Research activity during and father the PhD
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1 PhD course: 2005 – 2009

During 2004 I have applied for a position as PhD Student at the University of Bologna (Italy). I have been selected for this position and the course started in January 2005, under the supervision of Prof. Maurizio Gabbrielli. The first three years have been funded by a government scholarship. The last year, instead, I have applied for a scholarship (Assegno di ricerca) funded by the University of Bologna.

Since the beginning of my career as a PhD student I have been interested in the general topic of concurrency theory. More precisely I have been interested in studying how the different constructs of concurrent languages influence their expressiveness and which are the techniques to identify the gaps of expressiveness.

The influence of non-determinism. At the beginning, inspired by the works by Plotkin [9, 10], we decided to focus on how a particular form of non determinism affects the expressiveness of a variant of Milner’s CCS. In this variant, replication is used instead of recursion. The relative expressiveness of the two calculi was studied in [3]. We were interested in further investigate those results so to be able to shed light on the abilities of the language and its construct when that particular form of non determinism was disabled. To do so we appeal to formalism less expressive than Turing machines, namely formal grammars in the Chomsky hierarchy. The results of this work have been described in [1, 7].

Linda and its constructs. Immediately after, still interested in how slightly different operators can change considerably the expressive power of a language, we considered an asynchronous version of CCS where messages are exchanged by means of shared memory. The language is usually referred as a variant of the Linda framework. In this context one can consider several variants for the operators of message retrieval: for instance, the reading
operation can stop the current computation and wait till another process publish the required message or it can check if the message is present and choose what to do accordingly. Depending on the particular chosen operator, several variants of the same language can be obtained. Those variants are not only different in their expressiveness: the resultant language can be or not Turing powerful, but also the expressiveness gap is underlined by the existence of different techniques for obtaining fully abstract denotational semantics [5, 7].

Multiplicity. The key feature (where the expressiveness lies) in the retrieval operators in Linda is the ability of recognizing if in the shared memory a message is present once or multiple times. Something similar happens in languages like CHR (Constraint Handling Rules) or the $\kappa$-calculus. For these calculi we exploit several techniques to identify the different expressive power of their constructs. We compare languages by means of embeddings of one calculus into another as in [6, 7]; or by determining the decidability of properties by reducing to the halting problem or to equivalent problems in formalism like Petri nets as in [4, 7].

2 Research fellow with temporary appointment – 2009

In 2009, the scholarship won in 2008, has been extend for another year, again under the supervision of Prof. Maurizio Gabbrielli. I have collaborated in a project regarding the analysis of concurrent languages.

During this year, we have started to consider higher order concurrent languages. This family of calculi seems suitable for modeling problems in the area of web services, cloud computing, etc. In particular, we were interested in finding families of calculi where important properties (like reachability of given configuration, termination, ...) can be proven to be decidable. To do so, we appealed to the theory of Well Structured Transition Systems. A first attempt in this direction is [8].

3 Post Doctoral position – 2010

In January 2010, I have been selected for a post doc position in the group Sardes of INRIA Rhône Alpes, in Grenoble (France). I am working in a joint-project between INRIA and the group VERIMAG under the supervision of Joseph Sifakis and Jean-Bernard Stefani.

We are currently designing a process calculus that models component-based systems. The calculus should serve as a formalization of the BIP framework [2]. In particular the calculus features priorities, and a centralized process that coordinates the evolution of subcomponents.
References


