CSC4007 Advanced Machine Learning (2018-2019)

Module Description

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Pre-Requisites

CSC3060-QUB-AUT [Artificial Intelligence and Data Analytics] or CSC3061-QUB-SPR [Video Analytics and Machine Learning] or basic maths skills (linear algebra, optimization, probability theory)

Co-Requisites

None

Compulsory Element

None

Course Contents

• Overview of learning problems

• Supervised Learning
o Linear regression
o Feature mapping
o Regularization
o Validation
o Over-fitting vs. under-fitting
o Classification

• Kernel Methods
o Kernelization, non-linear feature mapping
o Support vector machine

• Ensemble Methods
o Model averaging
o Model selection

• Unsupervised learning
o Dimensionality reduction
o Clustering

• Neural networks
o Convolutional networks
o Auto-encoders
o Recurrent Networks

Supplementary Notes

None

Learning Outcomes

Be able to:
• Explain when and how machine learning is useful in industry, public institutions and research.
• Know and apply state-of-art machine learning techniques.
• Demonstrate the ability to understand and describe the underlying mathematical framework behind these operations.
• Design and develop original machine learning pipelines applied to a variety of problems
• Formulate and evaluate novel hypothesis
• Analyse an application problem, considering its suitability for applying machine learning, and propose a sensible solution
• Evaluate the performance of proposed machine learning solutions through rigorous experimentation
• Analyse quantitative results and use them to refine initial solutions
• Communicate finding effectively and in a convincing manner based on data, and compare proposed systems against existing state-of-art solutions

Skills

Problem solving. Self and independent learning. Research. Working with others and organisational skills. Critical analysis. Quantitative evaluation. Mathematical and logical thinking.

Textbooks

[1] Trevor Hastie, Robert Tibshirani and Jerome Friedman: The Elements of Statistical Learning: Data Mining, Inference, and Prediction Springer, Second Edition, 2009.
[online at http://www-stat.stanford.edu/~tibs/ElemStatLearn/]
[2] Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach: Deep Learning (Adaptive Computation and Machine Learning Series), 2017
[publicly online: https://www.deeplearningbook.org/]