



IN PARTNERSHIP WITH:  
**CNRS**

**Université Nice - Sophia  
Antipolis**

Activity Report 2017

## **Project-Team WIMMICS**

Web-Instrumented Man-Machine Interactions,  
Communities and Semantics

IN COLLABORATION WITH: Laboratoire informatique, signaux systèmes de Sophia Antipolis (I3S)

RESEARCH CENTER  
**Sophia Antipolis - Méditerranée**

THEME  
**Data and Knowledge Representation  
and Processing**



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## Project-Team WIMMICS

*Creation of the Team: 2012 January 01, updated into Project-Team: 2013 July 01*

### **Keywords:**

#### **Computer Science and Digital Science:**

- A1.1.7. - Peer to peer
- A1.2.9. - Social Networks
- A2.1. - Programming Languages
- A2.1.1. - Semantics of programming languages
- A3.1.1. - Modeling, representation
- A3.1.2. - Data management, quering and storage
- A3.1.3. - Distributed data
- A3.1.4. - Uncertain data
- A3.1.5. - Control access, privacy
- A3.1.6. - Query optimization
- A3.1.7. - Open data
- A3.2. - Knowledge
- A3.2.1. - Knowledge bases
- A3.2.2. - Knowledge extraction, cleaning
- A3.2.3. - Inference
- A3.2.4. - Semantic Web
- A3.2.5. - Ontologies
- A3.3.2. - Data mining
- A3.4. - Machine learning and statistics
- A3.5. - Social networks
- A3.5.2. - Recommendation systems
- A4.7. - Access control
- A5.1. - Human-Computer Interaction
- A5.1.1. - Engineering of interactive systems
- A5.1.2. - Evaluation of interactive systems
- A5.2. - Data visualization
- A5.7.2. - Music
- A5.8. - Natural language processing
- A5.10.5. - Robot interaction (with the environment, humans, other robots)
- A7.1.3. - Graph algorithms
- A7.2.2. - Automated Theorem Proving
- A8.2.2. - Evolutionary algorithms
- A9. - Artificial intelligence
- A9.1. - Knowledge
- A9.2. - Machine learning
- A9.4. - Natural language processing
- A9.5. - Robotics
- A9.7. - AI algorithmics

**Other Research Topics and Application Domains:**

- B1.2.2. - Cognitive science
- B2. - Health
- B5.6. - Robotic systems
- B5.8. - Learning and training
- B6.3.1. - Web
- B6.3.2. - Network protocols
- B6.3.4. - Social Networks
- B6.5. - Information systems
- B8.2. - Connected city
- B8.5. - Smart society
- B8.5.1. - Participative democracy
- B9. - Society and Knowledge
- B9.1. - Education
- B9.1.1. - E-learning, MOOC
- B9.1.2. - Serious games
- B9.4.1. - Computer science
- B9.4.5. - Data science
- B9.5. - Humanities
- B9.5.1. - Psychology
- B9.5.2. - Juridical science
- B9.5.5. - Sociology
- B9.5.8. - Linguistics
- B9.5.10. - Digital humanities
- B9.7. - Knowledge dissemination
- B9.7.1. - Open access
- B9.7.2. - Open data
- B9.8. - Privacy
- B9.10. - Ethics

## 1. Personnel

**Research Scientists**

- Fabien Gandon [Team leader, Inria, Senior Researcher, HDR]
- Olivier Corby [Inria, Researcher]
- Alain Giboin [Inria, Researcher]
- Alexandre Monnin [Inria, Starting Research Position, until Aug 2017]
- Serena Villata [CNRS, Researcher]

**Faculty Members**

- Elena Cabrio [Univ de Nice - Sophia Antipolis, Associate Professor]
- Michel Buffa [Univ de Nice - Sophia Antipolis, Associate Professor]
- Catherine Faron Zucker [Univ de Nice - Sophia Antipolis, Associate Professor, HDR]
- Nhan Le Thanh [Univ de Nice - Sophia Antipolis, Professor]
- Isabelle Mirbel [Univ de Nice - Sophia Antipolis, Associate Professor, HDR]
- Peter Sander [Univ de Nice - Sophia Antipolis, Professor]



Andrea Tettamanzi [Univ de Nice - Sophia Antipolis, Professor]

#### **PhD Students**

Ahmed El Amine Djebri [Univ de Nice - Sophia Antipolis, from Sep 2017]  
Amosse Edouard [Univ de Nice - Sophia Antipolis, until Aug 2017]  
Michael Fell [CNRS, from May 2017]  
Raphaël Gazzotti [Synchronext]  
Tobias Mayer [Univ de Nice - Sophia Antipolis, from Oct 2017]  
Thu Huong Nguyen [Univ de Nice - Sophia Antipolis, from Mar 2017]  
Emilie Palagi [Inria]  
Tuan Anh Pham [University of Danang, Vietnam]  
Mahamadou Toure [UGB, from Apr 2017]  
Molka Dhouib [Inria, SILEX]  
Abdoul Macina [Univ de Nice - Sophia Antipolis]  
Amel Ben Othmane [Univ de Nice - Sophia Antipolis, until Jun 2017]  
Tran Duc Minh [Univ de Nice - Sophia Antipolis, University of Danang, Vietnam]

#### **Technical staff**

Valerio Basile [Inria, until Aug 2017]  
Thierry Bergeron [CNRS]  
Geraud Fokou Pelap [Inria, from Feb 2017]  
Fabrice Jauvat [CNRS, from Feb 2017 until Oct 2017]  
Elmahdi Korfed [Inria, from Feb 2017]  
Roque Lopez Condori [Inria, from Feb 2017]  
Patrice Pena [CNRS, until Jun 2017]  
Oscar Rodríguez Rocha [Inria]  
Franck Michel [CNRS]  
Erwan Demairy [Inria]  
Guillaume Etevenard [Inria, from Sep 2017]

#### **Intern**

Oussama Lahlou [Univ de Nice - Sophia Antipolis, from Apr 2017 until Sep 2017]

#### **Administrative Assistant**

Christine Foggia [Inria]

#### **Visiting Scientists**

Cristian Cardellino [Universidad de Córdoba, Argentina, from Jul 2017 until Aug 2017]  
Guidedi Kaladzavi [University of Maroua, Cameroon, from Oct 2017]  
Dario Malchiodi [Università degli Studi di Milano, Italy, from May 2017 until Jun 2017]  
Yaroslav Nechaev [Fondazione Bruno Kessler, Trento, Italy, from Sep 2017 until Dec 2017]  
Thanh Tuan Nguyen [Agence universitaire de la Francophonie, from Oct 2017]  
Debora Nozza [Università degli Studi di Milano-Bicocca, from Feb 2017 until May 2017]  
Milagro Teruel [Universidad de Córdoba, Argentina, from Jun 2017 until Aug 2017]

#### **External Collaborators**

Claude Frasson [Univ. Montreal]  
Freddy Lecue [Accenture Technology Labs]

## 2. Overall Objectives

### 2.1. Presentation

#### 2.1.1. Context and Objectives

The Web became a virtual place where persons and software interact in mixed communities. These large scale mixed interactions create many problems that must be addressed with multidisciplinary approaches [70]. One particular problem is to reconcile formal semantics of computer science (e.g. logics, ontologies, typing systems, protocols, etc.) on which the Web architecture is built, with soft semantics of people (e.g. posts, tags, status, relationships, etc.) on which the Web content is built.

*Wimmics proposes models and methods to bridge formal semantics and social semantics on the Web.* [69]

From a formal modeling point of view, one of the consequences of the evolutions of the Web is that the initial graph of linked pages has been joined by a growing number of other graphs. This initial graph is now mixed with sociograms capturing the social network structure, workflows specifying the decision paths to be followed, browsing logs capturing the trails of our navigation, service compositions specifying distributed processing, open data linking distant datasets, etc. Moreover, these graphs are not available in a single central repository but distributed over many different sources. Some sub-graphs are small and local (e.g. a user's profile on a device), some are huge and hosted on clusters (e.g. Wikipedia), some are largely stable (e.g. thesaurus of Latin), some change several times per second (e.g. social network statuses), etc. And each type of network of the Web is not an isolated island. Networks interact with each other: the networks of communities influence the message flows, their subjects and types, the semantic links between terms interact with the links between sites and vice-versa, etc.

Not only do we need means to represent and analyze each kind of graphs, we also do need the means to combine them and to perform multi-criteria analysis on their combination. Wimmics contributes to this understanding by: (1) proposing multidisciplinary approaches to analyze and model the many aspects of these intertwined information systems, their communities of users and their interactions; (2) formalizing and reasoning on these models using graphs-based knowledge representation from the semantic Web to propose new analysis tools and indicators, and support new functionalities and better management. In a nutshell, the first research direction looks at models of systems, users, communities and interactions while the second research direction considers formalisms and algorithms to represent them and reason on their representations.

#### 2.1.2. Research Topics

The research objectives of Wimmics can be grouped according to four topics we identify in reconciling social and formal semantics on the Web:

**Topic 1 - users modeling and designing interaction on the Web:** The general research question addressed by this objective is *"How do we improve our interactions with a semantic and social Web more and more complex and denser?"*. Wimmics focuses on specific sub-questions: *"How can we capture and model the users' characteristics?"* *"How can we represent and reason with the users' profiles?"* *"How can we adapt the system behaviors as a result?"* *"How can we design new interaction means?"* *"How can we evaluate the quality of the interaction designed?"*

**Topic 2 - communities and social interactions analysis on the Web:** The general question addressed in this second objective is *"How can we manage the collective activity on social media?"*. Wimmics focuses on the following sub-questions: *"How do we analyze the social interaction practices and the structures in which these practices take place?"* *"How do we capture the social interactions and structures?"* *"How can we formalize the models of these social constructs?"* *"How can we analyze and reason on these models of the social activity?"*

**Topic 3 - vocabularies, semantic Web and linked data based knowledge representation on the Web:**

The general question addressed in this third objective is "What are the needed schemas and extensions of the semantic Web formalisms for our models?". Wimmics focuses on several sub-questions: "What kinds of formalism are the best suited for the models of the previous section?" "What are the limitations and possible extensions of existing formalisms?" "What are the missing schemas, ontologies, vocabularies?" "What are the links and possible combinations between existing formalisms?" In a nutshell, an important part of this objective is to formalize as typed graphs the models identified in the previous objectives in order for software to exploit them in their processing (in the next objective).

**Topic 4 - analyzing and reasoning on heterogeneous semantic graphs on the Web:** The general research question addressed in this last objective is "What are the algorithms required to analyze and reason on the heterogeneous graphs we obtained?". Wimmics focuses on several sub-questions: "How do we analyze graphs of different types and their interactions?" "How do we support different graph life-cycles, calculations and characteristics in a coherent and understandable way?" "What kind of algorithms can support the different tasks of our users?".

## 3. Research Program

### 3.1. Users Modeling and Designing Interaction on the Web

Wimmics focuses on interactions of ordinary users with ontology-based knowledge systems with a preference for semantic Web formalisms and Web 2.0 applications. We specialize interaction design and evaluation methods to Web application tasks such as searching, browsing, contributing or protecting data. The team is especially interested in using semantics in assisting the interactions. We propose knowledge graph representations and algorithms to support interaction adaptation for instance for context-awareness or intelligent interactions with machine. We propose and evaluate Web-based visualization techniques for linked data, querying, reasoning, explaining and justifying. Wimmics also integrates natural language processing approaches to support natural language based interactions. We rely on cognitive studies to build models of the system, the user and the interactions between users through the system, in order to support and improve these interactions. We extend the user modeling technique known as *Personas* where user models are represented as specific, individual humans. *Personas* are derived from significant behavior patterns (i.e., sets of behavioral variables) elicited from interviews with and observations of users (and sometimes customers) of the future product. Our user models specialize *Personas* approaches to include aspects appropriate to Web applications. Wimmics also extends user models to capture very different aspects (e.g. emotional states).

### 3.2. Communities and Social Interactions Analysis

The domain of social network analysis is a whole research domain in itself and Wimmics targets what can be done with typed graphs, knowledge representations and social models. We also focus on the specificity of social Web and semantic Web applications and in bridging and combining the different social Web data structures and semantic Web formalisms. Beyond the individual user models, we rely on social studies to build models of the communities, their vocabularies, activities and protocols in order to identify where and when formal semantics is useful. We propose models of collectives of users and of their collaborative functioning extending the collaboration personas and methods to assess the quality of coordination interactions and the quality of coordination artifacts. We extend and compare community detection algorithms to identify and label communities of interest with the topics they share. We propose mixed representations containing social semantic representations (e.g. folksonomies) and formal semantic representations (e.g. ontologies) and propose operations that allow us to couple them and exchange knowledge between them. Moving to social interaction we develop models and algorithms to mine and integrate different yet linked aspects of social media contributions (opinions, arguments and emotions) relying in particular on natural language processing and argumentation theory. To complement the study of communities we rely on multi-agent systems to simulate and study social behaviors. Finally we also rely on Web 2.0 principles to provide and evaluate social Web applications.

### **3.3. Vocabularies, Semantic Web and Linked Data Based Knowledge Representation**

For all the models we identified in the previous sections, we rely on and evaluate knowledge representation methodologies and theories, in particular ontology-based modeling. We also propose models and formalisms to capture and merge representations of different levels of semantics (e.g. formal ontologies and social folksonomies). The important point is to allow us to capture those structures precisely and flexibly and yet create as many links as possible between these different objects. We propose vocabularies and semantic Web formalizations for the whole aspects we model and we consider and study extensions of these formalisms when needed. The results have all in common to pursue the representation and publication of our models as linked data. We also contribute to the transformation and linking of existing resources (informal models, databases, texts, etc.) to be published on the semantic Web and as linked data. Examples of aspects we formalize include: user profiles, social relations, linguistic knowledge, business processes, derivation rules, temporal descriptions, explanations, presentation conditions, access rights, uncertainty, emotional states, licenses, learning resources, etc. At a more conceptual level we also work on modeling the Web architecture with philosophical tools so as to give a realistic account of identity and reference and to better understand the whole context of our research and its conceptual cornerstones.

### **3.4. Analyzing and Reasoning on Heterogeneous Semantic Graphs**

One of the characteristics of Wimmics is to rely on graph formalisms unified in an abstract graph model and operators unified in an abstract graph machine to formalize and process semantic Web data, Web resources, services metadata and social Web data. In particular Corese, the core software of Wimmics, maintains and implements that abstraction. We propose algorithms to process the mixed representations of the previous section. In particular we are interested in allowing cross-enrichment between them and in exploiting the life cycle and specificity of each one to foster the life-cycles of the others. Our results all have in common to pursue analyzing and reasoning on heterogeneous semantic graphs issued from social and semantic Web applications. Many approaches emphasize the logical aspect of the problem especially because logics are close to computer languages. We defend that the graph nature of Linked Data on the Web and the large variety of types of links that compose them call for typed graphs models. We believe the relational dimension is of paramount importance in these representations and we propose to consider all these representations as fragments of a typed graph formalism directly built above the Semantic Web formalisms. Our choice of a graph based programming approach for the semantic and social Web and of a focus on one graph based formalism is also an efficient way to support interoperability, genericity, uniformity and reuse.

## **4. Application Domains**

### **4.1. Social Semantic Web**

A number of evolutions have changed the face of information systems in the past decade but the advent of the Web is unquestionably a major one and it is here to stay. From an initial wide-spread perception of a public documentary system, the Web as an object turned into a social virtual space and, as a technology, grew as an application design paradigm (services, data formats, query languages, scripting, interfaces, reasoning, etc.). The universal deployment and support of its standards led the Web to take over nearly all of our information systems. As the Web continues to evolve, our information systems are evolving with it.

Today in organizations, not only almost every internal information system is a Web application, but these applications also more and more often interact with external Web applications. The complexity and coupling of these Web-based information systems call for specification methods and engineering tools. From capturing the needs of users to deploying a usable solution, there are many steps involving computer science specialists and non-specialists.

We defend the idea of relying on Semantic Web formalisms to capture and reason on the models of these information systems supporting the design, evolution, interoperability and reuse of the models and their data as well as the workflows and the processing.

## 4.2. Linked Data on the Web and on Intranets

With billions of triples online (see Linked Open Data initiative), the Semantic Web is providing and linking open data at a growing pace and publishing and interlinking the semantics of their schemas. Information systems can now tap into and contribute to this Web of data, pulling and integrating data on demand. Many organisations also started to use this approach on their intranets leading to what is called linked enterprise data.

A first application domain for us is the publication and linking of data and their schemas through Web architectures. Our results provide software platforms to publish and query data and their schemas, to enrich these data in particular by reasoning on their schemas, to control their access and licenses, to assist the workflows that exploit them, to support the use of distributed datasets, to assist the browsing and visualization of data, etc.

Examples of collaboration and applied projects include: SMILK Joint Laboratory, Corese, DBpedia.fr.

## 4.3. Assisting Web-based Epistemic Communities

In parallel to linked open data on the Web, social Web applications also spread virally (e.g. Facebook growing toward 1.5 billion users) first giving the Web back its status of a social read-write media and then putting it back on track to its full potential of a virtual place where to act, react and interact. In addition, many organizations are now considering deploying social Web applications internally to foster community building, expert cartography, business intelligence, technological watch and knowledge sharing in general.

By reasoning on the Linked Data and the semantics of the schemas used to represent social structures and Web resources, we provide applications supporting communities of practice and interest and fostering their interactions in many different contexts (e-learning, business intelligence, technical watch, etc.).

We use typed graphs to capture and mix: social networks with the kinds of relationships and the descriptions of the persons; compositions of Web services with types of inputs and outputs; links between documents with their genre and topics; hierarchies of classes, thesauri, ontologies and folksonomies; recorded traces and suggested navigation courses; submitted queries and detected frequent patterns; timelines and workflows; etc.

Our results assist epistemic communities in their daily activities such as biologists exchanging results, business intelligence and technological watch networks informing companies, engineers interacting on a project, conference attendees, students following the same course, tourists visiting a region, mobile experts on the field, etc. Examples of collaboration and applied projects: EduMICS, OCKTOPUS, Vigiglobe, Educlever, Gayatech.

## 4.4. Linked Data for a Web of diversity

We intend to build on our results on explanations (provenance, traceability, justifications) and to continue our work on opinions and arguments mining toward the global analysis of controversies and online debates. One result would be to provide new search results encompassing the diversity of viewpoints and providing indicators supporting opinion and decision making and ultimately a Web of trust. Trust indicators may require collaborations with teams specialized in data certification, cryptography, signature, security services and protocols, etc. and this will raise the specific problem of interaction design for security and privacy. In addition, from the point of view of the content, this requires to foster the publication and coexistence of heterogeneous data with different points of views and conceptualizations of the world. We intend to pursue the extension of formalisms to allow different representations of the world to co-exist and be linked and we will pay special attention to the cultural domain and the digital humanities. Examples of collaboration and applied projects: Zoomathia, Seempad, SMILK,

## 4.5. Artificial Web intelligence

We intend to build on our experience in artificial intelligence (knowledge representation, reasoning) and distributed artificial intelligence (multi-agent systems - MAS) to enrich formalisms and propose alternative types of reasoning (graph-based operations, reasoning with uncertainty, inductive reasoning, non-monotonic, etc.) and alternative architectures for linked data with adequate changes and extensions required by the open nature of the Web. There is a clear renewed interest in AI for the Web in general and for Web intelligence in particular. Moreover distributed AI and MAS provide both new architectures and new simulation platforms for the Web. At the macro level, the evolution accelerated with HTML5 toward Web pages as full applications and direct Page2Page communication between browser clearly is a new area for MAS and P2P architectures. Interesting scenarios include the support to a strong decentralization of the Web and its resilience to degraded technical conditions (downscaling the Web), allowing pages to connect in a decentralized way, forming a neutral space, and possibly going offline and online again in erratic ways. At the micro level one can imagine the place RDF and SPARQL could take as data model and programming model in the virtual machines of these new Web pages and, of course, in the Web servers. RDF is also used to serialize and encapsulate other languages and becomes a pivot language in linking very different applications and aspects of applications. Example of collaboration and applied projects: MoreWAIS, Corese, Vigiglobe collaboration.

## 4.6. Human-Data Interaction (HDI) on the Web

We need more interaction design tools and methods for linked data access and contribution. We intend to extend our work on exploratory search coupling it with visual analytics to assist sense making. It could be a continuation of the Gephi extension we built targeting more support for non expert to access and analyze data on a topic or issue of their choice. More generally speaking SPARQL is inappropriate for common users and we need to support a larger variety of interaction means with linked data. We also believe linked data and natural language processing (NLP) have to be strongly integrated to support natural language based interactions. Linked Open Data (LOD) for NLP, NLP for LOD and Natural Dialog Processing for querying, extracting and asserting data on the Web is a priority to democratize its use. Micro accesses and micro contributions are important to ensure public participation and also call for customized interfaces and thus for methods and tools to generate these interfaces. In addition, the user profiles are being enriched now with new data about the user such as his current mental and physical state, the emotion he just expressed or his cognitive performances. Taking into account this information to improve the interactions, change the behavior of the system and adapt the interface is a promising direction. And these human-data interaction means should also be available for “small data”, helping the user to manage her personal information and to link it to public one or collective one maintaining her personal and private perspective as a personal Web of data. Finally, the continuous knowledge extractions, updates and flows add the additional problem of representing, storing, querying and interacting with dynamic data. Examples of collaboration and applied projects: QAKIS, Sychonext collaboration, ALOOF, DiscoveryHub, Wasabi, MoreWAIS.

**Web-augmented interactions with the world:** The Web continues to augment our perception and interaction with reality. In particular, Linked Open Data enable new augmented reality applications by providing data sources on almost any topic. The current enthusiasm for the Web of Things, where every object has a corresponding Web resource, requires evolutions of our vision and use of the Web architecture. This vision requires new techniques as the ones mentioned above to support local search and contextual access to local resources but also new methods and tools to design Web-based human devices interactions. accessibility, etc.) These new usages are placing new requirements on the Web Architecture in general and on the semantic Web models and algorithms in particular to handle new types of linked data. They should support implicit requests considering the user context as a permanent query. They should also simplify our interactions with devices around us jointly using our personal preferences and public common knowledge to focus the interaction on the vital minimum that cannot be derived in another way. For instance the access to the Web of data for a robot can completely change the quality of the interactions it can offer. Again these interactions and the data they require raise problems of security and privacy. Examples of collaboration and applied projects: ALOOF, AZKAR, MoreWAIS.

## 5. Highlights of the Year

### 5.1. Highlights of the Year

#### 5.1.1. Awards

We received a best paper presentation award for the paper about the WebAudio Guitar Tube Amp Simulator of the Wasabi Project at WebAudio Conference in August [49].

We received an UCA distinction for this award.

We received an UCA distinction for a spotlight paper at ISWC [32].

BEST PAPERS AWARDS:

[56]

J. YOUNG, V. BASILE, M. SUCHI, L. KUNZE, N. HAWES, M. VINCZE, B. CAPUTO. *Making Sense of Indoor Spaces Using Semantic Web Mining and Situated Robot Perception*, in "AnSWeR 2017 - 1st International Workshop on Application of Semantic Web technologies in Robotics", Portoroz, Slovenia, The Semantic Web: ESWC 2017 Satellite Events, Springer, May 2017, vol. 10577, pp. 299-313 [DOI : 10.1007/978-3-319-70407-4\_39], <https://hal.inria.fr/hal-01657672>

[31]

C. CARDELLINO, M. TERUEL, L. ALONSO ALEMANY, S. VILLATA. *A Low-cost, High-coverage Legal Named Entity Recognizer, Classifier and Linker*, in "ICAIL-2017 - 16th International Conference on Artificial Intelligence and Law", Londres, United Kingdom, June 2017, 22 p. , <https://hal.archives-ouvertes.fr/hal-01541446>

## 6. New Software and Platforms

### 6.1. CORESE

*COnceptual REsource Search Engine*

KEYWORDS: Semantic Web - Search Engine - RDF - SPARQL

FUNCTIONAL DESCRIPTION: Corese is a Semantic Web Factory, it implements W3C RDF, RDFS, SPARQL 1.1 Query and Update as well as RDF Inference Rules.

Furthermore, Corese query language integrates original features such as approximate search and extended Property Path. It provides STTL: SPARQL Template Transformation Language for RDF graphs. It also provides LDScript: a Script Language for Linked Data. Corese provides distributed federated query processing.

- Participants: Erwan Demairy, Fabien Gandon, Fuqi Song, Olivier Corby, Olivier Savoie and Virginie Bottollier
- Partners: I3S - Mnemotix
- Contact: Olivier Corby
- URL: <http://wimmics.inria.fr/corese>

### 6.2. DBpedia

KEYWORDS: RDF - SPARQL

FUNCTIONAL DESCRIPTION: DBpedia is an international crowd-sourced community effort to extract structured information from Wikipedia and make this information available on the semantic Web as linked open data. The DBpedia triple stores then allow anyone to solve sophisticated queries against Wikipedia extracted data, and to link the different data sets on these data. The French chapter of DBpedia was created and deployed by Wimmics and is now an online running platform providing data to several projects such as: QAKIS, Izipedia, zone47, Sépage, HdA Lab., JocondeLab, etc.

RELEASE FUNCTIONAL DESCRIPTION: The new release is based on updated Wikipedia dumps and the inclusion of the DBpedia history extraction of the pages.

- Participants: Fabien Gandon and Elmahdi Korfed
- Contact: Fabien Gandon
- URL: <http://wiki.dbpedia.org/>

### 6.3. Discovery Hub

*Discovery Hub Exploratory Search Engine*

KEYWORD: Search Engine

FUNCTIONAL DESCRIPTION: Recommendation system on top of DBpedia

- Participants: Alain Giboin, Emilie Palagi, Fabien Gandon and Nicolas Marie
- Partner: Alcatel-Lucent
- Contact: Fabien Gandon
- URL: <http://discoveryhub.co/>

### 6.4. Fuzzy labelling argumentation module

*Fuzzy labelling algorithm for abstract argumentation*

KEYWORDS: Artificial intelligence - Multi-agent - Knowledge representation - Algorithm

FUNCTIONAL DESCRIPTION: The goal of the algorithm is to compute the fuzzy acceptability degree of a set of arguments in an abstract argumentation framework. The acceptability degree is computed from the trustworthiness associated with the sources of the arguments.

- Participant: Serena Villata Milanesio
- Contact: Serena Villata Milanesio

### 6.5. Qakis

*Question-Answering wiki framework based system*

KEYWORD: Natural language

FUNCTIONAL DESCRIPTION: The QAKiS system implements question answering over DBpedia. QAKiS allows end users to submit a query to an RDF triple store in English and obtain the answer in the same language, hiding the complexity of the non-intuitive formal query languages involved in the resolution process. At the same time, the expressiveness of these standards is exploited to scale to the huge amounts of available semantic data. Its major novelty is to implement a relation-based match for question interpretation, to convert the user question into a query language (e.g. SPARQL). English, French and German DBpedia chapters are the RDF data sets to be queried using a natural language interface.

- Participants: Alessio Palmero Aprosio, Amine Hallili, Elena Cabrio, Fabien Gandon, Julien Cojan and Serena Villata Milanesio
- Contact: Elena Cabrio
- URL: <http://www.qakis.org/>

## 7. New Results

### 7.1. Users Modeling and Designing Interaction

#### 7.1.1. User-centered Heuristics for the Control of Personal Data

**Participants:** Patrice Pena, Alain Giboin.



This work is done in collaboration with Karima Boudaoud and Yoann Bertrand, SPARKS, I3S, in the context of the PadDOC FUI project. Last year we elaborated a set of user-centered heuristics and a procedure for designing and evaluating systems allowing the control of personal data. The elaboration of the heuristics was based on: (1) the transposal of Nielsen's heuristics and of Scapin and Bastien's ergonomic criteria to the control of personal data ; (2) the user centering of the Privacy-by-Design notion of integrated privacy; and (3) the integration of Altman's interaction approach to privacy. This year we evaluated the heuristics and the procedure by asking security specialists and HCI ergonomists to apply them to the designed PadDOC user interfaces. A not yet published report sets out the results of this evaluation together with the heuristics and the procedure.

### ***7.1.2. Design of a User-Centered Evaluation Method of Exploratory Search Systems Based on a Model of the Exploratory Search Process***

**Participants:** Emilie Palagi, Alain Giboin, Fabien Gandon.

This work was undertaken in the context of the PhD of Emilie Palagi, in cooperation with Raphaël Troncy (EURECOM). Our method takes into account users' exploratory search (ES) behavior and is based on a cognitive model of an ES task. We work on two applications: Discovery Hub (Wimmics project – Inria) and 3city (EURECOM project). During the second year of PhD, we analyzed several models of information seeking process and we compared them with our own grid of the typical characteristics of ES activities [41].

We used Ellis' model of Information Seeking as a basis for the elaboration of our model of ES process: we modified it to better suit the ES characteristics. We evaluated our model by comparing it to video records of three ES sessions on Discovery Hub <sup>1</sup>: we wrote down the different chains of the different model's features used by the users in their ES session. For the three records, we were able to identify the features of our model. From this analysis, we conclude that our model of ES can express the users' activity during an ES task. In this evaluation of our model, we also identified and listed the possible transitions between the model's features. These transitions do not reflect all the possible transitions in an ES session, but they express ES behaviors that all ES systems should facilitate. Based on the ES model's features and the possible transitions between them, we designed two different evaluation and design methods of ES systems which do not involve necessarily users:

- Without users: Heuristics of ES and a procedure that explains how to use them. These heuristics are principles for the interaction design. The Heuristics of ES can be used several time along the design process of the ES system (in the design and evaluation phases).
- With users: a guide for the elaboration of a customizable test protocol. The goal of the test is to analyze ES session records in order to find the model's features. In this guide, we give indications to customize the protocol and prepare users tests (e.g. the users selection). Then, we also explain how to analyze the ES sessions recorded.

We are currently testing the heuristics and the test protocol.

### ***7.1.3. User-centered Redesign of a User Interface Allowing to Remotely Control the AZKAR Robot***

**Participants:** Thierry Bergeron, Alain Giboin, Michel Buffa.

In the context of the AZKAR project, we redesigned, with a user-centered method, the user interface allowing to remotely control the AZKAR robot. The original user interface was dedicated to the developer of the Web-RTC <sup>2</sup> aspects of the solution. The new interface is dedicated to end-users such as distant visitors of a museum who remotely control the robot installed in the museum.

### ***7.1.4. Needs Analysis of the Target Users of the WASABI musical search platform***

**Participants:** Alain Giboin, Isabelle Mirbel, Michel Buffa, Elmahdi Korfed.

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<sup>1</sup> <http://discoveryhub.co/>

<sup>2</sup> Real Time Communication

In the context of the ANR project WASABI, we started an analysis of the needs of the target users of the future WASABI platform. We began with composers and musical content broadcasters. We will continue with musicologists, journalists, and sound engineers.

### 7.1.5. From User Goals to Process-Based Service Compositions

**Participant:** Isabelle Mirbel.

Complex user's needs often require heterogeneous services to be combined together. In this work, we explore a novel approach to enable flexible and dynamic composition of heterogeneous services for end users who are usually not familiar with technical process models. End-users are only required to model their goals and semantic reasoning is used for the composition itself. The possible service compositions are expressed in BPMN <sup>3</sup> in order to be then processed by a BPMN engine. Since the composition is built on-the-fly, this approach avoids static linking of services and therefore is much more flexible. The results of this research have been published in [39].

## 7.2. Communities and Social Interactions Analysis

### 7.2.1. Semantic Web for B2B Applications

**Participants:** Molka Dhoubi, Catherine Faron Zucker, Andrea Tettamanzi.

This CIFRE PhD thesis is in collaboration with Silex France company, a startup that connects companies and service providers that are best suited to meet their needs through a sourcing Web service. In this thesis, we will be interested on the semantic side of the platform in order to represent a social network of service providers and companies and recommend automatically a service provider that matches companies needs. In this thesis, we focus on three research axis: (i) Modeling of skills and activity sectors and information extraction from unstructured texts; (ii) How to match companies needs and service providers descriptions; (iii) Recommendation of service providers by reasoning on the social network.

We developed a SKOS <sup>4</sup> thesaurus of skills and activity sectors with the aim of semantically annotating B2B service offers, automatically categorizing them and matching them with service requests.

## 7.3. Vocabularies, Semantic Web and Linked Data based Knowledge Representation

### 7.3.1. Semantic Web for Biodiversity

**Participants:** Franck Michel, Catherine Faron Zucker.

As a continuation of the work initiated with the *Muséum National d'Histoire Naturelle* of Paris during the last two years, we have proposed a model to represent taxonomic and nomenclatural information as Linked Data, and we published the french taxonomic register on the Web along this model <sup>5</sup>. Furthermore, we are now leveraging this work to develop an activity related to biodiversity data sharing and integration: we presented the model and dataset in a workshop of the ISWC conference [38] as well as at the TDWG conference on biodiversity information standards [37]. We are in the process of publishing this data set on AgroPortal <sup>6</sup>, the bioportal-based ontology repository for agronomy and agriculture. We are involved in the Bioschemas.org W3C community group with the objective of fostering the definition and adoption of common biodiversity-related markup.

### 7.3.2. RDF Modelization of Education Resources

**Participants:** Geraud Fokou Pelap, Catherine Faron Zucker, Fabien Gandon, Olivier Corby.

<sup>3</sup>Business Process Model and Notation

<sup>4</sup>Simple Knowledge Organization System, W3C recommendation.

<sup>5</sup><http://taxref.mnhn.fr/lod/Dataset/10.0/>

<sup>6</sup><http://agroportal.lirmm.fr/>

EduMICS (Educative Models Interactions Communities with Semantics) is a joint laboratory (LabCom, 2016-2018) between the Wimmics team and the Educlever company. Adaptive Learning, Social Learning and Linked Open Data and links between them are at the core of this LabCom. The purpose of EduMICS is both to develop research and technologies with the ultimate goal to adapt educational progressions and pedagogical resource recommendation to learner profiles.

This year, we propose a novel RDF modelisation for Educlever's Data. Once this novel modelisation have been validated, we built a migration tool to migrate Educlever data from the old model into the new one. We also performed benchmarking of the new model with Educlever's uses cases queries. In order to perform this benchmark we store RDF data in four triplestore, Corese, Allegrograph, GraphDB and Virtuoso. Next steps of the project are: perform test in real exploitation environnement, find a way to use graph database in RDF context and how to perform reasoning to recommend and adapt activities to learn. Topics covered by EduMICS include: ontology-based modeling of educational resources; ontology-based integration of heterogenous data sources; ontology-based reasoning; semantic analysis of a social network of learners; pedagogical resource recommendation adapted to learner profiles.

### 7.3.3. *Intelliquiz Project*

**Participants:** Oscar Rodríguez Rocha, Catherine Faron Zucker.

Intelliquiz is a research project carried out in collaboration with Qwant. The main goal of this project is to create a smart quiz game engine, able to:

1. generate credible alternative answers from a given set of questions and answers,
2. generate a multiple choice questions game based on specific subjects (initially by exploiting the non-structured dataset of the famous French multiple choice questions game "Les Incollables"),
3. generate a set of multiple choice questions and answers (quiz) about a specific subject, to be proposed to a user (a learner / player)
4. adapt the resulting quiz to the user's profile, context and past experience,
5. set up the fundamentals of an intelligent platform for education.

This work was published at EDULEARN [32].

### 7.3.4. *Reconciling DBpedia Chapters*

**Participants:** Serena Villata, Elena Cabrio, Fabien Gandon.

Together with Alessio Palmero Arosio (FBK, Italy), we addressed the issue of reconciling information obtained by querying the SPARQL endpoints of language-specific DBpedia chapters. DBpedia is a RDF triple store whose content is automatically created by extracting information from Wikipedia. Starting from a categorization of the possible relations among the resulting instances, we provide a framework to: (i) classify such relations, (ii) reconcile information using argumentation theory, (iii) rank the alternative results depending on the confidence of the source in case of inconsistencies, and (iv) explain the reasons underlying the proposed ranking. We release the resource obtained applying our framework to a set of language-specific DBpedia chapters, and integrate such framework in the Question Answering system QAKiS, that exploits such chapters as RDF datasets to be queried using a natural language interface. The results of this research have been published in the Semantic Web Journal [25].

### 7.3.5. *Ontological Representation of Normative Requirements*

**Participants:** Serena Villata, Elena Cabrio, Fabien Gandon.

Together with Guido Governatori (Data61, Australia), we have proposed a proof of concept for the ontological representation of normative requirements as Linked Data on the Web. Starting from the LegalRuleML ontology, we present an extension of this ontology to model normative requirements and rules. Furthermore, we define an operational formalization of the deontic reasoning over these concepts on top of the Semantic Web languages. The results of this research have been published at the JURIX 2017 conference [52].

### 7.3.6. *LDScript Linked Data Script Language*

**Participants:** Olivier Corby, Catherine Faron Zucker, Fabien Gandon.

LDScript is a script language for the Semantic Web of Linked Data built on top of SPARQL filter language. It enables users to define extension functions for SPARQL queries in a language that is highly compatible with SPARQL. This year we generalized and uniformized the design of the language with query in function, second order functions (map, funcall, apply, reduce), lambda expressions, *return* statement, method call. We also introduced literal extension datatypes to manage list, triple, graph and query solution mapping as RDF extended literals. This work was published at ISWC and listed as *spotlight paper* in the conference program [32].

### 7.3.7. *SHACL Validator*

**Participant:** Olivier Corby.

In the context of the SHACL W3C working group to design a Shapes Constraint Language for validating RDF graphs, we have written a SHACL validator using two languages developed in the team: STTL, SPARQL Template Transformation Language, and LDScript. An online demo server have been set up <sup>7</sup>.

### 7.3.8. *HAL Open Data*

**Participant:** Olivier Corby.

The HAL open archive is provided with an Open Data SPARQL endpoint <sup>8</sup>. We participated, with CNRS CCSD team <sup>9</sup>, to the design of the RDF Schema of the open data server and we developed a Linked Data Hypertext Navigator <sup>10</sup> on top of the HAL open data server.

### 7.3.9. *Graph Database for the Semantic Web*

**Participants:** Erwan Demairy, Olivier Corby.

In the context of an Inria two years grant, we conducted in collaboration with Johan Montagnat (I3S, CNRS) a study of graph databases (Orient DB, Titan DB, Neo4j) and of the TinkerPop abstract query language. The purpose of this study was to design a mapping between RDF statements and graph databases and conversely. In addition, we designed a mapping of SPARQL query patterns to TinkerPop. We have implemented with Corese a binding of a generic SPARQL interpreter on top of TinkerPop that enables us to query a RDF oriented graph database with SPARQL.

### 7.3.10. *Mobile Linked Data Sharing in Technologically Constrained Environment*

**Participants:** Fabien Gandon, Mahamadou Toure.

During the second year of the MoReWAIS project we finalized the state of the art report [61]. In addition to the initial points of the survey, namely caching of client-side data and cache federation, querying and sharing of data, Linked Open Data and data privacy, we have identified and added an important point for this state of the art, which is the domain of collaborative RDF graph modification. This last point raises the question of identifying the mechanisms proposed in the literature that make it possible to solve the constraints related to the availability, the processing loads balance and sources and data reliability in decentralized peer-to-peer architectures. These mechanisms make it possible to replicate, share and collaboratively modify a graph. We also worked on an architecture model (network and data) and opted for a three-tier architecture with a data model based essentially on graph replication and cooperative caching.

## 7.4. Analyzing and Reasoning on Heterogeneous Semantic Graphs

### 7.4.1. *Distributed Artificial Intelligence for Linked Reviewable Data Management on the Semantic Web*

**Participants:** Ahmed El Amine Djebri, Andrea Tettamanzi.

<sup>7</sup><http://corese.inria.fr>

<sup>8</sup><http://data.archives-ouvertes.fr/sparql>

<sup>9</sup>Center for Direct Scientific Communication

<sup>10</sup><http://corese.inria.fr>

The aim of this PhD thesis that started this year is to study and to propose original solutions to many key aspects: Knowledge Representation in case of uncertain, incomplete and reviewable data; Uncertainty Representation in a data source, with provenance; Distributed Knowledge Revision and Propagation; Reasoning over Uncertain, Incomplete and distributed data-sources. Starting from an open Web of Data, this work tries to give the users more objective, exhaustive and certain views and information about their queries, based on distributed data sources with different levels of certainty and trustworthiness.

#### **7.4.2. Uncertainty Management**

**Participant:** Andrea Tettamanzi.

In collaboration with Didier Dubois and Henri Prade of IRIT, Toulouse, and Giovanni Fusco, a geographer of the ESPACE CNRS UNS laboratory, we have developed a theory of uncertain logical gates in possibilistic networks and we have illustrated their application on a problem of human geography [17].

With Giovanni Fusco, we have approached the problem of selecting among various models of a phenomenon, in the form of Bayesian networks, and we have illustrated our solution by applying it to the case of urban sprawl [35].

Finally, together with Didier Dubois and Henri Prade of IRIT, Toulouse, and Célia da Costa Pereira of I3S, we have proposed a possibilistic approach to handle topical metadata about the validity and completeness of information coming from multiple source, with the aim of aggregating it in a possibilistic belief base [45].

#### **7.4.3. Mining the Semantic Web for OWL Axioms**

**Participants:** Thu Huong Nguyen, Andrea Tettamanzi.

The aim of the research in this PhD thesis is to learn OWL2 ontologies from RDF data in an open world. The first task is the extraction of axioms based ontology learning techniques using the evolutionary algorithm. Then, developing the methods for OWL axioms evaluation. In the half of the year, research work has been concentrated on the Grammatical Evolution algorithm to explore the set of disjointed classes axioms in search for the ones that are best suited to describe the recorded RDF data.

#### **7.4.4. Logical Foundations of Cognitive Agents**

**Participant:** Andrea Tettamanzi.

Together with Célia da Costa Pereira of I3S, Beishui Liao of Zhejiang University, China, Alessandra Malerba and Antonino Rotolo of the University of Bologna, Italy, and Leendert van der Torre of the University of Luxembourg we have proposed a computational model for legal interpretation based on fuzzy logic and argumentation, which has been presented at the 16th International Conference on Artificial Intelligence and Law [46].

#### **7.4.5. Agent-Based Recommender Systems**

**Participants:** Amel Ben Othmane, Nhan Le Thanh, Andrea Tettamanzi, Serena Villata.

We have proposed a spatio-temporal extension for our multi-context framework for agent-based recommender systems (CARS) [27], to which we have then added representation and algorithms to manage uncertainty, imprecision, and approximate reasoning: a paper describing this latter development has been accepted at the 10th International Conference on Agents and Artificial Intelligence (ICAART 2018), which will be held in Madeira on January 16–18, 2018.

#### **7.4.6. RDF Mining**

**Participants:** Catherine Faron Zucker, Fabien Gandon, Andrea Tettamanzi, Tran Duc Minh.

In collaboration with Claudia d'Amato of the University of Bari, we have carried on our investigation about extracting knowledge from RDF data, by refining our evolutionary approach to discover multi-relational rules from ontological knowledge bases exploiting the services of an OWL reasoner [42], which we have called EDMAR. In addition, we have finally developed a coherent and organic theory of possibilistic testing of OWL axioms against RDF data [22]. The intuition behind it is to evaluate the credibility of OWL 2 axioms based on the evidence available in the form of a set of facts contained in a chosen RDF dataset.

#### 7.4.7. *Argument Mining*

**Participants:** Serena Villata, Elena Cabrio, Fabien Gandon, Mihai Dusmanu.

We have presented an argument mining approach which applies supervised classification to identify arguments on Twitter. Moreover, we present two new tasks for argument mining, namely facts recognition and source identification. We study the feasibility of the approaches proposed to address these tasks on a set of tweets related to the Grexit and Brexit news topics. The results of this research have been published at the EMNLP 2017 conference [51].

In this direction, we have also, in collaboration with the Heron Lab of the University of Montreal, presented an empirical study about the impact of emotions and mental states on the argumentation people address in online debates. The results of this research have been published on the *Argument & Computation Journal* [24]. Another empirical experiment with humans has been addressed to study the impact of the three persuasive argumentation strategies called Ethos, Logos and Pathos, on the emotions and mental states of debaters. The results of this research have been published at the HCI 2017 conference [28].

Moreover, Serena Villata has co-authored a vulgarization paper for the *AI Magazine*, about computational argumentation [16].

Finally, Serena Villata, together with Matthias Thimm (Universitat Koblenz-Landau), has reported and analyzed the results of the first Computational Argumentation Challenge (ICCMA) in a *Artificial Intelligence Journal* [23].

#### 7.4.8. *Mining Legal Documents*

**Participants:** Serena Villata, Cristian Cardellino, Milagro Teruel, Laura Alonso Alemany.

We have proposed a Named Entity Recognizer, Classifier and Linker for the legal domain. More precisely, we try to improve Information Extraction in legal texts by creating a legal Named Entity Recognizer, Classifier and Linker. With this tool, it is possible to identify relevant parts of texts and connect them to a structured knowledge representation, the LKIF ontology. This tool has been developed with relatively little effort, by mapping the LKIF ontology to the YAGO ontology and through it, taking advantage of the mentions of entities in Wikipedia. These mentions are used as manually annotated examples to train the Named Entity Recognizer, Classifier and Linker. We have evaluated the approach on holdout texts from Wikipedia and also on a small sample of judgments of the European Court of Human Rights, resulting in a very good performance, i.e., around 80% F-measure for different levels of granularity. The results of this research have been published at the EACL 2017 conference [30], the FLAIRS 2017 conference [29], and the ICAIL 2017 conference [31]. A poster paper has been published at ISWC 2017 [64]. This research is addressed in the context of the EU H2020 MIREL project. The ICAIL paper has been awarded as “Best Innovative Paper” of the conference.

#### 7.4.9. *Cognitive Agent-Based Modeling*

**Participant:** Andrea Tettamanzi.

Within the framework of the multi-disciplinary Franco-Colombian TOMSA research project, in collaboration with researchers of the I3S and ESPACE CNRS UNS laboratory and of the University of the Andes, we have developed a novel agent-based modeling approach based on belief-desire-intention (BDI) agents and we have demonstrated its potential by applying it to the coupled modeling of urban segregation and growth [43].

#### 7.4.10. *Robots Autonomously Learning about Objects*

**Participants:** Valerio Basile, Elena Cabrio, Roque Lopez Condori.

Autonomous robots that are to assist humans in their daily lives must recognize and understand the meaning of objects in their environment. However, the open nature of the world means robots must be able to learn and extend their knowledge about previously unknown objects on-line. In this third year of the project, we have investigated the problem of unknown object hypotheses generation, and employed a semantic Web-mining framework along with deep-learning-based object detectors. This allows us to make use of both visual and semantic features in combined hypotheses generation. We have experimented on data from mobile robots in real world application deployments, showing that this combination improves performance over the use of the methods in isolation.

Moreover, we have built DeKO, a large-scale RDF repository of prototypical knowledge about objects <sup>11</sup>. This version of DeKO provides, mainly, information about locations and typical usage of objects (e.g. Telephone LocatedAt Office, Spoon usedFor Eating). In addition, DeKO also provides an RDF explorer where users can find knowledge about objects navigating through their relations. DeKO was built by parsing natural language text with KNEWS [67] and using Distributional Semantics [68].

Frame clustering is an important module inside DeKO, since it could allow us to find representative frame instances, i.e. prototypical knowledge about objects. For frame clustering in DeKO, we followed a hierarchical clustering approach motivated mainly by two reasons: i) it does not require a pre-specified number of clusters and ii) most of these algorithms are deterministic. However, hierarchical clustering is expensive in terms of time, making it too slow for large data sets. In order to solve this problem, we applied a parallelization strategy using a map-reduce approach together with some heuristics in the preprocessing phase (e.g. filtering of frame instances). Currently, we are setting the server environments to perform the experiments over all the collection of DeKO. The following paper have been published on the topic: [44].

#### 7.4.11. *Event Identification and Classification in Short Messages*

**Participants:** Amosse Edouard, Elena Cabrio, Nhan Le Thanh.

This work investigates the potential of exploiting information from the Linked Open Data KBs to detect, classify and track events on social media, in particular Twitter. More specifically, we address 3 research questions: i) How to extract and classify messages related to events? ii) How to cluster events into fine-grained categories? and 3) Given an event, to what extent user-generated contents on social medias can contribute in the creation of a timeline of sub-events? We provide methods that rely on Linked Open Data KBs to enrich the context of social media content; we show that supervised models can achieve good generalisation capabilities through semantic linking, thus mitigating overfitting; we rely on graph theory to model the relationships between named entities and the other terms in tweets in order to cluster fine-grained events. Finally, we use domain ontologies and local gazetteers to identify relationships between actors involved in the same event, to create a timeline of sub-events. We show that enriching the named entities in the text with information provided by LOD KBs improves the performance of both supervised and unsupervised machine learning models.

The following papers have been published on the topic: [33], [34], [18].

#### 7.4.12. *NLP over Song Lyrics*

**Participants:** Michael Fell, Elena Cabrio, Fabien Gandon.

The goal of the WASABI project is to jointly use information extraction algorithms and the Semantic Web formalisms to produce consistent musical knowledge bases. Then, Web Audio technologies are applied to explore them in depth. More specifically, textual data such as song lyrics or free text related to the songs will be used as sources to extract implicit data (such as the topics of the song, the places, people, events, dates involved, or even the conveyed emotions) using Natural Language Processing (NLP) algorithms. Jointly exploiting such knowledge, together with information contained in the audio signal, can improve the automatic extraction of musical information, including for instance the tempo, the presence and characterization of the voice, musical emotions, identify plagiarism, or even facilitate the music unmixing.

Work in the first half year has been focused on two points. First, we delivered a report on the existing literature on NLP of song lyrics. Second, our endeavors of the last months are research on the estimation of the structure of song texts.

The following paper has been published on the topic: [55].

#### 7.4.13. *Conversational Agent Assistant*

**Participants:** Raphaël Gazzotti, Catherine Faron Zucker, Fabien Gandon.

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<sup>11</sup><http://deko.inria.fr/>

This CIFRE PhD thesis is performed in collaboration with SynchroNext, a company located in Nice. As part of this thesis, we are interested in setting up an ECA (Embodied Conversational Agents) for FAQs to advisers. The ECA will need to integrate a question and answer system to address the most common issue types without human intervention. For this purpose, it must be able to understand the questions asked in natural language by the users and to reason with the knowledge acquired. Beyond such a system of questions and answers, the ECA must be able to reopen the conversation with the Internet user according to the nature of his requests or the sequence of questions formulated. The objective is to reduce the dropout rate of Internet users on FAQs and to reduce the number of incoming calls and e-mails. This will enable customer advisers to focus on more difficult questions.

We considered the different questions from customers as a multi-label unbalanced classification problem. In order to improve the results of the categorization, we were interested in increasing vectors with domain specific knowledge and named entities, then by reducing these vectors with feature selection. Also, we look after the tuning of hyperparameters with Bayesian optimization.

#### **7.4.14. HealthPredict**

**Participants:** David Darmon, Catherine Faron Zucker, Virginie Lacroix-Hugues, Fabien Gandon, Raphaël Gazzotti.

This project is performed in collaboration with the Département d'Enseignement de Recherche en Médecine Générale (DERMG) at UNS and SynchroNext, a company located in Nice. HealthPredict is a digital health solution aimed at the early management of patients through consultation with their general practitioner and healthcare circuit. Concretely, it is a predictive artificial intelligence interface that allows to cross the data of symptoms, diagnosis and medical treatments of the population in real time to make a more accurate prognosis, choose a more adapted treatment and reduce side effects.

## **8. Bilateral Contracts and Grants with Industry**

### **8.1. Bilateral Contracts with Industry**

#### **8.1.1. PREMISSE Collaborative Project**

**Participants:** Molka Dhoub, Catherine Faron Zucker, Andrea Tettamanzi.

Partner: SILEX France.

This collaborative project with the SILEX France company started in march 2017, funded by the ANRT (CIFRE PhD) and UCA (post-doc). SILEX France is developing a B2B (business to business) platform where service providers and consumers upload their service offers or requests in free natural language; the platform is intended to recommend service providers to the applicant, which are likely to fit his/her service request. The aim of this project is to develop a solution to link together service providers and consumers.

#### **8.1.2. Synchronext Collaborative Project**

**Participants:** Raphaël Gazzotti, Catherine Faron Zucker, Fabien Gandon.

Partner: Synchronext.

This project is funded by the ANRT (CIFRE PhD). Synchronext is a startup aiming at developing Semantic Web business solutions. The goal of this project is to develop a NLP and semantic Web based artificial agent for online support in the insurance domain. The objective is to reduce the dropout rate of Internet users on FAQs and to reduce the number of incoming calls and e-mails. This will enable to customer advisers to focus on more difficult questions. As a first step, we are working on automatically categorizing online requests to properly rout them.



## 8.2. Bilateral Grants with Industry

### 8.2.1. *Intelliquiz Carnot Project*

**Participants:** Oscar Rodríguez Rocha, Catherine Faron Zucker.

Partner: GAYAtech/QWANT.

This project started in March 2017. It is a joint project with Gayatech (now acquired by QWANT) on the automatic generation of quizzes from the Web of Data. It is a continuation of a former collaborative project with GAYAtech on the recommendation of pedagogical resources based on ontology-based modelling and processing.

Based on example quizzes extracted from the famous game *Les Incollables* card game, we are proposing an approach to develop quizzes from a domain ontology and we are experimenting on the geographical domain for primary school students.

### 8.2.2. *Inria LabCom EduMICS*

**Participants:** Catherine Faron Zucker, Geraud Fokou Pelap, Olivier Corby, Fabien Gandon, Alain Giboin.

Partner: Educlever.

EduMICS (Educative Models Interactions Communities with Semantics) is a joint laboratory (LabCom, 2016-2018) between the Wimmics team and the Educlever company. Adaptive Learning, Social Learning and Linked Open Data and links between them are at the core of this LabCom. The purpose of EduMICS is both to develop research and technologies with the ultimate goal to adapt educational progressions and pedagogical resource recommendation to learner profiles.

During the first year of the project we worked on developing light-weight ontologies and thesaurus to capture the Educlever ontological knowledge and we annotated the pedagogical resources of the Educlever solution. Then we developed a benchmark and showed that Semantic Web solutions can be deployed within their industrial context. In the continuation of this first step of the project, we will show the added value of Semantic Web modelling enabling ontology-based reasoning on the acquired knowledge graph.

## 9. Partnerships and Cooperations

### 9.1. Regional Initiatives

#### 9.1.1. *SPARKS Team (I3S)*

Wimmics is member of the I3S SPARKS team (Scalable and Pervasive softwARe and Knowledge Systems) led by Andrea Tettamanzi, with Johan Montagnat (CNRS, I3S). It is structured according to three axes: FORUM, ELK and S3.

##### 9.1.1.1. *SPARKS FORUM Axis*

Wimmics contributes to the SPARKS FORUM research axis (FORMalizing with Users and Models). Catherine Faron Zucker and Alain Giboin are co-animators of FORUM.

##### 9.1.1.2. *SPARKS S3 Axis*

Wimmics contributes to the SPARKS S3 research group (Scalable Software Systems). Olivier Corby contributes with federated distributed query processing in Corese with Johan Montagnat and Abdoul Macina. Catherine Faron Zucker and Franck Michel contribute on it with Johan Montagnat on heterogeneous data integration.

##### 9.1.1.3. *SPARKS ELK Axis*

The ELK activity is about Extracting and Learning Knowledge. Andrea Tettamanzi is a co-animator of ELK with Frédéric Precioso (I3S, UNS).

## 9.2. National Initiatives

### 9.2.1. *NiceCampus Research Lab*

**Participant:** Nhan Le Thanh.

NiceCampus Research Lab (from training to/and through research to a Joint International Laboratory) is a framework for cooperation for research training. This framework is proposed by the University of Nice Sophia Antipolis to support the 911 Vietnamese research training program that aims to support the development of Vietnamese universities. The NiceCampus Lab Project was a winner of the AUF Call for Proposals 2016-2017. In this context, the MIRE (Maison de l'innovation et de la recherche NiceCampus) was created at University of Da Nang (Vietnam).

### 9.2.2. *DILPROSPECT*

**Participant:** Andrea Tettamanzi.

We participated in the interdisciplinary DILPROSPECT CNRS Project, with researchers of many other research units, including the UMR 7300 ESPACE and INRA on the study of the interface between constructed and natural land on the French Riviera.

### 9.2.3. *AZKAR*

**Participants:** Alain Giboin, Thierry Bergeron, Michel Buffa, Catherine Faron Zucker.

The AZKAR research project <sup>12</sup>, funded by the BPI, started in 2014, ended in September 2017. This project brings together the world of robotics assistance and the Web of linked data. Its goal was to experiment P2P remote control of a mobile robot using only Web technologies, as well as using artificial intelligence supported by semantic Web formalisms, schemas and datasets in the context of museum visits. Many experiments took place at the Museum of the Great War of Meaux and at the Cité des Sciences de la Villette. The places thus visited at a distance, the spaces and the elements they contain are described with the help of an ontology of the scenes, objects, observation points and paths specific to the museum. Geography and collections are captured using linked data and integrated with Web resources external to the museum to enrich the scenes and objects observed. On this basis, we have designed a demonstrator to offer external media based on visited museum scenes, implementing SPARQL queries on a previously populated triplestore.

### 9.2.4. *ANR WASABI*

**Participants:** Michel Buffa, Elena Cabrio, Catherine Faron Zucker.

The ANR project WASABI started in January 2017 with IRCAM, Deezer, Radio France and the SME Parisson, consists in building a 2 million songs knowledge base of commercial popular music (rock, pop, etc.) Its originality is the joint use of audio-based music information extraction algorithms, song lyrics analysis algorithms (natural language processing), and the use of the Semantic Web. Web Audio technologies will then explore these bases of musical knowledge by providing innovative applications for composers, musicologists, music schools and sound engineers, music broadcasters and journalists.

### 9.2.5. *ANR SIDES 3.0*

**Participants:** Catherine Faron Zucker, Olivier Corby, Fabien Gandon, Alain Giboin, Andrea Tettamanzi.

Partners: Université Grenoble Alpes, Inria, Ecole Normale Supérieure de Lyon, Viseo, Theia.

SIDES 3.0 is an ANR project (2017-2020) which started in fall 2017. It is led by Université Grenoble Alpes (UGA) and its general objective is to introduce semantics within the existing SIDES educational platform <sup>13</sup> for medicine students, in order to provide them with added value educational services.

Web site: <https://www.uness.fr/projets/sides>

<sup>12</sup><http://www.azkar.fr>

<sup>13</sup><http://side-sante.org/>

### 9.2.6. *Ministry of Culture: DBpedia.fr*

**Participants:** Elmahdi Korfed, Fabien Gandon.

This DBpedia.fr project proposes the creation of a French chapter of the DBpedia database. This project was the first project of the Semanticpedia convention signed by the Ministry of Culture, the Wikimedia foundation and Inria.

Web site: <http://dbpedia.fr>

### 9.2.7. *Convention between Inria and the Ministry of Culture*

**Participant:** Fabien Gandon.

We supervise the research convention with the Ministry of Culture to foster research and development at the crossroad of culture and digital sciences. This convention signed between Inria and the Ministry of Culture provides a framework to support projects at the cross-road of the cultural domain and the digital sciences.

### 9.2.8. *QWANT-Inria Joint Laboratory*

**Participant:** Fabien Gandon.

We supervise the QWANT-Inria Joint Laboratory where joint teams are created and funded to contribute to the search engine research and development. The motto of the joint lab is Smart Search and Privacy with five research directions:

- Crawling, Indexing, Searching
- Execution platform, privacy by design, security, ethics
- Maps and navigation
- Augmented interaction, connected objects, chatbots, personal assistants
- Education technologies (EdTech)

### 9.2.9. *GDRI Zoomathia*

**Participants:** Catherine Faron Zucker, Franck Michel, Alexandre Monnin, Andrea Tettamanzi.

Wimmics is partner of the International Research Group (GDRI) Zoomathia funded by two CNRS institutes: INEE and INSHS. It aims at studying transmission of zoological knowledge from Antiquity to Middle-Age through material resources (bio residues, artefacts), iconography and texts.

One of the goals of the project is to design a thesaurus and semantically annotate resources, capturing different types of knowledge: zoonyme, historical period, zoological speciality (ethology, anatomy, physiology, psychology, zootechnique, etc.), literary genre or iconography.

This year, as a continuation of the work initiated with the *Muséum National d'Histoire Naturelle* of Paris during the last two years, we have proposed a model to represent taxonomic and nomenclatural information as Linked Data, and we published the french taxonomic register on the Web along this model.

On another note, we worked with researchers from CEPAM on the applying plagiarism detection methods in the analysis of manuscript transmission.

Web site: <http://www.cepam.cnrs.fr/zoomathia/>

### 9.2.10. *FUI PadDOC*

**Participants:** Patrice Pena, Alain Giboin.

PadDOC goal is to contribute to accelerating the digital transition of citizen, local and regional authorities, administrations and enterprises, by : (1) developing an open standard and innovative software and hardware resources to facilitate nearby or distant administrative formalities and procedures; (2) improving the security of the holder's personal data by putting these data under the exclusive control of the holder; (3) by exploiting unmarked communicating supports (such as smartphones or tablets) for all chain actors. PadDOC partners are: Docapost BPO, Anyces, ABC SmartCard and the teams Rainbow, Media-Coding and Wimmics. Started in November 2014, the project ended this year (June 2017). Wimmics contributed to the analysis, design and evaluation of the PadDOC security-oriented user interfaces

### 9.3. European Initiatives

**Program: CHIST-ERA**

**Project acronym: ALOOF**

Project title: Autonomous Learning of the Meaning of Objects

Duration: 2013-2017

Coordinator: University of Rome La Sapienza (Italy)

Other partners: University of Birmingham (United Kingdom), Technische Universität Wien (Austria), Inria Sophia Antipolis Méditerranée (France).

Abstract: The goal of ALOOF is to significantly advance the ability of today's autonomous systems to adapt to ever changing, dynamic real world environments by enabling them to learn about the meaning of objects from resources accessible through the Web. In ALOOF we focus on objects and the knowledge gaps a service robot will encounter about them. The fundamental contribution is to enable robots to translate between the representations they use in their situated experience and those on the Web.

**Program: Research and Innovation Staff Exchange (RISE) project, funding under Marie Skłodowska-Curie grant**

**Project acronym: MIREL**

Project title: Mining and Reasoning with legal text

Duration: 2016-2019

Coordinator: Leendert van der Torre, University of Luxembourg

Other partners: University of Bologna (Italy), University of Torino (Italy), University of Huddersfield (UK), Inria (France), APIS (Bulgaria), Nomotika s.r.l. (Italy), DLVSystem s.r.l. (Italy), Zhejiang University (China), Research Organization of Information and Systems (Japan), University of Cape Town (South Africa), National University of La Plata (Argentina), National University of Córdoba (Argentina), Universidad Nacional del Sur in Bahía Blanca (Argentina), National ICT Australia Ltd (Australia), Stanford University (USA).

Abstract: The MIREL project will create an international and inter-sectorial network to define a formal framework and to develop tools for Mining and Reasoning with Legal texts, with the aim of translating these legal texts into formal representations that can be used for querying norms, compliance checking, and decision support. MIREL addresses both conceptual challenges, such as the role of legal interpretation in mining and reasoning, and computational challenges, such as the handling of big legal data, and the complexity of regulatory compliance. It bridges the gap between the community working on legal ontologies and NLP parsers and the community working on reasoning methods and formal logic. Moreover, it is the first project of its kind to involve industrial partners in the future development of innovative products and services in legal reasoning and their deployment in the market. MIREL promotes mobility and staff exchange between SMEs to academies in order to create an inter-continental interdisciplinary consortium in Law and Artificial Intelligence areas including Natural Language Processing, Computational Ontologies, Argumentation, and Logic & Reasoning.

Web site: <http://www.mirelproject.eu/>

### 9.4. International Initiatives

#### 9.4.1. Inria International Labs

##### 9.4.1.1. MoReWAIS

Title: Mobile Read Write Access and Intermittent to Semantic Web

International Partner (Institution - Laboratory - Researcher):

UGB (Senegal) - LANI - Moussa LO

Start year: 2016

See also: <https://project.inria.fr/morewais/>

MoReWAIS proposes to explore the specificities (advantages and constraints) of mobile knowledge sharing. The mobile application targeted in MoReWAIS must allow communities and their users to enrich and access more easily the knowledge base using the user's context with its richness (e.g. location, other users close-by) and addressing its limitations (e.g. intermittent access, limited resources).

## 9.4.2. Inria International Partners

### 9.4.2.1. Informal International Partners

Fondazione Bruno Kessler, Digital Humanities and Human Language Technologies research units, Trento, Italy

University of Turin, Computer Science Department, Italy.

University of Luxembourg, Computer Science and Communication Lab, Luxembourg.

Data61, Brisbane, Australia.

MIRE-DNIIT : Innovation & Recherche at Danang International Institute of Technology

The project, in which Nhan Le Thanh (UNS) is involved, consists of installing within Danang University a UCA campus called DNIIT (Danang International Institute of Technology) with the objective of development and valorization of collaborative projects of applied research and implementation of UCA training centers at the Doctoral and Master level for Vietnamese students. The project obtained financial support from Ministry of Research and AUF (University Agency of La Francophonie). DNIIT was officially created on May 5th with the opening of six project and the setting up of the UCA e-Tourism Master's office.

## 9.5. International Research Visitors

### 9.5.1. Visits of International Scientists

#### 9.5.1.1. Internships

##### **Oussama Lahlou**

May-October

Institution: EMSI (Ecole Marocaine des Sciences de l'Ingénieur)

Subject: "An Ontology for modeling remote museum visits"

Supervisors: Michel Buffa, Thierry Bergeron

##### **Yaroslav Nechaev**

Ph.D. student, University of Trento, Italy (October 2017-present).

Subject: Improving the prediction of objects and relations on images by using large unsupervised corpora like Twitter and Wikipedia.

### 9.5.2. Visits to International Teams

#### 9.5.2.1. Research Stays Abroad

Raphaël Gazzotti

Date: March-April.

Visit of the Natural Language Processing research group of the Universidad Nacional de Córdoba, Argentina, for one month as a secondment of the MIREL H2020 Project.

We proceed to the tokenization of a small sample of questions and answers from the customer service of a big insurance company. Then, following a guideline, we annotated, thankfully to a graphical interface developed within the Natural Language Processing research group at the FaMAF, insurance-related concepts from this corpus and considered them as Named Entities. We mapped these concepts to two ontologies -YAGO and Property and Casualty data model developed by the Object Management Group that we translated to OWL format- [50]. We expect to map them to more ontologies and increase existing ones, like a financial ontology and another specific to communication, then ultimately to Linked Open Data. In a future step, we would like to identify and label automatically concepts using a small annotated corpus as a training set. We believe that annotated concepts can improve automatic categorization of questions and help to reason with different levels of abstraction.

## 10. Dissemination

### 10.1. Promoting Scientific Activities

#### 10.1.1. Scientific Events Organisation

##### 10.1.1.1. General Chair, Scientific Chair

Michel Buffa was co-responsible of the W3CX WebDev contest at Perth's Festival of the Web Standardization, W3C track at WWW 2017.

Catherine Faron Zucker:

- co-chair of the ESWC2017 workshop on Semantic Web for Scientific Heritage (SW4SH 2017),
- co-chair of the 2nd scientific day of the Inria Learning Lab, Rennes, 10/02/2017, Rennes
- co-chair of the AFIA Industry Forum for Artificial Intelligence (FIIA2017) on Knowledge management, 27/04/2017, Paris
- co-chair of the AFIA day Opportunities and Challenges of Artificial Intelligence (PDIA2017) on AI algorithms and tools, 06/10/2017, Paris

Fabien Gandon:

- General Chair EGC 2017
- Co-chair Workshop LDDL linked data and distributed ledgers (blockchain)
- PhD Symposium co-chair at ISWC 2017

Serena Villata was general chair, together with Leendert van der Torre, of the 20th International Conference on Principle and Practice of Multi-Agent Systems PRIMA, Nice, France, November.

#### 10.1.2. Scientific Events Selection

##### 10.1.2.1. Chair of Conference Program Committees

Catherine Faron Zucker: Research and Innovation co-chair of the 13th Int. Conference on Semantic Systems (Semantics 2017).

##### 10.1.2.2. Member of the Conference Program Committees

Michel Buffa: WebAudio conference 2017

Elena Cabrio: Association for Computational Linguistics conference (ACL), Empirical Methods in Natural Language Processing (EMNLP), Extended Semantic Web Conference (ESWC), International Semantic Web Conference, Thirty-First AAAI Conference on Artificial Intelligence (AAAI-17) .

Olivier Corby: International Semantic Web Conference (ISWC), Extended Semantic Web Conference (ESWC), Querying the Web of Data workshop at ESWC (QuWeDa), Conférence de Recherche en Informatique (CRI), GraphQ: 6th International Workshop on Querying Graph Structured Data, Journées Francophones d'Ingénierie des Connaissances (IC), GKR workshop at IJCAI, Symposium sur l'Ingénierie de l'Information Médicale (SIIM).

Catherine Faron Zucker: WWW 2018 (The Web Conference), ICCS 2018 (Int. Conference on Conceptual Structures), IJCAI (Int. Joint Conference on Artificial Intelligence), PRIMA (Int. Conference on Principles and Practice of Multi-Agent Systems), WebSci (ACM Web Science conference), ESWC (European Semantic Web Conference), ISWC (Int. Semantic Web Conference), GKR@IJCAI (Int. Workshop on Graph Structures for Knowledge Representation and Reasoning), IC (Ingénierie des Connaissances), EGC 2018 (Extraction et Gestion des Connaissances), EIAH (Environnements Informatiques pour l'Apprentissage Humain), CNRIA (Colloque National (sénégalais) sur la Recherche en Informatique et ses Applications).

Fabien Gandon: SemWebPro, Senior PC ISWC, Senior PC IJCAI, ESWC, IC, WebScience, WI.

Alain Giboin: ISWC, VOILA Workshop (at ISWC), IC .

Roque López: Applied Natural Language Processing (ANLP, track of SIMBig).

Isabelle Mirbel: International Conference on Advanced Information Systems Engineering (CAISE), IEEE International Conference on Research Challenges in Information Science (RCIS), INformatique des ORganisations et Systèmes d'Information et de Décision (INFORSID), Toulouse, France, Second International Workshop on Semantic Web for Cultural Heritage (SW4CH).

Oscar Rodríguez Rocha: KEOD, KSE , Semantics.

Andrea Tettamanzi: ECG 2018, EvoApplications 2017, GECCO 2017, IC 2017, ISWC 2017, LREC 2018, SAC 2018, Web Intelligence 2017, and WWW 2018 SW4SH workshop at ESWC 2017.

Serena Villata: IJCAI, AAI, AAMAS, JURIX, ICAIL.

### **10.1.3. Journal**

#### *10.1.3.1. Member of the Editorial Boards*

Catherine Faron Zucker: Revue d'Intelligence Artificielle.

Fabien Gandon Editor of a special issue SWJ journal for best papers of ESWC 2015 and co-author of its introduction [65]

Isabelle Mirbel: Ingénierie des Systèmes d'Information (Hermès).

Serena Villata: Artificial Intelligence & Law.

#### *10.1.3.2. Reviewer - Reviewing Activities*

Elena Cabrio: Journal of Web Semantics, the Computational Linguistics journal, Argument and Computation.

Catherine Faron Zucker: IEEE's Transactions on Learning Technologies (TLT), International Journal of Medical Informatics (IJMI), internationale Traitement Automatique des Langues (TAL), revue Sciences et Technologies de l'Information et de la Communication pour l'Éducation et la Formation (STICEF), Revue d'Intelligence Artificielle (RIA).

Alain Giboin: International Journal of Human-Computer Studies, Journal of Web Semantics.

Andrea Tettamanzi : International Journal of Approximate Reasoning, Semantic Web Journal, IEEE Transactions on Fuzzy Systems, Computers, Environment and Urban Systems.

Serena Villata: Journal of Logic and Computation, Argument & Computation, Artificial Intelligence Journal.

### **10.1.4. Invited Talks**

Michel Buffa, "Visites de musées à distance par un robot autonome intelligent" SemWeb Pro conference, Paris, France.

Elena Cabrio was invited speaker of the 12th International Conference on Computational Semantics (IWCS), 19-22 September, Montpellier, France.

Olivier Corby:

- "Best Practice & Design Pattern for the Semantic Web", JDEV, Marseille, July 5th.
- "A Transformation Language for the Web of Data", Data Sciences workshop, ENIT, Tunis, September 13th.
- "Semantic Web Languages and Tools", Journée *Perspectives et défis de l'Intelligence Artificielle*, AFIA, Paris, October 6th.

Fabien Gandon

- Keynote Cognitum workshop IJCAI 2017, talk on Bridging social semantics and formal semantics on the Web August 20th,  
<http://cognitum.ws/2017/07/01/cognitum-2017-programproceedings/>
- Keynote at summer academy of the German National Scholarship foundation Semantic Web & Linked data and Wimmics research, September 25th,
- Invited talk at Boston Consulting group Data Analytics evening on Semantic Web ad Linked data and Wimmics research, February 21st,
- Keynote for Data Science day EDF, on Semantic Web & Linked data and Wimmics research, November 17th,
- Talk at Mediametrie, Semantic Web & Linked data and Wimmics research, December 1st,
- Invited keynote Luxembourg Institute of Science and Technology (LIST) Semantic Web & Linked data and Wimmics research, December 12th.
- Talk at EDHEC Nice MBA Data Analytics Club about Semantic Web, Semantic Web & Linked data and Wimmics research.

Alain Giboin:

"How to use and teach heuristics for evaluating HCI applications" in the workshop "Enseignement de l'IHM : enjeux et solutions pour les enseignants en IUT, écoles et universités" at IHM'17.

Emilie Palagi:

"Design of a User-Centered Evaluation Method for Exploratory Search Engines", Labex UCN@Sophia Scientific Day, November 28th.

Andrea Tattamanzi:

- Invited talk on "Possibilistic Test of OWL Axioms under the Open-World Assumption" at the WASPIQ Workshop in Arras, June 27th.
- Conference on "Unsupervised Learning" at Amadeus, Sophia Antipolis, November 8th.

### 10.1.5. Scientific Expertise

Michel Buffa is member of the WebAudio W3C Working Group and UNS academic representative at W3C.

Catherine Faron Zucker is the scientific referent of the Inria Learning Lab.

Catherine Faron Zucker was leading the working group in charge of drafting the scientific challenge on Digital Science for Education for the upcoming Inria strategic plan (2018-2022).

Catherine Faron Zucker participated to one of the working groups in charge of drafting the national strategic plan on Artificial intelligence, France IA.

Catherine Faron Zucker reviewed project proposals for the Academic Research Community (ARC) 6 of Auvergne Rhône Alpes region.

### 10.1.6. Research Administration

Olivier Corby is member of the scientific board of Université Côte d'Azur RISE academy (Network, Information, Digital Society).



Catherine Faron Zucker is General Treasurer of the French Society for Artificial Intelligence (AFIA).

Catherine Faron Zucker is leading the steering committee of the AFIA college on Knowledge Engineering.

Catherine Faron Zucker was member of the 2017 recruitment committees of Ecole des Mines de Saint Etienne, Université de Lorraine (Nancy), Université Paul Valéry (Montpellier).

Fabien Gandon:

- director of the joint research laboratory QWANT-Inria
- supervising the convention between the Ministry of Culture and Inria
- representative of Inria at W3C consortium
- representative of Inria in the Web Science Trust Network
- member of the Steering Committee of the Scientific Board of Inria Sophia Antipolis (Bureau CP)
- member of ESWC Steering committee
- member of IW3C2 Steering committee for WWW conference series

Alain Giboin: is member of the scientific committee of the IDEX Jedi Academy 5 "Homme, Idées et Milieux". is co-facilitator of the IDEX Jedi Academy 5 initiative "Humanités numériques" (with Arnaud Zucker, CEPAM, and Damon Mayaffre, BCL), is member of the scientific committee of MSHS Axis 2 "TIC, Usages et Communautés". Is co-facilitator of the initiative "Artefacts et Coordination" of MSHS Axis 2 and served as scientific correspondent for Inria Sophia of COERLE (Inria Comité Opérationnel d'Evaluation des Risques Légaux et Ethiques), in tandem with the legal correspondent Nadège Camelio-Laurent.

### 10.1.7. Seminar Organization

"Les lundis de l'ergonomie" is a cycle of seminars on Human Computer Interaction (HCI) and UX Design organized by Emilie Palagi and Louise Chaussade. This multidisciplinary series of talks attract academic and professional profiles but also anyone interested in social science's approach to digital matters. This year, presentations took place with Laureline Améaume, Manuel Boutet and Naji Bouchiba. The slides and some video records are available on line <sup>14</sup>.

## 10.2. Teaching - Supervision - Juries

### 10.2.1. Teaching

#### Teaching Responsibilities

Michel Buffa is Director of MIAGE department (Informatics for Business) at UNS.

Catherine Faron Zucker coordinates the Web option of the 5th year of Polytech Nice Sophia engineering school and is in charge of continuous training for the computer science department of Polytech Nice Sophia Antipolis.

Isabelle Mirbel is Vice-dean of Science Department at University of Nice-Sophia Antipolis (UNS).

Andrea Tettamanzi manages the 3rd year of the *Licence* (Bachelor of Science) in Business Informatics (MIAGE) at the UFR Science of the University of Nice-Sophia Antipolis (UNS).

#### Teaching

Licence: Andrea Tettamanzi, Algorithmics – Object Oriented Programming – Python, 50h, L2, UNS, France.

Licence: Andrea Tettamanzi, Advanced Web Programming (client side), 39h, L2, UNS, France.

Licence: Andrea Tettamanzi, Web, 18 h ETD, L3, UNS, France.

Licence: Elena Cabrio, Web Server Programming, 45h, L1 INFO, UNS, France.

Licence: Elena Cabrio, Introduction to the Web, 48h, L1 INFO, UNS, France.

<sup>14</sup><https://lundisergo.hypotheses.org/>

License: Elena Cabrio, Introduction to the Web, 40h, L2 MASS, UNS, France.

License: Elena Cabrio, Internship supervision, 6h, L3 MIAGE, UNS, France.

Licence: Geraud Fokou Pelap, Object Oriented Programming (Java), 45h, L3, MIAGE, UNS, France.

Licence : Isabelle Mirbel, Web programming (Persistence). 54h, L3, UNS, France.

Licence: Michel Buffa, JavaScript, 40h, L3 Miage, UNS, France.

Master: Michel Buffa, Technologies Web, 30h, M1 Miage, UNS, France.

Master: Michel Buffa, Server Side JavaScript & Front-end Frameworks, 30h, M2 Miage NTDP & MBDS, UNS, France.

Master: Michel Buffa, Programmable Web Front-end, 30h, M2 Polytech, UNS, France.

Master: Elena Cabrio, Web Science, 10h, M2 IFI, UNS, France.

Master: Elena Cabrio, Knowledge Engineering, 5h, M1 IFI, UNS, France.

Master: Olivier Corby, Oscar Rodríguez Rocha, Catherine Faron Zucker, Fabien Gandon, Semantic Web of Data, 45h, M2, UNS, France.

Master: Olivier Corby, XML, 20h, M2 IMAFA, UNS, France.

Master: Olivier Corby, Semantic Web, 3H, M2, University of Montpellier, France.

Master: Olivier Corby, Semantic Web, 18H, M2, ENSI, Tunis, Tunisia.

Master: Catherine Faron Zucker, Web languages, 42h, M1, Polytech UNS.

Master: Catherine Faron Zucker, Knowledge Engineering, 9h, M2 IFI, Polytech, UNS.

Master: Fabien Gandon, Semantic Web, 28h, M2, Data Science Technical Institute

Master: Fabien Gandon, Web Science, 3h, M1, UNS, France.

Master: Alain Giboin, Human-Computer-Interaction Design and Evaluation, 54h, M2, UNS.

Master: Alain Giboin, Interaction Techniques and Multimodality, 8h, M2, UNS.

Master: Alain Giboin, Task and Activity Analysis for HCI design and evaluation, 6h, M2 Sociology and Ergonomics of Digital Technologies, UNS.

Master: Alain Giboin, HCI Design and Evaluation, 10h, M2 Sociology and Ergonomics of Digital Technologies, UNS.

Master : Alain Giboin, Economics and ICT: Ergonomics, 6h, M2 Economics and ICT, ISEM, UNS.

Master : Isabelle Mirbel, Project Management, 24h, M2, UNS, France.

Master : Isabelle Mirbel, Requirement Engineering, 42h, M1, UNS, France.

Master : Isabelle Mirbel, Advanced Databases. 48h, M1, UNS, France.

Master: Andrea Tettamanzi, Distributed Systems, 18h, M1, UNS, France.

Master: Andrea Tettamanzi, Parallelism, 18h, M1, UNS, France.

Master: Andrea Tettamanzi, Web Science, 5h, M1, UNS, France.

Master: Andrea Tettamanzi, Fuzzy Description Logics, 5h, M2, UNS, France.

Master: Andrea Tettamanzi, Ontology Learning, 5h, M2, UNS, France.

Master: Andrea Tettamanzi, Data Analysis in Distributed Environment, 18h, M2, UNS, France.

Master: Molka Dhoub, Knowledge Engineering, 2h, M2, UNS, France

Master: Oscar Rodríguez Rocha, Knowledge Engineering, 18h, M2, UNS, France.

### **E-learning MOOC**

Michel Buffa, "JavaScript Intro", June on EDx (MIT/Harvard).

Michel Buffa, "HTML5 Coding Essentials and Best Practices" on EDx.

Michel Buffa, "HTML5 Apps and Games" on Edx.

More than 400.000 subscriptions since 2015 on these three MOOCs.

Fabien Gandon, Olivier Corby & Catherine Faron Zucker, Introduction au Web Sémantique, 2 x 7 weeks, <https://www.fun-mooc.fr/>, Inria, France Université Numérique, Education for Adults, 4870 registered.

Fabien Gandon, Olivier Corby & Catherine Faron Zucker, Introduction to a Web of Linked Data, 2 x 4 weeks, <https://www.fun-mooc.fr/>, Inria, France Université Numérique, Education for Adults, 1703 registered.

#### **Tutorial, Summer School**

Elena Cabrio & Serena Villata: Argument Mining course at the 29th European Summer School in Logic, Language, and Information (ESSLLI 2017). University of Toulouse, France, July 17-28.

Olivier Corby: RDF & SPARQL at EGC, Grenoble, France, January 24th.

Olivier Corby: STTL: A Transformation Language for the Web of Data, JDEV, Marseille, July 5th.

Fabien Gandon: Introduction to Linked data and semantic Web, Grenoble, France, January 24th.

Fabien Gandon: Linked data and semantic Web, Winter school Complex Network, Inria UNS, France

### **10.2.2. Supervision**

HdR : **Catherine Faron Zucker**, *Knowledge Modelling and Processing for the Social Semantic Web*, UNS, June 12th.

PhD: **Amel Ben Othmane**, *CARS - Un système multi-agent pour l'aide à la décision dans des applications spatio-temporelles incertaines*, UNS, Nhan Le Thanh, Serena Villata and Andrea Tettamanzi, October 12th.

PhD: **Amosse Edouard**, *Détection et Analyse d'Événement dans les Messages Courts sur Twitter*, UNS, Nhan Le Thanh and Elena Cabrio, September 25th.

PhD: **Franck Michel**, *Heterogeneous Databases Federation in Distributed Environment*, UNS, Johan Montagnat, Catherine Faron Zucker, March 3rd.

PhD: **Tuan Anh Pham**, *Study and integration of the mechanism of workflow control in MVC (Model View Controller) architecture: design and implementation of an APM (Activity Process Management) platform for dynamic information systems on the networks*, UNS, Nhan Le Thanh, September 22nd.

PhD in progress: **Molka Dhouib**, *Modeling of a social network of service providers and companies – recommendation of service providers by reasoning on the social network*, UNS, Catherine Faron Zucker with Andrea Tettamanzi.

PhD in progress: **Tran Duc Minh**, *Learning Ontologies from Linked Open Data*, Andrea Tettamanzi, UNS and Nguyen Thanh Binh, University of Danang.

PhD in progress: **Ahmed El Amine Djebri**, *Distributed Artificial Intelligence for Linked Reviewable Data Management on the Semantic Web*, UNS, Andrea Tettamanzi.

PhD in progress: **Michael Fell**, *Natural Language Processing of Song Lyrics*, UNS, Elena Cabrio, Fabien Gandon.

PhD in progress: **Raphaël Gazzotti**, *Conversational Agent Assistant Endowed with Natural Language and Intuition*, UNS & SynchroNext, Fabien Gandon, Catherine Faron Zucker.

PhD in progress: **Tobias Mayer**, *Argument Mining for Clinical Trials*, UNS, Johan Montagnat (CNRS, I3S), Serena Villata and Céline Poudat (UNS).

PhD in progress: **Thu Huong Nguyen**, *Mining the Semantic Web for OWL Axioms*, Andrea Tettamanzi, UNS.

PhD in progress: **Emilie Palagi**, *Design of a Model-based Method for Evaluating Exploratory Search Systems*, UNS, Labex UCN@Sophia, Alain Giboin, Fabien Gandon with Raphaël Troncy (Eurecom).

PhD in progress: **Mahamadou Toure**, *Mobile Access for the Web of Data*, Fabien Gandon, Pascal Molli and Moussa Lo, UGB, UNS.

### 10.2.3. Juries

Catherine Faron Zucker:

- reviewer of Pauline Folz's PhD thesis, entitled *Collaboration dans une fédération de consommateurs de données liées*, defended on October 12 at Université de Nantes;
- reviewer of Hamadache's PhD thesis, entitled *Analyse et recherche dans les réseaux sociaux : vers la caractérisation et l'identification significative d'une identité de structure noyau possible au sein d'un processus évolutionnaire décrivant la dynamique d'un réseau social*, defended on July 16th at Université d'Annaba, Algérie;
- jury member of Olivier Wang's PhD thesis, entitled *Analytics Learning for Rule-Based Systems*, defended on June 28 at Ecole Polytechnique, Paris-Saclay.

Fabien Gandon:

- President of the Ph.D. jury of Franck Michel on "Integrating Heterogeneous Data Sources In The Web Of Data", University Côte d'Azur 03/03/2017
- Reviewer HDR Hala Skaf Molli on "Decentralized Data Management for the Semantic Web", l'Université de Nantes, 6/9/2017
- President of the HDR Catherine Faron-Zucker on "", University Côte d'Azur, 12/06/2017
- Reviewer HDR of Pierre-Antoine Champin on "Empowering Ambivalence Supporting multiple interpretations in knowledge-based systems", Université Claude Bernard Lyon 1, 13/06/2017
- Reviewer for PhD of Iacopo Vagliano on "Content Recommendation Through Linked Data", Politecnico di Torino, 5/4/2017

Nhan Le Thanh:

- Reviewer and President of the Jury for Jérémy Bénard, "Import, export et traduction sémantiques génériques basés sur une ontologie de langages de représentation de connaissances", Université de La Réunion, June 12th.
- Reviewer for HDR thesis of Jean-Baptiste LAMY, "Représentation, iconisation et visualisation des connaissances : Principes et applications à l'aide à la décision médicale", University of Rouen, December 12th.

Isabelle Mirbel was jury member of PhD Thesis :

- Samedi Heng, "Impact of Unified User-Story-Based Modeling on Agile Methods: Aspects on Requirements, Design and Life Cycle Management", under the supervision of Yves Wautelet and Manuel Kolp, Université Catholique de Louvain, February.
- Guillaume Surroca, "ViewointS: vers une émergence de connaissances collectives par élicitation de point de vue", under the supervision of Stefano A. Cerri, Philippe Lemoisson and Clément Jonquet, Université de Montpellier, June.

Andrea Tettamanzi was reviewer of the PhD thesis of:

- Iacopo Vagliano, *Content Recommendation Through Linked Data*, Politecnico di Torino, May 5th;

and Chairman of the Jury for the thesis of

- Tuan Anh Pham, *Study and integration of the mechanism of workflow control in MVC (Model View Controller) architecture: design and implementation of an APM (Activity Process Management) platform for dynamic information systems on the networks*, September 22nd.

#### 10.2.4. Internships

- Arthur Lemaire de Mil

Date: May–August

Institution: École Nationale Supérieure de Cognitique, École Polytechnique de Bordeaux.

Title: User-centered redesign of the user Interface allowing to remotely control the AZKAR robot

Supervisors: Thierry Bergeron, Alain Giboin.

### 10.3. Popularization

Michel Buffa:

- New-York-Times, March 14th: "Let a Robot Be Your Museum Tour Guide" <sup>15</sup>.
- Nice-Matin December 8th: "Et si vous visitiez une exposition à l'autre bout de la planète, sans bouger de votre salon" <sup>16</sup>.

Catherine Faron Zucker:

- Interview on Artificial Intelligence for Higher Education in *L'Étudiant* online journal <sup>17</sup>.

Fabien Gandon:

- Interview for Science et Vie Junior about Semantic Web
- Interview for Survey Magazine about Semantic Web
- SIF article on the history of the Web [62]

## 11. Bibliography

### Major publications by the team in recent years

- [1] S. BENLAMINE, M. CHAOUACHI, S. VILLATA, E. CABRIO, C. FRASSON, F. GANDON. *Emotions in Argumentation: an Empirical Evaluation*, in "International Joint Conference on Artificial Intelligence, IJCAI 2015", Buenos Aires, Argentina, Proceedings of the Twenty-Fourth International Joint Conference on Artificial Intelligence, IJCAI 2015, July 2015, pp. 156-163, <https://hal.inria.fr/hal-01152966>
- [2] E. CABRIO, S. VILLATA. *Natural Language Arguments: A Combined Approach*, in "20th European Conference on Artificial Intelligence (ECAI 2012)", Montpellier, France, August 2012, <https://hal.inria.fr/hal-00724780>
- [3] E. CABRIO, S. VILLATA, F. GANDON. *A Support Framework for Argumentative Discussions Management in the Web*, in "ESWC - 10th International Conference on The Semantic Web: Semantics and Big Data", Montpellier, France, Lecture Notes in Computer Science, Springer, May 2013, vol. 7882, pp. 412-426, Best Paper Award, <https://hal.inria.fr/hal-00907877>
- [4] O. CORBY, R. DIENG-KUNTZ, C. HEBERT. *A Conceptual Graph Model for W3C Resource Description Framework*, in "Conceptual Structures: Theory, Tools and Applications, Proc. of the 8th Int. Conference on Conceptual Structures (ICCS'2000)", Darmstadt, Allemagne, B. GANTER, G. W. MINEAU (editors), Springer-Verlag, LNAI n. 1867, August 13 -17 2000, pp. 468-482

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- [8] F. GANDON, C. FARON-ZUCKER, O. CORBY. *Web sémantique: comment lier données et schémas sur le Web ?*, Dunod, May 2012, ISBN: 978-2-10-057294-6
- [9] G. GOVERNATORI, A. ROTOLO, S. VILLATA, F. GANDON. *One License to Compose Them All - A Deontic Logic Approach to Data Licensing on the Web of Data*, in "ISWC - 12th International Semantic Web Conference - 2013", Sydney, Australia, Lecture Notes in Computer Science, Springer, October 2013, vol. 8218, pp. 151-166, <https://hal.inria.fr/hal-00907883>
- [10] S. VILLATA, L. COSTABELLO, N. DELAFORGE, F. GANDON. *A Social Semantic Web Access Control Model*, in "Journal on Data Semantics", March 2013, vol. 2, n<sup>o</sup> 1, pp. 21-36, <https://hal.inria.fr/hal-00907866>

## Publications of the year

### Doctoral Dissertations and Habilitation Theses

- [11] A. BEN OTHMANE. *CARS -A Multi-agent Framework to Support the Decision Making in Uncertain Spatio-temporal Real-world Applications*, UCA, I3S, October 2017, <https://hal.archives-ouvertes.fr/tel-01680984>
- [12] A. EDOUARD. *Event detection and analysis on short text messages*, Université Côte d'Azur, October 2017, <https://tel.archives-ouvertes.fr/tel-01679673>
- [13] C. FARON ZUCKER. *Knowledge Modelling and Processing for the Social Semantic Web*, Université Côte d'Azur, June 2017, Habilitation à diriger des recherches, <https://hal.archives-ouvertes.fr/tel-01664280>
- [14] F. MICHEL. *Integrating Heterogeneous Data Sources in the Web of Data*, Université Côte d'Azur, March 2017, <https://hal.archives-ouvertes.fr/tel-01508602>
- [15] T. A. PHAM. *OntoApp : a declarative approach for software reuse and simulation in early stage of software development life cycle*, Université Côte d'Azur, September 2017, <https://tel.archives-ouvertes.fr/tel-01680766>

### Articles in International Peer-Reviewed Journals

- [16] K. ATKINSON, P. BARONI, M. GIACOMIN, A. HUNTER, H. PRAKKEN, C. REED, G. R. SIMARI, M. THIMM, S. VILLATA. *Towards Artificial Argumentation*, in "AI magazine", October 2017, vol. 38, n<sup>o</sup> 3 [DOI : 10.1609/AIMAG.v38i3.2704], <https://hal.archives-ouvertes.fr/hal-01643470>

- [17] D. DUBOIS, G. FUSCO, H. PRADE, A. G. B. TETTAMANZI. *Uncertain logical gates in possibilistic networks: Theory and application to human geography*, in "International Journal of Approximate Reasoning", 2017, vol. 82, pp. 101 - 118 [DOI : 10.1016/J.IJAR.2016.11.009], <https://hal.archives-ouvertes.fr/hal-01445519>
- [18] A. EDOUARD, E. CABRIO, S. TONELLI, N. LE THANH. *Semantic Linking for Event-Based Classification of Tweets*, in "International Journal of Computational Linguistics and Applications", April 2017, 12 p. , <https://hal.inria.fr/hal-01529729>
- [19] C. FIGUEROA, I. VAGLIANO, O. RODRÍGUEZ ROCHA, M. TORCHIANO, C. FARON ZUCKER, J. C. CORRALES, M. MORISIO. *Allied: A Framework for Executing Linked Data- Based Recommendation Algorithms*, in "International Journal on Semantic Web and Information Systems", October 2017, vol. 13, n<sup>o</sup> 4, pp. 134 - 154 [DOI : 10.4018/IJSWIS.2017100107], <https://hal.inria.fr/hal-01619781>
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- [21] Z. MENG, F. GANDON, C. FARON ZUCKER. *Overlapping community detection and temporal analysis on Q&A sites*, in "Web Intelligence and Agent Systems", 2017, vol. 15, pp. 115 - 142 [DOI : 10.3233/WEB-170356], <https://hal.inria.fr/hal-01520115>
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- [24] S. VILLATA, E. CABRIO, I. JRAIDI, S. BENLAMINE, M. CHAOUACHI, C. FRASSON, F. GANDON. *Emotions and personality traits in argumentation: An empirical evaluation1*, in "Argument and Computation", May 2017, vol. 8, n<sup>o</sup> 1, pp. 61 - 87 [DOI : 10.3233/AAC-170015], <https://hal.archives-ouvertes.fr/hal-01643474>
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- [28] M. BENLAMINE, S. VILLATA, R. GHALI, C. FRASSON, F. GANDON, E. CABRIO. *Persuasive Argumentation and Emotions: An Empirical Evaluation with Users*, in "International Conference on Human-Computer Interaction", Vancouver, Canada, July 2017, vol. 40, pp. 187 - 671 [DOI : 10.1016/S0166-4115(08)62386-9], <https://hal.archives-ouvertes.fr/hal-01560271>
- [29] C. CARDELLINO, M. TERUEL, L. A. ALEMANY, S. VILLATA. *Learning Slowly To Learn Better: Curriculum Learning for Legal Ontology Population*, in "Thirtieth International Florida Artificial Intelligence Research Society Conference (FLAIRS 2017)", Marco Island, Florida, United States, 2017, <https://hal.archives-ouvertes.fr/hal-01572442>
- [30] C. CARDELLINO, M. TERUEL, L. A. ALEMANY, S. VILLATA. *Legal NERC with ontologies, Wikipedia and curriculum learning*, in "15th European Chapter of the Association for Computational Linguistics (EACL 2017)", Valencia, Spain, 2017, pp. 254 - 259 [DOI : 10.18653/v1/E17-2041], <https://hal.archives-ouvertes.fr/hal-01572444>
- [31] *Best Paper*  
C. CARDELLINO, M. TERUEL, L. ALONSO ALEMANY, S. VILLATA. *A Low-cost, High-coverage Legal Named Entity Recognizer, Classifier and Linker*, in "ICAIL-2017 - 16th International Conference on Artificial Intelligence and Law", Londres, United Kingdom, June 2017, 22 p. , <https://hal.archives-ouvertes.fr/hal-01541446>.
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