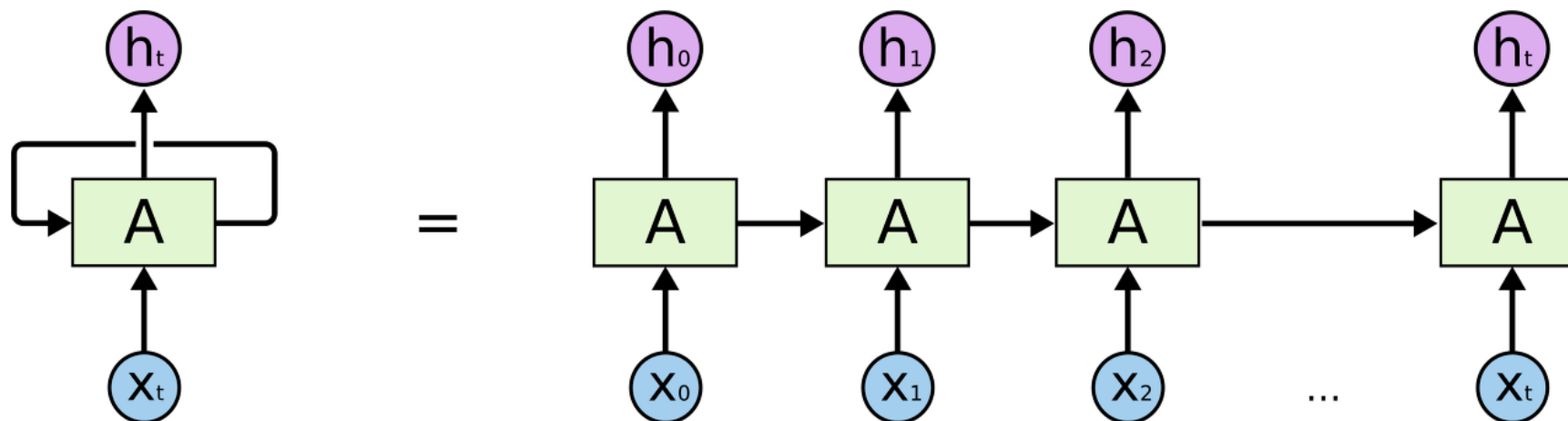
[<https://deeplearningsandbox.com/how-to-build-an-image-recognition-system-using-keras-and-tensorflow-for-a-1000-everyday-object-559856e04699>]

Recurrent Neural Network



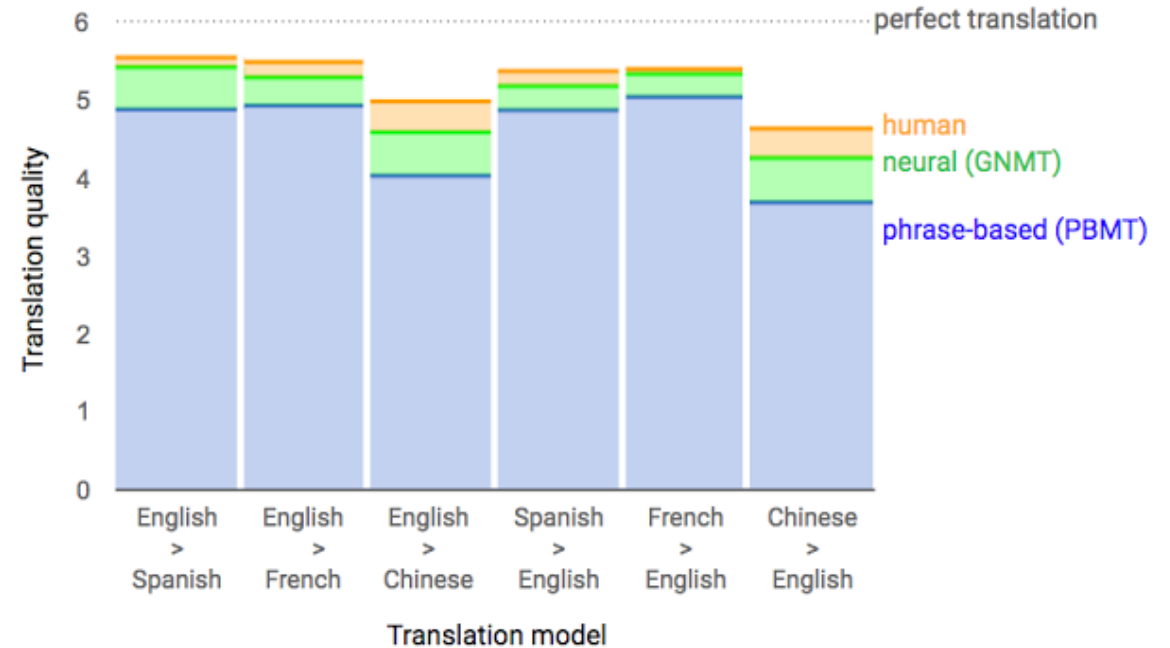
- Recurrent Neural Network (순환신경망)

- 자연어 처리(Natural Language Proccession; NLP)나 음성 인식(Speech Recognition, Speech-to-Text; STT)처럼 순서가 있는 데이터를 처리



Recurrent Neural Network

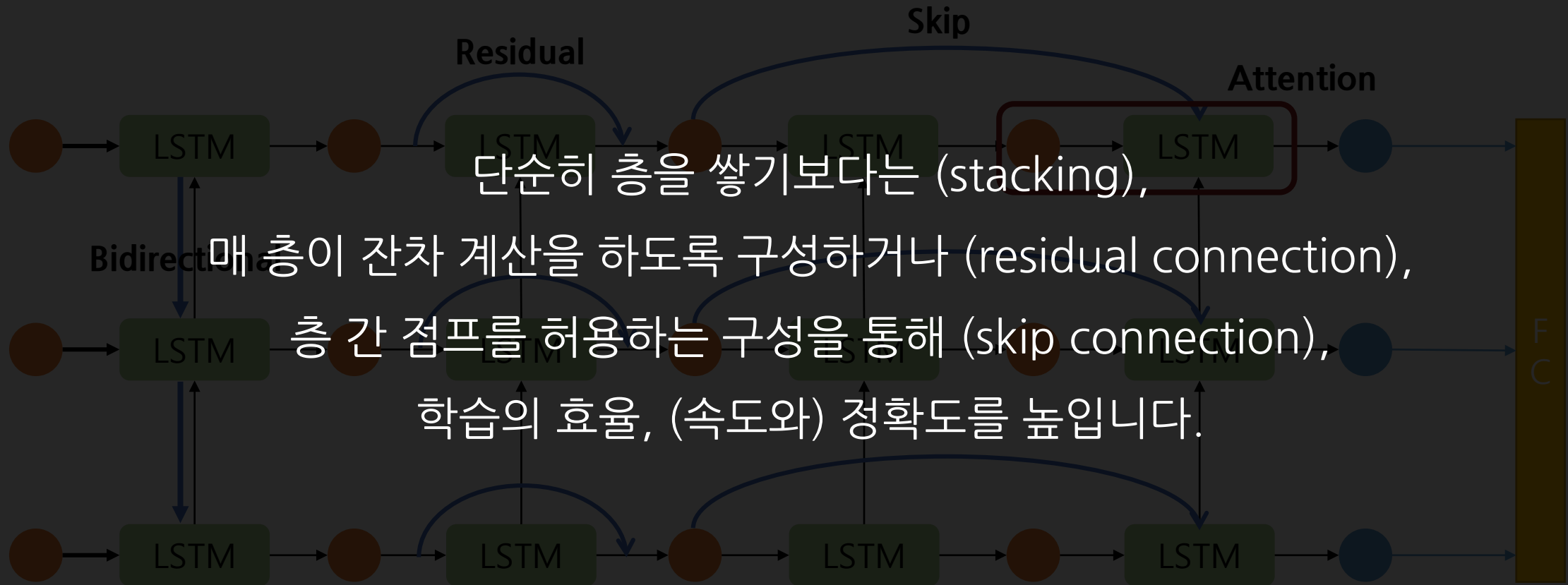
- RNN applications
 - Language Modeling
 - Speech Recognition
 - Machine Translation
 - Conversation Modeling/ Question Answering
 - Image/Video Captioning
 - Image/Music/Dance Generation



[“골빈해커의 3분 딥러닝”, 김진중, 2017]

Deep learning model

- 다층 구조, 딥 구조 만들기

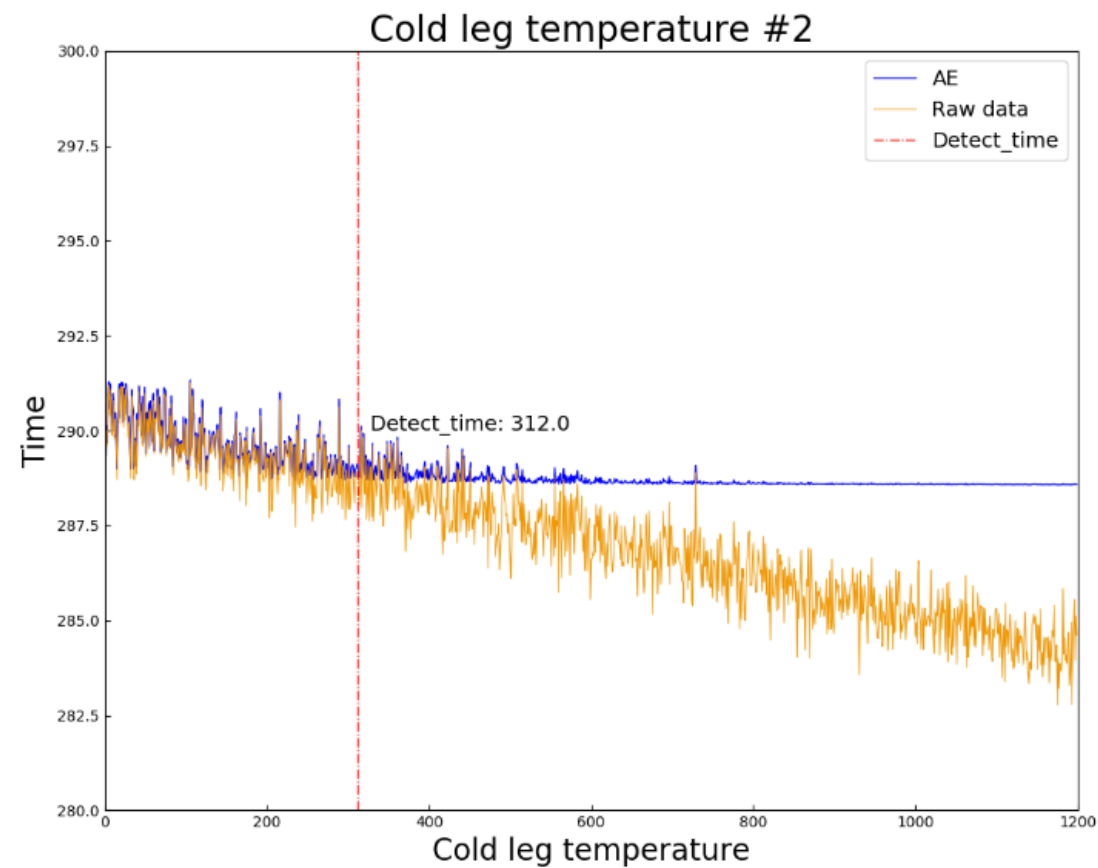
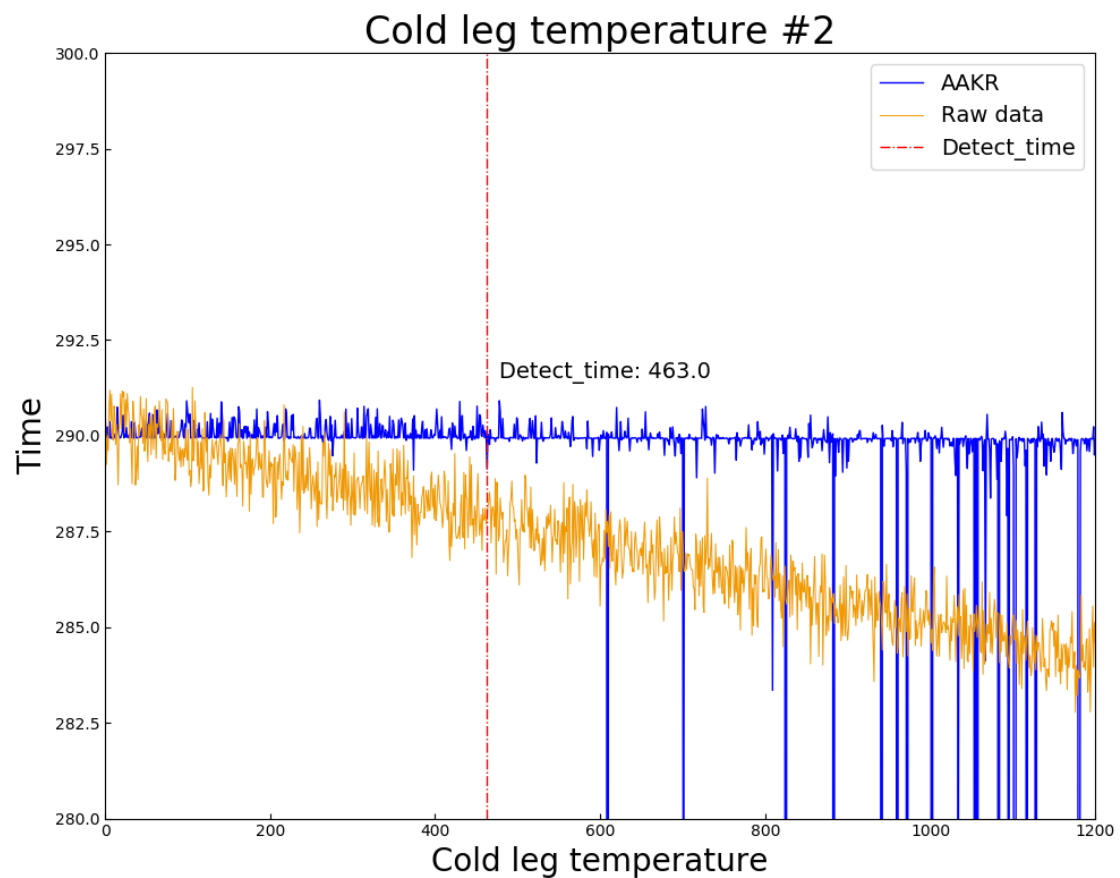
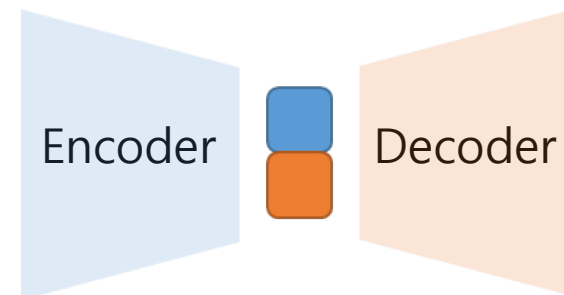


Deep learning in NPPs

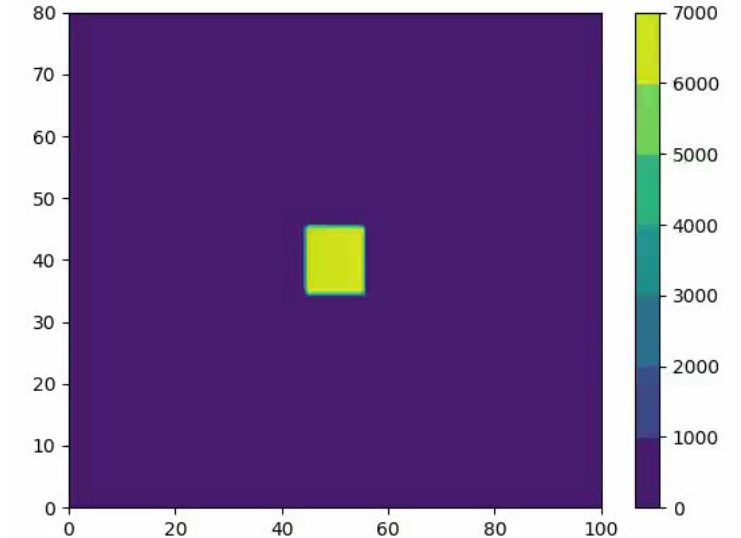
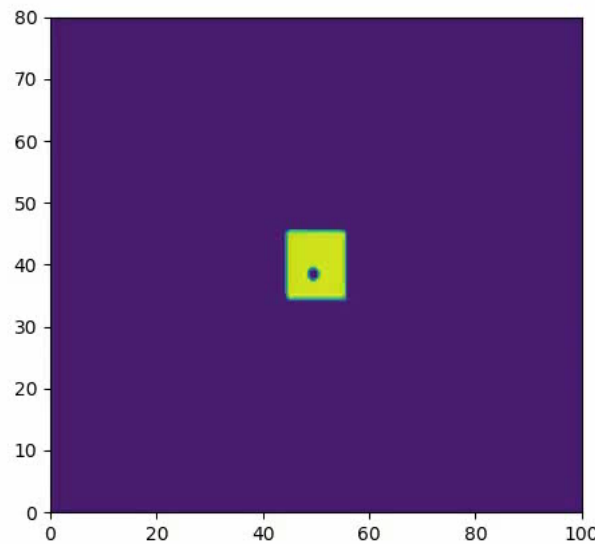
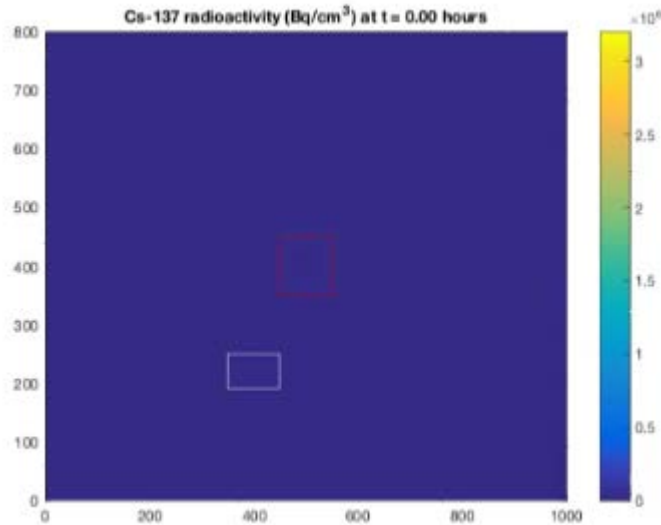
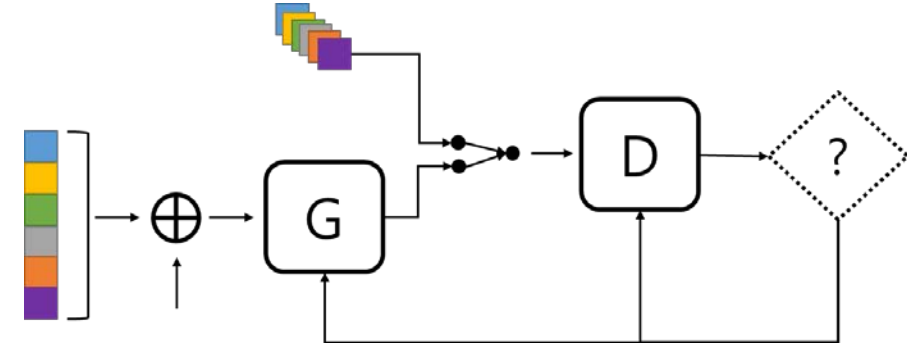
Monitoring

- Sensor drift detection

- Cold leg temperature (AAKR, Autoencoder)



Signal reconstruction

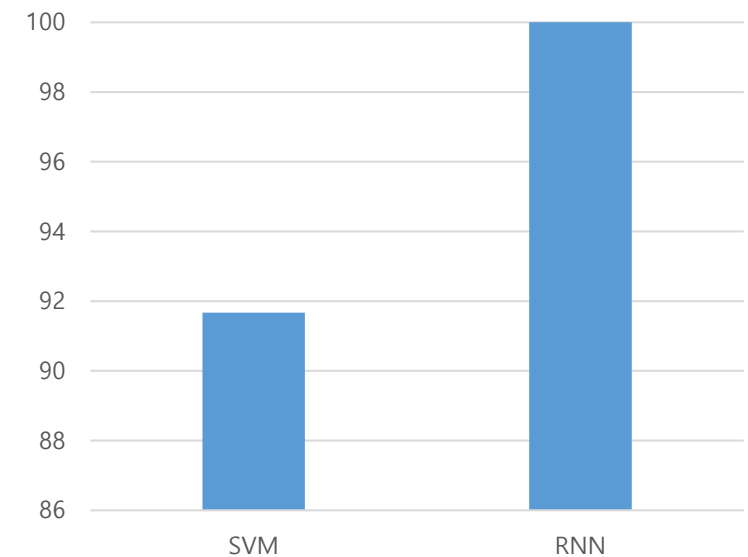
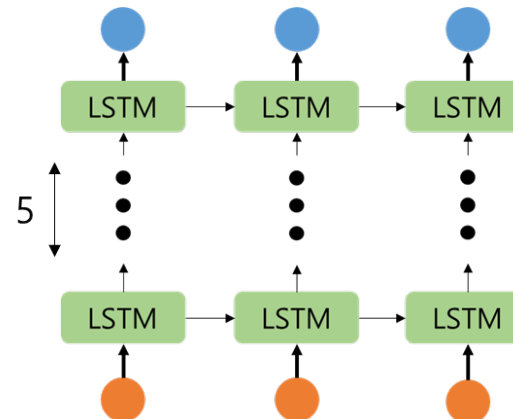
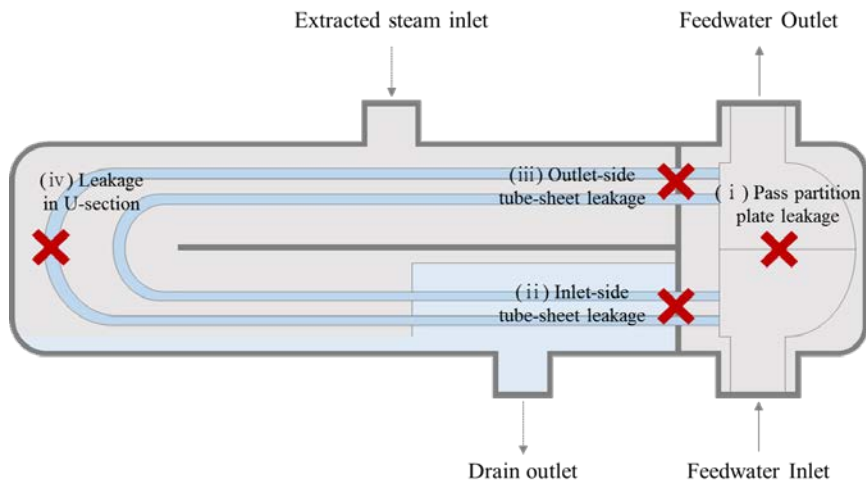


Diagnostics

• Feedwater heater

– 누설진단 (SVM, Stack - RNN)

- SVM (Accuracy: 91.67%)
- RNN (Accuracy: 100%)

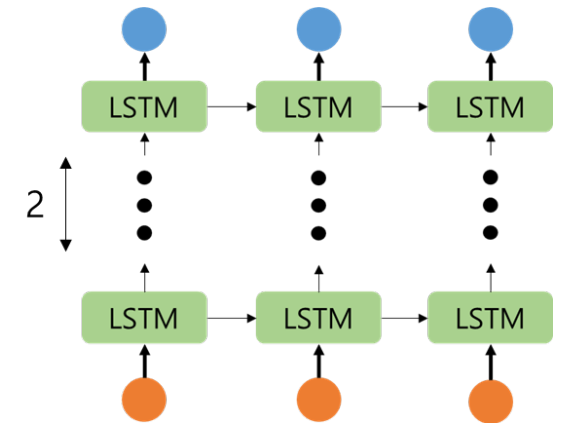
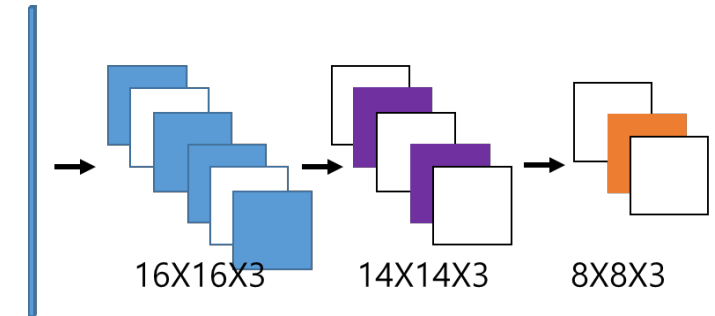
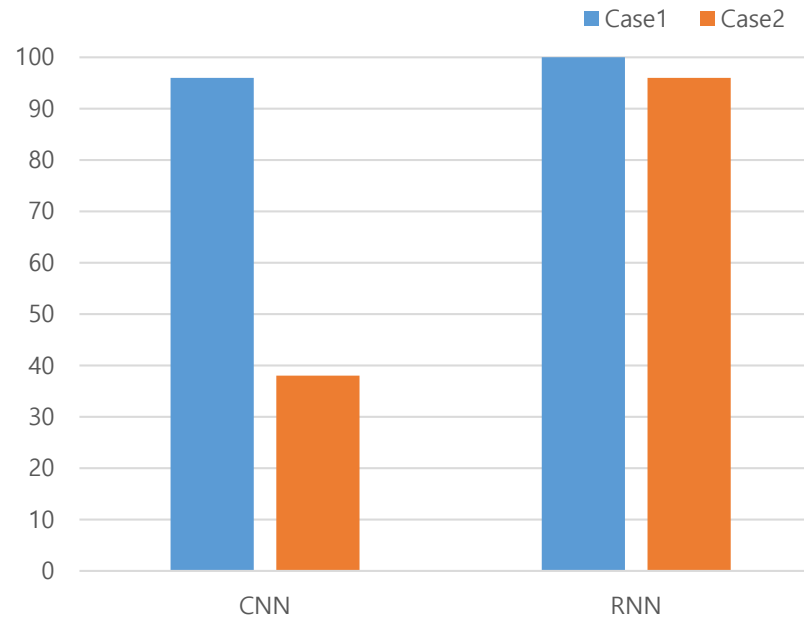
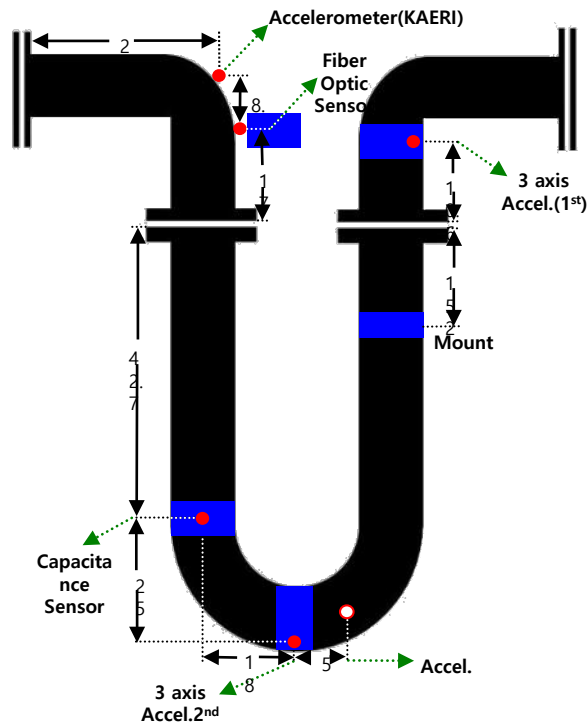


Diagnostics

• 원전배관

- 배관 두께 진단 (CNN, S-RNN)

- CNN(Case1 - Accuracy: 96%; Case2 - Accuracy: 38%)
- RNN(Case1 - Accuracy: 100%; Case2 - Accuracy: 96%)

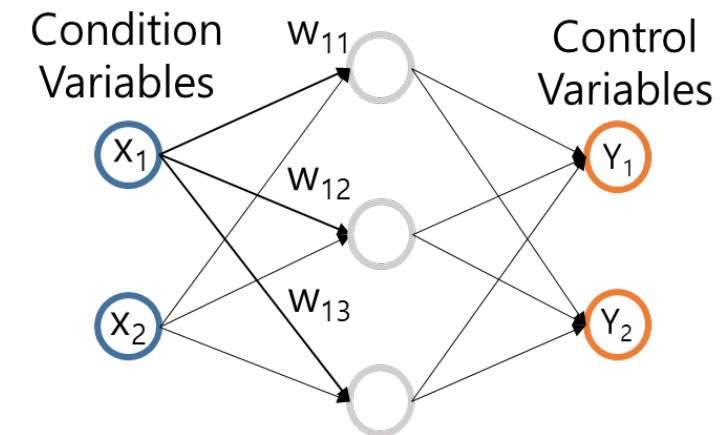
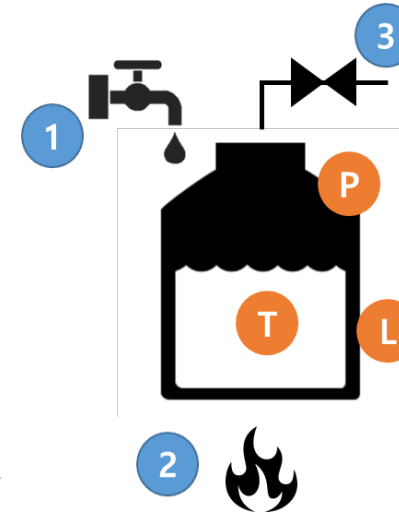
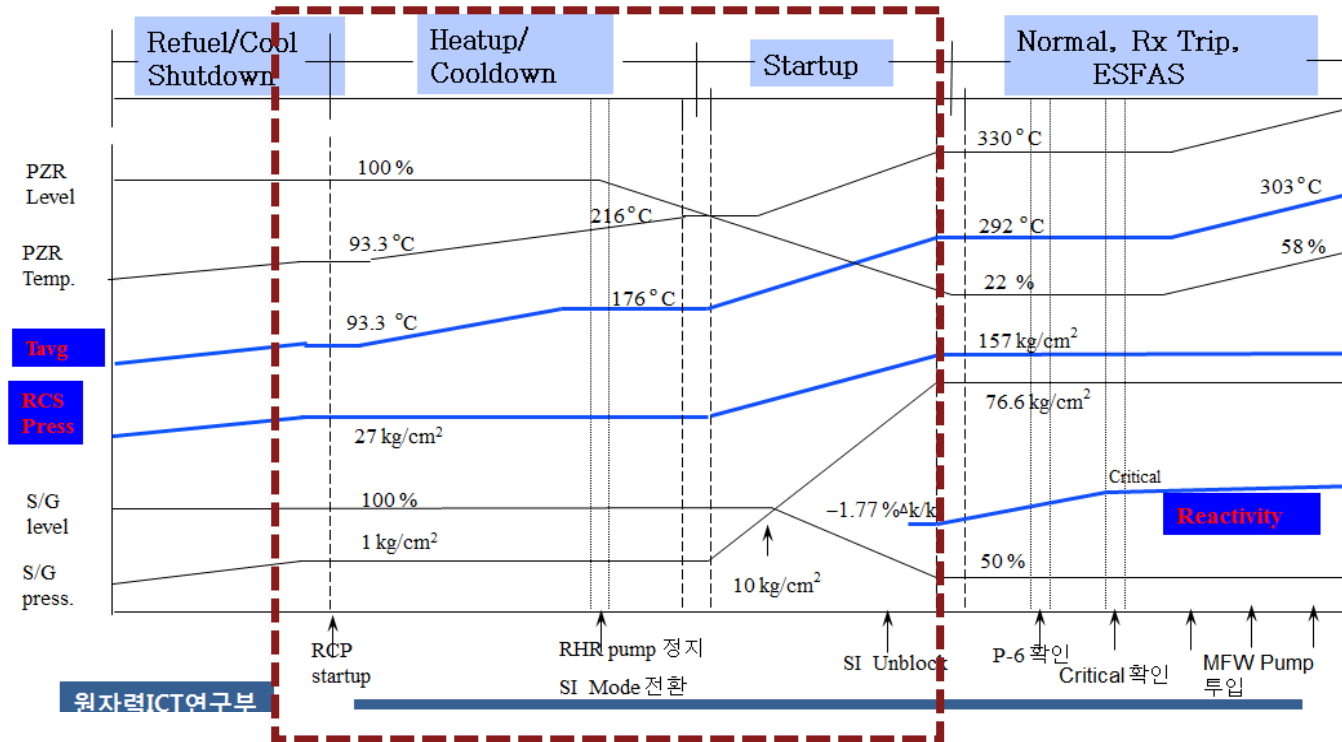


Automation system

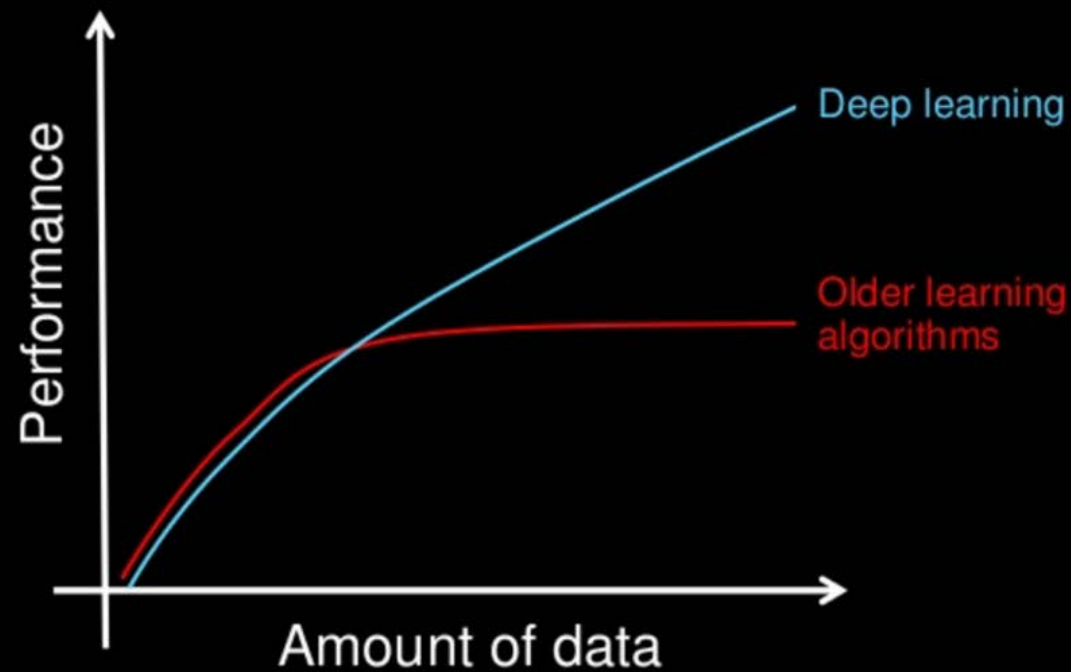
• 기동/정지 자동화

- Feasibility study

• 가압기 기포 생성



Why deep learning



How do data science techniques scale with amount of data?

감사합니다.

hyeonmin10@gmail.com
hyeonmin@kaeri.re.kr