Bayesian Machine Learning

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Timetable: Course of 20 hours. Class meets on Thursday (lecture room) and Friday (lab), 14:30-16:30. First lecture on Thursday, January 17th, 2019.
Room: Thursday lectures: 318 DEI/G, Dept. of Information Engineering, DEI/G Building, 3rd floor. Friday lectures: Te, Dept. of Information Engineering, DEI/G Building, 2nd floor.

Course requirements: Basics of Probability Theory. Basics of R Programming.

Examination and grading: Homework assignments and final project.

SSD:

Aim: The course will introduce fundamental topics in Bayesian reasoning and how they apply to machine learning problems. In this course, we will present pros and cons of Bayesian approaches and we will develop a graphical tool to analyse the assumptions of these approaches in classical machine learning problems such as classification and regression.

Course contents:

Introduction of classical machine learning problems.

1. Mathematical framework
2. Supervised and unsupervised learning

Bayesian decision theory

1. Two-category classification
2. Minimum-error-rate classification
3. Bayes decision theory
4. Decision surfaces

Estimation

1. Maximum Likelihood Estimation
2. Expectation Maximization
3. Maximum A Posteriori
4. Bayesian approach

Graphical models

1. Bayesian networks
2. Two-dimensional visualization

Evaluation

1. Measures of accuracy

References:

[1] J. Kruschke, Doing Bayesian Data Analysis: A Tutorial Introduction With R and Bugs, Academic Press 2010

Christopher M. Bishop, Pattern Recognition and Machine Learning (Information Science and Statistics), Springer 2007

Richard O. Duda, Peter E. Hart, David G. Stork, Pattern Classification (2nd Edition), Wiley-Interscience, 2000

Yaser S. Abu-Mostafa, Malik Magdon-Ismail, Hsuan-Tien Lin, Learning from Data, AML-Book, 2012 (supporting material available at http://amlbook.com/support.html)

David J. C. MacKay, Information Theory, Inference and Learning Algorithms, Cambridge University Press, 2003 (freely available and supporting material at http://www.inference.phy.cam.ac.uk/mackay/

David Barber, Bayesian Reasoning and Machine Learning, Cambridge University Press, 2012 (freely available at http://web4.cs.ucl.ac.uk/staff/D.Barber/pmwiki/pmwiki.php?n=

Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012 (supporting material http://www.cs.ubc.ca/ murphyk/MLbook/)