



Introduction

Prof. Seungchul Lee
Industrial AI Lab.

Course Information For MECH437

- Course title: AI for ME (= Machine Learning)
 - B011
 - online
- Instructor: Prof. Seungchul Lee
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 - jongmok7@postech.ac.kr
 - Office: 5-427

Instructor

- 2018 - present: POSTECH
 - Industrial AI Lab.
- 2013 - 2017: UNIST
 - iSystems Design Lab.
- 2010, Ph.D. from the University of Michigan, Ann Arbor
 - S. M. Wu Manufacturing Research Center
 - The Center of Intelligent Maintenance Systems (IMS)
- 2008, M.S. from the University of Michigan, Ann Arbor
- 2005, B.S. of Electrical Engineering from Seoul National University
- 2001, B.S. of Mechanical Engineering from Seoul National University




Course Information For MECH437

- Basic knowledge for machine learning
 - Linear algebra
 - Optimization
- Python in class, assignments, and project
 - Used a lot
 - I highly recommend not to take this course for those who are not familiar with coding
 - Lots of coding problems in both homework and exam
- Grading
 - Two in-class exams (30% + 30%)
 - Many assignments (20%)
 - Project (10%)
 - Class participation (10%)

Lecture Materials

- All lecture materials are already available at
 - <https://iai.postech.ac.kr/teaching/machine-learning>
 - <https://www.youtube.com/playlist?list=PLGMtjo8jDX9ACghcCLack0uCqHPWJaC14>
 - Homework assignments (with an email notice)
- Minor changes can be made as semester goes



MACHINE LEARNING

Machine Learning
[YouTube]

Dates	Topics	with Python	Slides	Homework	Solution
	Installation	python installation			
	Installation	docker installation (optional)			
	Python	Basics of Python			
	Introduction	INote#00	pdf#00		
	Linear Algebra	INote#01	pdf#01	HW#01	HW#01 Solution
	Optimization	INote#02	pdf#02	HW#02	HW#02 Solution
	Regression: Basics	INote#03_1			
	Regression: Overfitting and Regularization	INote#03_2			



Machine Learning (기계학습)
77 videos • 12,934 views • Last updated on Oct 2, 2020

<https://matchup.smartlearn.io/>
<http://iai.postech.ac.kr/index.php/ma...>

IAI IAI POSTECH SUBSCRIBED

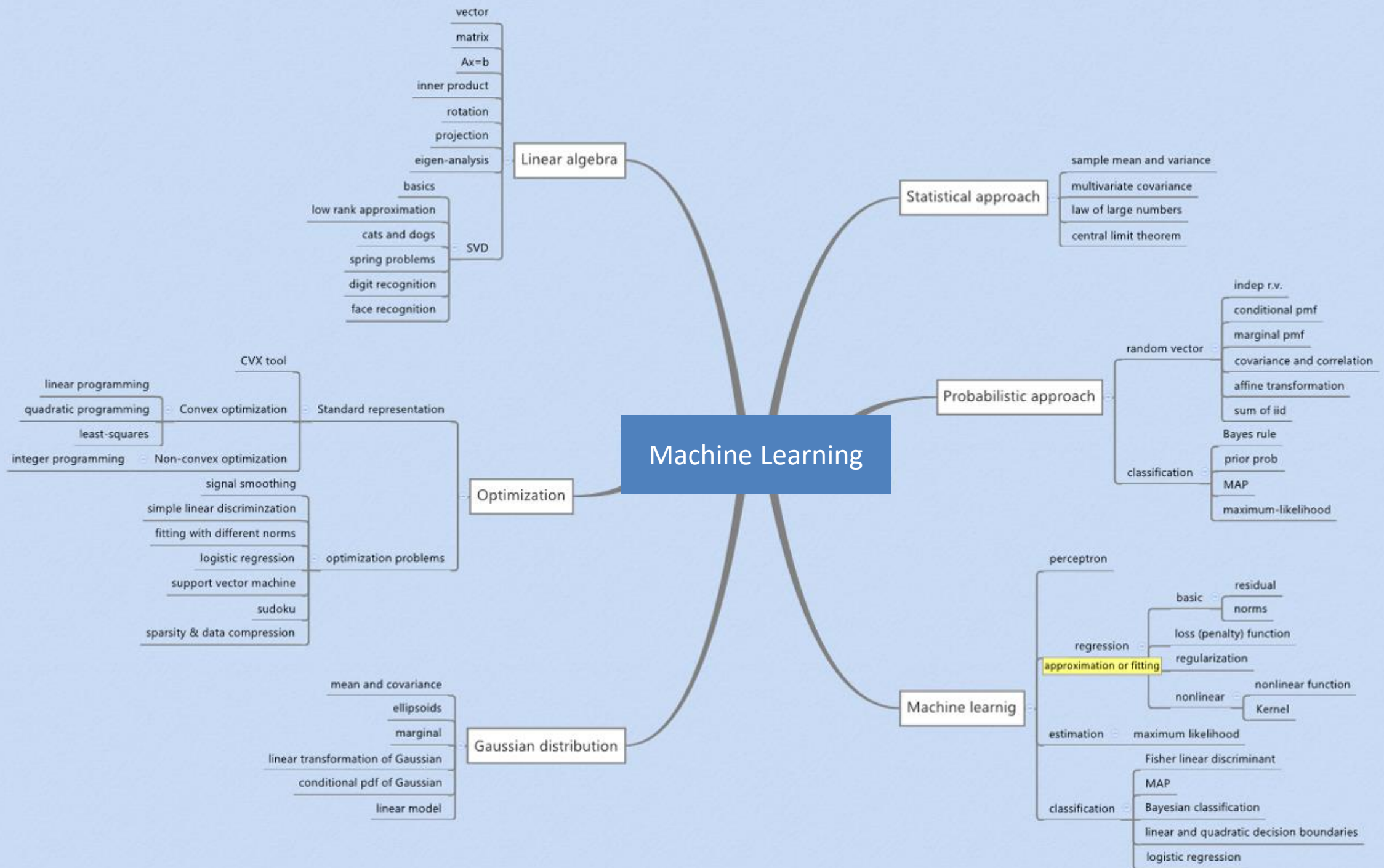
- 1 Machine learning 강의 소개 IAI POSTECH 2:39
- 2 A_week1_01 머신러닝 소개 IAI POSTECH 5:18
- 3 A_week1_02 머신러닝의 예시 IAI POSTECH 6:02
- 4 A_week1_03 머신러닝 프레임워크(Machine Learning Framework) IAI POSTECH 7:01
- 5 A_week2_01 파이썬 설치와 주피터 노트북 IAI POSTECH 13:43
- 6 A_week3_01 파이썬 기초 IAI POSTECH 25:50

Communication Channels

- Communication will mainly be done through PLMS
 - Announcement
 - Group e-mail

What Will We Cover?

Course Roadmap



Python

- Python coding example

```
y = np.empty([m,1])

# Run K-means
for n_iter in range(500):
    for i in range(m):
        d0 = np.linalg.norm(X[i,:] - mu[0,:],2)
        d1 = np.linalg.norm(X[i,:] - mu[1,:],2)
        d2 = np.linalg.norm(X[i,:] - mu[2,:],2)

        y[i] = np.argmin([d0, d1, d2])

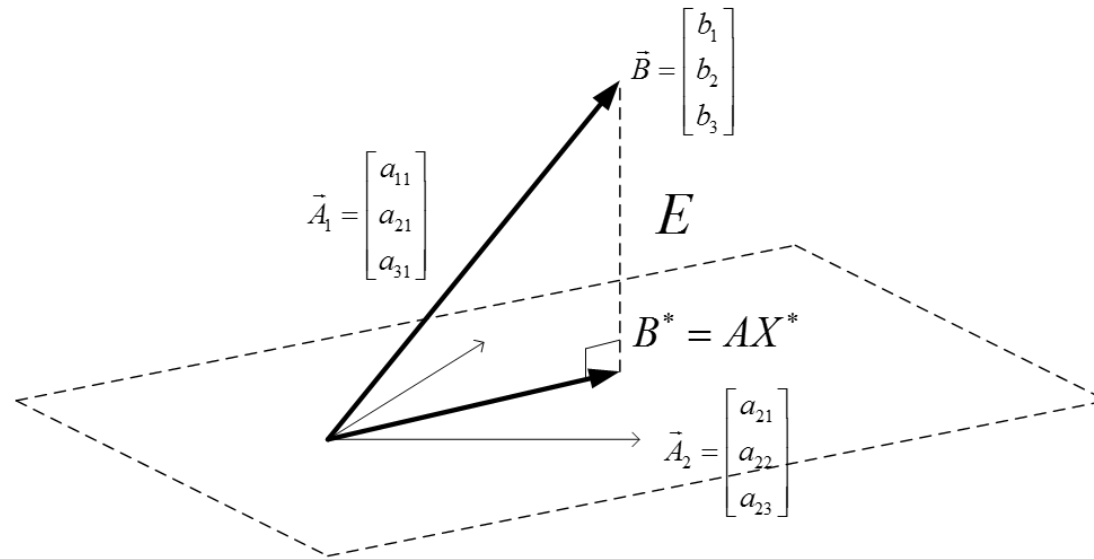
    err = 0
    for i in range(k):
        mu[i,:] = np.mean(X[np.where(y == i)[0]], axis=0)
        err += np.linalg.norm(pre_mu[i,:] - mu[i,:],2)

    pre_mu = mu.copy()

    if err < 1e-10:
        print("Iteration:", n_iter)
        break
```

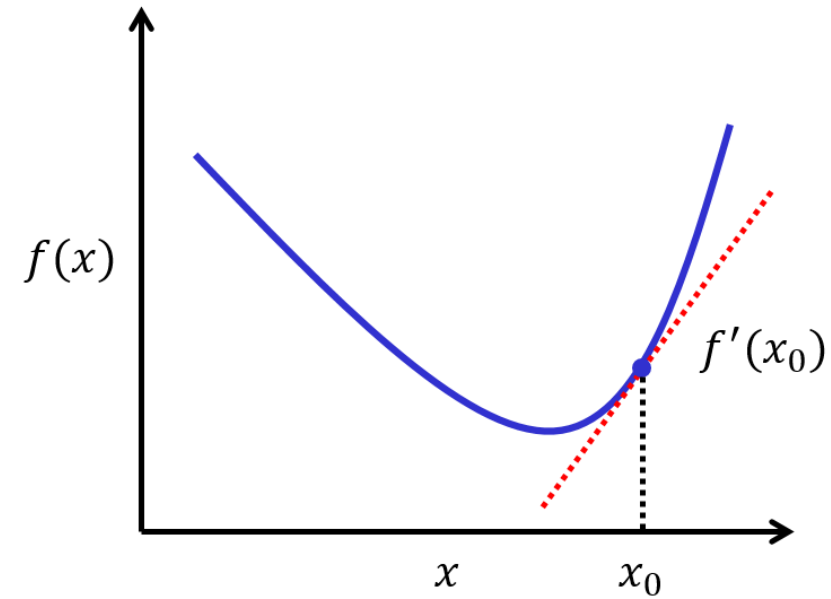
Linear Algebra

- Vector and Matrix
- $Ax = b$
- Projection
- Eigen analysis
- Least squares



Optimization

- Least squares
- Convex optimization (cvx or cvxpy)
- Gradient descent

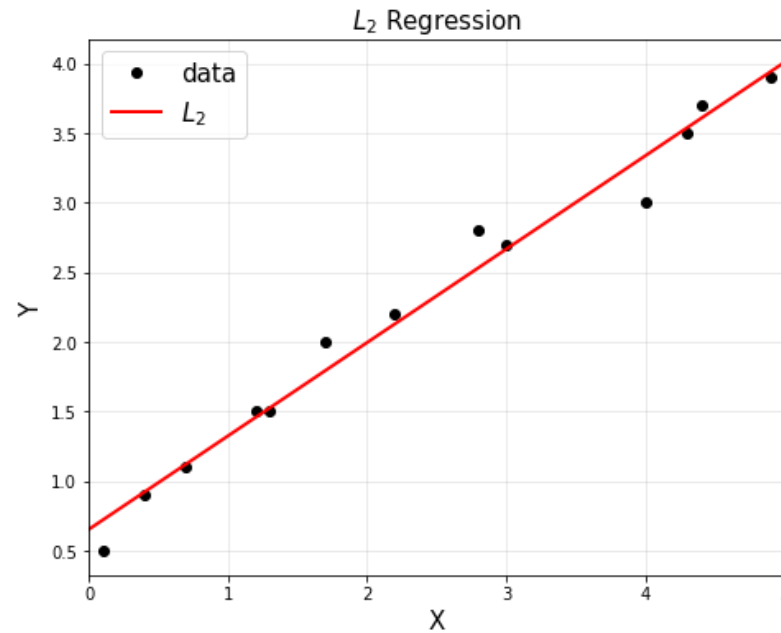


Statistics and Probability

- Statistics
 - Law of large numbers, central limit theorem
 - Correlation
 - Monte Carlo simulation
- Probability
 - Random variable, Gaussian density distribution, conditional probability
 - maximum likelihood (MLE), maximum a posterior (MAP), Bayesian thinking

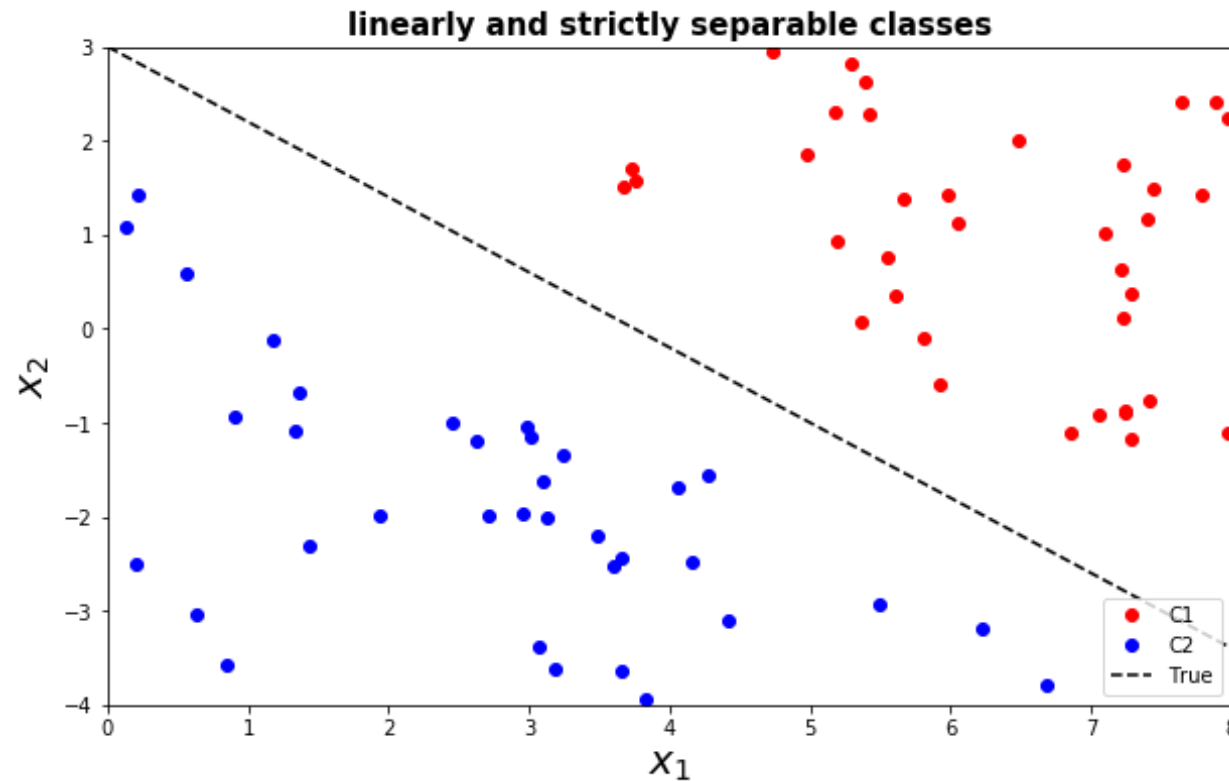
Regression (Data Fitting or Approximation)

- Statistical process for estimating the relationships among variables



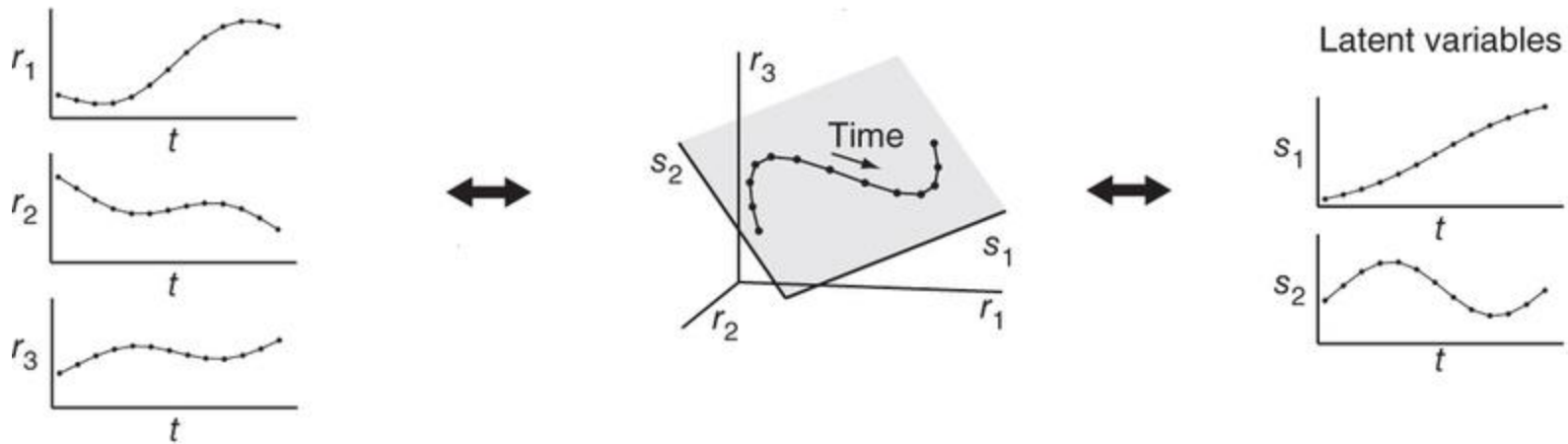
Classification

- The problem of identifying to which of a set of categories (sub-populations) a new observation belongs, on the basis of a training set of data containing observations (or instances) whose category membership is known
- To find classification boundaries

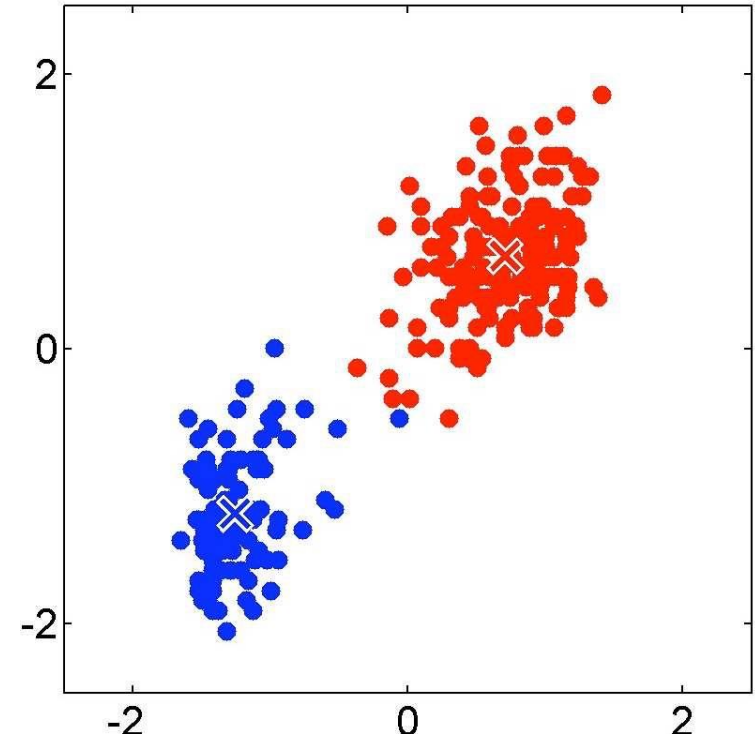
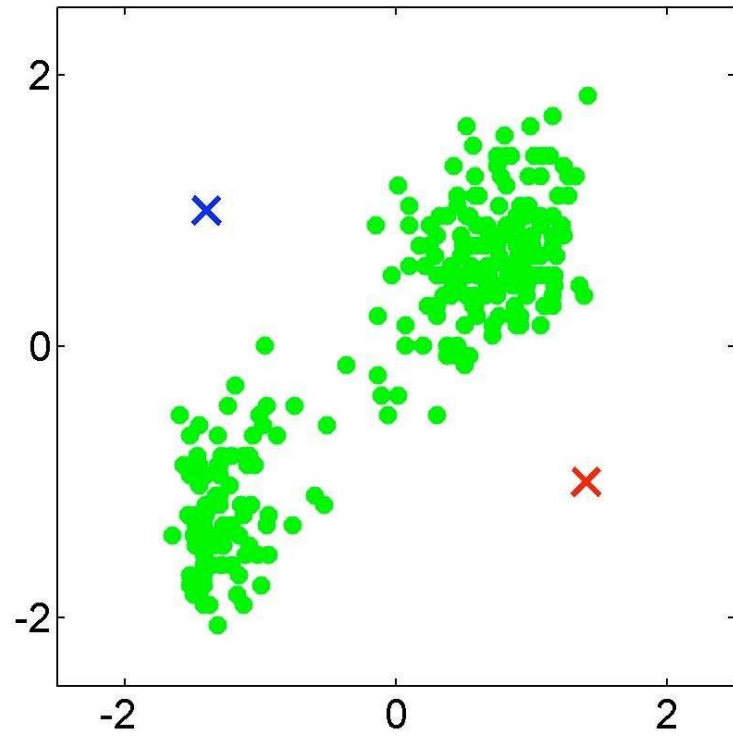


Dimension Reduction

- Multiple Sensors + Principal Components
- the process of reducing the number of random variables under consideration, and can be divided into feature selection and feature extraction.

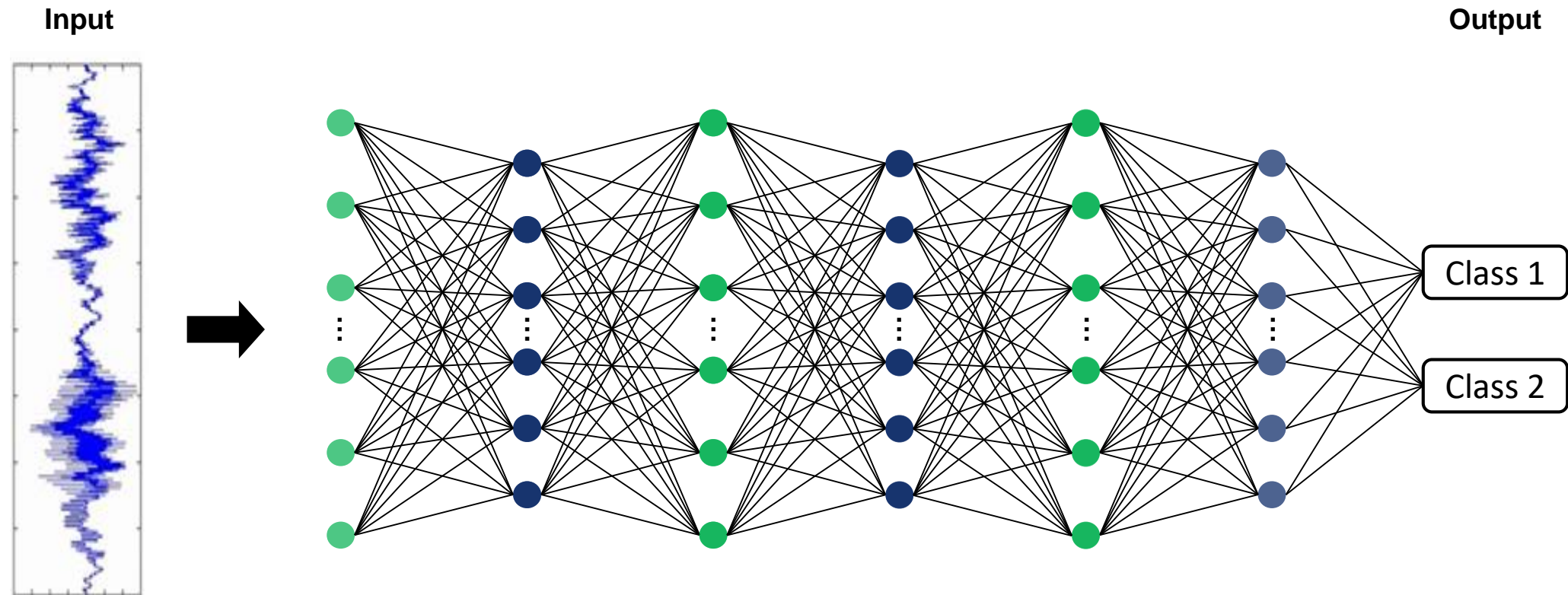


Clustering




Deep Artificial Neural Networks

- Complex/Nonlinear universal function approximator
 - Linearly connected networks
 - Simple nonlinear neurons



Deep Learning

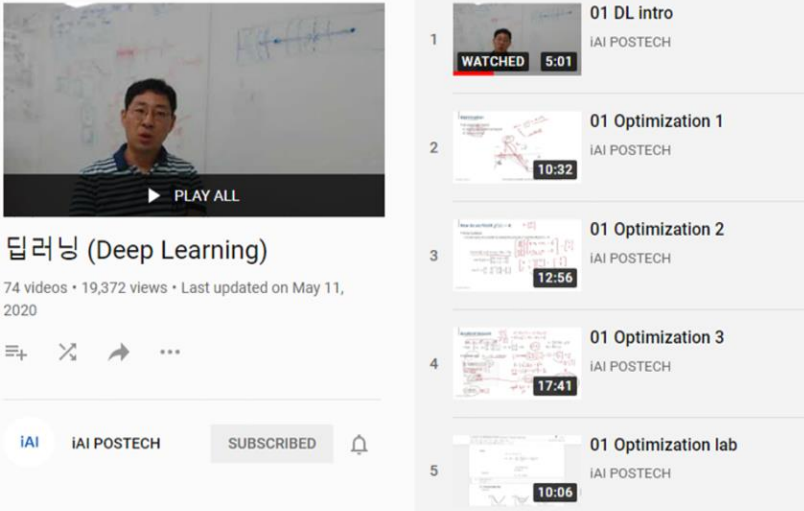
- Deep learning will not be covered in this course
- I am lecturing a graduate course for deep learning in fall semester
 - Advanced AI for ME (MECH527)
 - 고급기계인공지능 in Korean
- For those who are eager to learn about deep learning
 - <https://iai.postech.ac.kr/teaching/deep-learning>
 - <https://www.youtube.com/playlist?list=PLGMtjo8jDX9BuhD15T0W0E-loUhAwgFpZ>



DEEP LEARNING

Deep Learning
[YouTube]

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	Machine Learning	INote#02_1			
	Machine Learning with TensorFlow	INote#02_2	pdf#02	HW#02	HW#02 Solution



▶ PLAY ALL

딥러닝 (Deep Learning)

74 videos • 19,372 views • Last updated on May 11, 2020

1 01 DL intro IAI POSTECH 5:01

2 01 Optimization 1 IAI POSTECH 10:32

3 01 Optimization 2 IAI POSTECH 12:56

4 01 Optimization 3 IAI POSTECH 17:41

5 01 Optimization lab IAI POSTECH 10:06

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- 기계공학과 인공지능을 접목하는 연구를 시작하고 있으며
- 관련 정보들을 모아두었습니다.
 - <https://sites.google.com/view/aiksme>