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Title of Thesis: **Development of Inference System in Softcomputing Framework**

Abstract

Introduction

Synergistic neuro-fuzzy systems combine the merits of the connectionist and fuzzy approaches and hence exploit parallel computation, demonstrate the ability to operate and adapt in both numeric as well as linguistic environments. These systems deal with cognitive uncertainties in a manner more like humans and by virtue of their ability to refine initial domain knowledge, they are being extensively used in a wide range of robust intelligent decision making application. Though recent research is centered on neuro-fuzzy systems, the unattempted and unsolved issues of these systems are very extensive in nature. Hence, the scope of the present research work is limited to the design and implementation of a class of neuro-fuzzy systems.

Objectives

This thesis deals with a coherent blend of potential problems of neuro-fuzzy systems which will help define a framework for the present research work. Specially, the present work addresses the following objectives:

(a) To incorporate a mechanism that can handle numeric and linguistic inputs seamlessly;
(b) To stress on the economy of the number of parameters that a model employs to solve a particular problem;
(c) To be able to easily incorporate data-driven as well as expert knowledge in the generation of an initial set of if-then rules;
(d) To attempt to have the system learn data driven knowledge to fine tune the set of if-then rules;
(e) To be able to interpret a trained fuzzy - neural system.

The resulting model called the subsethood based Fuzzy Neural Inference System (subsethood based FNIS).

Subsethood Based Fuzzy Neural Inference System (Subsethood based FNIS)

The present work explores the subsethood class of fuzzy neural inference systems developed in MATLAB 7.1 environment. The resulting model is called subsethood based Fuzzy Neural Inference System. Chapter 3, in the thesis, describes the proposed model with extensive computational expressions underlying its operation.

Architecture:

The proposed model directly embeds fuzzy rules of the form:

If x1 is LOW and x2 is HIGH then y is MEDIUM

where LOW, MEDIUM and HIGH are fuzzy sets defined respectively on input or output universes of discourse (UOD's). Input nodes represent domain variables or features, and output nodes represent target variables or classes. Each hidden node represents rule and input-hidden node connections represents fuzzy rule antecedents. Each output-hidden node connection represents a fuzzy rule consequent. Fuzzy sets corresponding to linguistic levels of fuzzy if-then rules (such as

LOW, MEDIUM and HIGH), are defined on input and output UOD's and are represented symmetric Gaussian membership functions specified by a center and spread. Fuzzy weights from input nodes to rule nodes and from rule nodes to output nodes are modeled by the center and spread of a Gaussian fuzzy set. Data-driven knowledge in the form of fuzzy if-then rules is translated directly into network architecture.

a. **Subsethood based Fuzzy Neural Inference System simultaneously admits numeric as well as fuzzy inputs.**
b. **Subsethood based Fuzzy Neural Inference System uses fuzzy inner products for aggregation.**
c. **Subsethood based Fuzzy Neural Inference System uses volume defuzzification.**
d. **Subsethood based Fuzzy Neural Inference System is trained using a gradient descent algorithm**

Applications:

Subsethood based FNIS is tested for different applications as Function Approximation, classification, Image compression and speed control and found better than the several existing fuzzy neural techniques.

a) **Narazaki-Ralescu function approximation.**
b) **Iris data classification.**
c) **Subsethood based FNIS Application in Medical Diagnosis.**
d) **Subsethood based FNIS Application in Image compression.**
e) **Subsethood based FNIS Application in Control.**