HIS 2011 Pre-conference Workshop

11ᵗʰ International Conference on Hybrid Intelligent Systems
December 5-8, 2011, Malacca, Malaysia

"Bayesian Neural Network Workshop"

General Synopsis

Regularization imposes stability on an ill-posed problem [R1], the equation is ill-posed if it is not well-posed [A1]. The effect of regularization is the output smoothing of the neural network. With an attempt of smoothing, it improves the generalization of neural network by a mechanism to balance between how well the function fits the data and how smooth it is (penalizing using Bayesian prior) [R2]. There are many approaches in regularization, namely Tikhonov Regularization, Iterative Regularization, etc. In this workshop, we will explore the Bayesian Regularization which imposes prior distributions on model parameters. The model parameters involved are the weights of the Neural Network.

Notes:

- [R1] : Henna Umar "Regularization",
  http://homepages.inf.ed.ac.uk/rbf/CVonline/LOCAL_COPIES/AV0405/UMAR/ .

- [R2]: Micheal E. Tipping, "Bayesian Inference: An Introduction to Principles and Practice in Machine Learning".

- [A1]:

  According to Hadamard, a problem is well-posed (or correctly-set) if
  a. it has a solution,
  b. the solution is unique,
  c. the solution depends continuously on data and parameters.
  Or a solution exists for each $y \in Y$, $\exists \ x \in X$ such that $Ax = y$
  the solution is unique i.e. $Ax1 = Ax2 \ \Rightarrow \ x1 = x2$
  the solution is stable i.e. $A-1$ is continuous

Learning Objectives

At the end of the workshop, participants will be able:-
- To identify ill-posed problem.
- To regularize ill-posed problem using Bayesian approach.
- To integrate Bayesian Methods with MLP Neural Networks.

Method of delivery

The workshop will be conducted with a mixture of both lecture and practical oriented mode. Fundamental theories of the discussion topics will be delivered via lecture while the implementation will be carried out with hands-on approach.

This is a half day session with schedule as follows:

Session	Length	Topics
1	1 .5 hour	Theory and fundamentals of regularization and Bayesian method.
2	1 .5 hour	Fundamentals of Neural Networks and how Bayesian regularization connects to it.
3	1 hour	Practical/hands-on examples in MATLAB

Discussion Topics

The discussion includes Bayesian Method, Frequentist method versus Bayesian method, Hyperparameters, *Maximum a posteriori* probability (*MAP*), Neural Networks, Weight penalty, Integration of Bayesian Methods in MLP Neural Networks and the Review on other regularization techniques.

Pre-requisite Skill Level

Basic knowledge in Neural Network and sore exposure in Bayesian techniques

Provided Handouts/Takeaways

Each attendee will take with them Hot MATLAB codes that they can then use after the conference.

Presenter

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Mohammad Shazri bin Shahrir is a research and development engineer currently leading the AI research cluster at Extol MSC Berhad, Malaysia. He has worked extensively on the artificial intelligent research projects particularly in pattern recognition. His work has included detailed analysis, design, augmentation and prototyping of the solutions in Quantum Cryptography, Signature verification, face recognition and verification, time tabling, etc. Shazri's research interests include mathematical and machine learning theories and implementation such as Neural Networks, SVM, ARTMAP, AdaBoost, Bayesian Believe Networks, Principal Component Analysis, Fisher-Face , Eigen-face, Laplacian Face, Mahalonobis Distance, Solving Eigen-Problem, Quadratic Programming, Inverse of Arbitrarily Sized Symmetric Matrices, Primal-Dual Simplex, Integer Programming,Time-Tabling Problem, Image Manipulation, Discrete Fourier Transform, Wavelet Transform, etc.