IN PARTNERSHIP WITH:
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Activity Report 2015

Project-Team DREAM

Diagnosing, Recommending Actions and Modelling

IN COLLABORATION WITH: Institut de recherche en informatique et systèmes aléatoires (IRISA)

RESEARCH CENTER
Rennes - Bretagne-Atlantique

THEME
Data and Knowledge Representation and Processing

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Creation of the Project-Team: 2004 October 04, end of the Project-Team: 2015 December 31

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2. Overall Objectives

2.1. Introduction

The objective of the Dream projet-team is to design smart surveillance and decision-support systems, using knowledge acquisition from massive and heterogeneous data. The team has a special interest on spatial and/or temporal data.

To achieve this ambitious objective, the Dream project-team concentrates its efforts on the following sub-problems:

- Facilitating queries in massive and heterogeneous data
- Mining complex patterns in massive data
- Developping novel decision-support systems that integrate the user in the analysis loop

This research is conduced in collaboration with our academic and industrial partners. Many decision-support work are motivated by environmental applications, which provide real use cases and collaboration with domain experts to validate the interest of the proposed methods.

3. Research Program

3.1. Introduction

The research agenda of the Dream project-team revolves around the following 4 main topics:

- Simulator-based decision support systems
- Incremental learning
- Mining complex patterns
- Answer Set Programming

3.2. Simulator-based decision support systems

A common way to investigate and understand complex phenomena, such as those related to ecosystems, consists in designing a computational model and implementing a simulator to test the system behavior under various parameters. Analyzing the ouput data of such simulators enables a fine grained understanding of the system studied, however huge quantities of data are produced. To be able to exploit these simulators in decision support scenarios, it is thus critical to provide methods to simplify the interactions with the simulator and handle the large quantity of data produced.

- One approach is to store all the simulation data in a datawarehouse and provide scientists and experts with tools to analyze efficiently the simulation data. Providing users with means to dig through large amount of multidimensional data, from more or less abstract viewpoints, and express preferences on the returned results is an important research topic in databases and data mining. To this end, *Skyline queries* constitute a relevant approach as they retrieve the most interesting objects with respect to multi-dimensional criteria with the possibility of making compromises on conflicting dimensions. The challenge is to define and implement skyline queries in a datawarehouse context. In this field, we are investigating efficient interactive tools for answering dynamic [51] and hierarchical [52] skyline queries.
- Another approach is to simplify the simulation model. For some applications, the system is too complex for a traditional numerical simulation to give relevant results in a short amount of time. It is especially the case when data and knowledge are not available to supply numerical models. Qualitative models offer a good alternative to model complex systems in this context. This abstracted representation offers an efficient computation on model exploration and gives relevant results when querying the system behavior. In the Dream project-team we are focusing on qualitative models of dynamical systems described as Discrete Event Systems (DES). Recent studies have emphasized the great interest of coupling model-checking techniques with qualitative models. We propose to use the timed automata formalism that allow the explicit representation of time [45]. In this context, the research issues we investigate are the following.
  - The size of a global model constructed from an abstracted description of the system and domain knowledge is potentially huge. A challenging problem is to reduce the size of this model using artificial intelligence tools [54].
  - It is necessary to propose a high-level language to explore and predict future changes of the system. Using this language, a stakeholder should express easily any requirements he wants to ask on the system behavior. We investigate the formalization of query patterns relying on recent temporal logics that can be exploited using model-checking techniques [68].
  - Simulators are good at providing ouput data for a fixed time period. Another challenge is to determine if some state can be reached (reachability problem) and keep on simulate until reaching this state. A further challenge is computating the optimal strategy for a reachability problem (*"what is the best sequence of actions to reach a specific state at a specific time ?"*). In this case we propose to use extended timed automata, such as timed game automata or priced time automata, with controller synthesis methods [46].
- When modelling becomes increasingly complex because of ever-increasing numbers of combined processes, making model-based decision aids are essential. Our approach uses symbolic learning techniques on simulated data to synthetise complex processses and help in decision making. Thus, rule induction has attracted a great deal of attention in Machine Learning and Data Mining. However, generating rules is not an end in itself because their applicability is not straightforward, especially when their number is high.

  Our goal is to lighten the burden of analyzing a large set of classification rules when the user is confronted to an "unsatisfactory situation" where his expectations or hypotheses are not met. In this case, he needs help to decide about the appropriate action to remedy to this situation. The method

consists in comparing the situation to a set of classification rules. For this purpose, we have proposed a framework for learning action recommendations dealing with complex notions of feasibility and quality of actions [80].

3.3. Incremental learning

The first learning algorithms were batch learning. They examine all examples and produce a concept description, that is generally not further modified. This is not adapted to dynamic settings where data are delivered continuously. For such settings, incremental algorithms have been proposed. These algorithms examine the training example one at a time (or set by set), maintaining a "best-so-far" description which may be modified each time a new example (or set of examples) arrives. In order to strengthen the learning process, some specific old examples are often kept: this is called partial memory systems. A more specific classification of incremental learning can be found in [74].

Current issues in incremental learning are

- for partial instance memory: how to select examples, [72]
- the problem of *hidden*: the target concept may depend on unknown variables, which are not given as explicit attributes [84]
- the problem of *concept drift*: the target changes with time [83], [57]
- the problem of *masked example*: the data distribution may change and some examples may not be anymore visible.

In many application domains, model inference and further modifications have to be validated by an expert. Thus, the model should be a *glass box* and its representation language should be easily understandable by a human expert. This is why we investigate rule-based formalisms for incremental learning [57].

3.4. Mining complex patterns

Pattern mining, a subdomain of data mining, is an unsupervised learning method which aims at discovering interesting knowledge from data. Association rule extraction is one of the most popular approach and has received a lot of interest in the last 20 years. For instance, many enhancements have been proposed to the well-known Apriori algorithm [43]. It is based on a level-wise generation of candidate patterns and on efficient candidate pruning having a sufficient relevance, usually related to the frequency of the candidate pattern in the data-set (i.e., the support): the most frequent patterns should be the most interesting. Later, Agrawal and Srikant proposed a framework for "mining sequential patterns" [44], which extends Apriori by coping with the order of elements in patterns. Such approach initiated research on *temporal pattern mining*, which is of particular interest for the DREAM team. The simplest temporal patterns are sequential patterns that constraints the order of the events in one of its occurrences. More advanced approaches also exploit quantitative information in order to provide significant patterns about both ordering and duration of events as well as inter-event delay. A challenge is that the classical anti-monotony property, used to prune the search space, is difficult to define in this case.

Much work in pattern mining have attempted to improve the runtime efficiency of algorithms, on the one hand, by proposing more efficient representation and execution schemes such as pattern-growth methods [62], or, on the other hand, by focusing on condensed representations such as closed patterns [78], [82]. Other research directions have been investigated to enhance the syntax of patterns e.g. temporal and periodic patterns, mutidimensional and hierarchical patterns, constrained patterns, contextual patterns, etc. Despite these improvements, the size of the results may still be too high. Post-mining or visualization methods are currently inverstigated in the community to let the user focus on results that correspond to his own preferences.

Another challenge of pattern mining is that for each pattern mining task (such as mining itemsets, sequences or graphs) there are many specialized algorithms, each exploiting some ad-hoc optimizations. It is very hard for a practitioner to find an algorithm suited for his problem, and such an algorithm may not exist. There is a need to propose novel *generic* pattern mining algorithms, that exploit the main algorithmic advances proposed in the last 20 years, and that only require a description of their pattern mining problem from practioners. Recently, we have proposed ParaMiner [77], a generic pattern mining algorithm using state of the art optimizations and exploiting the parallelism of multicore processors. The practitioner only has to enter a pattern interest criteria and check that it verifies a *strong accessibility* property coming from set theory. As of now, ParaMiner is the fastest generic pattern mining algorithm, being competitive with specialized algorithm on several pattern mining tasks.

Other approaches propose a completely declarative way to specify the pattern mining problem. In this case, the most used framework is Constraint Programming [61]. We are investigating another approach based on *Answer Set Programming*.

3.5. Answer Set Programing (ASP)

The DREAM team is investigating declarative approaches to solve complex problems such as causal reasoning, landscape simultation and pattern mining. One such approach is ASP.

ASP (Answer set programming) [60], [47] is a programming paradigm enabling declarative problem solving. It combines a rich yet simple modelling language with high-performance solving capacities, tailored to Knowledge Representation and Reasoning. "Declarative problem solving" means that the program is close to the way a problem is enunciated, and not to the way the problem is solved. This facilitates writing and revising programs. ASP is an outgrowth of research on the use of non monotonic reasoning in knowledge representation. ASP programs [67] consist in rules that look like Prolog rules, but the computational mechanism is different [69].

ASP allows to solve search problems in NP (and theoretically in NP^{NP}) in a uniform way (being more compact than boolean approaches like SAT solvers). ASP is good when dealing with knowledge representation, particularly when logical rules or graphs are involved. The versatility of ASP is reflected by the ASP solver clasp, winning first places at ASP, SAT and other competitions.

The main interests of using ASP are: 1) the ease to write and to update programs, and 2) the efficiency of the ASP solvers (improved in the recent versions).

Our main challenge is to propose ASP modeling that scales up to solving real problems. We are especially working on the modeling of sequential pattern mining with ASP in order to mine real datasets in a flexible and efficient way.

Our second challenge is to model a wide range of expert knowledge to include reasoning into the solving processes, in order to output more meaningful results.

4. Application Domains

4.1. Introduction

The Dream project-team research applications have been oriented towards surveillance, monitoring and decision support. Our domains of application are:

- Agriculture and environment
- Health
- Exploitation of execution traces in an industrial setting

4.2. Environmental decision making

Keywords: environment, decision methods

The need for decision support systems in the environmental domain is now well-recognized. It is especially true in the domain of water quality. The challenge is to preserve the water quality from pollutants as nitrates and herbicides, when these pollutants are massively used by farmers to weed their agricultural plots and improve the quality and increase the quantity of their crops. The difficulty is then to find solutions which satisfy contradictory interests and to get a better knowledge on pollutant transfer.

In this context, we are cooperating with INRA (Institut National de Recherche Agronomique) and developing decision support systems to help regional managers in preserving the river water quality. This work began in ANR projects like APPEAU and ACASSYA or the PSDR GO CLIMASTER project (Changement climatique, systèmes agricoles, ressources naturelles et développement territorial).

The approach we advocate is to rely on a qualitative modeling, in order to model biophysical processes in an explicative and understandable way. The SACADEAU model associates a qualitative biophysical model, able to simulate the biophysical process, and a management model, able to simulate farmers' decisions. One of our main contributions is the use of qualitative spatial modeling, based on runoff trees, to simulate the pollutant transfer through agricultural catchments.

The second issue is the use of learning/data mining techniques to discover, from model simulation results, the discriminant variables and automatically acquire rules relating these variables. One of the main challenges is that we face spatiotemporal data. The learned rules are then analyzed automatically in order to recommend actions to improve a current "unsatisfactory" situation.

Our main partners are the SAS INRA research group, located in Rennes and the BIA INRA and AGIR INRA research groups in Toulouse.

Ecosystem Management

The objective of ecosystem management is to ensure sustainable ecosystems even when submitted to various stressors such as natural disturbances or human pressures. Several studies have already demonstrated the interest of qualitative modelling for ecosystems [56]. In our case, we propose to couple a qualitative modelling with model-checking tools to explore marine ecosystems (as explained section 3.2). We applied our approach on a small-scale subsistence fishery in a coral reef lagoon (Uvea, New Caledonia). A well described foodweb model provides us with useful input data for steady-state biomass data and estimates of production and consumption. A timed automata model was developed using EcoMata to investigate the direct and indirect effects of various fishing strategies on a subset of the trophic network.

This work has been realized in collaboration with ecologists: Yves-Marie Bozec (today in position in Marine Spatial Ecology, University of Queensland, Australia) and Guy Fontenelle (Professeur at Agrocampus Ouest).

A second application has been studied in the dairy management area. Over an hydrid modelling on the grazing activities, four methods to generate the best grazing management activity has been proposed. The expert partners are researchers from the SAS INRA research group, located in Rennes.

4.3. Health

Keywords: health-care, patient monitoring, medicament usage, pharmaco-immunology, health-care pathways, wireless sensors

Clinical monitoring, electronic patient records and computer supported disease management produce more and larger volumes of clinical data. This data is a strategic resource for healthcare institutions. Data mining brings the facility to discover patterns and correlation hidden within the data repository and assists professionals to uncover these patterns and to exploit them to improve medical care.

We are working on two aspects of health-care:

- exploitation of data from the french care insurance (Assurance Maladie) that contains records of drug reimbursements for pharmaco-immunology purposes. Our goal is to reconstruct and mine patients' healthcare pathways in order to detect regularities and anomalies in the way patients take medicaments and alert medical authorities in case some problems are detected, such as non

expected negative consequences of medicament intake. We are working in the framework of a project funded by the National Medicament Security Agency (ANSM - Agence Nationale de la Sécurité du Médicament) for building a platfom enabling focused studies on specific medicaments as well as discovering potential problems with medicament usage. This means selecting from billions of patients records, patients sharing similar medical contexts and showing different consequences of medicament intake,

- veterinary monitoring of feedlot cattle in big farms from sensors recording behavioral and physiological data. As farms are becoming bigger and bigger, detecting ill animals by visual appraisal is becoming more and more difficult. With the advent of cheap wireless sensors, animals (i.e. cows or steers) may be monitored in quasi real time for detecting relevant changes in their behavior that could be related to specific diseases. We are exploring diverse methods for detecting changes on multivariate data, such as cusum charts, specific sequential patterns or distribution of frequent patterns. We are specifically working with veterinaries from the university of Calgary (Canada) for monitoring feedlot cattle in farms growing up to 50.000 animals.

4.4. Exploitation of execution traces

Keywords: log analysis, data mining, embedded systems

We have an ongoing collaborations with STMicroelectronics, which is one of the world top-5 electronic chip makers. Nowadays, set-top boxes, smartphones or onboard car computers are powered by highly integrated chips called System-on-Chip (SoC). Such chips contain on a single die processing units, memories, IO units and specialized accelerators (such as audio and video encoding/decoding). Programming SoC is a hard task due to their inherent parallelism, leading to subtle bugs when several components do not deliver their results within a given time frame. Existing debuggers and profilers are ill-adapted in this case because of their high intrusivity that modifies the timings. Hence the most used technique is to capture a trace of the execution and analyze it post-mortem. While Alexandre Termier was in Grenoble he initiated several works for analyzing such traces with data mining techniques [71], [65], which he is now pursuing with his colleagues of the Dream project-team [24].

5. Highlights of the Year

5.1. Highlights of the Year

The Dream project ended on the 31st of december 2015. A new EPI project, named Lacodam, is under way.

6. New Software and Platforms

6.1. Platforms

The Dream project-team, in collaboration with their applicative partners, has proposed and maintains several important software platforms for its main research topics.

6.1.1. Platform: Environmental decision-support systems

Participants: Marie-Odile Cordier, Christine Largouët, Véronique Masson.

6.1.1.1. SACADEAU

Système d'Acquisition des Connaissances pour l'Aide à la Décision sur la qualité de l'EAU
FUNCTIONAL DESCRIPTION

the Sacadeau system is an environmental decision software that implements the Sacadeau transfer model. The Sacadeau simulation model couples two qualitative models, a transfer model describing the pesticide transfer through the catchment and a management model describing the farmer decisions. Giving as inputs a climate file, a topological description of a catchment, and a cadastral repartition of the plots, the Sacadeau model simulates the application of herbicides by the farmers on the maize plots, and the transfer of these pollutants through the catchment until the river. The two main simulated processes are the runoff and the leaching. The output of the model simulation is the quantity of herbicides arriving daily to the stream and its concentration at the outlets. The originality of the model is the representation of water and pesticide runoffs with tree structures where leaves and roots are respectively up-streams and down-streams of the catchment.

- Contact: Véronique Masson
- URL: http://www.irisa.fr/dream/SACADEAU/

6.1.1.2. EcoMata

FUNCTIONAL DESCRIPTION

The EcoMata tool-box provides means for qualitative modeling and exploring ecosystems and for aiding to design environmental guidelines.We have proposed a new qualitative approach for ecosystem modeling based on timed automata (TA) formalism combined to a high-level query language for exploring scenarios.

- Participants: Marie-Odile Cordier, Yulong Zhao, Christine Largouët and Thomas Guyet
- Contact: Christine Largouët
- URL: https://team.inria.fr/dream/fr/ecomata/

6.1.1.3. PaturMata

KEYWORDS: Bioinformatics - Biology
SCIENTIFIC DESCRIPTION

In the PaturMata software, users can create a pasture system description by entering herds and plots information. For each herd, the only parameter is the number of animals. For each plot, users should enter the surface, the density, the herb height, the distance to the milking shed, a herb growth profile and an accessibility degree.

Users then specify pasturing and fertilization strategies. Finally, users can launch a pasture execution. PaturMata displays the results and a detailed trace of pasture. Users can launch a batch of different strategies and compare the results in order to find the best pasture strategy.

PaturMata is developed in Java (Swing for the GUI) and the model-checker that is called for the timed properties verification is UPPAAL .
FUNCTIONAL DESCRIPTION

The Paturmata tool-box provides means for qualitative modeling and exploring agrosystems, specifically management of herd based on pasture. The system is modelled using a hierarchical hybrid model described in timed automata formalism.

- Contact: Christine Largouët

6.1.2. Platform: Pattern Mining

Participants: Thomas Guyet, René Quiniou.

6.1.2.1. QTempIntMiner

Temporal pattern mining in sequences
SCIENTIFIC DESCRIPTION

The QTempIntMiner data mining software implements several algorithms (QTIAPRIORI and QTIPREFIXSPAN). The software is mainly implemented in Matlab. It uses the Mixmod toolbox to compute multi-dimensional Gaussian distributions. The main features of QTEMPINTMINER are:

- a tool for generating synthetic noisy sequences of temporal events,
- an implementation of the QTEMPINTMINER, QTIAPRIORI and QTIPREFIXSPAN algorithms,
- a graphical interface that enables the user to generate or import data set and to define the parameters of the algorithm and that displays the extracted temporal patterns.
- a sequence transformer to process long sequences of temporal events. Long sequences are transformed into a database of short temporal sequences that are used as input instances for the available algorithms.

The software includes one new algorithm based on the separation of the set of interval to extract more efficiently but less accurately the time interval in temporal patterns. This new algorithm version is still under evaluation on simulated and real datasets.

This year, an APP deposit of the early version (in Matlab) of this framework has been done. In parallel, we started the developement of a C++ version of the framework.

- Participants: Thomas Guyet and René Quiniou
- Partner: AGROCAMPUS
- Contact: Thomas Guyet
- URL: http://www.irisa.fr/dream/QTempIntMiner/

6.1.3. Platform: Diagnostic and Monitoring Systems

Participants: Marie-Odile Cordier, René Quiniou, Sophie Robin, Laurence Rozé.

6.1.3.1. ManageYourself

FUNCTIONAL DESCRIPTION

The ManageYourself software comes from a collaborative project between Dream and the Telelogos company aiming at monitoring smartphones from a stream of observations made on the smartphone state.

Today's smartphones are able to perform calls, as well as to realize much more complex activities. They are small computers. But as in computers, the set of applications embedded on the smartphone can lead to problems. The aim of the project ManageYourself is to monitor smartphones in order to avoid problems or to detect problems and to repair them. To this end, a model of the martphone system is learned and updated incrementally.

- Contact: Laurence Rozé

6.1.3.2. Odisseptale

KEYWORDS: Biology - Health
FUNCTIONAL DESCRIPTION

The Odisseptale software implements disease detectors using monitoring of data provided by sensors placed on calves or cows. Sensors record streams of data such as body temperature, physical activity, feeding behavior, etc. These data are transmitted regularly to a monitoring software that aims to detect if a noticeable change has occurred on the data streams. Several detectors can be simultaneously active and each contribute to the final decision (detection of a disease). Two kinds of detectors have been implemented: a generic detector based on adaptive CUSUM and a symbolic pattern-based detector. Odisseptale provides also facilities for parameter setting and performance evaluation.

- Contact: René Quiniou

6.2. TraceSquiz

FUNCTIONAL DESCRIPTION

TraceSquiz is a software developped in collaboration with STMicroelectronics. Its goal is to reduce the volume of execution trace captured during endurance tests of multimedia applications. It uses anomaly detection techniques to "learn" regular parts of the trace and only capture the irregular ones. The software is written in C++.

- Participants: Alexandre Termier, Serge Vladimir Emteu Tchagou, René Quiniou
- Contact: Serge Vladimir Emteu Tchagou

7. New Results

7.1. Simulator-based decision support

Participants: Philippe Besnard, Marie-Odile Cordier, Anne-Isabelle Graux, Christine Largouët, Véronique Masson, Laurence Rozé.

7.1.1. Ecosystem model-checking for decision-aid

Former studies of ecosystem modelling have concentrated on temporal modelling. In recent studies we have focussed on the formalization of spatial diffusion of a prey-predator trophic network composed of weeds and ground beetle. For this purpose, an approach coupling landscape representation and population models has been used. A reaction-diffusion model was developped through the synchronization ability of timed-automata. The agronomical rules of beetle migration and weeds diffusion have been translated into communications between timed automata. Landscapes have been simulated and can be evaluated thanks to landscape-metrics distance. The optimization aims to maximize the ground beetle abundance while minimizing the use of pesticides. The model obtained in this first study is quite complex but preliminary results are beeing studied.

7.1.2. Controler synthesis for optimal strategy search

Similarly to previous work, this approach relies on a qualitative model of a dynamical system. The problem consists in finding a strategy in order to help the user achieveing a specific goal. The model is now considered as a timed game automata expressing controllable and uncontrollable actions. The strategy represents the sequence of actions that can be performed by a user to reach a particular state (in case of a reachability problem for instance). A first approach based on a "generate and test" method has been developped for the marine ecosystem example [86].

Recently, we generalized the work of Yulong Zhao applied in the context of a dairy production system [87] to the planning domain. The planning task consists in selecting and organizing actions in order to reach a goal state in a limited time and in an optimal manner, assuming actions have a cost. We propose to reformulate the planning problem in terms of model-checking and controller synthesis on interacting agents such that the state to reach is expressed using temporal logic. We have chosen to represent each agent using the formalism of Priced Timed Game Automata (PTGA). PTGA is an extension of Timed Automata that allows the representation of cost on actions and uncontrollable actions. Relying on this domain description, we define a planning algorithm that computes the best strategy to achieve the goal. This algorithm is based on recognized model-checking and synthesis tools from the UPPAAL suite. The expressivity of this approach is evaluated on the classical *Transport Domain* which is extended in order to include timing constraints, cost values and uncontrollable actions. This work has been implemented and performances evaluated on benchmarks.

7.1.3. A datawarehouse for simulation data

In previous work we have proposed a datawarehouse architecture to store the huge data produced by deep agricultural simulation models [50]. This year, we have worked on hierarchical skyline queries to introduce skyline queries in a datawarehouse framework. Conventional skyline queries retrieve the skyline points in a context of dimensions with a single hierarchical level. However, in some applications with multidimensional and hierarchical data structure (e.g. data warehouses), skyline points may be associated with dimensions having multiple hierarchical levels. Thus, we have proposed an efficient approach reproducing the effect of the OLAP operators "drill-down" and "roll-up" on the computation of skyline queries [52]. It provides the user with navigation operators along the dimensions hierarchies (i.e. specialize / generalize) while ensuring an online calculation of the associated skyline.

Anne-Isabelle Graux, on leave from INRA (National Institute for Agronomical Research), is working on an adaptation and extension of this method for storing the simulation results of a comprehensive farm model named MELODIE [53]. The new datawarehouse will enable the analysis of simulation results within dynamic preferences, related to grassland management for instance, for identifying the data satisfying the best compromises with respect to possibly inconsistent criteria.

7.1.4. Post-mining classification rules

We consider sets of classification rules with quantitative and qualitative attributes inferred by supervised machine learning, as in the framework of the Sacadeau project. Our aim is to improve the human understanding of such sets of rules. First, we consider quantitative attributes in rules that often contain too many intervals which are difficult to intepret. We propose two algorithms to merge some of these intervals in order to get more understandable rules. These algorithms take into account the final rule quality. We are also working on formalizing what could be the quality of a set of rules. There are lots of studies about the quality of one rule but very few about the quality of the whole set of rules and this is still an issue.

7.2. Data Mining

Participants: Marie-Odile Cordier, Yann Dauxais, Serge Vladimir Emteu Tchagou, Clément Gautrais, Thomas Guyet, Yves Moinard, Benjamin Negrevergne, René Quiniou, Laurence Rozé, Alexandre Termier.

7.2.1. Sequential pattern mining with intervals

In previous work, we developed a framework for sequential pattern mining with intervals [3]. It has been applied in various application (care-pathways, customer relationship management databases [35], etc.).

This year we explored chronicle mining algorithms for mining care-pathways (see section 9.1.1, for an applicative context). Chronicles are alternative patterns for representing temporal behaviors [58]. A chronicle can be briefly defined as a set of events linked by constraints indicating the minimum and maximum time elapsed between two events. A care-pathway contains point-based events (e.g. surgery) and interval-based events (e.g. drug exposures). A chronicle can express such a complex temporal behaviour, for instance: *The patient was exposed to a drug X between 1 and 2 years, he met his doctor between 400 to 600 days after the beginning of the exposure and, finally, he was hospitalized.*

The first algorithm we worked on [23] is an adaptation of existing chronicle mining algorithms [55], [63] to mine the complete set of frequent chronicles from a collection of care-pathways. This algorithm uses the search-space browsing strategy of HDCA [55] and the support evaluation of CCP-Miner [63]. As the complete set of chronicle is huge, we also proposed an incomplete algorithms based on the original simplifications of [58]. These algorithms were implemented and evaluated on real and simulated datasets.

We also investigated discriminant chronicles mining which consists in extracting the chronicles that are α times more frequent in a database $\mathcal{D}_+$ than in a database $\mathcal{D}_-$. Mining discriminant chronicles is very useful to discover the features of care-pathways that are related, for instance, to a specific disease. Our approch has been implemented and is under evaluation.

7.2.2. Multiscale segmentation of satellite image time series

Satellite images enable the acquisition of large-scale ground vegetation information. Images have been recorded for several years with a high acquisition frequency (one image every two weeks). Such data are called satellite image time series (SITS). Several articles were published this year and they correspond to past work on algorithms and method to analyse SITS.

In [11], we presented a method to segment an image through the characterization of the evolution of a vegetation index (NDVI) on two scales: annual and multi-year. The main issue of this approach was the required computation resources (time and memory).

We also explored the supervised classification of SITS using classification trees for time-series [27] by implementing a parallelized version of this algorithm. Next, we explored the adaptation of the object-oriented segmentation to SITS. The object-oriented segmentation is able to segment images based on segment uniformity. We proposed a measure for time-series uniformity and applied the adapted algorithm on large multivariate SITS of Senegal [10].

Third, we presented an supervised approach to extract features from classified satellite images to analyse urban sprawl [28]. In this work, we have satellite images at only two dates, and the objective is to identify characteristics that can foster or prevent changes.

Our satellite images analysis approaches are used in two applicative contexts: understanding urban sprawl and analyzing drought in Senegal. Analysis of urban sprawl was a collaborative work with collegues in remote sensing, in landscapes analysis and in economical modelling. Our collective contribution was published in a book of the PDD2 [1] program [38]. Analysis of drought in Senegal is a long term collaboration with H. Nicolas (INRA/SAS) that we would like to continue in a collaboration with A. Fall (Université of Dakar) to confront our results with ground observations.

7.2.3. Analysis and simulation of landscape based on spatial patterns

Researchers in agro-environment need a great variety of landscapes to test their scientific hypotheses using agro-ecological models. Real landscapes are difficult to acquire and do not enable the agronomists to test all their hypotheses. Working with simulated landscapes is then an alternative to get a sufficient variety of experimental data. Our objective is to develop an original scheme to generate landscapes that reproduce realistic interface properties between parcels. This approach consists of the extraction of spatial patterns from a real geographic area and the use of these patterns to generate new "realistic" landscapes. It is based on a spatial representation of landscapes by a graph expressing the spatial relationships between the agricultural parcels (as well as the roads, the rivers, the buildings, etc.), in a specific geographic area.

In past years, we worked on the exploration of graph mining techniques, such as gSPAN [85], to discover the relevant spatial patterns present in a spatial-graph. We assume that the set of the frequent graph patterns are the characterisation of the landscape. Our remaining challenge was to simulate new realistic landscapes that reproduce the same patterns.

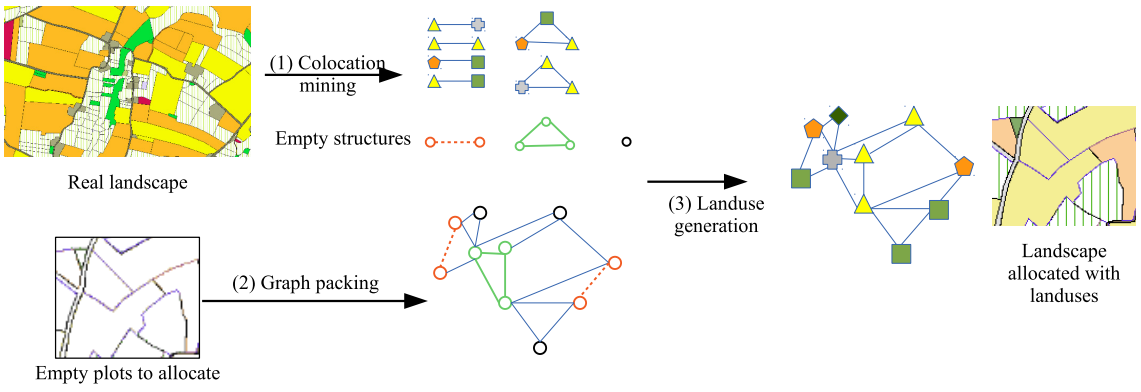

Figure 1. Simulation process in three steps: 1) characteristic graph-patterns mining, 2) graph packing of the cadastral landscape and 3) crop allocation.

[1] PDD2: Paysage Developpement Durable/Landscape Sustainable Developpent

We have formalized the simulation process as a graph packing problem [66]. The process is illustrated by Figure 1. Solving instances of the general graph packing problem has a high combinatorics and no efficient algorithm can solve it. We proposed an ASP program to tackle the combinatorics of the graph packing and to assign the land use considering some expert knowledge. Our approach combines the efficiency of ASP to solve the packing issue and the simplicity of the declarative programming to take into account expert contraints on the land use. Contraints about the minimum surface of crops or about the impossibility of some crops colocation can be easily defined. This work have been presented at the conference RFIA and an extended version has been published in the Revue d'Intelligence Artificielle (RIA) [13].

In addition, we are collaborating with J. Nicolas (EPI Dyliss) to improve the efficiency of our first programs. The improvements are based on symmetry breaking of ASP programs. To this end, we proposed a simplified encoding of the graph patterns using spanning trees and used automorphism detection in graph patterns to automatically encodes symmetry breakings. Intensive evaluation of our encoding shown that this improvement enable to tackle significantly larger graphs than early programs did. This work will be soon submitted to a high ranking conference.

7.2.4. Mining with ASP

In pattern mining, a pattern is considered interesting if it occurs frequently in the data, i.e. the number of its occurrences is greater than a fixed given threshold. As non informed mining methods tend to generate massive results, there is more and more interest in pattern mining algorithms able to mine data considering some expert knowledge. Though a generic pattern mining tool that could be tailored to the specific task of a data-scientist is still a holy grail for pattern mining software designers, some recent attempts have proposed generic pattern mining tools [61] for itemset mining tasks. In collaboration with Torsten Schaub, we explore the ability of a declarative language, such as Answer Set Programming (ASP), to solve pattern mining tasks efficiently. In 2011, Jarvisälo proposed a first attempt devoted to itemset mining [64]. In Dream, we are working on sequential pattern mining, which is known to be more challenging than itemset mining and which has been also recently considered by constraint programming approaches [76].

We have worked on encoding in ASP most of sequential pattern mining tasks: sequences with constraints (gaps, maximum length, etc.), closed/maximal patterns, emergent sequences. Our first result is to show that ASP is suitable for encoding such complex pattern mining tasks. The experimental results show that our purely declarative approach is less efficient than constraint programming approaches [36]. Nonetheless, it is suitable to be blend with intensive knowledge. The challenge is now to show that our ASP framework can extract the meaningful patterns that other approaches loose in the overwhelming amount of sequential patterns.

A first attempt has been done in this direction in collaboration with J. Romero from the University of Potsdam. We used the system ASPRIN to define preferences on patterns. Defining preferences on patterns is also a classical approach to select the most interesting patterns. Some classical preferences on sequential patterns have been defined and the ASPRIN system is used to extract the preferred patterns according to one preference or a combination of preferences (skypatterns [81])

This work will be soon submitted to a high ranking international conference.

7.2.5. Mining time series

Monitoring cattle. Following the lines of a previous work [79], we are working on a method for detecting Bovine Respiratory Diseases (BRD) from behavioral (walking, lying, feeding and drinking activity) and physiological (rumen temperature) data recorded on feedlot cattle being fattened up in big farms in Alberta (Canada). This year, we have especially worked on multivariate sensor data analysis, especially on the evaluation of different combinations of sensors for determining the best configuration and parameter setting. This work was part of Afra Verena Mang's master thesis defended in september 2015 [73]. Two papers are in preparation.

SIFT-based time-series symbolisation Time series classification is an application of particular interest with the increase of such data. Computing the distance between time-series is time consuming. An abstract representation of time-series that accurately approximates distances between time-series and makes easier

their comparison is highly expected. In [17], we proposed a time series classification scheme grounded on the SIFT framework [70] adapted to time series. The SIFTs feed a Bag-of-Words representation of time-series. We have shown that this framework efficiently and accurately classifies time series, despite the fact that BoW representation ignores temporal order.

Mining sequential patterns from multimedia data Analyzing multimedia data to extract knowledge is a challenging problem due to the quantity and complexity of such data. Finding recurrent patterns is one method to structure and segment the data. In a collaboration with the EPI LinkMedia, we have proposed audio data symbolization and sequential pattern mining methods to extract patterns from audio streams. Experiments show this the task is hard and that the symbolization is a critical step for extracting relevant audio patterns [29].

7.2.6. Mining customer data for predicting and explaining attrition

Predicting customer defection in a retail context is difficult because, in most situations, the customer does not leave the store totally (there is no contract break as with banks or phone operators). We have proposed a new pattern model for representing the evolution of an individual customer purchase behavior that enables to early detect and to explain customer attrition. In particular, this model enables the analyst to determine which important kinds of product receives less and less attention from the customer. Thus, this model provides actionable knowledge at an individual scale that lets the retailer trigger targeted marketing actions to counter attrition. A poster has been submitted to the EBDT conference. This work has been performed during Clément Gautrais's master [59] and will be further investigated and extended during his PhD.

7.2.7. Mining energy consumption data

Machine tools in companies consume a lot of energy (before, during and after producing worked pieces). This year, we are beginning to work, with the start-up Energiency, on mining machine tool energy consumption data in order to propose energy savings to the companies. Firstly, we try to determine, according to the analyzed company, which data-mining algorithm should be used and which is the best configuration and parameter setting. Then, we aim to extract actions rules from patterns to help companies to consume less energy.

7.2.8. Trace reduction

One problem of execution trace of applications on embedded systems is that they can grow very large, typically several Gigabytes for 5 minutes of audio/video playback. Some endurance tests require continuous playback for 96 hours, which would lead to hundreds of Gigabytes of traces, that current techniques cannot analyze. We have proposed TraceSquiz, an online approach to monitor the trace output during endurance test, in order to record only suspicious portions of the trace and discard regular ones. This approach is based on anomaly detection techniques. Our detailed experiments have shown that our approach has a good anomaly detection performance, and can reduce the size of an output trace by an order of magnitude [24]. Serge Emteu successfully defended his PhD about this work on the 15/12/2015 [5].

7.3. Causal reasoning and argumentation

Participants: Philippe Besnard, Louis Bonneau de Beaufort, Marie-Odile Cordier, Yves Moinard.

7.3.1. Searching for explanations from causal relations and ontology for argumentation

We have continued our work on reasoning (precisely search for explanations) from causal relations and ontology [48]. We resort to a well-known model [49] in computational argumentation in order to provide some structure to the collection of potential explanations given by our causal formalism. We have developed a case study, namely the Xynthia storm case, (February 2010, western France, trial September 2014) for which there exists a huge amount of data from various official reports. We have implemented an ASP program which thereby provides another application, besides those already mentioned: mining and landscape simulation, for ASP.

7.3.2. Cognitive maps and Bayesian causal maps

Cognitive map is a qualitative decision model which is frequently used in social science and decision making applications. This model allows to easily organize individuals' judgments, thinking or beliefs about a given problem in a graphical representation containing different concepts and influences between them. However, cognitive maps cannot model uncertainty within the variables and provides only deductive reasoning (predicting an effect given a cause). In [37], we show how to translate the knowledge represented in cognitive maps in the form of arguments and attack relations among them. Given a decision problem, we propose to build, first, a cognitive map by eliciting knowledge from experts and then to transform it into a weighted argumentation framework (WAF for short) for ensuring efficient reasoning. Another contribution concerns enriching the WAF obtained from a given cognitive map for dealing with dynamics through the consideration of a varying set of observations.

Cognitive maps and Bayesian networks are useful formalisms to address knowledge representation. Cognitive maps are powerful graphical models for gathering or displaying knowledge but while offering an easy means to express individuals judgments, drawing inferences remains a difficult task. Bayesian networks are widely used for decision making processes that face uncertain information or diagnosis but are difficult to elicitate. To take advantage of both formalisms and to overcome their drawbacks, Bayesian causal maps (BCM) were developed [75]. In [6], we propose to start from a causal map to construct the model and then set the conditional probabilities. Once the common causal map (CM) is built we can transform it into a BCM which combines causal modeling techniques and bayesian probability theory. We have developed a complete framework and applied it on a real problem in an environmental context. The implemented decision facilitating tool enables the representation of different shellfish dredgers views about their activity as well as the test of different fishery management scenarios.

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. SocTrace: analysis of SOC traces

Participants: Serge Vladimir Emteu Tchagou, Alexandre Termier.

SoCTrace is a FUI project led by STMicroelectronics, with the companies ProbaYes and Magilem, Université Joseph Fourier and Inria Rhône-Alpes. Its goal is to provide an integrated environment for storing and analyzing execution traces. In this project, we are working on data mining techniques for analyzing the traces, and on the use of ontologies to enable querying traces with a higher level of abstraction.

8.1.2. ITRAMI: Interactive Trace Mining

Participants: Alexandre Termier, Thomas Guyet, René Quiniou.

ITRAMI is a Nano2017 project. Such projects are designed to support joint research efforts between STMicrolectronics and academic partners in the domain of embedded systems. Alexandre Termier is the PI of this projet, having for goal to design novel data mining methods for interactive analysis of execution traces. Such methods aim at considerably reducing the time that STMicroelectronics developers spend at understanding, debugging and profiling applications running on STMicrolectronics chips. The project work is done at University Joseph Fourier (Grenoble), in collaboration with DREAM researchers Thomas Guyet and René Quiniou. Two contractual personnel are working on the project in Grenoble: Willy Ugarte as a postdoc, and Soumay Ben Alouane as an engineer.

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. PEPS: Pharmaco-epidemiology for Health Products

Participants: Thomas Guyet, René Quiniou, Véronique Masson, Alexandre Termier.

The PEPS project (Pharmaco-epidemiology des Produits de Santé) is funded by ANSM (national agency for health security). The project leader is E. Oger from the clinical investigation center CIC-1414 INSERM/CHU Rennes. The other partners located in Rennes are the Institute of Research and Technology (IRT) B<>Com, EHESP and the LTSI. The project started in january 2015 and is funded for 4 years (3.6M€).

The PEPS project has two parts: the clinical studies and a research program dedicated to the development of innovative tools for pharmaco-epidemiological studies with medico-administrative databases. The pharmaco-epidemiology is the study of the uses, the effectiveness and the effects of health products (especially drugs) for the patients in a real live context, on a large population. Using medico-administrative databases – that contains information about the reimbursement of the medication, the medical visits and the cares – is a recent approach to enable studies on large cohortes and to reduce the response time to a pharmaco-epidemiology question.

Our contribution to this project will be the proposal of pattern mining algorithms and reasoning techniques to analyze typical care pathways of specific groups of insured patients.

9.2. International Initiatives

9.2.1. Inria International Partners

9.2.1.1. Informal International Partners

9.2.1.1.1. University of Calgary: Monitoring cattle in big herds with multiple sensors
Participant: René Quiniou.

The state of Alberta produces a significant part of the beef meat in Canada. Big farms feeds up around 40.000 bull calves in feedlots grouping 200-300 animals. Diseases such as Bovine Respiratory Diseases (BRD) are frequent and may propagate quickly in such conditions. So, it is important to detect as soon as possible when an animal is sick. We are collaborating with the Department of Production Animal Health, University of Calgary for designing monitoring systems able to generate early alarms when an animal is sick. Precisely, we are studying the properties of new sensors and their aptitude to provide relevant data for BRD detectors.

9.2.1.1.2. University of Potsdam: preferences in mining with ASP
Participant: Thomas Guyet.

The research group "knowledge processing and information systems" of the University of Potsdam, so called Potascco group, develops a collection of tools and programs for Answer Set Programming such as the `clingo` solver or the ASPRIN system, developed by J. Romero to handle preferences on ASP models. They have strong expertise in problem encoding with ASP. In addition to T. Schaub Inria position, we initiate some collaborations with other members of the Potascco group in order to strengthen our relationships. T. Guyet and J. Romero worked together on using preferences to select best sequential patterns with ASP (see section 7.2.4) using the ASPRIN system. T. Guyet visited the Potascco group in may 2015.

10. Dissemination

10.1. Promoting Scientific Activities

10.1.1. Scientific events organisation

10.1.1.1. General chair, scientific chair

Local chairs of PFIA 2015 in Rennes (T. Guyet, R. Quiniou).

Organization chair (T. Guyet) and program committee members (T. Guyet, R. Quiniou) of GAST workshop at EGC 2015 and at EGC 2016.

10.1.1.2. Member of the organizing committees

Organizer of the workshop "Data mining in industry: case study in embedded systems" at the IRISA Data Science fair (A. Termier).

10.1.2. Scientific events selection

10.1.2.1. Member of the conference program committees

Program committee members of EGC 2015 and 2016 (R. Quiniou, A. Termier).

Program committee member of IJCAI 2015 and 2016 (T. Guyet).

Program committee member of KR 2016 (T. Guyet).

Program committee member of DSAA 2015 (A. Termier)

Program committee member of ICDM 2015 (A. Termier)

Program committee member of ECML/PKDD 2015 (A. Termier)

Program committee member of KDD 2016 (A. Termier)

10.1.3. Journal

10.1.3.1. Member of the editorial boards

Members of the editorial board of RIA (Revue d'Intelligence Artificielle) (T. Guyet).

10.1.3.2. Reviewer - Reviewing activities

Journal of Biomedical Informatics (T. Guyet).

ACM Computing Surveys (T. Guyet).

Data Mining and Knowledge Discovery (A. Termier)

The Very Large DataBases journal (A. Termier)

10.1.4. Invited talks

"Intelligence articielle et Fouille de données: questions ouvertes et perspectives pour les thématiques des JFPDA", JFPDA conference, july 2015: T. Guyet.

"Pattern mining with ASP", LIFO, Orléans, october 2015: T. Guyet

"Intelligence articielle et Fouille de données", I-Cube, Strasbourg, november 2015: T. Guyet

"Pattern mining for execution traces: a report", GREY, Caen, February 2015: A. Termier

10.1.5. Leadership within the scientific community

Representative of Inria for the "e-Agriculture" program, which goal is to organize further governmental actions to develop numerical agriculture: A. Termier

Co-representative of Inria, with E. Prados, in the Transition^2 action undertaken with the FING: A. Termier

Member of the AFIA board, treasurer (since october 2011): T. Guyet.

10.1.6. Scientific expertise

Evaluation of a project proposal for the University of Padova: A. Termier

Evaluation of a CIFRE PhD proposal for the ANRT: A. Termier

Evaluation of a project proposal for the ANR: R. Quiniou

10.1.7. Research administration

Member of INRA CEI (Engineers Evaluation Committee): T. Guyet.

10.2. Teaching - Supervision - Juries

10.2.1. Teaching

Many members of the EPI Dream are also faculty members and are actively involved in computer science teaching programs in ISTIC, INSA and Agrocampus-Ouest. Besides these usual teachings Dream is involved in the following programs:

Master: Module DSS: Apprentissage sur des données séquentielles symboliques, 10 h, M2, Istic University of Rennes 1 (R. Quiniou).

Master: C++ Programming, M1, ENSAI , Rennes (T. Guyet),

Master: Géoinformation, M2, Agrocampus Ouest Rennes (L. Bonneau, T. Guyet, C. Largouët)

10.2.2. Supervision

PhD: Serge Vladimir Emteu Tchagou, "Stream mining techniques for online monitoring of MP-SoC applications", december 15th 2015, co-supervisors Alexandre Termier, René Quiniou, Miguel Santana and Jean-François Méhaut

PhD in progress: Clément Gautrais, "Mining massive data from client purchases", october 1st 2015, Alexandre Termier, Peggy Cellier, Thomas Guyet and René Quiniou

PhD in progress: Yann Dauxais, "Query-language for care-pathway mining and analysis", february 1st 2015, David Gross-Amblard, Thomas Guyet, André Happe

10.2.3. Juries

Committee member of Serge Vladimir Emteu Tchagou Phd defense (Université de Grenoble Alpes): R. Quiniou, A. Termier.

Committee member of Ying Xiao Phd defense (Université de Lorraine): C. Largouët

Thesis advisory committee member of Benoit Bellot (INRA/IGEPP): T. Guyet.

Comittee member of Haykel Boukadida Phd defense (Université de Rennes 1): A. Termier

Comittee member of Elisa Fromont HDR defense (Université Jean Monet, St Etienne): A. Termier

10.3. Popularization

M.-O. Cordier is editorial board member of Interstices webzine.

11. Bibliography

Major publications by the team in recent years

[1] P. BESNARD, M.-O. CORDIER, Y. MOINARD. *Ontology-based inference for causal explanation*, in "Integrated Computer-Aided Engineering", 2008, vol. 15, n^{o} 4, pp. 351-367, http://hal.inria.fr/inria-00476906/en/

[2] C. GASCUEL-ODOUX, P. AUROUSSEAU, M.-O. CORDIER, P. DURAND, F. GARCIA, V. MASSON, J. SALMON-MONVIOLA, F. TORTRAT, R. TRÉPOS. *A decision-oriented model to evaluate the effect of land use and agricultural management on herbicide contamination in stream water*, in "Environmental modelling & software", 2009, vol. 24, pp. 1433-1446

[3] T. GUYET, R. QUINIOU. *Extracting temporal patterns from interval-based sequences*, in "International Joint Conference on Artificial Intelligence (IJCAI)", Barcelone, Spain, July 2011, http://hal.inria.fr/inria-00618444

[4] Y. PENCOLÉ, M.-O. CORDIER. *A formal framework for the decentralised diagnosis of large scale discrete event systems and its application to telecommunication networks*, in "Artificial Intelligence Journal", 2005, vol. 164, n^{o} 1-2, pp. 121-170, http://hal.inria.fr/inria-00511104/en/

Publications of the year

Doctoral Dissertations and Habilitation Theses

[5] S. V. EMTEU TCHAGOU. *On-the-fly trace reduction for analyzing multimedia embedded systems applications*, Université de Grenoble Alpes, December 2015, https://hal.inria.fr/tel-01247429

Articles in International Peer-Reviewed Journals

[6] L. BONNEAU DE BEAUFORT, K. SEDKI, G. FONTENELLE. *Inference reasoning on fishers' knowledge using Bayesian causal maps*, in "Ecological Informatics", 2015 [*DOI :* 10.1016/J.ECOINF.2015.09.006], https://hal.archives-ouvertes.fr/hal-01231072

[7] P. DUSSEUX, Y. ZHAO, M.-O. CORDIER, T. CORPETTI, L. DELABY, C. GASCUEL, L. HUBERT-MOY. *PaturMata, a model to manage grassland under climate change*, in "Agronomy for Sustainable Development", December 2015, vol. 35, n° 3, pp. 1087-1093, https://hal.archives-ouvertes.fr/hal-01237980

[8] P. DUSSEUX, Y. ZHAO, M.-O. CORDIER, T. CORPETTI, L. DELABY, C. GASCUEL-ODOUX, L. HUBERT-MOY. *PaturMata, a model to manage grassland under climate change, Agronomy for Sustainable Development*, in "Agronomy for Sustainable Development", March 2015, pp. 10.1007/s13593-015-0295-0 [*DOI :* 10.1007/s13593-015-0295-0], https://hal.archives-ouvertes.fr/hal-01152055

[9] M. GEBSER, A. HARRISON, R. KAMINSKI, V. LIFSCHITZ, T. SCHAUB. *Abstract Gringo*, in "Theory and Practice of Logic Programming", 2015, vol. 15, n° 4-5, pp. 449-463, https://hal.inria.fr/hal-01186999

[10] T. GUYET, S. MALINOWSKI, M.-C. BENYOUNÈS. *Extraction des zones cohérentes par l'analyse spatio-temporelle d'images de télédétection*, in "International Journal of Geomatics and Spatial Analysis / Revue Internationale de Géomatique", 2015, 22 p. , https://hal.inria.fr/hal-01184095

[11] T. GUYET, H. NICOLAS. *Long term analysis of time series of satellite images*, in "Pattern Recognition Letters", November 2015 [*DOI :* 10.1016/J.PATREC.2015.11.005], https://hal.inria.fr/hal-01239504

[12] S. VIDELA, I. KONOKOTINA, L. ALEXOPOULOS, J. SAEZ-RODRIGUEZ, T. SCHAUB, A. SIEGEL, C. GUZIOLOWSKI. *Designing experiments to discriminate families of logic models*, in "Frontiers in Bioengineering and Biotechnology", September 2015, 9 p. [*DOI :* 10.3389/FBIOE.2015.00131], https://hal.inria.fr/hal-01196178

Articles in National Peer-Reviewed Journals

[13] T. GUYET, Y. MOINARD, R. QUINIOU. *Programmation par ensembles réponses pour simuler l'assolement d'un paysage*, in "Revue des Sciences et Technologies de l'Information - Série RIA : Revue d'Intelligence Artificielle", 2015, vol. 29, n° 3-4, 28 p. , https://hal.inria.fr/hal-01184092

International Conferences with Proceedings

[14] M. ABSEHER, M. GEBSER, N. MUSLIU, T. SCHAUB, S. WOLTRAN. *Shift-design with Answer Set Programming*, in "Proceedings of the Thirteenth International Conference on Logic Programming and Nonmonotonic Reasoning (LPNMR'15)", Lexington, United States, F. CALIMERI, G. IANNI, M. TRUSZCZYŃSKI (editors), lnai, Springer, 2015, vol. 9345, 7 p. , forthcoming, https://hal.inria.fr/hal-01186995

[15] B. ANDRES, A. BIEWER, J. ROMERO, C. HAUBELT, T. SCHAUB. *Improving Coordinated SMT-based System Synthesis by Utilizing Domain-specific Heuristics*, in "Proceedings of the Thirteenth International Conference on Logic Programming and Nonmonotonic Reasoning (LPNMR'15)", Lexington, United States, F. CALIMERI, G. IANNI, M. TRUSZCZYŃSKI (editors), lnai, Springer, 2015, vol. 9345, forthcoming, https://hal.inria.fr/hal-01187002

[16] B. ANDRES, D. RAJARATNAM, O. SABUNCU, T. SCHAUB. *Integrating ASP into ROS for Reasoning in Robots*, in "Proceedings of the Thirteenth International Conference on Logic Programming and Nonmonotonic Reasoning (LPNMR'15)", Lexington, US, F. CALIMERI, G. IANNI, M. TRUSZCZYŃSKI (editors), 2015, 25 p. , forthcoming, https://hal.inria.fr/hal-01187006

[17] A. BAILLY, S. MALINOWSKI, R. TAVENARD, T. GUYET, L. CHAPEL. *Bag-of-Temporal-SIFT-Words for Time Series Classification*, in "ECML/PKDD Workshop on Advanced Analytics and Learning on Temporal Data", Porto, Portugal, September 2015, https://halshs.archives-ouvertes.fr/halshs-01184900

[18] M. BANBARA, M. GEBSER, K. INOUE, M. OSTROWSKI, A. PEANO, T. SCHAUB, T. SOH, N. TAMURA, M. WEISE. *aspartame: Solving Constraint Satisfaction Problems with Answer Set Programming*, in "Proceedings of the Thirteenth International Conference on Logic Programming and Nonmonotonic Reasoning (LPNMR'15)", Lexington, United States, F. CALIMERI, G. IANNI, M. TRUSZCZYŃSKI (editors), lnai, Springer, September 2015, vol. 9345, pp. 112-126 [*DOI :* 10.1007/978-3-319-23264-5_10], https://hal.inria.fr/hal-01186996

[19] A. BIEWER, B. ANDRES, J. GLADIGAU, T. SCHAUB, C. HAUBELT. *A symbolic system synthesis approach for hard real-time systems based on coordinated SMT-solving*, in "Proceedings of the Conference on Design, Automation and Test in Europe (DATE'15)", San Jose, United States, W. NEBEL, D. ATIENZA (editors), ACM, 2015, pp. 357-362, https://hal.inria.fr/hal-01187000

[20] J. BOMANSON, M. GEBSER, T. JANHUNEN, B. KAUFMANN, T. SCHAUB. *Answer Set Programming modulo Acyclicity*, in "Proceedings of the Thirteenth International Conference on Logic Programming and Nonmonotonic Reasoning (LPNMR'15)", Lexington, United States, F. CALIMERI, G. IANNI, M. TRUSZCZYŃSKI (editors), Springer, September 2015, vol. 9345, pp. 143-150 [*DOI :* 10.1007/978-3-319-23264-5_13], https://hal.inria.fr/hal-01187003

[21] G. BREWKA, J. P. DELGRANDE, J. ROMERO, T. SCHAUB. *Implementing preferences with asprin*, in "Proceedings of the Thirteenth International Conference on Logic Programming and Nonmonotonic Reasoning (LPNMR'15)", Lexington, United States, F. CALIMERI, G. IANNI, M. TRUSZCZYŃSKI (editors), lnai, Springer, 2015, vol. 9345, forthcoming, https://hal.inria.fr/hal-01187004

[22] G. BREWKA, J. P. DELGRANDE, J. ROMERO, T. SCHAUB. *asprin: Customizing Answer Set Preferences without a Headache*, in "Proceedings of the Twenty-Ninth National Conference on Artificial Intelligence (AAAI'15)", Austin, United States, B. BONET, S. KOENIG (editors), AAAI Press, 2015, pp. 1467-1474, https://hal.inria.fr/hal-01187001

[23] Y. DAUXAIS, D. GROSS-AMBLARD, T. GUYET, A. HAPPE. *Chronicles mining in a database of drugs exposures*, in "ECML Doctoral consortium", Porto, Portugal, Proceedings of the ECML Doctoral consortium, September 2015, https://hal.inria.fr/hal-01184100

[24] S. V. EMTEU TCHAGOU, A. TERMIER, J.-F. MÉHAUT, B. VIDEAU, M. SANTANA, R. QUINIOU. *Reducing trace size in multimedia applications endurance tests*, in "Design, Automation & Test in Europe Conference & Exhibition (DATE)", Grenoble, France, 2015, https://hal.archives-ouvertes.fr/hal-01093576

[25] M. GEBSER, T. JANHUNEN, H. JOST, R. KAMINSKI, T. SCHAUB. *ASP Solving for Expanding Universes*, in "Proceedings of the Thirteenth International Conference on Logic Programming and Nonmonotonic Reasoning (LPNMR'15)", Lexington, US, F. CALIMERI, G. IANNI, M. TRUSZCZYŃSKI (editors), lnai, Springer, 2015, vol. 9345, forthcoming, https://hal.inria.fr/hal-01187005

[26] M. GEBSER, R. KAMINSKI, B. KAUFMANN, J. ROMERO, T. SCHAUB. *Progress in clasp series 3*, in "Proceedings of the Thirteenth International Conference on Logic Programming and Nonmonotonic Reasoning (LPNMR'15)", Lexington, US, F. CALIMERI, G. IANNI, M. TRUSZCZYŃSKI (editors), lnai, Springer, 2015, vol. 9345, forthcoming, https://hal.inria.fr/hal-01186997

[27] T. GUYET. *Extracting characteristics of Satellite Image Time Series with Decision Trees*, in "MultiTemp", Annecy, France, Proceedings of the MultiTemp Workshop, IEEE, 2015, pp. 260-263, https://hal.inria.fr/hal-01178943

[28] T. GUYET. *Landscape features that prevent or foster urban sprawl*, in "MultiTemp 2015 : 8th International Workshop on the Analysis of Multitemporal Remote Sensing Images", Annecy, France, Proceedings of the MultiTemp Workshop, July 2015, pp. 244-247, https://hal.inria.fr/hal-01178944

[29] C. HARDY, L. AMSALEG, G. GRAVIER, S. MALINOWSKI, R. QUINIOU. *Sequential pattern mining on multimedia data*, in "European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Database Workshop on Advanced Analytics and Learning on Temporal Data", Porto, Portugal, 2015, https://hal.archives-ouvertes.fr/hal-01186446

[30] O. IEGOROV, A. TERMIER, V. LEROY, J.-F. MÉHAUT, M. SANTANA. *Data Mining Approach to Temporal Debugging of Embedded Streaming Applications*, in "15th International Conference on Embedded Software (EMSOFT'2015)", Amsterdam, Netherlands, October 2015, https://hal.archives-ouvertes.fr/hal-01178782

[31] H. MIRISAEE, A. CHOUAKRIA DOUZAL, A. TERMIER. *Selecting Representative Instances from Datasets*, in "IEEE International Conference on Data Science and Advanced Analytics (DSAA 2015)", Paris, France, October 2015, https://hal.archives-ouvertes.fr/hal-01191805

[32] H. MIRISAEE, E. GAUSSIER, A. TERMIER. *Improved Local Search for Binary Matrix Factorization*, in "Twenty-Ninth AAAI Conference on Artificial Intelligence", Austin, United States, AAAI, January 2015, pp. 1198-1204, https://hal.archives-ouvertes.fr/hal-01178773

[33] B. O. TEHRANI, S. AMER-YAHIA, A. TERMIER. *Interactive User Group Analysis*, in "24th ACM International Conference on Information and Knowledge Management (CIKM 2015)", Melbourne, Australia, ACM, October 2015, https://hal.archives-ouvertes.fr/hal-01178784

[34] P. VICOL, J. P. DELGRANDE, T. SCHAUB. *An Implementation of Consistency-Based Multi-Agent Belief Change using ASP*, in "Proceedings of the Thirteenth International Conference on Logic Programming and Nonmonotonic Reasoning (LPNMR'15)", Lexington, United States, F. CALIMERI, G. IANNI, M. TRUSZCZYŃSKI (editors), lnai, Springer, 2015, vol. 9345, 7 p. , forthcoming, https://hal.inria.fr/hal-01186998

National Conferences with Proceedings

[35] K. GASHTEOVSKI, T. GUYET, R. QUINIOU, A. DA SILVA, V. MASSON. *Sequential pattern mining for customer relationship management analysis*, in "Atelier GAST@EGC2015", Luxembourg, Luxembourg, January 2015, https://hal.inria.fr/hal-01097466

[36] T. GUYET, Y. MOINARD, R. QUINIOU, T. SCHAUB. *Fouille de motifs séquentiels avec ASP*, in "Extraction et Gestion de Connaissances (EGC)", Reims, France, Actes de la conférence Extraction et Gestion de Connaissances, RNTI, 2016, https://hal.inria.fr/hal-01239501

Conferences without Proceedings

[37] K. SEDKI, L. BONNEAU DE BEAUFORT. *Constructing Weighted Argumentation Framework with Cognitive Maps*, in "International Conference on Tools with Artificial Intelligence (ICTAI)", Vietri sul Mare, Italy, IEEE, November 2015 [*DOI :* 10.1109/ICTAI.2015.108], https://hal.archives-ouvertes.fr/hal-01231192

Scientific Books (or Scientific Book chapters)

[38] É. ATHANÉ, J. BOURBEILLON, T. COISNON, T. GUYET, A. MARSHALL, H. NICOLAS, W. OUESLATI, D. ROUSSELIÈRE, J. SALANIÉ. *Paysages et étalement urbain : Aspects physiques et culturels à travers l'exemple de l'aire urbaine d'Angers*, in "Biodiversité, paysage et cadre de vie - La démocratie en pratique", Victoires Editions, 2015, pp. 91-110, https://hal.inria.fr/hal-01178942

[39] P. DURAND, P. MOREAU, L. RUIZ, J. SALMON-MONVIOLA, F. VERTES, C. BARATTE, C. BENHAMOU, T. BOUADI, M.-O. CORDIER, S. CORGNE, P. DUSSEUX, P. FAVERDIN, C. GASCUEL, L. HUBERT-MOY, V. PARNAUDEAU, E. RAMAT, T. RAIMBAULT, V. VIAUD. *Des modèles et des outils pour des projets de territoire*, in "Comment réconcilier agriculture et territoire", Matière à débattre et décider, Editions Quae, 2015, 151 p. p. , https://hal.archives-ouvertes.fr/hal-01209250

[40] M. GEBSER, R. KAMINSKI, P. OBERMEIER, T. SCHAUB. *Ricochet Robots Reloaded: A Case-study in Multi-shot ASP Solving*, in "Advances in Knowledge Representation, Logic Programming, and Abstract Argumentation: Essays Dedicated to Gerhard Brewka on the Occasion of His 60th Birthday", T. EITER, H. STRASS, M. TRUSZCZYNSKI, S. WOLTRAN (editors), lnai, Springer, 2015, vol. 9060, pp. 17-32 [*DOI :* 10.1007/978-3-319-14726-0_2], https://hal.inria.fr/hal-01187007

[41] A. TERMIER. *Distributed Computing for Enumeration*, in "Encyclopedia of Algorithms", Springer Berlin Heidelberg, 2015 [*DOI :* 10.1007/978-3-642-27848-8_724-1], https://hal.archives-ouvertes.fr/hal-01178769

Other Publications

[42] A. BAILLY, S. MALINOWSKI, R. TAVENARD, T. GUYET, L. CHAPEL. *Dense Bag-of-Temporal-SIFT-Words for Time Series Classification*, January 2016, working paper or preprint, https://hal.archives-ouvertes.fr/hal-01252726

References in notes

[43] R. AGRAWAL, T. IMIELINSKI, A. N. SWAMI. *Mining Association Rules between Sets of Items in Large Databases*, in "Proceedings of the 1993 ACM SIGMOD International Conference on Management of Data", Washington, D.C., P. BUNEMAN, S. JAJODIA (editors), 26–28 1993, pp. 207–216

[44] R. AGRAWAL, R. SRIKANT. *Mining sequential patterns*, in "Eleventh International Conference on Data Engineering", Taipei, Taiwan, P. S. YU, A. S. P. CHEN (editors), IEEE Computer Society Press, 1995, pp. 3–14

[45] R. ALUR, D. DILL. *A theory of timed automata*, in "Theoretical Computer Science", 1994, vol. 126, pp. 183-235

[46] E. ASARIN, O. MALER, A. PNUELI. *Symbolic Controller Synthesis for Discrete and Timed Systems*, in "Hybrid Systems II, LNCS 999", Springer, 1995, pp. 1–20

[47] C. BARAL. *Knowledge Representation, Reasoning and Declarative Problem Solving*, Cambridge University Press, 2003

[48] P. BESNARD, M.-O. CORDIER, Y. MOINARD. *Arguments using ontological and causal knowledge*, in "FoIKS", Bordeaux, France, C. BEIERLE, C. MEGHINI (editors), Springer, March 2014, vol. 8367, pp. 79–96, https://hal.inria.fr/hal-00931679

[49] P. BESNARD, A. HUNTER. *Elements of Argumentation*, The MIT Press, june 2008, http://mitpress.mit.edu/books/elements-argumentation

[50] T. BOUADI. *Analyse multidimensionnelle interactive de résultats de simulation. Aide à la décision dans le domaine de l'agroécologie*, Thèse Université Rennes 1, November 2013, https://tel.archives-ouvertes.fr/tel-00933375

[51] T. BOUADI, M.-O. CORDIER, R. QUINIOU. *Computing Skyline Incrementally in Response to Online Preference Modification*, in "Transactions on Large-Scale Data- and Knowledge- Centered Systems", 2013, vol. 10, pp. 34-59 [*DOI :* 10.1007/978-3-642-41221-9_2], http://hal.inria.fr/hal-00920548

[52] T. BOUADI, M.-O. CORDIER, R. QUINIOU. *Computing Hierarchical Skyline Queries "On-the-fly" in a Data Warehouse*, in "DAWAK 2014 - 16th International Conference on Data Warehousing and Knowledge Discovery", Munich, Germany, LNCS, Springer Verlag, September 2014, https://hal.inria.fr/hal-01052864

[53] X. CHARDON, C. RIGOLOT, C. BARATTE, S. ESPAGNOL, C. RAISON, R. MARTIN-CLOUAIRE, J. RELLIER, A. LE GALL, J. DOURMAD, B. PIQUEMAL, P. LETERME, J. PAILLAT, L. DELABY, F. GARCIA, J. PEYRAUD, J. POUPA, T. MORVAN, P. FAVERDIN. *MELODIE: a whole-farm model to study the dynamics of nutrients in dairy and pig farms with crops*, in "animal", 2012, vol. 6, n^{o} 10, pp. 1711-1721 [*DOI :* 10.1017/S1751731112000687], https://hal.inria.fr/hal-00849187

[54] M.-O. CORDIER, C. LARGOUËT, Y. ZHAO. *Model-Checking an Ecosystem Model for Decision-Aid*, in "26th IEEE International Conference on Tools with Artificial Intelligence, ICTAI 2014, Limassol, Cyprus, November 10-12, 2014", 2014, pp. 539–543

[55] D. CRAM, B. MATHERN, A. MILLE. *A complete chronicle discovery approach: application to activity analysis*, in "Expert Systems", 2012, vol. 29, n^{o} 4, pp. 321–346

[56] J. DAMBACHER, W. HIRAM, P. ROSSIGNOL. *Qualitative predictions in model ecosystems*, in "Ecological Modelling", 2003, vol. 161, pp. 79-93

[57] M. DECKERT. *Incremental rule-based leraners for handling concept drift : an overview*, in "foundations of computing and decision sciences", 2013, vol. 38, pp. 35-65

[58] C. DOUSSON, T. V. DUONG. *Discovering Chronicles with Numerical Time Constraints from Alarm Logs for Monitoring Dynamic Systems*, in "IJCAI", T. DEAN (editor), Morgan Kaufmann, 1999, pp. 620-626

[59] C. GAUTRAIS. *Analysis of customer attrition in a large retail dataset*, Master Thesis Report, University of Rennes 1, 2015

[60] M. GELFOND, V. LIFSCHITZ. *The Stable Model Semantics for Logic Programming*, in "Proceedings of ICLP", 1988

[61] T. GUNS, A. DRIES, G. TACK, S. NIJSSEN, L. DE RAEDT. *MiningZinc: A modeling language for constraint-based mining*, in "Proceedings of the Twenty-Third international joint conference on Artificial Intelligence", AAAI Press, 2013, pp. 1365–1372

[62] J. HAN, J. PEI, Y. YIN. *Mining Frequent Patterns Without Candidate Generation*, in "SIGMOD Rec.", May 2000, vol. 29, n^{o} 2, pp. 1–12, http://doi.acm.org/10.1145/335191.335372

[63] Z. HUANG, X. LU, H. DUAN. *On mining clinical pathway patterns from medical behaviors*, in "Artificial Intelligence in Medicine", 2012, vol. 56, n^{o} 1, pp. 35–50

[64] M. JÄRVISALO. *Itemset mining as a challenge application for answer set enumeration*, in "Logic Programming and Nonmonotonic Reasoning", Springer, 2011, pp. 304–310

[65] C. KAMDEM KENGNE, L. C. FOPA, A. TERMIER, N. IBRAHIM, M.-C. ROUSSET, T. WASHIO, M. SANTANA. *Rewriting Large Multimedia Application Execution Traces with few Event Sequences*, in "KDD 2013 - International Conference on Knowledge Discovery and Data Mining", Chicago, IL, United States, ACM, August 2013, pp. 1348-1356, Session Industrial and government emerging (Security & Privacy) [*DOI :* 10.1145/2487575.2488211], https://hal.archives-ouvertes.fr/hal-00923538

[66] D. G. KIRKPATRICK, P. HELL. *On the Completeness of a Generalized Matching Problem*, in "Proceedings of the Tenth Annual ACM Symposium on Theory of Computing", New York, NY, USA, STOC '78, ACM, 1978, pp. 240–245, http://doi.acm.org/10.1145/800133.804353

[67] A. LALLOUET, Y. MOINARD, P. NICOLAS, I. STÉPHAN. *Programmation logique*, in "Panorama de l'intelligence artificielle Ses bases méthodologiques, ses développements", P. MARQUIS, O. PAPINI, H. PRADE (editors), Cépaduès, January 2013, vol. 2, http://hal.inria.fr/hal-00758896

[68] C. LARGOUËT, M.-O. CORDIER. *Patrons de scénarios pour l'exploration qualitative d'un écosystème*, in "RFIA 2010 (Reconnaissance des Formes et Intelligence Artificielle)", France Caen, 2010

[69] V. LIFSCHITZ. *What Is Answer Set Programming?*, in "Proceedings of the Twenty-Third AAAI Conference on Artificial Intelligence, AAAI 2008, Chicago, Illinois, USA, July 13-17, 2008", 2008, pp. 1594–1597

[70] D. G. LOWE. *Distinctive image features from scale-invariant keypoints*, in "International journal of computer vision", 2004, vol. 60, n^{o} 2, pp. 91–110

[71] P. LÓPEZ-CUEVA, A. BERTAUX, A. TERMIER, J.-F. MÉHAUT, M. SANTANA. *Debugging Multimedia Application Traces through Periodic Pattern Mining*, in "EMSOFT 2012, part of ESWEEK - Embedded Systems Week", Tampere, Finland, ACM, October 2012, pp. 13-22, Session 1A: Testing and Characterization of Embedded Software [*DOI :* 10.1145/2380356.2380366], https://hal.archives-ouvertes.fr/hal-00750941

[72] M. A. MALOOF, R. S. MICHALSKI. *Incremental learning with partial instance memory*, in "Artificial Intelligence", 2004, vol. 154, pp. 95-261

[73] A.-V. F. MANG. *Advances in Detection and Diagnosis of Bovine Respiratory Disease in Feedlot Cattle*, Master Thesis Report, University of Calgary, 2015

[74] R. S. MICHALSKI. *A theory and methodology of inductive leraning*, in "Machine learning : an Arificial Intelligence Approach", 1983, vol. I

[75] S. NADKARNI, P. P. SHENOY. *A Bayesian network approach to making inferences in causal maps*, in "European Journal of Operational Research", 2001, vol. 128, n^{o} 3, pp. 479–498

[76] B. NEGREVERGNE, T. GUNS. *Constraint-based sequence mining using constraint programming*, in "Integration of AI and OR Techniques in Constraint Programming", Springer, 2015, pp. 288–305

[77] B. NEGREVERGNE, A. TERMIER, M.-C. ROUSSET, J.-F. MÉHAUT. *ParaMiner: a Generic Pattern Mining Algorithm for Multi-Core Architectures*, in "Data Mining and Knowledge Discovery", May 2014, vol. 28, n^{o} 3, pp. 595-633 [*DOI :* 10.1007/s10618-013-0313-2], https://hal.archives-ouvertes.fr/hal-00923535

[78] N. PASQUIER, Y. BASTIDE, R. TAOUIL, L. LAKHAL. *Discovering Frequent Closed Itemsets for Association Rules*, in "Proceedings of the 7th International Conference on Database Theory", London, UK, ICDT '99, Springer-Verlag, 1999, pp. 398–416, http://dl.acm.org/citation.cfm?id=645503.656256

[79] E. TIMSIT, S. ASSIÉ, R. QUINIOU, H. SEEGERS, N. BAREILLE. *Early detection of bovine respiratory disease in young bulls using reticulo-rumen temperature boluses*, in "The Veterinary Journal", 2010 [*DOI :* 10.1016/j.tvjl.2010.09.012]

[80] R. TRÉPOS, A. SALLEB-AOUISSI, M.-O. CORDIER, V. MASSON, C. GASCUEL-ODOUX. *Building Actions From Classification Rules*, in "Knowledge and Information Systems (KAIS) journal", 2013, vol. 34, n^{o} 2, pp. 267-298 [*DOI :* 10.1007/s10115-011-0466-5], http://hal.inria.fr/hal-00649388

[81] W. UGARTE, P. BOIZUMAULT, B. CRÉMILLEUX, A. LEPAILLEUR, S. LOUDNI, M. PLANTEVIT, C. RAÏSSI, A. SOULET. *Skypattern mining: From pattern condensed representations to dynamic constraint satisfaction problems*, in "Artificial Intelligence", 2015

[82] T. UNO, T. ASAI, Y. UCHIDA, H. ARIMURA. *An efficient algorithm for enumerating closed patterns in transaction databases*, in "Proc. DS'04, LNAI 3245", 2004, pp. 16–31

[83] G. WIDMER, M. KUBAT. *Learning flexible Concepts form Streams of Examples : FLORA2*, in "proceeding of the 10th European Conference On Artificial Intelligence", WILEY AND SONS (editor), 1992, pp. 463-467

[84] G. WIDMER, M. KUBAT. *Learning in the presence of concept drift and hidden contexts*, in "Machine Learning", 1996, vol. 23, n^{o} 1, pp. 69-101

[85] X. YAN, J. HAN. *gSpan: Graph-Based Substructure Pattern Mining*, in "Proceedings of the 2002 IEEE International Conference on Data Mining", Washington, DC, USA, ICDM '02, IEEE Computer Society, 2002, pp. 721–

[86] Y. ZHAO, M.-O. CORDIER, C. LARGOUËT. *Répondre aux questions "Que faire pour" par synthèse de contrôleur sur des automates temporisés - Application à la gestion de la pêche*, in "RFIA 2012 (Reconnais-

sance des Formes et Intelligence Artificielle)", Lyon, France, January 2012, pp. 978-2-9539515-2-3, Session "Posters", http://hal.inria.fr/hal-00656543

[87] Y. ZHAO. *Qualitative modelling and strategy synthesis of grazing activities*, Université Rennes 1, January 2014, https://tel.archives-ouvertes.fr/tel-00933443