Activity Report 2018

# Project-Team WIMMICS

# Web-Instrumented Man-Machine Interactions, Communities and Semantics

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# Project-Team WIMMICS

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

*WIMMICS is located on the SophiaTech Campus, Polytech Nice-Sophia Templiers 1 building.*

**Keywords:**

### Computer Science and Digital Science:

A1.2.9. - Social Networks
A1.3.4. - Peer to peer
A2.1. - Programming Languages
A2.1.1. - Semantics of programming languages
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A3.5. - Social networks
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A7.1.3. - Graph algorithms
A7.2.2. - Automated Theorem Proving
A8.2.2. - Evolutionary algorithms
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## Other Research Topics and Application Domains:

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B5.8. - Learning and training
B6.3.1. - Web
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B6.5. - Information systems
B8.2. - Connected city
B8.5. - Smart society
B8.5.1. - Participative democracy
B9. - Society and Knowledge
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B9.1.2. - Serious games
B9.5.1. - Computer science
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B9.6. - Humanities
B9.6.1. - Psychology
B9.6.2. - Juridical science
B9.6.5. - Sociology
B9.6.8. - Linguistics
B9.6.10. - Digital humanities
B9.7. - Knowledge dissemination
B9.7.1. - Open access
B9.7.2. - Open data
B9.9. - Ethics
B9.10. - Privacy

# 1. Team, Visitors, External Collaborators

**Research Scientists**

Fabien Gandon [Team leader, Inria, Senior Researcher, HDR]
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Michael Fell [CNRS]
Raphaël Gazzotti [SynchroNext]
Abdoul Macina [Univ Côte d'Azur]
Tobias Mayer [Univ Côte d'Azur]
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Thu Huong Nguyen [Univ de Nice - Sophia Antipolis]
Emilie Palagi [Inria, from Sep 2018 until Nov 2018]
Mahamadou Toure [UGB]
Thuy Trieu [University of Timisoara, Romania, from Mar 2018 until Jul 2018]
Vorakit Vorakitphan [Inria, from Oct 2018]

**Technical staff**

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Géraud Fokou Pelap [Inria, from Feb 2018]
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Hai Huang [Inria, from May 2018]
Elmahdi Korfed [CNRS]
Roque Lopez Condori [Inria, Aug 2018]
Oscar Rodríguez Rocha [Inria, from Apr 2018, granted by U. numérique des sciences de la santé et du sport]

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Anna Bobasheva [Inria, from May 2018 until Nov 2018]
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   Milagro Teruel [Universidad de Córdoba, Argentina, from Apr 2018 until Jun 2018]
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# 2. Overall Objectives

## 2.1. Context and Objectives

The Web became a virtual place where persons and software interact in mixed communities. The Web has the potential of becoming the collaborative space for natural and artificial intelligence, raising the problem of supporting these worldwide interactions. These large scale mixed interactions create many problems that must be addressed with multidisciplinary approaches [74]. 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 [73] in order to address some of the challenges in building a Web as a universal space linking many different kinds of intelligence.*

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 to 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.

## 2.2. Research Topics

WIMMICS stands for Web-Instrumented Man-Machine Interactions, Communities, and Semantics.

The research objectives of Wimmics can be grouped according to four topics that 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 dense ?*". 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 and Artificial Intelligence formalisms 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 - artificial intelligence processing: learning, 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 and Artificial Intelligence Formalisms on the Web

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 that 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. Artificial Intelligence Processing: Learning, 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 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 with 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. 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.fstandar

## 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 of 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 that we built targeting more support for non experts to access and analyze data on a topic or an 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 her current mental and physical state, the emotion she just expressed or her 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 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

Serena Villata has been invited to deliver an Early Career Spotlight Talk at the main conference in Artificial Intelligence (IJCAI), namely the 27th International Joint Conference on Artificial Intelligence [1], on July 2018 in Stockholm (Sweden). The topic of this invited Early Career Spotlight Talk, *Artificial Argumentation for Humans*, is detailed in the related publication [62].

BEST PAPER AWARD:

[51]
O. RODRÍGUEZ ROCHA, C. FARON ZUCKER. *Automatic Generation of Quizzes from DBpedia According to Educational Standards*, in "The 3rd Educational Knowledge Management Workshop (EKM 2018)", Lyon, France, April 2018, https://hal.inria.fr/hal-01758737

# 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

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[1] https://www.ijcai-18.org/early-career-talks/

## 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: Recommandation 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 to 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:** Alain Giboin, Patrice Pena, Fabien Gandon.

This work (done in collaboration with Karima Boudaoud and Yoann Bertrand, SPARKS, I3S, in the context of the PadDOC FUI project) led to the elaboration and the evaluation of 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.

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

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

In the context of the ANR project WASABI, we performed an analysis of the needs of the target users of the future WASABI platform. This analysis has been reported in an internal report.

### 7.1.3. *Modeling the Users of Collaborative Ontology Building Environments*

**Participant:** Alain Giboin.

We undertook a study on the evolution of the user model of collaborative ontology building environments (COBEs). By a user model – or a contributor model – we refer to the representation that COBEs designers have of the users of their systems and more generally of the actors contributing to the building of ontologies. This study aimed at emphasizing the importance to get a better knowledge of potential COBE contributors in order to design collaborative tools better suited to these contributors. The study was published in [55]. In this paper, we describe: (1) the method we used to study the evolution of the user/contributor model; (2) the evolution of the model (in terms of user types, user characterizations, and user's environment characterizations); (3) the parallel evolutions of: (a) the methods of COBEs design, (b) the systems themselves, and (c) the methods of collaborative ontology building; we mention some evolution perspectives envisioned by the designers.

### 7.1.4. *Design of a User-Centered Evaluation Method for Exploratory Search Systems*

**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 specially work on Discovery Hub (Wimmics project – Inria) and 3cixty (EURECOM project) ESSs. During the third year of the PhD, we continued the evaluation of our model of exploratory search by comparing it to video records of seven other ES sessions on Discovery Hub, Frankenplace and 3cixty. We analyzed the videos with the same methodology: we wrote down the different chains of the different model's features used by the users in their ES session. For all the records we were able to identify the features of our model and extend our table of observed possible transitions between the model's features. From this analysis, we conclude that our model of ES can express the users' activity during an ES task. This work was partially published in [49].

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 necessarily involve users:

- Without users: Heuristics of ES and a procedure to use them. These heuristics are principles for the interaction design. The Heuristics of ES can be used several times along the design process of the ES system (in the design and evaluation phases). We presented the heuristics and evaluated them. This work was published in [48].

- 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. We focused on two model-based elements of this customizable test protocol: a protocol for the elaboration of exploratory search tasks, and a video analysis grid for the evaluation of recorded exploratory search sessions.

### 7.1.5. Supporting Learning Communities with Intelligent services

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

The *Système Intelligent d'Enseignement en Santé 3.0* (SIDES 3.0), (Intelligent Health Education System 3.0), is a 3 years project funded by the French National Agency for Research (ANR) within the framework of the call for projects DUNE 2016. It builds upon a national Web platform, the *Système Informatique D'Evaluation en Santé (SIDES)* (Health Assessment Information System), used since 2013 by the faculties of medicine in France which enables them to perform all of their validation exams on tablets, providing them with automatic corrections. It contributes to the preparation of medical students to perform the *Epreuves Classantes Nationales (ECN) informatisées (ECNi)* (Computerized National Qualifying Events) which have been successfully held in France in June 2016 (8000 candidates simultaneously throughout France). The SIDES platform is administered by the 35 medicine faculties in France and is used by more than 70,000 students throughout their training. The system is also used to prepare students for *ECNi*. Over the last 3 years, more than 4 million clinical cases (made up of 15 questions each) have been performed by students (all activities combined).

Building on this success, the SIDES 3.0 project aims to upgrade the SIDES solution to an innovative solution providing the user with intelligent learning services based on a modelization of the pedagogical resources with Semantic Web models and technologies. It is coordinated by the *Université Numérique Thématique (UNT) en Santé et Sport* [2]. This structure offers an ideal national positioning for support and coordination of training centers (UFR) and also offers long-term financial sustainability. In this framework, we focus on developing and applying adaptive learning approaches to automatic quiz generation from existing questions, and quiz recommendation adapted to user profiles and learning contexts, to allow medical students to better achieve their educational objectives by answering quizzes [50], [51].

### 7.1.6. Explainable Predictions Using Product Reviews

**Participants:** Elena Cabrio, Fabien Gandon, Nicholas Halliwell, Freddy Lecue, Serena Villata.

This is a joint work between Accenture and Wimmics team, funded by Accenture. The goal of this project is to design a recommender system that returns explainable predictions to the user, incorporating text from the product reviews in the explanation. To start, we have replicated results from current state of the art methods. We then gathered a dataset of Amazon books and corresponding reviews, and ran the current state of the art algorithm on our dataset. The next steps will be to build a deep learning model to outperform the current state of the art algorithm, and develop a method to explain the predictions to the user using the product reviews.

### 7.1.7. Argument Mining

**Participants:** Elena Cabrio, Fabien Gandon, Claude Frasson, Andrea Tettamanzi.

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[2] http://www.uness.fr

We have published a survey paper about Argument Mining at IJCAI [61]. Argument mining is the research area aiming at extracting natural language arguments and their relations from text, with the final goal of providing machine-processable structured data for computational models of argument. This research topic has started to attract the attention of a small community of researchers around 2014, and it is nowadays counted as one of the most promising research areas in Artificial Intelligence in terms of growing of the community, funded projects, and involvement of companies. In this paper, we presented the argument mining tasks and we discussed the obtained results in the area from a data-driven perspective. An open discussion highlights the main weaknesses suffered by the existing work in the literature and proposes open challenges to be faced in the future.

Together with two colleagues from FBK Trento (Italy), we applied argumentation mining techniques, in particular relation prediction, to study political speeches in monological form, where there is no direct interaction between opponents. We argued that this kind of technique can effectively support researchers in history, social and political sciences, which must deal with an increasing amount of data in digital form and need ways to automatically extract and analyse argumentation patterns. We tested and discussed our approach based on the analysis of documents issued by R. Nixon and J. F. Kennedy during 1960 presidential campaign. We relied on a supervised classifier to predict argument relations (i.e., support and attack), obtaining an accuracy of 0.72 on a dataset of 1,462 argument pairs. The application of argument mining to such data allowed not only to highlight the main points of agreement and disagreement between the candidates' arguments over the campaign issues such as Cuba, disarmament and health-care, but also an in-depth argumentative analysis of the respective viewpoints on these topics. The results of this research have been published at AAAI [58].

In this direction, we have also, in collaboration with the Heron Lab of the University of Montreal, presented an empirical study about the relation between argumentative persuasion and emotions. Argumentative persuasion usually employs one of the three persuasion strategies: Ethos, Pathos or Logos. Several approaches have been proposed to model persuasive agents, however, none of them explored how the choice of a strategy impacts the mental states of the debaters and the argumentation process. We conducted a field experiment with real debaters to assess the impact of the mental engagement and emotions of the participants, as well as of the persuasiveness power of the arguments exchanged during the debate. Our results showed that the Pathos strategy is the most effective in terms of mental engagement. The results of this research have been published at FLAIRS [60].

Together with Souhila Kaci (LIRMM) and Leendert van der Torre (University of Luxembourg), we have proposed a formal framework to reason about preferences in abstract argumentation. Consider an argument A that is attacked by an argument B, while A is preferred to B. Existing approaches will either ignore the attack or reverse it. We introduced a new reduction of preference and attack to defeat, based on the idea that in such a case, instead of ignoring the attack, the preference is ignored. We compared this new reduction with the two existing ones using a principle-based approach for the four Dung semantics. The principle-based or axiomatic approach is a methodology to choose an argumentation semantics for a particular application, and to guide the search for new argumentation semantics. For this analysis, we also introduced a fourth reduction, and a semantics for preference-based argumentation based on extension selection. Our classification of twenty alternatives for preference-based abstract argumentation semantics using six principles suggests that our new reduction has some advantages over the existing ones, in the sense that if the set of preferences increases, the sets of accepted arguments increase as well. The results of this research have been published at COMMA [36].

Together with Celia da Costa Pereira (I3S) and Mauro Dragoni (FBK Trento), we presented SMACk, an opinion summary system built on top of an argumentation framework with the aim to exchange, communicate and resolve possibly conflicting viewpoints. SMACk allows the user to extract debated opinions from a set of documents containing user-generated content from online commercial websites, and to automatically identify the mostly debated positive aspects of the issue of the debate, as well as the mostly debated negative ones. The key advantage of such a framework is the combination of different methods, i.e., formal argumentation theory and natural language processing, to support users in making more informed decisions, e.g., in the context of online purchases. The results of this research have been published in the AI Communications journal [14].

## 7.2. Communities and Social Interactions Analysis

### 7.2.1. *Argumentation and Emotion Detection with Adaptive Sentiment Analysis*

**Participants:** Vorakit Vorakitphan, Serena Villata, Elena Cabrio.

This PhD work just started in the context of the ANSWER project with Qwant search engine. One of the main objectives of the ANSWER project is to use emotion detection algorithms within text inquiries and sentiment analysis to provide powerful enhancements in the search results from Qwant search engine. The final goal is to extract effective and scalable indicators of sentiment, emotions, and argumentative relations in order to offer the users additional means to filter the results selected by the search engine. Powerful algorithms in state-of-art will be focused to define new criteria for filtering search results, i.e., the expression of a feeling in the answers found by the search engine. By doing as mentioned, textual elements to which we wish to associate a polarity will no longer be considered in their individuality but connected to each other by polarized relations to be analyzed in a higher level setting. Currently, the work progress is in the survey of state-of-the-art based on emotion detection algorithms and implementation of sentiment analysis. Then the next target, classification models with multi-label features based on emotion detection, will be deeply explored as a starting point of this research. Moreover, NLP related to emotional news content will be taken into account to build a novel dataset based on emotion annotation from news articles in sentence-level.

### 7.2.2. *Cyberbullying Events Prevention*

**Participants:** Pinar Arslan, Michele Corazza, Elena Cabrio, Serena Villata.

In the CREEP EIT project, we built an emotion detection classifier to automatically identify the emotion for user-generated texts such as Twitter and Instagram posts. The correlation analysis that we carried out to get a better understanding of the associations between emotions and cyberbullying instances unveiled that certain emotions (e.g., anger, joy) would be good indicative features to detect cyberbullying instances. Hence, our pipeline firstly reveals automatically detected emotion labels for social media texts to be used to detect cyberbullying instances. The automatically predicted emotion labels were used as one of the predictors for our cyberbullying detection classifier. As part of the project, we successfully built a classifier for offensive language in social media interactions for English, Italian and German using neural networks. This classifier was evaluated by participating in two shared tasks: Germeval (German offensive language detection) and Evalita (Italian hate speech detection). For the Germeval Challenge [29], two systems for predicting message-level offensive language in German tweets were used: one discriminates between offensive and not offensive messages, and the second performs a fine-grained classification by recognizing also classes of offense. Both systems are based on the same approach, which builds upon Recurrent Neural Networks used with the following features: word embeddings, emoji embeddings and social-network specific features. The model combines word-level information and tweet-level information to perform the classification tasks. Our best performing model ranked 7th out of 51 submitted runs on the binary classification task, 5th out of 25 for the fine-grained classification task. For the Evalita Challenge shared tasks [28], our submissions were based on three separate classes of models: a model using a recurrent layer, an ngram-based neural network and a LinearSVC. For the Facebook task and the two cross-domain tasks we used the recurrent model and obtained promising results, especially in the cross-domain setting. For Twitter, we used an ngram-based neural network and the Linear SVC-based model. Our system ranked 1st in the Facebook to Twitter dataset, 2nd in the Twitter to Facebook dataset, 3rd in the Facebook dataset and 4th on the Twitter dataset.

### 7.2.3. *Modeling of a Social Network of Service Providers*

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

In the framework of a collaborative project with Silex France company and the CIFRE PhD thesis of Molka Dhouib, our aim is to model the social network of service providers and companies registered in the *software as a service* sourcing tool developed by Silex for the recommendation of the service providers that are best suited to meet the service requests expressed by companies. Our aim is to automate the matching of service requests and offers by reasoning on the social network of service providers and companies. We developed an automatic categorization of companies, service requests and service offers based on their textual descriptions. We conducted some experiments using state-of-the-art supervised Machine Learning techniques to classify

Silex textual data into predefined categories, and to choose the best vector representations of the textual descriptions of service offers and requests in the Silex platform, and the best Machine Learning algorithm. This work has been presented at the French conference on applications of Artificial Intelligence APIA2018 [31].

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

### 7.3.1. *Modeling a Vocabulary of Professional Skills and Fields of Activities*

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

In the framework of the collaborative project with Silex France company aiming to model the social network of service providers and companies, as a preliminary step, we developed a dedicated vocabulary of competences and fields of activities to semantically annotate B2B service offers. We started with the study of existing reference taxonomies representing skills, professions and fields of activities and we formalized them in SKOS. Then we built a SKOS vocabulary from the internal Silex repositories. Finally we performed a semi-automatic alignment of these vocabularies. This work has been presented at the French conference on Knowledge Engineering IC 2018 [53].

### 7.3.2. *Representing and Querying a Knowledge Graph on Pedagogical Resources*

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

In the framework of the EduMICS (Educative Models Interactions Communities with Semantics) joint laboratory (LabCom) between the Wimmics team and the Educlever company, we built a knowledge graph from the database of the Educlever platform describing learning resources, and related knowledge and skills. We deployed our proposed Semantic Web based solution within the industrial environment of Educlever, using Web services, and we showed the added value of Semantic Web modelling enabling to implement new functionalities with SPARQL queries on the knowledge graph. This work has been presented at the SemWeb.Pro 2018 day [56] and at the WEBIST conference [34].

### 7.3.3. *A Learnable Crawler for Linked Open Data*

**Participants:** Hai Huang, Fabien Gandon.

This work is supported by the ANSWER project in cooperation with Qwant company. It consists of designing a learnable Linked Data crawler featured by a prediction component which is able to predict whether a newly discovered URI contains RDF data or not.

As the Web of Linked Open Data is growing exponentially, crawling for Linked Data has become increasingly important. Unlike normal Web crawlers, a Linked Data crawler performs selectively to collect linked RDF (including RDFa) data on the Web. From the perspectives of throughput and coverage, given a newly discovered URI, the key issue of Linked Data crawlers is to decide whether this URI is desirable to download (if it contains RDF data). Current solutions adopt heuristic rules aiming to filter irrelevant URIs. Unfortunately, it would hurt the coverage of crawling. In this work, we developed a learnable Linked Data crawler featured by a prediction component which is able to predict whether a newly discovered URI contains RDF data or not. We extracted useful features from the context RDF graph of the URI. The prediction model is based on FTRL-proximal [3] online learning algorithm. We evaluated it through extensive experiments in comparison with a number of baseline methods and demonstrated its efficiency.

### 7.3.4. *Argument Mining on Clinical Trials*

**Participants:** Tobias Mayer, Serena Villata, Elena Cabrio.

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[3]FTRL: Follow The Regularized Leader

This work was done in the context of the PhD of Tobias Mayer, which is situated in the IADB project, "Inté-gration et Apprentissage sur les Données Biomédicales". We created a new annotated dataset of Randomized Controlled Tirals (RCT) about four different diseases (glaucoma, diabetes, hepatitis B, and hypertension), containing 976 argument components (697 containing evidence, 279 claims) together with a first approach for the argumentative component detection [39]. Empirical results are promising and show the portability of the proposed approach over different branches of medicine. Furthermore, we proposed a new sub-task of the argument component identification task: evidence type classification, which distinguishes the provided evidence on a more fine-grained level. To address it, we proposed a supervised approach and we tested it on our data set [40].

As a collaboration with "Base, Corpus, Language" (BCL) at UCA within the IADB project, we anonymized and cleaned clinical reports (from CHU Nice), built a "raw" French corpus from it and are currently working on transferring the above mentioned annotations and models to this data set.

### 7.3.5. *Structure Detection in Song Lyrics*
**Participants:** Michael Fell, Elena Cabrio, Fabien Gandon.

In the context of the WASABI ANR project, we work on the estimation of the structure of song lyrics. For this, we have built a predictive model that successfully segments song texts into their underlying paragraphs - a task called "Lyrics Segmentation". We have augmented existing state-of-the-art models for Lyrics Segmentation in two ways: (i) by applying convolutional neural networks to the task alongside of novel feature representations. This work resulted in a publication at the COLING conference [33]; (ii) by extending the feature representation with time-synchronized audio features, we improve the segmentation model performance. It can now also use audio cues when text cues are non-indicative; this improves segmentation performance. Our current endeavors aim at summarizing song texts so that journalists and musicologists can perform efficient searches under different perspectives (e.g. structure and semantic content).

### 7.3.6. *Legal Information, Privacy*
**Participants:** Elena Cabrio, Serena Villata.

Together with Valentina Leone and Luigi di Caro (University of Torino), we presented the *InvestigatiOnt* tool which aims to ease the interaction of end users with legal ontologies in order to spread the use of machine-processable legal information as well as its understanding. This research is addressed in the context of the EU H2020 MIREL project. The results of this research have been published as demo paper at ISWC [71].

Together with Sabrina Kirrane (Vienna University of Economics and Business) and Matthieu d'Aquin (National University of Ireland Galway), we examined 78 articles from dedicated venues, the Privacy Online workshop series, two SPOT workshops, as well as the broader literature that connects the Semantic Web research domain with issues relating to privacy, security and/or policies. Specifically, we classified each paper according to three taxonomies (one for each of the aforementioned areas), in order to identify common trends and research gaps. We concluded by summarising the strong focus on relevant topics in Semantic Web research (e.g. information collection, information processing, policies and access control), and by highlighting the need to further explore under-represented topics (e.g., malware detection, fraud detection, and supporting policy validation by data consumers). The results of this research have been published in the Semantic Web journal [16].

### 7.3.7. *Semantic Web for Biodiversity*
**Participants:** Franck Michel, Catherine Faron Zucker.

The collaboration initiated with the French National Museum of Natural History of Paris (MNHN) is now giving rise to the development of an activity related to biodiversity data sharing and integration.

The TAXREF-LD linked data dataset, that we produced jointly with the MNHN, now appears in the Linked Open Data cloud [4] and is published on AgroPortal [5], the ontology Web portal for agronomy and agriculture. At the Biodiversity Information Standards conference (TDWG 2018), we presented some insights in the modelling of biodiversity Linked Data [45], we demonstrated how SPARQL Micro-Services can help in the integration of heterogeneous biodiversity-related data sources [43]. We also presented a poster on the Bioschemas.org initiative [46], a W3C community group that seeks the definition and adoption of common biology-related markup. In this context, we have proposed a first specification of the Taxon term [6] whose adoption as part of the official Schema.org vocabulary is currently being discussed with Google.

We took part in the D2KAB ANR project submission that aims to turn agronomy and biodiversity data into semantically described, interoperable, actionable open-knowledge. The project has been accepted and is due to start in June 2019.

### 7.3.8. *Integration of Heterogeneous Data Sources*
**Participants:** Franck Michel, Catherine Faron Zucker, Fabien Gandon.

With the incentive of fostering the integration of Linked Data and non RDF data sources, we published two contributions this year, together with Johan Montagnat from I3S.

First, we proposed a generic method to bridge the gap between the Semantic Web and NoSQL worlds [42]. To avoid defining yet another SPARQL translation method for each and every database, a SPARQL query is translated into a pivot abstract query, spanning all database-independent steps. Only then, the abstract query is translated into the target database query language while taking into account the specific database capabilities and constraints.

Second, we defined the SPARQL Micro-Service architecture that harnesses the Semantic Web standards to enable automatic combination of Linked Data and data residing in Web APIs (aka. REST Web services). A SPARQL micro-service is a lightweight, task-specific SPARQL endpoint that provides access to a small, resource-centric virtual graph, while dynamically assigning dereferenceable URIs to Web API resources that do not have URIs beforehand. The graph is delineated by the Web API service being wrapped, the arguments passed to this service, and the restricted types of RDF triples that this SPARQL micro-service is designed to spawn.

This work was presented at the ESWC conference [42] and the LDOW workshop at the Web Conference [44]. We also conducted an experimentation where we dynamically augment biodiversity Linked Data with data from multiple Web APIs: Flickr, Biodiversity Heritage Library, Encyclopedia of Life, Macauley scientific media archive, and MusicBrainz [43].

### 7.3.9. *Linked Data Script Language*
**Participant:** Olivier Corby.

We have designed and implemented LDScript, a programming language compatible with SPARQL that enables users to write extension functions that are directly executable in SPARQL queries.

We have leveraged pattern matching for structured objects such as lists where we can retrieve first elements, intermediate sublist and last elements. We have defined event driven processing where the SPARQL interpreter emits events which are processed by LDScript functions. The function definitions are annotated with event names. This enables users to trace query execution, to overload SPARQL statements such as "*order by, distinct*" and to extend SPARQL with new statements implemented as functions. In particular we are able to overload SPARQL operators for extension datatypes such as romain numbers or values with units. We are also able to trap and overload SPARQL execution errors with specific LDScript functions. In addition, we have introduced a second order "eval" function that enables us to evaluate the arguments of expressions that caused an error.

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[4] http://lod-cloud.net/
[5] http://agroportal.lirmm.fr/ontologies/TAXREF-LD/
[6] http://bioschemas.org/devSpecs/Taxon/

LDScript has been extended in order to process SPARQL Update in addition to SPARQL Query. Hence LDScript can be used to implement Semantic Web services with the following statements: SPARQL Query and Update, OWL RL entailment, RDF transformation to HTML.

This a follow up work on the formalism that was originally published at ISWC 2017 [72].

### 7.3.10. Graphic Display for RDF Graphs

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

This work has been done in the context of an Inria funding for software development (ADT).

In order to perform Linked Data visualisation, we connected the D3.js graphic display library to the Corese Web server. We designed an STTL transformation that generates D3 graph format with stylesheet from RDF graph. The graph display is performed thanks to SVG code generated by D3. The graph display can be interactive, that is hypertext navigation can be associated with a click on graph nodes. We have setup a demo with HAL open data server [7], see figure 1.
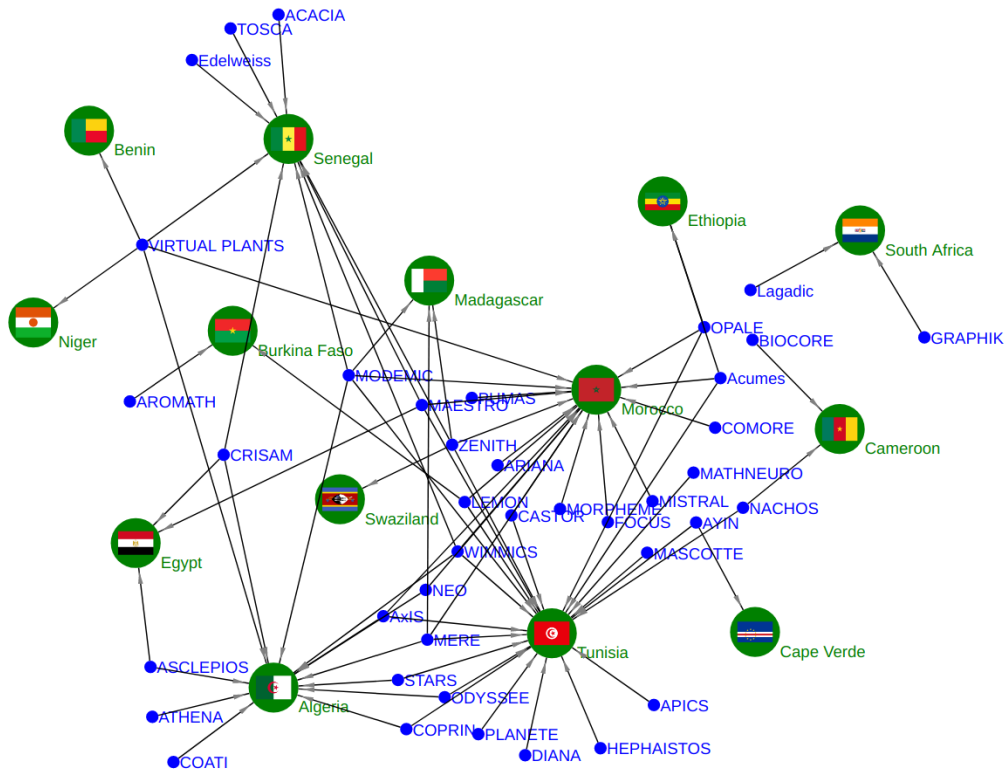


*Figure 1. Inria Sophia Antipolis teams publishing with south American countries.*

This work has been presented at the software development day at Inria Sophia Antipolis, November 14th.

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[7]http://corese.inria.fr

### 7.3.11. Federated Query Scaler
**Participant:** Olivier Corby.

This work is done in the context of the *Federated Query Scaler* Inria exploratory research project (PRE) together with Olivier Dameron and Vijay Ingalalli from Dyliss team at Inria Rennes.

In this project, focused on SPARQL federated queries, Vijay Ingalalli designed a graph index for distributed SPARQL endpoints that enables us to predict whether joins between patterns can be performed within endpoints. We also wrote a compiler that generates a SPARQL query with service clauses from a federated query, that is a query annotated with several SPARQL endpoints URL.

We welcomed Vijay Ingalalli at Inria Sophia Antipolis, January 15-19, and Olivier Corby visited the Dyliss team in Rennes, March 4-6.

## 7.4. Analyzing and Reasoning on Heterogeneous Semantic Graphs

### 7.4.1. Distributed Artificial Intelligence for Revisable Linked Data Management
**Participants:** Ahmed El Amine Djebri, Andrea Tettamanzi, Fabien Gandon.

The aim of this PhD thesis 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. We proposed a vocabulary to formalize uncertainty representation, and a framework to handle uncertainty mapping to sentences and contexts. This work has been presented as a poster at ISWS [68].

### 7.4.2. Learning Class Disjointness Axioms using Grammatical Evolution
**Participants:** Thu Huong Nguyen, Andrea Tettamanzi.

The aim of this research is to discover automatically class disjointness axioms from recorded RDF facts on the Web of Data. This may be regarded as a case of inductive reasoning and ontology learning. The instances, represented by RDF triples, play the role of specific observations, from which axioms can be extracted by generalization. We proposed the use of Grammatical Evolution, one type of evolutionary algorithm, for mining disjointness OWL2 axioms from an RDF data repository such as DBpedia. For the evaluation of candidate axioms against the DBpedia dataset, we adopt an approach based on possibility theory. We have submitted a paper to the conference EuroGP 2019.

### 7.4.3. Semantic Data for Image Recognition
**Participants:** Anna Bobasheva, Fabien Gandon.

This work is done in the context of the MonaLIA project with French Ministry of Culture, in collaboration with Frédéric Precioso, I3S, UCA. It consists of a preliminary study on image recognition of the Joconde database in connection with semantic data (JocondeLab).

The goal of this project is to exploit the cross-fertilization of recent advances in image recognition and semantic indexing on annotated image databases in order to improve the accuracy and the details of the annotation. The idea is, at first, to assess the potential of machine learning (including deep learning) and the semantic annotations on the Joconde database (350 000 illustrated artwork records from French museums). Joconde also contains metadata based on a thesaurus. In a previous project (JocondeLab) these metadata were formalized in Semantic Web formalism and were linking the iconographic Garnier thesaurus and DBpedia to the data of the Joconde database.

We developed SPARQL queries on Joconde database to extract the subset of images to train the Deep Learning classifier. We identified class subsets with enough labeled images for training, we balance number of images per class and we avoid images with intersected classes.

We tuned the pre-trained VGG16 implementation of the CNN classifier to classify the artwork images using well-known VGG16 with batch normalization [75] to train the classifier for the artwork images. We learned transfer from the training of the network on the ImageNet dataset to decrease the training time and we ran the classifier on many datasets and in different modes.

We developed another set of queries on the metadata to find the dependencies between the classification outcome and the artwork properties by applying statistical methods. We identified the usable (populated enough with reasonable number of categorical values) properties of the metadata. We used Recursive Feature Elimination (RFE) and Decision Tree to identify the top most statistically significant dependent variables and decision splitting values.

Results have been presented at a workshop of Ministry of Culture and Inria, November 22nd, at Bibliothèque Nationale de France in Paris.

### 7.4.4. *Hospitalization Prediction*
**Participants:** Catherine Faron Zucker, Fabien Gandon, Raphaël Gazzotti.

HealthPredict is a project conducted in collaboration with the Département d'Enseignement de Recherche en Médecine Générale (DERMG) at Université Côte d'Azur and the SynchroNext company. It aims at providing a digital health solution for the early management of patients through consultation with their general practitioner and health care circuit. Concretely, it is a predictive Artificial Intelligence interface that allows us to cross the data of symptoms, diagnosis and medical treatments of the population in real time to predict the hospitalization of a patient. The first results of this project will be presented at the French EGC 2019 conference [54]. In this paper, we report and discuss the results of our first experiments on the database PRIMEGE PACA that contains more than 350,000 consultations carried out by 16 general practitioners. We propose and evaluate different ways to enrich the features extracted from electronic medical records with ontological resources before turning them into vectors used by Machine Learning algorithms to predict hospitalization.

### 7.4.5. *Fake News Detection*
**Participants:** Jérôme Delobelle, Elena Cabrio, Serena Villata.

This work is part of the RAPID CONFIRMA (COntre argumentation contre les Fausses InfoRMAtion) DGA project aiming to automatically detect fake news and limit their diffusion. For this purpose, a framework will be developed to detect fake news, to reduce their propagation and to propose the best response strategies.

Thus, in addition to identifying the communities propagating these fake news, we will use methods from Natural Language Processing and Argumentation Theory to propose automatically extracted counter-arguments (adapted to target audience) from the existing reference press articles. These arguments allow to attack the false information detected in the fake news. Argument Mining techniques will make it possible to (1) analyse the argumentation in natural language, for example by looking for the argumentative structures, identifying the relations of support or attack between the arguments; (2) locate the data related to specific information (related to fake news) on the Web.

### 7.4.6. *Mining and Reasoning on Legal Documents*
**Participants:** Cristian Cardellino, Milagro Teruel, Serena Villata.

Together with Cristian Cardellino, Fernando Cardellino, Milagro Teruel and Laura Alonso Alemany from Univ. of Cordoba, we have proposed a methodology to improve argument annotation guidelines by exploiting inter-annotator agreement measures. After a first stage of the annotation effort, we have detected problematic issues via an analysis of inter-annotator agreement. We have detected ill-defined concepts, which we have addressed by redefining high-level annotation goals. For other concepts, that are well-delimited but complex, the annotation protocol has been extended and detailed. Moreover, as can be expected, we showed that distinctions where human annotators have less agreement are also those where automatic analyzers perform worse. Thus, the reproducibility of results of Argument Mining systems can be addressed by improving inter-annotator agreement in the training material. Following this methodology, we are enhancing a corpus annotated

with argumentation, available online [8] together with guidelines and analyses of agreement. These analyses can be used to filter performance figures of automated systems, with lower penalties for cases where human annotators agree less. This research is addressed in the context of the EU H2020 MIREL project. The results of this research have been published at LREC [59].

Together with some colleagues from Data61 Queensland (Australia) and Antonino Rotolo (University of Bologna), we proposed a formal framework that can instantiate in agents' dialogues moral/rational criteria, such as the maximin principle, Pareto efficiency, and impartiality, which were used, e.g., by John Rawls' theory or rule utilitarianism. Most ethical systems define how the individuals ought, morally, act being part of a society. The process of elicitation of a moral theory governing the agents in a society requires them to express their own norms with the aim to find a moral theory on which all may agree upon. This research is addressed in the context of the EU H2020 MIREL project. The results of this research have been published at DEON [57].

### 7.4.7. *Argumentation*

**Participants:** Serena Villata, Andrea Tettamanzi.

In collaboration with Mauro Dragoni of FBK and Célia da Costa Pereira of I3S, we have proposed the SMACk System, combining argumentation and aspect-based opinion mining [14].

### 7.4.8. *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), to which we have added representation and algorithms to manage uncertainty, imprecision, and approximate reasoning in time and space [47].

### 7.4.9. *RDF Mining*

**Participants:** Duc Minh Tran, Andrea Tettamanzi.

In collaboration with Dario Malchiodi of the University of Milan and Célia da Costa Pereira of I3S, we have studied the use of a prediction model as a surrogate of a possibilistic score for OWL axioms [38], [37].

In collaboration with Claudia d'Amato of the University of Bari, we made a comparison of rule evaluation metrics for EDMAR, our evolutionary approach to discover multi-relational rules from ontological knowledge bases exploiting the services of an OWL reasoner [52].

# 8. Bilateral Contracts and Grants with Industry

## 8.1. Bilateral Contracts with Industry

### 8.1.1. *Joint Lab Inria - Qwant*

Fabien Gandon is director of the joint Lab Inria - Qwant

### 8.1.2. *Intelliquiz Carnot Project*

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

Partner: Qwant/GAYAtech.

This project ended in March 2018. It was a joint project with GAYAtech (acquired by Qwant during the project) 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. We developed an approach to generate quizzes from DBpedia and we experimented it on the geographical domain for primary school students.

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[8]https://github.com/PLN-FaMAF/ArgumentMiningECHR

*8.1.2.1. Joint Lab EduMICS*

Catherine Faron Zucker is the scientific leader of the EduMICS (Educative Models Interactions Communities with Semantics) 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 second year of the project, we continued the deployment of Semantic Web technologies within the industrial context of Educlever, showing the added value of Semantic Web modelling enabling ontology-based reasoning on a knowledge graph. To continue our collaboration, we submitted a project proposal to the call for projects *AAP Partenariat d'Innovation et Intelligence Artificielle*; we successfully passed the first phase.

### 8.1.3. PREMISSE Collaborative Project

**Participants:** Molka Dhouib, 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 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.

### 8.1.4. 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. Accenture

Wimmics received two grants from Accenture to support work on explainable AI. They will fund the PhD of Nicholas Halliwell on that topic.

# 9. Partnerships and Cooperations

## 9.1. Regional Initiatives

### 9.1.1. ALDRAI UCA Project

At the center of the project, there is a triple ambition. The first is methodological and epistemological: it is a question of contributing to the development of the field of computational humanities via new tools of exploration of corpora, beyond the lexical approach (without excluding it, obviously, but in complementing) - it is a question of learning how to mobilize Artificial Intelligence to locate arguments, ideas and not simply terms, uses of terms, semantic fields. The second ambition is academic and transdisciplinary: the field studied in the project - administrative law from 1799 to today - concerns several disciplines (the history of law, administrative law, modern and contemporary history, philosophy, political science, administrative science)

and the development of digital technology will make it possible to considerably widen the sources available for its study, both from the point of view of their analysis (thanks to the exploratory tools mentioned in the previous point) and from the point of view of their nature. The third ambition is professional: practitioners already use the available databases (such as ArianeWeb [9] - for administrative case law) but they need to be able to question them more finely, in relation to the theoretical questions they ask themselves. This need is all the stronger as the so-called *digital transformation of justice* is developing in the sense of automating decision-making processes, based on the disputes already settled through the implementation of systematic line of all court decisions (pursuant to the law of 7 October 2016 on the Digital Republic). Magistrates as lawyers therefore need new digital tools to work and several start-ups have appeared in the sector called Legal Tech.

Partners: UNS (faculté de lettres and faculté de droit), Inria, UCA, École Pratique des Hautes Études [10] and Institut des Systèmes Complexes de Paris IDF [11], duration: 2018-2019.

### 9.1.2. IADB UCA Project

IADB, *Integration and Learning on Biomedical Data* [12], is a project funded by UCA JEDI Labex (Université Côte d'Azur). The goal of the project is to leverage medical prognosis and decision making in the clinical domain with big data analysis techniques, Natural Language Processing and Machine Learning. The partners are: I3S, Wimmics, CHU Nice and BCL (Bases, Corpus, Language) Laboratory.

### 9.1.3. INCERTIMMO UCA Project

INCERTIMMO, *Uncertainty in Real Estate Spatial Modeling in the City* [13], is a research and development partnership funded by UCA and Kinaxia [14] company. UCA partners are: I3S, ESPACE [15], and IMREDD [16].

## 9.2. National Initiatives

### 9.2.1. PIA GDN ANSWER

**Participants:** Fabien Gandon, Hai Huang, Vorakit Vorakitphan, Serena Villata, Elena Cabrio.

ANSWER stands for Advanced aNd Secured Web Experience and seaRch [17]. It is a GDN project (Grands Défis du Numérique) from the PIA program (Programme d'Investissements d'Avenir) on Big Data. The project is between four Inria research teams and the Qwant company.

The aim of the ANSWER project is to develop the new version of the Qwant [18] search engine by introducing radical innovations in terms of search criteria as well as indexed content and users' privacy.

The purpose is to strengthen everyone's confidence in the search engine and increase the effectiveness of Web search. Building trust in the search engine is based on innovations in (1) Security: computer security, privacy; (2) Completeness: completeness and heterogeneity of (re)sources; and (3) Neutrality: analysis, extraction, indexing, and classification of data.

Increasing the effectiveness of Web-based research relies on innovations related to (1) Relevance: variety and value of content taken into account, measurement of emotions carried by query results; (2) Interaction with the user: adaptation of the interfaces to the types of research; and (3) Performance: perceived relevance of results and response time.

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[9] http://arianeinternet.conseil-etat.fr/arianeinternet/
[10] https://www.ephe.fr/
[11] https://iscpif.fr/
[12] *Intégration et Apprentissage sur les Données Biomédicales*
[13] *Prise en compte de l'Incertitude pour une Modélisation Spatiale des Valeurs Immobilières dans la Ville*
[14] http://www.kinaxia.fr/
[15] http://univ-cotedazur.fr/laboratoires_old/espace
[16] http://imredd.fr/
[17] https://project.inria.fr/answer/
[18] http://www.qwant.com

The proposed innovations include:

- Design and develop models and tools for the detection of emotions in query results:
  - Ontology, thesaurus, linguistic resources
  - Metrics, indicators, classification of emotions
- Design and develop new crawling algorithms:
  - Dynamic crawling strategies
  - Crawlers and indexes for linked open data
- Ensure respect for privacy:
  - Detection of Internet tracking
  - Preventive display of tracing techniques
  - Certified security of automatic adaptation of ads to keywords entered by the user

### 9.2.2. DGA CONFIRMA

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

The theme of this new project with DGA is counter argumentation against fake news. Its duration is 2018-2020.

### 9.2.3. Ministry of Culture: MonaLIA 1.0

**Participants:** Anna Bobasheva, Fabien Gandon.

The MonaLIA 1.0 project is a preliminary study on the coupling of learning methods (Deep Neural Networks) and knowledge-based methods (Semantic Web) for image recognition and the enhancement of descriptive documentary records. The approach is applied and evaluated on the collection and data in the Joconde database in order to identify the possibilities and challenges offered by this coupling in assisting in the creation and maintenance of such an annotated collection.

### 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 then explore these bases of musical knowledge and provide 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 [19] for medicine students, in order to provide them with added value educational services.

Web site: https://www.uness.fr/anr/projets/dune/sides3.0

### 9.2.6. DBpedia.fr

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

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[19] http://side-sante.org/

The 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*
**Participants:** Fabien Gandon, Alain Giboin.

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, personnal assistants
- Education technologies (EdTech)

We identify possibilities of exploiting the Qwant search engine to improve the search for information in the digital cultural resources of the French Ministry of Culture. At the end of the project, some possibilities will be selected and will be the subject of research actions in the context a long-term project.

### 9.2.9. *Inria Federated Query Scaler*
**Participant:** Olivier Corby.

Federated Query Scaler is an Exploratory Research Project (PRE) funded by Inria, together with the Dyliss team at Inria Rennes. The topic of this project is the study of distributed SPARQL queries in the context of bioinformatics.

### 9.2.10. *GDRI Zoomathia*
**Participants:** Catherine Faron Zucker, Franck Michel, Andrea Tettamanzi.

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

As a continuation of the work initiated with the *Muséum National d'Histoire Naturelle* (MNHN) during the last three years, the TAXREF-LD linked data dataset, that we produced jointly with the MNHN, now appears in the Linked Open Data cloud [20] and is published on AgroPortal [21]. Relatedly, we have reflected on modelling principles for biodiversity Linked Data [45].

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

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[20] http://lod-cloud.net/
[21] http://agroportal.lirmm.fr/ontologies/TAXREF-LD/

## 9.3. European Initiatives

### 9.3.1. *CREEP EIT Project*

The CREEP project (Cyberbulling Effects Prevention) aims at identifying and preventing the possible negative impacts of cyberbullying on young people. It seeks to realize advanced technologies for the early detection of cyberbullying phenomena through the monitoring of social media and the communication of preventive advices and personalized recommendations tailored to teenagers' needs through a virtual coaching system (chatbot). Partners: University of Trento, Fondazione Bruno Kessler, Inria, ExpertSystem, NeuroNation; duration: 2018-2020.

Web site: http://creep-project.eu/.

### 9.3.2. *MIREL*

MIREL, MIning and REasoning with legal text, is a Research and Innovation Staff Exchange (RISE) project, funded by Marie Skłodowska-Curie grant, duration: 2016-2019

The coordinator is Leendert van der Torre, University of Luxembourg

Other partners are: 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).

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 Associate Teams Not Involved in an Inria International Labs*

#### MoReWAIS

MoReWAIS stands for Mobile Read Write Access and Intermittent to Semantic Web.

Partners: UGB (Senegal) - LANI - Moussa Lo; start year: 2016.

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).

Web site: https://project.inria.fr/morewais/.

## 9.5. International Research Visitors

### 9.5.1. Visits of International Scientists

**Christian Cardellino**: PhD, Universidad de Córdoba, Argentina, May and July.
**Andrei Ciortea**: PostDoc, University of Saint Gallen, Switzerland, Labex UCN@Sophia grant, November-December.
**Kaladzavi Guidedi**: PostDoc CEA-MITIC University of Maroua, Cameroon, MoreWAIS grant, November-December.
**Phan Hieu Ho**: PhD, Polytechnic Institute, Danang, Vietnam, April-July.
**Milagro Teruel**: PhD, Universidad de Córdoba, Argentina, May-June.
**Thuy Trieu**: PhD, University of Timisoara, Romania, March-July.

### 9.5.2. Research Stays Abroad

- Fabien Gandon visited CSIRO, Brisbane, Australia from July to August 2018. In the context of the project MIREL he worked on the problem of aligning semantic Web schemas (argumentation and generic schemas) to support interoperable and linked arguments on the Web as an extension of Web annotation and Web provenance.

- Raphaël Gazzotti visited the Natural Language Processing research group of the Universidad Nacional de Córdoba, Argentina, for two months as a secondment of the MIREL H2020 Project, March-April. We carried out information retrieval of medical test results within free text in french Electronic Medical Records by a symbolic approach. In a future step, we could annotate automatically free texts with this method then train a machine learning algorithm in order to have a better generalization of this extraction process. We also worked on a sequential machine learning modelization suited to Electronic Medical Records. This model exploits the potential of Conditional Random Fields and consequently allows us to interpret the decision made by the algorithm across all the different consultations of a patient, moreover, all medical test results can be considered with this modelization.

# 10. Dissemination

## 10.1. Promoting Scientific Activities

### 10.1.1. Scientific Events Organisation

#### 10.1.1.1. General Chair, Scientific Chair

Elena Cabrio was:

- Co-chair of CLiC-it: Fifth Italian Conference on Computational Linguistics, Turin, December.
- Challenge co-chair of The Web Conference (WWW), Lyon, France, April 23-27.

Catherine Faron Zucker was Program Chair together with Chiara Gandini of the 21st International Conference on Knowledge Engineering (EKAW 2018), November, Nancy.

Fabien Gandon was general co-chair of The Web Conference in Lyon, April, 2018.

Serena Villata was:

- Program Chair together with Eduardo Ferme of the 17th edition of the International Workshop on Non-Monotonic Reasoning (NMR), Tempe (Arizona), October,
- Chair together with Filip Radlinski of the "Poster and Demo" session of the Web Conference (WWW), Lyon, France, April,
- Chair together with Harko Verhagen, Mehdi Dastani and Jurgen Dix of the Dagstuhl Seminar on Normative Multi-Agent Systems NorMAS, April [67]

*10.1.1.2. Member of the Organizing Committees*
Michel Buffa organized the *WebAudio Plugins* Workshop at the Web Audio conference, Berlin, September 19-21.

Fabien Gandon was co-organizer of the Joint Day Inria Ministry of Culture 22/11/2018.

Alain Giboin was member of the organization committee of HCSE.

## 10.1.2. Scientific Events Selection

*10.1.2.1. Chair of Conference Program Committees*
Olivier Corby was co-chair of the poster and demo track at EKAW, together with Philipp Cimiano.

Isabelle Mirbel was co-chair of the Doctoral Consortium at IEEE International Conference on Research Challenges in Information Science (RCIS).

*10.1.2.2. Member of the Conference Program Committees*
Michel Buffa: WebAudio Conference, ISWC.

Elena Cabrio: Association for Computational Linguistics conference (ACL), EMNLP, Extended Semantic Web Conference (ESWC), International Semantic Web Conference (ISWC), AAAI Conference on Artificial Intelligence.

Olivier Corby: The Web Conference 2019, IC, Digital Health, EKAW, ICCS, ISWC, QuWeDa.

Catherine Faron Zucker: The Web Conference (WWW) 2019, ICCS, ISWC, Web Science, ESWC, IJCAI, Semantics, Web Audio Conference WAC, workshop WWW Educational Knowledge Management EKM, workshop WWW Reasoning on Data RoD, EGC 2019, EIAH, IC, CNIA.

Fabien Gandon: The Web Conference (WWW), IJCAI, ISWC (Blue Sky), EGC, SemWeb.Pro.

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

Isabelle Mirbel: International Conference on Advanced Information Systems Engineering (CAISE).

Oscar Rodríguez Rocha: KEOD, KSE, EKAW, IJCAI, ECAI, Semantics.

Andrea Tettamanzi: AAAI-19, AAMAS, ACM (SWA Track), EGC 2019, EKAW, PPSN, TheWebConf 2019, Web Intelligence, WILF, WIVACE. He was also senior PC Member of IJCAI/ECAI and got a mention as distinguished PC Member.

## 10.1.3. Journal

*10.1.3.1. Member of the Editorial Boards*
Catherine Faron Zucker: Revue d'Intelligence Artificielle.

Isabelle Mirbel: Ingénierie des Systèmes d'Information.

*10.1.3.2. Reviewer - Reviewing Activities*
Elena Cabrio: Journal Argument and Computation.

Catherine Faron Zucker: The Journal of Web Science, Journal of Web Semantics (JWS), International Journal on Semantic Web and Information Systems (IJSWIS), IEEE Transactions on Computational Social Systems (TCSS), IEEE's Transactions on Learning Technologies (TLT), Multimodal Technologies and Interaction (MTI), Ingénierie des systèmes d'information (ISI).

Andrea Tettamanzi: Semantic Web Journal, IEEE Transactions on Evolutionary Computation.

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

## 10.1.4. Invited Talks

Michel Buffa: Presentation of the ANR WASABI project and of WebAudio technologies at the "Journée Ministère de la Culture - Inria" on 22/11 as part of the agreement between these two institutions, at the BnF.

Presentation of the WebAudio, WebMidi and WebAssembly W3C standards. Developer's Day of the TPAC conference in Lyon, October, Lyon, France.

AZKAR Project, post-mortem presentation *Remote museum visits by an intelligent mobile robot*, during Mobility session: Autonomous and Connected Vehicle and Smart Cities, RoboPACA conference, Sophia Antipolis, France.

Elena Cabrio: *Argument Mining for Machine Translation*, 13th Machine Translation Marathon, Prague, September 6th.

*From Linguistics to Computation across the Mountains to the Sea*, FBK PhD Day, February 2nd, Trento (Italy).

Olivier Corby: *LDScript : a Linked Data Script Language*, Inria Montpellier, March 21st.

*Semantic Web of Linked Data*, Inria Rennes, April 5th.

Fabien Gandon: *Web Science, Artificial Intelligence and Intelligence Augmentation*, Invited Talk at Dagstuhl Perspectives Workshop 18262 - 10 Years of Web Science: Closing The Loop, 27/06/2018.

*The revolutions of the Web planet*, Invited talks I3S General Assembly, Nice, 5/07/2018.

*Adding Missing Links to bridge Natural and Artificial Intelligence on the Web*, Invited talks at University of Queensland, Brisbane, 08/08/2018.

*A Web linking all kinds of intelligence*, Invited talks at « Przemiany Festival », Copernicus Science Centre, French Embassy in Warsaw, 15/09/2018.

*Towards a Web linking all kinds of intelligence*, Invited Talk at SophI.A Summit, 07/11/2018.

Andrea Tettamanzi: Invited talk on *Guess What You Don't Know: Towards an Evolutionary Epistemology of Ontology Learning* at the 21st International Conference on Knowledge Engineering and Knowledge Management, Nancy, France, November 14th.

Conference on *Unsupervised Learning* at Amadeus, Sophia Antipolis, March 26th.

Tutorial talk on *Uncertainty in the Semantic Web: The case of axiom scoring* at the 12th International Conference on Scalable Uncertainty Management, Milan, Italy, October 3rd.

Conference on *Unsupervised Learning* at Amadeus, Sophia Antipolis, October 19th.

Serena Villata has been invited to deliver an Early Career Spotlight Talk at the main conference in Artificial Intelligence (IJCAI), namely the 27th International Joint Conference on Artificial Intelligence [22], in July in Stockholm (Sweden). The topic of this invited Early Career Spotlight Talk, *Artificial Argumentation for Humans* is detailed in the related publication [62].

## 10.1.5. Leadership within the Scientific Community

Fabien Gandon is:

- member of IW3C2 steering committee for The Web Conference (WWW series).
- member of SWSA steering committee for the ISWC conference (as general chair of ISWC 2019).
- member of ESWC conference steering committee.
- member of Web Science Trust Network

## 10.1.6. Scientific Expertise

Olivier Corby was reviewer for two project submissions at Université Gaston Berger, Senegal.
Catherine Faron Zucker:

- is the scientific referent of the Inria Learning Lab,
- was reviewer for the LabCom V3 2018 of the French Agence Nationale de la Recherche (ANR),
- was reviewer for the ARC6 call for projects of Auvergne Rhône Alpes region,
- was reviewer for the RIN call for projects of Normandie region.

Alain Giboin was reviewer for the Generic Call for Projects of the French Agence Nationale de la Recherche (ANR).

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[22]https://www.ijcai-18.org/early-career-talks/

### 10.1.7. Research Administration

Olivier Corby is member of the scientific board of Université Côte d'Azur RISE academy (Network, Information, Digital Society) and member of the Scientific and Pedagogical committee of the Digital Systems for Humans, DS4H, graduate school at UCA.

Catherine Faron Zucker:

- is General Treasurer of the French Society for Artificial Intelligence (AFIA).
- was leading the steering committee of the AFIA college on Knowledge Engineering until June 2018.
- was member of the 2018 recruitment committee for young graduate scientists (CRCN) at Inria Lille.
- is member of the permanent commission of human resources (CPRH) of Université Nice Sophia Antipolis, section CNU 27

Fabien Gandon is:

- Vice-head of science for Inria Sophia Antipolis - Méditerranée (Délégué Scientifique Adjoint, DSA)
- Advisory Committee representative of Inria at the World-Wide Web Consortium (W3C)
- Director of the joint research Laboratory Qwant-Inria
- Representative of Inria in the Web Science Trust Network
- Leader of the research convention with the French Ministry of Culture-Inria

Alain Giboin:

- was member of the scientific committee of the IDEX Jedi Academy 5 "Homme, Idées et Milieux".
- was co-facilitator of the Idex Jedi Academy 5 initiative "Humanités numériques" (with Arnaud Zucker, CEPAM).
- 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.
- served as scientific correspondent for Inria Sophia Antipolis of COERLE (Inria Comité Opérationnel d'Evaluation des Risques Légaux et Ethiques), in tandem with the legal correspondent Nadège Camelio-Laurent.

Isabelle Mirbel was Vice-dean of the Science Faculty at University Nice-Sophia Antipolis until July 2018.

"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 Naji Bouchiba, Guillene Ribière, Alessandro Trezzi, Manuel Boutet, Marc Relieu. The slides and some video records are available online [23].

### 10.1.8. Editorial Activities

Catherine Faron Zucker is among the scientific editors of the proceedings of the 21st International Conference on Knowledge Engineering and Knowledge Management, Nov 2018, Nancy, France. Lecture Notes in Computer Science 11313, Springer [65].

Serena Villata is among the authors of two editorial activities:

- Qingliang Chen, Paolo Torroni, Serena Villata: Preface. Fundam. Inform. 158(1-3): v-vii [13],
- Ugo Pagallo, Monica Palmirani, Pompeu Casanovas, Giovanni Sartor, Serena Villata: AI Approaches to the Complexity of Legal Systems - AICOL International Workshops 2015-2017: AICOL-VI@JURIX 2015, AICOL-VII@EKAW 2016, AICOL-VIII@JURIX 2016, AICOL-IX@ICAIL 2017, and AICOL-X@JURIX 2017, Revised Selected Papers. Lecture Notes in Computer Science 10791, Springer [66].

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[23] https://lundisergo.hypotheses.org/

### 10.1.9. Standardization

- Michel Buffa is member of the WebAudio W3C working group and is Academic Representative of Université Côte d'Azur at W3C (AC Rep).

- Fabien Gandon is Advisory Committee representative of Inria at the World-Wide Web Consortium (W3C)

## 10.2. Teaching - Supervision - Juries

### 10.2.1. Teaching

Michel Buffa is director of MIAGE Nice-Sophia Antipolis: Licence, Master 1 and four Master 2 degrees, about 350 students [24].

Elena Cabrio is responsible of the internship program, 40 hours, (L3 and M2 MIAGE), University of Nice-Sophia Antipolis (UNS), France.

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

Andrea Tettamanzi has managed the 3nd year of the *Licence* (Bachelor of Science) in Business Informatics (MIAGE) at the UFR Science of the University of Nice-Sophia Antipolis (UNS),

License: Elena Cabrio, Web Server Programming, 45 hours, (L1 INFO), UNS, France.

License: Elena Cabrio, Introduction to the Web, 40 hours, (L2MASS), UNS, France.

Licence: Michel Buffa, JavaScript: L3 Miage (40h)

License: Elena Cabrio, Internship supervision, 18 hours, (L3MIAGE), UNS, France.

Licence: Isabelle Mirbel, Web programming (Persistency), 36h, L3, UNS, France.

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

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

Licence: Andrea Tettamanzi, Web, 30 h, L3, UNS, France.

Master: Elena Cabrio, WebScience, 10 hours, (M2IFI), UNS, France.

Master: Elena Cabrio, Computational Linguistics, 30 hours, (Lettres), UNS, France.

Master: Elena Cabrio, Natural Language Processing for AI, 24 hours, (M1 INFO), UNS, France.

Master: Olivier Corby, Catherine Faron Zucker, Oscar Rodríguez Rocha, Semantic Web of Data, 65h, M2, UNS, France.

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

Master: Catherine Faron Zucker, Oscar Rodríguez Rocha, Andrea Tettamanzi, Knowledge Engineering, 35h, M2, UNS, France.

Master: Catherine Faron Zucker, Oscar Rodríguez Rocha, Web Languages, 35h, M1, UNS, France.

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

Master: Fabien Gandon, Integrating Semantic Web technologies in Data Science developments, 2*28 h, M2, DSTI, France.

Master/PhD: Semantic Web and Linked Data Graphs, 3 h, Winter School on Complex Networks 2018 (5th edition), France.

Master: Alain Giboin, Human-Computer-Interaction Design and Evaluation, 21h, M2, UNS.

Master: Alain Giboin, Human-Computer-Interaction Adaptation of User Interfaces, 4h, M2, UNS.

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[24]http://miage.unice.fr

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, Digital Strategy (formerly: Economics and ICT) : Ergonomics, 13h, M2 Economics and ICT, ISEM, UNS.

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

Master: Isabelle Mirbel, Requirement Engineering, 36h, M1, UNS, France.

Master: Andrea Tettamanzi, Logic for AI, 30 h, M1, UNS, France.

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

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

Master: Andrea Tettamanzi, Data analysis in distributed environment, 18 h, M2, UNS, France.

**E-learning**

Michel Buffa, MOOC *JavaScript Intro* EDx platform.

Michel Buffa, MOOC *HTML5 Coding Essentials and Best Practices*, Edx platform.

Michel Buffa, MOOC *HTML5 Apps and Games*, also on EDx platform.

Fabien Gandon, Catherine Faron Zucker, Olivier Corby, MOOC *Web sémantique*, FUN.

Fabien Gandon, Catherine Faron Zucker, Olivier Corby, MOOC *Web of Data*, FUN.

Fabien Gandon, Catherine Faron Zucker, Olivier Corby, MOOC *Web of Data*, Coursera [25], to be run in 2019.

## 10.2.2. Supervision

HdR: **Michel Buffa**, *Des wikis aux simulations d'amplificateurs de guitare à lampes, le Web plateforme universelle*, UNS, December 12th, President : Fabien Gandon.

HdR: **Serena Villata**, *Explainable, Trustable and Emphatic Artificial Intelligence: from Formal Argumentation Theory to Argumentation for Humans*, UNS, July 4th, President : Fabien Gandon.

PhD: **Duc Minh Tran**, *Learning Ontologies from Linked Open Data*, Andrea Tettamanzi, UNS and Nguyen Thanh Binh, University of Danang, July [12].

PhD: **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), November 23rd.

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

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

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

PhD in progress: **Raphaël Gazzotti**, *Modeling and Classification of Descriptions to Assist Decision Making*, UNS & SynchroNext, Catherine Faron Zucker, Fabien Gandon.

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

PhD in progress: **Vorakit Vorakitphan**, *Argumentation and Emotions Emotion Detection with Adaptive Sentiment Analysis*, Elena Cabrio, Serena Villata, UCA.

Tobias Mayer attended:

- Advanced Course on Data Science & Machine Learning [26] (Siena, July 18-24)

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- 3rd Summer School on Argumentation, [27] (Warsaw, September 06-10)

### 10.2.3. Juries

Catherine Faron Zucker was reviewer of the PhD thesis of

- Joe Raad, *Identity Management in Knowledge Graphs*, Université Paris Saclay, defended on 30/11/2018;
- Valentina Beretta, *Data veracity assessment: enhancing Truth Discovery using a priori knowledge*, Ecole des Mines Télécom IMT Mines Alès, defended on 30/10/2018;
- Landy Rajaonarivo, *Approche co-évolutive humain-système pour l'exploration de bases de données*, Ecole Nationale d'Ingénieurs de Brest (ENIB), defended on 29/06/2018;
- Manel Achichi, *Linking Heterogeneous Open Data – Application to the Musical Domain*, Université de Montpellier, defended on 15/02/2018.

Fabien Gandon was

- Jury Member for HDR Frédérique Segond, *Transformer les Données afin d'Etancher la Soif de l'Ere de la Connaissance*, University Grenoble Alpes, defended 17/01/2018
- Opponent for PhD Valentina Ivanova, *Fostering User Involvement in Ontology Alignment and Alignment Evaluation*, Linköping University Department of Computer and Information Science Division of Database and Information Techniques, defended 26/01/2018
- President for HDR Serena Villata, *Explainable, Trustable And Emphatic Artificial Intelligence From Formal Argumentation Theory To Argumentation For Humans*, University Côte d'Azur, defended 04/07/2018
- Reviewer for PhD Jörg Waitelonis, *Linked Data Supported Information Retrieval*, Karlsruher Institut für Technologie (KIT), defended 09/07/2018
- Reviewer for PhD Thesis Silvio Cardoso, *MAISA- Maintenance of Semantic Annotations*, Université Paris-Sud, LRI, and LIST Luxembourg, defended 30/11/2018
- President for HDR Michel Buffa, *Des wikis aux simulations d'amplificateurs de guitare à lampes, le Web plateforme universelle...*, University Côte d'Azur, defended 12/12/2018
- External Reviewer for PhD Thesis Luigi Asprino, *Engineering Background Knowledge for Social Robots*, University of Bologna, report sent the 15/12/2018
- Jury member for Tenure Track position for a Researcher in the field of Knowledge-based Systems in Healthcare at Bruno Kessler Foundation (FBK), 2018

Andrea Tettamanzi was:

- Jury member of the HDR theses of Giovanni Fusco, *Ville, Complexité, Incertitude. Enjeux de connaissance pour le géographe et l'urbaniste*, Université Côte d'Azur, February 5th;
- Jury member of the HDR theses of Chan Le Duc, *Raisonnement et révision pour des ontologies en logique de description*, Université Paris 8, November 29th.
- Chairman of the Jury for the PhD thesis of Abdoul Macina, UNS, December 17th on *SPARQL Distributed Query Processing over Linked Data*.
- Reviewer for the thesis of Victor Eduardo Fuentes, *Méta alignement méta heuristique*, whose defense was not authorized by Université du Québec, Montréal.

## 10.3. Popularization

### 10.3.1. Interventions

- Michel Buffa presented the WASABI ANR project during *La fête de la Science* in *L'esprit Sorcier* TV program [28].

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[26] https://acdl2018.icas.xyz/
[27] http://waw2018.argdiap.pl/summer-school/
[28] https://youtu.be/-iExdePDsPA

# 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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[6] L. COSTABELLO, S. VILLATA, F. GANDON. *Context-Aware Access Control for RDF Graph Stores*, in "ECAI - 20th European Conference on Artificial Intelligence - 2012", Montpellier, France, August 2012, https://hal.inria.fr/hal-00724041

[7] F. GANDON, C. F. ZUCKER, O. CORBY. *Web sémantique: comment lier données et schémas sur le Web ?*, Dunod, May 2012, ISBN: 978-2-10-057294-6

[8] 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

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[10] C. DA COSTA PEREIRA, A. G. B. TETTAMANZI. *A Syntactic Possibilistic Belief Change Operator: Theory and empirical study*, in "Web Intelligence and Agent Systems: An International Journal", 2014, vol. 12, n° 2, pp. 155-169 [*DOI :* 10.3233/WIA-140290], https://hal.archives-ouvertes.fr/hal-00983200

## Publications of the year

### Doctoral Dissertations and Habilitation Theses

[11] M. BUFFA. *From wikis to tube guitar amplifier simulations, the universal web platform..*, Université Côte d'Azur, December 2018, Habilitation à diriger des recherches, https://hal.univ-cotedazur.fr/tel-01963301

[12] D. M. TRAN. *Discovering multi-relational association rules from ontological knowledge bases to enrich ontologies*, Université Côte d'Azur, July 2018, https://tel.archives-ouvertes.fr/tel-01926812

**Articles in International Peer-Reviewed Journals**

[13] Q. CHEN, P. TORRONI, S. VILLATA. *Preface*, in "Fundamenta Informaticae", February 2018, vol. 158, n$^{\text{o}}$ 1-3, pp. 1-3 [*DOI :* 10.3233/FI-2018-1639], https://hal.archives-ouvertes.fr/hal-01876428

[14] M. DRAGONI, C. DA COSTA PEREIRA, A. G. B. TETTAMANZI, S. VILLATA. *Combining Argumentation and Aspect-Based Opinion Mining: The SMACk System*, in "AI Communications", February 2018, vol. 31, n$^{\text{o}}$ 1, pp. 75 - 95 [*DOI :* 10.3233/AIC-180752], https://hal.inria.fr/hal-01721538

[15] F. GANDON. *A Survey of the First 20 Years of Research on Semantic Web and Linked Data*, in "Revue des Sciences et Technologies de l'Information - Série ISI : Ingénierie des Systèmes d'Information", December 2018 [*DOI :* 10.3166/ISI.23.3-4.11-56], https://hal.inria.fr/hal-01935898

[16] S. KIRRANE, S. VILLATA, M. D'AQUIN. *Privacy, security and policies: A review of problems and solutions with semantic web technologies*, in "Open Journal Of Semantic Web", January 2018, vol. 9, n$^{\text{o}}$ 2, pp. 153 - 161 [*DOI :* 10.3233/SW-180289], https://hal.archives-ouvertes.fr/hal-01876423

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[19] F. MICHEL, C. FARON ZUCKER, O. GARGOMINY, F. GANDON. *Integration of Web APIs and Linked Data Using SPARQL Micro-Services - Application to Biodiversity Use Cases*, in "Information", December 2018, vol. 9, n$^{\text{o}}$ 12 [*DOI :* 10.3390/INFO9120310], https://hal.archives-ouvertes.fr/hal-01947589

[20] F. MICHEL, C. FARON ZUCKER, J. MONTAGNAT. *Bridging the Semantic Web and NoSQL Worlds: Generic SPARQL Query Translation and Application to MongoDB*, in "Transactions on Large-Scale Data- and Knowledge-Centered Systems", 2018, https://hal.archives-ouvertes.fr/hal-01926379

[21] A. TCHECHMEDJIEV, A. ABDAOUI, V. EMONET, S. ZEVIO, C. JONQUET. *SIFR annotator: ontology-based semantic annotation of French biomedical text and clinical notes*, in "BMC Bioinformatics", November 2018, vol. 19, pp. 405-431 [*DOI :* 10.1186/s12859-018-2429-2], https://hal.archives-ouvertes.fr/hal-01927130

**International Conferences with Proceedings**

[22] M. BUFFA, J. LEBRUN. *Guitarists will be happy: guitar tube amp simulators and FX pedals in a virtual pedal board, and more!*, in "Web Audio Conf 2018", Berlin, Germany, September 2018, https://hal.univ-cotedazur.fr/hal-01893681

[23] M. BUFFA, J. LEBRUN. *Real-Time Emulation of a Marshall JCM 800 Guitar Tube Amplifier, Audio FX Pedals, in a Virtual Pedal Board*, in "WWW2018 - TheWebConf 2018 : The Web Conference, 27th International World Wide Web Conference", Lyon, France, April 2018 [*DOI :* 10.1145/3184558.3186973], https://hal. univ-cotedazur.fr/hal-01721463

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[27] J. CHEN, F. LECUE, J. PAN, I. HORROCKS, H. CHEN. *Knowledge-based Transfer Learning Explanation*, in "Principles of Knowledge Representation and Reasoning: Proceedings of the Sixteenth International Conference", Tempe, United States, October 2018, https://hal.inria.fr/hal-01934907

[28] M. CORAZZA, S. MENINI, P. ARSLAN, R. SPRUGNOLI, E. CABRIO, S. TONELLI, S. VILLATA. *Comparing Different Supervised Approaches to Hate Speech Detection*, in "EVALITA 2018", Turin, Italy, December 2018, https://hal.archives-ouvertes.fr/hal-01920266

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[31] M. T. DHOUIB, C. FARON ZUCKER, A. TETTAMANZI. *Categorization of B2B Service Offers: Lessons learnt from the Silex Use case*, in "4ème conférence sur les Applications Pratiques de l'Intelligence Artificielle APIA2018", Nancy, France, July 2018, https://hal.archives-ouvertes.fr/hal-01830905

[32] A.-M. DÉRY-PINNA, A. GIBOIN, L. SOPHIE, P. RENEVIER. *A new approach for spatio-temporal data mining*, in "IHM 2018 - 30eme conférence francophone sur l'Interaction Homme-Machine", Brest, France, TeC-Travaux en Cours, AFIHM, October 2018, pp. 1-8, https://hal.archives-ouvertes.fr/hal-01899181

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