Experiment 8

Case study on Hybrid Systems

Course: Artificial Intelligence & Soft Computing Lab **Course Code:** CSL703

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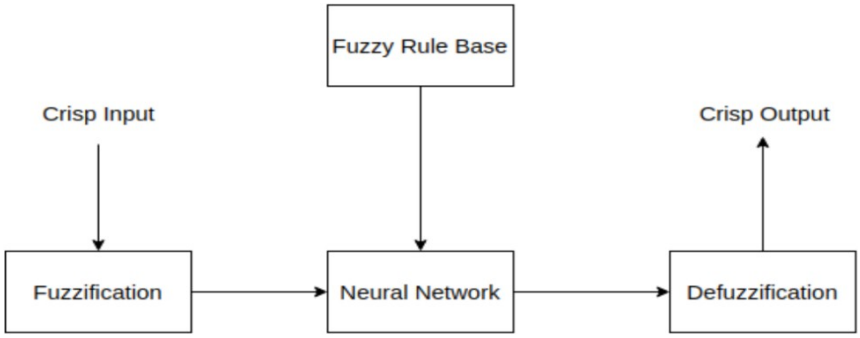
AIM	Case study on Hybrid Systems
Problem Statement:	Case study on Hybrid Systems
Learning Objective:	Case study on Hybrid Systems .
Learning Outcome:	Case study on Hybrid Systems
Course Outcome:	CSL703.5 To realize the basic building blocks of Hybrid Systems
Program Outcome:	(PO 3) Design/ development of solutions: Breadth and uniqueness of engineering problems i.e., the extent to which problems are original and to which solutions have previously been identified or codified (PO 12) Lifelong Learning
Bloom's Taxonomy Level:	• Remembering • Understanding
Theory:	A Hybrid system is an intelligent system which is framed by combining at least two intelligent technologies like Fuzzy Logic, Neural networks, Genetic algorithm, reinforcement Learning, etc. The combination of different techniques in one computational model make these systems possess an extended range of capabilities. These systems are capable of reasoning and learning in an uncertain and imprecise environment. These systems can provide human-like expertise like domain knowledge, adaptation in noisy environments etc. NEURO FUZZY SYSTEM: Neuro fuzzy system is based on a fuzzy system which is trained on the basis of working of neural network theory. The learning process operates only on the local information and causes only local changes in the underlying fuzzy system. A neuro-fuzzy system can be seen as a 3-layer feedforward neural network.



Neuro-Fuzzy Hybrid System

Working flow:

- In input layer, each neuron transmits external crisp signals directly to the next layer.
- Each fuzzification neuron receives a crisp input and determines the degree to which the input belongs to input fuzzy set.
- Fuzzy rule layer receives neurons that represent fuzzy sets.
- An output neuron, combines all inputs using fuzzy operation UNION.
- Each defuzzification neuron represents single output of neuro-fuzzy system.

Advantages:

- It can handle numeric, linguistic, logic, etc kind of information.
- It can manage imprecise, partial, vague or imperfect information.
- It can resolve conflicts by collaboration and aggregation.
- It has self-learning, self-organizing and self-tuning capabilities.
- It can mimic human decision-making process.

Disadvantages:

- Hard to develop a model from a fuzzy system
- Problems of finding suitable membership values for fuzzy systems
- Neural networks cannot be used if training data is not available.

Applications:

- Student Modelling
- Medical systems
- Traffic control systems
- Forecasting and predictions

Study of Hybrid Neuro fuzzy inference system for forecasting flood event Vulnerability in Indonesia

Introduction:

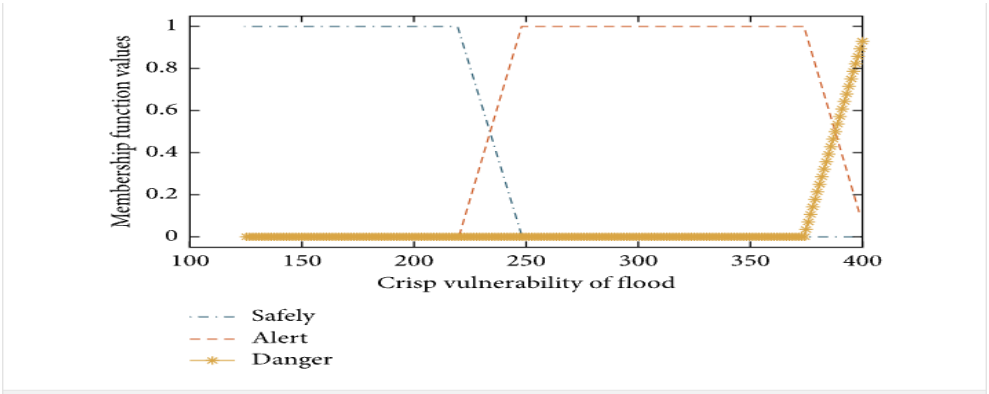
An experimental investigation was conducted to explore the fundamental difference among the Mamdani fuzzy inference system (FIS), Takagi–Sugeno FIS, and the proposed flood forecasting model, known as hybrid neurofuzzy inference system (HN-FIS). The study aims finding which approach gives the best performance for

forecasting flood vulnerability. Due to the importance of forecasting flood event vulnerability, the Mamdani FIS, Sugeno FIS, and proposed models are compared using trapezoidal-type membership functions (MFs). The fuzzy inference systems and proposed model were used to predict the data time series from 2008 to 2012 for 31 subdistricts in Bandung, West Java Province, Indonesia. Our research results showed that the proposed model has a flood vulnerability forecasting accuracy of more than 96% with the lowest errors compared to the existing models.

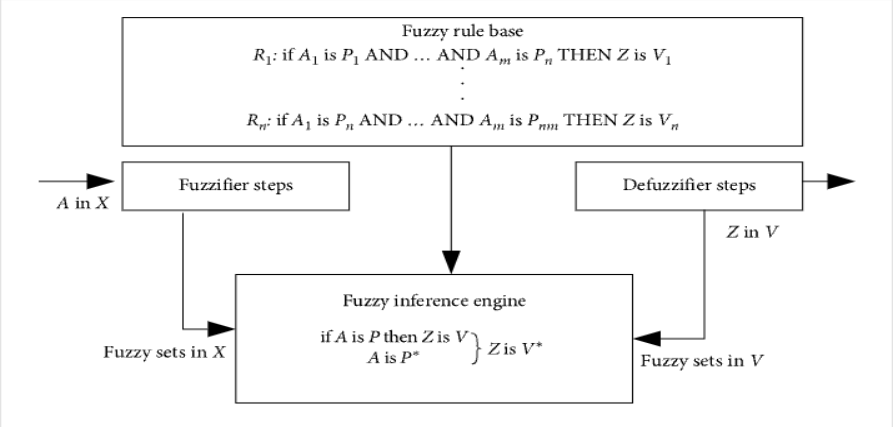
Process:

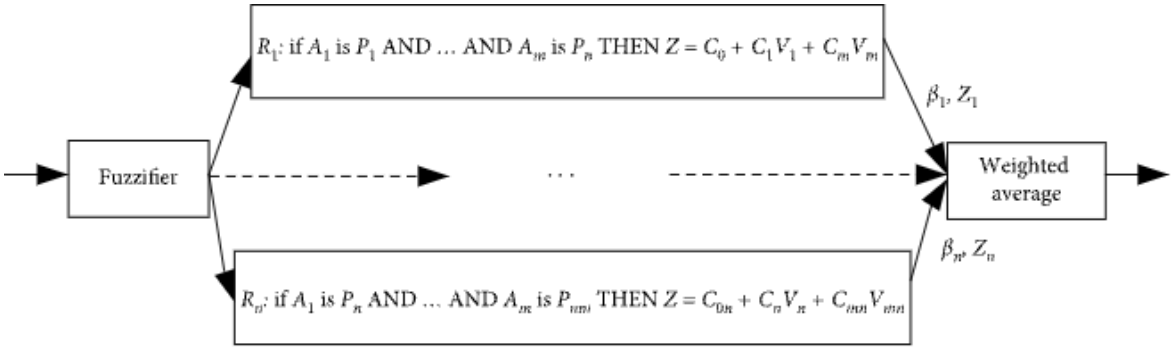
This study proposes a hybrid approach based on the neural network and fuzzy inference system for flood event vulnerability, namely, hybrid neurofuzzy inference system (HN-FIS). The HN-FIS is a model which can automatically learn and also obtain the output which can present the essence of fuzzy logic. The system was applied in 31 subdistricts in Bandung. The flood forecasting depends on several variable inputs: population density, altitude of the area, and rainfall in time series from 2008 to 2012. The main contributions of this paper are (i) presenting a hybrid forecasting for flood vulnerability based on the neural network and fuzzy inference system for accurate flood forecasting employing data variables which utilized Bandung database for flood vulnerability forecasting and (ii) developing an effective hybrid forecasting approach for flood vulnerability with higher accuracy.

Membership function curves of flood forecasting fuzzy variable output.



Mamdani fuzzy inference system architecture.



	The architecture of the Sugeno fuzzy inference system.  **Conclusion:** Neural network adopts a linear equation, which cannot present human assessment reasonably. hybrid neurofuzzy inference system model can show its readability and understandability and present the essence of fuzzy logic more clearly.
Conclusion:	Case study of Hybrid System is explored