A Port Graph Calculus and its Application to Autonomic Computing

Hélène Kirchner
joint work with Oana Andrei

INRIA Bordeaux - Sud-Ouest Research Center, France
Helene.Kirchner@inria.fr

Autonomic computing refers to self-manageable systems initially provided with some high-level instructions from administrators. This is a biologically inspired computation model that gained much interest with the recent development of large scale distributed systems such as service infrastructures and grids. For such systems, there is a crucial need for theories and formal frameworks to model computations, to define languages for programming and to establish foundations for verifying important properties of these systems.

From our previous work on biochemical applications, the structure of *port graph* (or multigraph with ports) and a rewriting calculus have emerged to model interactions between molecules or proteins. We propose port graphs as a formal model for distributed resources and grid infrastructures, where each resource is modeled by a node with ports. The lack of global information and the autonomous and distributed behavior of components are modeled by a multiset of port graphs and rewrite rules which are applied locally, concurrently, and non-deterministically. Some computations take place wherever it is possible and in parallel, while others may be controlled by strategies.

In this talk, we first introduce port graphs, that are graphs with multiple edges and loops, with nodes having explicit connection points, called ports, and edges attaching to ports of nodes. We then define a rewrite calculus on these graphs where rules and strategies are themselves port graphs, i.e. first-class objects of the calculus. As a consequence, they can be rewritten as well, and rules can create new rules, providing a way of modeling emergence in a system.

This approach also provides a formal framework to reason about computations and to verify desirable properties. We give some suggestions on expressing properties of a modeled system as strategies. This work in progress opens the way to many further research topics.