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Project-Team COAST

Web Scale Trustworthy Collaborative Service Systems

IN COLLABORATION WITH: Laboratoire lorrain de recherche en informatique et ses applications (LORIA)

RESEARCH CENTER
Nancy - Grand Est

THEME
Distributed Systems and middleware

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Project-Team COAST

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2. Overall Objectives

2.1. Overall Objectives

The advent of the Cloud, of smart mobile devices and of service-based architecture has opened a field of possibilities wide as the invention of the Web 25 years ago. Software companies now deliver applications and services using the Web as a platform. From text to video editing, from data analytics to process management, they distribute business applications to users within their web browser or on some mobile appliance [1]. These services are deployed on sophisticated infrastructures that can cope with very demanding loads. The Software as a Service approach (SaaS) highlights their cooperative nature, by enabling the storage of data in cloud infrastructures that can be easily shared among users. Thus, clients consume applications through service API (web services), available on delivery platforms, called stores or markets. This approach of the distribution of software outstrips the traditional software distribution channels, in both scale and opportunity. Scale has different dimensions : the number of users (communities rather than groups), the size of data produced and managed (billions of documents), the number of services and of organizations (tens of thousands). Opportunity refers to the infinite number of combinations between these services and the many ways to consume and use them.

This fast-paced evolution challenges research because the creation of applications from the composition of services must incorporate new content and context based constraints. From a socio-technical perspective, the behaviour of users is evolving constantly as they get acculturated to new services and ways to cooperate. Mere enhancement of current existing solutions to cope with these challenges is likely insufficient. We conduct a dedicated research effort to tackle the problems arising from the evolution of contemporary technologies and of those we can anticipate.

[1] See http://blog.programmableweb.com/2011/09/16/open-api-growth-a-visualization/

For this purpose, we explore three directions: large scale collaborative data management, data centred service composition and above all, a foundation for the construction of trustworthy collaborative systems.

Large scale collaborative data management concerns mostly the problem of allowing people to collaborate on shared data, synchronously or not, on a central server or on a peer to peer network. Although this research has a long history referring back to [24], new challenges arise regarding needs that are occurring with the acculturation of users to collaboration like the number of participants to a collaboration (a crowd), sharing among different organisations and the nature of documents that are shared and produced. The problem here is to design new algorithms and to evaluate them under different usage conditions and constraints and for different kinds of data.

Data centred service composition deals with the challenge of creating applications by composing services from different providers. Service composition has been studied for some time now but the technical evolution and the growing availability of public API oblige us to reconsider the problem [23]. Our goal here is, taking into account this evolution, like the advent of the Cloud, the availability at a large scale of public API based on the REST [2] architectural style, to design models, methods and tools to help developers to compose these services in a safe and effective way.

Based on the work that we do in the two first topics, our main research direction aims at providing support to build **trustworthy collaborative applications** based on the knowledge that we can gather from the underlying algorithms, from the composition of services and from the quality of services that can be deduced and monitored. The complexity of the context in which applications are executed does not allow to provide proven guarantees. Our goal is to base our work on a contractual and monitored approach to provide users with confidence in the service they use. It is very surprising to see to what extent people rely today on services with very little knowledge about the amount of confidence they put in these services. As soon as these services are based on composition of other unknown services, it becomes very difficult to understand the consequences of the failure of a component of the composition for instance.

We follow a path that portrays a ruptured continuum, to underscore both the endurance of the common questions along with the challenge of accommodating a new scale. We regard collaborative systems as a combination of supportive services, encompassing safe data management and data sharing. Trustworthy data centred services are an essential support for collaboration at the scale of communities and organisations. We see there that we aim at combining our results and expertise to achieve a new leap forward toward the understanding and the mastering of methods and techniques that allow the engineering and the use of large scale collaborative systems.

3. Research Program

3.1. Introduction

Our scientific foundations are grounded on distributed collaborative systems supported by sophisticated data sharing mechanisms and on service oriented computing with an emphasis on orchestration and on non-functional properties.

Distributed collaborative systems enable distributed group work supported by computer technologies. Designing such systems requires an expertise in Distributed Systems and in Computer-supported collaborative Work research area. Besides theoretical and technical aspects of distributed systems, the design of distributed collaborative systems must take into account the human factor to offer solutions suitable for users and groups. The Coast team vision is to move away from a centralized authority based collaboration towards a decentralized collaboration where users have full control over their data that they can store locally and decide with whom to share them. The Coast team investigates the issues related to the management of distributed shared data and coordination between users and groups.

[2] representational state transfer

Service oriented Computing [26] is an established domain on which the ECOO, Score and now the Coast teams have been contributing for a long time. It refers to the general discipline that studies the development of computer applications on the web. A service is an independent software program with a specific functional context and capabilities published as a service contract (or more traditionally an API). A service composition aggregates a set of services and coordinates their interactions. The scale, the autonomy of services, the heterogeneity and some design principles underlying Service Oriented Computing open new research questions that are at the basis of our research. They span the disciplines of **distributed computing**, **software engineering** and **computer supported collaborative work** (CSCW). Our approach to contribute to the general vision of Service Oriented Computing and more generally to the emerging discipline of Service Science has been and is still to focus on the issue of the efficient and flexible construction of reliable and secure high level services through the coordination/orchestration/composition of other services provided by distributed organizations or people.

3.2. Consistency Models for Distributed Collaborative Systems

Collaborative systems are distributed systems that allow users to share data. One important issue is to manage consistency of shared data according to concurrent access. Traditional consistency criteria such as serializability, linearizability are not adequate for collaborative systems.

Causality, Convergence and Intention preservation (CCI) [30] are more suitable for developing middleware for collaborative applications.

We develop algorithms for ensuring CCI properties on collaborative distributed systems. Constraints on the algorithms are different according to the kind of distributed system and to the data structure. The distributed system can be centralized, decentralized or peer-to-peer. The type of data can include strings, growable arrays, ordered trees, semantic graphs and multimedia data.

3.3. Optimistic Replication

Replication of data among different nodes of a network allows improving reliability, fault-tolerance, and availability. When data are mutable, consistency among the different replicas must be ensured. Pessimistic replication is based on the principle of single-copy consistency while optimistic replication allows the replicas to diverge during a short time period. The consistency model for optimistic replication [28] is called eventual consistency, meaning that replicas are guaranteed to converge to the same value when the system is idle.

Our research focuses on the two most promising families of optimistic replication algorithms for ensuring CCI:

- the operational transformation (OT) algorithms [24]
- the algorithms based on commutative replicated data types (CRDT) [27].

Operational transformation algorithms are based on the application of a transformation function when a remote modification is integrated into the local document. Integration algorithms are generic, being parametrized by operational transformation functions which depend on replicated document types. The advantage of these algorithms is their genericity. These algorithms can be applied to any data type and they can merge heterogeneous data in a uniform manner.

Commutative replicated data types is a new class of algorithms initiated by WOOT [25] a first algorithm designed WithOut Operational Transformations. They ensure consistency of highly dynamic content on peer-to-peer networks. Unlike traditional optimistic replication algorithms, they can ensure consistency without concurrency control. CRDT algorithms rely on natively commutative operations defined on abstract data types such as lists or ordered trees. Thus, they do not require a merge algorithm or an integration procedure.

3.4. Process Orchestration and Management

Process Orchestration and Management is considered as a core discipline behind Service Management and Computing. It includes the analysis, the modelling, the execution, the monitoring and the continuous improvement of enterprise processes and is for us a central domain of studies.

Much efforts have been devoted in the past years to establish standard business process models founded on well grounded theories (e.g. Petri Nets) that meet the needs of both business analysts but also of software engineers and software integrators. This has lead to heated debate in the BPM community as the two points of view are very difficult to reconcile. On one side, the business people in general require models that are easy to use and understand and that can be quickly adapted to exceptional situations. On the other side, IT people need models with an operational semantic in order to be able transform them into executable artefacts. Part of our work has been an attempt to reconcile these point of views. It resulted in the development of the Bonita Business process management system and more recently on our work in crisis management where the same people are designing, executing and monitoring the process as it executes. But more generally, and at a larger scale, we have been considering the problem of processes spanning the barriers of organisations and thus more general problem of service composition as a way to coordinate inter organisational construction of applications providing value based on the composition of lower level services [22].

3.5. Service Composition

We are considering processes as pieces of software whose execution traverse the boundaries of organisations. This is especially true with service oriented computing where processes compose services produced by many organisations. We tackle this problem from very different perspectives, trying to find the best compromise between the need for privacy of internal processes from organisations and the necessity to publicize large part of them, proposing to distribute the execution and the orchestration of processes among the organisations themselves, and attempting to ensure non-functional properties in this distributed setting [21].

Non-functional aspects of service composition relate to all the properties and service agreements that one wants to ensure and that are orthogonal to the actual business but that are important when a service is selected and integrated in a composition. This includes transactional context, security, privacy, and quality of service in general. Defining and orchestrating services on a large scale while providing the stakeholders with some strong guarantees on their execution is a first class problem for us. For a long time, we have proposed models and solutions to ensure that some properties (e.g. transactional properties) were guaranteed on process execution, either through design or through the definition of some protocols. Our work has also been extended to the problems of security, privacy and service level agreement among partners. These questions are still central in our work. One major problem of current approaches is to monitor the execution of the compositions, integrating the distributed dimension. This problem can be tackled using event-based algorithms and techniques. Using our event oriented composition framework DISC, we have obtained new results dedicated to the runtime verification of violations in service choreographies.

4. New Software and Platforms

4.1. MUTE

Multi-User Text Editor

FUNCTIONAL DESCRIPTION

MUTE (Multi-User Text Editor) is a web-based text editing tool that allows users to edit documents collaboratively in real-time. It implements our recent work on collaborative editing algorithms and more specifically the LogootSplit+ approach. Compared to existing web-based collaborative text editing tool this editor does not require a powerful central server since the server is not performing any computation and acts as a simple broadcast server. Our editor offers support for working offline while still being able to reconnect at a later time.

- Participants: Gérald Oster, François Charoy, Claudia-Lavinia Ignat, Phillippe Kalitine, Matthieu Nicolas and Victorien Elvinger
- Contact: Gérald Oster
- URL: https://github.com/coast-team/mute/

4.2. NetFlux

Peer-to-Peer Network Library over WebRTC
FUNCTIONAL DESCRIPTION

NetFlux is a Nodejs library that allows users to deploy a peer-to-peer network between web browsers using the WebRTC technology.

- Participants: Gérald Oster, Phillippe Kalitine, Matthieu Nicolas.
- Contact: Gérald Oster
- URL: https://github.com/coast-team/netflux

4.3. MUTE-structs

Peer-to-Peer Network Library over WebRTC
FUNCTIONAL DESCRIPTION

MUTE-structs is a Nodejs module that provides an implementation of the LogootSplit CRDT algorithm. It is an optimistic replication algorithm that ensures eventual consistency on replicated text sequences. It is used in the MUTE real-time collaborative text editor.

- Participants: Gérald Oster, Claudia-Lavinia Ignat, Phillippe Kalitine, Matthieu Nicolas and Victorien Elvinger
- Contact: Gérald Oster
- URL: https://github.com/coast-team/mute-structs

4.4. Replication Benchmarker

FUNCTIONAL DESCRIPTION

The Replication Benchmarker is a performance evaluation framework for optimistic replication mechanisms used in collaborative applications. It contains a library of implementation of several CRDT (Commutative Replicated Data Type) and OT (Operational Transformation) algorithms for different data types: text, set, trees. The framework is able to evaluate the performance of comparable algorithms on different corpus of event traces. These event traces can be produced randomly according to different parameters, can be extracted from actual real-time editing session that have been recorded, or can be automatically extracted from distributed version control repositories such as the one produced with Git. Performances of the algorithms are measured in terms of execution time, memory footprint and quality of merge result (compared to manual merge history stored in git repositories).

- Participants: Pascal Urso and Gérald Oster
- Contact: Pascal Urso
- URL: https://github.com/score-team/replication-benchmarker/

4.5. Rivage

Real-tIme Vector grAphic Group Editor
FUNCTIONAL DESCRIPTION

Rivage is a real-time collaborative graphical editor. Several users can edit at the same time and in real-time a graphical document, user changes being immediately seen by the other users. The editor relies on a peer-to-peer architecture where users can join and leave the group at any time. Each user has a copy of the shared document and user changes on the document copies are merged in real-time by using a CRDT (Commutative Replicated Data Type) algorithm.

- Participant: Claudia-Lavinia Ignat
- Contact: Claudia-Lavinia Ignat
- URL: https://github.com/stephanemartin/rivage/

5. New Results

5.1. Evaluation and Design of Consistency Maintenance Algorithms for Complex Data

Participants: Luc André, Quang Vinh Dang, Claudia-Lavinia Ignat, Gérald Oster, Pascal Urso.

Since the Web 2.0 era, the Internet is a huge content editing place on which users collaborate. Such shared content can be edited by thousands of people. However, current consistency maintenance algorithms seem not to be adapted to massive collaborative updating involving large amounts of contributors and a high velocity of changes. This year we continued our work on the evaluation of existing collaborative editing approaches and on the design of new algorithms that overcome limitations of state of the art ones. We designed new optimistic replication algorithms for maintaining consistency for complex data such as wikis and strings and we evaluated existing algorithms in large scale settings.

Wikis are one of the most important tools of Web 2.0 allowing users to easily edit shared data. However, wikis offer limited support for merging concurrent contributions on the same pages. Users have to manually merge concurrent changes and there is no support for an automatic merging. Real-time collaborative editing reduces the number of conflicts as the time frame for concurrent work is very short. We proposed extending wiki systems with real-time collaboration and designed an automatic merging solution adapted for rich content wikis [5]. Our merging solution is based on an operational transformation approach for which we defined operations with high-level semantics capturing user intentions when editing wiki content such as move, merge and split. Our solution is the first one that deals with high level operations, existing approaches being limited to operations of insert, delete and update on textual documents.

Over the last years we designed a CRDT-based consistency maintenance algorithm for strings [20] for peer-to-peer large scale collaboration that is used by our MUTE collaborative editor which will be integrated in the virtual desktop of the OpenPaaS::NG project. This algorithm called LogootSplit can be seen as an extension for variable-sized elements (e.g. strings) of one of the first basic CRDT algorithms for unit elements (e.g. characters) proposed by our team called Logoot [32]. Its principles are general and can be applied to other basic CRDT algorithms. This year we proposed another algorithm for strings based on the RGA algorithm [9].

By means of simulations we measured the delays in popular real-time collaborative editing systems such as GoogleDocs and Etherpad [12] in terms of the number of users that edit a shared document and their typing frequency. Delays exist between the execution of one user's modification and the visibility of this modification to the other users. Such delays are in part fundamental to the network, as well as arising from the consistency maintenance algorithms and underlying architecture of collaborative editors. Results of this study support our team assertion that delay associated with conventional consistency maintenance algorithms will impede group performance.

5.2. Probabilistic Partial Orderings

Participants: Jordi Martori Adrian, Pascal Urso.

Ensuring reliable and ordered communication between computers usually requires acknowledgment messages. In systems with a high rate of broadcast communication, the cost of such acknowledgment messages can be large. We propose to use the causal ordering information required by some applications to detect and request missing messages. To circumscribe the number of unnecessary requests we combine local awareness and probabilistic methods. Our model allows us to obtain reliable communication within a latency equivalent to unordered communication and lower network usage than acknowledgment systems [18].

5.3. Computational Trust based on User Behavior

Participants: Quang Vinh Dang, Claudia-Lavinia Ignat.

We continued our investigation on computing a trust score for each user according to their behaviour during a collaborative task. Previously we proposed a contract-based collaboration model [31] where trust in users is established and adjusted based on their compliance to the contracts specified by the data owners when they share the data.

We continued this work by proposing an experimental design for testing the proposed trust-based collaboration model. We studied the trust game, a money exchange game that has been widely used in behavioural economics for studying trust and collaboration between humans. In this game, exchange of money is entirely attributable to the existence of trust between users. In the context of the trust game we proposed a trust metric that reflects user behaviours during the collaboration [10]. This metric is robust against fluctuating user behaviour. Our trust metric is the first one that was proposed in the context of the trust game in order to predict user behaviour.

In order to compute the trust score of users according to their contributions during a collaborative editing task, we need to evaluate the quality of the document content. As an initial work in this direction we investigated how to automatically assess the quality of Wikipedia articles in order to guide readers towards high quality articles and to suggest to authors which articles need to be improved. In this context we proposed two automatic assessment methods of the quality of Wikipedia articles. In the first approach we introduced readability features for a better prediction of quality [11]. The second approach is based on a deep-learning mechanism that automatically learns features from document contents rather than manually defining them [13], [4].

5.4. A model to secure collaborative resources within Enterprise Social Networks

Participants: Ahmed Bouchami, Olivier Perrin.

Enterprise social networks (ESN) are collaborative environments that raise major challenges to secure them. In his thesis [2], Ahmed Bouchami addressed the problem of authentication of digital identities within collaborative communities. He proposed an interoperable architecture for managing federated authentication, thus allowing each enterprise to preserve its (own) authentication mechanism and each principal to perform a single sign on authentication regarding different enterprises. He also proposed access control management. His flexible access control model is based on a set of identity attributes, and a formal language based on temporal logic. This model allows for checking the consistency of the policies defined. with the model.

Last, the access control system offers the ability to control the user-centric sharing policies through policies based on a risk management mechanism, which makes the access control mechanism dynamic. The risk mechanism is based on the NIST's risk definition with an alignment with a set of parameters that include access control in the ESN context. More precisely, the dynamic risk management includes, the collaborative resource's importance, the authentication system's vulnerabilities and trust level reflected through the behavior of each collaborative actor. On this latter aspect of trust, a reputation score is computed using the history of collaborative interactions of each subject of the collaborative environment. Finally, a prototype is available and was demonstrated within the OpenPaaS ESN project.

5.5. Risk management for the deployment of a business process in a multi-cloud context

Participants: Amina Ahmed Nacer, Claude Godart, Elio Goettelmann, Samir Youcef.

The lack of trust in cloud organizations is often seen as obstacle to SaaS developments. This work proposes an approach which supports a trust model and a business process model in order to allow the orchestration of trusted business process components in the cloud.

The contribution is threefold and consists in a method, a model and a framework. The method categorizes techniques to transform an existing business process into a risk-aware process model that takes into account security risks related to cloud environments. These techniques are partially described in the form of constraints to automatically support process transformation. The model formalizes the relations and the responsibilities between the different actors of the cloud. This allows to identify the different information required to assess and quantify security risks in cloud environments.

The framework is a comprehensive approach that decomposes a business process into fragments that can automatically be deployed on multiple clouds. The framework also integrates a selection algorithm that combines the security information of cloud offers and of the process with other quality of service criteria to generate an optimized configuration. It is implemented in a tool to assess cloud providers and decompose processes.

Rooted in past years work, we are contributing this year at the methodological and framework levels in two directions:

- At the methodological level, while our risk computing model rested previously only on data provided by cloud providers (provider-side risk model), we are developing a risk model integrating client-side knowledge (client-side risk model).
- At the framework level, we have integrated the ability to integrate fake BP fragments in the objective to increase the obfuscation of a deployed BP logic [15].

5.6. Cloud Provisioning for Elastic BPM

Participants: François Charoy, Samir Youcef, Guillaume Rosinosky.

Even though the cloud computing paradigm has proven benefits, it faces a serious problem that can compromise its commercial success. It concerns the lack of an efficient approach for using optimally the available resources. For this, several approaches have been proposed [29]. However, they suffer from several shortcomings. Often only one objective is taken into account, expressing all operations in terms of cost. Furthermore, business processes should be insured with elasticity and multi-tenancy mechanism while adjusting the available resources to the dynamic load distribution. We proposed to optimize two conflicting objectives, namely the number of migrations of tenants and the cost incurred using a set of resources. Our approach allows to take into account the multi-tenancy property and the Cloud computing elasticity, and is efficient as shown by an extensive experimentation based on real data from Bonita BPM customers [16]. In order to secure the scientific value of our findings we have set up a experimentation infrastructure for making repeatable experiments on the Cloud [17]

5.7. Orchestration of crowdsourcing activities

Participants: François Charoy, Kahina Bessai.

Crowdsourcing is an important paradigm in human problem solving using the Web. When they face a workload outburst, businesses may choose to outsource some or all of their process tasks to the crowd in order to maintain the quality of service promised for their customers. This may occur in situations like crisis management, when organizations are overloaded by a sudden event breakout. These tasks are generally difficult to implement as solution based on software service only. So, the use of crowdsourcing platform seems enticing. To ensure efficient and wise use of resources, methods assisting decision making need to be developed whose aim is to assist businesses in choosing the most knowledgeable workers. We addressed the resource allocation problem in crisis context by defining a delegation approach based on crowdsourcing as resource provider. We introduce a mathematical model for business process execution in crowd-sourcing context and an exact optimization algorithm. As the problem addressed is NP-complete, we proposed a more efficient algorithm that we validated through simulation [7]. Furthermore, to overcome the limitations of existing works we take into account the fact that business process tasks are ordered while optimizing the overall execution time of a given business process instance under budget constraint. We used a synthetic crowd model or valitation. We have also defined a model to validate our work for geo-crowdsourcing activities [8].

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

6.1.1. Industrial funding Groupe Open (2016–2019)

Groupe Open is a leading french company specialised in digital services and operations. The goal of the project is to propose an industrial composition model for APIs that takes into account the new constraints imposed by this new way to distribute and operate software. It will be based on a formal API contract along with trust and reputation attributes in order to allow consumers to anticipate risks regarding the quality and the safety of services. A PhD student is under recruitment for this project. Coast funding : 237,000 €

6.2. Bilateral Grants with Industry

6.2.1. CIFRE Grant with Bonitasoft

Participants: François Charoy, Samir Youcef, Guillaume Rosinosky.

Bonitasoft is a leading software company in the domain of open source Business Process Management Systems. The objective of this grant is to help Bonitasoft to support effective elastic BPM operation in the Cloud by leveraging the business knowledge, the process models and the execution history of process instances and correlate them with cloud resource consumption. Guillaume Rosinosky has been recruited as a PhD Student to work on this project. We will define models that will be validated based on a detailed analysis of existing use cases that we have started to collect from Bonitasoft and its clients.

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Region Lorraine TV Paint (2016–2017)

Participants: Claudia-Lavinia Ignat [contact], Gérald Oster, Quang Vinh Dang, Matthieu Nicolas.

Partners: TVPaint Development, Inria COAST project-team

Website: https://www.tvpaint.com/

This is a project in collaboration with TVPaint Development financed by Region Lorraine. The goal is to contribute to the creation of a collaborative system dedicated to animation movies, that allows to manipulate high quantities of digital artifacts in a collaborative way.

7.2. National Initiatives

7.2.1. OpenPaas NG (2015–2018)

Participants: Claudia-Lavinia Ignat, François Charoy [contact], Gérald Oster, Olivier Perrin, Jean-Philippe Eisenbarth, Phillippe Kalitine, Matthieu Nicolas, Mohammed Riyadh Abdmeziem, Kahina Bessai, Victorien Elvinger, Quentin Laporte Chabasse, Hoai Le Nguyen, Hoang Long Nguyen.

Partners: Linagora, XWiki SAS, Nexedi, COAST project-team (Université de Lorraine, LORIA), DaScim team (LIX).

Website: http://www.open-paas.org/

This project is financed by BpiFrance and involves French industrial leaders in open-source software development (Linagora, Nexedi, XWiki) and academic partners in collaborative work (COAST team) and recommender systems (DaScim team, LIX). The goal of the project is to develop next generation cloud enabled virtual desktop based on an Enterprise Social Network to provide advanced collaborative and recommendation services. COAST team is responsible of the work package dedicated to the design of the peer-to-peer collaborative middleware. In this context, we bring our expertise on data replication for collaborative data in peer-to-peer environments and on trust and access control and identity management in distributed collaborative information systems.

7.2.2. Inria ADT PLM (2014-2016)

Participants: Gérald Oster [contact], Matthieu Nicolas.

Partners: COAST project-team, MYRIADS project-team.

Website: https://github.com/BuggleInc/plm/

This work is performed jointly with Martin Quison (previously member of project-team VERIDIS, now Professor at ENS Rennes).

The Programmer's Learning Machine (PLM) is a software platform dedicated to computer programming education. This generic platform offers support to teachers for creating programming microworlds suitable to teaching courses. It features an integrated and graphical environment, providing a short feedback loop to students in order to improve the effectiveness of the autonomous learning process.

This project aims at establishing an experimental platform for studying the teaching of basic programming and a research instrument to design new collaborative learning environments.

7.3. European Initiatives

7.3.1. FP7 & H2020 Projects

7.3.1.1. SyncFree (2013-2016)

Participants: Pascal Urso [contact], Jordi Martori Adrian.

Program: FP7-ICT-2013-10

Project acronym: SyncFree

Project title: Large-scale computation without synchronisation

Duration : October 2013 - September 2016

Coordinator: Marc Shapiro, Inria

Other Partners: REGAL project-team (Inria Paris - Rocquencourt / LIP6, coordinator), Basho Technologies Limited (United Kingdom), Trifork AS (Denmark), Rovio Entertaiment OY (Finland), Faculdade de Ciências e Tecnologia (Universidade Nova de Lisboa, Portugal), Université Catholique de Louvain (Belgium), Ko c University (Turkey), Technische Universität Kaiserslautern (Germany) and COAST project-team.

Large-scale on-line services including social networks and multiplayer games handle huge quantities of frequently changing shared data. Maintaining their consistency is relatively simple in a centralised cloud, but no longer possible due to increased scalability requirements. Instead, data must be replicated across several distributed data centres, requiring new principled approaches to consistency that have been explored by the SyncFree project. http://syncfree.lip6.fr/

7.4. International Initiatives

7.4.1. Inria Associate Teams Not Involved in an Inria International Labs

7.4.1.1. USCOAST2

Title: User Studies on Trustworthy Collaborative Systems

International Partner (Institution - Laboratory - Researcher):

Wright State University (United States) - Department of Psychology, Knoesis - Valerie Shalin

Start year: 2016

See also: http://uscoast.loria.fr

The proposed project addresses the perception of trust by users, the appropriateness of a trust-based security approach and the role of trust metrics in the management of distributed work. The main challenge of this project is how to measure trust based on user behaviour and to verify by means of experimental studies with users that the trust-based mechanism is acceptable by users. We plan to apply this trust-based mechanism for two types of applications. The first one is collaborative editing where user trust will be computed based on the quality of user contributions for a document or project. The second type of application is in the management of work over a large group of people in order to conduct efficient, high-yield, high-density real time crowdsourcing activities.

Partners of USCOAST2 project have complementary expertise. Coast provides expertise in collaborative methods, systems and related technologies. Coast will propose algorithms that track and manipulate trust metrics. Kno.e.sis provides expertise on the analysis of human work-related behavior, including methods of data collection and data analysis, as well as a theoretical foundation for the evaluation of human performance. Knoesis will analyse trust from a psychological phenomenon point of view.

7.5. International Research Visitors

7.5.1. Visits to International Teams

7.5.1.1. Research Stays Abroad

- Claudia-Lavinia Ignat visited the Department of Computer Science & Knoesis, Wright State University for 1 month in the period June–July 2016 in the context of the associated team USCOAST2
- Gérald Oster visited the Department of Computer Science & Knoesis, Wright State University for 1 month in the period June–July 2016 in the context of the associated team USCOAST2

8. Dissemination

8.1. Promoting Scientific Activities

8.1.1. Scientific Events Organisation

8.1.1.1. Member of the Organizing Committees

- François Charoy was co-chair of the PhD Forum for ICSOC 2016
- Claudia-Lavinia Ignat is in the organisation committee of The Fifteenth International Workshop on Collaborative Editing Systems in conjunction with CSCW 2017

8.1.2. Scientific Events Selection

8.1.2.1. Member of the conference program committees

- Claude Godart was PC member of the conference program committee of BPMDS (Business Process Modeling, Development and Support), EDOC (The enterprise computing conference), ICSOC (International Conference on Services Oriented Computing), IEEE CLOUD Computing, ICWS (IEEE International Conference on Web Services), SCC (IEEE International Conference on Services Computing), S2 ICIOT (S2 International Conference on Internet of Things), IEEE/WIC/ACM WI (Web Intelligence conference), WISE (Web Information Systems Engineering) conferences.
- Claudia-Lavinia Ignat was PC member of CSCW (International Conference on Computer Supported Cooperative Work and Social Computing) 2016, CDVE (International Conference on Cooperative Design, Visualization and Engineering) 2016, ICEBE (International Conference on e-Business Engineering) 2016 and The First IFIP Internet of People Workshop (IoP-W'16) in conjunction with Networking 2016 conference

- Olivier Perrin was PC Member of ICSOC 2016, I3E 2016 (15th IFIP Conference on e-Business, e-Services and e-Society), VECOS 2016 (10th International Workshop on Verification and Evaluation of Computer and Communication Systems), and some workshops.
- François Charoy was PC Member of ICEBE (International Conference on Business Engineering) 2016, CTS 2016 (International Symposium on Collaborative Technologies and Systems), DG.O (International Conference on Digital Government Research) 2016, IEEE WETICE 2016, ICSOC 2016, IEEE International Conference on Business Information Systems and of several workshops.
- Khalid Benali was PC Member of WorldCIST'16 (World Conference on Information Systems and Technologies), I-ESA'2016 (Interoperability of Enterprise Software and Applications), AFIN 2016 (International Conference on Advances in Future Internet), I3E 2016 (IFIP Conference on e-Business, e-Services and e-Society), ICICS 2016 (7th International Conference on Information and Communication Systems), MEDES 2016 (8th International Conference on Management of Digital EcoSystems), SYSCO'16 (third international conference on collaborative systems) and SoEA4EE'2016 (The 8th Workshop on Service oriented Enterprise Architecture for Enterprise Engineering).
- Gérald Oster was a PC member of CoopIS 2016 (International Conference on Cooperative Information Systems).

8.1.3. Journal

8.1.3.1. Member of the editorial boards

- Claude Godart is member of the editorial board of IEEE Transactions on Service Computing, International Journal of Services Computing, and member of the review board of the International Journal of Next Generation Computing.
- Claudia-Lavinia Ignat is member of the editorial board of Journal of CSCW (Computer Supported Cooperative Work).
- François Charoy is member of the editorial board of Service Oriented Computing and Applications Journal (Springer).

8.1.3.2. Reviewer - Reviewing activities

- In 2016, Olivier Perrin reviewed papers for IEEE Transactions on Services Computing journal, IEEE Transactions on Parallel and Distributed Systems and Journal of Systems and Software.
- In 2016, Claudia-Lavinia Ignat reviewed papers for Concurrency and Computation: Practice and Experience, World Wide Web Journal, CHI 2016 and CSCW 2017.
- In 2016, Gérald Oster reviewed papers for Computer Supported Cooperative Work Journal, Concurrency and Computation: Practice and Experience journal and CSCW 2017.

8.1.4. Invited talks

- François Charoy has been invited as a keynote Speaker at the IEEE WETICE Conference in Paris [6] on Collaborative Networks and Crisis Management.
- Claudia-Lavinia Ignat gave an invited lecture in May 2016 at SOAMED Graduate School in Berlin on Replicated Data Consistency
- Claudia-Lavinia Ignat gave an invited talk in June 2016 at the Department of Psychology, Wright State University, on Large-scale trust-based collaboration
- Claudia-Lavinia Ignat gave an invited talk in July 2016 at the Department of Computer Science and Engineering, Ohio Center of Excellence in Knowledge-enabled Computing (Kno.e.sis), Wright State University on Large-scale trust-based collaboration
- Gérald Oster gave an invited talk in July 2016 at the Department of Computer Science and Engineering, Ohio Center of Excellence in Knowledge-enabled Computing (Kno.e.sis), Wright State University on Distributed real-time collaborative editing

8.2. Teaching - Supervision - Juries

8.2.1. Teaching

Permanent members of the COAST project-team are leading teachers in their respective institutions. They are responsible of lectures in disciplines like software engineering, database systems, object oriented programming and design, distributed systems, service computing and more advanced topics at all levels and in different of departments in the University. Most of the PhD Students have also teaching duties in the same institutions. As a whole, the COAST team accounts for more than 2500 hours of teaching. Members of the COAST team are also deeply involved in the pedagogical and administrative life of their departments.

- Gérôme Canals was the head of the Computer science department of the Nancy-Charlemagne University Institute of Technology (IUT Nancy Charlemagne) since September 2010 and until August 2016, and is responsible for the professional licence degree "Web application programming" since sept. 2001.
- Claude Godart is responsible for the Computer Science department of the engineering school ESSTIN.
- Khalid Benali is responsible for the professional Master degree speciality "Distributed Information Systems" of MIAGE and of its international branch in Morocco.
- François Charoy is responsible of the Software Engineering specialisation at the TELECOM Nancy Engineering School of University of Lorraine.
- Pascal Urso is responsible for the "Security, Services, Systems and Network" track of the master degree in computer science at University of Lorraine since September 2013.

8.2.2. Supervision

PhD (in progress): Quang Vinh Dang, Trust-based large scale collaboration, started in 10/2014, Claudia-lavinia Ignat and François Charoy

PhD (in progress): Hoai Le Nguyen, Study of group performance and behavior in collaborative editing, started in 9/2015, Claudia-Lavinia Ignat and François Charoy

PhD (in progress): Hoang Long Nguyen, A Trust Based Authorization Model and Framework for the Cloud, started in 11/2015, Claudia-Lavinia Ignat and Olivier Perrin

PhD (defended): Luc André, Replication and Consistency Maintenance in Peer-to-Peer Collaborative Environment, started in 9/2011, François Charoy and Gérald Oster

PhD (in progress): Victorien Elvinger, Secured Replication for Peer-to-Peer Collaborative Infrastructures, started in 10/2015, François Charoy and Gérald Oster

PhD (defended): Ahmed Bouchami , Sécurité des données collaboratives d'une plateforme PaaS, started in 11/2012, Olivier Perrin

PhD (in progress): Jordi Martori i Adrian, Data constraints for large-scale collaboration, started in 10/2013, François Charoy and Pascal Urso

PhD (in progress): Guillaume Rosinoski, Elastic BPM and the Cloud, started in 10/2014, François Charoy and Samir Youssef

PhD (in progress): Quentin Laporte-Chabasse, Federation of Organisations over Peer to Peer Collaborative Network, started in 10/2016, François Charoy and Gérald Oster

PhD (in progress): Béatrice Linot, Trust in cooperative systems, Jérome Dinet et François Charoy, started 11/2016

8.2.3. Juries

- François Charoy was head of the Selection committee at TELECOM Nancy, Université de Lorraine

COAST members were members of the following PhD and HdR defense committees:

- Mondi Ravi, PhD, Université de Grenoble, January 2016 (François Charoy)

- Tomasz Buchert, PhD, Université de Lorraine, January 2016 (François Charoy)
- Luc André, PhD, Université de Lorraine, May 2016 (François Charoy and Gérald Oster)
- Adrian Shatte, PhD, James Cook University, Cairns, Australia, September 2016 (François Charoy)
- Wassim Derguech, PhD, National University of Ireland, Galway, Ireland, December 2016 (François Charoy)
- Philippe Dirix, PhD, Université de Lille, July 2016 (Khalid Benali)
- Bouchra El Idrissi, PhD, Université Mohammed V de Rabat, Maroc, September 2016 (Khalid Benali)
- Ghada Gharbi, PhD, Université de Toulouse 3, November 2016 (Claude Godart)
- Hind Benfenatki, PhD, Université de Lyon 1, December 2016 (Claude Godart)
- Brice Nedelec, PhD, Université de Nantes, October 2016 (Gérald Oster)
- Anthéa Mayzaud, PhD, Université de Lorraine, October 2016 (Olivier Perrin)
- Noran Azmy, PhD, Universität des Saarlandes and Université de Lorraine, November 2016 (Olivier Perrin)

8.3. Popularization

- In March 2016 members of the team (François Charoy and Phillippe Kalitine) participated to the "Rencontres Université Entreprise" in Paris to demonstrate the collaborative editor MUTE (http://www.rue-aef.com)
- In January 2016 Claudia-Lavinia Ignat presented Coast research activities to the first year students at Ecole de Mines de Nancy
- In May 2016 Claudia-Lavinia Ignat gave a lecture on Replicated Data Consistency at SOAMED Graduate School in Berlin
- In May 2016 Claudia-Lavinia Ignat organised the meeting Research@Inria at Inria Nancy-Grand Est for presenting to internship students, PhD students and postdocs various Inria programs and the main research topics at Inria with a focus on activities of research teams at Inria Nancy-Grand Est. She also presented the main activities of a researcher and briefly described her research work.
- In November 2016 members of the team (François Charoy and Matthieu Nicolas) participated to the "Rencontre Inria-Industrie" (RII) on the topic - Interactions avec les objets et services numériques" in Lille to demonstrate MUTE collaborative editor
- In December 2016 members of the team (Claudia-Lavinia Ignat, Gérald Oster, Matthieu Nicolas and Phillippe Kalitine) participated to the "Rencontre Inria-Industrie" (RII) on the topic - Nouvelles technologies pour la protection des données et des systèmes numériques" in Nancy to demonstrate collaborative editor MUTE
- In December 2016 members of the team (Gérald Oster, Matthieu Nicolas and Phillippe Kalitine) demonstrated the collaborative editor MUTE during the visit of the Rectors of the Mexican Technological Universities at LORIA in the context of the bilateral MEXPROTEC program.

8.4. Institutional commitment

- Claudia-Lavinia Ignat is in charge of European affairs for Inria Nancy Grand-Est. She is the Delegate of International Relations for Inria Nancy-Grand Est and member of COST-GTRI commission. She is member of the Inria Nancy-Grand Est COMIPERS committee. She participated to a working group in charge with the design of a booklet for industrials describing the technological offer of Inria Nancy-Grand Est (she was responsible for the part concerning Large-scale collaborative services and systems). She is responsible with the activity kindergarten at AGOS Inria Nancy-Grand Est.

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Doctoral Dissertations and Habilitation Theses

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[2] A. BOUCHAMI. *Security of collaborative resources in enterprises social networks*, Université de lorraine, September 2016, https://tel.archives-ouvertes.fr/tel-01402629

Articles in International Peer-Reviewed Journals

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Invited Conferences

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[8] K. BESSAI, F. CHAROY. *Optimization of Orchestration of Geocrowdsourcing Activities*, in "Third International Conference on Information Systems for Crisis Response and Management in Mediterranean Countries (ISCRAM-med 2016)", Madrid, Spain, Lecture Notes in Business Information Processing, Springer, October 2016, https://hal.inria.fr/hal-01356053

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