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Neuro-Fuzzy Based Intelligent System for Performance Evaluation of Team Members

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Abstract

In this research paper, a neuro-fuzzy based intelligent system is developed for performance evaluation of team members. This system has five inputs and one output. The inputs are engagement survey, employee satisfaction, special project count, days late last 30 and absence. The output is performance score of a team member. Each input and output are having their membership functions. Every input is having three membership functions. The output is having four membership functions. These membership functions are discussed in section of proposed work. The whole work is implemented in MATLAB software. The dataset is taken from Kaggle website. The accuracy of proposed system is 92%.

Introduction

Fuzzy logic is a developing tool for its modelling using real values taken from structured range. It is likely to maintain as many features of classical logic as feasible. Fuzzy logic is a data processing methodology that is highly advisable when trying to model imprecise information and to make rational decisions in an uncertainty environment. The fuzzy expert system is based on three walks. In the first walk, the non-fuzzy set is transformed into fuzzyset. It is known as fuzzification. In the second walk, the input fuzzy set is converted into output fuzzy set. In the third walk, the fuzzy set value is converted into concrete value. Mamdani fuzzy system is broadly acknowledged for confining skilled knowledge. It consents to illustrate the knowledge in extra perceptive way. Mamdani fuzzy system employs the method of defuzzification of a fuzzy outcome. Because of the perceptive environment of the rule base, the decision support applications widely use Mamdani fuzzy system. Mamdani fuzzy system is inflexible in a design phase of a system. In Sugeno fuzzy system, the crisp output is calculated by using weighted average method. Therefore, the defuzzification procedure is bypassed in Sugeno fuzzy system. Sugeno fuzzy system has no output membership functions. Sugeno technique is computationally proficient and works healthy with adaptive and optimization procedures, which builds it very striking in direct problems. The optimization and adaptive procedures are able to adapt the membership functions so that fuzzy expert system finest forms the data. Neuro-fuzzy system being an adaptive technique is a grouping of fuzzy logic with neural network. This hybrid system can be more efficient. Hence the solving method is adaptive neuro-fuzzy expert system.

Problem Definition

The performance evaluation is a review based upon an individual's job performance and assigned duties. Ideally, performance evaluations provide a stepping-stone for the employee and supervisor to identify and discuss areas where performance can be improved. It can also be an important opportunity for employee and manager expectations to be reinforced or clarified.

Poorly-implemented performance management will cost a company in a number of ways. If an employee performs well and then feels that they were assessed unfairly, they lose self-esteem, which can create resentment towards management, leads to lower engagement and lower performance rates. Also, giving negative appraisals with no data or proof to back up claims of poor performance can be risky. Employees who feel like they haven‟t been evaluated fairly could take legal action against your company. Moreover, without data and metrics to rely on to gauge performance, managers are more likely to give biased reviews. So, intelligent systems are needed to resolve these issues. Simple rule based intelligent systems do not tell the probability that the evaluation of performance of an employee is close to the reality. In simple rule-based systems, although the evaluation is probable but one missing parameter fails to evaluate the employee correctly. The simple rule intelligent systems ask the user about the values of evaluation parameters and users reply yes or no to the parameters. If the users reply yes to all the parameters of evaluation process, then that evaluation is done by the simple rule based medical systems. So, in this way the simple rule based intelligent systems do not calculate the probability of evaluation. Therefore, the concept of fuzzy logic is required. With fuzzy logic, the system is able to calculate the probability that the evaluation is close to reality. Further, the drawback of fuzzy intelligent system is to select and design the membership functions and fuzzy rules manually. It is an important issue in fuzzy modelling. So, to remove this drawback a hybrid model i.e., neuro fuzzy inference system has been used for the evaluation of performance of employees being undertaken in this research. In this inference system, the rules and membership functions are generated automatically.

Proposed Work

The proposed intelligent system based on neuro-fuzzy technique has five inputs. These inputs are as follow:

1. Engagement Survey
2. Employee satisfaction.
3. Special projects count.
4. Days late last 30.
5. Absence.

Engagement Survey

The input Engagement survey has three input membership functions. These membership functions are: Contented, satisfied and unsatisfied. These membership functions are shown in figure 1.

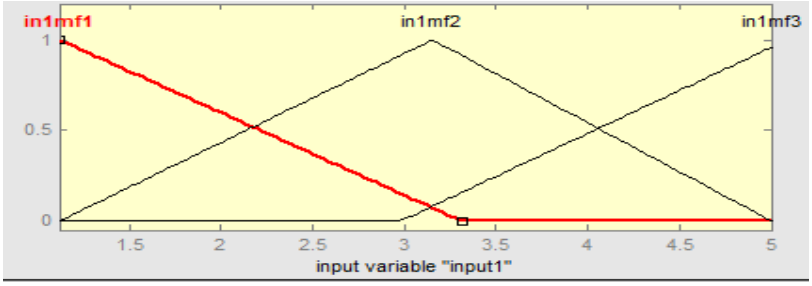

Figure 1: Input membership functions of Engagement survey.

In1mf1: input1, membership function 1

In1mf2: input1, membership function 2

In1mf3: input1, membership function 3

Employee Satisfaction

This input is also having three membership functions which are good, average, poor. These are shown in figure 2.

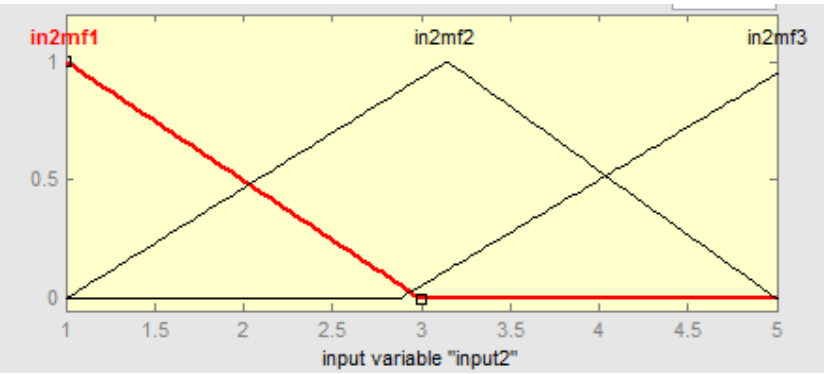

Figure 2: Input membership function for Employee Satisfaction

In2mf1: input 2, membership function1

In2mf2: input 2, membership function2

In2mf3: input 2, membership function3

Special projects count

This input is also having three membership functions which are poor, normal, outstanding. These are shown in figure 3.

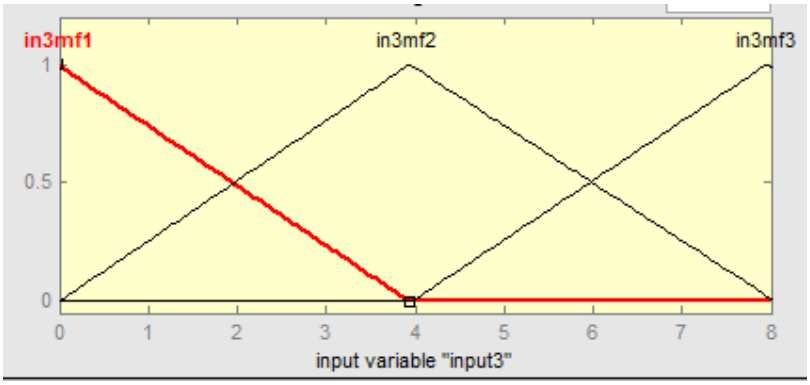

Figure 3: Input membership function for special projects count

In3mf1: input 3, membership function1

In3mf2: input 3, membership function2

In3mf3: input 3, membership function3

Days late last 30

This input is also having three membership functions which are high, moderate, low. These are shown in figure 4.

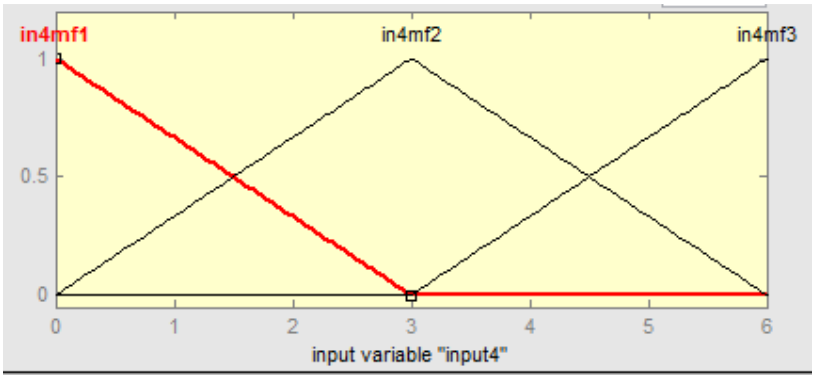

Figure 4: input membership functions for Days late last 30

In4mf1: input 4, membership function1

In4mf2: input 4, membership function2

In4mf3: input 4, membership function3

Absence

This input is also having three membership functions which are high, average, low. These are shown in figure 5.

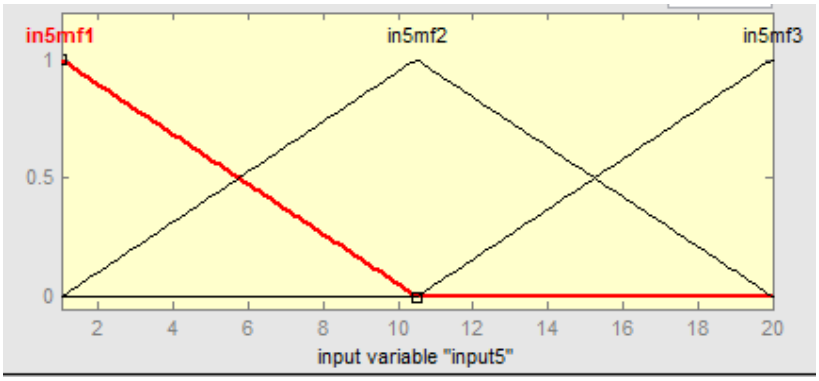

Figure 5: input membership functions for absence

In5mf1: input 5, membership function1

In5mf2: input 5, membership function2

In5mf3: input 5, membership function3

The output of the proposed system is performance score and its membership functions are a) needs improvement b)PIP c)Fully meets d) Exceeds

The structure of the system, Rules, Rule viewer, Surface viewer, ANFIS structure, Training error are shown in figure 6, 7,8 and 9 respectively.

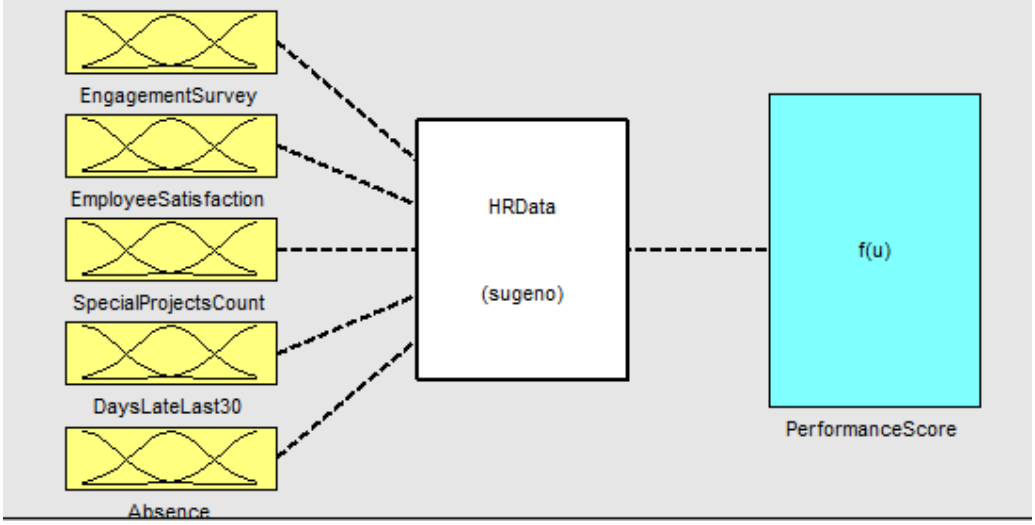

Figure 6: The structure of proposed system.

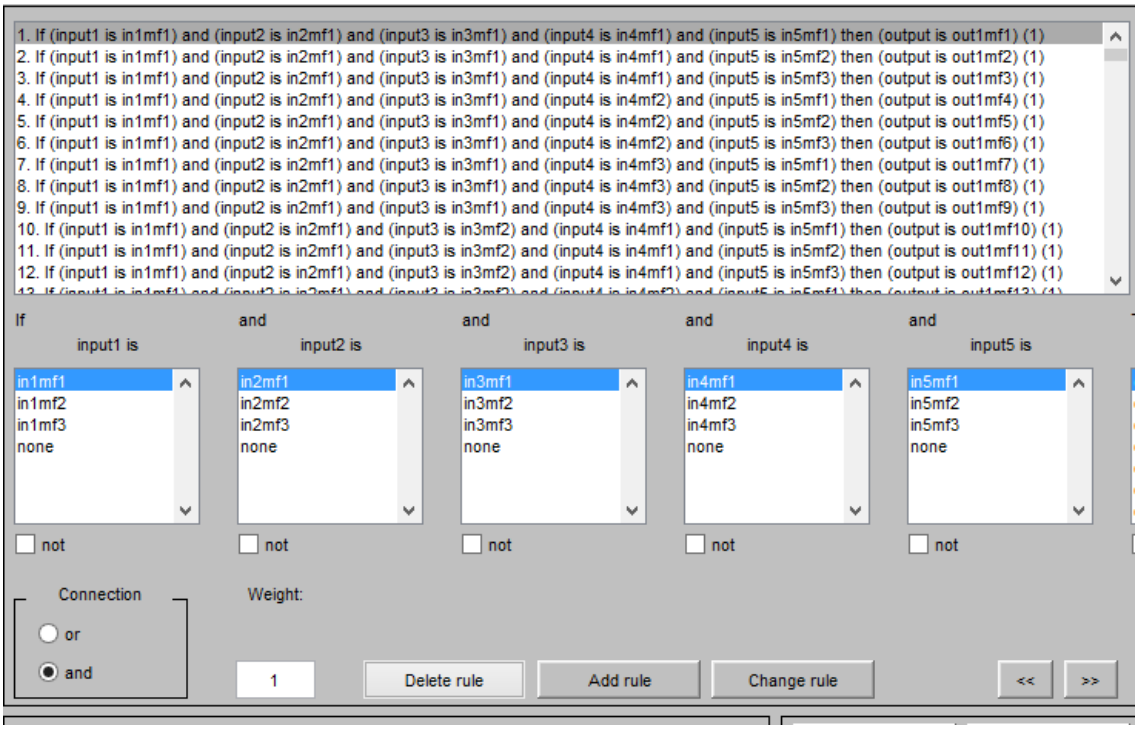

Figure 7: Rules

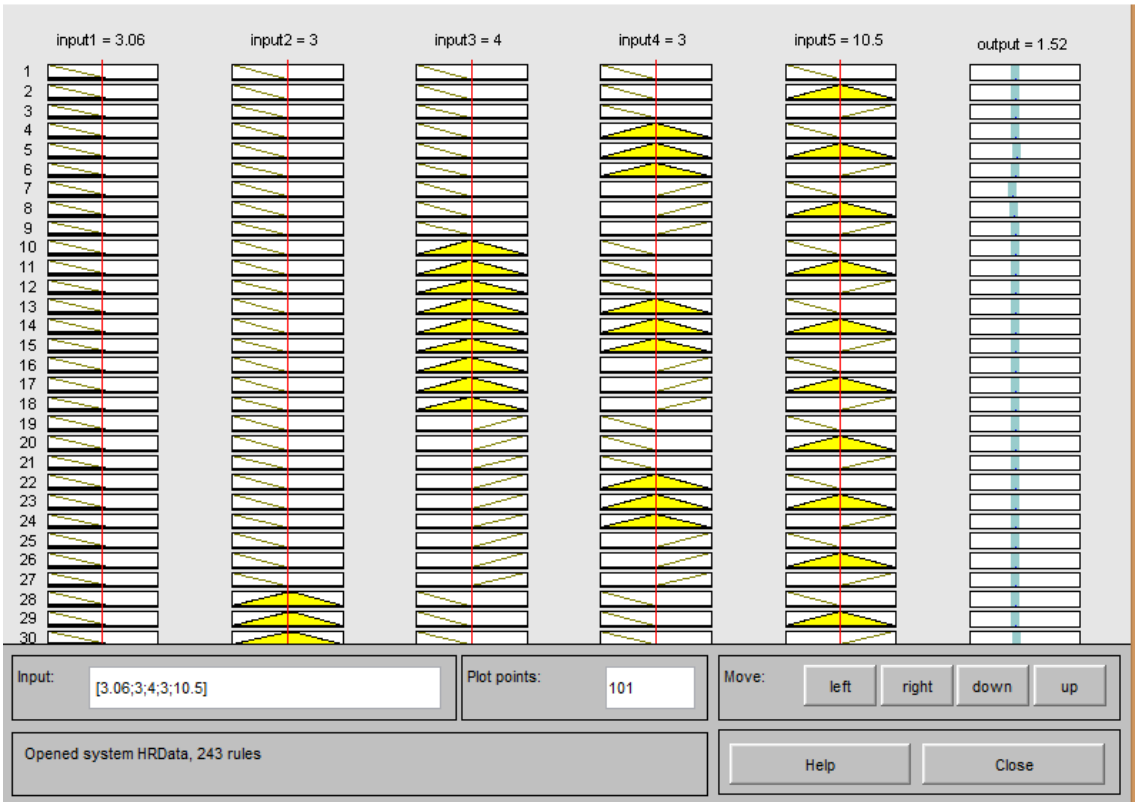

Figure 8: Rule Viewer

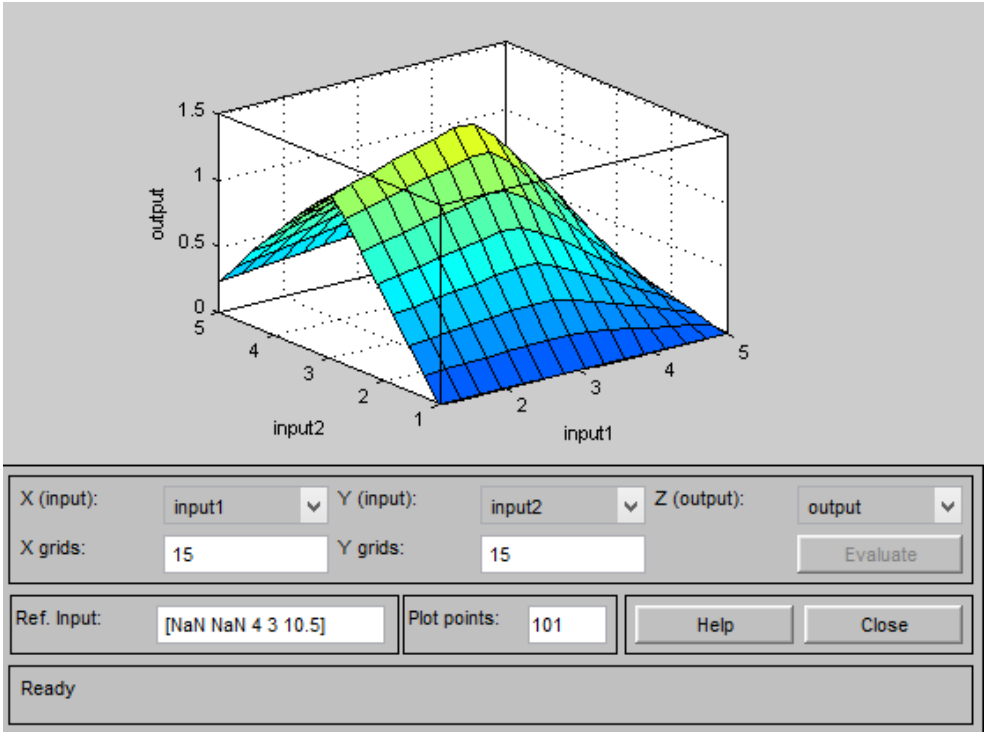

Figure 9: Surface Viewer

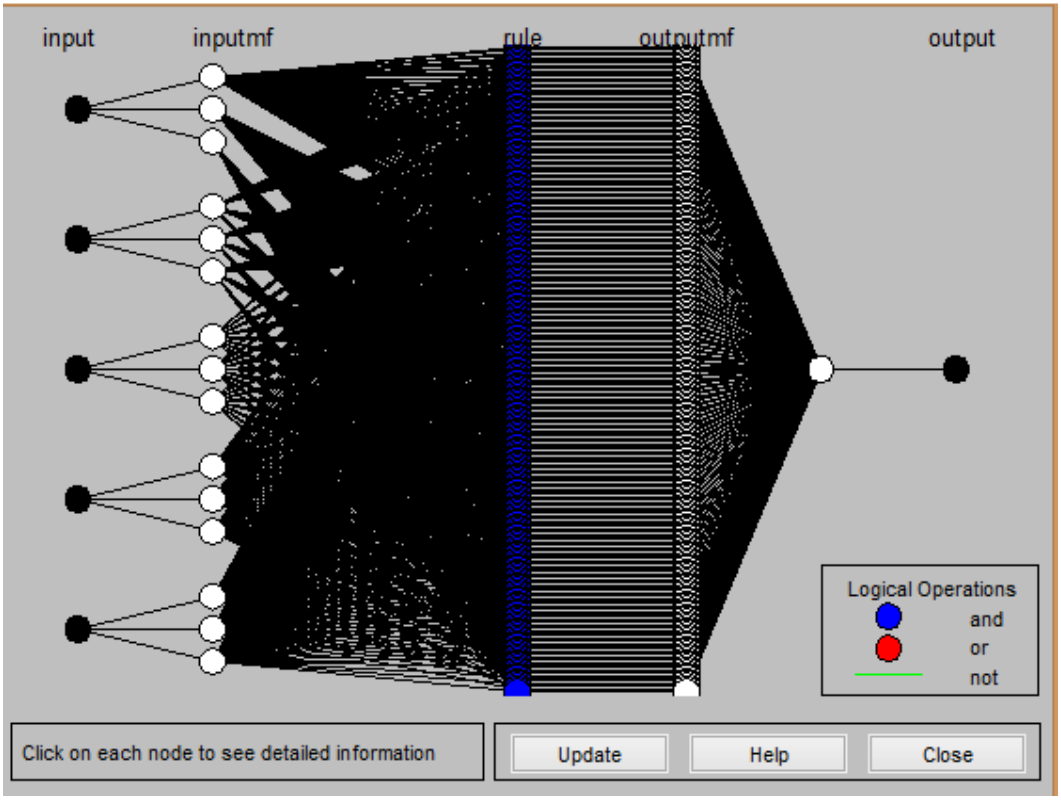

Figure 10: ANFIS Structure

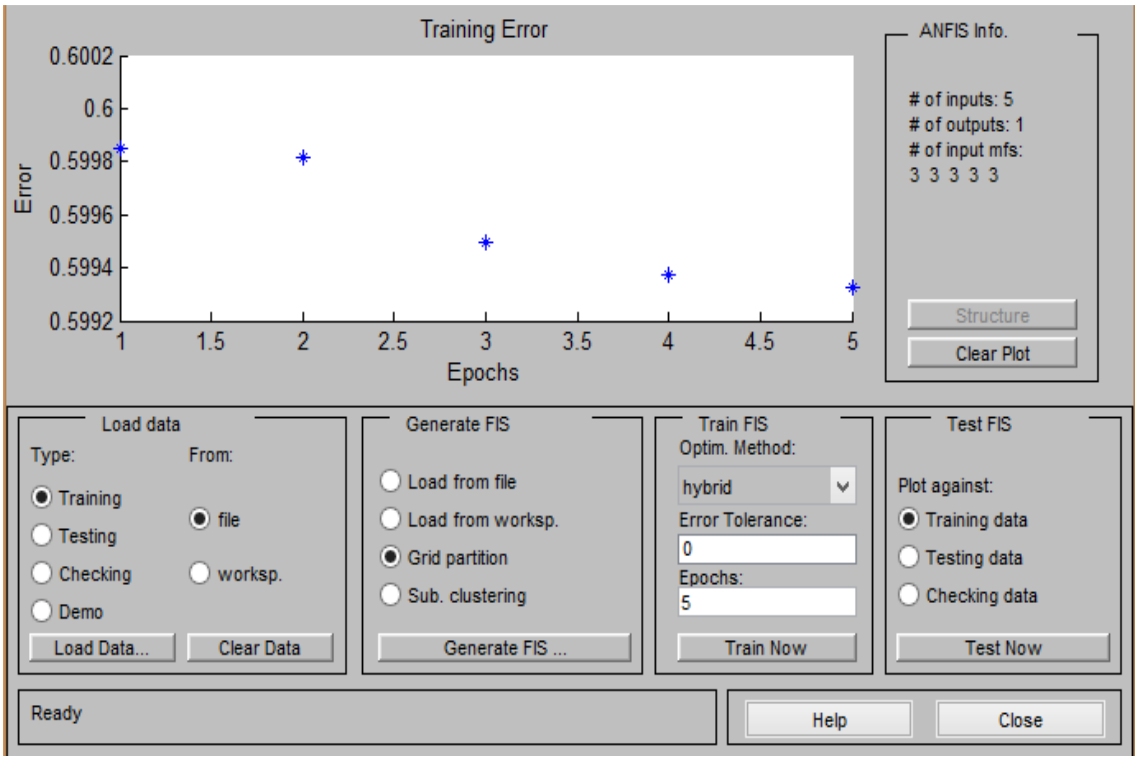

Figure 11: Training Error

Results

The dataset for this research work is taken from Kaggle website. This dataset is further divided in to training and testing parts. 70 percent of the dataset is considered as training dataset and 30% dataset is considered as testing dataset. System is trained with 70% of the dataset and after this rest of the dataset that is testing dataset is used for testing the proposed system. The inputs are given to the system and output is taken from the system and then the output of the system is matched with the actual output and found the value of true positive rate, false positive rate, true negative rate and false negative rate. Further with the help of these values, the performance parameter that is accuracy is calculated and its value is found as 92%.

Conclusion and future scope

From this research work, it is concluded that the proposed system is very beneficial for the organization in performance evaluation of their employees. This system is very helpful for employers. A system or machine and Matlab software are required to run this software. In future, one can add more inputs and output in the proposed system for better performance. Proposed system may also be trained with more dataset for better results.

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