Third Joint Research Workshop on

Coinduction, Interaction and Composition

DI-CCTC

Universidade do Minho, Braga, Portugal

7-8 May, 2009

Promoted by
DI-CCTC, Minho University, Portugal
CWI, Amsterdam The Netherlands

Organisation
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Context & Objectives

Both from a theoretical and a technological point of view, *global computing* raises a number of challenging and difficult research questions whose relevance for the future of Software Engineering cannot be underestimated. On the theory side, examples include the quest for interaction models, coordination calculi, foundations for co-operation and mobility, resource usage and security, semantics and methods for service specification, orchestration and deployment, among many others.

On the other hand, long term research in *coalgebra theory* and *coindution* provided an useful set of both conceptual and methodological tools to study the the semantics of reactive, interactive and mutable systems.

In such a context, this third Joint Research Workshop, intends to bring together Dutch and Portuguese research groups on both *coalgebraic methods* and their application to the development of models and calculi for *interaction, composition and coordination* of software components and services. Is is expected the workshop will promote a deep understanding of these topics and their interplay, raising new research questions and fostering further collaboration.

Format

The workshop will consist of a number of talks by researchers and PhD students, allowing ample time for discussion. If you want to contribute, please send a title and an abstract to `lsb@di.uminho.pt`, asap.

Registration

Registration is free of charge, but please send an email to `lsb@di.uminho.pt` confirming your participation. Non Minho participants should also indicate their travelling details to book accommodation.

Support

FCT
Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

May, 7

09.30 **On the Eclipse coordination tools and dynamic reconfigurations in Reo**
(Christian Krause, CWI)

Abstract
In this talk I will give an overview of the latest developments in the Eclipse Coordination Tools (ECT). I will mainly focus on dynamic reconfigurations in Reo and show how we can formally model and analyze them using methods from the theory of algebraic graph transformation. I will also show a live demo of a reconfiguration of a deployed and running coordinator.

10.15 **Coordination via constraint interaction**
(José Proença, CWI)

Abstract
Wegner describes coordination as constrained interaction. We take this approach literally and define 'interaction constraints' and a coordination model based on partial, iterative and interactive constraint satisfaction. Our model captures behaviour of Reo connectors described in terms of 'synchronisation' and 'data flow constraints', plus various modes of interaction with the outside world. Underlying our approach is an engine performing (partial) constraint satisfaction of the sets of constraints, enabling local satisfaction of constraints and avoiding global synchronisation over the entire constraints set.

11.00 **Coffee break**

11.30 **Fault-based test case generation for component connectors**
(Sun Meng, CWI)

Abstract
The complex interactions appearing in service-oriented computing make coordination a key concern in service-oriented systems. In this talk, we present a fault-based method to generate test cases for component connectors from specifications. For connectors, faults are caused by possible errors during the development process, such as wrongly used channels, missing or redundant subcircuits, or circuits with wrongly constructed topology. We give test cases and connectors a unifying formal semantics by using the notion of design, and generate test cases by solving constraints obtained from the specification and faulty connectors. A prototype symbolic test case generator serves to demonstrate the automatization of the approach.

12.15 **Validating software integration with coordination analysis**
(Nuno Rodrigues, UM)

Abstract
What sort of coordination strategies emerge in a software integration process? How can such strategies be discovered in the integrated system and further analysed? How close are they to the coordination component of the envisaged architectural model which was supposed to guide the integration process? This talk discusses this sort of questions in the context of a real case-study. The approach adopted is based on a methodology enabling semi-automatic discovery of coordination patterns from source code, combining generalised slicing techniques and graph manipulation.

13.00 **Lunch**

May, 7

14.00 **Automata Models for Component Connectors**
(Marcello Bonsangue, CWI and Leiden University)

Abstract
Reo is an exogenous coordination language for component connectors extending data flow networks with synchronization and context-dependent behavior. In this talk I will review some automata models for Reo and discuss some of their properties.

14.45 **Quantitative domain theory**
(Dirk Hofmann, Aveiro University)

Abstract
One of the nice features of domain theory is the strong interaction between order-theoretic, topological and algebraic ideas. For instance, continuous lattices can be described as ordered sets with certain completeness properties, as injective topological T_0-spaces with respect to embeddings, or as Eilenberg–Moore algebras for the filter monad on Set. Since F.W. Lawvere's famous 1973 paper it is well-known that both ordered sets and metric spaces can be viewed as quantale-enriched categories: the former ones for the quantale $\mathsf{V} = 2$, the latter ones for the quantale $\mathsf{V} = [0, \infty]$. There exist many interesting attempts in the literature to introduce the notion of *continuous metric spaces*, or, more general, *continuous* V*-categories*; usually based on generalisations of the order-theoretic description of continuous lattices. In this talk we will consider an approach to domain theory using "enriched topological spaces". In particular, we obtain a V-enriched equivalent to the filter monad, whose algebras might deserve to be called continuous V-categories.

15.30 **On the design of a Galculator**
(Paulo Silva, UM)

Abstract
Galculator is the name of the prototype of a proof assistant of a special brand: it is solely based on the algebra of Galois connections. When combined with the point-free transform and tactics such as the indirect equality principle, Galois connections offer a very powerful, generic device to tackle the complexity of proofs in program verification. This talk presents the underlying theoretical concepts of Galculator and shows how they can be put together in a working tool.

16.00 **Coffee break**

16.30 **Pointfree Alloy: the other side of the moon**
(José Nuno Oliveira, UM)

Abstract
Alloy is known as a lightweight formal method based on a declarative modeling language whose syntax has an object-oriented flavour. What is perhaps less known is that Alloy's logic draws much from the relational formalisms of Tarski-Givant's "set theory without variables", as the aphorism "in Alloy, everything is a relation" tells. The language includes a pointfree (PF) subset which promotes "relational thinking" in a natural way. In this talk I will show how to use the PF-transform to convert pointwise into (binary relational) pointfree Alloy so as to complement bounded model checking with proof by calculation in AOP (algebra of programming) style. The approach includes the use of (allegorial) diagrams whose commuting squares depict not only data models but also facts about them (vulg. invariants). An illustration of the approach will be given taken from the VFS (Verified File System) case study, a challenge put forward by Rajeev Joshi and Gerard Holzmann in 2007.

17.15 **Mapping between Alloy specifications and relational database implementations**
(Hugo Pacheco, UM)

Abstract
The emergence of lightweight formal methods tools such as Alloy improves the software design process, by encouraging developers to model and verify their systems before engaging in hideous implementation details. However, an abstract Alloy specification is far from an actual implementation, and manually refining the former into the later is unfortunately a non-immediate task. In this talk, we present a subset of the Alloy language that is (almost) directly equivalent to a relational database model containing ordered relations, superkeys and foreign key constraints. This semantic correspondence is a first step towards the automatic materialization of Alloy models into relational databases. It also enables the refactoring of legacy databases into Alloy.

20.00 *Workshop Dinner*, Restaurante De Bouro
(`www.pai.pt/restaurantes/de-bouro/y:PT_75659057_9999_5__1.html`)

May, 8

09.30 **Sampling, splitting and merging in coinductive stream calculus**
(Jan Rutten, CWI)

Abstract
We try to understand so-called periodic stream samplers from a coinductive perspective, and give some initial ideas on the correspondence between stream circuits that allow splitting and merging, on the one hand, and the notion of rationality of streams, on the other.

10.15 **A Kleene Theorem for Polynomial Coalgebras**
(Alexandra Silva, CWI-UM)

Abstract
For polynomial functors G , we show how to generalize the classical notion of regular expression to G -coalgebras. We introduce a language of expressions for describing elements of the ?nal G -coalgebra and, analogously to Kleene?s theorem, we show the correspondence be- tween expressions and ?nite G -coalgebras.

11.00 **Coffee break**

11.30 **Quasi-final coalgebraic semantics**
(Luís Monteiro, UNL)

Abstract
I propose to relax the requisite of finality to account for a greater variety of behaviours. To that purpose the notion of a quasi-final object (nb: not weakly final) in an arbitrary concrete category will be introduced. To illustrate this notion, behaviours from van Glabbeek's spectrum, such as traces, ready-traces and failures, will be shown to give rise to quasi-final objects. Finally, I will address the extension of Turi and Plotkin's mathematical OS to quasi-final objects.

12.15 **On refinements of algebraic specifications**
(Alexandre Madeira, UA-UM)

Abstract
In the algebraic specification of software systems, it is desirable to have freedom in the implementation process, namely for the software reuse. In this talk we discuss two issues in order to achieve this freedom: in the first one, we go beyond the traditional assumption of maintaining the set of observable sorts during the refinement process by the possibility of changing it between the process steps, i.e., we analise the stepwise refinement with encapsulation and desencapsulation of sorts during the process. As second topic, we suggest a formalization of the refinement concept where a formula may be mapped into a set of formulas, instead of the traditional refinements based on signature morphisms, where a formula is mapped into another one. This refinement formalisation is based on the *logical interpretation concept* of the *abstract algebraic logic*.

13.00 **Lunch**

14.00 **Symbolic Execution of Reo Circuits**
(Marjan Sirjani, Reykjavik University)

Abstract
Reo is a coordination language that can be used to model different systems. We propose a technique for symbolic execution of Reo circuits using constraint automata and more specifically, data constraints. This technique enables us to obtain the relations among the data passing through different nodes in the circuit and also the coordination patterns. As an alternative to constructing the symbolic execution tree, we propose an algorithm similar to the algorithms used for converting deterministic finite automata to regular expressions. Our technique can be used for analyzing data-dominated systems whereas the model checking approach is best suited for the study of control-dominated applications. Deadlocks can also be checked. We illustrate the technique on a set of data dominated circuits as well as a non-trivial critical section problem. A tool is implemented to automate the proposed technique.

14.45 **Matrices are Arrows! an AOP perspective on (typed) linear algebra**
(Hugo Macedo, UM)

Abstract
The advent of on-chip parallelism poses many challenges to current programming languages. Traditional approaches based on compiler or hand-coded optimizations are giving place to trendy generative techniques, based on DSLs for high-level program transformation. In this talk we will report on first steps in the attempt to lay the (categorical) semantics of a particular class of DSLs addressing numerical programming under the motto "matrices are arrows!" This shifts the traditional view of matrices as indexed structures to an index-free representation analogous to that of the pointfree algebra of programming (AOP). The use of biproducts, abide-laws, fusion-laws etc to reason about particular matrix transforms such as those used in Gaussian elimination, LU decomposition and so on will be emphasised.

15.30 **Hot topic discussion**