

# Curriculum Vitae et Studiorum

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## SHORT BIO

I am a *Full Professor in Computer Engineering* at the Faculty of Engineering, Free University of Bozen-Bolzano. I received a BEng *cum laude* in Computer Science Engineering in 2003, a MEng *cum laude* in Computer Science Engineering in 2005, and a PhD in Electronics, Computer Science and Telecommunications Engineering in 2009, all from the University of Bologna.

*My research is in artificial intelligence and information systems for the modelling, analysis, and mining of processes and agents.* The Leitmotiv is the combination of model-driven and data-driven techniques to engineer trustworthy and reliable process-aware information systems and agent dynamics. Two dimensions are particularly characteristic of my research: the consideration of multiple perspectives beyond the process control flow (most prominently data, uncertainty, and time), and the focus on process specifications that strive to balance flexibility and control. To tackle these problems I advocate a true trans-disciplinary approach at the intersection of artificial intelligence, formal methods, data management, process mining, business process and information systems engineering.

On these topics, I authored a *Springer monograph* and *more than 250 papers*, many of which in top-tier international journals and conferences, such as Information Systems, Journal of Artificial Intelligence Research, ACM Trans. on the Web, ACM Trans. on Intelligent Systems and Technology, ACM Trans. on Software Engineering and Methodology, IEEE Trans. on Knowledge and Data Engineering, AAAI, IJCAI, PODS, KR, AAMAS, ECAI, BPM, CAiSE, ICPM.

I am coordinator of the PRIN Italian project PINPOINT on explainable and knowledge-aware process mining. I have been investigator in the EU STREP Project ACSI (Artifact-Centric Service Interoperation) and in the EU IST-IP Project Optique (Scalable End-user Access to Big Data), as well as principal investigator and co-investigator in several local and transnational projects focused on processes and data.

My current h-index is *43*, and my current i-10 index is *135*, with *8062* overall citations (source: Google Scholar, as of December 31, 2023). I belong to the *top 2% most cited scientists worldwide* according to the well-known PLoS Biol *Updated science-wide author databases of standardized citation indicators* by Ioannidis, Boyack, and Baas (last update: October 2023).

In 2015, I received the “*Marco Somalvico*” *2015 Prize* from the Italian Association for Artificial Intelligence, as best under 35 Italian researcher who autonomously contributed to advance the state-of-the-art in Artificial Intelligence. I am also recipient of *10 best paper awards* and *2 test-of-time awards*.

I am currently *Vice-dean for Studies* and *Director* of the *Bachelor Degree in Informatics and Management of Digital Business* in the Faculty of Engineering, Free University of Bozen-Bolzano.

I am one of the co-founders of *Ontopic s.r.l.*, the first spin-off of the Free University of Bozen-Bolzano, which aims at developing next-generation semantic technologies for intelligent data access and integration.

I am strongly committed to scientific outreach: I regularly meet the general public, industries, and students to discuss about *the nature of artificial intelligence and its societal implications*.

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## 1 Personal Information

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**English** *C1 level (IELTS Academic 7.5)*  
**German** *B2 level (Patentino di bilinguismo B)*

## 2 Education Since Leaving School

2000 – 2003

**Bachelor Degree in Computer Engineering**, obtained on July 23, 2003 at the Faculty of Engineering, *University of Bologna*. BEng thesis title: *Modelling interaction in multiagent systems* (supervisor: Prof. Paola Mello). Final mark *110/110 cum laude*.

2003 – 2005

**Master Degree in Computer Engineering**, obtained on October 26, 2005 at the Faculty of Engineering, *University of Bologna*. MEng thesis title: *A graphical language for the specification and verification of protocols* (supervisor: Prof. Paola Mello). Final mark: *110/110 cum laude*.

2006 – 2009

**PhD in Computer Science, Electronics and Telecommunications Engineering**, obtained on April 8, 2009 at the *University of Bologna*. PhD thesis title: *Specification and Verification of Declarative Open Interaction Models - A Logic-Based Framework* (supervisor: Prof. Paola Mello).

## 3 Employment and Appointments Held

### 3.1 Present Appointment

From 01/10/2021

**Full Professor** in the Faculty of Engineering (formerly - until 28/02/2023 - Faculty of Computer Science), *Free University of Bozen-Bolzano* (UNIBZ). Scientific Sector: *ING-INF/05 (Sistemi di Elaborazione delle Informazioni)*.

Responsibilities: Research and teaching activity focussed on *artificial intelligence and information systems for the modelling, analysis, and mining of (data-aware) processes and agents*. Coordination of an internationally renown research group that works on artificial intelligence techniques for process foundations, engineering, and mining, contributing to the mutual advancement of these fields. Coordination of and participation to European, National and local research projects. Student supervision. Several institutional duties at the faculty level, including leading responsibilities in teaching (course coordination, vice-deanship). Increasing commitment to third mission activities, in terms of connections and collaborative projects with industries, and dissemination to the general public (in particular about artificial intelligence and its societal implications).

### 3.2 Professional Experience

Jan. 2009 – Apr. 2009

**Postdoctoral fellow** on *process mining: analysis of business process audit trails*, Department of Electronics, Computer Science and Systems (DEIS), University of Bologna (UNIBO), as part of the

CINI<sup>1</sup> FIRB Project RBNE05BFRK “TOCAI.IT: Knowledge-Oriented Technologies for the Integration of Networked Enterprises”.

May 2009 – Oct. 2009

**Postdoctoral fellow** on *application of AI techniques for the analysis of foreign tourist flows*, DEIS-UNIBO, as part of the the MIUR PRIN Project 2007-7WWCR8 “Forms of correlations among italian style, tourist flows and consumer trends related to made in Italy”.

Nov. 2009 – Apr. 2011

**Postdoctoral researcher** on *declarative approaches for the specification and verification of clinical guidelines* at DEIS-UNIBO, University of Bologna.

May 2011 – Jun. 2017

**Researcher** with a fixed-term contract (first RTD Junior, then tenure-track RTD senior), Faculty of Computer Science, *Free University of Bozen-Bolzano* (UNIBZ).

Jul. 2017 – Sep. 2021

**Associate Professor**, Faculty of Computer Science, UNIBZ. Scientific Sector: *ING-INF/05 (Sistemi di Elaborazione delle Informazioni)*.

## 4 Research

*My research is in artificial intelligence and information systems for the modelling, analysis, and mining of processes and agents.* The Leitmotiv is to develop novel, foundational and applied model-driven and data-driven techniques to engineer trustworthy and reliable process-aware information systems and agent dynamics. On the one hand, I aim at obtaining formal models of (data-aware) processes that can be transparently analysed and inspected for safety and correctness, or built guaranteeing such properties by design, and develop algorithmic techniques for their analysis and inspection; on the other hand, I aim at exploiting observational data about reality (such as event logs of process executions, or digital traces generated by agents) to automatically learn models that reflect the observed behaviour (cf. process discovery), and to establish relations between the observed and expected behaviour (cf. conformance checking and monitoring). To tackle these problems I advocate a true transdisciplinary approach integrating artificial intelligence, formal methods, data management, process mining, business process and information systems engineering.

My research is well described by the manifesto in [J-25], and by some of the open challenges listed in [J-22]. The problems I study pertain the *whole lifecycle of a dynamic system* and the role of data therein: from *modelling and design-time verification to monitoring and operational support* and, finally, *data-driven discovery, analysis, conformance checking, and continuous improvement*. This provides an interesting playground where model-driven and data-driven techniques come together, pushing the boundaries of research in diverse fields: *artificial intelligence, information systems, process management and mining*.

Tackling this type of problems requires to develop and combine knowledge and competencies in all such research areas, usually investigated in isolation. I actively work to *overcoming the separation of these fields*, not only in my scientific achievements and research collaborations, but also when I take official roles in the organisation of conferences and events. This is also witnessed by the quite wide range of top-tier publication venues I target, and by my heterogeneous collaboration network with excellent researchers. I truly believe that *only by cross-fertilising these areas we can achieve significant results with long-term impact*.

My research aims at bridging the gap between theory and practice. On the one hand, I devise *formal models and rigorous techniques to understand the computational boundaries* of several key problems defined over the entire lifecycle of data-aware dynamic systems. On the other hand, I work on *connecting such models and techniques to concrete, end user-oriented languages and methodologies*, and I am also interested in the *effective development of proof-of-concept prototypes*, linking foundations

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<sup>1</sup>Consorzio Interuniversitario Nazionale per l'Informatica, [www.consorzio-cini.it/](http://www.consorzio-cini.it/)

and engineering. We avoid, whenever possible, to develop ad-hoc algorithmic solutions to the problems with study, and instead approach them via *knowledge compilation* to then employ *well-established, industrial-strength technologies, such as SAT and SMT solvers, model checkers, planners, operations research solvers and automated reasoners of different kinds*.

I coordinate an internationally renown research group in the Faculty of Engineering in the Free University of Bozen-Bolzano. The group, called *Artificial Process Intelligence (API)*, includes several professors, researchers, and students. I directly support the research activity of one assistant professor with fixed-term contract (RTDa), one Post-Doc, and one PhD student (with two additional PhD students as co-supervisor). *We are recognised, worldwide, as one of the key research groups at the intersection of AI and information systems*. Two of my former PhD students, and one of my former Post-Docs, have become Professors in top-tier Universities.

## 4.1 Main Research Lines

I briefly expand next the main lines of research I am currently pursuing. References point to a selection of particularly relevant entries in the publication list, but do not exhaustively cover all the relevant papers I co-authored.

### 4.1.1 Relational Dynamic Systems

Relational dynamic systems are dynamic systems operating over full-fledge relational (that is, first-order) states, where each state contains objects, properties, and relations [C-173]. In our research, we have provided fundamental, highly impactful results on the *formalization and automated verification* of relational dynamic systems, and on their application in AI (with a focus on reasoning about actions and processes, and on multiagent systems) and information systems (with particular emphasis on process management - BPM). Studying these systems is extremely challenging, as the interplay between the data and the process component makes them infinite-state.

From the foundational point of view, we have considered three main settings:

- Dynamic systems operating over a *relational database* [W-215, C-163], identifying well-behaved, interesting classes for which it is possible to verify branching- [C-171, J-41], linear-time [C-149, C-94] and reachability [C-134, C-122] first-order properties; to obtain our results, we have employed a combination of techniques from database theory, classical logics, data abstraction, temporal model checking, and bisimulations. Our results have been recently extended to runtime verification as well [C-94]. A mini-survey of these results can be found in [W-215].
- Dynamic systems operating over (Description Logic) *knowledge bases* where data are interpreted under incomplete knowledge, extending the techniques studied for relational dynamic systems to this richer setting [C-187, J-53, C-175] also dealing with inconsistency [C-176, C-159].
- Dynamic systems operating over different types of working memories with multiple datatypes together with *read-only, relational data*, studying a *parameterized form of verification* where the system is analysed irrespectively of the configuration of read-only data. These are the most general systems that can be studied in this spectrum. Substantial research achievements, both foundational and practical, have been obtained towards verification of (parameterized) safety properties, using a combination of techniques from model theory, automated reasoning, symbolic verification of infinite-state systems, and SMT [BC-69, J-37, J-32, J-29]. This culminated in verification techniques for the most expressive models conceived so far in this spectrum [C-88].

Lately, these results have been for the first time ever carried over more general, linear-time properties. This has been made possible by combining this series of results with parallel advancements on automata-based techniques for LTL over finite traces operating over numerical data elements [C-100, C-84]. The combination is tackled in [?].

In AI, we have grounded our investigation on different action theories:

- the *Situation Calculus* [C-150, J-41, C-94];

- *planning domains* operating over *infinite object domains* [C-152, C-146];
- *multiagent systems* with agents exchanging *relational data* [C-158], with agent interactions regulated by (*first-order*) *commitments* [C-170], and with *swarms* consisting of an *unknown number of agents* equipped with (parameterized) synchronization mechanisms [C-117, C-110].

Two facts, in particular, are worth to be mentioned:

- The notion of *state-bounded system* [C-171, C-163, J-41], identified to single out relevant decidable fragments for verification, has created a profound impact in the AI community, spawning a huge body of consequent research.
- The SMT-based line of research has revealed novel connections, and brought genuinely novel advancements, in automated reasoning and infinite-state symbolic model checking as a whole [J-37, J-32, J-29, C-88].

The application of foundational results for relational dynamic systems to BPM and data management has led to a number of contributions along three streams:

- *artifact-/data-centric business processes* [C-171, C-183, J-49, C-125, J-37];
- *object-centric and multi-case processes* captured using high-level Petri nets with tokens carrying references to tuples of identifiers [J-50, J-31] and extended with relational databases [C-146, J-48, C-131], also dealing with their application to enterprise integration patterns [J-34];
- *extensions of the de-facto BPMN standard* with persistent data and corresponding query/update languages based on SQL [C-125, C-112], as well as with data-correlating process fragments within case management [C-113].

Finally, we have engineered proof-of-concept software artefacts, ranging from verification to enactment, and building on:

- *SMT-based technology*, with very promising performance [J-37, C-117, J-32];
- *conventional planners* [C-152, C-146];
- *standard SQL-based relational technology* [C-182, C-127];
- state-space exploration techniques for *coloured Petri nets* [J-34].

The results produced in this research have led to *three best paper awards* and a number of tutorials and invited keynotes at international events. Together with the achievements on temporal logics on finite traces for declarative processes (cf. Section 4.1.3), they constitute the core scientific contributions for which I received the prestigious **Artificial Intelligence “Marco Somalvico” 2015 career prize** (cf. Section 4.7). We are currently preparing a Springer book on *integrated models for processes and data*.

#### 4.1.2 Lightweight Data-Aware and Decision-Aware Dynamic Systems

Lightweight data-aware dynamic systems are data-aware dynamic systems that do not employ full-fledged first-order states, but use instead more lightweight data structures to keep track of relevant, structural information. In our research, we have extensively studied *dynamic systems operating over data variables* [W-218], considering in particular data variables *carrying numerical values* (reals, integers, ...), and where actions are equipped with *arithmetic conditions*.

In spite of being lightweight, reasoning about such systems is extremely challenging. We have identified increasingly expressive classes of systems amenable to reasoning and verification, generalizing previously identified boundaries, and considering in particular:

- *controlled forms of data conditions* [C-136, C-129, C-116, C-100, C-99] and *structural restrictions* on how the process chains such conditions over time [C-100, C-99], also showing how to deal with specifications containing components that belong to different classes [C-100];

- different types of properties, from *soundness*<sup>2</sup> [C-136, C-129, J-38] to *linear-time* [C-100] and *branching-time* [C-99] *temporal model checking*, as well as *strategy synthesis* in adversarial settings [J-38, C-116].

In AI, our investigation is advancing the state-of-the-art in formal specification and reasoning about:

- *Data-aware agents operating in a non-cooperative environment*, where states are represented as assignments of variables from different data domains, going beyond the conventional, propositional case [C-116, C-100, C-99].
- *Data-aware multiagent systems including non-cooperative agents*, where it is necessary to understand whether a controller agent can strategically achieve desired properties irrespectively of how non-cooperative agents behave; we have in particular introduced an *adversarial* notion of the well-established correctness property of *soundness*[J-38], as well as of general linear-time properties on finite traces [C-116].

In BPM, this setting is interesting for a threefold reason:

- Data variables and corresponding logical conditions capture lightweight decision models, in particular the *OMG standard DMN S-FEEL*, which *we were the first to formalize in logic* [J-42], including extensions dealing with background knowledge and *decision models under incomplete information* [J-40]. We have exploited this fact to formalize *decision-aware processes*, showing how key correctness properties relating the process control-flow, data variables, and decisions can be decided using our verification machinery [C-136]. We have also integrated these two streams to formalise and analyse *BPMN processes enriched with case data and S-FEEL decision models* [J-33].
- Dynamic systems operating over data variables encode<sup>3</sup> the widely studied framework of *data Petri nets*. A data Petri net is a Petri net enriched with a set of registers storing values from different datatypes, and where net transitions are annotated with conditions expressing guards and constrained writes on the registers [C-136, C-129]. Conceptually, the evolution of the net from an initial marking can be understood as the execution of a process instance (i.e., a case), interpreting the registers as case data.
- Formal analysis of data Petri nets is crucial not only because of the subtle interplay of control-flow and data conditions, but also because (fragments of) data Petri nets can be *discovered from event data* using a loosely coupled combination of control-flow discovery and decision mining techniques. No correctness guarantees hold for the resulting models, which may indeed contain errors [C-101]. Soundness checking is instrumental in this setting, and we have hence developed techniques for soundness verification of data Petri nets dealing with numerical data variables [C-101], extending them to deal with automatic repair capabilities for unsound models, where the original behaviour is maximally preserved [?]. We have also moved beyond verification, considering the problem of conformance checking of data-aware logs against data Petri nets, where the task is to check whether observed traces fit the model and, if not, provide feedback on the extent and nature of deviations. We effectively approached this problem using SMT techniques [C-111, C-98, J-26] (see Section 4.1.6 for more details).

The results produced in this research have led to <i>two best paper awards</i> (see Section 4.7).
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#### 4.1.3 Temporal Logics over Finite-Traces for Declarative Process/Agent Specifications

A central theme when specifying behaviours (such as an agent program, the control flow of a process, the rules of an interaction protocol) is that of *flexibility*, that is, on guaranteeing that there enough autonomy of choice is given when the specification is enacted.

I have carried out research on this topic since the very beginning of my PhD studies, where I brought forward the paradigm of *declarative, open interaction models* to declaratively describe and

<sup>2</sup>Soundness expresses that whenever the system starts, it is always possible to achieve a desired, end configuration.

<sup>3</sup>Under the assumption that concurrency is interpreted as interleaving.

reason about flexible processes and multiagent interactions, and provided seminal results that have spawned a huge bulk of research in AI and information systems. In particular, I have contributed to the shift of attention from infinite to finite-trace temporal logics, which better suit with behaviours that are expected to eventually reach a terminating state, and have an automata-theoretic characterisation based on standard finite-state automata over finite words. This means that every specification can be determined. In addition, building and manipulating automata on finite words is much more amenable to efficient algorithmic techniques than the case of automata on infinite words.

In AI, we have in fact extensively contributed to logic-based approaches in this spectrum, in particular through *temporal logics over finite traces* and *extensions of logic programming*, focussing on a variety of reasoning tasks throughout the whole lifecycle of dynamic systems [J-63, B-1, J-57, C-167]. In particular:

- We have obtained key seminal results on *temporal logics on finite traces* (in particular LTL over finite traces,  $LTL_f$ ) [C-167, J-30] and their *automata-theoretic characterisation* to express and reason about *constraints and metaconstraints on agent behaviours* (that is, constraints predicating on the satisfaction and violation of other constraints), also considering *hyperproperties* that predicate over *multiple traces at once* [C-109]. Of particular interest is the fact that, being these logics on finite traces, they are characterised by standard finite-state automata, which have better algorithmic properties than their infinite-trace counterparts, and directly provide an operational mechanism for execution.
- We have introduced *probabilistic LTL over finite traces* [C-121], supporting quantified uncertainty on the future in a superposition semantics, where alternative futures coexist, each with its own derived probability.
- We have investigated *process constraints co-referring through a data model*, to scope the effect of activities and constraints on the objects and relations they operate on; this calls for moving from temporal propositional logics to well-behaved fragments of temporal description logics [BC-68, C-123].
- We have studied how *logic programming*-based frameworks (such as abductive logic programming and Event Calculus) can be employed to express and reason about *rich constraints with metric time and different forms of data* [J-63, B-1, J-55], also infusing constraints inside frameworks for *agent-based requirements engineering* [W-260, J-59] and *multiagent interaction protocols* [B-1, J-60].
- We have extended the commitment-based approach for open multiagent systems, introducing first-order commitments whose conditions are enriched with time and data [W-256, C-199, C-195, J-54, C-170], developing monitoring [C-199, C-195, J-54], simulation [J-58], and formal verification [C-170] techniques for this enriched setting.

In BPM, I have been among the pioneers in *declarative, constraint-based process modelling*, and have contributed to the foundations of the well-known *Declare* language since the early days of its introduction by Pesic and van der Aalst.<sup>4</sup> In the research on this topic:

- We have provided seminal contributions on the *formal foundations of declarative process modelling* using logic-based approaches [J-63, B-1], most notably temporal logics over finite traces [C-167, C-166, J-30].
- We have introduced different *extensions of Declare* where *events carry data attributes* and constraints are enriched with *metric temporal conditions and data-based guards* [J-63, B-1, J-55, C-105, C-93].
- We have introduced the novel paradigm of *object-centric behavioral constraints* to declaratively capture process constraints that correlate over data objects, and can consequently elegantly capture *multi-case processes involving one-to-many and many-to-many relationships* among the manipulated

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<sup>4</sup>Pesic, M., Schonenberg, H., van der Aalst, W.M.P., *DECLARE: Full Support for Loosely-Structured Processes*. EDOC 2007: 287-300.

objects [W-234, BC-68, C-123]; such processes are widespread in reality, but contemporary process modelling notations struggle in representing them properly.

- We have introduced the notion of *probabilistic process constraint*, investigating how to infuse uncertainty in declarative processes [C-119, J-28].

Most importantly, we have tackled a wide range of (non-standard) reasoning and learning tasks for  $LTL_l$ -based declarative specifications (also enriched with data), considering their full lifecycle lifecycle:

- *discovery/learning* of  $LTL_l$  formulae from data, considering the discriminative setting where traces are labelled as positive or negative [C-205, J-65, C-96, J-24] and that where only positive traces are given [C-161, C-155, J-47, C-179];
- different forms of *conformance checking* to relate traces recorded in an event log with the traces of a given specification and detect deviations [C-105, J-28];
- advanced forms of *runtime verification and monitoring* of traces generated by black-box systems, considering at once the tracked prefix of an execution, and its possible future continuations [C-192, C-189, C-166, J-30, C-94, C-84].

These contributions are recalled in more detail in Sections 4.1.6 and 4.1.7.

The results produced in this research have led to *one best paper award*, and to the “**Marco Cadoli**” **Distinguished Dissertation Award** for my PhD thesis (cf. Section 4.7). I also authored a highly-cited Springer monograph with some key results of this research [B-1]. Together with the achievements on formal specification and reasoning for relational dynamic systems (cf. Section 4.1.1), these results also constitute the core scientific contributions for which I received the prestigious **Artificial Intelligence “Marco Somalvico” 2015 career prize** (cf. Section 4.7).

#### 4.1.4 Dealing with Uncertainty in Data and Processes

Handling uncertainty in dynamic systems is a cornerstone in AI and BPM. We are studying how to formalize and develop different forms of analysis when dealing with uncertainty in event data, and/or uncertainty in the process models.

Dealing with uncertain event data is important as in several application domains, recording events is noisy, error-prone, and subject to incompleteness. In addition, when events are not directly recorded, but are inferred through machine learning pipelines tailored to event/activity recognition (such as techniques to extract structured events from videos), they natively come with stochastic information.<sup>5</sup> In [C-98, ?] we have introduced, for the first time, an approach for checking conformance of event logs with data attributes against data-aware process models. The approach is based on SMT/OMT, and tackles different forms of uncertainty: uncertainty about the event itself (indicating the confidence that the event happened at all), uncertainty about timestamps (with time intervals that may induce different total orderings when trying to resolve uncertainty), uncertainty about activities (with confidence levels on which among a set of activities may have been recorded), uncertainty about data attributes (which may come with multiple, possible values).

As for uncertainty at the model level, we have considered the case where non-determinism in the process is resolved through stochastic choice.

- In the *declarative* setting, we have introduced a novel probabilistic temporal logic over finite traces coupled with automata-based techniques for reasoning [C-121]. A relevant fragment of this logic has been identified, in which a sort of separability property for reasoning on the probabilistic and temporal aspects of the logic in a loosely-coupled can be employed to reason with the same worst-case complexity of standard  $LTL_l$  (without uncertainty). This fragment naturally applies to BPM, and we have in fact used it to model uncertain constraint-based process models and defined various techniques for probabilistic conformance checking, discovery, and monitoring, laying the foundations for *probabilistic declarative process mining* [C-120, C-119, J-28].

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<sup>5</sup>Gal, A., *Everything there is to Know about Stochastically Known Logs*, ICPM 2023: xvii-xxiii.

- In the *procedural* setting, we have studied generalized stochastic Petri nets equipped with silent transitions, essential to capture complex, behaviours including advanced constructs such as loops, skippable actions, and concurrency, as well as behaviours where some actions are kept private. First, we have identified a class of stochastic nets where it is possible to compute trace probabilities via enumeration [C-107, C-106]. Then, we have generalised our results to full stochastic Petri nets with silent labels, showing for the first time how techniques from Markov chain analysis and qualitative model checking of quantitative systems could be suitably combined to compute the probability of (visible) traces and the probability that a temporal property holds in a given stochastic system [C-102, J-18]. These techniques are in turn instrumental to provide exact analytic techniques for computing trace probabilities and stochastic conformance measures [J-18].

The results produced in this research have led to <i>one best paper award</i> (cf. Section 4.7).
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#### 4.1.5 Object-centric Processes and Multi-Process Systems

A common limitation in the representation and analysis of processes is to consider isolated, case-centric processes, where every execution is separate from the others, and evolves a single object. This is often not corresponding to reality, where multiple executions are intertwined and evolve multiple interrelated objects at once.<sup>6</sup> This more realistic setting has recently entered into information systems engineering and process mining in its full complexity, with two main relevant settings:

- *Object-centric processes* - processes where every execution co-evolves different objects involved in one-to-many and many-to-many relations, with divergence (events manipulating multiple related objects), convergence (flows evolving single events in parallel), and complex synchronisation conditions (where an event is only enabled if multiple related objects are in a given state).
- *Multi-process systems* - systems where a single execution simultaneously flows through multiple processes at once, and such processes may contain common parts or be related by global constraints.

As for object-centric processes, we have introduced and/or studied formal models covering the most important modelling requirements, and developed automated reasoning techniques for their analysis:

- *Object-aware nets* [C-118] and *Petri nets with identifiers* [C-103], where tokens in the net carry references to objects or relations, in turn used to express different forms of synchronisation.
- Object-centric behavioural constraints [BC-68, C-123], where temporal constraints co-refer through objects or relations, providing advanced scoping and synchronization mechanisms.

As for multi-process systems, we have brought forward an integrated, hybrid approach where local data-aware process models are interconnected through common tasks and global temporal constraints [C-93, J-20], studying its application in the healthcare domain [J-21]. We have defined the execution semantics of this hybrid approach, providing enactment and monitoring capabilities using a subclass of (data-aware) automata [C-84]. Monitoring, in particular, comes with advanced techniques to detect unavoidable future conflicts or occurred violations, indicating that it is not possible to properly progress all local processes, and/or satisfy all global constraints. Conflicts are reported by highlighting which components are involved, and by providing indications on the impact of the execution of each activity, in terms of (further) conflicts or violations, and their severity.

#### 4.1.6 Intelligent Systems for Multi-Perspective Process Mining

Process mining [W-254] is an innovative approach at the intersection of model-driven engineering and data science, whose purpose is to analyse the event data generated through the execution of processes, so as to obtain insights on how processes are executed in reality, and enable continuous improvement based on factual evidence. Interestingly, *key process mining tasks are closely related to core problems in AI: process discovery* corresponds to *model learning* of dynamic systems/agents, *conformance checking* relates to *plan/goal recognition*, and *monitoring* has a deep roots in AI and formal methods.

Our approach to process mining is distinctive in two respects:

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<sup>6</sup>See <https://multiprocessmining.org>.

- We tackle *multiple perspectives* beyond the control-flow dimension - in particular data, time, and uncertainty.
- We contributed to laying the basis of *declarative process mining*, focussed on temporal logics over finite traces.

An orthogonal, characterising aspect of our research in process mining is that we attack discovery and conformance checking problems using intelligent systems, that is, relying on well-established, industrial-strength AI techniques, such as SAT and SMT solvers, model checkers, planners, and automated reasoners of different kinds. We have been also contributing to data preparation for process mining (see Section 4.1.8) and to process mining at runtime, i.e., operational decision support, which includes monitoring (see Section 4.1.7).

I have contributed to the creation of the area of *declarative process mining* [BC-67], where event data are combined with declarative process models, later lifting this framework to the probabilistic setting where there is (quantified) uncertainty on the satisfaction of constraints [J-28]. In this spectrum, we have developed state-of-the-art techniques for *discovering interpretable  $LTL_I$  specifications* from event data, considering two settings:

- *Discriminative mining*, where the input is an event log partitioned into positive and negative traces, and the goal is to discover a set of constraints that correctly discriminate the two groups of traces, by accepting all positive traces and rejecting all negative ones; we have been exploiting inductive logic programming [C-205, J-65]<sup>7</sup>, SAT [J-24], and answer-set programming [C-96], to effectively attack this task.
- *Specification mining*, where the input is a standard event log, and the goal is to discover a set of process constraints that “best” describes the traces contained therein; this calls for defining metrics to measure the “interestingness factor” of traces and events w.r.t. constraints, and techniques for selecting interesting constraints, at the same time incorporating reasoning to handle redundancies and inconsistencies [C-161, C-155, J-47]; we have also showed that such techniques combine well with decision mining towards discovering data-aware Declare constraints [C-179], and lend themselves to naturally account for uncertainty [J-28].
- In [C-96], we have started a line of research that has the potential of blending these two approaches. There, we take discriminative mining with preferences. Preferences are used to select, among distinct discriminating specifications, the “best” ones. We are then unifying discriminative and specification mining by studying how metrics for specification mining can be expressed as preferences.

I was among the first researchers to look into conformance checking of event data against process models, in the early days of process mining.<sup>8</sup> Specifically:

- We started by considering classical boolean, “yes/no” conformance checking results considering multi-perspective process models and process constraints incorporating temporal and data conditions, and employing logic programming techniques to perform the checking task [W-257, B-1]; these techniques have been applied in several case studies, in particular collaborative project management [W-257], wastewater management [J-62], and clinical guidelines in healthcare [C-204, BC-74].
- We have advanced alignment-based conformance checking (where non-conforming traces come with an indication on how well they align to what the model prescribes), showing how SMT solving and planning technologies can be effectively employed to compute “data-aware” alignments against procedural [C-111, J-26] and declarative [C-105] process models.
- We have extended the computation of alignments to deal with uncertainty in the model [C-107, C-106] and in the event data [C-98], throwing a bridge between conformance checking and plan recognition in AI [?].

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<sup>7</sup>This is the first approach to Declare discovery in the literature, and one of the first approaches in AI to deal with learning temporal specifications from data.

<sup>8</sup>The first paper I wrote, when I was an MEng student, is indeed on this topic [C-208].

- We have provided seminal contributions in stochastic conformance checking, introducing analytic techniques for measuring trace probabilities in stochastic process models, and in turn provide solid foundations for computing stochastic conformance checking measures [C-102, J-18]. We are now investigating how this and related approaches can be used to support formally-grounded process improvement and redesign methods.

Last but not least, we are actively researching the emerging area of *object-centric process mining*, where the focus is on real-life processes where multiple objects are co-evolved at once. We have contributed with different formal models for object-centric processes (see Section 4.1.5), and are now employing these models to provide foundations of object-centric discovery and conformance checking, supporting for the first time advanced multi-object synchronization constructs [C-78]. In addition, I am part of the standardization effort for *object-centric event data* of the IEEE task force for process mining. We are in particular studying how event knowledge graphs, relying on graph databases for storage and retrieval, and on semantic rules for creation and manipulation, can be effectively employed [?].

The results produced in this research have led to <i>two best paper awards</i> (cf. Section 4.7).
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#### 4.1.7 Runtime Verification, Monitoring, and Operational Support

Dynamic systems are often constituted by autonomous agents and heterogeneous components whose internal specification is either unknown or not accessible, so that techniques to ascertain their correctness at design-time, such as model checking and testing, are not applicable. This calls for approaches to check desired properties at runtime, by monitoring the executions of such black-box systems. In AI, monitoring is essential to track the behaviour of black-box agents and systems - particularly relevant in the very common case where the system is fully or partly constituted by machine learning components, and to verify that multiagent systems satisfy desired interaction protocols [C-145, C-84]. In BPM, monitoring is one of the essential task of operational (decision) support, an umbrella term describing the application of process mining to running process executions (as opposed as to already completed ones) [W-254, J-52].

We have approached the monitoring problem through runtime verification where, given a logical property to be verified against running executions of the system, the monitor emits a provably correct verdict. Specifically:

- We have studied *prefix monitoring* (i.e., monitoring the recorded portion of an execution under scrutiny) against rich, data- and time-aware specifications. In particular, we have developed a reactive implementation of the Event Calculus [J-61], and employed it to formalise and monitor asagent [C-199, J-54] and web-service interactions [W-258] as well as process executions [J-55].
- We were the first to study *anticipatory monitoring* (i.e., monitoring considering not only the recorded execution prefix, but also its infinitely many possible continuations) in the finite-trace setting, that is, where the infinitely many continuations of a prefix have a finite (unbounded) length. Specifically, we have shown how to construct anticipatory automata-based monitors for temporal logics over finite traces, considering also meta-properties (that is, properties predicating on the monitoring states of other properties) [C-192, C-189, C-166, J-30], as well as sophisticated data-aware properties where conditions can relate the values of numerical variables [C-84] and richer data structures [?] across time instants.
- Anticipatory monitoring of data-aware processes has been extended to deal with hybrid specifications consisting of multiple procedural processes, linked through global declarative constraints, where the same instance flows concurrently through all processes at once [C-93, J-20]. This is particularly relevant in healthcare, where patients with co-morbidities are subject to multiple clinical guidelines at once, and where their interaction, and that with background medical knowledge, may bring to conflicting situations [C-198]. Anticipatory monitoring helps there in detecting such conflicts as earliest as possible, returning them to healthcare professionals for taking countermeasures, if needed. This requires to suitably curate monitors, ensuring that they continue to return relevant feedback even when some procedural component or declarative constraint gets violated [J-21].

The results produced in this research have led to a *test-of-time award* (cf. Section 4.7).

#### 4.1.8 Semantic Technologies for Data Analysis Pipelines

One of the main open challenges in process mining does not actually pertain process mining per sé, but is about the preparation of event data to fuel process mining techniques. In fact, event data are often implicitly stored inside (legacy) information systems, such as relational databases underlying ERP/CRM systems. While extracting event data from information systems is usually tackled using manually programmed pipelines (such as ETL procedures), we have defined a methodology and working toolchain for data preparation that relies on a unique combination of semantic technologies and techniques based on ontology-based data access and integration [C-142, C-143, C-144]. This toolchain is particularly relevant when it comes to object-centric processes, whose corresponding event logs cannot be flattened into traces, but come with a full-fledged network of events and related objects [W-220, W-221, ?].

The achieved results are back-propagating to the area of semantic data access and integration, where we are extending the framework of ontology-based data access to support multiple ontological layers [C-135], and are working towards semi-automating the setup of ontology-based data access systems [C-108, W-223]. Interestingly, this makes our approach completely general, and applicable to any data analysis pipeline requiring to map relational data into a specific data format. We have in fact employed these ideas to obtain a contractual, commitment-oriented view of timestamped data stored in a legacy relational database, so as to reconstruct and query the state of normative and contractual primitives [C-128].

The results produced in this research have led to *one best paper award* (cf. Section 4.7).

## 4.2 Software Tools

Several software tools (mainly proof-of-concept prototypes) have been designed and implemented as a result of, or in connection with, our research achievements. I provide next a non-exhaustive list of tools implemented by myself, current/former members of my group, or colleagues based (in part) on foundational results developed with us:

- **ADA - Arithmetic DDS Analyzer**, a framework for data-aware dynamic systems and data Petri nets operating over (numerical) data variables, dealing with linear-time verification [C-100, ?], branching-time verification [C-99], soundness checking [C-101] and model repair [?], and monitoring [C-84].
- **db-driven MCMT**, the module of the SMT-based MCMT model checker dedicated to checking safety properties over relational processes with read-only and read-write databases [C-125, J-37].
- **CoCoMoT**, an SMT-based conformance checking tool modulo theories for computing alignments on data Petri nets (also dealing with uncertainty in the log) [C-111, C-98].
- **SAFE - Swarm Safety Detector**, a web interface for SMT-based verification of parameterized MASs with different synchronization semantics, via encoding into the MCMT model checker [C-117].
- **onprom**, a toolchain based on semantic technologies for extracting event data from relational databases [C-143, C-144, W-220, W-221].
- **RuM - Rule Mining made simple**, a desktop application that provides a comprehensive set of declarative process mining tools in a single unified package [C-104].
- **jREC**, a JAVA+Prolog reactive Event Calculus reasoner tailored to monitoring [J-61, BC-73].
- **Mobucon**, a jREC-based monitoring framework for process constraints enriched with data and temporal conditions [J-55].
- **ComMon**, a jREC-based monitoring framework for (first-order) commitment-based interactions [J-54].

- **SCIFF Checker**, a plug-in of the ProM process mining framework to classify traces in a log based on their conformance to process constraints [W-257].

### 4.3 Research Impact

The high relevance of my scientific work is witnessed by the prestigious venues in which my research results have been published, by the wide recognition of my research track by the scientific community (cf. Section 4.7), and by the bibliometric indexes related to my publication record.

I co-authored a *Springer monograph and more than 250 peer-reviewed scientific publications*, published in world-class referred international journals such as *ACM Transactions on the Web*, *ACM Transactions on Intelligent Systems and Technology*, *Journal of Artificial Intelligence Research*, *Information & Computation*, *Journal of Autonomous Agents and Multiagent Systems*, *Information Systems*, *Formal Aspects of Computing*, as well as prestigious and highly selective conferences such as *AAAI*, *IJCAI*, *AAMAS*, *KR*, *PODS*, *BPM*, *CAiSE*, *ICPM*, *ECAI*, *EDOC*.

According to *Google Scholar*, as of December 31, 2023:

- my papers have received **8062 overall citations** (4847 since 2014);
- I have have an **h-index**<sup>9</sup> of **43** (34 since 2014);
- I have an **i-10 index**<sup>10</sup> of **135** (95 since 2014).

According to *Scopus*, as of December 31, 2023:

- my papers have received **4701 overall citations**;
- I have have an **h-index of 34**.

According to the well-known PLoS Biol database by Ioannidis, Boyack, and Baas on standardised citation metrics<sup>11</sup>, I belong to the **top 2% most cited scientists worldwide**.

The full list of my scientific contributions, per type and reverse chronological order, is provided at the end of the CV.

### 4.4 Main Research Collaborations

- G. De Giacomo (University of Oxford and Sapienza University of Rome), F. Patrizi (Sapienza University of Rome), Paolo Felli (University of Bologna) - foundations of knowledge representation, reasoning, and mining for data-aware processes and for declarative processes based on linear temporal logics on finite traces.
- W.M.P. van der Aalst, A. Berti (RWTH Aachen) - object-centric process mining;
- A. Gianola (Instituto Superior Técnico, University of Lisbon) - foundations of data-aware processes, SMT-based techniques for process analysis and process mining;
- D. Fahland (Eindhoven University of Technology) - foundations of data-aware and object-centric processes;
- D. Fahland (Eindhoven University of Technology), J. Stoyanovich (New York University) - event knowledge graphs and temporal property graphs for representing object-centric event logs;
- S. Ghilardi (University of Milan) - foundations of data-aware processes and their SMT-based verification;
- A. Rivkin (Technical University of Denmark), J.M. van der Werf (University of Utrecht), A. Polyvyanyy (University of Melbourne) - formal models and process discovery techniques for object-centric processes;

<sup>9</sup>A researcher has a value of the Hirsch-index (or h-index) equal to  $h$  if  $h$  of her/his  $N$  publications have at least  $h$  citations each, while the other  $N-h$  publications have not more than  $h$  citations each. The h-index measures the cumulative impact of the scientific production of a researcher, evaluated by means of the number of citations that her/his work has obtained.

<sup>10</sup>The i10-index is the number of publications with at least 10 citations.

<sup>11</sup>Ioannidis, John P.A. (2023), *October 2023 data-update for "Updated science-wide author databases of standardized citation indicators"*, Elsevier Data Repository, V6, doi: 10.17632/btchxktzyw.6

- A. Gal (Technion), S. Leemans (RWTH Aachen), A. Polyvyanyy (University of Melbourne) - stochastic process mining, process mining with different forms of uncertainty;
- S. Leemans (RWTH Aachen), A. Senderovich (York University) - foundations of stochastic process models and their formal analysis;
- A. Kalenkova (University of Adelaide), H. Reijers (Utrecht University), A. Senderovich (York University) - process improvement and redesign using stochastic models;
- L. Geatti, A. Montanari (University of Udine) - reasoning and synthesis techniques for declarative processes based on linear temporal logics on finite traces;
- R. Peñaloza (University of Milano Bicocca) - declarative process analysis and mining based on probabilistic extensions of temporal logics on finite traces;
- L. Pontieri (ICAR-CNR) - integration of symbolic and sub-symbolic AI techniques for process analysis and mining.
- F. Chesani, D. Loreti, P. Mello (University of Bologna), C. Di Francescomarino (University of Trento) - learning of temporal constraints from event logs.

## 4.5 Scholarships

2005

*1-year technology transfer grant on the formalisation and verification of care flows*, awarded by the SPINNER Consortium<sup>12</sup>.

2006

*3-year MIUR<sup>13</sup> scholarship* for a PhD in Electronics, Computer Science and Telecommunications Engineering, University of Bologna.

2009

*2-year postdoctoral research scholarship* at the Department of Electronics, Computer Science and Systems, University of Bologna.

2010

*1-month visitor travel grant*, awarded by the Netherlands Organization for Scientific Research (NWO). Hosting Institution: Architecture for Information Systems group, Eindhoven University of Technology.

2020

*1-month visiting professor scholarship*, LSV-Cachan, Paris (*not used due to COVID-19*).

## 4.6 Research Grants and Projects

I have been involved in a number of international, national, and regional research projects. The following table summarizes the research funds I have obtained as principal investigator or co-investigator. Numbers are in Euro. Some useful remarks:

- In March 2023 the Faculty of Computer Science at UNIBZ got merged in the new Faculty of Engineering.
- PRIN is the most important line of funding for research projects in Italy, supported by the Italian Ministry of University.
- UNIBZ CRC are single-unit projects funded by the Free University of Bozen-Bolzano through an anonymous, selective peer-review process involving international reviewers.
- UNIBZ ID projects are interdisciplinary projects funded by the Free University of Bozen-Bolzano through an anonymous, selective peer-review process involving international reviewers. They involve two principal investigators from two different Faculties (one acting also as overall coordinator of the project).

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<sup>12</sup>*Spinner* is the intermediary organization managing the global grant of the Emilia Romagna Regional Operative Program (ROP) 2007-2013, European Social Fund (ESF), Axis IV Human Capital, Objective 2 “Regional Competitiveness and Employment”.

<sup>13</sup>Italian Ministry of Education, Universities and Research.

- Commissioned research indicates a project commissioned by industry through a direct research contract.
- The startup budget is assigned to a single person by the Free University of Bozen-Bolzano when that person starts his/her activity as a new professor, based on a project proposal. The budget ranges from 0 to 50K.

Funding agency	Project title	Funding (CS Fac., UNIBZ)		Overall project coordinator
		As Fac. PI	As Fac. Co-PI	
UNIBZ CRC	VeriClig: Automated Extraction and Verification of Clinical Guidelines		60 000	Fac. of CS, UNIBZ (Diego Calvanese)
UNIBZ CRC	KENDO: Knowledge-driven Enterprise Distributed Computing	46 000		Fac. of CS, UNIBZ (Marco Montali)
UNIBZ CRC	PARCIS: Process-aware Reliability Checking for Information Systems		23 000	Fac. of CS, UNIBZ (Werner Nutt)
UNIBZ CRC	OnProm: Ontology-Driven Process Mining		50 000	Fac. of CS, UNIBZ (Diego Calvanese)
Euregio Proj. Network	KAOS: Knowledge-Aware Operational Support		83 000	Fac. of CS, UNIBZ (Diego Calvanese)
UNIBZ CRC	PWORM: Planning for Workflow Management		70 000	Fac. of CS, UNIBZ (Sergio Tessaris)
UNIBZ CRC	REKAP: Reasoning and Enactment for Knowledge-Aware Processes	99 000		Fac. of CS, UNIBZ (Marco Montali)
UNIBZ CRC	DACoMan: Data-Aware Controllers for Manufacturing		64 000	Fac. of CS, UNIBZ (Paolo Felli)
ERDF 2014-2020	IDEE: Data Integration for Energy Efficiency		225 000	R3GIS company (Paolo Viskanic)
CHIST-ERA 2014-2020	PACMEL: Process-aware Analytics Support based on Conceptual Models for Event Logs		125 000	Fac. of CS, UNIBZ (Diego Calvanese)
UNIBZ Startup	VERBA: VERification of Business Artifacts	50 000		Fac. of CS, UNIBZ (Marco Montali)
UNIBZ project	DUB: Discovery of University Business processes	30 000		Fac. of CS, UNIBZ (Marco Montali)
UNIBZ ID	WineID: Wine Identity Card	60 000		Fac. of ST, UNIBZ (Emanuele Boselli)
Accenture Fac. Award	QUEST: QUERying Security Trails	50 000		Fac. of CS, UNIBZ (Marco Montali)
Research contract	SPMI: Semantic Process Mining in Industry	17 000		Fac. of CS, UNIBZ (Marco Montali)
UNIBZ ID	ADAPTERS: Self-adaptive decision-making techniques for hybrid renewable energy smart grids	60 000		Fac. of ST, UNIBZ (Massimiliano Renzi)
Italian PRIN	PINPOINT: exPlainable kNowledge-aware PrOcess INTelligence	168 000		Fac. of CS, UNIBZ (Marco Montali)
Commissioned research	telAIo Part 1: planning for chassis production		45 000	Fac. of ENG, UNIBZ (Sarah Winkler)
Commissioned research	telAIo Part 2: replanning for chassis production		50 000	Fac. of ENG, UNIBZ (Nicola Gigante)
<b>TOTAL</b>		580 000	795 000	

A fine-grained description of my participation to research projects is listed next.

#### PRIN 2005

**Investigator** for the MIUR PRIN italian Project 2005-011293 *Specification and Verification of Agents Interaction Protocols*, Coordinator Prof. Alberto Martelli.

#### FIRB 2005

**Investigator** for the FIRB Italian Project RBNE05BFRK *TOCAI.IT: Knowledge-Oriented Technologies for Enterprise Aggregation in Internet*, Coordinator Prof. Maurizio Lenzerini. In particular, I contributed to activity 9: “Discovery and Classification of Processes and Intra/Inter-Organizational Knowledge”.

PRIN 2007

**Investigator** for the MIUR PRIN Italian Project 2007-7WWCR8 *Forms of Correlation between Italian Style, Touristic Flows and Made in Italy's Consumers Trends.*, Coordinator Prof. Bernardo Valli.

Feb. 2012 – Feb. 2014

**Coordinator** (jointly with Diego Calvanese) for the 2-year project *Automated Extraction and Verification of Clinical Guidelines*, supported with  $\sim 60\,000\text{€}$  by the Foundation of the Free University of Bozen-Bolzano.

May 2011 – May 2013

**Investigator** for the EU FP7 IST-STREP Project *Artifact-centric Service Interoperation (ACSI)*. The goal of the project is to dramatically reduce the effort and time-to-usage of designing, deploying, and maintaining environments that support service collaborations. The project was coordinated by IBM Israel, and the additional partners were Sapienza Università di Roma, Italy, Imperial College, U.K., Technische Universiteit Eindhoven, Netherlands, Tartu Ulikool, Estonia, Indra Software Labs, Spain, and Colibra, Belgium.

The project was funded with  $452\,800\text{€}$  for the Free University of Bozen-Bolzano, and got an evaluation of *excellent*.

Jun. 2011 - May. 2014

**Investigator** for the Project *MANaGing Completeness of Data (MAGIC)*. The goal of the project is to develop approaches and techniques to manage the quality of data, considering in particular their completeness. The problem investigated by considering not only the data, but also the business processes that, in many situations, are used to manipulate such data.

The project involved the IT department of the province, as well as the Land Systems branch of the international automotive supplier GK.N Driveline, and was funded with  $\sim 250\text{K€}$  by the Autonomous Province of Bozen-Bolzano.

Nov. 2013 - Oct. 2016

**Investigator** for the EU FP7 IST-IP Project *Scalable End-user Access to Big Data (Optique)*. The main objective of Optique is to develop an extensible platform that provides a complete and generic solution to the data access challenges posed by big data. It brings about a paradigm shift for data access by providing a semantic end-to-end connection between users and data sources, enabling users to rapidly formulate intuitive queries, and seamlessly integrating data spread across multiple distributed data sources. The project was coordinated by the University of Oslo, Norway, and the additional partners are Oxford University, U.K., Hamburg University of Technology, Germany, Sapienza Università di Roma, Italy, National and Kapodistrian University of Athens, Greece, Fluid Operations AG, Germany, Siemens AG, Germany, Statoil, Norway, and DNV, Norway.

The project was funded with  $873\,000\text{€}$  for the Free University of Bozen-Bolzano.

Jan. 2015-

**Principal investigator** for the UNIBZ Project *KENDO: Knowledge-driven ENTERprise Distributed cOMputing*. KENDO aims at developing a formal, verifiable and executable framework for enterprise distributed systems (EDSs) empowered with knowledge. The core aspect of KENDO is to inject domain and technological knowledge encompassing both static (data-related) and dynamic (process-related) aspects into the upper layers of the internet stack (from application down to networking), and use such knowledge to drive their computation. In this way, the system nodes become able to exploit their knowledge, together with the data they acquire from the interaction with users and other nodes, to take informed decisions and perform their computation.

The project was funded with  $45\,475\text{€}$  by the Free University of Bozen-Bolzano.

Jan. 2015-Dec. 2018

**Principal co-investigator** for the UNIBZ CRC Project *Process-aware Reliability Checking for Information Systems (PARCIS)*. Formalisms for representing and defining the flow of activities in a business process are increasingly employed for specifying the usage of information systems. Recently

both practitioners and researchers have perceived the need to enrich business process modelling languages by features to describe how processes access and modify relevant data. In research, the interplay of processes and data has been usually investigated by following a top-down approach, which aimed at decidable fragments of expressive formalisms and envisaged model checkers as the target reasoning platform. In PARCIS, we pursued a bottom-up approach, drawing upon concepts and techniques from classical database research by (i) limiting the interactions of processes and databases to well-understand types of queries, (ii) focusing on properties of processes that can be captured in terms of properties of queries and integrity constraints, and (iii) following an approach to “compile away” the process model into queries in expressive query languages, so that reasoning consists in performing well-known inferences on queries.

The project was funded with 22 783 € by the Free University of Bozen-Bolzano.

Since Jan. 2016

**Principal co-investigator** for the UNIBZ CRC Project *OnProm: Ontology-Driven Process Mining*. OnProm focusses on the fundamental, but typically neglected, phase, of data preparation for process mining. Process mining techniques assume that the input data are explicitly organized in a well-defined event log. However, enterprises do not usually have such an explicit representation, while they employ information systems that reflect the domain knowledge, and where event-related information is only implicitly present. OnProm aims at bridging the gap between domain-oriented information systems and the event logs required for process mining. In particular, we want to exploit well-assessed techniques and tools coming from intelligent data management and ontology-based data access, in order to help domain experts in extracting event-related information from the legacy data present in the enterprise information systems.

The project was supported by the Eindhoven University of Technology (Prof. van der Aalst), and funded with ~ 50 000 € by the Free University of Bozen-Bolzano.

Jun. 2016 – May 2019

**Principal co-investigator** for the Euregio (Bolzano-Innsbruck-Trento) Interregional Project Network IPN12 *Knowledge-Aware Operational Support*. KAOS aims at creating a new generation of operational support techniques for business process management, by empowering them with domain knowledge. In particular, KAOS will develop a foundational framework of concepts covering organisations, processes, participants and information, providing the basis for the realization of operational support techniques that enjoy flexibility and are able to support domain experts and business analysts in the effective execution and supervision of business processes. The project was coordinated by the Free University of Bozen-Bolzano, and involves the University of Innsbruck and FBK-IRST from Trento.

The project was funded by Euregio with ~ 82 700 € for the Free University of Bozen-Bolzano.

Jan. 2017 – Dec. 2020

**Investigator** for the ERDF Project *Collaborative Construction Process Management (COckPiT)*. Globally, the construction industry is one of the main fields of economy. During the research project build4future, the PRECISE methodology for managing the whole lifecycle of a construction process has been introduced. PRECISE decomposes a construction process in three main phases: the modelling of the process, the scheduling of the activities to be performed on-site, and the runtime monitoring of the construction progress. In particular, the modelling of the process was done in the context of workshops among the participating companies who defined (i) a representation of the building; (ii) the tasks to be executed, and (iii) the resources needed. Currently, there is no commercial system available to support all the three phases of modelling, scheduling and monitoring in a satisfactory way. The objectives of our proposed project COckPiT are to close this gap and provide: (Obj1) Full support for the collaborative definition of process models. (Obj2) Full support for short-term capacity scheduling based on the real-time construction progress. (Obj3) Full support for construction progress measurement on-site. The overall outcome of the project will be a framework for collaborative and real-time management of processes in construction, based on Industry 4.0 principles. The project is coordinated by the Faculty of Computer Science at UNIBZ, and involves the Faculty of Science and Technology at UNIBZ, Fraunhofer Italia, and a network of SMEs operat-

ing in the region.

The project is funded by the European Regional Development Fund with 747.700 €.

Jun. 2017 – Mar. 2020

**Principal co-investigator** for the UNIBZ Project *Planning for Workflow Management (PWORM)*. The need to extend business processes with the capability to handle complex data objects has led to significant practical and theoretical advances in the field of business process modelling. On the practical side, there are several well-established suites for control flow and data modelling; nonetheless, they lack of support for formal verification tasks taking into account data as well as control flow. On the theoretical side, there is a significant literature for data aware processes far from concrete BPM architectures, and they are difficult to apply to existing systems. As a consequence they struggle to produce an impact in the Business Process community. With this project we aim at bridging the gap between these two separate worlds by providing a concrete framework for modelling data-aware processes capturing common features of widely used BPM suites and a set of automated reasoning services to support its usage. In particular, we aim at demonstrating the advantages of using automated planners to provide reasoning services for BPM systems.

The project is funded with  $\sim 70\,000$  € by the Free University of Bozen-Bolzano.

Jan. 2018 – June 2021

**Principal investigator** for the UNIBZ Project *Reasoning and Enactment for Knowledge-Aware Processes (REKAP)*. The ultimate goal of REKAP is to develop a foundational framework, and a corresponding prototype implementation, for the specifying, enacting, and reasoning upon knowledge-aware processes. These are integrated models combining processes, domain knowledge, and data, so as to give a holistic view of how a company operates as a whole. Three concrete goals are foreseen. First, we want to make knowledge-aware business processes executable on top of standard relational technology. Second, we want to enrich the devised execution framework with verification capabilities, making the foundational results present in the literature finally operational. Third, we want to characterize the notion of “event” in the context of knowledge-aware business processes, so as to understand how an atomic execution step of the process reflects into an update on the underlying database. While this is well-understood in the case of pure control-flow processes, the presence of data makes it a particularly challenging task, instrumental to make well-established process analysis and mining techniques applicable also in this knowledge-rich setting.

The project is funded with 99 000 € by the Free University of Bozen-Bolzano.

Aug. 2018 – Oct. 2021

**Principal co-investigator** for the UNIBZ Project *Data-Aware Controllers for Manufacturing (DACoMan)*. In the vision of Industry 4.0, modern manufacturing activities are geographically distributed, creating a multi-tier structure in which multiple enterprises realise the so-called manufacturing-as-a-service paradigm. One key requirement in this complex setting is to assess in real time whether and how the specification of the process required to manufacture a given product (or one of its subassemblies) can be executed in a given facility. Crucially, the process specification of desired products merge two fundamental aspects: the control-flow, which prescribes all the possible arrangements of manufacturing and assembly operations that need to be executed, and the data dimension, which enriches such description with the specification of required operation parameters, data manipulation directives and a set of requirements on the data collected. In this project, we propose suitable and novel data-aware representations of manufacturing resources, product specifications and production processes, together with classes of practical and implementable algorithmic approaches for the computation of data-aware controllers. Moreover, we introduce a formal specification language for the additional requirements to be imposed on the executions of such data-aware controllers. This allows us to apply formal techniques for data-aware product specifications and for providing provable certifications before, during and after production.

The project is funded with 64 000 € by the Free University of Bozen-Bolzano.

Oct. 2019 – May 2022 **Faculty principal Co-investigator** of the UNIBZ unit for the ERDF 2014-2020 Project *Data Integration for Energy Efficiency (IDEE)*. The aim of the IDEE project is to

develop a technological infrastructure based on semantic technologies for the integration of data concerning buildings, with an emphasis on the energy related data, and to provide techniques and tools for the visualization and analysis of such data. The project is developing a case study based on the municipality of Merano, where current and historical data about energy consumption: (gas, electricity, distance-heating), as well as cadaster data will be accessed and integrated using the ontology-based data access technology developed by the KRDB Research Centre for Knowledge and Data at UNIBZ. The project is coordinated by R3-GIS, a local company specialised in the development of geographical information systems to manage building and energy-related data, and has as additional participant Alperia, the main energy provider in South Tyrol.

The project is funded through European Social Funds with  $\sim 225\,000\text{€}$  for the Free University of Bozen-Bolzano.

Feb. 2019 – July 2022 **Principal investigator** for the UNIBZ personal start-up project *VERification of Business Artifacts (VERBA)*. VERBA aims at providing a proof-of-concept, concrete verification framework for business artifacts, one of the main conceptual frameworks for the representation of integrated models for business processes and master data. This is achieved by relying on one of the most promising technologies for the verification of infinite-state systems, namely model checking with Satisfiability-Modulo-Theories (SMT). While SMT model checkers have been already successfully applied in practice to verify programs and parameterized distributed systems, their application in the context of data-aware processes is still unexplored, yet very promising.

The project is funded by UNIBZ with  $50\,000\text{€}$ .

From Mar. 2019 **Faculty principal Co-investigator** of the UNIBZ unit for the CHIST-ERA 2014-2020 Project *Process-aware Analytics Support based on Conceptual Models for Event Logs (PACMEL)*. Nowadays great attention is paid to the Industry 4.0. concept whose central idea is the exploitation of large amounts of data generated by different kinds of sensors, to enact highly automatized, robust processes and to develop high quality monitoring systems of process realization that support intelligent semi-autonomous decision making. At the same time, big data analytics as core competency and a process-oriented management approach are very often indicated as one of the main pillars of any modern company. Towards this, the main objective of PACMEL is to develop a process-aware analytics framework for analyzing data from sensors and devices to enable the use of this data for process modeling and analysis, with the aim of improving the business processes according to the BPM cycle.

The project is funded by MIUR through the CHIST-ERA framework with  $\sim 125\,000\text{€}$  for the Free University of Bozen-Bolzano.

From Aug. 2019 **Faculty Principal Investigator** of the Computer Science Faculty for the UNIBZ ID Project *Wine Identity Card (WineID)*. The project brings forward a new approach to treat the analytical data of the samples obtained testing different winemaking procedures for Pinot blanc and Pinot noir (two top wines produced in South Tyrol). The aim is to identify and validate new protocols to assess wine authenticity (use of admitted / not admitted winemaking procedures, additives and coadiuvants, type of the grape - blend) which will be proposed to wine control authorities to update or integrate the current methods. This is achieved by synergically integrating the enology competencies of the UNIBZ Faculty of Science and Technology, with those in process and data analytics of the UNIBZ Faculty of Computer Science. The winemaking processes for Pinot blanc and noir will be modeled, and chemical data will be collected on real process executions, considering raw materials, intermediates of production, and finished products. The collected, multi-dimensional data will be then analyzed using techniques grounded in data and process analytics.

The project is coordinated by the Faculty of Science and Technology, and is funded by UNIBZ with  $\sim 60\,000\text{€}$  for the Faculty of Computer Science.

From June 2022 **Coordinator and Principal Investigator** of the Italian PRIN 2020 Project *ex-Plainable kNowledge-aware PrOcess INTelligence (PINPOINT)*. The project focusses on process mining, the frontier of process intelligence, and deals with two main issues in the process mining lifecycle:

1. the lack of documentation and traceability, due to the heterogeneity of its steps, the presence of ad-hoc procedures, and the usage of black-box components that do not provide interpretable insights into the produced results;
2. the challenge of integrating and using domain knowledge within process mining pipelines, to empower learning and inference algorithms towards meaningful results.

Building on recent advancements in explainable artificial intelligence and multi-perspective declarative languages and techniques, PINPOINT aims at developing a full-fledged set of techniques towards explainable, knowledge-aware process intelligence. This is instrumental to create auditable, verifiable, trustworthy process mining results, and in turn make them actionable.

The project is coordinated by the Faculty of Computer Science at UNIBZ, and involves four additional units: Sapienza University of Rome, University of Milano Bicocca, CNR, and University of Calabria.

The project is funded by the Italian Ministry of University through the PRIN scheme, with a total contribution of  $\sim 795\,000\text{€}$ , of which  $\sim 168\,000$  are assigned to UNIBZ.

From Aug. 2022

**Faculty Principal Investigator** of the Computer Science Faculty for the UNIBZ ID Project *Self-adaptive decision-making techniques for hybrid renewable energy smart grids (ADAPTERS)*. The project focusses on Hybrid Renewable Energy Systems (HRES), and deals with the identification, adaptation, and exploitation of suitable declarative languages to capture the different HRES constraints and optimisation objectives, and to invoke corresponding solvers mixing offline and online techniques, adapting the produced results to a wide range of possible energy demands and varying boundary conditions.

The project is coordinated by the Faculty of Science and Technology, and is funded by UNIBZ with  $60\,000\text{€}$  for the Faculty of Computer Science.

From Nov. 2023

**Principal Co-Investigator and project manager** of the Commissioned Research project *telAio: planning and replanning for chassis production*, commissioned by *Automobili Lamborghini*. The project aims at providing a flexible and customised planning and re-planning platform for the manufacturing of the Lamborghini Revuelto sport car, produced by Automobili Lamborghini S.p.A. in Sant’Agata Bolognese, Italy. The platform supports the optimisation of production volumes by aiding decision making in exceptional circumstances such as plant faults, while accounting for the needs of the operators working at the plant.

The project comes in two parts and provides, in its entirety, a funding of  $95\,000\text{€}$  for the Faculty of Engineering, UNIBZ.

## 4.7 Prizes and Awards

I have received national prizes and best paper awards in recognition of the importance and impact of my research.

### *Career Awards*

Jun. 25, 2009

**Recipient** of the “**Marco Cadoli**” **Distinguished Dissertation Award**, awarded by the Italian Association for Logic Programming to the *best Italian PhD thesis focused on computational logics and defended in the period 2007–2009*.

In their reviews of the thesis,

- Prof. Wil van der Aalst declared: *The thesis is truly excellent [...] The work covers a broad area and provides deep and interesting results.*
- Prof. Robert Kowalski declared: *The subject of the thesis [...] is exceptionally broad and outward-looking. [...] This is one of the best PhD theses I have seen in a long time.*

May 2010

**Finalist** for the **Lions prize for scientific research and technological innovation**, awarded

by the Lions Club to the best PhD thesis defended in 2009–2010, and carried out within the PhD School for Information Science and Engineering at the University of Bologna.

2011

Paper *Social Commitments in Time: Satisfied or Compensated* selected as one of the “best of DALT” **highly influential (most cited) papers**, within the Declarative Agent Languages and Technologies workshop series.

Sep. 25, 2015

**Recipient of the Artificial Intelligence “Marco Somalvico” 2015 Prize**, awarded by the *Italian Association for Artificial Intelligence (AI\*IA)* to the *best Italian researcher under 35 years of age who autonomously contributed to advance the state-of-the-art in Artificial Intelligence*. In its report, the Prize Committee declared that:

Of particular significance and impact is his contribution to the development of innovative AI techniques in the context of Business Process Management, an area in which he is one of the top recognized persons in Europe (in spite of his young age).

2016

**Recipient of the Faculty Outstanding Achievement Award of 2016**, given by the Faculty of Computer Science at the Free University of Bozen-Bolzano to a member who provided outstanding scientific contributions and service to the Faculty.

2018

**Recipient of the Faculty Best Teacher Award of 2018**, given in recognition of outstanding teaching effort within the study programs of the Faculty of Computer Science at the Free University of Bozen-Bolzano.

2019

**Runner-up** for the 2019 edition of the *South Tyrol Research Prize for young researchers*, as one of the **top-three under 40 researchers in South Tyrol (in all fields)**.

2021

**Runner-up Test-of-Time Award** at BPM 2021, for the paper *Monitoring Business Constraints with Linear Temporal Logic: An Approach Based on Colored Automata*, considered as one of the two top-influential papers among those appeared in BPM 2011 and BPM 2012.

#### *Best Paper Awards and Other Mentions*

- **Best paper award** at the 7th International Symposium “From Agent Theory to Agent Implementation” (AT2AI-7), Vienna (Austria), April 6-7 2010, for the paper *Monitoring Time-Aware Social Commitments with Reactive Event Calculus*.
- **Best paper award** at the 7th International Conference on Web Reasoning and Rule Systems (RR-2013), Mannheim (Germany), July 27-29 2013, for the paper *Verification and Synthesis in Description Logic Based Dynamic Systems*.
- **Best paper award** at the 13th International Conference on Business Process Management (BPM 2015), Innsbruck (Austria), August 31 - September 3 2015, for the paper *Ensuring Model Consistency and Minimality in Declarative Process Discovery*.
- **Outstanding IJCAI PC Member** at the 25th International Joint Conference on Artificial Intelligence (IJCAI 2016), New York City (USA), July 9-15 2016.
- **Best paper award** at the 14th International Conference on Business Process Management (BPM 2016), Rio de Janeiro (Brasil), September 18-22 2016, for the paper *Semantics and Analysis of DMN Decision Tables*.

- **Best paper award** at the 1st International Joint Conference on Rules and Reasoning (RuleML+RR 2017), London (UK), July 12-15 2017, for the paper *Semantic DMN: Formalizing decision models with domain knowledge*.
- **Runner-up best paper** at the 6th European Conference on Service-Oriented and Cloud Computing (ESOCC 2017), Oslo (Norway), September 27-29 2017, for the paper *IoT-based Compliance Checking of Multi-party Business Processes modeled with Commitments*.
- **Best paper award** at the 22nd International Enterprise Computing Conference (EDOC 2018), Stockholm (Sweden), October 16-19 2018, for the paper *Formalizing Application Integration Patterns*.
- **Distinguished IJCAI PC Member** at the 27th International Joint Conference on Artificial Intelligence and the 23rd European Conference on Artificial Intelligence (IJCAI-ECAI 2018), Stockholm (Sweden), July 13-19 2018.
- **Best paper award** at the 23rd International Enterprise Computing Conference (EDOC 2019), Paris (France), October 28-31 2019, for the paper *Representing and Querying Norm States Using Temporal Ontology-Based Data Access*.
- **Best paper award** at the 23rd International Conference on Principles and Practice of Multi-Agent Systems (PRIMA 2020), AoE (online), November 18-20 2020, for the paper *A SMT-based Implementation for Safety Checking of Parameterized Multi-Agent Systems*.
- **Best paper award** at the 19th International Conference on Business Process Management (BPM 2021), Rome (Italy), September 6-10 2021, for the paper *CoCoMoT: Conformance Checking of Multi-perspective Processes via SMT*.
- **Best paper award** at the 20th International Conference on Business Process Management (BPM 2022), Münster (Germany), September 11-16 2022, for the paper *Reasoning on Labelled Petri Nets and their Dynamics in a Stochastic Setting*.

## 5 Experience in Academic Teaching

I consider teaching as the most direct and possibly profound impact we, as researchers, have on society in the short term. I believe that the same philosophy I apply to research also applies to teaching: students need to get exposed to multiple facets of the same topic - conceptual, formal, algorithmic, empirical - to properly understand that topic in its full complexity. To this end, intuitions and rigorous arguments have to be continuously interleaved. Saying it with Maria Montessori: *“to teach details is to bring confusion; to establish the relationship between things is to bring knowledge”*.

I started being a teaching assistant for University-level courses when I was only 22. Since then, I have been consistently and continuously involved in teaching, first as a teaching assistant for BEng and MEng courses at the University of Bologna, and then as a lecturer for BSc and MSc courses at the Free University of Bozen-Bolzano. In addition, I have been involved in teaching activity and scientific dissemination with a variety of audiences, from elementary and high-school students to undergraduate, graduate and PhD students, from scientists and researchers to professionals working in the industry, and even the general audience. I am passionate about teaching, and I always try to convey even very technical and difficult concepts in an understandable way, balancing rigorous and formal presentation with concrete and effective examples. I do my best to actively involve the audience during my talks, and to establish a friendly and informal environment. I always fine-tune and adapt my slides, my speech, the drawings I do on the blackboard, and the examples I use, carefully taking into account who is listening.

Since 2015, I am actively involved in the management of study programs at the Free University of Bozen-Bolzano, and had the possibility of designing, and coordinating, a new MSc program in computational data science. Since 2019, I am Vice-Dean for Studies in the Faculty of Computer Science, service that I continued to provide in the newly established Faculty of Engineering from March 2023 onwards.

## 5.1 Taught Courses

A.Y. 2011/2012

**Lecturer** of *Distributed Systems* (4ECTS), Bachelor in Computer Science and Engineering, Free University of Bozen-Bolzano.

General lecturer evaluation: *definitely positive* 33,33%; *generally positive* 53,34%; *generally negative* 13,33%; *definitely negative* 0%; *missing* 0%.

**Lecturer** of *Conceptual Modeling for Information Systems*  $\hat{A}$  (4ECTS), MSc in Computer Science, Free University of Bozen-Bolzano.

General lecturer evaluation: *definitely positive* 50,00%; *generally positive* 50,00%; *generally negative* 0%; *definitely negative* 0%; *missing* 0%.

A.Y. 2012/2013

**Lecturer** of *Knowledge Representation and Ontologies*  $\hat{A}$  (8ECTS – 4 taught by him), Erasmus Munds European Master in Computational Logic, Free University of Bozen-Bolzano.

General lecturer evaluation: *definitely positive* 80,00%; *generally positive* 20,00%; *generally negative* 0%; *definitely negative* 0%; *missing* 0%.

**Lecturer** of *Conceptual Modeling for Information Systems*  $\hat{A}$  (4ECTS), MSc in Computer Science, Free University of Bozen-Bolzano.

General lecturer evaluation: *definitely positive* 73,33%; *generally positive* 26,67%; *generally negative* 0%; *definitely negative* 0%; *missing* 0%.

A.Y. 2013/2014

**Lecturer** of *Data and Process Modelling* (8ECTS), MSc in Computer Science, Free University of Bozen-Bolzano.

Excerpt from the evaluation by students attending the course:

- Does the teacher stimulate / motivate interest in the subject?  
*Definitely YES* 40,00%; *generally YES* 60,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.
- Does the teacher explain the subject clearly?  
*Definitely YES* 40,00%; *generally YES* 60,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.

A.Y. 2014/2015

**Lecturer** of *Data and Process Modelling* (8ECTS), MSc in Computer Science, Free University of Bozen-Bolzano.

Excerpt from the evaluation by students attending the course:

- Does the teacher stimulate / motivate interest in the subject?  
*Definitely YES* 57,00%; *generally YES* 43,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.
- Does the teacher explain the subject clearly?  
*Definitely YES* 43,00%; *generally YES* 57,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.
- Does the teacher display teaching ability?  
*Definitely YES* 57,00%; *generally YES* 43,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.

**Lecturer** of a 32-hour advanced course on *Data and Process Modelling*, delivered in April and May 2015 to ~30 IT experts working for the Province of Bozen-Bolzano.

Overall lecturer evaluation: 4.7/5.

A.Y. 2015/2016

**Lecturer** of *Data and Process Modelling* (8ECTS), MSc in Computer Science, Free University of Bozen-Bolzano.

Excerpt from the evaluation by students attending the course:

- Does the teacher stimulate / motivate interest in the subject?  
*Definitely YES* 71,00%; *generally YES* 29,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.
- Does the teacher explain the subject clearly?  
*Definitely YES* 57,00%; *generally YES* 43,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.

- Does the teacher display teaching ability?  
*Definitely YES* 71,00%; *generally YES* 29,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.

A.Y. 2016/2017

**Lecturer** of *Data and Process Modelling* (8ECTS), MSc in Computer Science, Free University of Bozen-Bolzano.

Student evaluations not available.

A.Y. 2017/2018

**Lecturer** of *Data and Process Modelling* (8ECTS), MSc in Computer Science, Free University of Bozen-Bolzano.

Student evaluations not available.

A.Y. 2018/2019

**Lecturer** of *Data and Process Modelling* (6ECTS), MSc in Computational Data Science, Free University of Bozen-Bolzano.

Excerpt from the evaluation by students attending the course:

- Does the teacher stimulate / motivate interest in the subject?  
*Definitely YES* 86,00%; *generally YES* 14,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.
- Does the teacher explain the subject clearly?  
*Definitely YES* 86,00%; *generally YES* 14,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.
- Does the teacher display teaching ability?  
*Definitely YES* 100,00%; *generally YES* 0,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.

**Lecturer** of *Intelligent Systems* (6ECTS), BSc in Computer Science, Free University of Bozen-Bolzano.

Excerpt from the evaluation by students attending the course:

- Does the teacher stimulate / motivate interest in the subject?  
*Definitely YES* 42,00%; *generally YES* 48,00%; *generally NO* 5%; *definitely NO* 5%; *missing* 0%.
- Does the teacher explain the subject clearly?  
*Definitely YES* 63,00%; *generally YES* 37,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.
- Does the teacher display teaching ability?  
*Definitely YES* 68,00%; *generally YES* 32,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.

A.Y. 2019/2020

**Lecturer** of *Data and Process Modelling* (6ECTS), MSc in Computational Data Science, Free University of Bozen-Bolzano.

Excerpt from the evaluation by students attending the course:

- Does the teacher stimulate / motivate interest in the subject?  
*Definitely YES* 55,00%; *generally YES* 45,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.
- Does the teacher explain the subject clearly?  
*Definitely YES* 55,00%; *generally YES* 45,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.
- Does the teacher display teaching ability?  
*Definitely YES* 73,00%; *generally YES* 27,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.

**Lecturer** of *Data and Process Modelling for Business Informatics* (6ECTS), BSc in Informatics and Management of Digital Business, Free University of Bozen-Bolzano. (*held online*)

Excerpt from the evaluation by students attending the course:

- Does the teacher stimulate / motivate interest in the subject?  
*Definitely YES* 39,00%; *generally YES* 61,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.
- Does the teacher explain the subject clearly?  
*Definitely YES* 44,00%; *generally YES* 56,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.
- Does the teacher display teaching ability?  
*Definitely YES* 61,00%; *generally YES* 39,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.

**Responsible** for the *Capstone projects*, projects carried out by students on real data provided by companies and institutions, as part of the MSc in Computational Data Science.

A.Y. 2021/2022

**Lecturer** of *Data and Process Modelling* (6ECTS), MSc in Computational Data Science, Free University of Bozen-Bolzano. (*held online*)

Excerpt from the evaluation by students attending the course:

- Does the teacher stimulate / motivate interest in the subject?  
*Definitely YES* 50,00%; *generally YES* 50,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.
- Does the teacher explain the subject clearly?  
*Definitely YES* 63,00%; *generally YES* 25,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.
- Does the teacher display teaching ability?  
*Definitely YES* 63,00%; *generally YES* 37,00%; *generally NO* 0%; *definitely NO* 0%; *missing* 0%.

**Lecturer** of *Data and Process Modelling for Business Informatics* (6ECTS), BSc in Informatics and Management of Digital Business, Free University of Bozen-Bolzano. (*held online*)

Excerpt from the evaluation by students attending the course:

- Does the teacher stimulate / motivate interest in the subject?  
*Definitely YES* 24,00%; *generally YES* 62,00%; *generally NO* 14%; *definitely NO* 0%; *missing* 0%.
- Does the teacher explain the subject clearly?  
*Definitely YES* 29,00%; *generally YES* 52,00%; *generally NO* 19%; *definitely NO* 0%; *missing* 0%.
- Does the teacher display teaching ability?  
*Definitely YES* 28,00%; *generally YES* 67,00%; *generally NO* 5%; *definitely NO* 0%; *missing* 0%.

A.Y. 2022/2023

**Lecturer** of *Data and Process Modelling* (6ECTS), MSc in Computing for Data Science, Free University of Bozen-Bolzano.

Evaluations not available.

**Lecturer** of *Data and Process Modelling for Business Informatics* (6ECTS), BSc in Informatics and Management of Digital Business, Free University of Bozen-Bolzano.

Excerpt from the evaluation by students attending the course:

- Does the teacher stimulate / motivate interest in the subject?  
*Definitely YES* 21,00%; *generally YES* 68,00%; *generally NO* 11%; *definitely NO* 0%; *missing* 0%.
- Does the teacher explain the subject clearly?  
*Definitely YES* 16,00%; *generally YES* 74,00%; *generally NO* 5%; *definitely NO* 5%; *missing* 0%.
- Does the teacher display teaching ability?  
*Definitely YES* 21,00%; *generally YES* 63,00%; *generally NO* 16%; *definitely NO* 0%; *missing* 0%.

## 5.2 Advanced Courses and Tutorials

A.Y. 2014/2015

**Lecturer** of *Research Methods* (4ECTS), module *Presenting Scientific Work*, PhD in Computer Science, Free University of Bozen-Bolzano.

A.Y. 2015/2016

**Lecturer** of *Research Methods* (4ECTS), module *Presenting Scientific Work*, PhD in Computer Science, Free University of Bozen-Bolzano.

A.Y. 2016/2017

**Lecturer** of *Research Methods* (4ECTS), module *Presenting Scientific Work*, PhD in Computer Science, Free University of Bozen-Bolzano.

**Lecturer** of *Verification of Data-Centric Systems* (together with Diego Calvanese), Summer School on Logic, Artificial Intelligence, and Verification (LAIve 2017), TU Wien, Austria, July 3-5,2017.

**Lecturer** of *OBDA For Log Extraction in Process Mining*, 13th Reasoning Web Summer School

(RW 2017), Birkbeck College London, UK, July 7-11, 2017.

**Lecturer** of *Verification of Data-Aware Processes* (together with Diego Calvanese), 29th European Summer School in Logic, Language, and Information (ESSLLI 2017), University of Toulouse, France, 17-28 July, 2017.

A.Y. 2017/2018

**Tutorial** on *Integrated modeling and verification of processes and data* at the *15th International Conference on Business Process Management (BPM 2017)*, Barcelona, Spain, September 10-15, 2017.

**Tutorial** on *Process mining: from zero to hero* at the *18th International Conference on Product-Focused Software Process Improvement (PROFES 2017)*, Innsbruck, Austria, November 30-December 1, 2017.

A.Y. 2020/2021

**Lecturer** of *Research Methods* (4ECTS), module *Presenting Scientific Work*, PhD in Computer Science, Free University of Bozen-Bolzano.

**Tutorial** on *RuM: Declarative Process Mining, Distilled* at the *19th International Conference on Business Process Management (BPM 2021)*, Rome, Italy, September 6-10, 2021.

A.Y. 2021/2022

**Lecturer** of *Research Methods* (4ECTS), module *Presenting Scientific Work*, PhD in Computer Science, Free University of Bozen-Bolzano.

**Lecturer** of the module *declarative process mining* at the *1st Summer School on Process Mining*, RWTH Aachen, Germany, July 4-8, 2022.

A.Y. 2022/2023

**Lecturer** of *Research Methods* (4ECTS), module *Presenting Scientific Work*, PhD in Computer Science, Free University of Bozen-Bolzano.

**Advanced course** on *Data-aware processes - modeling and verification* at the *6th Advanced Course on Petri Nets*, Torun, Poland, September 3-8, 2023.

A.Y. 2023/2024

**Lecturer** of *Research Methods* (4ECTS), module *Presenting Scientific Work*, PhD in Computer Science, Free University of Bozen-Bolzano.

**Tutorial** on *Process mining and artificial intelligence* at the *22nd International Conference of the Italian Association for Artificial Intelligence (AIxIA 2023)*, Rome, Italy, November 7, 2023.

### 5.3 Teaching Labs

A.Y. 2003/2004

*Operating Systems* BEng in Computer Engineering, University of Bologna.

A.Y. 2005/2006

*Operating Systems* BEng in Computer Engineering, University of Bologna.

2005 – 2011

Seminars, class and lab lectures for the *Fundamentals of Artificial Intelligence* and *Applications of Artificial Intelligence* courses, MEng in Computer Engineering, Univ. of Bologna.

A.Y. 2006/2007

*Lab of Computer Science*, BEng in Computer Engineering, University of Bologna.

A.Y. 2007/2008

*Lab of Computer Science*, BEng in Computer Engineering, University of Bologna.

A.Y. 2008/2009

*Fundamentals and Lab of Computer Science* BEng in Automation Engineering, University of Bologna.

*Fundamentals of Computer Science*, BEng in Computer Engineering, University of Bologna.

A.Y. 2017/2018

*Database Systems*, BSc in Computer Science, Free University of Bozen-Bolzano.

*Programming Paradigms*, BSc in Computer Science, Free University of Bozen-Bolzano.

A.Y. 2020/2021

*Programming Projects*, BSc in Computer Science, Free University of Bozen-Bolzano.

*Web and Internet Technologies*, BSc in Computer Science, Free University of Bozen-Bolzano.

*Data and Process Modelling for Business Informatics*, BSc in Informatics and Management for Digital Business, Free University of Bozen-Bolzano.

## 5.4 Supervision and Evaluation of Theses

I strongly support collaborative research, and I particularly enjoy supporting students and young researchers in developing their ideas and research vision.

### *Theses Evaluation Panels*

2017

- **President** of the evaluation commission for the *2017 AI\*IA “Marco Cadoli” award*, given to the best Italian PhD dissertation in artificial intelligence.
- **Member** of the evaluation commission for the *2017 Best BPM Dissertation Award*, given to the best PhD dissertation in business process management.

2018

- **Member** of the evaluation commission for the *2018 Best BPM Dissertation Award*, given to the best PhD dissertation in business process management.

2019

- **Member** of the evaluation commission for the *2019 Best BPM Dissertation Award*, given to the best PhD dissertation in business process management.

2020

- **President** of the evaluation commission for the *2020 Best Process Mining Dissertation Award*, given to the best PhD dissertation in process mining.
- **Member** of the evaluation commission for the *2020 Best BPM Dissertation Award*, given to the best PhD dissertation in business process management.
- **Member** of the evaluation commission for the *2020 Leonardo Lesmo Best Master Thesis Award*, given by the Italian Association for Artificial Intelligence (AIxIA) to the best AI Master thesis defended in an Italian University.

2021

- **President** of the evaluation commission for the *2021 Best Process Mining Dissertation Award*, given to the best PhD dissertation in process mining.

2022

- **Vice-President** of the evaluation commission for the *2022 GULP Best PhD Thesis award*, given by the Italian Association of Logic Programming to the best PhD Italian thesis on computational logics.

### *Supervision of PhD Theses*

2011 – 2015

**Co-supervisor** of Dmitry Solomakhin on *combining process and ontological modelling*. The thesis was not concluded, since Dmitry found a job in the industry.

2012 – 2015

**Supervisor** of Anna Roubickova on *theoretical and experimental analysis of case-based planning techniques*.

2012 – 2016

**Co-supervisor** of Ario Santoso on *verification of data-aware business processes in the presence of ontologies*.

2014 – 2019

**Supervisor** of Andrey Rivkin on *integrated modeling, execution, and verification of processes and data*. With his PhD dissertation, Andrey won the *Best PhD student award* within the Faculty of Computer Science, Free University of Bozen-Bolzano.

2017 – 2022

**Supervisor** of Alessandro Gianola on *SMT-based Safety Verification of Data-Aware Processes*. With his PhD dissertation, Alessandro won three prestigious international awards: the 2022 Best Italian PhD Thesis in Theoretical Computer Science Award given by the Italian Chapter of EATCS, the 2022 Best BPM Dissertation Award given by the BPM Association, and the 2023 CADE Bill McCune PhD Award in Automated Reasoning given by CADE Inc.

2018

**Co-supervisor** of Williams Rizzi (jointly with Chiara Ghidini and Chiara Difrancescomarino from FBK-IRST) on the topic *predictions and recommendations in process mining*.

2019 – now

**Co-supervisor** of Francesco Di Cosmo (jointly with Diego Calvanese) on the verification of declarative distributed systems.

2020 – now

**Supervisor** of Alessandro Burigana on epistemic reasoning for interorganisational processes.

2021 – now

**Co-supervisor** of Rikayan Chaki (jointly with Diego Calvanese) on object-centric declarative process mining.

#### *Evaluation of PhD Theses*

2012

- **Reviewer and member of the examination panel** for the defense of the PhD Thesis *Reasoning about Actions in Transaction Logic*, by Martin Rezk, Free Univ. of Bozen-Bolzano.

2013

- **External reviewer** for the PhD Thesis *Process Mining of Artful Processes*, by Claudio di Ciccio, Sapienza Università di Roma.
- **Reviewer and member of the examination panel** for the defense of the PhD Thesis *Context-aware Music Recommendation: Recommending Music for Places of Interest*, by Marius Kaminskis, Free Univ. of Bozen-Bolzano.

2014

- **Member of the final examination committee** for the PhD in Computer Engineering at Sapienza University of Rome.

2015

- **Vice-chair of the examination panel** for the PhD defense by Silvano Colombo Tosatto on *Proving Regulatory Compliance: Business Processes, Logic, Complexity*, University of Luxembourg and University of Turin.

2016

- **Member of the examination panel** for the PhD defense by Montserrat Estanol on *Artifact-centric Business Process Models in UML: Specification and Reasoning*, Universitat Politècnica de Catalunya.

2018

- **Member of the final examination committee** for the PhD in Computer Science and Engineering at the *University of Bologna*.
- **Reviewer and member of the examination panel** for the PhD Defense by Marvin Triebel on *Preserving Data Integrity in Distributed Systems*, Humboldt-Universität zu Berlin.

2019

- **Reviewer and member of the examination panel** for the PhD Defense by Eduardo González López de Murillas on *Process Mining on Databases: Extracting Event Data from Real Life Data Sources*, Eindhoven University of Technology.
- **Reviewer and member of the examination panel** for the PhD Defense by Guangming Li on *Process Mining based on Object-Centric Behavioral Constraint (OCBC) models*, Eindhoven University of Technology.
- **Reviewer and member of the examination panel** for the PhD Defense by Alexey A. Mitsyuk on *Structure-Preserving Process Model Repair Based on Event Logs*, National Research University Higher School of Economics, Faculty of Computer Science, Moscow.

2020

- **Reviewer and member of the examination panel** for the PhD Defense by Mathilde Boltenhagen on *Optimization Techniques for Conformance Checking and Model Repair in Process Mining*, ENS-Paris Saclay, Paris.

2021

- **Reviewer and member of the examination panel** for the PhD Defense by Christoffer Olling Back on *Hybrid Process Mining: Inference & Evaluation Across Imperative & Declarative Approaches*, University of Copenhagen.
- **Member of the examination panel** for the PhD Defense by Rituraj Singh on *Data Centric Workflows for Crowdsourcing Application*, Université de Rennes.

2022

- **Member of the examination panel** for the PhD Defense by Marjolein Deryck on *Knowledge Base Systems in Practice*, KU Leuven.
- **Reviewer** for the PhD Thesis by Daniel Reissner on *Quality Measures in Process Mining: Tackling the scalability challenge*, University of Melbourne.
- **Reviewer and Member of the examination panel** for the PhD Defense by Roman A. Nesterov on *Discovering Process Models for Multi-Agent Systems from Event Logs*, National Research University Higher School of Economics, Faculty of Computer Science, Moscow, and University of Milano-Bicocca.
- **Reviewer and Member of the examination panel** for the PhD Defense by Roman A. Parvizimosaed on *Symboleo: Specification and Verification of Legal Contracts*, University of Ottawa.

2023

- **Reviewer and Member of the examination panel** for the PhD Defense by Vadim Denisov on *Process Mining for Systems with Shared Resources and Queues*, Technical University of Eindhoven, the Netherlands.

*Supervision of Bachelor/Master Theses*

Supervision of Master theses:

2013

- **Supervisor** of the MSc thesis by Andrey Rivkin, European Master in Computational Logic, on *Formal Verification of Data-Aware Business Processes Based on Petri Nets*.

2015

- **Supervisor** of the MSc thesis by Alina Aleksandrova, European Master in Computational Logic, on *Engineering data-aware commitment-based multiagent systems*.
- **Supervisor** of the MSc thesis by Manfred Gerstgrasser, MSc in Computer Science, Free University of Bozen-Bolzano, on *Ontology-Based Data Access and relational mapping*.

2017

- **Supervisor** of the MSc thesis by Gianluca Stivan, MSc in Computer Science, on *Kiki: weak memory models for parallel data processing*.
- **Supervisor** of the MSc thesis by Aman Sinha, European Master in Computational Logic, on *Database-centric colored Petri nets*.
- **Co-supervisor** of the MSc thesis by Simone Tritini, MSc in Computer Science, on *Object-centric behavioral constraints*.

2019

- **Co-supervisor** of the MSc thesis by Luca Sabiucciu, MSc in Computer Science, on *Explorative Mining of Oncology Patient Processes*.

2020

- **Supervisor** of the MSc thesis by Aurelia Pagano, MSc in Computer Science, on *Flexibility in Business Process Models: an Application-oriented Comparative Study*
- **Supervisor** of the MSc thesis by Luca Bellettati, MSc in Computer Science, on *Encoding dapSL into a running system: DAPHNE*.

2022

- **Supervisor** of the MSc thesis by Abdelhalim Daftaoui, MSc in Computational Data Science, on *Extraction of Object-Centric Event Logs from Relational Databases*.

2023

- **Supervisor** of the MSc thesis by Johan Leandro Porras Galindo, MSc in Computing for Data Science, on *semantic analysis of manufacturing processes* (ongoing).

Supervision of Bachelor theses:

2015

- **Supervisor** of the BSc Thesis by Riccardo Steffan, BSc in Computer Science, on *A Reactive Event Calculus reasoner running in JAVA*.

2017

- **Supervisor** of the BSc Thesis by Luca Sabiucciu, BSc in Computer Science, on *A tool for the verification of data-aware business processes*.

2019

- **Supervisor** of the BSc Thesis by Davide Briozzi, BSc in Computer Science, on *An SMT-based formalization of Petri nets with data*.
- **Supervisor** of the BSc Thesis by Davide Perez Cuevas, BSc in Computer Science, on *Simulation of Ant Colonies Walking on Graphs*.

- **Supervisor** of the BSc Thesis by *Marco Briozzi*, BSc in Computer Science, on *An SMT-based formalization of Petri nets with data*.
- **Co-supervisor** of the BSc Thesis by *Alessandro Mattivi*, BSc in Computer Science, on *Implementation of an OpenAI Gym environment for AI education*.

2023

- **Supervisor** of the BSc Thesis by *Elena Battiston*, BSc in Informatics and Management of Digital Business, on *Integrating Chatbots and BPM for Conversational Process Analysis*.
- **Supervisor** of the BSc Thesis by *Enisa Huseni*, BSc in Informatics and Management of Digital Business, on *Subjective Conformance Checking for Business Processes*.
- **Supervisor** of the BSc Thesis by *Delia Mennitti*, BSc in Informatics and Management of Digital Business, on *Modelling object-centric processes with procedural and declarative notations*.

## 6 Academic Responsibilities

I am involved in the organization of top-tier international conferences and other events. I actively participate to faculty-related activities, and contribute to establish connections and collaborations with the territory. I gained experience in the design and management of study programmes in computer science, artificial intelligence, and data science.

### 6.1 Institutional Responsibilities

May 2011 – now

**Member** of the *PhD Committee in Computer Science*, Free University of Bozen-Bolzano.

Jan. 2013 – Dec. 2015

**Elected member** of the *Board of Directors of the Italian Association for Logic Programming (GULP)*.

Feb. 2014 – Aug. 2017

**Member** of the *Degree Committee of the Master in Computer Science*, Free University of Bozen-Bolzano.

Jun. 2015 – May 2019

**Academic Erasmus contact point** for the *Master in Computer Science*, Free University of Bozen-Bolzano.

Sep. 2017 – Feb. 2023

**Coordinator** of the *PRISM (PRocess-aware Information Systems Management* research group at the Faculty of Computer Science, Free University of Bozen-Bolzano.

Sep. 2017 – Apr. 2023

**Director** of the *Master Degree Programme in Computational Data Science* at the Faculty of Computer Science, Free University of Bozen-Bolzano.

Jan. 2019 – Dec. 2021

**Elected member** of the *Board of Directors of the Italian Association for Logic Programming (GULP)*.

Oct. 2019 – Feb. 2023

**Vice-dean for Studies** for the Faculty of Computer Science, Free University of Bozen-Bolzano.

Nov. 2019 – Now

**Member of the steering committee** of the *IEEE Task Force on Process Mining*.

Apr. 2022 – Now

**Member** of the *committee of the national PhD in Artificial Intelligence and Cybersecurity*, coordinated by Sapienza University of Rome.

Feb. 2023 – today

**Vice-dean for Studies** for the Faculty of Engineering, Free University of Bozen-Bolzano.

May 2023 – today

**Director** of the *Bachelor Degree Programme in Informatics and Management of Digital Business* at the Faculty of Computer Engineering, Free University of Bozen-Bolzano.

## 6.2 Organisational Responsibilities

2011

- **Demo co-chair** of the *5th International Symposium on Rules (RuleML@BRF 2011)*, Fort Lauderdale, Florida, USA.
- **Chair of the Doctoral Program** at the *Third International Spring School on Computational Logic (ISCL 2011)*, Bertinoro, Italy.

2012

- **Organization co-chair** of the *Joint Workshop on Security in Business Processes (SPB'12)*, in conjunction with BPM 2012, Tallin, Estonia.
- **Co-organizer** of the *Workshop on Popularize Artificial Intelligence (PAI-2012)*, in conjunction with AI\*IA 2012, Rome, Italy.

2013

- **Demo co-chair** of the *11th International Conference on Service Oriented Computing (ICSOC 2013)*, Berlin, Germany.
- **Co-chair** of the *2nd International Workshop on Knowledge-Intensive Business Processes (KiBP 2013)*, Kauai, Hawaii.
- **Co-organizer** of the *2nd Workshop on Popularize Artificial Intelligence (PAI-2013)*, in conjunction with AI\*IA 2013, Turin, Italy.

2014

- **Co-chair** of the special session on *Action Languages: Theory & Practice*, in the context of the *8th Hellenic Conference on Artificial Intelligence (SETN 2014)*, Ioannina, Greece.

2015

- **Proceedings and Publicity Chair** of the *34th ACM Symposium on Principles of Database Systems (PODS)*, Melbourne, Australia.
- **Co-chair** of the *Enterprise Engineering track* at the *30th ACM Symposium On Applied Computing (SAC)*, Salamanca, Spain.
- **Chair** of the *Doctoral Consortium* at the *9th International Conference on Web Reasoning and Rule Systems (RR)*, Berlin, Germany.
- **Co-chair** of the *4th Workshop on Data- & Artifact-Centric BPM (DAB)*, Innsbruck, Austria.

2016

- **Publicity co-chair** of the *15th International Conference on Business Process Management (BPM)*, Barcelona, Spain.
- **Member of the organization committee** of the *28th European Summer School in Logic, Language and Information (ESSLLI)*, Bolzano, Italy.

2017

- **Co-chair** of the *1st International Workshop on Business Process Innovation with Artificial Intelligence (BPAI)*, co-located with BPM 2017, Barcelona, Spain.

2018

- **Program chair** of the *foundations track* at the *16th International Conference on Business Process Management (BPM)*, Sydney, Australia.

- **Program chair** of the *33rd Italian Conference on Computational Logic (CILC)*, Bolzano, Italy.
- **Organization co-chair** of the *1st International Workshop on Reasoning about Actions and Processes: Highlights of Recent Advances* at KR 2018, Tempe, Arizona.

2019

- **Program chair** of the *3rd International Joint Conference on Rules and Reasoning (RuleML+RR2019)*, Bolzano, Italy.
- **Co-chair** of the *1st International Workshop on Methods for Interpretation of Industrial Event Logs (MIEL2019)*, co-located with BPM 2019, Vienna, Austria.
- **Co-chair** of the *1st International Workshop on Strategic Modeling and Reasoning meets Process Mining (SMRPM2019)*, co-located with EDOC 2019, Paris, France.

2020

- **Program chair** of the *2nd IEEE International Conference on Process Mining (ICPM2020)*, Padua, Italy.
- **Program chair** of the *International Conference Modeling and Analysis of Complex Systems and Processes (MACSPro'2020)*, Venice, Italy.

2021

- **Program chair** of the *23rd IEEE International Conference on Business Informatics (CBI2021)*, Bolzano, Italy.

2022

- **General chair** of the *4th International Conference on Process Mining (ICPM2022)*, Bolzano, Italy.
- **General chair** of the *26th International Conference on Enterprise Computing (EDOC2022)*, Bolzano, Italy.
- **Track chair** for the Business Process Management track of the *24th IEEE International Conference on Business Informatics (CBI2022)*, Amsterdam, the Netherlands.
- **Program co-chair** of the *1st International Workshop on Process Management in the AI era*, co-located with IJCAI 2022, Vienna, Austria.

2023

- **Track co-chair** for the Business Process Management track of the *25th IEEE International Conference on Business Informatics (CBI2023)*, Prague, Czech Republic.

2024

- **General chair** of the *23rd International Conference of the Italian Association for Artificial Intelligence (AIxIA 2024)*, Bolzano, Italy.

## 7 Memberships

I am member of national and international associations, and I am constantly invited to become member of the program committee for top-tier international conferences and national events, as well as to act as a reviewer for world-class international journals.

### 7.1 Membership to Scientific Associations and Working Groups

- *Association for the Advancement of Artificial Intelligence (AAAI)*.
- *Institute of Electrical and Electronics Engineers (IEEE)*.
- *IEEE Task Force on Process Mining*.
- *International Association for Ontology and its Applications (IAOA)*.
- *Associazione Italiana per l'Intelligenza Artificiale (AI\*IA)*.
- *Associazione Italiana per la Programmazione Logica (GULP)*.

## 7.2 Membership to Editorial Boards

Since Feb. 2023

**Associate Editor** for *ACM Computing Surveys*, ACM.

Since Apr. 2023

**Area editor** for *Information Systems*, Elsevier.

Since Sep. 2023

**Editorial Board Member** for *Process Science*, Springer.

Managing *Associate Editor* for:

- Information Systems – special issue *BPM 2018 selected papers in foundations and engineering*.
- Fundamenta Informaticae – special issue *33rd Italian Conference on Computational Logic: CILC 2018*
- Theory and Practice of Logic Programming – special issue *RuleML+RR 2019 selected papers*.
- Information Systems – Special Issue *ICPM 2021 selected papers*.

## 7.3 PC Membership at International Conferences and Workshops

**Senior PC Member** for:

2016

- 19th International Conference on Principles and Practice of Multiagent Systems (PRIMA 2016).

2017

- 15th International Conference on Business Process Management (BPM 2017).

2018

- 17th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2018).

2019

- 28th International Joint Conference on Artificial Intelligence (IJCAI 2019).
- 17th International Conference on Business Process Management (BPM 2019).
- 18th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2019).

2020

- 29th International Joint Conference on Artificial Intelligence (IJCAI 2020).
- 24th European Conference on Artificial Intelligence (ECAI 2020).
- 18th International Conference on Business Process Management (BPM 2020).

2021

- 30th International Joint Conference on Artificial Intelligence (IJCAI 2021).
- 19th International Conference on Business Process Management (BPM 2021).

2022

- 36th AAAI Conference on Artificial Intelligence (AAAI 2022).
- 20th International Conference on Business Process Management (BPM 2022).

2023

- 21th International Conference on Business Process Management (BPM 2023).

2024

- 22nd International Conference on Business Process Management (BPM 2024).
- 36th International Conference on Advanced Information Systems Engineering (CAiSE 2024).

**PC member for:**

2008

- AI\*IA 2008 WS on Multi-Agent Systems and Bioinformatics (MAS&BIO 2008).

2011

- 22nd Int. Joint Conf. on Artificial Intelligence (IJCAI 2011).
- 10th Int. Conf. on Autonomous Agents and Multiagent Systems (AAMAS 2011).
- 26th Italian Conf. on Computational Logic (CILC 2011).

2012

- 1st Int. WS on Knowledge-intensive Business Processes (KiBP 2012).

2013

- 23rd Int. Joint Conf. on Artificial Intelligence (IJCAI 2013).
- 12th Int. Conf. on Autonomous Agents and Multiagent Systems (AAMAS 2013).
- 28th ACM Symposium on Applied Computing (SAC 2013).
- AI\*IA 2013 WS on AI meets Business Processes (AIBP2013).

2014

- 23rd ACM Int. Conf. on Information and Knowledge Management (CIKM 2014).
- 21st Eu. Conf. on Artificial Intelligence (ECAI 2014).
- 12th Int. Conf. on Service Oriented Computing (ICSOC 2014).
- 8th Int. Conf. on Web Reasoning And Rule Systems (RR 2014).
- 29th ACM Symp. on Applied Computing (SAC 2014).
- 4th Int. Symp. on Data-Driven Process Discovery and Analysis (SIMPDA 2014).
- 11th Int. WS on Web Services and Formal Methods (WS-FM:FASOCC 2014).

2015

- 24th Int. Joint Conf. on Artificial Intelligence (IJCAI 2015).
- 29th AAAI Conf. on Artificial Intelligence (AAAI-15).
- 14th Int. Conf. on Autonomous Agents and Multiagent Systems (AAMAS 2015).
- 13th Int. Conf. on Business Process Management (BPM 2015).
- 24th ACM Int. Conf. on Information and Knowledge Management (CIKM 2015).
- 9th Int. Conf. on Web Reasoning and Rule Systems (RR 2015).
- 9th Int. Web Rule Symp. (RuleML 2015).
- 2nd Int. Conf. on Methodologies and Intelligent Systems for Technology Enhanced Learning (MIS4TEL 2015).
- 30th Italian Conf. on Computational Logic (CILC 2015).

2016

- 25th Int. Joint Conf. on Artificial Intelligence (IJCAI 2016).
- 15th Int. Conf. on Knowledge Representation and Reasoning (KR 2016).
- 15th Int. Conf. on Autonomous Agents and Multiagent Systems (AAMAS 2016).
- 22nd Eu. Conf. on Artificial Intelligence (ECAI 2016).
- 14th Int. Conf. on Business Process Management (BPM 2016).
- 31st Italian Conf. on Computational Logic (CILC 2016).

2017

- 26th Int. Joint Conf. on Artificial Intelligence (IJCAI 2017).
- 1st Int. Joint Conf. Conference on Rules and Reasoning (RuleML+RR).
- Int. Conf. on Software and System Processes (ICSSP 2017).
- 5th Int. WS on Strategic Reasoning (SR 2017).

- 5th Int. WS on Declarative/Decision/Hybrid Mining and Modelling for Business Processes (DeHMiMoP'17).
- 32nd Italian Conf. on Computational Logic (CILC 2017).

2018

- 37th ACM SIGMOD-SIGACT-SIGAI Symp. on Principles of Database Systems (PODS 2018).
- 32nd AAAI Conf. on Artificial Intelligence (AAAI-18).
- 16th Int. Conf. on Principles of Knowledge Representation and Reasoning (KR 2018).

2019

- 1st Int. Conf. on Process Mining (ICPM 2019).
- 33rd AAAI Conf. on Artificial Intelligence (AAAI-19).
- 2nd Int. WS on Reasoning about Actions and Processes: Highlights of Recent Advances (ACTIONS@ICAPS 2019).

2020

- 34th AAAI Conf. on Artificial Intelligence (AAAI-20).
- 17th International Conference on Principles of Knowledge Representation and Reasoning (KR 2020).
- 2020's Conference on Prestigious Applications of Intelligent Systems (PAIS 2020).
- 1st Int. WS on Event Data and Behavioral Analytics (EdbA'20).
- 35th Italian Conf. on Computational Logic (CILC 2020).

2021

- 35th AAAI Conf. on Artificial Intelligence (AAAI-21).
- 33rd Int. Conf. on Advanced Information Systems Engineering (CAiSE'21).
- 42nd Int. Conf. on Application and Theory of Petri Nets and Concurrency (PetriNets 2021).
- 3rd Int. Conf. on Process Mining (ICPM 2021).
- 18th Int. Conf. on Principles of Knowledge Representation and Reasoning (KR 2021).
- 25th Int. Enterprise Distributed Object Computing Conference (EDOC 2021).
- 12th Int. Symp. on Games, Automata, Logics, and Formal Verification (GandALF 2021).

2022

- 31st Int. Joint Conf. on Artificial Intelligence (IJCAI 2022).
- 19th Int. Conf. on Principles of Knowledge Representation and Reasoning (KR 2022).
- 43rd Int. Conf. on Application and Theory of Petri Nets and Concurrency (PetriNets 2022).
- CAiSE Forum at the 34th Int. Conf. on Advanced Information Systems Engineering (CAiSE Forum'22).
- 16th International Conference on Research Challenges in Information Science (RCIS 2022).

2023

- 37th AAAI Conf. on Artificial Intelligence (AAAI-23).
- 32nd Int. Joint Conf. on Artificial Intelligence (IJCAI 2023).
- 20th Int. Conf. on Principles of Knowledge Representation and Reasoning (KR 2023).
- 44th Int. Conf. on Application and Theory of Petri Nets and Concurrency (PetriNets 2023).
- 35th Int. Conf. on Advanced Information Systems Engineering (CAiSE 2023).

2024

- 38th AAAI Conf. on Artificial Intelligence (AAAI-24).
- 33rd Int. Joint Conf. on Artificial Intelligence (IJCAI 2024).
- 45th Int. Conf. on Application and Theory of Petri Nets and Concurrency (PetriNets 2024).

## 7.4 Review Activity

Reviewer for the following international journals:

- ACM Transactions on Database Systems (ACM TODS),
- ACM Transactions on Software Engineering and Methodology (ACM TOSEM),
- ACM Transactions on Internet Technology (ACM TOIT),
- Journal of Artificial Intelligence Research (JAIR),
- Journal of Computer and System Science (JCSS),
- IEEE Transactions on Knowledge and Data Engineering (IEEE TKDE),
- IEEE Transactions on Services Computing (IEEE TSC),
- Journal of Autonomous Agents and Multi-Agent Systems (JAAMAS),
- Theoretical Computer Science (TCS),
- Information Systems (IS),
- Business & Information Systems Engineering (BISE),
- Software and Systems Modeling (SoSym)
- AI Communications,
- Journal of Intelligent Information Systems (JIIS),
- Data & Knowledge Engineering (DKE),
- SIGMOD Record,
- Springer Computing,
- Fundamenta Informaticae,
- LNCS Transactions on Petri Nets and Other Models of Concurrency (ToPNoC).

## 8 Dissemination

Preparing and delivering (colourful) presentations for disseminating the results of my research activity is one of the activities I enjoy most. I often disseminate my research through invited talks, presentations at top-tier international conferences and workshops and seminars. I am also contributing to the consolidation and enhancement of contacts between the Free University of Bozen-Bolzano and world-leading scientists.

### 8.1 Invited Talks and Keynotes

Dec. 12, 2007

**Invited talk** at the *PSW thematic day on web services verification*, LORIA – INRIA, Nancy (France). Title: *Declarative specification and verification of service choreographies*.

Nov. 30, 2010

**Keynote speech** at the *Annual meeting of the Interdisciplinary Laboratory on Interacting Knowledge Systems (ILIKS)*, LOA–CNR, Trento (Italy). Title: *Monitoring time-aware social commitments*.

Nov. 1, 2012

**Invited talk** at the Workshop on Foundations of Biomedical Knowledge Representation, Lorentz Center, Leiden (the Netherlands). Title: *Clinical guidelines - conformance verification when dealing with computerized and human-enhanced Processes*.

Sep. 6, 2014

**Invited talk** at the 1st Workshop on Parameterized Verification (Satellite Event of Concur 2014), Rome (Italy). Title: *Verification of parameterized, data-aware dynamic systems*.

Sep. 25, 2015

**Invited talk** at the 14th Conference of the Italian Association for Artificial Intelligence, related to the “Marco Somalvico 2015 award”, Ferrara, Italy. Title: *Data and processes: a challenging, though necessary, marriage*.

June 21, 2016

**Keynote speech** at the Workshop on Algorithms & Theories for the Analysis of Event Data (ATAED 2016), co-located with Petri Nets 2016, Torun, Poland. Title: *Marrying data and processes: from model to event data analysis*.

Nov 29, 2016

**Keynote speech** at the General Meeting of the SOAMED PhD School, Zeuthen (Berlin), Germany. Title: *DB-Nets: on the marriage of colored Petri nets and relational databases*.

Feb. 22, 2017

**Invited talk** at the 1st International Workshop on Formal Methods and Artificial Intelligence (FMAI 2017), University of Naples, Italy. Title: *Temporal logics over finite traces for declarative BPM: a success story*.

Apr. 5, 2019

**Invited talk** at “Ontology makes sense” - A symposium in honour of Nicola Guarino, University of Trento, Italy. Title: *Enriching data models with behavioral constraints*.

Sep. 2, 2019

**Keynote speech** at the 7th International Workshop on DECLarative, DECision and Hybrid approaches to processes (DEC2H 2019), co-located with BPM 2019, Vienna, Austria. Title: *Putting decisions in perspective(s)*.

Feb. 4, 2021

**Keynote speech** at the *Belgian Process Mining Research Day 2021* (online). Title: *From legacy data to event data*.

Nov. 2, 2021

**Invited talk** at the XES Workshop, co-located with ICPM 2021, Eindhoven, the Netherlands. Title: *From legacy data to event data*.

Nov. 3, 2021

**Panelist** at the *3rd International Conference on Process Mining (ICPM 2021)*, Eindhoven, the Netherlands. “Battle” with the industry on the topic *Data Quality in Process Mining*.

Sep. 9, 2022

**Keynote speech** at the 26th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems (KES 2022). Title: *Intelligent systems for process mining*.

Sep. 11, 2022

**Keynote speech** at the 6th International Workshop on Artificial Intelligence for Business Process Management (AI4BPM 2022), co-located with BPM 2022, Münster, Germany. Title: *Process framing via constraints for augmented BPM*.

Oct. 6, 2022

**Panelist** at the 26th International Conference on Enterprise Design, Operations and Computing (EDOC 2022). Title of the panel: *Augmented Business Process Management*.

Nov. 21, 2022

**Invited presentation** at the 2022 Data4SmartHealth Workshop, Bolzano, Italy. Title: *A bird-eye-view on process mining, with a focus on healthcare*.

Dec. 12, 2022

**Invited presentation** at the International Medical Informatics and Telemedicine Symposium (ITIM 2022), Bolzano, Italy. Title: *Process mining in healthcare*.

Feb. 7, 2023

**Keynote speech** at the 1st AAAI Bridge Program on Artificial Intelligence and Business Process

Management (AAAI-AI4BPM 2023), co-located with AAAI 2023, Washington DC, US. Title: *From propositional to relational dynamic systems: AI for data-aware processes.*

Mar. 27, 2023

**Keynote speech** at the 1st AAAI Spring Symposium On the Effectiveness of Temporal Logics on Finite Traces in AI (SSS-LTLf 2023), San Francisco, US. Title: *Declarative process management and mining: a killer application for LTLf.*

Jul. 21, 2023

**Keynote speech** at the 1st Canadian Process Mining Community Meeting, York University, Toronto, Canada. Title: *Declarative processes: reasoning and mining.*

Nov. 3, 2023

**Keynote speech** at the conference *Chat GPT and AI writing tools: how can we respond in Higher Education?*, Bolzano, Italy. Title: *Reflections on artificial intelligence and language processing.*

## 8.2 Presentations at International Conferences and Workshops

June 24, 2005

Presentation at the 18th IEEE Symposium on Computer Based Medical Systems (CBMS'05), Dublin (Ireland). Title: *Using Social Integrity Constraints for On-the-fly Compliance Verification of Medical Protocols.*

Aug. 28, 2006

Presentation at the 4th International Workshop on AI for Service Composition (AISC2006), in conjunction with ECAI2006, Riva del Garda (Italy). Title: *Abduction for Specifying and Verifying Web Service Choreographies.*

Sep. 09, 2006

Presentation at the 3rd International Workshop on Web Services and Formal Methods (WS-FM 2006), Vienna (Austria). Title: *Computational Logic for Run-Time Verification of Web Services Choreographies: Exploiting the SOCS-SI Tool.*

Sep. 01, 2008

Presentation at the 4th International Workshop on Business Process Intelligence (BPI2008), in conjunction with BPM2008, Milan (Italy). Title: *Checking Compliance of Execution Traces to Business Rules.*

Sep. 05, 2008

Presentation at the 5th International Workshop on Web Services and Formal Methods (WS-FM2008), Milano (Italy). Title: *Verification of Choreographies During Execution Using the Reactive Event Calculus.*

July 09, 2009

Demo presentation at the 10th Italian Workshop “From Objects to Agents” (WOA 2009), Parma (Italy). Title: *A REC-Based Commitment Tracking Tool.*

June 04, 2010

Presentation at the 7th International Symposium “From Agent Theory to Agent Implementation” (AT2AI-7), Vienna (Austria). Title: *Monitoring Time-Aware Social Commitments with Reactive Event Calculus.* Best Paper Award.

Aug. 29, 2011

Presentation at the 4th International Workshop on Process-Oriented Information Systems in Healthcare (ProHealth'11), Clermont-Ferrand (France). Title: *Conformance Checking of Executed Clinical Guidelines in presence of Basic Medical Knowledge.*

May 20, 2013

presentation at the Dagstuhl Seminar on Automated Reasoning on Conceptual Schemas, Schloss Dagstuhl (Germany). Title: *On the Relationship Between OBDA and Relational Mapping*.

June 23, 2013

presentation at the 32nd ACM SIGACT SIGMOD SIGART Symposium on Principles of Database Systems (PODS 2013), New York (USA). Title: *Verification of Relational Data-Centric Dynamic Systems with External Services*.

July 27, 2013

Presentation at the 7th International Conference on Web Reasoning and Rule Systems (RR-2013), Mannheim (Germany). Title: *Verification and Synthesis in Description Logic Based Dynamic Systems*. Best Paper Award.

Aug. 20, 2013

Presentation at the Dagstuhl Seminar on Verifiably Secure Process-Aware Information Systems, Schloss Dagstuhl (Germany). Title: *Data-Aware Business Processes - Formalization and Reasoning Support*.

May 21, 2014

Presentation at the 13th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2014). Title: *Verification of Data-Aware Commitment-Based Multiagent System*.

June 17, 2014

Presentation at the 29th Italian Conference on Computational Logic (CILC 2014). Title: *Specification and Verification of Commitment-Regulated Data-Aware Multiagent Systems*.

July 21, 2014

Presentation at the 14th International Conference on Principles of Knowledge Representation and Reasoning (KR 2014). Title: *State-Boundedness in Data-Aware Dynamic Systems*.

Sep. 11, 2014

Presentation at the 12th International Conference on Business Process Management (BPM 2014), Eindhoven (the Netherlands). Title: *Monitoring Business Metaconstraints Based on LTL and LDL for Finite Traces*.

Jan. 27, 2015

Presentation at the 29th AAAI Conference on Artificial Intelligence (AAAI 2015), Austin (USA). Title: *Verification of Relational Multiagent Systems with Data Types*.

June 10, 2015

Presentation at the 27th International Conference on Advanced Information Systems Engineering (CAiSE 2015). Title: *Declarative Process Modeling in BPMN*.

July 12, 2017

Presentation at the 1st International Joint Conference on Rules and Reasoning (RuleML+RR 2017), London (UK). Title: *Semantic DMN: Formalizing Decision Models with Domain Knowledge*.

September 22, 2018

Presentation at the 33rd Italian Conference on Computational Logic (CILC 2018). Title: *Modeling and Reasoning over Declarative Data-Aware Processes: The Object-Centric Behavioral Constraint Approach*.

Sep. 4, 2019

Presentation at the 17th International Conference on Business Process Management (BPM 2019), Vienna (Austria). Title: *Modeling and Reasoning over Declarative Data-Aware Processes with Object-Centric Behavioral Constraints*.

Sep. 4, 2019

Presentation at the 17th International Conference on Business Process Management (BPM 2019), Vienna (Austria). Title: *Formal Modeling and SMT-Based Parameterized Verification of Data-Aware BPMN*.

Feb. 9, 2020

Presentation at 34th AAAI Conference on Artificial Intelligence (AAAI-20), New York (USA). Title: *Temporal Logics Over Finite Traces with Uncertainty*.

June 11, 2020

Presentation at the *CAiSE Forum 2020*, online conference. Title: *Probabilistic Conformance Checking Based on Declarative Process Models*.

Sep. 15, 2020

Presentation at the 18th International Conference on Business Process Management (BPM 2020), online conference. Title: *Extending Temporal Business Constraints with Uncertainty*.

Sep. 18, 2020

Presentation at the 17th International Conference on Principles of Knowledge Representation and Reasoning (KR 2020), online conference. Title: *Strategy Synthesis for Data-Aware Dynamic Systems with Multiple Actors*.

Nov. 2, 2021

Presentation at the 3rd International Conference on Process Mining (ICPM 2021), Eindhoven, the Netherlands. Title: *Probabilistic Trace Alignment*.

June 9, 2022

Presentation at the 34th International Conference on Advanced Information Systems Engineering (CAiSE 2022), Leuven, Belgium. Title: *Soundness of Data-Aware Processes with Arithmetic Conditions*.

Sep. 14, 2022

Presentation at the 20th International Conference on Business Process Management (BPM 2022), Münster, Germany. Title: *Reasoning on Labelled Petri Nets and Their Dynamics in a Stochastic Setting*.

July 23, 2022

Presentation at the 1st International Workshop on Process Management in the AI era (PMAI 2022), co-located with IJCAI 2022, Vienna, Austria. Title: *Verification of Generic, Relational Transition Systems*.

Feb. 7, 2023

Presentation at the 1st AAAI Bridge Program on Artificial Intelligence and Business Process Management (AAAI-AI4BPM 2023), co-located with AAAI 2023, Washington DC, US. Title: *On the Flexibility of Regular Process Behaviors*.

Sep. 11, 2023

Presentation at the 1st International Workshop on Formal Methods for Business Process Management (FMBPM 2023), co-located with BPM 2023, Utrecht, the Netherlands. Title: *Reasoning about knowledge in BPM: call for a systematic approach*.

Oct. 24, 2023

Presentation at the 5th International Conference on Process Mining (ICPM 2023), Rome, Italy. Title: *Repairing soundness properties in data-aware processes*.

### 8.3 Seminars

Jan. 8, 2008

Invited seminar, Eindhoven University of Technology, Eindhoven (the Netherlands). Title: *Verification of Declarative Business Processes and Choreographies*.

Jan. 17, 2008

Presentation at the final meeting of the PRIN 2005 Project “Specification and Verification of Agent Interaction Protocols”, Alessandria (Italy). Title: *Verification of Declarative Business Processes and Choreographies*.

July 19, 2010

Tutorial, Eindhoven University of Technology, Eindhoven (the Netherlands). Title: *Reasoning on Execution Traces with the Event Calculus*.

July 29, 2010

Invited seminar, Eindhoven University of Technology, Eindhoven (the Netherlands). Title: *Business Constraints Monitoring and Operational Support*.

Dec. 15, 2010

Invited seminar, KRDB Research Centre for Knowledge and Data, Free Univ. of Bozen-Bolzano. Title: *Specification and Verification of Declarative Open Interaction Models*.

July 06, 2011

Group seminar, KRDB Research Centre, Free Univ. of Bozen-Bolzano, Bolzano (Italy). Title: *Runtime Reasoning with the Event Calculus: from Theory to Practice*.

May 03, 2012

Group seminar, KRDB Research Centre, Free Univ. of Bozen-Bolzano, Bolzano (Italy). Title: *Verification of Relational Data-Centric Dynamic Systems*.

Dec. 20, 2012

Invited seminar, FBK-IRST, Trento (Italy). Title: *Towards Convergence of Data and Processes: the Artifact-Centric Approach*.

Jan. 16, 2015

Invited seminar, University of Luxembourg. Title: *Monitoring Business Constraints and Metaconstraints with LTL and LDL on Finite Traces*.

May 31, 2016

Invited seminar, University of Verona, Verona (Italy). Title: *Data-Aware Business Processes: balancing between expressiveness and verifiability*.

Dec 12, 2016

Invited seminar, University of Seville, Seville (Italy). Title: *Declarative, Constraint-Based Business Process Management*.

Nov. 28, 2018

Invited seminar, Humboldt University of Berlin. Title: *Temporal Logics over Finite Traces for Declarative BPM: a Success Story*.

Feb. 27, 2019

Invited seminar, Eindhoven University of Technology. Title: *Cooking with Data and Processes*.

May 14, 2019

Invited seminar, Eindhoven University of Technology. Title: *10 Years Playing with Declare and Temporal Logics on Finite Traces*.

May 16, 2019

Invited seminar, RWTH Aachen. Title: *10 Years Playing with Declare and Temporal Logics on Finite Traces.*

May 22, 2020

Online seminar as part of the KRDB Summer Online Seminars 2020. Title: *Modeling and Reasoning over Declarative Data-Aware Processes.*

May 26, 2021

Invited seminar in the Hasselt University BINF Research Seminar Series. Title: *From Case-Isolated to Object-Centric Processes - A Tale of Two Models.*

May 16, 2022

Invited seminar, AdONE TUM Graduate School, Technical University of Munich (online). Title: *Process Reasoning and Mining with Uncertainty.*

Mar. 24, 2023

Invited seminar, Brown University, Providence, US. Title: *Declarative process management and mining.*

Nov. 2, 2023

Invited seminar, University of Udine, Udine, Italy. Title: *Modelling, monitoring, mining declarative processes using LTLf and automata.*

Nov. 15, 2023

Invited seminar as part of the Data, Knowledge and Action Seminar Series, University of Oxford (online). Title: *LTLf for declarative processes.*

## 8.4 Invitations at International Events and Research Visits

01/2008 Visiting researcher at the *Architecture for Information Systems Group*, TU/e Eindhoven.

10/2008 Lorentz Center WS *Computer-based Clinical Guidelines and Protocols.*

07/2019 Visiting researcher at the *Architecture for Information Systems Group*, TU/e Eindhoven.

10/2012 Lorentz Center WS *Foundations of Biomedical Knowledge Representation.*

05/2013 Dagstuhl Seminar *Automated Reasoning on Conceptual Schemas.*

08/2013 Dagstuhl Seminar *Verifiably Secure Process-Aware Information Systems.*

02/2015 Visiting researcher at the *Department of Information Technology*, University of Uppsala.

06/2015 Visiting researcher at the *Department of Information Technology*, University of Uppsala.

11/2016 Visiting researcher at the *IDEA Research Group*, University of Seville.

## 9 Third Mission and Entrepreneurship

I actively participate to third mission in various forms. The most important achievement so far has been the creation of the first spin-off of the Free University of Bozen-Bolzano, which I co-founded.

I am strongly committed to *scientific outreach regarding artificial intelligence*: I regularly meet the general public, industries, and students to discuss about *the nature of artificial intelligence and its societal implications*.

In addition, I contribute in various forms to strengthen and widen the connection between academia and stakeholders operating in the local territory.

## 9.1 Entrepreneurship

Together with Diego Calvanese, Benjamin Cogrel, Peter Hopfgartner, and Guohui Xiao, in February 2019 I co-founded *Ontopic s.r.l.*, the first spin-off of the Free University of Bozen-Bolzano. Ontopic focuses on the development of novel technologies for intelligent data access and integration, centred around the notion of *virtual knowledge graph*. I act as scientific advisor for the company, in particular for what concerns the application of the Ontopic foundations and toolchain in the context of process mining and process analytics. Some key facts about Ontopic:

- On 12 December 2018 Ontopic was admitted to the IDM Incubator at the NOI Technology Park in Bolzano, after a selective review process.
- On 11 July 2019 Ontopic signed an agreement with the Free University of Bozen-Bolzano, to officially become a spin-off recognized by the University.
- Starting from November 2019 the company is running an innovation project, financed with  $\sim 150\,000$  € by the Autonomous Province of Bozen-Bolzano.
- Examples of projects:
  - a joint project with Siris Academics (Barcelona, Spain) on integration of higher education data for the Sorbonne University in France;
  - a joint project with Siris Academics (Barcelona, Spain) on integration of open research data for the Toscana Region in Italy;
  - a joint project with Werfen (Milano, Italy) and Endian (Bolzano, Italy) on data integration for predictive maintenance.

## 9.2 Projects Commissioned by Industry

More details on all projects (including projects commissioned by industry) are in Section 4.6.

Dec. 2019 - Mar. 2020

**Principal investigator** for the Commissioned Research project *SPMI: Semantic Process Mining in Industry*, commissioned by EBITmax. The project focussed on the investigation of process mining techniques, enriched with ontologies, for the analysis of event data produced during construction processes.

From Nov. 2023

**Principal co-investigator and project manager** of the Commissioned Research project *telAio: planning and replanning for chassis production*, commissioned by *Automobili Lamborghini*. The project aims at providing a flexible and customised planning and re-planning platform for the manufacturing of the Lamborghini Revuelto sport car, produced by Automobili Lamborghini S.p.A. in Sant’Agata Bolognese, Italy. The platform supports the optimisation of production volumes by aiding decision making in exceptional circumstances such as plant faults, while accounting for the needs of the operators working at the plant.

## 9.3 Outreach on Artificial Intelligence

Since October 2023, I write a **monthly column** on artificial intelligence for *AltoAdigeinnovazione*, a digital newspaper focussed on South Tyrol and innovation. The list of articles follows.

Oct. 2023 *L’uomo e l’intelligenza artificiale. Tre riflessioni fondamentali.*

Nov. 2023 *All’origine del termine “intelligenza artificiale”* (with Alessandro Mosca).

Jan. 2023 *Fragile e spaventosa. Quale futuro per l’Intelligenza Artificiale?*

**Presentations** on artificial intelligence to the general public, students, and industry stakeholders:

Oct. 26, 2020

**Invited presentation** to the *general public* at the *Accademia di Studi italo-tedesca*, Merano. Title: *Artificial intelligence in today’s Society.*

May 5, 2021

**Invited presentation** to *students of the senior high-school Gandhi in Merano (BZ, Italy)*. Title: *Artificial intelligence and today's society*.

May 9, 2022

**Invited presentation** to *students of the senior high-school Gandhi in Merano (BZ, Italy)*. Title: *Artificial intelligence, today*.

Mar. 16, 2023

**Invited presentation** to the *members of the Rotary Club Merano (Bolzano, Italy)*. Title: *Artificial intelligence: what it is, how does it work, which applications*.

Apr. 11, 2023

**Invited presentation** to *unionists participating to the LabourAcademy project, organised by AFI-IPL - a local research and counsel facility with special focus on labour themes (Bolzano, Italy)*. Title: *Digitalization in the workplace: the role of AI*.

May 11, 2023

**Keynote** to *industry stakeholders at the KONVERTO talks (Bolzano, Italy)*. Title: *Research Frontiers and Visions for Big Data and AI*.

May 12, 2023

**Invited presentation** to the *general public at Centro per la cultura Mairania (Merano, Italy)*. Title: *Artificial intelligence: what it is, how does it work, what is happening*.

Sep. 27, 2023

**Invited presentation** to the *industry at VisionAlps - Accelerating Digital Transformation of Alps (Bolzano, Italy)*. Title: *Artificial intelligence: three reflections, three applications*.

Oct. 11, 2023

**Invited presentation** to the *general public at Fondazione Upad (Bolzano, Italy)*. Title: *Artificial intelligence explained*.

Oct. 18, 2023

**Invited presentation** to the *university community and the general public as part of the Studium generale of UNIBZ (Bolzano, Italy)*. Title: *The nature of artificial intelligence*.

Nov. 22, 2023 **Keynote** to the *employees of SIAG - Südtiroler Informatik Informatica Alto Adige AG (Bolzano, Italy)*. Title: *Reflections on the nature of artificial intelligence*.

Nov. 29, 2023 **Invited presentation** to the *general public, decision makers, public administration, and several companies as part of the event AI per la trasformazione digitale delle amministrazioni locali: sfide e opportunità, organised by the Cerchio ICT, a consortium of several ICT companies operating in Italy (in presence in Bolzano and streamed in Bologna, Trento, and Schio, Italy)*. Title: *Machine intelligence: three reflections, one example*.

Jan. 29, 2024 **Invited presentation** to the *general public at Fondazione Upad (Bolzano, Italy)*. Title: *Artificial intelligence: challenges and opportunities*.

Feb. 6, 2024 **Three invited presentations** at the *Gandhi high school institute (Merano, Italy)*.  
Titles and audience:

- *Artificial intelligence in the net* - to students in the area of science;
- *Artificial intelligence, today* - to students in the area of humanities;
- *Update on artificial intelligence* - to professors.

**Interviews** on artificial intelligence:

- Newspaper interview, *Was kann der ChatBot?* (Die neue Südtiroler Tageszeitung, 05/02/2023).

- Newspaper interview, *Intelligenza artificiale, così le nuove tecnologie aiutano la lotta al COVID* (Alto Adige, 24/03/2021).
- TV interview on challenges and debates around AI, *Buongiorno regione* (Rai3 - regional branch, 18/05/2023).
- Newspaper interview, *L'AI fa emergere nuovi problemi etici* (Alto Adige, 31/05/2023).
- Newspaper interview, *KI-Zukunftsluft* (Salto, 14/07/2023).
- Web interview on artificial intelligence (Antonio Longo, 14/12/2023).
- Podcast on artificial intelligence and its applications in the alpine territory (Visionalps, September 2023).
- Radio interview, *Terza Missione* (Radiodue - regional branch, 31/12/2023).
- Radio interview, *Post it* (Radiouno - regional branch, 05/02/2024).

## 9.4 Other Industry Talks and Talks to the General Audience

Oct. 11, 2012

**Invited presentation** at the *industrial day on “Cloud Computing and Mobile”*, jointly organized by the local company Horizon<sup>14</sup>, together with Samsung. Title: *Sharing Knowledge - Towards the Convergence of Data, Processes, and Humans*<sup>15</sup>.

Dec. 18, 2012

**Faculty representative** at the *opening ceremony of a Samsung multimedia classroom* in Merano (Italy). Co-presenter of a talk on *Technology at School: Why, How, for Whom*<sup>16</sup>.

Oct. 24, 2013

**Selected Presentation** at the *1st Euregio Research Cooperation Day (ERCD)*, jointly organized by the Free Univ. of Bozen-Bolzano, Univ. of Innsbruck, Univ. of Trento. Title: *Management and Verification of Data and Business Processes*.

Nov. 24, 2015

**Invited presentation** at the *industrial day “Collavoriamo”*, organized by *Info Easy SRL* (Imola). Title of the presentation: *Towards an IT support to organizations based on reality*<sup>17</sup>.

Nov. 26, 2015

**Invited presentation** at the *5th Workshop “Computer Science Research Meets Business”*, focused on CRM Systems. Title: *Towards a business process management founded on reality*<sup>18</sup>.

May 26, 2016

**Invited presentation** at the *senior high school “Cantore”* in Bruneck-Brunico (BZ, Italy). Title of the presentation: *From Leibniz to Turing: the birth of computers and the discovery of the limitations of mathematics*<sup>19</sup>.

Nov. 7, 2019

**Selected presentation** at the *1st Industry Day of the Free University of Bozen-Bolzano*. Title: *IDEE: Data Integration for Energy Efficiency*.

Oct. 23, 2019

**Invited presentation** at *“Fit for Digital”, the 1st South Tyrolean event on digital transformation for the public administration*, EURAC, Bolzano. Title: *Processes and organizations: a look behind the paper wall*.

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<sup>14</sup><http://www.horizon.bz.it>

<sup>15</sup>Conoscenza condivisa - verso la convergenza di dati, processi e persone.

<sup>16</sup>Tecnologie a scuola: perché, come, per chi.

<sup>17</sup>Verso un supporto IT alle organizzazioni fondate sulla realtà.

<sup>18</sup>Verso una gestione dei processi aziendali basata sulla realtà.

<sup>19</sup>Da Leibniz a Turing: la nascita dei computer e la scoperta dei limiti della matematica.

Nov. 18, 2021

**Invited speaker** at the *Process Mining Café*, a podcast by Fluxicon. Title of the episode: *Process mining perspectives*.

Sep. 20, 2023

**Presentation** as part of the *Unlock Potential* event, organised by the NOI technology park in Bolzano to open the laboratories to the public. Title: *Digitalisation of work processes*.

## 9.5 Other Third Mission Activities

Since 10/2012

**Supporter of activities** with schools in the Province of Bozen-Bolzano, from primary to high schools.

Dec. 18, 2012

**Faculty representative** (together with Rosella Gennari), at the opening ceremony of a *Samsung multimedia classroom* in Merano (Italy).

Feb. 6, 2013

**Organizer** of the *Integrated Enterprise Modelling and BPM Meeting*, hosting researchers from the Euregio area (Trento, Bozen-Bolzano, Innsbruck).

2013 – 2014

**Faculty representative** for the *MINT (Mathematics, Informatics, Natural Sciences, Technology) high-school initiative*<sup>20</sup>.

Apr.–May 2015

**Lecturer of an advanced course** on *data and process modelling*, delivered to *more than 30 IT experts* working within the Province of Bozen-Bolzano.

Jun. 2017–May 2020

**Scientific advisor** and **member of the board of directors** of EBITmax<sup>21</sup>, a local company focused on business process re-engineering&continuous improvement, digital innovation, and process mining.

July 6, 2017

**Faculty representative** (together with Barbara Russo) at *Il Comprensorio Bolzano Città incontra la Libera Università di Bolzano*, a meeting to foster joint innovation activities of UNIBZ and local industries.

May 3, 2018

**Faculty representative** at *10 anni di QuiBolzano*, an event for the general public to celebrate the first 10 years of activity of the local newspaper “QuiBolzano” and to discuss the future development of the city of Bolzano.

Oct. 2018–Mar. 2023

**Columnist** of a series on *ICT and digital cities* appearing monthly in various newspapers (Qui-Bolzano, QuiMerano, QuiBassaAtesina) of the QuiMedia group. The column reaches large part of the South Tyrolean territory.

## 9.6 Publications About Me

In the press (talking about me and/or containing direct references to me):

- *Automatisierung im Krankenhaus* (Dolomiten, 19/12/2012).
- *Informatica, Montali premiato* (Corriere dell’Alto Adige, 27/09/2015).

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<sup>20</sup><http://www.mint.bz.it>

<sup>21</sup><http://ebitmax.com>

- *Intelligenza artificiale made in Südtirol - Montali: “Gruppo di ricerca eccellente”* (Corriere dell’Alto Adige, 30/09/2015).
- *Preis für “Künstliche Intelligenz” errungen* (Dolomiten,30/09/2015).
- *La ricerca come stile di vita* (QuiMerano, March 2017).
- *La ricerca come stile di vita* (QuiBolzano, April 2017).
- *Der Computer als Unternehmensberater* (academia.bz.it, 03/07/2017).
- *Analisi dei dati per strategie aziendali - Nuovo master all’ateneo bolzanino* (Alto Adige, 13/08/2017).
- *Den Nerv der Zeit treffen* (Dolomiten, 07/02/2018).
- *Impiego delle tecnologie al lavoro: serve un piano strategico* (economyST, 06/06/2018).
- *Appuntamento con la “Bolzano Digitale”* (QuiBolzano, 30/10/2018).
- *Cosa faccio? Risolvo problemi di incomunicabilità tra applicazioni software* (Academia.bz.it, 05/11/2018).
- *Ecco Ontopic, il primo spin-off ufficiale dell’unibz* (AltoAdigeinnovazione, 15/07/2019).
- *Brain 2019: l’intelligenza artificiale a Bolzano* (RAI3 Regione, 23/09/2019).
- *L’industria 4.0 nelle Pmi, a Rauch il Premio di ricerca* (Alto Adige, 20/12/2019).
- *Intelligenza artificiale, un seminario affascinante* (Alto Adige, 08/10/2020).
- *L’intelligenza artificiale tra rischi e opportunità* (Alto Adige, 12/10/2020).
- *Unibz e la cantina Franz Haas lanciano la carta d’identità dei vini altoatesini* (AltoAdigeinnovazione, 07/11/2020).
- *Università, otto docenti di Unibz tra gli scienziati più citati* (Alto Adige, 24/11/2020).
- *Enologia, da Unibz una carta d’identità per i vini altoatesini* (Alto Adige, 06/11/2020).
- *Arriva una carta d’identità per i vini dell’Alto Adige* (Alto Adige, 07/11/2020).
- *Otto professori di Unibz nel 2% degli scienziati più citati al mondo* (Alto Adige, 25/11/2020).
- *unibz: Gleich 8 Professoren unter “Top 2 Prozent”* (Dolomiten, 25/11/2020).
- *Die Top-Professoren* (Tageszeitung.it, 25/11/2020).
- *Acht Professoren der unibz unter Top zwei Prozent der Wissenschaftler weltweit* (Suedtirolnews.it, 25/11/2020).
- *Intelligenza artificiale, così le nuove tecnologie aiutano la lotta al COVID* (Alto Adige, 24/03/2021).
- *A Unibz il convegno internazionale per l’industria: focus sul Process Mining* (AltoAdigeinnovazione, 27/09/2022).
- *Il trilinguismo, la fuga di cervelli e la scarsa collaborazione. Unibz vista da Marco Montali, vicepresidente di Informatica* (AltoAdigeinnovazione, 13/01/2023).
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- *Was kann der ChatBot?* (Die neue Südtiroler Tageszeitung, 05/02/2023).
- *Il Gotha dell’Intelligenza Artificiale a congresso a Washington. C’era anche Unibz* (AltoAdigeinnovazione, 01/03/2023).
- *Reorganisation an der unibz* (Südtirolnews, 10/03/2023).
- *Reorganisation an unibz: Neue Fakultäten für Ingenieurwesen sowie Agrar-, Umwelt- und Lebensmittelwissenschaften offiziell gegründet* (Vinschger, 10/03/2023).
- *Unibz: nuove facoltà e nuovi presidi* (AltoAdigeinnovazione, 13/03/2023).
- *Neue Fakultäten an der Universität Bozen geschaffen* (Dolomiten, 14/03/2023).
- *L’AI fa emergere nuovi problemi etici* (Alto Adige, 31/05/2023).
- *KI-Zukunftsluft* (Salto, 14/07/2023).
- *L’intelligenza artificiale spiegata a tutti: una serata all’Upad all’interno del Festival Game Ground* (La voce di Bolzano, 09/10/2023).
- *Occasione preziosa per capire meglio cosa sia l’Intelligenza Artificiale* (BuongiornoSüdtirol, 09/10/2023).
- *OGGI ALLE 18 l’intelligenza artificiale spiegata dagli esperti* (Alto Adige, 11/10/2023).
- *Un’alleanza per l’intelligenza artificiale* (Alto Adige, 27/10/2023).
- *Schio. Passa per l’Intelligenza Artificiale la trasformazione digitale della pubblica amministrazione* (Alto Vicentino Online, 24/11/2023).
- *Passa per l’Intelligenza Artificiale la trasformazione della PA* (L’Eco Vicentino, 26/11/2023).
- *Intelligenza artificiale, la sfida* (Alto Adige, 29/01/2024).

- *Intelligenza artificiale, dal Gandhi alla Biblioteca* (Alto Adige, 09/02/2024).

In other media:

- When I got awarded with the Artificial Intelligence “Marco Somalvico” 2015 National Prize, I have been contacted by many local media channels, and had the possibility of disseminating my research to the general audience on the web, television, and radio, In particular:
  - The regional branch of the national TV channel *RAI3* interviewed me. A long version of the interview appeared in the *regional RAI3 show “Buongiorno Regione”*. A short version of the interview appeared in the *regional RAI3 news “TGR3”*.
  - Carmela Marsibilio interviewed me live during “Greenwich”, a radio show of the radio station *Radiodue* (regional branch of the national RAI channel), focused on interesting facts and persons from the region.
  - The regional TV channel *RTTR* interviewed me. The interview appeared on the *RTTR social media page*, as well as in the *RTTR TV news*.
  - My interviews and other news related to the prize appeared in a plethora of *social media*.
- On March 15, 2018 I participated to the live radio show *Zeppelin*, broadcasted from the regional radio station *Radiodue* (regional branch of the national RAI channel). The topic of discussion was the new master in computational data science offered at the Free University of Bozen-Bolzano under my coordination.
- On May 18, 2023 I got interviewed in the live TV show *Buongiorno regione*, broadcasted by the regional branch of Rai3. The topic of discussion was artificial intelligence.
- In September 2023, I got interviewed in the *Visionalps podcastx*, and talked about artificial intelligence and its applications in the alpine territory.
- On December 14, 2023 I got interviewed by the journalist Antonio Longo. The interview focussed on artificial intelligence and its relationship with society and scientific research, and got published on the web.
- On December 31, 2023, the Radiodue (regional branch) broadcast *Terza Missione* hosted my interview on artificial intelligence, data, and processes.

## 10 Publications

### Authored Books

- [B-1] M. Montali. *Specification and Verification of Declarative Open Interaction Models: a Logic-Based Approach*, vol. 56 of *Lecture Notes in Business Information Processing*. Springer, 2010. ISBN: 978-3-642-14537-7.

### Edited Volumes

- [EV-2] M. Montali, A. Senderovich, and M. Weidlich, editors. *Proceedings of the International Process Mining Workshops*, vol. 468 of *Lecture Notes in Business Information Processing*. Springer, 2023. ISBN: 978-3-031-27814-3.
- [EV-3] T. P. Sales, H. A. Proper, G. Guizzardi, M. Montali, F. M. Maggi, and C. M. Fonseca, editors. *Proceedings of the Enterprise Design, Operations, and Computing Workshops – IDAMS, SoEA4EE, TEAR, EDOC Forum, Demonstrations Track and Doctoral Consortium*, vol. 466 of *Lecture Notes in Business Information Processing*. Springer, 2023. ISBN: 978-3-031-26885-4.
- [EV-4] J. P. A. Almeida, D. Karastoyanova, G. Guizzardi, M. Montali, F. M. Maggi, and C. M. Fonseca, editors. *Proceedings of the 26th International Conference on Enterprise Design, Operations, and Computing (EDOC)*, vol. 13585 of *Lecture Notes in Computer Science*. Springer, 2022. ISBN: 978-3-031-17603-6.
- [EV-5] J. P. A. Almeida, T. D. Kühne, and M. Montali. Special issue on multi-level modeling process challenge editorial. *EMISA International Journal on Conceptual Modeling*, 17, 2022. DOI: 10.18417/emisa.17.4.
- [EV-6] G. De Giacomo, A. Guzzo, M. Montali, L. Limonad, F. Fournier, and T. Chakraborti, editors. *Proceedings of the Workshop on Process Management in the AI Era (PMAI), co-located with IJCAI 2022*, vol. 3310. CEUR Electronic Workshop Proceedings, 2022.
- [EV-7] P. Fodor and M. Montali. Special issue on the international joint conference on rules and reasoning (RuleML+RR 2019). *Theory and Practice of Logic Programming*, 22(2):158–161, 2022. DOI: 10.1017/S1471068422000023.
- [EV-8] M. Montali, I. Weber, M. Weske, and M. Reichert. Special issue: BPM 2018 selected papers in foundations and engineering. *Information Systems*, 103:101477, 2022. DOI: 10.1016/j.is.2019.101477.
- [EV-9] P. Felli, M. Montali, and M. Proietti. Special issue on the 33rd italian conference on computational logic: CILC 2018. *Fundamenta Informaticae*, 178(4), 2021. DOI: 10.3233/FI-2021-2007.
- [EV-10] B. van Dongen, M. Montali, and M. Thandar Wynn, editors. *Proceedings of the 2nd International Conference on Process Mining (ICPM 2020)*. IEEE Computer Society Press, 2020. ISBN: 978-1-7281-9832-3.
- [EV-11] P. Fodor, M. Montali, D. Calvanese, and D. Roman, editors. *Proceedings of the 3rd International Joint Conference on Rules and Reasoning (RuleML+RR)*, vol. 11784 of *Lecture Notes in Computer Science*. Springer, 2019. ISBN: 978-3-030-31094-3.
- [EV-12] P. Felli and M. Montali, editors. *Proceedings of the 33rd Italian Conference on Computational Logic (CILC 2018)*, vol. 2214 of *Lecture Notes in Computer Science*. CEUR Electronic Workshop Proceedings, 2018.

- [EV-13] M. Weske, M. Montali, I. Weber, and J. vom Brocke, editors. *Proceedings of the 16th International Conference on Business Process Management (BPM 2018)*, vol. 11080 of *Lecture Notes in Computer Science*. Springer, 2018. ISBN: 978-3-319-98647-0.
- [EV-14] M. Weske, M. Montali, I. Weber, and J. vom Brocke, editors. *Proceedings of the Business Process Management Forum 2018*, vol. 329 of *Lecture Notes in Business Information Processing*. Springer, 2018. ISBN: 978-3-319-98650-0.
- [EV-15] M. Baldoni, F. Chesani, P. Mello, and M. Montali, editors. *Proceedings of the Workshop Popularize Artificial Intelligence, co-located with the 13th Conference of the Italian Association for Artificial Intelligence (AI\*IA 2013)*, vol. 1107. CEUR Electronic Workshop Proceedings, 2013.
- [EV-16] M. Baldoni, F. Chesani, B. Magnini, P. Mello, and M. Montali, editors. *Proceedings of the AI\*IA Workshop and Prize for Celebrating 100th Anniversary of Alan Turing's Birth*, vol. 860. CEUR Electronic Workshop Proceedings, 2012.
- [EV-17] S. Bragaglia, C. V. Damasio, M. Montali, A. Preece, C. Petrie, M. Proctor, and U. Straccia, editors. *Proceedings of the 5th International RuleML2011@BRF Challenge*, vol. 799. CEUR Electronic Workshop Proceedings, 2011.

## Papers in Refereed International Journals

- [J-18] S. J. J. Leemans, F. M. Maggi, and M. Montali. Enjoy the silence: Analysis of stochastic petri nets with silent transitions. *Information Systems*, 2024. To appear.
- [J-19] J. M. van der Werf, A. Rivkin, M. Montali, and A. Polyvyanyy. Correctness notions for petri nets with identifiers. *Fundamenta Informaticae*, 190(2-4):159–207, 2024. DOI: 10.3233/FI-242169.
- [J-20] A. Alman, F. M. Maggi, M. Montali, F. Patrizi, and A. Rivkin. A framework for modeling, executing, and monitoring hybrid multi-process specifications with bounded global-local memory. *Information Systems*, 119:102271, 2023. DOI: 10.1016/J.IS.2023.102271.
- [J-21] A. Alman, F. M. Maggi, M. Montali, F. Patrizi, and A. Rivkin. Monitoring hybrid process specifications with conflict management: an automata-theoretic approach. *Artificial Intelligence in Medicine*, 139:102512, 2023. DOI: 10.1016/J.ARTMED.2023.102512.
- [J-22] I. Beerepoot, C. Di Ciccio, H. A. Reijers, S. Rinderle-Ma, W. Bandara, A. Burattin, D. Calvanese, T. Chen, I. Cohen, B. Depaire, G. D. Federico, M. Dumas, C. G. J. van Dun, T. Fehrer, D. A. Fischer, A. Gal, M. Indulska, V. Isahagian, C. Klinkmüller, W. Kratsch, H. Leopold, A. V. Looy, H. A. López, S. Lukumbuzya, J. Mendling, L. Meyers, L. Moder, M. Montali, V. Muthusamy, M. Reichert, Y. Rizk, M. Rosemann, M. Röglinger, S. Sadiq, R. Seiger, T. Slaats, M. Simkus, I. A. Someh, B. Weber, I. Weber, M. Weske, and F. Zerbató. The biggest business process management problems to solve before we die. *Computers in Industry*, 146:103837, 2023. DOI: 10.1016/j.compind.2022.103837.
- [J-23] D. Calvanese, A. Gal, D. Lanti, M. Montali, A. Mosca, and R. Shraga. Conceptually-grounded mapping patterns for virtual knowledge graphs. *Data and Knowledge Engineering*, 145:102157, 2023. DOI: j.datak.2023.102157.
- [J-24] F. Chesani, C. Di Francescomarino, C. Ghidini, D. Loreti, F. M. Maggi, P. Mello, M. Montali, and S. Tessaris. Process discovery on deviant traces and other stranger things. *IEEE Transactions on Knowledge and Data Engineering*, 35(11):11784–11800, 2023. DOI: 10.1109/TKDE.2022.3232207.

- [J-25] M. Dumas, F. Fournier, L. Limonad, A. Marrella, M. Montali, J. Rehse, R. Accorsi, D. Calvanese, G. De Giacomo, D. Fahland, A. Gal, M. La Rosa, H. Völzer, and I. Weber. Ai-augmented business process management systems: A research manifesto. *ACM Transactions on Management Information Systems*, 14(1):11:1–11:19, 2023. DOI: 10.1145/3576047.
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- [J-30] G. De Giacomo, R. De Masellis, F. M. Maggi, and M. Montali. Monitoring constraints and metaconstraints with temporal logics on finite traces. *ACM Transactions on Software Engineering and Methodology*, 31(4), 2022. DOI: 10.1145/3506799.
- [J-31] S. Ghilardi, A. Gianola, M. Montali, and A. Rivkin. Petri net-based object-centric processes with read-only data. *Information Systems*, 107, 2022. DOI: 10.1016/j.is.2022.102011.
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- [J-35] J. Sánchez-Ferreres, A. Burattin, J. Carmona, M. Montali, and L. Padró. Unleashing textual descriptions of business processes. *Software and Systems Modeling*, 20(6):2131–2153, 2021. DOI: 10.1007/s10270-021-00886-x.
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- [J-37] D. Calvanese, S. Ghilardi, A. Gianola, M. Montali, and A. Rivkin. Smt-based verification of data-aware processes: a model-theoretic approach. *Mathematical Structures in Computer Science*, 30(3):271–313, 2020. DOI: 10.1017/S0960129520000067.
- [J-38] M. de Leoni, P. Felli, and M. Montali. Soundness verification of data-aware process models with variable-to-variable conditions. *Fundamenta Informaticae*, 2020.
- [J-39] J. M. Pérez-Álvarez, M. T. Gómez López, R. Eshuis, M. Montali, and R. M. Gasca. Verifying the manipulation of data objects according to business process and data models. *Knowledge and Information Systems*, 62(7):2653–2683, 2020. DOI: 10.1007/s10115-019-01431-5.
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- [J-53] B. Bagheri Hariri, D. Calvanese, G. De Giacomo, R. De Masellis, P. Felli, and M. Montali. Description logic knowledge and action bases. *Journal of Artificial Intelligence Research*, 46:651–686, 2013. DOI: 10.1613/jair.3826.
- [J-54] F. Chesani, P. Mello, M. Montali, and P. Torroni. Representing and monitoring social commitments using the event calculus. *Autonomous Agents and Multi-Agent Systems*, 27(1):85–130, 2013. DOI: 10.1007/s10458-012-9202-0.

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## Book Chapters

- [BC-67] C. Di Ciccio and M. Montali. Declarative process specifications: Reasoning, discovery, monitoring. In W. M. P. van der Aalst and J. Carmona, editors, *Process Mining Handbook*, vol. 448 of *Lecture Notes in Business Information Processing*, pages 108–152. Springer, 2022. ISBN: 978-3-031-08847-6. DOI: 10.1007/978-3-031-08848-3\_4.

- [BC-68] A. Artale, D. Calvanese, M. Montali, and W. M. P. van der Aalst. Enriching data models with behavioral constraints. In S. Borgo, R. Ferrario, C. Masolo, and L. Vieu, editors, *Ontology Makes Sense - Essays in Honour of Nicola Guarino*, vol. 316 of *Frontiers in Artificial Intelligence and Applications*, pages 257–277. IOS Press, 2019. ISBN: 978-1-61499-954-6. DOI: 10.3233/978-1-61499-955-3-257.
- [BC-69] D. Calvanese, S. Ghilardi, A. Gianola, M. Montali, and A. Rivkin. From model completeness to verification of data-aware processes. In C. Lutz, U. Sattler, C. Tinelli, A. Turhan, and F. Wolter, editors, *Description Logic, Theory Combination, and All That - Essays Dedicated to Franz Baader on the Occasion of His 60th Birthday*, vol. 11560 of *Lecture Notes in Computer Science*, pages 212–239. Springer, 2019. DOI: 10.1007/978-3-030-22102-7\_10.
- [BC-70] E. Marengo, P. Dallasega, M. Montali, W. Nutt, and M. Reifer. Process management in construction - the expansion of the bolzano hospital. In J. vom Brocke and J. Mendling, editors, *Business Process Management Cases*, pages 257–274. Springer, 2018. ISBN: 978-3-319-58306-8. DOI: 10.1007/978-3-319-58307-5\_14.
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- [BC-73] S. Bragaglia, F. Chesani, P. Mello, M. Montali, and P. Torroni. Reactive event calculus for monitoring global computing applications. In A. Artikis, R. Craven, N. K. Cicekli, B. Sadighi, and K. Stathis, editors, *Logic Programs, Norms and Action*, vol. 7360 of *Lecture Notes in Computer Science*, pages 123–146. Springer, 2012. ISBN: 978-3-642-29413-6. DOI: 10.1007/978-3-642-29414-3\_8.
- [BC-74] F. Chesani, E. Lamma, P. Mello, M. Montali, S. Storari, P. Baldazzi, and M. Manfredi. Compliance checking of cancer-screening careflows: an approach based on computational logic. In S. Miksch, A. Ten Teije, and P. J. Lucas, editors, *Computer-Based Medical Guidelines and Protocols: a Primer and Current Trends*, vol. 139 of *Studies in Health Technology and Informatics*, pages 183–192. IOS Press, 2008. ISBN: 978-1-58603-873-1. DOI: 10.3233/978-1-58603-873-1-183.

## Papers in Refereed International Conferences

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- [C-76] A. Gianola, M. Montali, and S. Winkler. Linear-time verification of data-aware processes modulo theories via covers and automata. In *Proceedings of the 38th AAAI Conference on Artificial Intelligence (AAAI)*. AAAI Press/The MIT Press, 2024. To appear.
- [C-77] A. Alman, I. Donadello, F. M. Maggi, and M. Montali. Declarative process mining for software processes: The RuM toolkit and the Declare4Py python library. In R. Kadgien, A. Jedlitschka, A. Janes, V. Lenarduzzi, and X. Li, editors, *Proceedings of the 24th International Conference on Product-Focused Software Process Improvement (PROFES)*, vol. 14484 of *Lecture Notes in Computer Science*, pages 13–19. Springer, 2023. ISBN: 978-3-031-49268-6. DOI: 10.1007/978-3-031-49269-3\_2.

- [C-78] D. Barenholz, M. Montali, A. Polyvyanyy, H. A. Reijers, A. Rivkin, and J. M. van der Werf. There and back again: On the reconstructability and rediscoverability of typed jackson nets. In L. Gomes and L. Lorenz, editors, *Proceedings of the 44th International Conference on Petri Nets (PETRI NETS)*, vol. 13929 of *Lecture Notes in Computer Science*, pages 37–58. Springer, 2023. ISBN: 978-3-031-33619-5. DOI: 10.1007/978-3-031-33620-1\_3.
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*I declare, pursuant to art. 76 of Presidential Decree 445/2000, that the information is true. I authorize the processing of my personal data in accordance with Legislative Decree 30 June 2003, n. 196 "Code for the protection of personal data" and the GDPR 679/16 - "European Regulation on the protection of personal data".*