CHAPTER 3

PROBLEM STATEMENT AND RESEARCH METHODOLOGY

“The formulation of the problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill” - Albert Einstein

The problem that is taken up in this research is to improve the training speed of NN. In order to speed up the NN training process, many research works have investigated the detriments and devoted their efforts to various formation ranges from different amendments of existing algorithms to evolution of new algorithms. The different amendments includes initialization of optimal initial weight, adaptation of learning rate, adaptation of the momentum term, adaptation of the momentum term in parallel with learning rate adaptation and second order algorithm. This research focuses on improving the training speed of NN through stochastic sample selection mechanism. This chapter has clearly defined the problem that is being dealt with this research and also the objective of the research.

3.1 PROBLEM DEFINITION

Neural Network is the most accurate and popular strategy for solving classification problem due to its eminent characteristics (Lippmann 1987; Mehra and Wah 1992). Classification is the task that falls within the paradigm of supervised learning. The Back Propagation Network (BPN) is the most popular supervised training algorithm that has been used to train NN extensively for the past two decades (Rumelhart and McClelland 1986).
All of the previously mentioned efforts are focused on speeding the training process by reducing the total number of epochs or by converging quickly. But each and every technique employs all the input samples in the training dataset to the network for classification at each and every single epoch. In order to generalize the neural network well, both underfitting and overfitting of the training dataset should be avoided. Large amount of training dataset is required to avoid overfitting. However, large amount of training data normally requires very long training time (Plagianakos et al 1998) which affects the training rate. If a large amount of training data with high dimension is rendered for classification, then the existing techniques have a problem by slowing down classification. There is a real fact that the correctly classified input samples are not involved in the weight updation since the error rate is calculated based on the misclassification rate. So, the intention of this research is to propose a simple and new time efficient algorithm for training NN in a fast manner. The core idea is when an input pattern is categorized perfectly by the network, it will not be presented again for the subsequent n epochs. Only the patterns that are not categorized perfectly will be presented again for the next epoch. By this, the total number of trained input samples employed by the network gets reduced. Thereby, reducing the total amount of training dataset will reduce the training time.

3.2 OBJECTIVES

The main goal of the thesis is to improve the training speed of NN without affecting the performance of the system. The objectives in order to attain the above goal are:

- To develop simple and time efficient training algorithms for improving the training speed of NN through stochastic manifestation of training datasets.
• To incorporate into BPN supervised training algorithms for training the larger dataset for both binary and multiclass classification problems, and also into an incremental learning method

• To estimate the performance of the proposed training algorithms optimistically, the experiment is carried out using 5-fold cross-validation methods.

• To make thorough analysis of the proposed algorithm, the experiment is repeated by varying the training parameters for datasets with different dimension.

• To investigate the performance of the new algorithm with the existing algorithms both experimentally and statistically

3.3 SCOPE OF RESEARCH

A three-layer feedforward neural network is adopted for implementing BPN algorithm and all the AST training algorithms with same training architecture and training parameters. The performance of the proposed AST algorithms and the existing algorithm is compared and analysed in terms of training samples, training time and accuracy. In order to verify the efficiency of the proposed algorithms, the four datasets from University California Irvine Machine Learning Repository (UCIMLR) (Asuncion and Newman 2007) were employed which include Iris and Waveform datasets with multiple class and Heart and Breast Cancer datasets with binary class. The experiments are repeated with different learning rates for in-depth analysis and validated using fivefold cross validation method to avoid overfitting and the results are analysed. As a consequence, many issues concerning generalization, training data preprocessing and feature extraction are beyond the scope of this thesis. Although the focus in this work is the MLP, it is clearly important to develop techniques that are applicable to other models or systems with the same general characteristics.
3.4 RESEARCH METHODOLOGY

In this research, both algorithmic research and experimental research methodology (Paneerselvam 2006) were put in practice. The algorithmic research is carried out by developing the new training algorithms to obtain the optimal solution for the research problem. The experimental research is carried out with the implementation of developed time efficient training algorithms for varying training dataset sizes for two-class classification and multi-class classification problems and also for different learning rate using five-fold cross validation technique. The training performance of all AST algorithms are compared with that of the existing techniques and the empirical results yielded from various experiments are rendered in the form of tables, graphs and bar charts. In order to verify the results statistically, statistical analysis was carried out using factorial ANOVA (Analysis of Variance) to study the performance of each algorithm, as well as the effects of interactions between algorithms on the response variable.

3.5 CONCLUSION

This chapter has clearly delivered the definition of the problem that is being chosen in this research. The objective of the research has been provided and the scope of research has also been outlined. The research methodology that is being followed for analyzing the results statistically is also portrayed in this chapter.