

## CAREER

### PHD STUDENT | INRIA, COAST TEAM

October 2017 - Today | Nancy, France

#### EFFICIENT (RE)NAMING IN CONFLICT-FREE REPLICATED DATA TYPES

Conflict-free Replicated Data Types (CRDTs) are data structures behaving as traditional ones, like *Set* or *Sequence* data structures, but designed for a distributed usage. They are used in order to build large scale distributed systems adopting the optimistic replication model known as eventual consistency to replicate data among nodes. With this model, each node owning a copy of the data can edit it without any kind of coordination with other nodes. They then propagate the updates to others. The specification of CRDTs ensures that concurrent updates are resolved deterministically and that replicas eventually converge after observing all of them.

To achieve convergence, CRDTs proposed in the literature mostly rely on identifiers to reference updated elements. According to the kind of CRDT, identifiers have to comply to several constraints (unicity, forming a dense set...).

Because of these constraints, the identifiers size is often not bounded. Therefore, the size of metadata attached to each element increases with the number of updates. It thus exceeds more and more the size of data itself, decreasing the efficiency of the data structure over time.

The goal of this PhD is to address this issue by

- Proposing more efficient specifications of identifiers according to their set of constraints,
- Proposing mechanisms to rename identifiers to reduce their size.

### RESEARCH & DEVELOPMENT SOFTWARE ENGINEER | INRIA, COAST TEAM

September 2014 – September 2017 | Nancy, France

#### PROJECT OPENPAAS::NG

The goal of this project is to design an open-source enterprise social network providing a suite of peer-to-peer collaborative office applications. The aim is to offer a reliable and free alternative to existing solutions such as Google Apps. This project is a joint work with the team DaSciM (Data Science and Mining) from the computer science laboratory from the Ecole Polytechnique, Linagora, XWiki SAS and Nexedi.

In this project, the COAST team works on topics such as the interorganisational federation of peer-to-peer systems and the securing of communications in this kind of collaboration. Furthermore, the team provides its expertise on eventually consistent data replication mechanisms in distributed systems.

In order to validate them, these works have been integrated in **MUTE**, peer-to-peer web based real-time collaboration editor.

- Maintaining of *LogootSplit*[3][4] implementation
- Study of the literature on Conflict-free Replicated Data Types and of their use cases.
- Development and integration of an anti-entropy mechanism[5]

#### Publications

- [1] M. Nicolas, V. Elvinger, G. Oster, C.-L. Ignat, and F. Charoy. MUTE: A Peer-to-Peer Web-based Real-time Collaborative Editor. Proceedings of 15th European Conference on Computer-Supported Cooperative Work - Panels, Posters and Demos, pages 1–4, Sheffield, United Kingdom, Aug. 2017. EUSSET. doi: 10.18420/ecscw2017\_p5. URL <https://hal.inria.fr/hal-01655438>.
- [2] OpenPaaS::NG. EC1.1, Prototype : Infrastructure d'édition collaborative P2P. 2016.
- [3] OpenPaaS::NG. SP2-L2.9, Rapport décrivant l'implantation du moteur temps réel v1. 2016.
- [4] OpenPaaS::NG. SP2-L2.10, Rapport décrivant l'implantation du moteur temps réel v2. 2017.
- [5] OpenPaaS::NG. SP2-L2.2, Rapport décrivant l'implantation du composant middleware de réplication hybride pair-à-pair v1. 2017.

## ADT INRIA PLM

**The PLM** is an open-source programming exerciser. Developed by G  rald Oster and Martin Quinson, this application proposes to students to explore and to learn several concepts of the algorithmic through interactive and graphical exercises.

The goal of this project was to enhance this tool in an experimental platform dedicated to the teaching of computer science. To achieve this, a usage data collecting mechanism was required in order to generate a dataset. This dataset, made available to researchers, allows the realisation of research works on topics such as the design of an automatic helping tool which tailors error messages to students. A second objective of this project was to port the application, until then released as a desktop Java software, into a web application to make it available to the greatest number.

My works focused mainly on the realisation of that port. This major change of paradigm introduced several issues which needed to be addressed.

- Implementation and testing of the usage data collecting mechanism
- Conception and integration of a distributed architecture ensuring the scalability of the application
- Isolation of the execution of student code using containers
- Deployment and monitoring of a multi-components application

## INTERN | UNIVERSITY OF LORRAINE, COAST TEAM

April 2014 – August 2014 | Nancy, France

### DESIGN OF A WEB BASED REAL-TIME COLLABORATIVE EDITING TOOL

Coming from the research on collaborative editing, a new family of data replication and consistency maintenance algorithms was recently formalised : Conflict-free Replicated Data Types (CRDTs) approach. This new family addresses several unresolved issues from other approaches, especially its scalability.

The COAST team proposed a new algorithm from this family : *LogootSplit*.

In order to illustrate and highlight the work of the team on this new approach, my task was to design and implement a new real-time collaborative editing tool based on this algorithm.

- Implementation of *LogootSplit* as a library
- Design and development of **MUTE** , a real-time collaborative editing web app using this library

## INTERN | POLYTECHNIQUE MONTR  AL

September 2009 – June 2011 | Montreal, Canada

### DEVELOPMENT OF A TOOL TO CHECK THE CORRECTNESS OF COLLABORATIVE EDITING ALGORITHMS

Existing collaborative editing tools relies mostly on a specific family of algorithms to ensure the eventual consistency of copies : the operational transformation.

Two consistency properties *TP1* and *TP2* are defined and allow to ensure the correctness of algorithms from this family.

The goal of this internship was to develop a tool to automatically check the respect of these properties for a given algorithm.

- Implementation of several algorithms from the operational transformation family
- Development of the tool allowing to check if the algorithms ensure *TP1* and *TP2*

## EDUCATION

### MASTER DEGREE IN COMPUTER SCIENCE

Engineering degree in Computer Science at TELECOM Nancy

September 2011 – August 2014 | Nancy, France

## COMMUNICATION

I presented our research works on various occasions using MUTE. The aims of these presentations were to describe the issues encountered in nowadays systems (scalability, availability, privacy) and how CRDTs allow us to address them. These demos were also the opportunity to show the new usages introduced by this technology such as the seamless transition between real-time and asynchronous collaboration.

August 2017	ECSCW 2017 : MUTE : A Peer-to-Peer Web-based Real-time Collaborative Editor.
December 2016	HCERES Evaluation of the LORIA
	Inria Industry Meeting "New technologies to protect digital data and computer systems"
	Visit of a delegation of Technological University presidents from Mexico
November 2016	Inria Industry Meeting "Interaction with digital objects and services"
October 2016	Evaluation seminar of Inria teams working on "Distributed Systems and Middleware"