Introduction

Prof. Seungchul Lee

Industrial AI Lab.

Introduction

- 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

Tutorial Materials

- All tutorial materials are already available at
  - http://iai.postech.ac.kr/index.php/tutorials/

TUTORIALS

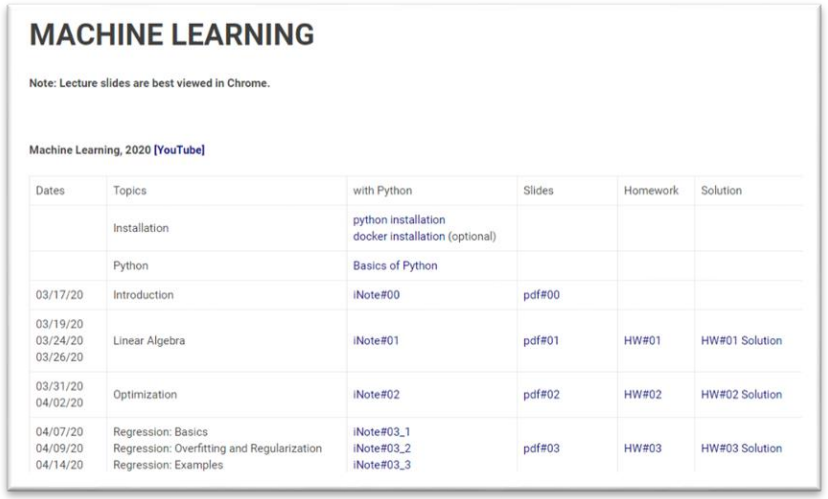
Note: Lecture slides are best viewed in Chrome.

[대한금속·재료학회] 인공지능재료과학 분과 2020 하계단기강좌 "딥러닝의 기초이론과 재료설계 및 공정 최적화에 응용"

Dates	Topics	Jupyter notebook	Slides
07/01/20	Python Installation		
	Linear Algebra	iNote#01	pdf#01
	Optimization and Gradient Descent	iNote#02	pdf#02
	Regression	iNote#03	pdf#03
	Classification	iNote#04	pdf#04
07/02/20	Artificial Neural Networks	iNote#05	pdf#05
	Autoencoder	iNote#06	pdf#06
	Convolutional Neural Networks (CNN)	iNote#07	pdf#07
	Generative Adversarial Networks (GAN)	iNote#08	pdf#08

(홍보) Machine Learning and Deep Learning

- All lecture materials are already available at
  - http://iai.postech.ac.kr/index.php/machine-learning/
  - http://iai.postech.ac.kr/index.php/deep-learning/

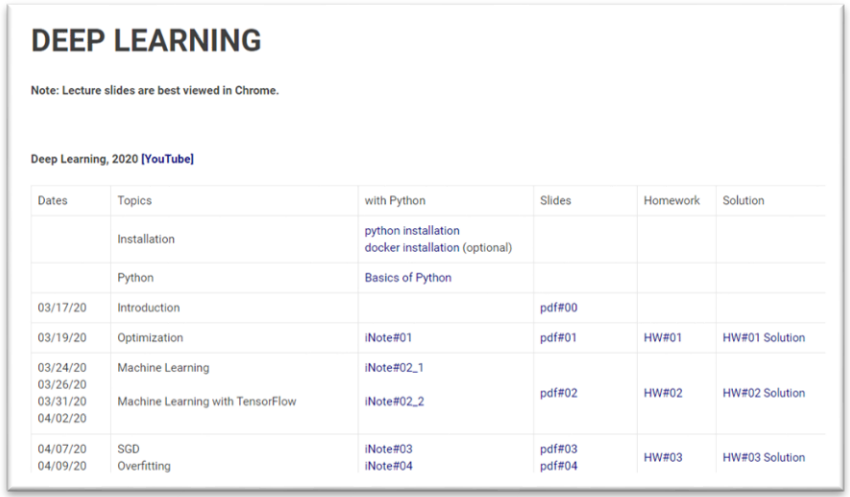


MACHINE LEARNING

Note: Lecture slides are best viewed in Chrome.

Machine Learning, 2020 [YouTube]

Dates	Topics	with Python	Slides	Homework	Solution
	Installation	python installation docker installation (optional)			
	Python	Basics of Python			
03/17/20	Introduction	iNote#00	pdf#00		
03/19/20 03/24/20 03/26/20	Linear Algebra	iNote#01	pdf#01	HW#01	HW#01 Solution
03/31/20 04/02/20	Optimization	iNote#02	pdf#02	HW#02	HW#02 Solution
04/07/20 04/09/20 04/14/20	Regression: Basics Regression: Overfitting and Regularization Regression: Examples	iNote#03_1 iNote#03_2 iNote#03_3	pdf#03	HW#03	HW#03 Solution



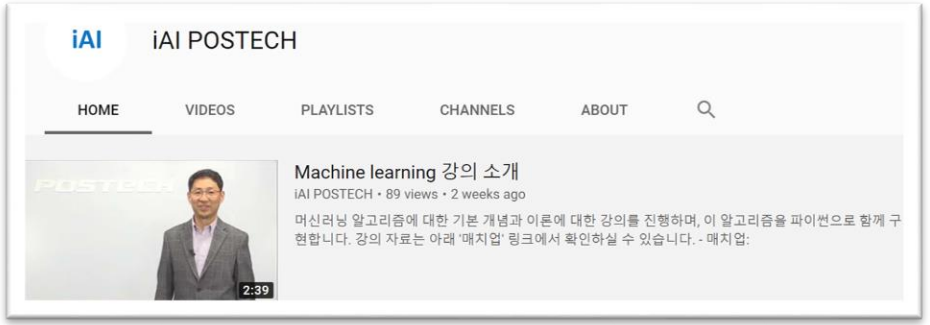
DEEP LEARNING

Note: Lecture slides are best viewed in Chrome.

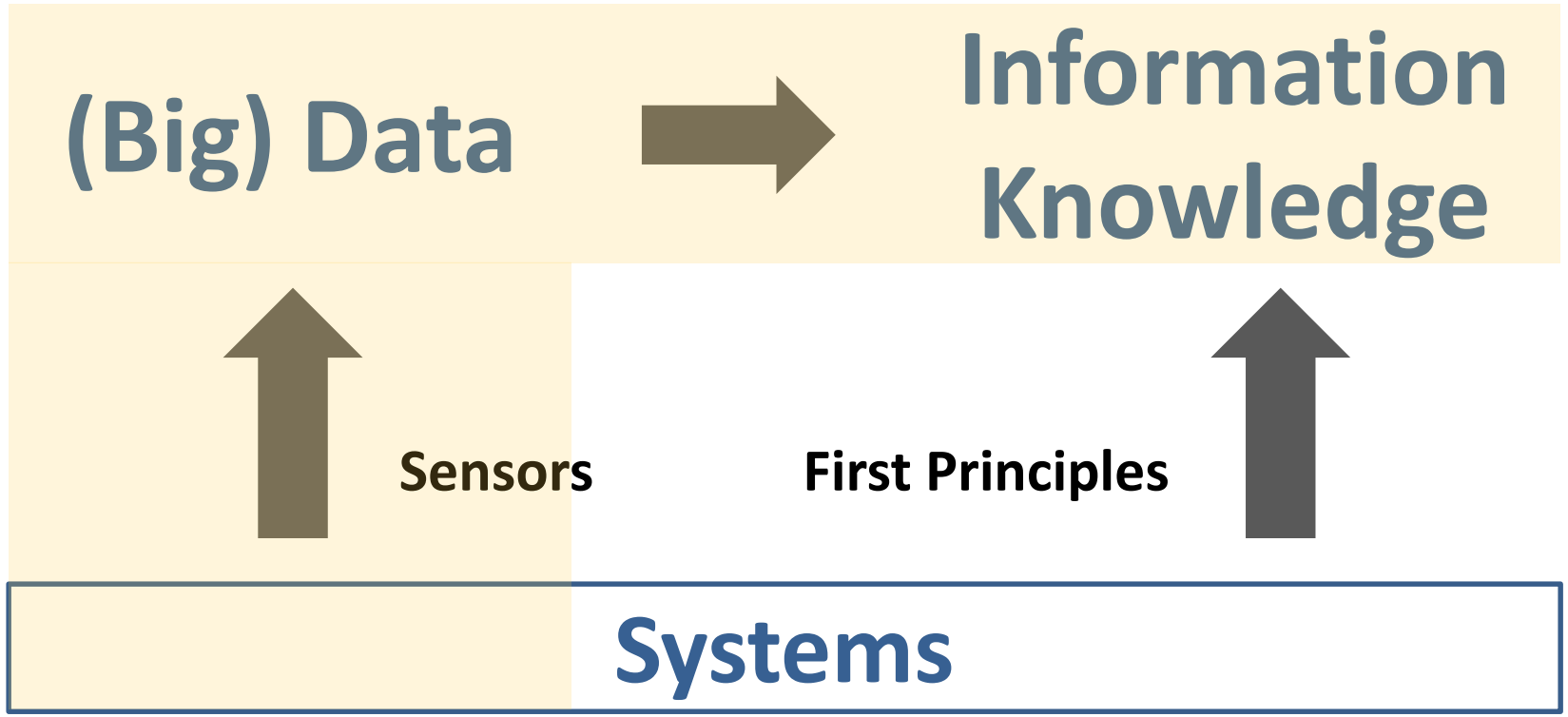
Deep Learning, 2020 [YouTube]

Dates	Topics	with Python	Slides	Homework	Solution
	Installation	python installation docker installation (optional)			
	Python	Basics of Python			
03/17/20	Introduction		pdf#00		
03/19/20	Optimization	iNote#01	pdf#01	HW#01	HW#01 Solution
03/24/20 03/26/20 03/31/20 04/02/20	Machine Learning Machine Learning with TensorFlow	iNote#02_1 iNote#02_2	pdf#02	HW#02	HW#02 Solution
04/07/20 04/09/20	SGD Overfitting	iNote#03 iNote#04	pdf#03 pdf#04	HW#03	HW#03 Solution

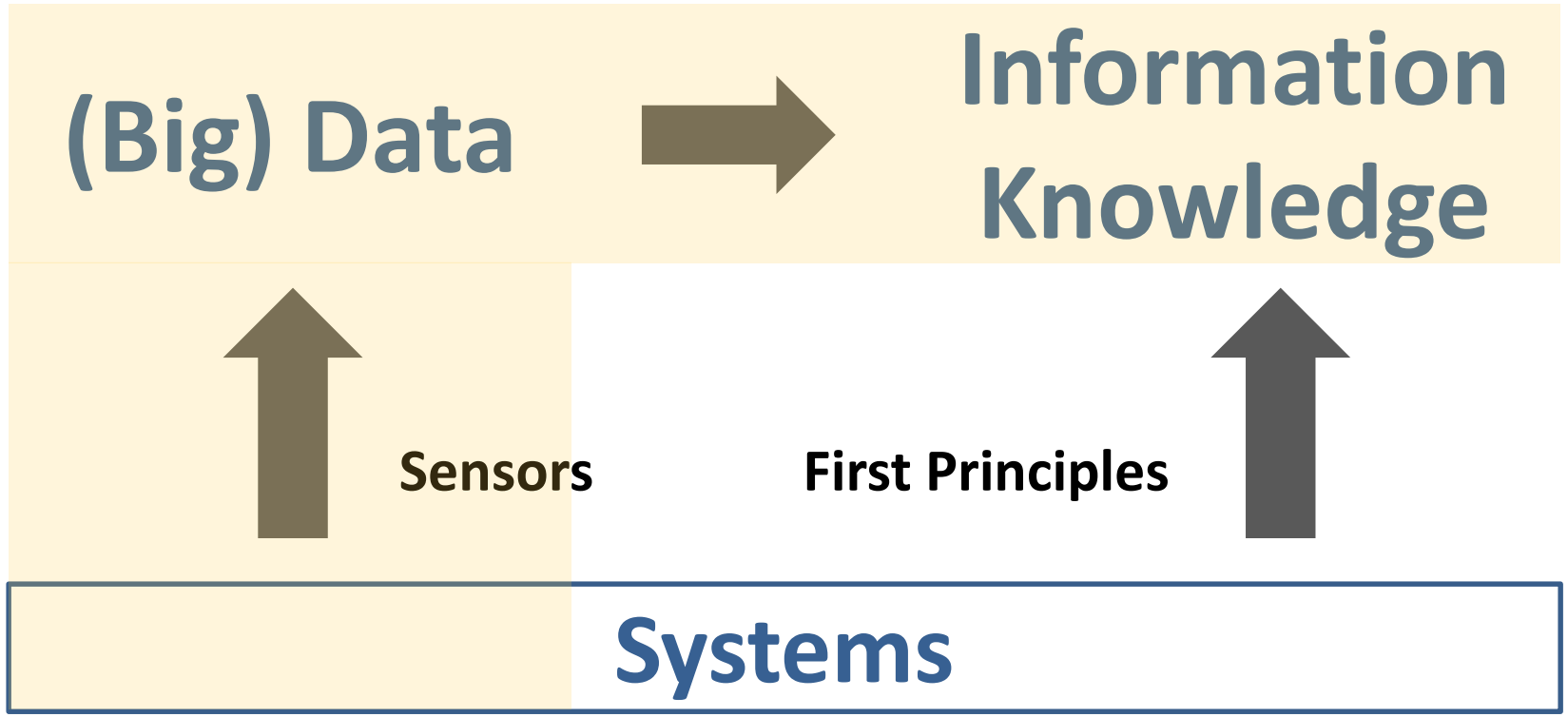
- 동영상 강의
  - YouTube
  - iAI POSTECH 검색
  - 구독



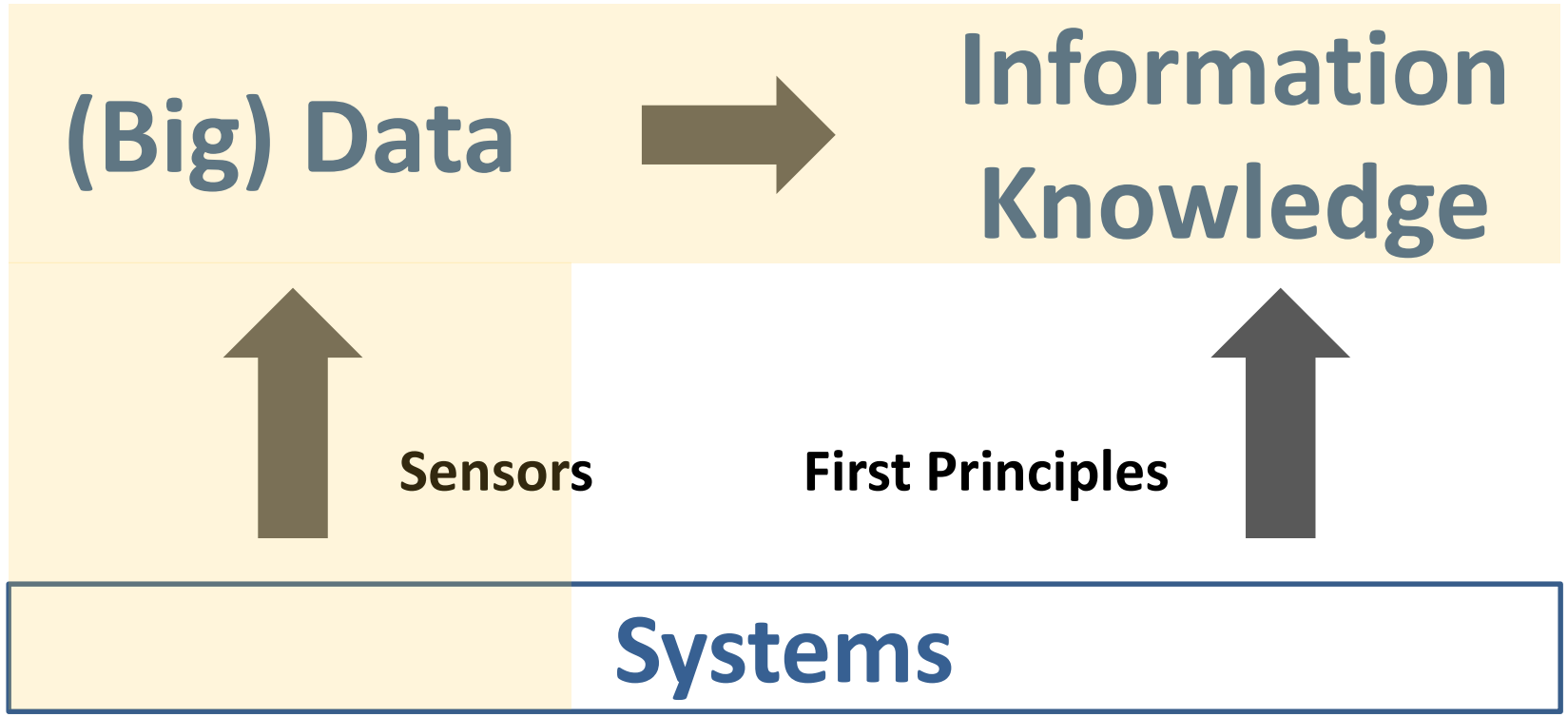
Statistics


(Big) Data
Information
Knowledge
Sensors
First Principles
Systems

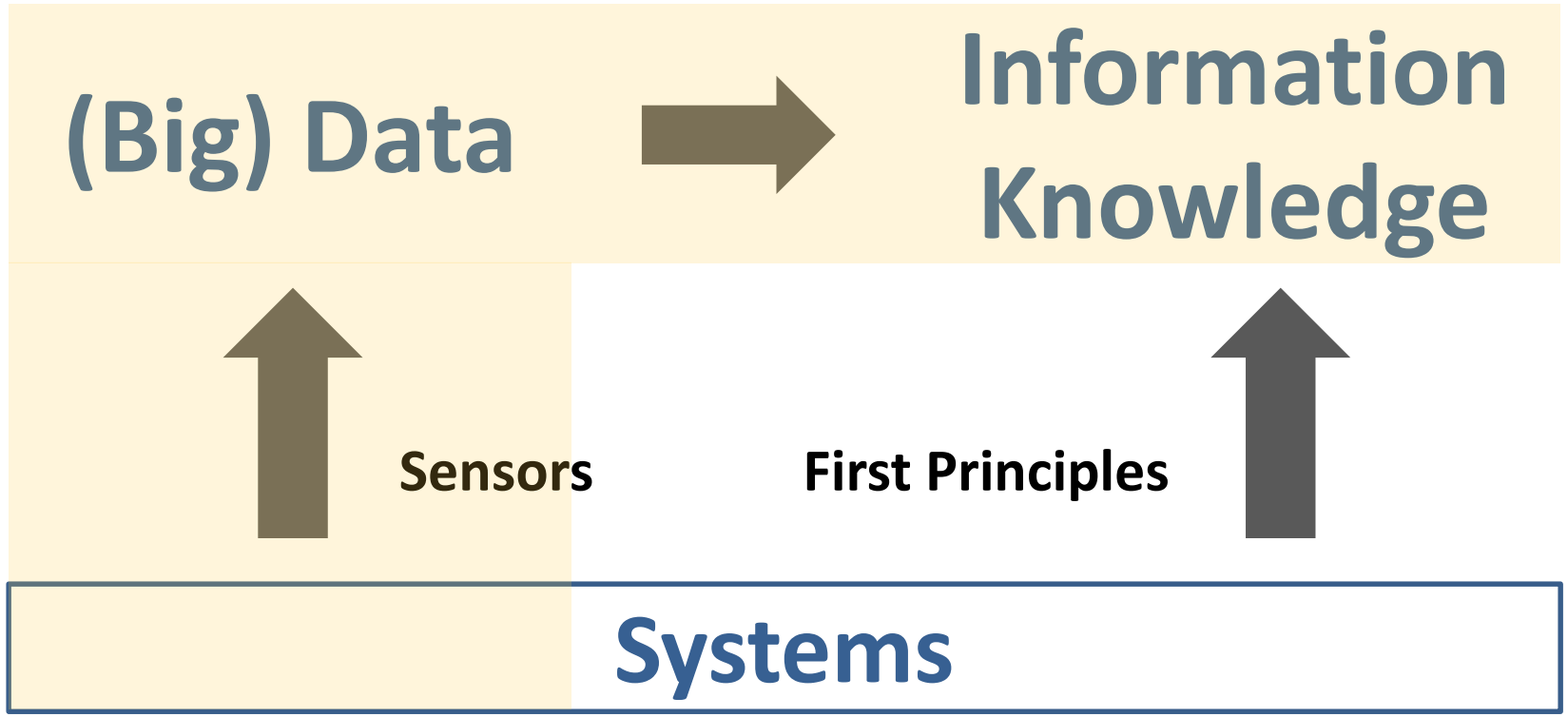
Statistics + Computer Science



Artificial Intelligence (AI)



Machine Learning and Deep Learning



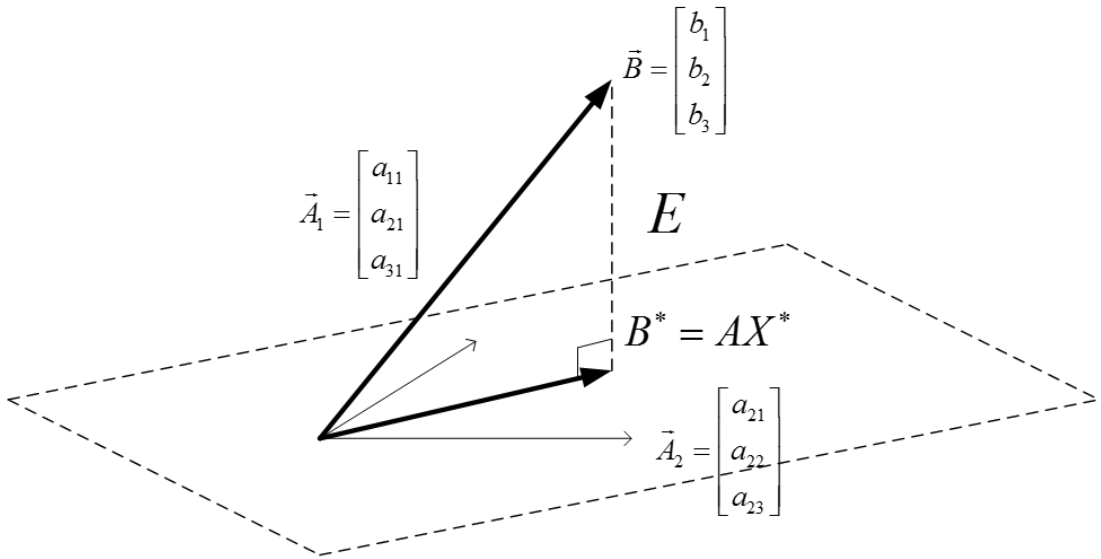
Python

- 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
```

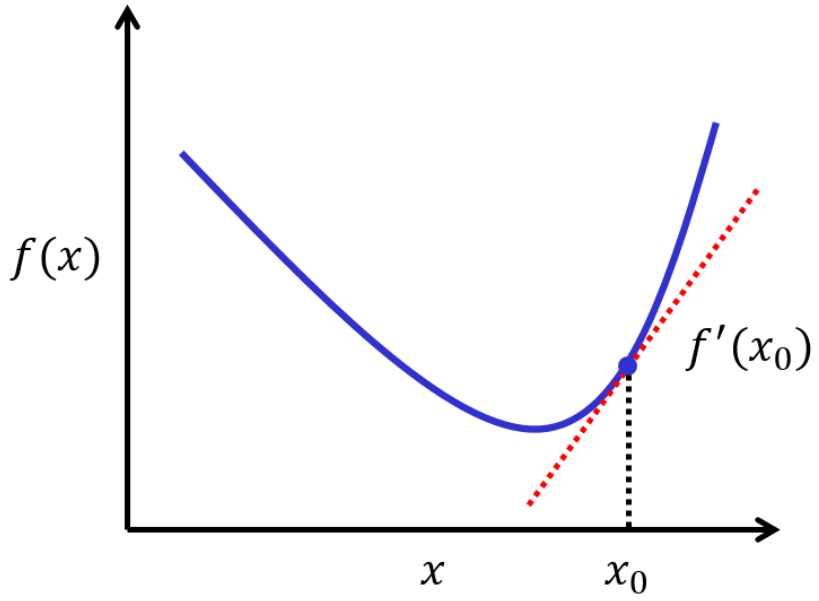
Linear Algebra

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



Optimization

- Least squares
- Convex optimization
- Gradient descent



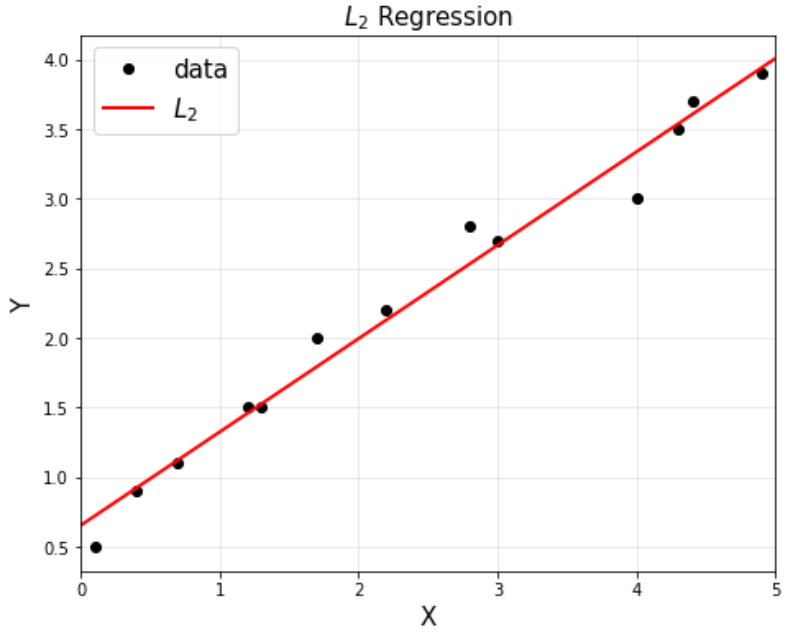
Statistics and Probability

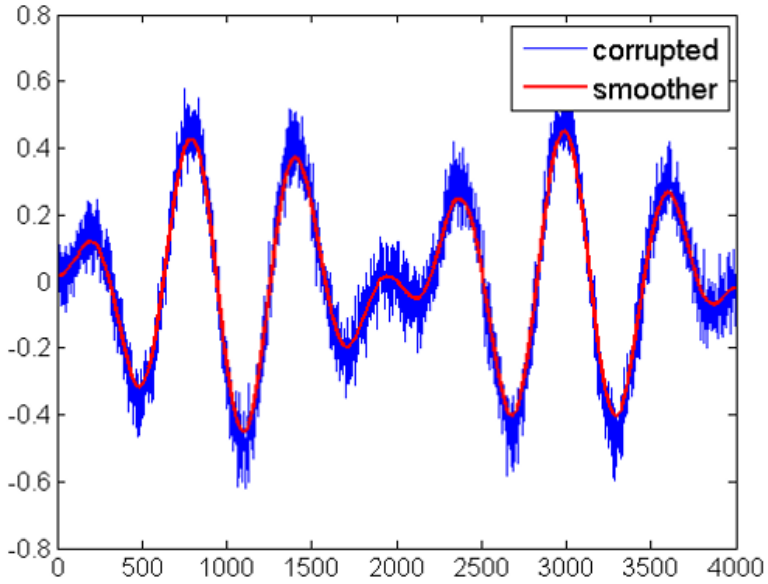
- Statistics
  - Law of large numbers, central limit theorem
  - Correlation
  - Monte Carlo simulation

- Probability
  - Random variable, Gaussian density distribution, conditional probability
  - maximum likelihood (MLE), maximum a posterior (MAP), Bayesian thinking

Regression (Data Fitting or Approximation)

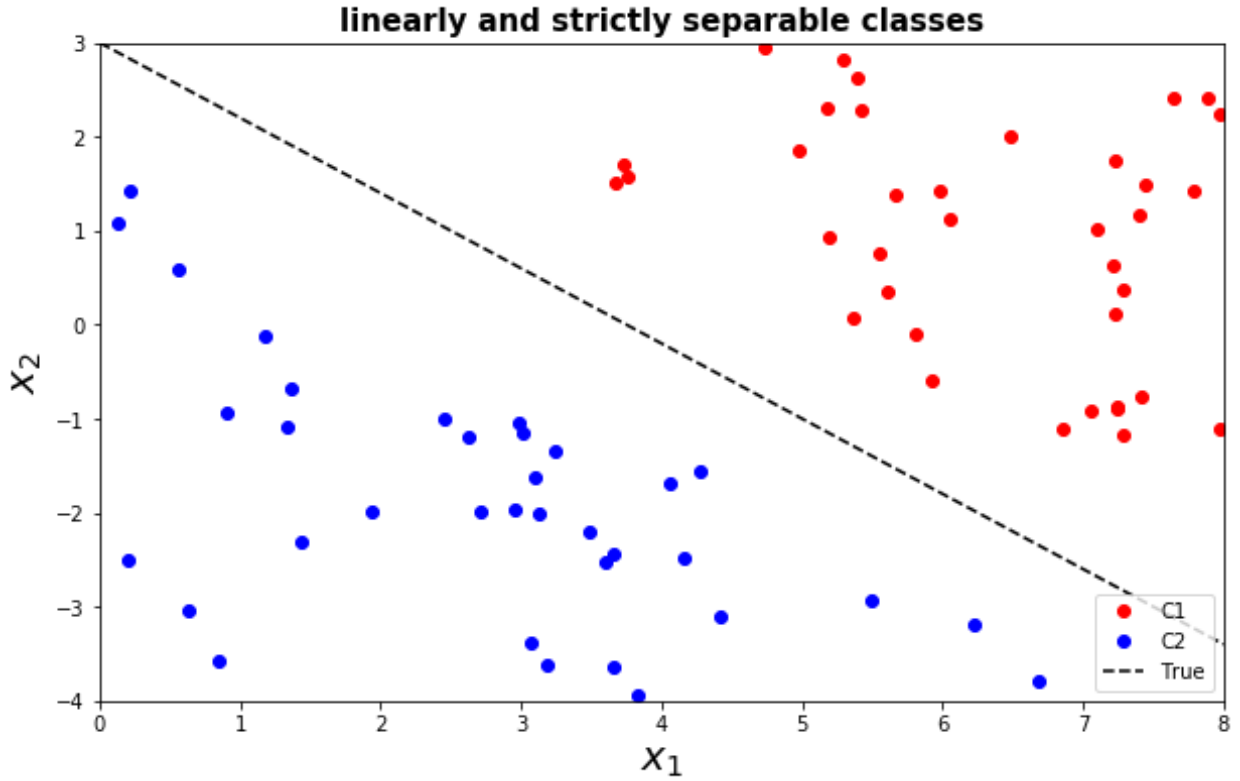
- Statistical process for estimating the relationships among variables





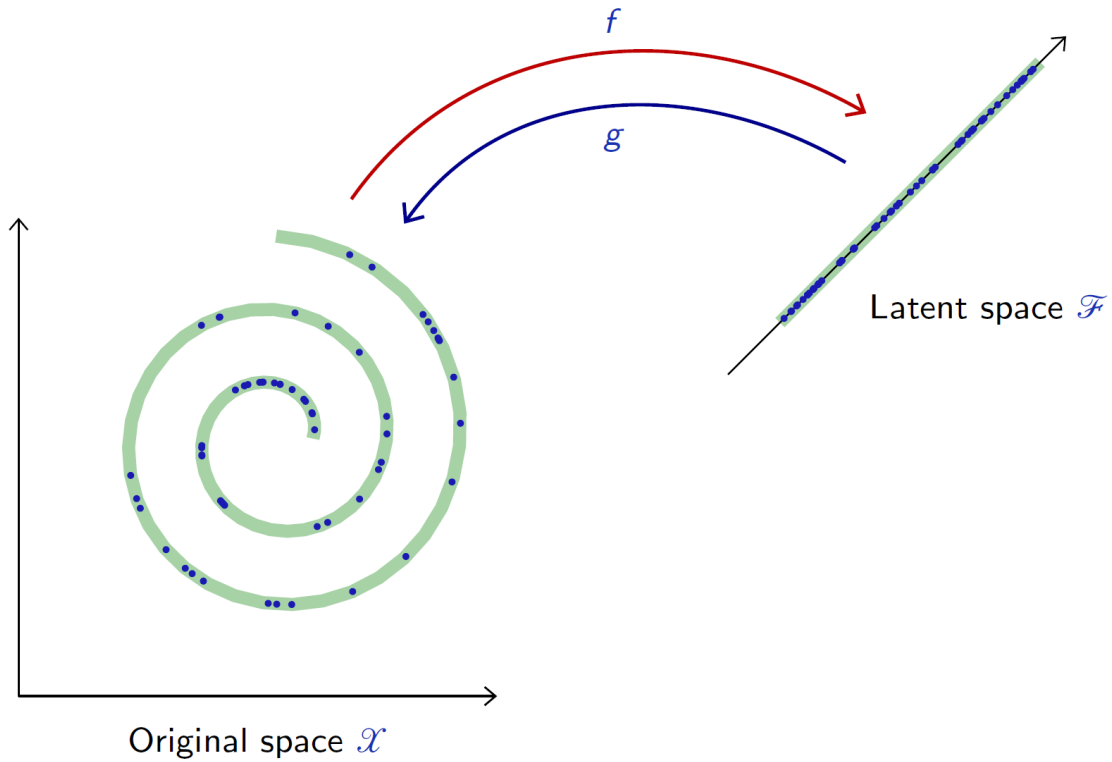
Classification

- 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

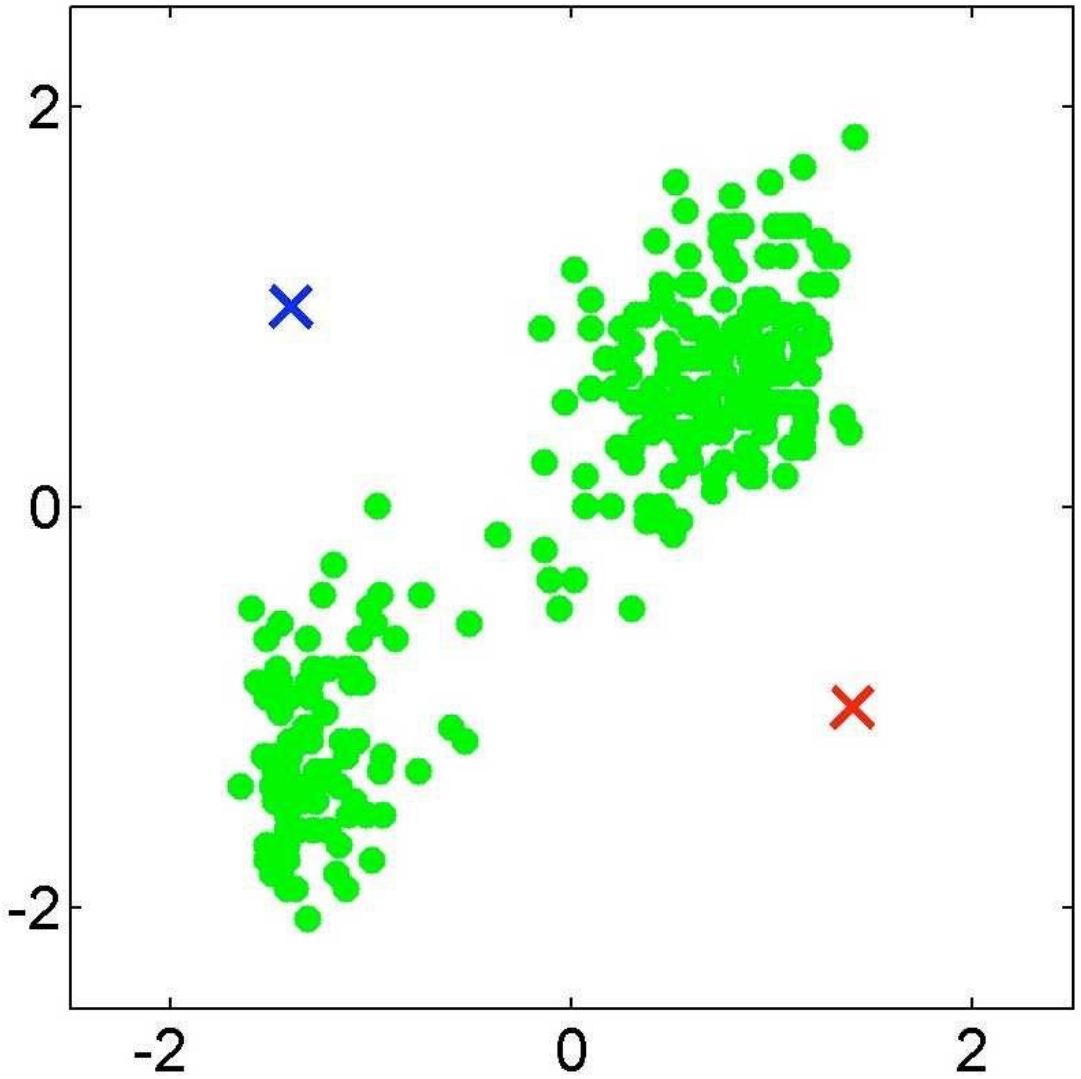


Dimension Reduction

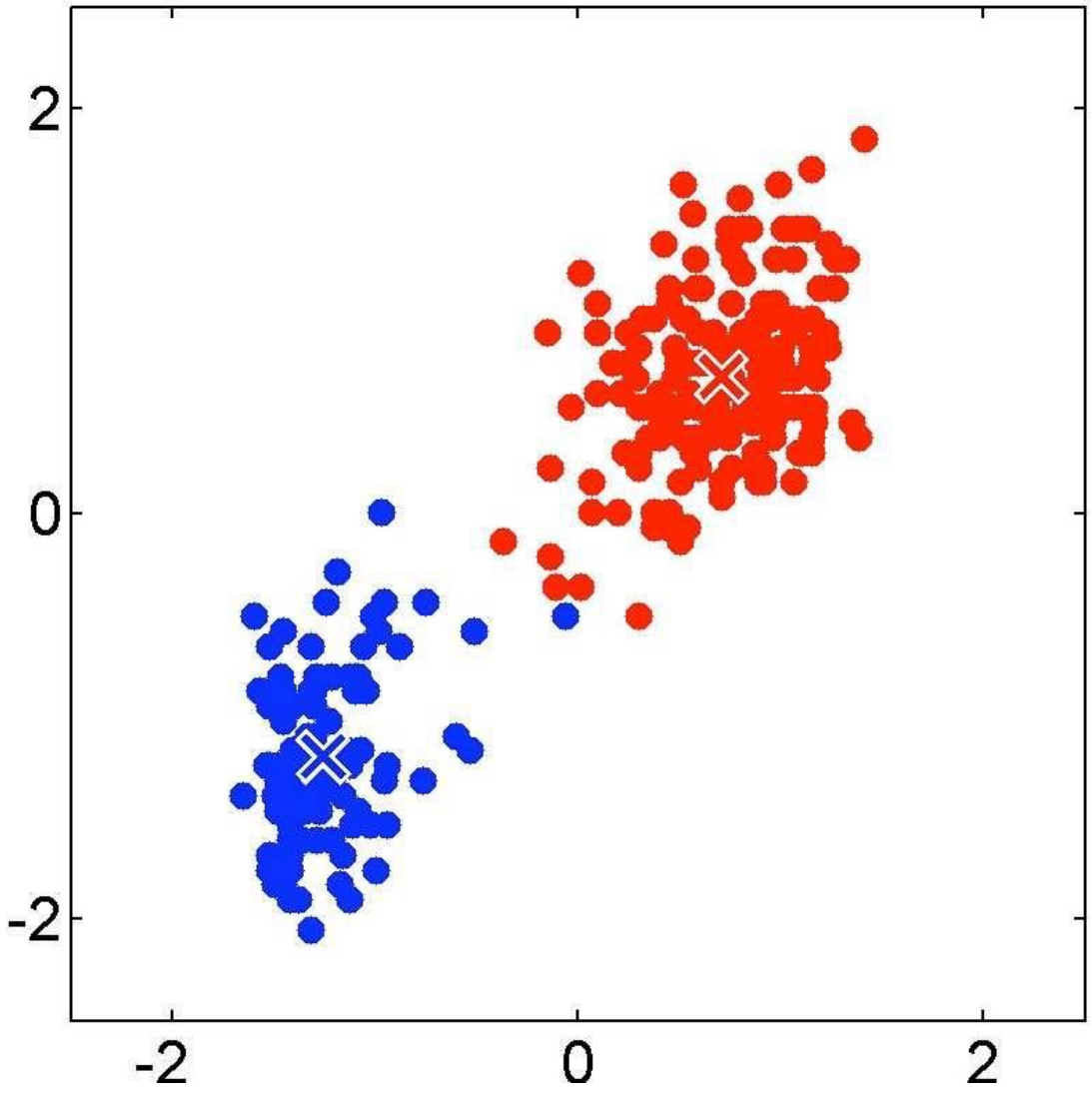
- the process of reducing the number of random variables under consideration, and can be divided into feature selection and feature extraction.



Clustering



Clustering



Deep Artificial Neural Networks

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