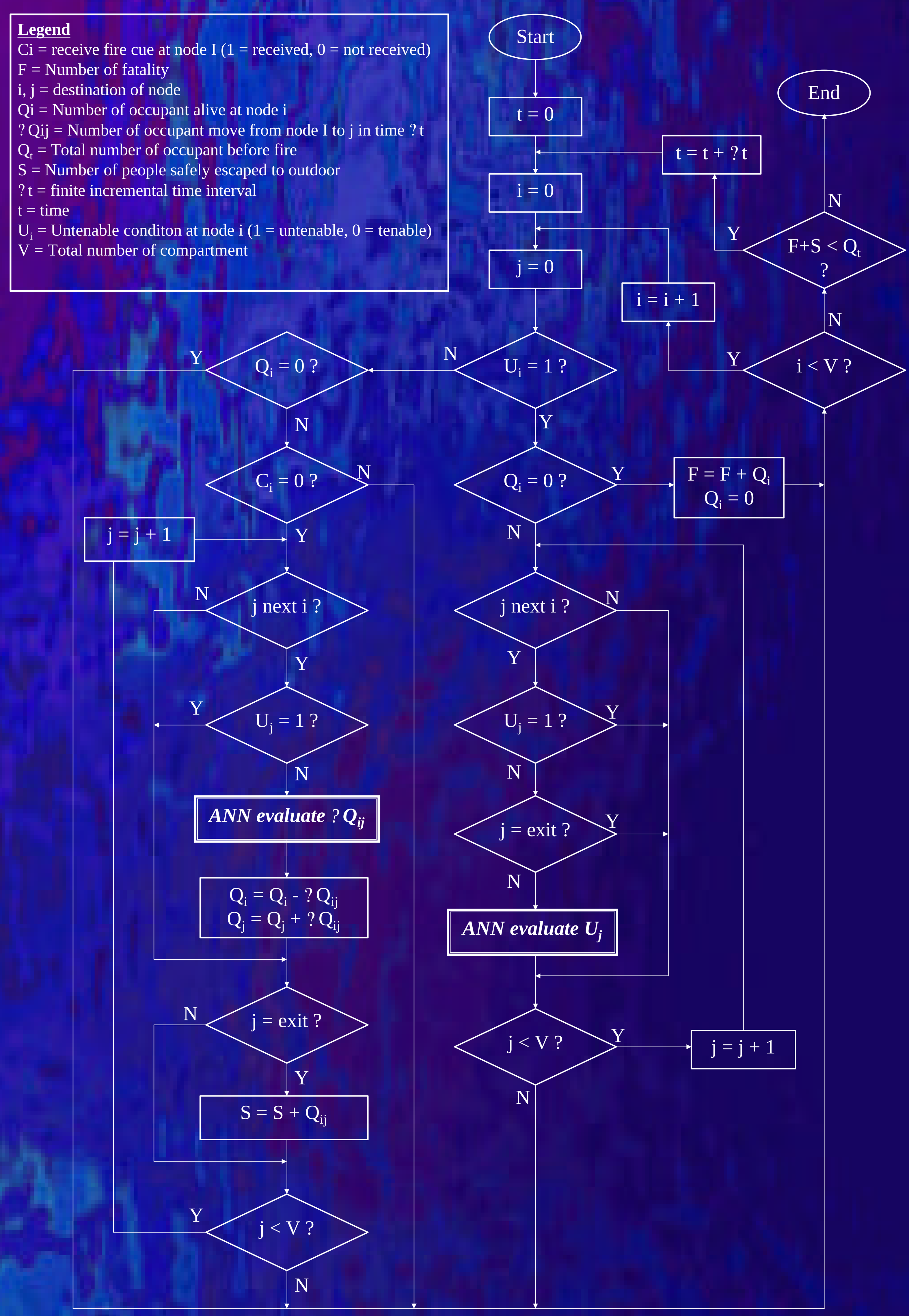
Application of Artificial Neural Network to Fire Risk Assessment

Student : Eric Wai Ming LEE Supervisor : Dr. Richard K.K. YUEN
Programme : Doctor of Philosophy
Department of Building and Construction, City University of Hong Kong

Fire risk assessment is an exercise to determine the risk level, which may be expressed in terms of cost of damage or fatalities, prior to the actual fire. An assessment framework for the evaluation of fatalities during fire based on network presentation is developed. Network presentation is one of the most easiest and efficient approaches to describe the configuration of a building. A building can divided into different compartments (e.g. rooms, corridors, lobbies, staircase, etc.). It can be represented by the nodes and links of the network. The compartments and the separations between them are represented, respectively, be the nodes and links. The networks can then be converted into matrix format for easy manipulation by computer. Since evaluation of fire scenarios and human behaviours for every time step during fire requires extensive computer resources and also computer time by the traditional simulation packages, instead, artificial neural network is proposed since it is able to carry out the prediction within seconds. However, the accuracy of prediction does rely on the quality of the training samples or historical data.

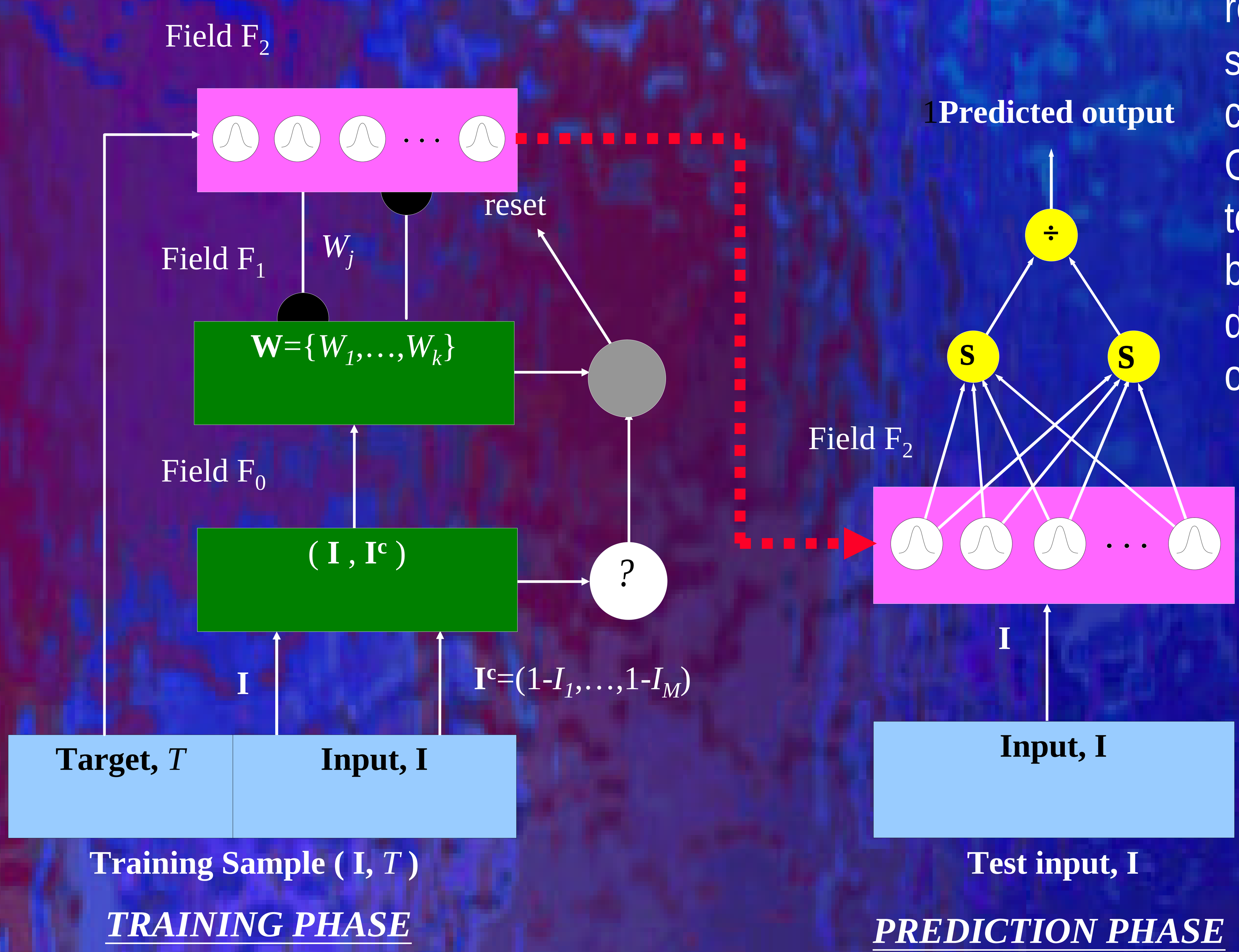
Due to the properties of fire data (i.e. limited in sample size and with noise embedded), a novel hybrid neural network model by combining Fuzzy ART and General-Regression-Neural Network denoted as GRNNFA has been developed. The noise removal ability of the network by compressing the training samples into kernels. Both online and offline version of the GRNNFA have been developed. The abilities of both models in noisy data regression were demonstrated by the *2-Intertwined-Spirals* and *Ozone* benchmarking problems.



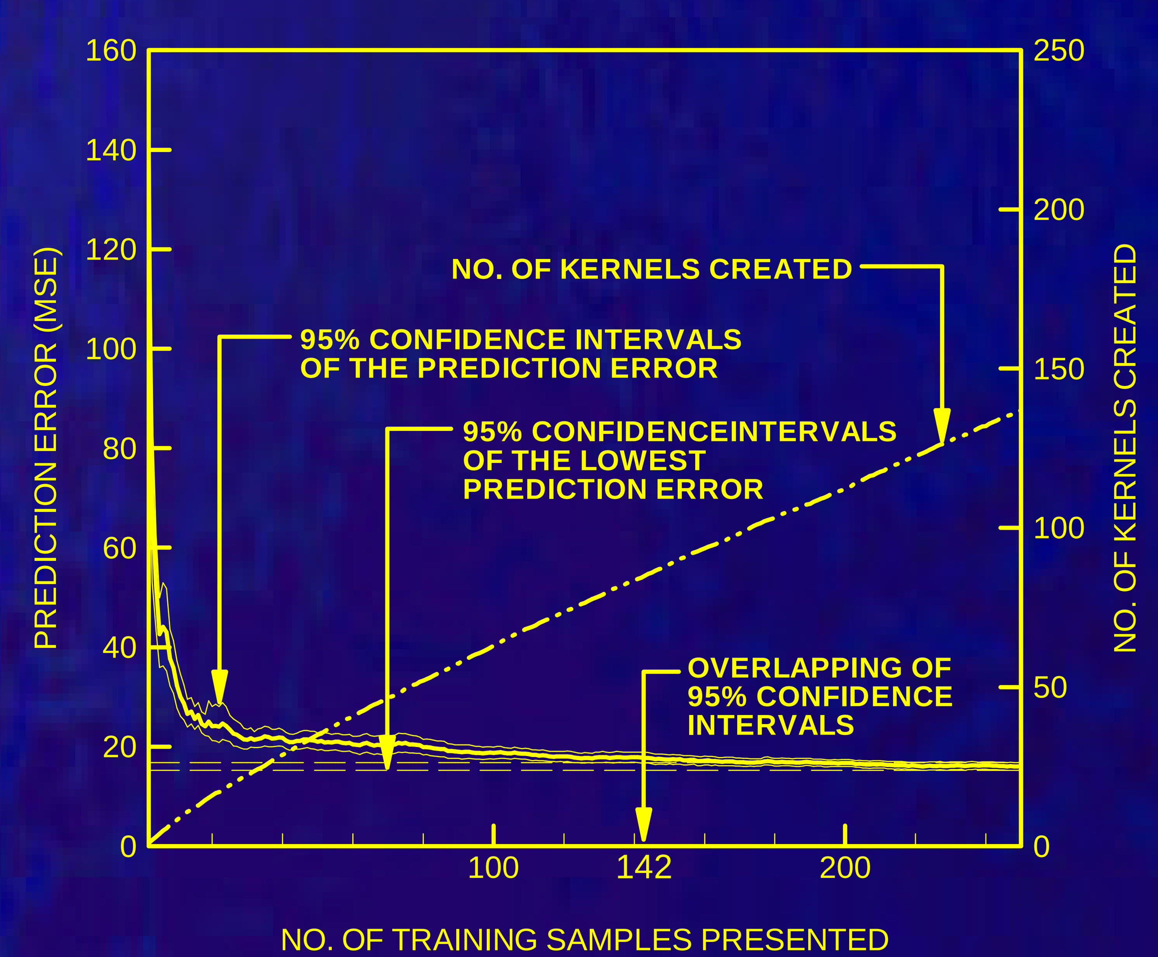
Fire Risk Assessment Framework

The GRNNFA-offline successfully reconstructed the 2-intertwined spirals (one of the hardest classification problems). The GRNNFA-online was also applied to solve the famous Ozone benchmarking problem. It demonstrates the fast convergence of the network prediction error.

Prediction result of 2-intertwined spirals



Architecture of GRNNFA



Prediction result of Ozone benchmarking problem