



ABCDE



Scientific Report

First name / Family name

Francesco Santini

Nationality

Italy

Name of the *Host Organisation*

INRIA

First Name / family name
of the *Scientific Coordinator*

François Fages

Period of the fellowship

03/09/2012 to 02/09/2013

I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

During the second period of my 12+12 ERCIM “Alain Besnsoussan” fellowship I visited the EPI Contraintes – INRIA, in Paris (France). Here, I had the chance to start collaborating with Dr. François Fages on CLP/SAT techniques to solve Subgraph Epimorphism (SEPI). SEPI can be seen as a variant of subgraph isomorphism (SISO). Our interest in this particular graph relation comes from reaction graphs in systems biology. When reactions are equipped with kinetics and species with concentrations, it yields a reaction model, which can be simulated. Then simulation can be compared to real-life data, and the model can be modified so that the simulation fits the data, which is the final goal. Modelers are interested in having the simplest model that behaves as the real-life data, so they apply mathematical reductions to their models. These reductions induce transformations on the underlying reaction graph, which can be captured using graph operations. Deciding a SEPI problem is NP-complete, and this justifies using approaches such as Constraint Programming and SAT solving. During the first steps of the collaboration we tested and compared these techniques on a database of Biological models (<http://biomodels.net>). In the future, we plan to “relax” the SEPI problem between two graphs, by finding adequate metrics to estimate the distance w.r.t. a crisp SEPI. In this way, we will be able to rank reductions according to a tightness value, but also to obtain a score for those problems unsolvable in the crisp approach.



II – PUBLICATION(S) DURING YOUR FELLOWSHIP

Stefano Bistarelli, Francesco Santini: Coalitions of Arguments: An Approach with Constraint Programming. Fundam. Inform. 124(4): 383-401 (2013) (accepted)

(Abstract) The aggregation of generic items into coalitions leads to the creation of sets of homogenous entities. In this paper we accomplish this for an input set of arguments, and the result is a partition according to distinct lines of thought, i.e., groups of “coherent” ideas. We extend Dung’s Argumentation Framework (AF) in order to deal with coalitions of arguments. The initial set of arguments is partitioned into not-intersected subsets. All the found coalitions show the same property inherited by Dung, e.g., all the coalitions in the partition are admissible (or conflict-free, complete, stable): they are generated according to Dung’s principles. Each of these coalitions can be assigned to a different agent. We use Soft Constraint Programming as a formal approach to model and solve such partitions in weighted AFs: semiring algebraic structures can be used to model different optimization criteria for the obtained coalitions. Moreover, we implement and solve the presented problem with JaCoP, a Java constraint solver, and we test the code over a small-world network.

"Combining Recommender and Reputation Systems to Produce Better Online Advice". Audun Josang, Guibing Guo, Maria Silvia Pini, Francesco Santini, Yue X. Modeling Decisions for Artificial Intelligence (MDAI) 2013, Springer. (accepted)

(Abstract) Although recommender systems and reputation systems have quite different theoretical and technical bases, both types of systems roughly serve the same purpose, which is to provide advice for decision making in e-commerce and online service environments. The similarity in purpose makes it natural to integrate both types of systems in order to produce better online advice, but their difference in theory and implementation makes the integration challenging. In this paper, we propose to use mappings to subjective opinions from values produced by recommender systems as well as from scores produced by reputation systems, and to combine the resulting opinions within the framework of subjective logic.

"Validation of Reo Configurations in an e-Banking Scenario". Maurice H. ter Beek, Fabio Gadducci, Francesco Santini: International Symposium on Architecting Critical Systems (ISARCS), ACM, 2013. (accepted)

(Abstract) We formalize dynamic reconfiguration of Reo circuits (which can be thought of as multi-party communication infrastructures built from primitive channels) through graph transformation, and apply it to a scenario from the Finance domain: a critical infrastructure controlling the business process of an e-banking system. In this scenario, reconfiguration is triggered as soon as the communication buffers reach specific predefined thresholds of congestion. These constraints are implemented inside the Reo model by associating suitable predicates to channels, thus extending previous results on the use of graph transformation for the reconfiguration of Reo’s graphical structures.

"A Tool for Behaviour-based Discovery of Approximately Matching Web Services". Mahdi Sargolzaei, Francesco Santini, Farhad Arbab, Hamideh Afsarmanesh: SEFM 2013. (accepted)

(Abstract) We present a tool that is able to discover stateful Web Services in a database, and to rank the results according to a similarity score expressing the affinities between



each of them and a user-submitted query. To determine these affinities, we take behaviour into account, both of the user's query and of the services. The names of service operations, their order of invocation, and their parameters may differ from those required by the actual user, which necessitates using similarity scores, and hence the notion of soft constraints. The final tool is based on Soft Constraint Automata and an approximate bisimulation among them, modeled and solved as a Constraint Optimisation Problem.

"Solving Subgraph Epimorphism Problems using CLP and SAT". Steven Gay, François Fages, Francesco Santini, Sylvain Soliman: WCB 2013 - Workshop on Constraint-Based-Methods for Bioinformatics. (accepted)

(Abstract) In this work, we compare CLP and SAT solvers on the problem of deciding the existence of a subgraph epimorphism between two graphs. Our interest in this variant of graph matching problem stems from the study of model reductions in systems biology, where large systems of biochemical reactions can be naturally represented by bipartite digraphs of species and reactions. In this setting, model reduction can be formalized as the existence of a sequence of vertex, species or reaction, deletion and merge operations that transforms a first reaction graph into a second graph. This problem is in turn equivalent to the existence of a subgraph (corresponding to delete operations) epimorphism (i.e. surjective homomorphism, corresponding to merge operations) from the first graph to the second. We show how subgraph epimorphism problems can be implemented as CP programs, as boolean clauses, and we compare the two approaches on a large benchmark of reaction graphs from systems biology.

"A First Comparison of Abstract Argumentation Systems: A Computational Perspective". Stefano Bistarelli, Fabio Rossi, Francesco Santini. Convegno Italiano di Logica Computazionale. (accepted)

(Abstract) In this paper we introduce an initial comparison among three different implementations of Abstract Argumentation Systems: ASPARTIX, ConArg, and DungO-Matic. These tools are tested over four different kinds of interaction graphs, corresponding to Erdos-Renyi networks, scale-free Barabasi networks, Watts-Strogatz, and Kleinberg small-world networks. Our final goal is to thoroughly evaluate their performance (in this work we test complete and stable semantics only), and to find the most efficient one, but also, more in general, to better study this kind of problems from the computational point of view.

"On Extending Soft Concurrent Constraint Programming with Rights on Actions". Stefano Bistarelli, Francesco Santini (submitted to Fundamenta Informaticae)

We present a fine-grained security model to enforce the access control on the shared constraint store in Concurrent Constraint Programming (CCP) languages. We show the model for a non-monotonic version of Soft CCP (SCCP), that is an extension of CCP where the constraints have a preference level associated with them. Crisp constraints can be modeled in the same framework as well. In the considered non-monotonic soft version (NmSCCP), it is also possible to remove constraints from the store. The language can be used for coordinating agents on a common store of information that represents the set of shared resources. In such scenarios, it is clearly important to enforce the integrity and confidentiality rights on the resources, in order, for instance, to hide part of the information to some agents, or to prevent an agent to consume too many resources. Finally, we present a bisimulation relation to check equivalence between two programs written in this language.



“Timed Soft Concurrent Constraint Programs: An Interleaved and a Parallel Approach”. Stefano Bistarelli, Maurizio Gabbrielli, Maria Chiara Meo, Francesco Santini (submitted to *Theory and Practice of Logic Programming*)

(Abstract) We propose a timed and soft extension of Concurrent Constraint Programming. The time extension is based on the hypothesis of bounded asynchrony: the computation takes a bounded period of time and is measured by a discrete global clock. Action prefixing is then considered as the syntactic marker which distinguishes a time instant from the next one. Supported by soft constraints instead of crisp ones, tell and ask agents are now equipped with a preference (or consistency) threshold which is used to determine their success or suspension. In the paper we provide a language to describe the agents behavior, together with its operational and denotational semantics, for which we also prove the compositionality and correctness properties. After presenting a semantics using maximal parallelism of actions, we also describe a version for their interleaving on a single processor (with maximal parallelism for time elapsing). Coordinating agents that need to take decisions both on preference values and time events may benefit from this language.

“Semantics Foundations for Deterministic Soft Concurrent Constraint Programming”
Fabio Gadducci, Francesco Santini, Frank D. Valencia (in preparation)

“On Comparing Abstract Argumentation Systems: A Computational Perspective”.
Stefano Bistarelli, Fabio Rossi, Francesco Santini (in preparation)

“Distributed Coordination with Reo: Design, Implementation, and a Service-inspired Case Study”. Sung Jongmans, Francesco Santini, Farhad Arbab (in preparation)

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

- 2nd International Workshop on Semantic Search over the Web (SSW 2012), in conjunction with the 38th International Conference on Very Large Databases (VLDB 2012) Istanbul, Turkey - August 27, 2012
- Web Services and Formal Methods, 9th International Workshop on Web Services and Formal Methods, WS-FM 2012 □ September 6-7, 2012, Tallinn, Estonia
- 1st International conference on Agreement Technologies, Dubrovnik, Croatia, 15-16 October 2012.
- 10th International Conference on Software Engineering and Formal Methods (SEFM), Thessaloniki, Greece, 1-5 October 2012.
- 4th International ACM SIGSOFT Symposium on Architecting Critical Systems Federated with CompArch 2013, 17–21 June 2013 in Vancouver, British Columbia, Canada.
- ERCIM Fall meetings 2012, Inria Sophia Antipolis, 24-26 October 2012.