Probabilistic models for distributed systems and networks

Mots clés :
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- Ecole doctorale : École Doctorale Informatique, Télécommunications, Électronique de Paris
- Domaine scientifique principal : Divers

Résumé du projet de recherche (Langue 1)

A distributed system can be represented by a graph in which nodes are the computing resources and edges are used for the communications between nodes. In this context, a distributed algorithm is executed locally by the nodes which use classical procedure to send and receive messages from the other nodes. Examples of such systems are large-scale networks like peer-to-peer networks, wireless sensor networks and mobile sensors (robots) networks. For such networks, generally composed of a large number of nodes and a complex structure, it is very difficult and even prohibitive to obtain information on the network in a centralized manner. Moreover, the increase in the number of nodes leads to a large dynamic behavior that may be caused either by the nodes mobility (robot networks) or by the churn (nodes may join or leave the system at will) for instance in peer-to-peer networks. These behaviors are clearly random phenomena that must be modeled in order to evaluate the performance of the network. For instance, in a sensor network, one must avoid the situation in which some critical nodes, leave the network. In the context of robot networks, the randomness comes from the movement of the robots on a graph and it is thus important to evaluate the time at which they meet each other. Moreover, it could be interesting to insert some randomness into the distributed algorithm to improve the performance of the system.

Résumé du projet de recherche (Langue 2)

The objective of this thesis work is to study these different types of distributed systems, not only by modeling the natural randomness of the system (nodes that join or leave, failure, ...) but also (nodes that join or leave, failure, ...) by the insertion of random choices in the algorithms themselves. The probabilistic models that will be used are mainly Markov chains/random walks and queueing systems. Some examples of performance measures of interest are the hitting of a node by a given message, the cover time, which is the time needed for a message to reach all the nodes and the time needed for two or more robots to meet each other. An important part of the work will be devoted to the definition of other performance measures and strategies to evaluate and understand better the behavior of such systems.

Informations complémentaires (Langue 1)

The PhD will be in collaboration with Professor Masafumi Yamashita from Kyushu University in Japan.

Informations complémentaires (Langue 2)

Probabilities, Markov chains, Probabilistic algorithms, Distributed algorithms.