Foundations of Machine Learning (ECE 5984)

- Course Logistics-

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Course Description

Machine learning studies how to make computers learn from data or experience. It has become a key component of modern Artificial Intelligence (AI) system and has been successfully used in many industrial applications, such as self-driving cars, assistative robots, chatbots, advanced searching, advertising, and so on. This course introduces key concepts and foundations of machine learning and various popular algorithms being used in the real-world problems. It is designed to give students not only practical machine learning algorithms but also in-depth mathematical and algorithmic grounding in the methods.

Prerequisites

- Calculus and Linear Algebra (GEDB001, GEDB002, GEDB003 or equivalents)
- Probability (ICE 2003 or equivalent)
- Basic programming skills
  - python, matlab, c, c++

Offline Lecture

- A typical whiteboard/blackboard lecture
- The slides may often be used for better and clear presentations
- The code demos will be provided
- ‘Cornerstone’ course
  - You will write the codes as a part of homework assignments
- This is an ‘English only’ course.
  - I will use English all the time
  - You are allowed to speak in Korean, e.g. asking questions. Then, I will try to translate it

Grading

- Class attendance and participation - [10%]
  - Bonus points for active participants
  - I will use ‘electronic attendance check’ provided by SKKU

- Homework - [40%]
  - There will be 4 assignments, including programming
  - It must be ***‘typed’***
  - Colab or Jupyter Notebook source code submission

- Final exam - [50%]
  - Openbook

Tentative Schedule

(W1) Introduction, Linear algebra and probability reviews	(W9) Neural networks
(W2) Linear regression, Gradient descent, Probabilistic interpretation	(W10) Neural networks
(W3) Logistic regression, Perceptron, Regularization	(W11) K-means clustering, Gaussian mixture models
(W4) Generalized linear models **(HW1)**	(W12) Expectation-maximization (EM) algorithm **(HW3)**
(W5) Gaussian discriminant analysis, naive bayes	(W13) Decision tree, Bagging, Boosting
(W6) Support vector machine, Convex optimization	(W14) Principal component analysis / Independent component analysis **(HW4)**
(W7) Kernel methods **(HW2)**	**(W15) Final Exam**
(W8) Learning theory	

TA and Contacts

- Junwoo Cho (jwcho000@g.skku.edu)

- Email only - I will not check the i-campus message
- Subject line must start with ‘[ECE 5984]’

Study Group

- It is not mandatory, but highly encouraged
  - This is a math heavy course
- You can discuss homework in study groups, but the solution should be written on your own.

Textbooks and References

- No textbooks, but just for your reference
- CS229 lecture notes (https://cs229.stanford.edu/syllabus.html)
- CS4780 lecture notes (https://www.cs.cornell.edu/courses/cs4780/2018fa/lectures/)
- PRML by Christopher Bishop at Microsoft Research
- Machine Learning by Kevin Murphy (Machine Learning | The MIT Press)
- Elements of Statistical Learning: data mining, inference, and prediction. 2nd Edition. (stanford.edu)

Good Luck!