대한기계학회 인공지능머신연구회
2021년 인공지능 여름학교

# 강의 소개 - 딥러닝 중급

2021.8.17

**Namwoo Kang**

Smart Design Lab
CCS Graduate School of Green Transportation
KAIST

# 강사소개: Namwoo Kang (강남우)

## Education

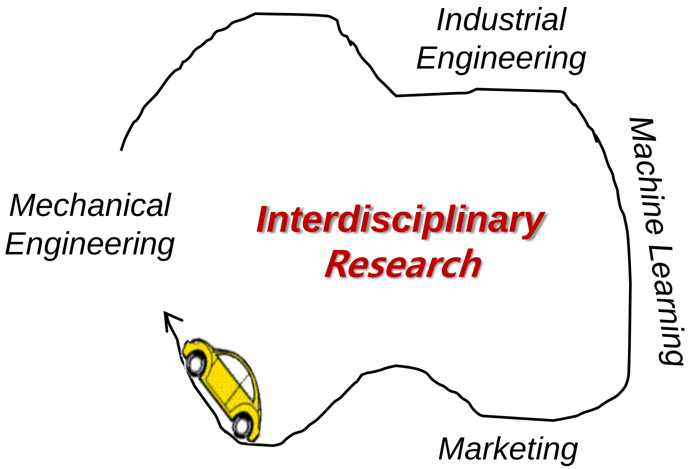
- 2014 Ph.D. Design Science (Mechanical Engineering & Marketing), University of Michigan
- 2007 M.S. Technology and Management, Seoul National University
- 2005 B.S. Mechanical and Aerospace Engineering, Seoul National University

## Academic Work & Industrial Experiences

- 2021 ~ Present, Assistant Professor, CCS Graduate School of Green Transportation, KAIST
- 2018 ~ 2021, Assistant Professor, Mechanical Systems Engineering, Sookmyung Women's University
- 2016 ~ 2018, Assistant Professor, K-School, KAIST
- 2014 ~ 2016, Research Fellow & Adjunct Lecturer, Mechanical Engineering, University of Michigan
- 2007 ~ 2010, Research Engineer, Hyundai Motor Company

## Professional Service

- Associate Editor - Journal of Mechanical Science and Technology (JMST)
- CAE 및 응용역학부문 총무이사 - Korean Society of Mechanical Engineers (KSME)
- 인공지능머신연구회 이사 - Korean Society of Mechanical Engineers (KSME)
- 인공지능소사이어티 이사 - Korean Institute of Information Scientists and Engineers (KIISE)
- 재무이사 - Korean Society for Prognostics and Health Management (KSPHM)
- IT융합부문 사업이사 - Korean Society of Mechanical Engineers (KSME)




## Awards

- Young Scientist Award, ACSMO (Asian Congress of Structural and Multidisciplinary Optimization), 2020
- 미래기술상, 한국전산구조공학회, 2019
- Dow Distinguished Award, Dow Sustainability Fellows, University of Michigan, 2014

SMART DESIGN LAB KAIST

# 강사소개: AI-based Mobility Design

*Product*

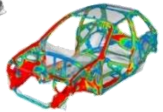
*Service*

**AI-based Mobility Design**

**(Physics + Data)**

## Mobility Product Design
**(Virtual Product Development)**


Style



Body

Chassis

Powertrain

## Mobility Service Design
**(Digital Twin for Shared Mobility)**

Real World (Data)

*Decisions Prediction*

*Data Feedback*

System Simulation, Prediction, and Optimization

Max {Sustainability, Profit}

**Autonomous Fleet Assignment**
(Deep Learning)

**Charging Station**
(Network Model)

**Demand Forecasting**
(Deep Learning)

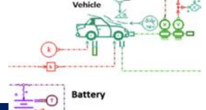
**EV Design**
(Engineering Simulation)

Fleet Assignment

Charging Station

Demand Forecasting

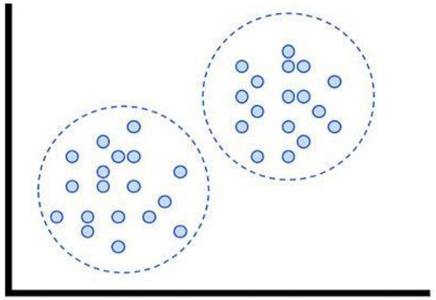
EV Design



# Contents

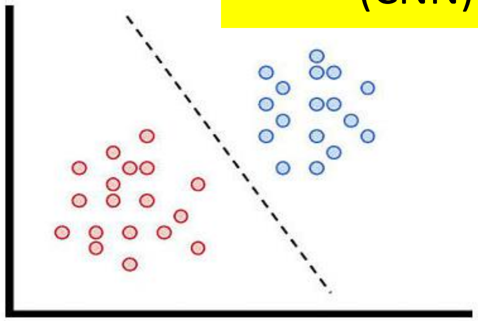
## ❖ Types of Learning

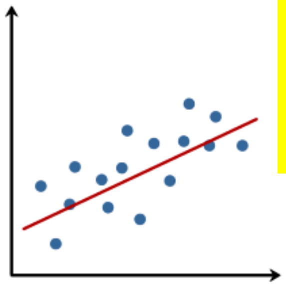
- Labeled data
- Direct feedback
- Predict outcome/future



Classification

Regression



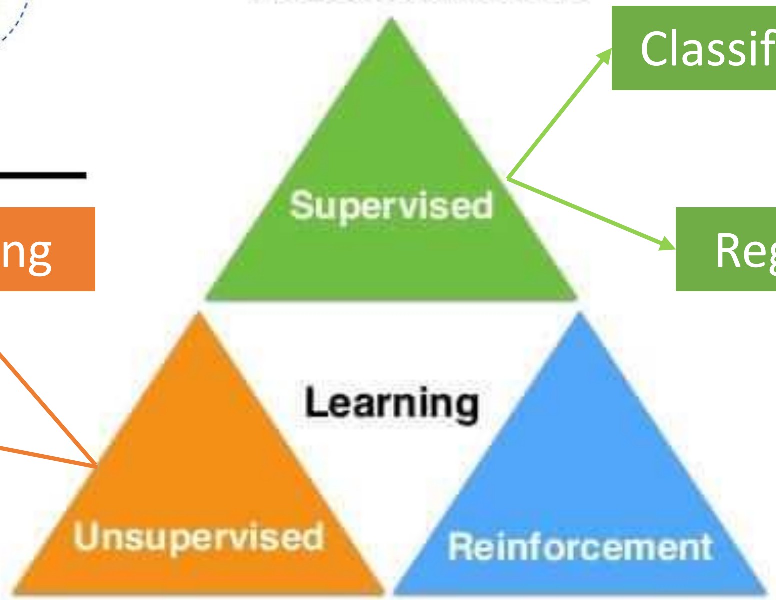


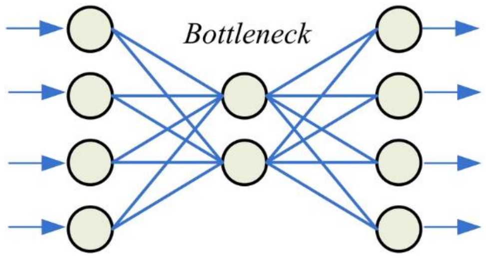
**Convolutional Neural Network** (CNN)

**Recurrent Neural Network** (RNN)

Clustering

Dimensionality Reduction & Generation

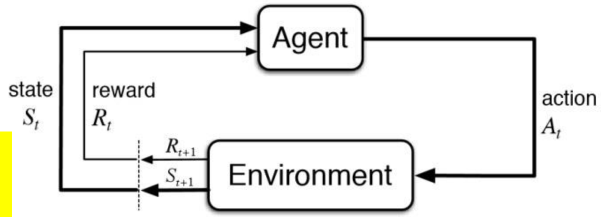



- No labels
- No feedback
- "Find hidden structure"

**Generative Models**
(ex. VAE, GAN)

- Decision process
- Reward system
- Learn series of actions




**Deep Reinforcement Learning**
(ex, DQN, A3C, PPO)



<https://www.techjini.com/blog/machine-learning/>

# Contents

- **Ch1: Introduction to Unsupervised Learning Part I** → Probability & Maximum Likelihood
- **Ch2: Introduction to Unsupervised Learning Part II** → Generative Model & Dimensionality Reduction
- **Ch3: Principal Component Analysis (PCA)** → Machine Learning Model
- **Ch4: Autoencoder & Anomaly Detection**
  + 실습
- **Ch5: Variational AutoEncoder (VAE)** → Deep Learning Models
  + 실습
- **Ch6: Generative Adversarial Network (GAN)**
  + 실습
- **Ch7: Application: Mechanical Design + AI** → CAD/CAM/CAE/Design Optimization + AI

# Reference

## ❑ 강의 슬라이드 및 실습코드는 아래의 링크에서 받으실 수 있습니다

- http://www.smartdesignlab.org/dl_aischool_2021.html
- Contributors: 김성신, 유소영, 이성희, 김은지

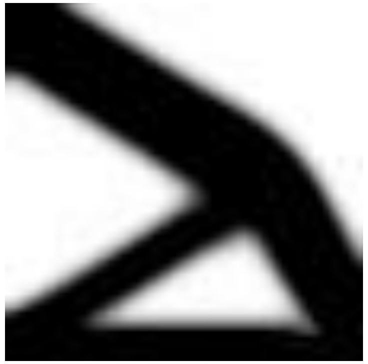
## ❑ 강의 소스

- Andrew Ng의 ML Class (www.holehouse.org/mlclass/)
- Fei-Fei Li & Justin Johnson & Serena Yeung, CS231n: Convolutional Neural Networks for Visual Recognition, Stanford (http://cs231n.stanford.edu/)
- Stefano Ermon & Aditya Grover, CS 236: Deep Generative Models , Stanford (https://deepgenerativemodels.github.io/)
- 모두를 위한 딥러닝 (https://hunkim.github.io/ml/)
- 모두를 위한 딥러닝 시즌 2 (https://deeplearningzerotoall.github.io/season2/lec_tensorflow.html)
- 이활석, Autoencoders (https://www.slideshare.net/NaverEngineering/ss-96581209)
- 최윤제, 1시간만에 GAN(Generative Adversarial Network) 완전 정복하기 (https://www.slideshare.net/NaverEngineering/1-gangenerative-adversarial-network?qid=c53ce33f-6643-4437-8e93-88776c9cebb1&v=&b=&from_search=5)
- 김성범, [핵심 머신러닝] Principal Component Analysis (PCA, 주성분 분석) (https://youtu.be/FhQm2Tc8Kic)

# 실습 - Structural Design Data

Input: design

56



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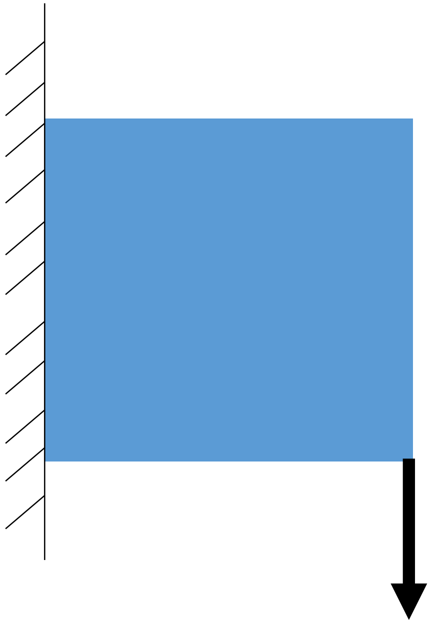
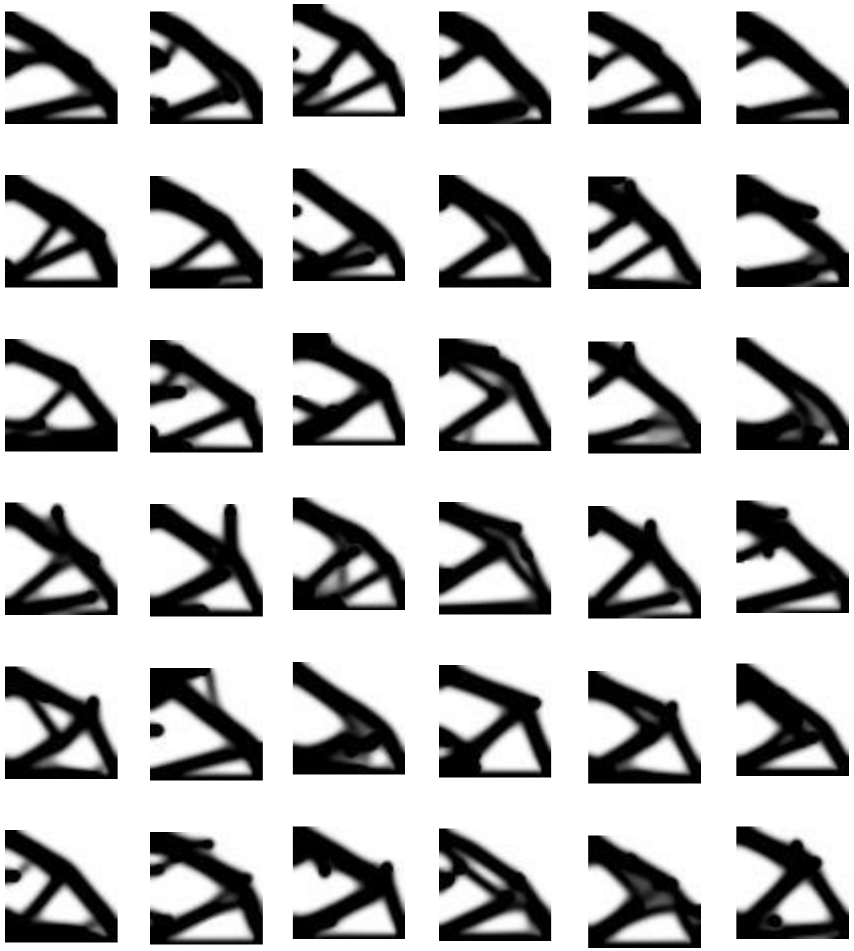


Output: compliance

$$c(\mathbf{x}) = \mathbf{U}^{\mathrm{T}}\mathbf{K}\mathbf{U}$$

$$\text{where } \mathbf{KU} = \mathbf{F}$$

data_3000 / data_5000



# What Questions Do You Have?

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www.smartdesignlab.org