New decision making models of processes synchronization in distributed systems

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In the groups of processes of distributed systems, it is necessary to make decisions based on agreements; these processes may operate in distributed teams; processes may require the use of shared resources in the form of mutual exclusion. The following question arises: what kind of decision models will be necessary to generate and incorporate the cognitive perspective to classical models, which transcend the traditional approach to the computer science? (They are considered as classical models for access to data structures shared in the form of mutual exclusion using critical regions from memory, the centralized algorithm, the Lamport distributed algorithm, improved by Ricart and Agrawala, token ring algorithm, and so on).

Keywords: Operating Systems; Communication between Groups of Processes; Aggregation Operators.

1. Introduction

In processing distributed computer systems frequently it is necessary the processes acting in groups to make decisions based on the agreement; these processes may operate on a same computer or several interconnected distributed teams; decisions which should achieve some level of agreement may be related to specific activity that does not require the use of shared resources in the form of mutual exclusion, or the realization of particular activity that requires the use of shared resources in the form of mutual exclusion, for which the requirements of levels of agreement are generally higher than for the previous case.

As a result of the foregoing, the following question arises: what are the new decision models that will be necessary to develop incorporating the cognitive perspective to the classic models for decision making in groups of processes, transcending the traditional approach of the computer science?

We will have to develop new decision models for the following types of situations: a) when does not undertakes the use of shared resources and agreement requirements are not strict; b) when does not undertake the use of shared resources and agreement requirements are strict; c) when it is committed to the use of shared resources and the agreement requirements are not strict; d) when it is committed to the use of shared resources and the agreement requirements are strict?

2. Knowledge State Of Areas That Would Contribute To New Decision Models

[1] is a follow-up of the evolution of concepts of Cybernetics on the basis of the pioneers, such as Wiener, von Neumann, von Forster, von Bertalanffy and Ashby, and shown that systemic-cybernetic language is a developed conceptual network.

[2] expresses that if all mind states (such as beliefs, thoughts and concepts) can be described as operations on symbolic representations, the mental activity (reasoning, planning and decision making) is equivalent to the execution of an algorithm. [3] defines the main concepts of cybernetics; expressed that cybernetics is any field of command and communication theory, both on the machine, as in the animal. He also claims that cybernetics aims to find common elements to the operation of machines and the nervous system of man and to develop a theory that encompasses the entire field of the control and communication in machines and living organisms. [4] presents notions such as decentralization, emergency, dynamic systems, recognition of patterns, adaptive conduct, etc., applied to robotics, ethology, economy, etc., all in order to present the image of embodied and embedded mind as an evolution from the connectionist mind.

[5] studying complex systems in their basic aspects, its main concepts and the construction of knowledge from the perspective of complex systems.

[6] presents the main concepts of enaction and emergence, and an overview of the evolution of the central concepts of cybernetics. [7] presents a mathematical and cognitive model that describes the resolution of problems as a cognitive process. [8] presents a new learning algorithm for fuzzy cognitive maps, based on the application of a swarm intelligence algorithm, called PSO (Particle Swarm Optimization).

[9] presents a model of cognitive goal processes of the mind. Cognitive processes are defined in a cognitive goal level in the LRMB (Layered Reference Model of the Brain) using the RTPA (Real-Time Process Algebra) and OAR (Object-Attribute-Relation) model for the representation and manipulation of internal information of cognitive goal processes.

[10] discusses the application of mental models to the human - computer interaction.

[11] describes the main communication algorithms in distributed systems

(classical algorithms of computer science). [12] shows the main algorithms for distributed coordination and management of the mutual exclusion (classical algorithms of computer science). [13] describe methods of multiple imputation of data to resolve the problem of missing data needed for decision-making. [14] shows an efficient and fault tolerant solution, for distributed mutual exclusion problem, from the perspective of the computer science. [15] presented some algorithms to manage mutual exclusion in computer networks, according to the computer science. [16] presents a group decision model with the use of OWA (Ordered Weighted Averaging) family aggregation operators. [17] studied the fuzzy preference modelling for multi-criteria decision support.

[18] presents the use of OWA (Ordered Weighted Averaging) aggregation operator’s family for decision-making. [19] presents the ANP (Analytic Network Process) and its application to a specific case of decision-making. The NPA is based on the MCDA (Multiple Criteria Decision Analysis). [20] studying decision support systems.

[21] analyzes group aggregation operators (by majority) in seeking the representation of the majority. [22] analyzes the aggregation of linguistic labels and measures of consensus for the autocratic decision-making using recommendations. [23] presents group decision-making models of fuzzy linguistic information.

[24] shows the combination of numerical and linguistic information in group decision-making. [23] studies, respectively, group decision-making using OWA linguistic operators and diffuse 2-tuple linguistic representation model for computing with words. [25] presents the WKC-OWA operator to aggregate information in democratic decision problems. [26] shows a group decision-making model using linguistic labels, and a new expression form of decision-makers’ preferences.

[21] discusses majority aggregation operators and its applications to group decision-making. [27] shows and study OWA (Ordered Weighted Averaging) operators applied to multi-criteria decision-making. [28] shows different probabilistic cognition models, using cognitive science, computer science, mathematics and statistics.

3. Proposed Data Structures

It will use a data arrays system with the following premises and structures.

It has groups of processes, across process nodes; processes access critical shared resources in the form of distributed mutual exclusion; you have to determine what will be the priorities for allocating resources to processes (will only be alternative assignment available resources, i.e. not assigned to processes): a) permission to access the shared resources of a node not depend only if nodes are using them or not, but the value of aggregation of opinions (priorities) of the different nodes regarding access to shared resources (alternatives); b) opinions (priorities) of the nodes, about granting access to shared resources (alternatives), will depend on variables representing the state of each node. Taking into account the requirements of resources of each process in each group, each node must express its priorities for the allocation of shared resources.

Nodes that host processes: 1,..., n.

Processes hosted in each of the n nodes: 1,..., p.

Distributed process groups: 1,..., g.

Size of each of the g groups of processes: 1,..., t.

Critical resources shared in the form of distributed mutual exclusion, available at each of the n nodes: 1,..., r.

Possible states of each of the p processes: a) group to which belongs the process (0 means independent process); b) waiting for a resource shared with his group of processes; c) waiting for a resource not shared with his group of processes; d) running with permission to access a resource shared with its process group; e) running without permission to access a resource shared with its process group; f) inactive.

Status of each of the n nodes: a) number of processes; b) priorities of processes; c) CPU usage; d) use of main memory; e) use of virtual memory; f) status of each of the r critical resources, shared in the form of distributed mutual exclusion in the node: i) assigned to a local process; ii) assigned to a remote process; iii) available; g) predisposition (nodal priority) to grant access to each of the r shared critical resources (alternatives) in the form of distributed mutual exclusion (result of consideration of the variables representing the state of the node, for each existing share critical). A tuple is obtained for each of the n nodes, each tuple will contain r values (nodal priorities) to share critical resources.

Systems global status: a) number g of groups of processes and size t (number of processes) of each group; b) percentages of consensus required to grant access to each of the r critical resources available in each of the n nodes; c) predisposition (global priority) to grant access to each of the r shared critical resources (alternatives), in the distributed mutual exclusion form, which will result from the aggregation of the nodal priorities for each existing share critical resource (alternative). A tuple r of normalized values (global priorities) is obtained to share critical resources; d) access decision to r critical resources, because of contrasting the normalized global priorities, to share these resources, with the percentages of consensus required to grant the respective accesses; e) the system global status must be updated repeatedly, while p processes require access to r shared resources.

The system is self regulates repeatedly considering local nodes status and the global system status. Updated local status because of the evolution of their processes, and access to your critical resources, taking into account the overall status of the system: distributed system where running groups of processes that have access to critical resources, notes to himself, and produces decisions of access to resources that modify the system global status and rearranged it repeatedly.

4. Conclusions and Future Works

It will The study of the main concepts of cognitive sciences suggests that the application of the same will allow to develop decision models for groups of processes that interact being able to share resources. These new decision models could be overcome to the classical computer sciences models, achieving a better overall performance, to make decisions considering details and a more global vision of the problems.

The new models should consider the possibility of imputation of missing data (due to failures in nodes or links) and fuzzy variables, using the family of OWA operators, creating specific aggregation operators to each types of situations considered. The developed models will be validated and adjusted by comparing their results with the commonly used models. The specific objectives are to generate decision models from the cognitive perspective to decision-making in groups of processes, transcending the traditional approach of the computer science. Base the new models on the principles of second order cybernetics, complex systems and self-regulation. The use of modifications of the OWA family operators [41], [42] will be studied, for the following types of situations: a) shared resources are not used and the consensus demands are not strict; b) shared resources are not used and consensus requirements are strict; c) shared resources are used and the consensus demands are not strict; d) shared resources are used and the consensus demands are strict. You must compare, whereas the performance, the new models with the known and generally accepted computer science models.

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