Statistical Machine Learning

Special Subjects
Elective 2 credit

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1. Course Description

Machine learning has significant performance improvement in recent years, therefore various fields adopt machine learning techniques. As machine learning has various methods, therefore, this subject will introduce the concept of statistical machine learning. To consider phenomena with uncertainty, statistical machine learning will give you a stable model estimated from statistical methods with high probability. You will study various basic methods of statistical machine learning with simple exercises using computer.
This subject corresponds to the diploma policy DP3.

2. Course Objectives

With the precondition that you have studied artificial intelligence and mathematical statistics for undergraduate, you will be able to understand various methods of statistical machine learning.

3. Grading Policy

Your overall grade in this class will be decided based on the final examination.
The two reports are required to receive the right to take the final examination, and the results of the two report are not considered for your overall grade.

4. Textbook and Reference

Textbook
You do not need any textbooks.
The lecture instruction book and materials such as Microsoft Excel macro programs for exercises are posted on LMS.
Reference
T. Hastie et al. The Elements of Statistical Learning 2nd. Ed., ISBN 978-0387848570. Springer
Goto and Kobayashi Introduction to pattern recognition and machine learning, ISBN 978-4-339-02479-1 (in Japanese). Corona-sha
Sugiyama Statistical machine learning, ISBN 978-4-274-50248-4 (in Japanese). Ohm-sha
Y. Wakui Bayes statistics as tools, ISBN 978-4-534-04647-5 (in Japanese). Nippon Jitsugyo Publishing
Y. Wakui and S. Wakui Bayes statistics, ISBN 978-4-8163-5181-5 (in Japanese). Natsume-sha
You can find the other good reference documents, so please obtain them for your own purpose.

5. Requirements(Assignments)

You should study the subject "multivariate analysis" for precondition of statistical machine learning, if you do not understand multivariate analysis at all.
To study statistical machine learning as well as multivariate analysis, it is important for you not only to learn the knowledge and technique, but also to experience the calculation by yourself.
You should review the exercises for each technique of statistical machine learning and apply them to your own problems.

6. Note

As you do the computer exercises using Microsoft Excel macro programs for Windows, you should prepare a Microsoft Windows PC with an internet connection and confirm whether Microsoft Excel 2007 or later can work on the PC.
This course will be taught in Japanese.

7. Schedule

[1] What is statistical machine learning?
[2] Supervised learning (1): linear regression models
[3] Supervised learning (2): logistic regression models
[4] Supervised learning (2): over-learning phenomena and model selection methods
[5] Supervised learning (4): Ridge regression models
[6] Supervised learning (5): PLS regression models
[7] Supervised learning (6): LASSO regression models
[8] Unsupervised learning (1): principal component analysis
[9] Unsupervised learning (2): independent component analysis
[10] Unsupervised learning (3): cluster analysis and k-means methods
[11] Unsupervised learning (4): Gaussian mixture models and EM algorithm
[12] Unsupervised learning (5): Graphical modelling and GLASSO
[13] Bayesian statistics (1): what is Bayesian statistics?
[14] Bayesian statistics (2): Bayes' theorem, etc
[15] Bayesian statistics (3): naive Bayes method, etc