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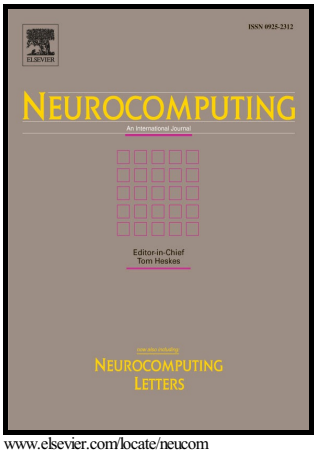

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A Framework for Static and Dynamic Analysis of Multi-Layer Fuzzy Cognitive Maps

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Abstract:
Fuzzy Cognitive Maps (FCMs) have progressively become a well-researched and extensively used set of tools for modeling real-world, complex decision making problems. Despite their fast growth, researchers and modelers are faced with the lack of a framework to analyze such models and help them assess their performance and efficiency. Moreover, when multi-layered FCM (ML-FCM) structures are used, which consist of a rich number of nodes and interconnections organized in different layers, this need becomes imperative. The present paper introduces an integrated analysis framework and a series of steps to gather useful static and dynamic information regarding ML-FCM models, as well as to interpret the corresponding results. The proposed type of analysis provides significant information on the model's complexity, the strength of its nodes and its tendency to promote or inhibit activation levels as a result of the presence of positive or negative cycles. In addition, it offers the means to perform dynamic analysis in the form of what-if scenarios. The framework is described and assessed using real-world problems from the engineering and political decision-making domains, which demonstrate its power and usefulness.

Keywords: Multi-Layer Fuzzy Cognitive Maps, Static and Dynamic Analysis, Node Strength, Cycles, Simulations.

1. Introduction

The fast growth of technology innovation, as well as the continuous technological developments and achievements have resulted in an increase in complexity for systems and processes that aim to support them. No matter the scientific area, experts, analysts and decision makers in general, often face the inability to effectively and efficiently describe a given problem and thus study its parameters so that they take the proper decisions at the right time. This problem is usually associated with the fact that there exists a high number of intertwined parameters