Modelling User Behavior and Requirements for Job Scheduling in Computational Grids

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ABSTRACT

Computational Grids (CGs) are a type of distributed system that virtually combine geographically distributed IT resources from many different administrative domains into one single customized computational infrastructure, CGs enable users to perform computational tasks or data storage capabilities in a transparent and secure manner. Unlike traditional distributed systems belonging to single administrative domain and having a few user types, in CGs several user types should co-exist and make use of resources according to the hierarchical nature and the presence of the multiple administrative domains, which impose different access and usage policies on resources. In the talk, we firstly highlight the most common Grid users types and their relationships and access scenarios in CGs corresponding to traditional requirements in Grid scheduling such as performance, and new requirements such as security and trust. We identify and analyze new features appearing in users' behavior in Grid scheduling, such as dynamic, selfish, cooperative, trustful, symmetric and asymmetric behavior. Analyzing and modelling such user requirements and behaviors to predict the users needs and actions are important in order to optimize the Grid system performance at individual and global levels.

Game theory in combination with economic theory is playing an important role in Internet computing to develop algorithms for finding equilibria in computational markets, computational auctions, Grid and P2P systems as well as security and information markets. The use of game-theoretic modelling of user behaviors in scheduling and resource allocation in CGs enables a highly scalable and efficient decision-making processes. We highlight the advantages and limitations of non-cooperative, cooperative and semi-cooperative game models based on assumptions that game players are rational and pursue well-defined objectives and they take into account their knowledge or expectations of other players behavior.

Artificial Neural Network (ANN) is another useful approach for supporting new user requirements such as security awareness. Making a prior analysis of trust levels of the resources and security demand parameters of tasks, the neural network is monitoring the scheduling and task execution processes. The network learns patterns in input (initial tasks and machines characteristics) and produce the tasks-machines mapping suggestions as the outputs.

Finally, while game-theoretic and ANN approaches are useful at modelling Grid users behaviors and requirements, they are not effective as stand alone approaches for solving the multi-objective optimization problems arising in such models. We then show how game-theoretic and neural networks can be combined with meta-heuristic approaches, such as Genetic Algorithms, to solve the optimization problem and achieve Grid system performance.

AUTHOR BIOGRAPHY

FATOS XHAFA holds a PhD in Computer Science from the Department of Languages and Informatics Systems (LSI) of the Technical University of Catalonia (UPC), Barcelona, Spain. He was a Visiting Professor at the Department of Computer Science and Information Systems, Birkbeck, University of London, UK (2009/2010) and a Research Associate at College of Information Science and Technology, Drexel University, Philadelphia, USA (2004/2005). Dr. Xhafa holds a permanent position of *Professor Titular* at the Department of LSI, UPC (Spain). His research interests include parallel and distributed algorithms, combinatorial optimization, approximation and meta-heuristics, networking and distributed computing, Grid and P2P computing. Dr. Xhafa has widely published in peer reviewed international journals, conferences/workshops, book chapters and edited books and proceedings in the field. Dr. Xhafa has an extensive editorial and reviewing service. He is Editor in Chief of the International Journal of Space-based and Situated Computing, and of International Journal of Grid and Utility Computing, Inderscience Publishers. He is an associate/member of Editorial Board of several international peer-reviewed scientific journals. He has also guest co-edited several special issues of international journals. Dr. Xhafa is actively participating in the organization of several international conferences. His email is fatos@lsi.upc.edu and his personal webpage at http://www.lsi.upc.edu/~fatos/.