



CoopIS 2025

31st International Conference on Cooperative
Information Systems

Final Program and Book of Abstracts

Marbella, Spain

20 - 22 October, 2025

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CoopIS 2025

Final Program and Book of Abstracts

31st International Conference on Cooperative Information Systems

Marbella - Spain
October 20 - 22, 2025

Sponsored by

INSTICC - Institute for Systems and Technologies of Information, Control and Communication

Table of Contents

Foreword5

Social Event and Banquet7

Important Information9

General Information10

Rooms Layout11

Program Layout12

 Monday Sessions: October 2019

 Tuesday Sessions: October 2127

 Wednesday Sessions: October 2235

Author Index43

Foreword

The International Conference on Cooperative Information Systems (CoopIS 2025) took place from October 20–22 in Marbella, Spain, celebrating its 31st edition. Since its launch in 1993 in Rotterdam, the Netherlands, CoopIS has evolved into a leading international venue that brings together researchers, practitioners, and industry experts. Over three decades, the conference has continuously fostered debate and innovation on cooperative information systems, highlighting their technological foundations as well as their economic and societal implications.

Cooperative Information Systems (CIS) facilitate the cooperation between individuals, organisations, smart devices, and systems of systems, by providing flexible, scalable, and intelligent services to enterprises, public institutions, and user communities. As a result, people and smart devices can interact, share information, and work together across physical barriers. The domain of CIS integrates research results from different related computing areas, such as: distributed systems, coordination technologies, collaborative decision making, enterprise architecture, business process management, and conceptual modelling. In recent years, several innovative technologies have emerged: Cloud Computing, Service Oriented Computing, the Internet of Things, Linked Open Data, Semantic Systems, Collective Awareness Platforms, Blockchain, Processes as a Service, etc, that enable the next generation of CISs.

CoopIS 2025 received 128 paper submissions from 31 countries, of which 19% were accepted and published as full papers. A single-blind paper review was performed for each submission by at least 2, but usually 3 or more, members of the International Program Committee, which is composed of established researchers and domain experts.

The high quality of the CoopIS 2025 program is enhanced by the keynote lectures delivered by distinguished speakers who are renowned experts in their fields: Barbara Pernici (Politecnico di Milano, Italy), Sonja Zillner (Siemens AG, Germany), and Carles Sierra (IIIA-CSIC, Spain).

The conference is complemented by a Demo Track of CoopIS 2025, chaired by Moataz Chouchen and Jeremy Mechouche, and a Special Session on Early Research Achievement, chaired by Mohamed Wiem Mkaouer and Slim Kallel.

All presented papers will be submitted for indexation by DBLP, Google Scholar, EI-Compendex, INSPEC, Japanese Science and Technology Agency (JST), Norwegian Register for Scientific Journals and Series, Mathematical Reviews, SCImago, Scopus, zbMATH, and Web of Science / Conference Proceedings Citation Index.

The program for this conference required the dedicated effort of many people. Firstly, we would like to thank the authors, whose research efforts are reported here. Next, we thank the members of the Program Committee and the auxiliary reviewers for their diligent and professional review. We would also like to extend our sincere gratitude to the invited speakers for their invaluable contributions and for taking the time to prepare their talks. Finally, a word of appreciation for the hard work of the INSTICC team; organising a conference of this level is a task that can only be achieved by the collaborative effort of a dedicated and highly competent team.

We wish you all an exciting and inspiring conference. We hope to have contributed to the development of our research community, and we look forward to having additional research results presented at the next edition of CoopIS, details of which are available at <https://coopis.scitevents.org>.

Cinzia Cappiello, Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Italy

Olaf Hartig, Linköping University, Sweden

Mohamed Sellami, COMPUTER science, Institut Polytechnique de Paris - Télécom SudParis, SAMOVAR, France

Ali Ouni, École de Technologie Supérieure (ÉTS Montreal), Canada

Social Event and Banquet

Venue: An evening at Tikitano featuring dinner and a Flamenco performance

Tuesday, 21st of October- 19:00 – 23:00 Perched along the golden coastline of Estepona, **Tikitano Restaurant** stands as one of the Costa del Sol's most captivating culinary destinations. This seaside haven blends the laid-back charm of southern Spain with the sophistication of fine Mediterranean dining, creating a truly unforgettable experience.



From the moment you arrive, Tikitano's magic is undeniable. With sweeping views of the Mediterranean and the Rock of Gibraltar, guests are treated to a dining experience where refined cuisine meets effortless coastal elegance. The restaurant's architecture harmonizes modern design with tropical allure -high ceilings, open terraces, and lush gardens evoke a sense of tranquility that is both luxurious and welcoming.



Tikitano's menu presents a contemporary interpretation of Mediterranean and international flavors, crafted from the finest locally sourced ingredients. Each dish reflects a balance of creativity, freshness, and precision that delights the senses.



A cherished favorite among both locals and travelers, Tikitano continues to define the essence of elegant seaside dining in southern Spain.

Adding to its allure, guests are invited to immerse themselves in the passion and artistry of live flamenco performances - an experience that captures the soul of Andalusia. From the first haunting strum of the guitar to the last resonant tap of the dancer's heel, every moment radiates emotion and rhythm. The powerful vocals, expressive handclaps, and mesmerizing dance moves weave together stories of love, joy, and longing.



More than just a show, it's a celebration of Spanish heritage - an evening where music, movement, and emotion come together under the Mediterranean sky. The passion of flamenco at Tikitano will leave you inspired long after the final note fades.

Source: Tikitano and Adobe Stock

Important Information

Internet Access

Please check at the welcome desk the information to connect to the wireless network.

Event App

Download the Event App from the Play Store and App Store now, to have mobile access to the technical program and also to get notifications and reminders concerning your favorite sessions.

Create Your Own Schedule *

The option "My Program" gives you the possibility of creating a selection of the sessions that you plan to attend. This service also allows you to print-to-pdf all papers featured in your selection thus creating a pdf file per conference day.

Digital Access to the Receipt *

By clicking on the option "Delegate Home" and then "Registration Documents" it will enable you to access the final receipt which confirms the registration payment.

Photos Availability

The photos taken at the venue will be shared with you shortly after the event is finished. There will be an option entitled "Photo Gallery" in PRIMORIS. There, besides having access to the photos, you can also create your own personal albums by selecting "My Albums "Create New Album" and also be able to tag yourself in those photos, using the option "Tag Me".

Keynotes Videos

The keynote lectures will also be available on video on the website after the event, as long as the appropriate authorization from the keynote is received, so you will be able to see them again or watch them should you have missed one.

Survey

Every year we conduct a survey to assess the participants' satisfaction with the conference and gather the suggestions. You will receive an e-mail after the event with the detailed information. Your contribution will be carefully analysed and a serious effort to react appropriately will be made.

* Please login to PRIMORIS (www.insticc.org/Primoris), select the role "Delegate" and the correct event.

If you have any doubt, we will be happy to help you at the Welcome Desk.

General Information

Welcome Desk/On-site Registration

Sunday, October 19 – Open from 16:00 to 18:00

Monday, October 20 – Open from 09:00 to 18:00

Tuesday, October 21 – Open from 08:30 to 18:15

Wednesday, October 22 – Open from 08:30 to 17:00

Opening Session

Monday, October 20, at 09:30 in the Andalucia 4 room.

Welcome Drink

Monday, October 20, at 18:00 in the Foyer room.

Closing Session & Awards Ceremony

Wednesday, October 22, at 16:45 in the Andalucia 1 room.

Farewell Drink

Wednesday, October 22, at 17:00.

Meals

Coffee-breaks will be served in the Foyer to all registered participants.

Lunches will be served in the Restaurant to all registered participants. Please check the hours in the Program Layout.

Communications

Wireless access will be provided free of charge to all registered participants.

Secretariat Contacts

CoopIS Secretariat

Address: Avenida de S. Francisco Xavier, Lote 7 Cv. C

2900-616 Setúbal, Portugal

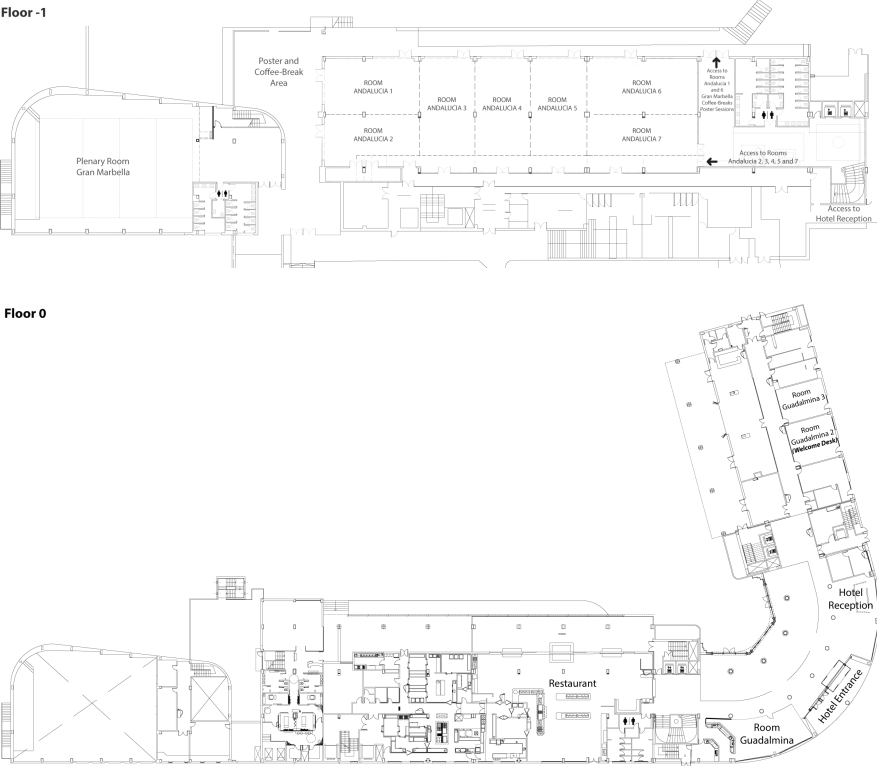
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website: <https://coopis.scitevents.org>

Rooms Layout



Program Layout

	Monday, October 20	Tuesday, October 21	Wednesday, October 22
9:00			
9:30	Opening Session	Oral Presentations (Online) 1	CoopIS Session 8
10:00	CoopIS Session 1	CoopIS Session 4	
10:30		Coffee-Break	
11:00		Keynote Lecture Carles Sierra	
11:30	Coffee-Break		CoopIS Session 9
12:00		Time Cushion	
12:30	CoopIS Session 2	CoopIS Session 5	Time Cushion
13:00			Keynote Lecture Sonja Zillner
13:30			
14:00	Lunch	Lunch	Lunch
14:30			
15:00	Keynote Lecture BARBARA PERNICI	CoopIS Session 6	Oral Presentations (Online) 2
15:30	Coffee-Break	CoopIS-DT Session 1	CoopIS Session 10
16:00		Coffee-Break	
16:30	CoopIS Session 3		Closing Session & Awards Ceremony
17:00	CoopIS-ERA Session	CoopIS Session 7	Farewell Drink
17:30		CoopIS-DT Session 2	
18:00	Welcome Drink		
18:30			
19:00		Buses to Banquet	
19:30			
20:00			
20:30			
21:00		Social Event	
21:30			
22:00			
22:30			
23:00		Buses from Banquet	
23:30			
24:00			

Final Program and Book of Abstracts

Contents

Monday Sessions: October 20

Opening Session (09:30 - 09:45)

Room Andalucia 4	21
----------------------------	----

Session 1 (09:45 - 11:15)

Room Andalucia 4: <i>Software Engineering for Information Systems</i>	21
Complete Paper #49: Automated Synthesis of Kubernetes Variability from OpenAPI Schemas, by Brian Flores, José Miguel Horcas, Mercedes Amor and Lidia Fuentes	21
Complete Paper #34: A Systematic Literature Review on Software Visualization Tools for Program Comprehension, by Stefan-Octavian Custura	21
Complete Paper #78: Automated Duplicate Bugs Detection: Do We Really Need all Bug Report Sections?, by Lobna Ghadhab, Ilyes Jenhani, Montassar Ben Messaoud and Mohamed Wiem Mkaouer	21
Complete Paper #93: Creation and Termination Patterns for Managing Processes with Board-Based Collaborative Tools, by Alfonso Bravo, Adela del-Rio-Ortega, Joaquín Peña and Manuel Resinas	21

Session 2 (11:45 - 13:30)

Room Andalucia 4: <i>Process Analytics and Technology I</i>	22
Complete Paper #48: Predicting Case Suffixes with Activity Start and end Times: A Sweep-Line Based Approach, by Muhammad Awais Ali, Marlon Dumas and Fredrik Milani	22
Complete Paper #59: BPMN Patterns for Process Variability, by Philipp Hehnle and Manfred Reichert	22
Complete Paper #135: Unsupervised Hierarchical Process Mining with the Process Fragment Miner, by Joern Tobis, Felix Schumann, Juergen Mangler and Stefanie Rinderle-Ma	22
Complete Paper #128: Accurate and Noise-Tolerant Extraction of Routine Logs in Robotic Process Automation, by Massimiliano de Leoni, Faizan Khan and Simone Agostinelli	22

Keynote Lecture (14:45 - 15:45)

Room Gran Marbella	23
On the Challenges of Sustainable Data Preparation, by BARBARA PERNICI	23

Session 3 (16:15 - 18:00)

Room Andalucia 4: <i>Neuro-Symbolic Systems and Knowledge Graphs</i>	23
Complete Paper #28: Adaptive by Design: Rethinking the MLOC Architecture for Learning Systems, by Marco Hüller, Roman Küble and Jörg Hähner	23
Complete Paper #54: Lazy Prediction in Querying Graph Databases, by Jacques Chabin, Cristina Aguiar, Mirian Halfeld-Ferrari, Martin Musicante and Lingchen Wang	23
Complete Paper #109: Path-Based Explanations for Knowledge Graph-Driven Course Recommendation, by Nadia Ben Hadj Boubaker, Zahra Kodia and Nadia Ayadi	23
Complete Paper #111: Prompting Strategies for LLM-Based Cooperative Data Service Discovery, by Devis Bianchini, Massimiliano Garda, Michele Melchiori and Anisa Rula	24

Special Session on Early Research Achievement (CoopIS-ERA) (16:15 - 18:00)

Room Andalucia 5: <i>Early Research Achievement</i>	24
Complete Paper #5: Towards Declarative Process Execution: Functionalities and Architecture, by Johannes Loebbecke, Dominik Voigt, Juergen Mangler and Stefanie Rinderle-Ma	24
Complete Paper #6: Attention-Based Connectivity Matrix Computation for Autism Spectrum Disorder Diagnosis from fMRI Data, by Sirine Sboui, Mohamed Djallel Dilmi and Faten Chaieb-Chakchouk	24
Complete Paper #9: Knowledge-Based, Context-Aware AI for Accurate Learner Classification with Resampling Techniques in Low-Resource Environments, by Sameher Ajili, Rym Cheour, Mariem Abid, Mouna Baklouti and Richard Hotte	24
Complete Paper #10: Lightweight LoRa Signal Quality Classification Using RSSI and SNR, by Boubaker Abdallah, Rym Cheour, Jalel Ktari and Olfa Kanoun	25

Complete Paper #11: A Hybrid Dynamic Knowledge Graph Building Approach, <i>by Sana Ben Abdallah Ben Lamine, Redouane Bouhamoum and Hajer Zghal</i>	25
---	----

Tuesday Sessions: October 21

Session 4 (09:00 - 10:15)

Room Andalucia 5: <i>Rule and Data Mining</i>	29
Complete Paper #144: From Prediction to Diagnostic Action: A Human-Centric System for Coronary Artery Disease Assessment, <i>by Mohamed Amine Chaabane, Imen Ben Said, Sirine Ayedi and Amine Bahloul</i>	29
Complete Paper #21: AI-Powered Cooperative Fleet Management Through Explainable Context-Aware Anomaly Detection, <i>by Nadeem Iftikhar, Cosmin-Stefan Raita, Aziz Kadem, Matthew Trinh, Yi-Chen Lin, David Buncek, Anders Vestergaard and Gianna Belle</i>	29

Oral Presentations (Online) 1 (09:00 - 10:15)

Room Andalucia 6 Online: <i>Online I</i>	29
Complete Paper #47: eRooMiner: A Data-Driven Approach for Root Cause Detection of Process Data Quality Issues, <i>by Shokoufeh Ghalibafan, Sareh Sadeghianasl and Moe Wynn</i>	29
Complete Paper #20: MuC: A Multi-Core Tucker Model with Core Attention, <i>by Yanhui Zhang, Dong Zhu and Aiping Liu</i>	29
Complete Paper #63: Ontology-Guided Chain-of-Thought Reasoning for Knowledge Graph Construction with Large Language Model, <i>by Gang Xiao, Wenhui Li, Jiawei Lu and Siyu Chen</i>	30

Keynote Lecture (10:45 - 11:45)

Room Gran Marbella	30
Machines That Know What Matters: Engineering Awareness of Social Values, <i>by Carles Sierra</i>	30

Session 5 (12:00 - 13:30)

Room Andalucia 5: <i>Process Analytics and Technology II</i>	30
Complete Paper #136: Discriminative Rule Learning for Outcome-Guided Process Model Discovery, <i>by Ali Norouzfard and Wil van der Aalst</i>	30
Complete Paper #137: Agentic Generation of Process Models from Regulatory Texts, <i>by Catherine Sai and Stefanie Rinderle-Ma</i>	30
Complete Paper #138: Out of Babylon: Object-Centric Conformance Checking on Graph-Based Abstractions, <i>by Erik Wrede, Jan Niklas van Detten, Lukas Liss and Sander J. J. Leemans</i>	31
Complete Paper #44: Orchestrating Cyber-Physical Operations with PRIME: A Passive Resource-Integrated Modeling Extension for BPMN, <i>by Leo Poss and Stefan Schöning</i>	31

Session 6 (14:45 - 16:15)

Room Andalucia 4: <i>Internet of Things and Digital Twins</i>	31
Complete Paper #71: Digital Twin Narratives: Framework for Clear Communication, <i>by Faten El Outa, Hugo Breuillard and Guillaume Dechambenoit</i>	31
Complete Paper #143: Impact-Sensitive Conflict Management in Smart IoT-Based Systems Using Attention Networks, <i>by Christon Awanyo, Nawal Guermouche and Morel Vianney</i>	31
Complete Paper #41: A Hybrid Query Language for Digital Twins, <i>by Philipp Zech, Manuel Burger, Linus Wald, Philipp Pobitzer, Sascha Hammes and Judith Michael</i>	32
Complete Paper #108: Trial by Twin: Behavior-Predictive Trust in Autonomous Drone Swarms, <i>by Danish Iqbal, Hind Bangui and Bruno Rossi</i>	32

Demo Track of CoopIS 2025 (CoopIS-DT) - Session 1 (14:45 - 16:15)

Room Andalucia 5: <i>Demo Track</i>	32
Complete Paper #5: AQG4SD: Automated GraphQL Query Generation for Cloud Service Discovery and Selection, <i>by Yann Ramusat, Vincent Tran, Sébastien Nguyen and Zakaria Maamar</i>	32
Complete Paper #11: GRAPE: A Guiding RML Authoring Projectional Editor in Action and User's First Impressions, <i>by Jakub Duchateau and Christophe Debruyne</i>	32

Session 7 (16:45 - 18:15)

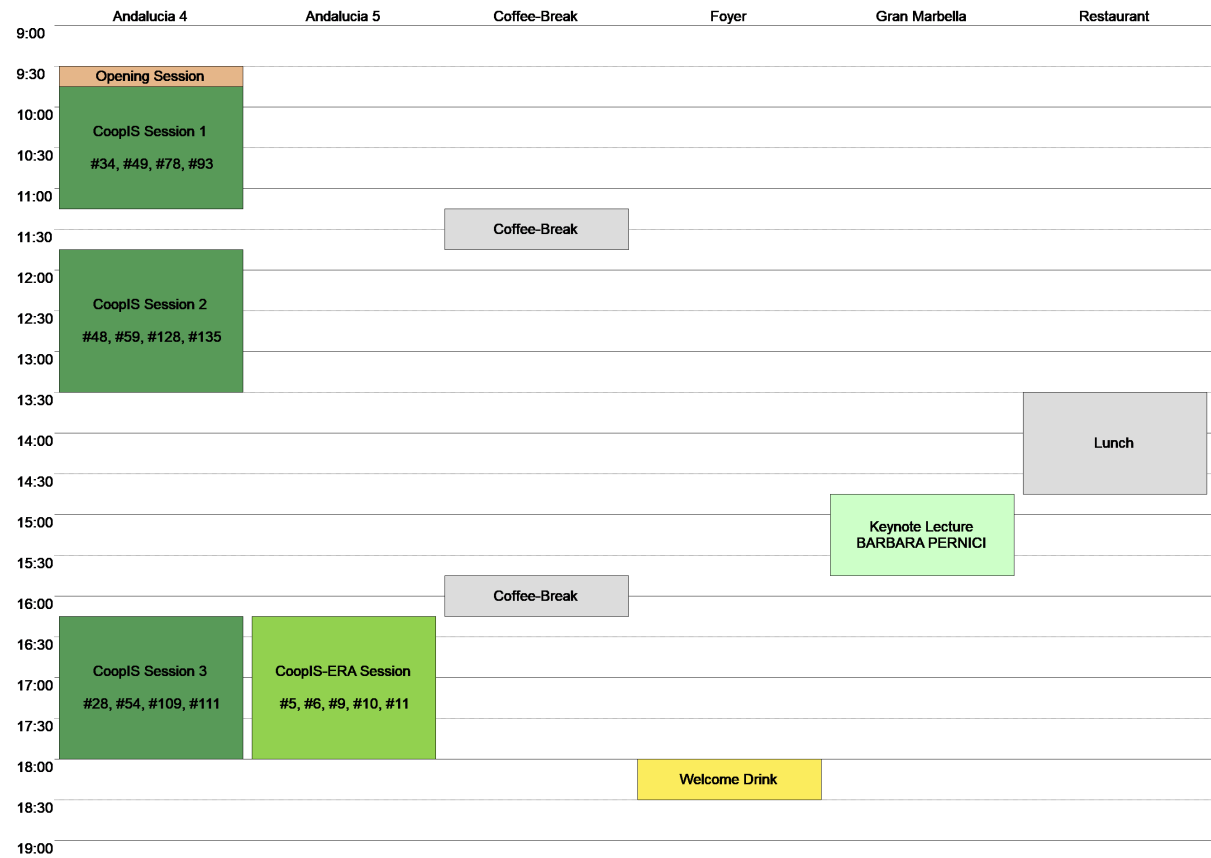
Room Andalucia 4: <i>Knowledge Representation and Management</i>	33
Complete Paper #66: Assessing the Stability of Rankings in Knowledge Graphs Against Perturbations, <i>by Hassan Abdallah, Béatrice Markhoff, Louise Parkin and Arnaud Soulet</i>	33
Complete Paper #22: Embedding-Based Ontology Term Recommendation System for FAIR Data Publishing Workflows, <i>by Nan Liu, Mohamed-Anis Koubaa, Andreas Schmidt, Karl-Uwe Stucky, Wolfgang Suess and Veit Hagenmeyer</i>	33
Complete Paper #65: Automated Model/Schema Interoperability with ML/AI Approaches: A Survey, <i>by Joshua Ocansey, Yngve Lamo, Adrian Rutle, Fazle Rabbi and Bahareh Fatemi</i>	33

Complete Paper #131: Performance Improvement for an Intensive SPARQL-Based Application: The ERA Route Compatibility Check Tool, <i>by Daniel Doña, Oscar Corcho and Edna Ruckhaus</i>	33
Demo Track of CoopIS 2025 (CoopIS-DT) - Session 2 (16:45 - 18:15)	
Room Andalucia 5: Demo Track	34
Complete Paper #12: BPFragmentODRL: A Web Tool for Generating ODRL Policies for Business-Process Fragments, <i>by Abderrahmane Maaradji and Zakaria Maamar</i>	34
Complete Paper #6: One Engine to Rule Them All: Executing Declarative Processes with CEP, <i>by Leo Poss and Stefan Schöning</i>	34
Complete Paper #8: Data Asset Analyzer: A Feature-Wise Evaluation System, <i>by Vanilson Burégio, Belkacem Chikhaoui, Zakaria Maamar and Amel Benna</i>	34
Wednesday Sessions: October 22	
Session 8 (09:00 - 10:30)	
Room Andalucia 1: Access Control	37
Complete Paper #62: RDF Query Answering in the Presence of Access Restrictions, <i>by Maxime Buron, Hritika Kathuria, Ioana Manolescu and George Siachamis</i>	37
Complete Paper #130: Fed-DL: Federated Learning with Distributed Ledger for Social Demographic Equality, <i>by Jaya Pathak, Yash Pandey, Jagat Sesh Challa and Amitesh Singh Rajput</i>	37
Complete Paper #133: Towards User-Centric Authorization for Data Access, Sharing and Control, <i>by Florian Weingartshofer, Aya Mohamed and Marc Kurz</i>	37
Complete Paper #77: A Hybrid GAM-Based Model for Predicting Vulnerability Exploitation, <i>by Noufal Issa, Damas Gruska and Loubna Ali</i>	37
Session 9 (11:00 - 12:15)	
Room Andalucia 1: Process Analytics and Technology III	38
Complete Paper #60: Extracting Object-Centric Event Logs from Incident Data Using Large Language Models, <i>by Ahmed Takiy Eddine Hamdi, Marwa Elleuch, Nassim Laga and Walid Gaaloul</i>	38
Complete Paper #89: Incremental Synchronization of BPMN Models and Documentations by Leveraging Structural Algorithms and LLMs, <i>by David Cremer, Benjamin Dalmás, Quentin Nivon and Gwen Salaün</i>	38
Complete Paper #91: A Framework for Assessing Overcompliance and Undercompliance in Business Processes, <i>by Johannes Loebbecke and Stefanie Rinderle-Ma</i>	38
Keynote Lecture (12:30 - 13:30)	
Room Gran Marbella	38
Responsible AI Engineering through the Systematic Management of Generative AI Risks, <i>by Sonja Zillner</i>	38
Oral Presentations (Online) 2 (14:45 - 16:45)	
Room Online 2: Online II	39
Complete Paper #134: Leveraging Data Augmentation and Siamese Learning for Predictive Process Monitoring, <i>by Sjoerd van Straten, Alessandro Padella and Marwan Hassani</i>	39
Complete Paper #17: NarrativeMind: A Dynamic Neural-Symbolic Decoder for Culturally-Authentic Arabic Story Generation, <i>by Mossab Ibrahim, Pablo Gervás and Gonzalo Méndez</i>	39
Complete Paper #132: Data Integrity-by-Design: Combining Declarative Object-Centric Choreographies and Entity Relationship Models, <i>by Tilman Zuckmantel, Hugo A. López, Yongluan Zhou, Boris Düdder and Thomas Hildebrandt</i>	39
Complete Paper #30: CodeASG: An Approach for Extracting Code Embeddings from Abstract Syntax Graphs, <i>by Alexandru-Gabriel Sirbu and Gabriela Czibula</i>	40
Complete Paper #112: Enhancing Suitable Tasks Selection for RPA Through Fuzzy AHP and AI Methods, <i>by Imen Korâani, Wiem Chebil and Sonia Ghannouchi</i>	40
Session 10 (14:45 - 16:45)	
Room Andalucia 1: Architecture and Management of Information Systems	40
Complete Paper #29: A Maturity Model for Blockchain Adoption in the Banking Industry, <i>by Faruk Hasić, Amalia Westgaver and Johannes De Smedt</i>	40
Complete Paper #100: A Method for Automated Deployment Architecture Reconstruction from Heterogeneously Nested Deployment Models, <i>by Marcel Weller, Uwe Breitenbücher and Steffen Becker</i>	40
Complete Paper #25: Inferring a Hierarchical Input Type for Plug-and-Play SQL, <i>by Santosh Aryal, Shubham Swami, Curtis Dyreson and Sourav Bhowmick</i>	41
Complete Paper #102: Boosting the Entity-Relationship Model for Document-Oriented Databases, <i>by Andrea Avignone, Silvia Chiusano, Alessandro Fiori and Riccardo Torlone</i>	41

Closing Session & Awards Ceremony (16:45 - 17:00)
Room Andalucia 1 41

Monday Sessions: October 20

Monday Sessions: October 20 Program Layout



Opening Session
09:30 - 09:45

CoopIS
Room Andalucia 4

Session 1A
09:45 - 11:15

Software Engineering for Information Systems

CoopIS
Room Andalucia 4

Complete Paper #49

Automated Synthesis of Kubernetes Variability from OpenAPI Schemas

Brian Flores, José Miguel Horcas, Mercedes Amor and Lidia Fuentes

ITIS Software, Universidad de Málaga, Spain

Keywords: Configuration, Feature Model, Kubernetes, Manifest Files, Software Product Line, Variability Modeling, YAML.

Abstract: Kubernetes (K8s) has emerged as the de facto standard for orchestrating containerized applications, offering extensive configurability to meet diverse deployment needs. However, this flexibility introduces significant complexity, leading to steep learning curves and a high propensity for configuration errors due to the manual navigation of vast documentation. While variability modeling techniques has proven successful in software product lines (SPLs) to manage such configuration complexity, its application in infrastructure systems such as K8s remains limited. This paper presents an automated approach for synthesizing a comprehensive K8s variability model directly from its official OpenAPI schemas. We demonstrate that this automatically generated model offers broader coverage of the configuration space than a manually constructed model previously developed from the API documentation. Furthermore, we evaluate the model's effectiveness in configuration validation against 250,000 real-world K8s configurations, comparing it with existing K8s validation tools. Our approach achieves 94.8% configuration validity, offering comprehensive structural and semantic checks that go beyond schema compliance or policy enforcement provided by other tools.

Complete Paper #34

A Systematic Literature Review on Software Visualization Tools for Program Comprehension

Stefan-Octavian Custura

Babes-Bolyai University, Faculty of Mathematics and Computer Science, Cluj-Napoca, Romania

Keywords: N/A

Abstract: As software systems are continuously being developed and more and more programmers are working on a project, program comprehension is a topic that should be analyzed thoroughly to help the industry accommodate changes for engineers, regardless of experience or age. This way, we tackled the field of Software Visualization and analysed its characteristics in the recent literature through a Systematic Literature Review, where we investigated what and how software is visualized, and how such tools can be empirically validated. Our study notes a mass use of three different approaches for software visualization, while also discovering representations in both graphical and numerical forms. This study also gathers information and views on where software visualization can expand with the current use of artificial intelligence in the day-to-day processes of industry software engineering. Our research shows that current software visualization tools are mainly based on the same three topics, *Code Metrics*, *Dependencies*, and *Code Changes*, but are starting

to expand in different directions, tackling more specific issues as the software development field is quickly growing, offering a development perspective towards new or combined approaches of how can program comprehension be enhanced.

Complete Paper #78

Automated Duplicate Bugs Detection: Do We Really Need all Bug Report Sections?

Lobna Ghadhab¹, Ilyes Jenhani², Montassar Ben Messaoud³ and Mohamed Wiem Mkaouer⁴

¹ *LARODEC, Higher Institute of Management of Sousse, Tunisia*

² *University of Doha for Science and Technology, Doha, Qatar*

³ *University of Tunis, LARODEC, Tunis Business School, Tunisia*

⁴ *University of Michigan, Flint, U.S.A.*

Keywords: Duplicate Bug Reports, Section Analysis, Pre-trained Neural Language Model, DistilRoBERTa.

Abstract: Duplicate bugs pose a significant challenge that consumes substantial resources and can complicate the bug triage process, requiring extra work to identify and merge duplicates. Several automated duplicate bug detection methods use Natural Language Processing to handle this problem. Bug reports are often long and contain multiple sections that can show some textual (dis)similarities. This disparity may affect the duplicate bug detection process and hence results in inefficient resource utilization. In this work, we study the impact of bug report sections on the detection of duplicates especially when these sections show some (dis)similarities. Filtering out the most pertinent sections can greatly alleviate computational load and reduce the chances of overlooking potential duplicate bugs. Using less sections would also reduce the cost of the duplicate bug detection system as less tokens may be used. To achieve our objective, we developed and analyzed two types of models. One section-based models are used to analyze the individual impact of bug report sections, whereas cross section-based models are used to analyze their collective impact. These models leverage a siamese network constructed from pretrained DistilRoBERTa [1] and fine-tuned for classification by the Multi-Layer Perceptron (MLP). Our findings reveal that the "title" and "description" sections show the highest relevance in duplicate bug detection, achieving f1-scores of 98.93% and 98.29% respectively. Conversely, the "steps to reproduce" and "actual results" sections tend to cause confusion when distinguishing between duplicate reports, which often results in a high misclassification rate.

Complete Paper #93

Creation and Termination Patterns for Managing Processes with Board-Based Collaborative Tools

Alfonso Bravo^{1,2}, Adela del-Rio-Ortega^{1,2}, Joaquín Peña¹ and Manuel Resinas^{1,2}

¹ *I3US Institute, Universidad de Sevilla, Spain*

² *SCORE Lab, Universidad de Sevilla, Spain*

Keywords: Board-Based Tools, Behavioral Patterns, Design Patterns.

Abstract: Board-Based Collaborative Work Management Tools (BBTs), such as Trello or Planner, are cooperative information systems that are widely used to support collaborative process coordination, task management, and knowledge sharing. However, designing effective boards can be challenging, particularly for non-technical users. Prior research has addressed this by identifying structural design patterns and a metamodel for board

design, but the focus has primarily been on card movement as the main action shaping board usage. This paper extends that work by analyzing the role that card and list creation and termination plays in BBTs. Based on this analysis, we contribute (1) a set of creation and termination patterns reflecting common usage behaviors, and (2) an extension to the existing metamodel accounting these actions. These contributions support the design of more effective and adaptable boards and provide a richer understanding of how boards are used in practice.

Session 2A
11:45 - 13:30
Process Analytics and Technology I

CoopIS
Room Andalucia 4

Complete Paper #48

Predicting Case Suffixes with Activity Start and end Times: A Sweep-Line Based Approach

Muhammad Awais Ali, Marlon Dumas and Fredrik Milani
University of Tartu, Tartu, Estonia

Keywords: Process Mining, Predictive Process Monitoring, Sequence Prediction.

Abstract: Predictive process monitoring techniques support the operational decision-making by predicting future states of ongoing cases of a business process. A subset of these techniques predict the remaining sequence of activities of an ongoing case (case suffix prediction). Existing approaches for case suffix prediction generate sequences of activities with a single timestamp (e.g. the end timestamp). This output is insufficient for resource capacity planning, where we need to reason about the periods of time when resources will be busy performing work. This paper introduces a technique for predicting case suffixes consisting of activities with start and end timestamps. In other words, the proposed technique predicts both the waiting time and the processing time of each activity. Since the waiting time of an activity in a case depends on how busy resources are in other cases, the technique adopts a sweep-line approach, wherein the suffixes of all ongoing cases in the process are predicted in lockstep, rather than predictions being made for each case in isolation. An evaluation on real-life and synthetic datasets compares the accuracy of different instantiations of this approach, demonstrating the advantages of a multi-model approach to case suffix prediction.

Complete Paper #59

BPMN Patterns for Process Variability

Philipp Hehne and Manfred Reichert

Institute of Databases and Information Systems, Ulm University, Germany

Keywords: Business Process Management, Process Configuration, Process Variability, Software Reuse, Process Family.

Abstract: Frequently, variants of the same business process are run in different organisations. Approaches have been proposed that allow managing process variants and reusing process models, i.e. changes can be applied centrally instead of applying them to each process variant. However, these approaches often extend modelling notations requiring proprietary tools. Therefore, we present modelling patterns for different types of variability in processes as solutions for this recurring problem by solely relying on standard BPMN 2.0, i.e. common BPMN 2.0 modelling tools and process engines can be used. As part of the evaluation, two processes encompassing variability were implemented and

executed on two process engines demonstrating the technical soundness of the patterns. In addition, results from expert interviews indicate that the patterns are useful, relevant, and easy to use.

Complete Paper #135

Unsupervised Hierarchical Process Mining with the Process Fragment Miner

Joern Tobis, Felix Schumann, Juergen Mangler and Stefanie Rinderle-Ma

TUM School of Computation, Information and Technology, Technical University of Munich, Garching, Germany

Keywords: Process Mining, Automated Process Discovery, Hierarchical Process Discovery, Event Abstraction, Model Abstraction, Unsupervised Process Mining.

Abstract: Abstracting processes into a hierarchical structure of subprocesses helps to improve the understandability and readability of process models. Mining such hierarchical process models from event logs is an active subfield in process mining research. Existing approaches often require activities to be labeled with a hierarchy notion or context data to identify hierarchies. In this work, we propose the ProcessFragmentMiner (PFM) to fragment an event log into subprocesses that represent the root process. PFM harnesses the dependency matrix generated by the heuristics miner in combination with different fragment ranking mechanisms. This work uses the inductive and split miner to mine the resulting process models for each fragment. PFM is evaluated against a supervised and an unsupervised hierarchical process mining approach from the literature. We find that PFM works best in combination with the presented Bigram ranking method and can match supervised approaches for some data sets. The proposed PFM approach enables hierarchical process mining on any event log without the need for any preprocessing steps.

Complete Paper #128

Accurate and Noise-Tolerant Extraction of Routine Logs in Robotic Process Automation

Massimiliano de Leoni¹, Faizan Khan¹ and Simone Agostinelli²

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² *Department of Engineering and Science, Universitas Mercatorum of Rome, Italy*

Keywords: Routine Log, Routine Identification, Robotic Process Automation, Routine-Type Model Discovery, Robotic Process Mining.

Abstract: Robotic Process Mining focuses on the identification of the routine types performed by human resources through a User Interface. The ultimate goal is to discover routine-type models to enable robotic process automation. The discovery of routine-type models requires the provision of a routine log. Unfortunately, the vast majority of existing works do not directly focus on enabling the model discovery, limiting themselves to extracting the set of actions that are part of the routines. They were also not evaluated in scenarios characterized by inconsistent routine execution, hereafter referred to as noise, which reflects natural variability and occasional errors in human performance. This paper presents a clustering-based technique that aims to extract routine logs. Experiments were conducted on nine UI logs from the literature with different levels of injected noise. Our technique was compared with existing techniques, most of which are not meant to discover routine logs but were adapted for the purpose. The results were

evaluated through standard state-of-the-art metrics, showing that we can extract more accurate routine logs than what the state of the art could, especially in the presence of noise.

Keynote Lecture
14:45 - 15:45

CoopIS
Room Gran Marbella

On the Challenges of Sustainable Data Preparation

BARBARA PERNICI
Politecnico di Milano, Italy

Abstract: Processing datasets to achieve high data (and meta-data) quality is mandatory in modern applications. However, the data preparation activities that are needed to reach such levels may easily become unsustainable due to, for example, resource intensity or scalability challenges. Moreover, some preparation efforts may become unnecessary if they result in negligible improvements or duplicate actions. The talk examines the sustainability aspects of data preparation through the lens of a circular economy. Within the data landscape, this perspective encourages practices that minimize waste, extend the data life cycle, and maximize reuse. We explore these practices and their impact on selecting and configuring effective data preparation strategies to design sustainable, high-quality data preparation pipelines. To this end, we present an evaluation model that integrates data quality metrics with sustainability parameters for human and computational tasks. Finally, we discuss the main challenges that are present in the evaluation of sustainability and data quality.

Session 3A
16:15 - 18:00

Neuro-Symbolic Systems and Knowledge Graphs

CoopIS
Room Andalucia 4

Complete Paper #28

Adaptive by Design: Rethinking the MLOC Architecture for Learning Systems

Marco Hüller, Roman Küble and Jörg Hähner
Organic Computing Group, University of Augsburg, Am Technologiezentrum 8, Augsburg, Germany

Keywords: MLOC, Organic Computing, Reinforcement Learning, XCS.

Abstract: Adaptive cyber-physical systems must cope with changing environments while guaranteeing reliable operation. The Multi-Layered Observer/Controller (MLOC) architecture provides a well-established blueprint for such self-organising systems, yet broader adoption is constrained by two key shortcomings: (i) a static, rule-based decision layer that scales poorly with state-space complexity and (ii) a fixed simulator that cannot model unforeseen dynamics. This paper proposes a lightweight redesign of MLOC's operational and adaptive layers. First, we propose replacing the XCS Classifier System (XCS) in Layer 1 with reinforcement learning agents, which reduces configuration effort and enables continuous control in high-dimensional domains. Second, we suggest a dynamic Layer 2 simulator that is fine-tuned or fully exchanged whenever an anomaly detector signals model drift. The detector differentiates between simulation mismatch and agent uncertainty, triggering simulator updates or focused agent fine-tuning without breaching MLOC's safety principle of avoiding exploratory actions in the real system. All components are lightweight, making them suitable for platforms with limited resources. Furthermore, depending on the chosen methods,

the models may remain interpretable—preserving one of the key advantages of the original XCS. The redesign preserves MLOC's hierarchical structure and unifies reactive control, long-term learning, and model maintenance, substantially widening its applicability to complex and uncertain environments.

Complete Paper #54

Lazy Prediction in Querying Graph Databases

Jacques Chabin¹, Cristina Aguiar², Mirian Halfeld-Ferrari¹, Martin Musicante³ and Lingchen Wang¹

¹ *Université d'Orléans, INSA CVL, LIFO, UR 4022, Orléans, France*

² *Department of Computer Science, University of São Paulo (USP), Brazil*

³ *DIMAp, Computer Science Department, UFRN, Natal, Brazil*

Keywords: Incomplete Graph Database, Link Prediction, Regular Path Query.

Abstract: This work focuses on querying incomplete data graphs using a hybrid, query-driven approach. The method combines the certainty of known paths with the flexibility of on-the-fly embedding-based link prediction guided by the query structure. A lazy-prediction strategy is used to improve relevance while limiting unnecessary inference. We evaluate our method on two embedding-based models and datasets, and test predictive strategies with different search space reductions.

Complete Paper #109

Path-Based Explanations for Knowledge Graph-Driven Course Recommendation

Nadia Ben Hadj Boubaker¹, Zahra Kodja¹ and Nadia Ayadi²

¹ *University of Tunis, ISG Tunis, SMART-LAB, Tunis, Tunisia*

² *Université Claude Bernard Lyon 1, CNRS, LIRIS (UMR 5205), Lyon, France*

Keywords: Recommendation Systems, Knowledge Graphs, Explainability, E-Learning.

Abstract: Recommendation systems (RS) play a key role in e-learning by guiding learners toward relevant educational resources. Yet, the integration of domain knowledge to enhance both accuracy and explainability remains underexplored. This paper presents an explainable e-learning RS grounded in an educational Knowledge Graph (KG). The KG is constructed by extracting and linking key course concepts, and leveraged through embedding techniques to improve recommendation quality. To ensure transparency, we propose a path-based explanation mechanism that identifies and ranks user-course connections using a scoring function combining similarity measures and random walk probabilities. A case study demonstrates that the approach not only improves recommendation accuracy but also generates diverse, interpretable explanations, contributing to more transparent and trustworthy systems.

Monday, 20

Complete Paper #111

Prompting Strategies for LLM-Based Cooperative Data Service Discovery

Devis Bianchini, Massimiliano Garda, Michele Melchiori and Anisa Rula

University of Brescia, Dept. of Information Engineering, Via Branze 38, 25123 - Brescia, Italy

Keywords: Large Language Models, Prompt Engineering, Retrieval-Augmented Generation, Data Service Discovery.

Abstract: In the context of Smart Manufacturing and the Internet of Production, data service discovery plays a central role in enabling cross-organizational collaboration and data-driven innovation. Nevertheless, effective discovery and composition of data services often require deep technical knowledge, limiting the autonomy of domain experts and R&D managers in designing analytics workflows. This paper presents a cooperative approach to data service discovery that combines Large Language Models (LLMs) with Retrieval-Augmented Generation (RAG), leveraging a conceptual model of data services and analytics scenarios. On top of this model, a set of prompting strategies are designed to support different levels of user expertise and interaction goals. These strategies leverage the cooperative nature of the approach, enabling domain experts and R&D managers to incrementally build, extend, and refine analytics data service pipelines through the interaction with LLMs. We describe how these prompting strategies are tightly integrated with the RAG components to inject contextual knowledge derived from a catalog of data services and analytics scenarios. The system is implemented using open-source technologies and evaluated extensively in a real-world smart factory case study. Our evaluation includes both quantitative metrics (precision, recall, faithfulness, factual correctness) and a qualitative user study, demonstrating the effectiveness of prompting strategies and the feasibility of LLM-supported data service discovery in cooperative industrial settings.

**Special Session - Session
16:15 - 18:00
Early Research Achievement**

**CoopIS-ERA
Room Andalusia 5**

Complete Paper #5

Towards Declarative Process Execution: Functionalities and Architecture

Johannes Loebbecke, Dominik Voigt, Juergen Mangler and Stefanie Rinderle-Ma

Technical University of Munich, TUM School of Computation, Information, and Technology, Garching, Germany

Keywords: Process Orchestration, Declarative Process Modeling, Declarative Process Execution, Process Compliance.

Abstract: Flexible, trusted, and compliant service orchestration, where executions adhere to constraints imposed by legal or business requirements, has become paramount for organizations. Using Business Process Management Systems (BPMS) to orchestrate services that implement human and computerized tasks can increase trust, enable efficient communication, and lead to flexible and transparent service orchestration. Existing BPMS generally use the imperative paradigm, which is suited for orchestrating strict processes with few deviations, while declarative models have been proposed for orchestrating processes with many and deeply diverging paths. However, no existing process execution engine supports the declarative paradigm

while preserving the advantages of BPMS. We propose a list of functional requirements of a declarative engine that can be achieved through loosely coupled integration with existing BPMS as a path towards declarative process execution.

Complete Paper #6

Attention-Based Connectivity Matrix Computation for Autism Spectrum Disorder Diagnosis from fMRI Data

Sirine Sboui^{1,2}, Mohamed Djallel Dilmi¹ and Faten Chaieb-Chakchouk¹

¹ *Efrei Paris Panthéon Assas University, 30-32 Avenue de la République, 94800-Villejuif, France*

² *Macif, 64 RUE RENE BOULANGER, 75010-PARIS, France*

Keywords: Attention Mechanism, Functional Connectivity Matrix, Pearson Correlation, Representations Fusion, fMRI Data, Spatiotemporal Data, Multivariate Timeseries, Autism Spectrum Disorder.

Abstract: This paper introduces a novel approach for autism spectrum disorder (ASD) classification from resting-state fMRI by replacing conventional Pearson correlation connectivity matrices with attention-based representations. From a theoretical standpoint, we demonstrate that Pearson correlation is a special case of the scaled dot-product attention mechanism under fixed projections and normalization, which allows attention to be viewed as a strict generalization of functional connectivity. Building on this formulation, we propose an end-to-end pipeline in which attention layers directly learn connectivity patterns from fMRI time series, eliminating the need for predefined functional correlation matrices. Experiments on the ABIDE-II dataset show that attention-based connectivity significantly improves diagnostic performance across diverse architectures, including MLP, vanilla Transformers, BrainNetCNN, and the Brain Network Transformer (BNT). The proposed method achieves a state-of-the-art accuracy of 90.4% with BNT, substantially outperforming correlation-based baselines. These results highlight the potential of attention mechanisms to enhance both the accuracy and interpretability of functional connectivity modeling in neuroimaging.

Complete Paper #9

Knowledge-Based, Context-Aware AI for Accurate Learner Classification with Resampling Techniques in Low-Resource Environments

Sameher Ajili¹, Rym Cheour^{1,2}, Mariem Abid³, Mouna Baklouti¹ and Richard Hotte³

¹ *Computer & Embedded Systems Laboratory (Ces.lab), National Engineering School of Sfax (ENIS), University of Sfax, Tunisia*

² *Higher Institute of Applied Science and Technology of Kasserine (ISSAT), University of Kairouan, Tunisia*

³ *Applied Artificial Intelligence Institute (I2A), TELUQ University, Montréal, QC, Canada*

Keywords: Learning Analytics, Class Imbalance, Low-Resource Education, Ensemble Learning, NLP Preprocessing, SMOTE.

Abstract: AI-driven prediction models face significant challenges in low-resource educational contexts, where cold start conditions and severe class imbalance data are prevalent. This study addresses this problem by proposing a methodological framework that integrates NLP-based preprocessing for feature extraction, advanced imbalance-aware resampling, and a comprehensive multi-model comparison. We evaluated the framework using

a small, authentic dataset of learners from Mali, applying ten classifiers, including SVM, Random Forest, XGBoost, and ensemble methods. Model performance was assessed using stratified 10-fold cross-validation, with and without resampling via Random Oversampling (ROS) and SMOTE strategies, with evaluation based on accuracy, F1-score, and AUC-ROC. Results show that ensemble methods, specifically Random Forest, Gradient Boosting and XGBoost, achieved over 90% accuracy, and superior F1-scores, after SMOTE, significantly outperforming baselines and ROS.

Complete Paper #10

Lightweight LoRa Signal Quality Classification Using RSSI and SNR

Boubaker Abdallah^{1,2}, Rym Cheour^{1,3}, Jalel Ktari¹ and Olfa Kanoun²

¹ *Computer & Embedded Systems Laboratory (Ces.lab), National Engineering School of Sfax (ENIS), University of Sfax, Tunisia*

² *Measurement and Sensor Technology, Technische Universität Chemnitz, Germany*

³ *Higher Institute of Applied Science and Technology of Kasserine (ISSAT), University of Kairouan, Tunisia*

Keywords: LoRa, LoRaWAN, Wireless Communication, IEEE Dataport, Signal Quality Classification, RSSI, SNR, Stratified Cross-Validation, Macro-F1, Random Forest.

Abstract: LoRa/LoRaWAN enables long-range and low-power connectivity but face significant challenges from signal fading, interference, and heterogeneous deployment. This paper presents supervised learning framework for classifying LoRa signal quality using non-PHY measurements (RSSI/SNR) drawn from IEEE Dataport. We introduce a four-level quality taxonomy and a reproducible pipeline with feature leakage-safe preprocessing and class-weighted imbalance mitigation. We benchmark representative classifiers, namely Logistic Regression, support vector machines with radial basis kernel, Random Forest, and a compact multilayer perceptron, under stratified five-fold cross-validation. Evaluation relies on macro-F1 as the primary endpoint, complemented by per-class precision, recall, and F1 as well as normalized confusion matrices. Error analyses highlight that residual confusions occur mainly between adjacent regimes, consistent with overlapping RSSI and SNR bands. The results indicate that lightweight models trained on RSSI and SNR can deliver robust, deployment-ready quality classification without access to physical-layer waveforms, supporting quality-of-service monitoring and adaptive configuration at LoRa gateways.

Complete Paper #11

A Hybrid Dynamic Knowledge Graph Building Approach

Sana Ben Abdallah Ben Lamine¹, Redouane Bouhamoum² and Hajer Zghal²

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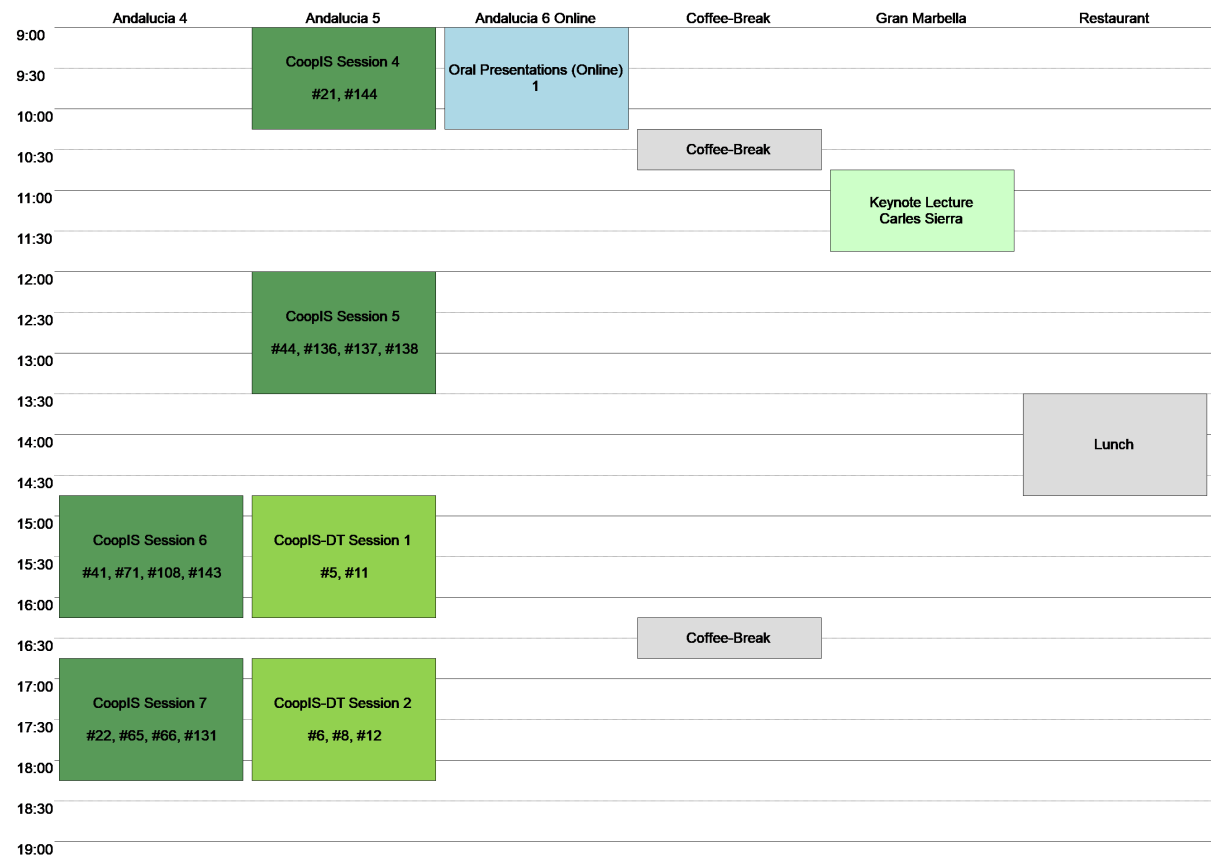
Keywords: Hybrid Knowledge Graph Construction, Ontology-Driven, Data-Driven.

Abstract: Interest is increasingly focused on Knowledge Graphs (KGs) thanks to their ability to structure heterogeneous information into an organized and interconnected form, enabling better reasoning, decision-making, and supporting advanced AI applications. The construction method of these KGs is just as

important, as it has a direct impact on automating their creation, guaranteeing their quality and their adaptation to constantly evolving needs and applications. In this paper, we propose a hybrid knowledge graph construction approach that combines the structured, ontology-driven top-down approach with the data-driven, iterative bottom-up approach, combining the rigor of top-down ontology design with the adaptability of bottom-up data integration. Our approach is three-phase : the first is a top-down ontology construction phase, the second is a bottom-up data integration and enrichment phase and the third is a hybrid integration and continuous evolution phase. Our aim is to create a more flexible construction method that takes into account structured, semi-structured and unstructured data, offering a comprehensive and dynamic KG. This approach is particularly effective for domains requiring both structured knowledge and dynamic data integration, from social media for example, like the healthcare domain. A detailed case study in this domain illustrates our proposal and demonstrates its feasibility and effectiveness.

Tuesday Sessions: October 21

Tuesday Sessions: October 21 Program Layout



Session 4A
09:00 - 10:15
Rule and Data Mining

CoopIS
Room Andalucia 5

Complete Paper #144

From Prediction to Diagnostic Action: A Human-Centric System for Coronary Artery Disease Assessment

Mohamed Amine Chaabane¹, Imen Ben Said^{1,2}, Sirine Ayedi³ and Amine Bahloul³

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Keywords: Machine Learning, Predictive Modeling, Coronary Artery Disease (CAD), Clinical Decision Support System (CDSS).

Abstract: Coronary Artery Disease (CAD), a leading cause of death worldwide, requires prompt and accurate diagnosis to enable effective treatment and avoid unnecessary or invasive procedures. Traditional statistical methods, such as those proposed by the European Society of Cardiology (ESC), often fall short in delivering reliable predictive performance, particularly in heterogeneous patient populations. To address this gap, this paper examines the application of Machine Learning (ML) to enhance CAD risk assessment and facilitate informed diagnostic decision-making. We propose a stacking ensemble model that combines multiple classifiers and achieves an accuracy of 83%, outperforming individual models. Building on this model, we introduce CARDiA, a human-centered, intelligent clinical decision support system (CDSS) designed to assist cardiologists in evaluating CAD likelihood and determining appropriate diagnostic actions. Beyond prediction, CARDiA integrates ESC clinical guidelines with a workflow-based reasoning engine to provide interpretable, guideline-aligned diagnostic pathways. By combining predictive accuracy with evidence-based, process-driven recommendations, CARDiA offers a robust and user-friendly tool to enhance CAD diagnosis in clinical practice.

Complete Paper #21

AI-Powered Cooperative Fleet Management Through Explainable Context-Aware Anomaly Detection

Nadeem Iftikhar¹, Cosmin-Stefan Raita¹, Aziz Kadem¹, Matthew Trinh², Yi-Chen Lin², David Buncek¹, Anders Vestergaard¹ and Gianna Belle¹

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Keywords: Cooperative Information Systems, Explainable Anomaly Detection, Context-Aware Systems, Data Quality, Fleet Management.

Abstract: Effective cooperative management of maritime fleets is challenged by technologies that cannot distinguish between actual technical faults and normal operational patterns influenced by weather. This ambiguity leads to frequent false alarms, undermining operator trust and limiting collaborative decision-making. To solve this problem, this paper introduces a framework that creates reliable, explainable knowledge from centrally-processed fleet data. The novelty relies in its two-stage process. First, it

fuses sensor data with external weather context and assesses the context's reliability using a *Weather Confidence Score*—a score derived from engine performance, vessel proximity to land, and an assessment of weather data trustworthiness. Second, a dual-autoencoder ensemble performs a counterfactual analysis to generate an explainable *Weather Influence Index*. The Weather Index quantifies weather's impact, enabling a granular classification of anomalies as *technical* or *weather-driven*, moving beyond simple binary flagging. Evaluation on real-world vessel data shows the framework can reliably differentiate these anomaly types, enabling more trustworthy fleet-wide monitoring.

Oral Presentations (Online) 1
09:00 - 10:15
Online I

CoopIS
Room Andalucia 6 Online

Complete Paper #47

eRooMiner: A Data-Driven Approach for Root Cause Detection of Process Data Quality Issues

Shokoufeh Ghalibafan, Sareh Sadeghianasl and Moe Wynn

Queensland University of Technology, Brisbane, Australia

Keywords: Process Mining, Event Log, Data Quality, Root Cause Analysis.

Abstract: Process mining relies on high-quality event logs for accurate analysis and decision-making. However, real-life event logs suffer from various types of data quality issues. Existing solutions are retroactive, detecting and repairing data quality issues after their occurrence in event logs. A more permanent and cost-effective solution would be to prevent these issues proactively, "prevention is better than the cure". This paper proposes a data-driven approach (*eRooMiner*) for identifying root causes of typical data quality issues in event logs to facilitate their prevention. The *eRooMiner* approach builds upon the typical data quality issues identified in the collection of eleven event log imperfection patterns, with a focus on imperfect labels which have the same meaning but different syntax. By learning from the data recorded in event logs, *eRooMiner* bridges the gap between theoretical and data-driven root cause analysis of event log imperfection patterns. The approach utilises machine learning and AI techniques to estimate the most probable root cause of specific data imperfections. The approach has been implemented and evaluated using real-life event logs and stakeholders. The results show that the proposed approach can correctly detect the potential root cause(s) of imperfect labels in various scenarios.

Complete Paper #20

MuC: A Multi-Core Tucker Model with Core Attention

Yanhui Zhang¹, Dong Zhu¹ and Aiping Liu²

¹ National University of Defense Technology, China,

² Aiping Li National University of Defense Technology, Changsha, Hunan, China

Keywords: Knowledge Graph Completion, Tensor Decomposition, Multi-Core Structure, Attention Mechanism.

Abstract: Knowledge graph completion (KGC) aims to infer missing triples from existing data. While tensor decomposition-based models offer strong expressiveness, their large core tensors often cause overfitting. We propose **MuC**, a multi-core tensor model that factorizes the core tensor into several smaller cores and introduces

a *core attention mechanism* to dynamically select relevant cores based on entity-relation input. To encourage diversity among cores, we design a *geometric consistency constraint*, and to stabilize multi-path interactions, we generalize embedding norm regularization into *channel regularization*. Experiments show that MuC improves MRR by **22.83%** on FB15k-237 and **21.51%** on YAGO3-10 compared to strong baselines. Further analysis of core attention weights and dataset characteristics demonstrates the effectiveness of MuC's dynamic core selection in enhancing adaptability and expressiveness.

Complete Paper #63

Ontology-Guided Chain-of-Thought Reasoning for Knowledge Graph Construction with Large Language Model

Gang Xiao, Wenhui Li, Jiawei Lu and Siyu Chen
China Jiliang University, Hangzhou 310018, China

Keywords: Knowledge Graph Construction, Ontology, Large Language Models, Chain-of-Thought Reasoning.

Abstract: To address the challenges of traditional knowledge graph construction (KGC) methods in terms of labor cost, accuracy and automation, this paper proposes a framework AdaOntoKG that combines ontology-driven and adaptive chain-of-thought reasoning (Adaptive CoT). The method first constructs a domain ontology based on domain boundaries, requirements, and data characteristics, and subsequently expands it automatically using LLMs. Then, in the knowledge extraction phase, AdaOntoKG establishes a feedback mechanism using Zero-Shot-CoT and Few-Shot-CoT to guide the triple extraction process. To ensure semantic consistency and structural validity, ontology constraints are applied for filtering and validation. Experiments are conducted on multiple benchmark datasets. The results show that AdaOntoKG generally outperforms mainstream baseline models in terms of F1 and AUC scores. Moreover, its performance on the ontology conformance metric demonstrates strong structural regularity and semantic consistency. In summary, AdaOntoKG demonstrates significant advantages in accuracy, controllability, and domain adaptability, providing a general and scalable solution for building high-quality knowledge graphs.

Keynote Lecture
10:45 - 11:45

CoopIS
Room Gran Marbella

Machines That Know What Matters: Engineering Awareness of Social Values

Carles Sierra
IIIA-CSIC, Spain

Abstract: Ethics in AI raises big questions about how we design and use autonomous systems responsibly. In this talk, I'll focus on one core challenge: how to engineer moral values into intelligent agents. We'll explore how human communities define social values, how these become norm-based social contracts, and how we can build computational models that make machines aware of them.

Session 5A

12:00 - 13:30

Process Analytics and Technology II

CoopIS

Room Andalucia 5

Complete Paper #136

Discriminative Rule Learning for Outcome-Guided Process Model Discovery

Ali Norouzifar and Wil van der Aalst
RWTH University, Aachen, Germany

Keywords: Process Mining, Process Discovery, Discriminative Process Modeling.

Abstract: Event logs extracted from information systems offer a rich foundation for understanding and improving business processes. In many real-world applications, it is possible to distinguish between desirable and undesirable process executions, where desirable traces reflect efficient or compliant behavior, and undesirable ones may involve inefficiencies, rule violations, delays, or resource waste. This distinction presents an opportunity to guide process discovery in a more outcome-aware manner. Discovering a single process model without considering outcomes can yield representations poorly suited for conformance checking and performance analysis, as they fail to capture critical behavioral differences. Moreover, prioritizing one behavior over the other may obscure structural distinctions vital for understanding process outcomes. By learning interpretable discriminative rules over control-flow features, we group traces with similar desirability profiles and apply process discovery separately within each group. This results in focused and interpretable models that reveal the drivers of both desirable and undesirable executions. The approach is implemented as a publicly available tool and it is evaluated on multiple real-life event logs, demonstrating its effectiveness in isolating and visualizing critical process patterns.

Complete Paper #137

Agentic Generation of Process Models from Regulatory Texts

Catherine Sai and Stefanie Rinderle-Ma

Technical University of Munich, TUM School of Computation, Information and Technology, Garching, Germany

Keywords: Process Model Generation, Regulatory Process Description, Natural Language Processing, BPMN, LLM, Multi-Agent.

Abstract: Process model generation is still mostly a manual task. A vast amount of process-relevant information is captured in textual sources such as regulatory documents and process descriptions. Hence, (semi-) automatic extraction of process model information from textual sources and translation into process models based on graphical notations such as BPMN are ongoing and, with the advent of generative AI, increasingly performant. However, existing approaches for process model generation from text are often limited to control flow aspects and require precise process descriptions as input. Regulatory documents describing processes pose different challenges than process descriptions and are widespread, highly relevant and of increasing volume in organizations. In this work, we exploit a generative AI architecture to present an approach that can automatically generate BPMN 2.0 process models from regulatory texts such as the GDPR. The approach is evaluated on five use cases with regulatory text and corresponding process models from different domains and with different challenges. This way, we can demonstrate that the

proposed approach can automatically generate reference models from regulatory requirement documentations. When compared to existing approaches, the proposed approach results in an improvement of both, syntactic and semantic process model quality.

Complete Paper #138

Out of Babylon: Object-Centric Conformance Checking on Graph-Based Abstractions

Erik Wrede¹, Jan Niklas van Detten^{1,2}, Lukas Liss¹ and Sander J. J. Leemans^{1,3}

¹ RWTH Aachen University, Aachen, Germany

² Celonis, Munich, Germany

³ Fraunhofer FIT, Germany

Keywords: Process Mining, Conformance Checking, Object-Centric.

Abstract: Process mining employs data-driven techniques to analyse and optimise business processes. An important step in such an analysis is to identify and quantify deviations between the observed and modelled behaviour of a business process using conformance checking techniques. While traditional conformance checking approaches utilise process models that primarily focus on events, recently proposed approaches also consider the involvement of business objects. These object-centric process models introduce new behavioural deviations due to the involvement of objects in events like missing objects in the execution of an event. However, existing object-centric conformance checking techniques do not precisely detect all these deviations and can only be applied to specific object-centric modelling formalisms. In this paper, we introduce a novel formalism-agnostic object-centric conformance checking approach that presents a common denominator for many object-centric modelling formalisms, enabling comparable conformance checking results. We evaluate our approach on a public object-centric log by demonstrating its ability to detect deviations across multiple modelling formalisms.

Complete Paper #44

Orchestrating Cyber-Physical Operations with PRiME: A Passive Resource-Integrated Modeling Extension for BPMN

Leo Poss and Stefan Schöning

University of Regensburg, 93040 Regensburg, Germany

Keywords: Business Process Management, Operational Perspective, Resource Management, Cyber-Physical Systems.

Abstract: The convergence of the Internet of Things (IoT) and Business Process Management (BPM) in cyber-physical systems highlights a critical limitation in current standards: the inability to effectively model and manage the operational lifecycle of physical resources. Standard BPMN lacks native constructs to differentiate between consumable materials, reusable tools, and generic data in the form of DataObjects, creating a *digital-physical divide* that hinders execution support and process transparency. This paper addresses this gap by presenting PRiME, a comprehensive and executable BPMN extension developed following the Design Science Research methodology. PRiME provides explicit constructs to model passive resource requirements, inventories, and physical flows while distinguishing between fungible materials and specific tool instances. The extension is validated through a prototype, demonstrating two key capabilities: providing *runtime* operational support through automated resource checklists and shortage

alerts, and enabling analysis through a *design-time* visualization of material flows. This concept helps bridge the gap between digital process models and physical resource orchestration, fostering a more holistic BPM that enables the support of manual tasks in cyber-physical environments.

Session 6A
14:45 - 16:15
Internet of Things and Digital Twins

CoopIS
Room Andalucia 4

Complete Paper #71

Digital Twin Narratives: Framework for Clear Communication

Faten El Outa, Hugo Breuillard and Guillaume Dechambenoit

French Geological Survey (BRGM), Orléans, France

Keywords: Environmental Digital Twins, Data Storytelling, Narrative Visualization, Human-Centered Communication, IA.

Abstract: Digital Twin (DT) systems are increasingly applied in environmental contexts to support real-time monitoring, forecasting, and decision-making. While technically advanced, many DT implementations fall short in communicating insights in ways that are accessible, interpretable, and actionable for diverse audiences. This paper introduces a user-centered framework that enhances the communicative power of environmental DTs through the integration of data storytelling techniques. The proposed approach is structured around five components: (i) a four-phase data storytelling process, (ii) a user-system interaction model driven by user intent, (iii) progressive levels of knowledge formalization, (iv) a workflow that adapts key data storytelling activities to generate DT outputs that are both analytically robust and communication-ready, and (v) a semantic mapping table that links analytical operations to narrative and visual outputs. Together, these components enable DT systems to transform analytical results into meaningful, audience-adapted stories. The framework is illustrated through environmental prediction use case, demonstrating its potential to enhance interpretability, increase user engagement, and support more informed decision-making.

Complete Paper #143

Impact-Sensitive Conflict Management in Smart IoT-Based Systems Using Attention Networks

Christson Awanyo¹, Nawal Guermouche² and Morel Vianney¹

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Keywords: IoT, Conflict Resolution, Non Functional Properties, Impact, Attention Model, Dynamic Systems, Large Scale IoT Systems, Smart City.

Abstract: Modern IoT environments are increasingly evolving into syst-em-of-systems, where independently managed subsystems interconnect and operate over shared IoT devices and infrastructures. As these heterogeneous systems evolve autonomously, the potential for IoT conflicts rises, particularly when they issue overlapping or competing control requests. This growing complexity underscores the need for a robust, dynamic, and real-time conflict management framework that can adapt to changing contexts and system behaviors. Traditional resolution strategies, such as fixed priorities or first-come-first-served, often fail to consider contextual factors and the effective impact of decisions, resulting in degraded

Tuesday, 21

non-functional properties.

To address these challenges, we propose an impact-aware, attention-based conflict management framework. Our approach resolves conflicts by jointly considering request importance and their predicted system-level consequences. By leveraging real-time contextual data and historical conflict patterns, the model dynamically selects resolution actions that minimize negative impacts. We demonstrate the effectiveness of this framework through extensive evaluations in a smart transportation scenario, using energy consumption and CO₂ emissions as key non-functional metrics.

Complete Paper #41

A Hybrid Query Language for Digital Twins

Philipp Zech¹, Manuel Burger^{2,1}, Linus Wald^{2,1}, Philipp Pobitzer^{2,1}, Sascha Hammes³ and Judith Michael⁴

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Keywords: Digital Twins, Models-Meet-Data, Domain-Specific Language, Query Language, Data Integration.

Abstract: The full potential of Digital Twins (DTs) is hindered by the challenge of integrating complex engineering models with high-frequency runtime data from disparate sources. Existing approaches lack a unified mechanism to query across the boundary of static models and dynamic data, leading to fragmented and inconsistent DT systems. We introduce a hybrid query language that unifies model and data retrieval, translating queries into SPARQL for model access and SQL for data access within a single declarative statement. Our evaluation demonstrates that this approach overcomes the models-meet-data challenge by enabling scalable, near real-time queries, thereby paving the way for more robust and integrated DT applications.

Complete Paper #108

Trial by Twin: Behavior-Predictive Trust in Autonomous Drone Swarms

Danish Iqbal, Hind Bangui and Bruno Rossi

Faculty of Informatics, Masaryk University, Brno, Czech Republic

Keywords: Trust, Modeling, Autonomous Drones, Digital Twin, Run-Time Compliance Checking, Attacks, Trust-Assurance.

Abstract: To achieve future autonomous mobility for Unmanned Aerial Vehicles (UAVs), reliable runtime trust assurance is crucial. This paper presents a trust-assurance method for autonomous drones utilizing runtime compliance checking via a Digital Twin (DT). The DT incorporates drone-specific metrics from AirSim simulations, including sensors' health and network centrality for real-time behavior analysis. Drones collaborate in swarms, sharing predictive and actual behaviors for trust assessment. The model uses Random Forest (RF), Support Vector Regression (SVR), and Convolutional Neural Network (CNN) to estimate swarm coordination rates as trust indicators, with each iteration classifying drones as Trusted or Malicious. The model was tested in an autonomous drone delivery system against various trust-related attacks, demonstrating SVR's effectiveness in estimating coordination rates and RF and SVM's role in trust classification.

Special Session - Session 1
14:45 - 16:15
Demo Track

CoopIS-DT
Room Andalusia 5

Complete Paper #5

AQG4SD: Automated GraphQL Query Generation for Cloud Service Discovery and Selection

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² University of Doha for Science and Technology, Qatar

Keywords: Cloud Service, Discovery, Selection, Generative AI, GraphQL, LLM.

Abstract: This paper demonstrates AQG4SD (*Automated Query Generation for Service Discovery*), an interactive tool that automates the discovery and selection of cloud services from user requirements defined in natural language. Leveraging Large Language Models (LLMs) and automated GraphQL query generation, the tool outperforms existing solutions by dynamically binding real-time public cloud pricing APIs. AQG4SD has the capacity of translating user requirements into actionable GraphQL queries, even when confronted to APIs not natively optimized for complex selection criteria. Preliminary experimental results are promising demonstrating the robustness of AQG4SD along with its suitability for an efficient and automated cloud resource management.

Complete Paper #11

GRAPE: A Guiding RML Authoring Projectional Editor in Action and User's First Impressions

Jakub Duchateau and Christophe Debruyne

Montefiore Institute, University of Liège, Belgium

Keywords: N/A

Abstract: RDF Mapping Language (RML) facilitates Knowledge Graph construction but presents significant authoring challenges. GRAPE, an open-source projectional editor, aims to simplify RML authoring. GRAPE offers a guided, text-like interface preventing syntax errors while maintaining RDF flexibility. We showcase its core features, including its language-oriented design and specialized notation. A user study with 20 MSc students revealed diverse user preferences: some felt reassured by the guided approach, while others preferred traditional text editors. These findings inform future GRAPE development.

Session 7A
16:45 - 18:15
Knowledge Representation and Management

CoopIS

Room Andalucia 4

Complete Paper #66

Assessing the Stability of Rankings in Knowledge Graphs Against Perturbations

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Keywords: N/A

Abstract: Knowledge graphs such as Wikidata serve as valuable resources for structuring and analyzing information across various domains. However, their crowdsourced nature makes them vulnerable to perturbations, including both intentional vandalism and unintentional errors, which can significantly impact rankings derived from these graphs. While previous studies have primarily focused on detecting and preventing entity-level perturbations, this paper investigates the potential impact of such perturbations on the stability of rankings at the structural level, specifically targeting relationships. We formalize the problem of ranking stability under perturbations, and we propose a probabilistic model to assess the likelihood of modifications to knowledge graph relationships changing the ranks of entities. We leverage complex network analysis, in order to evaluate ranking vulnerabilities. Our experimental study demonstrates varying levels of resilience in rankings depending on entity degree distributions and the nature of perturbations.

Complete Paper #22

Embedding-Based Ontology Term Recommendation System for FAIR Data Publishing Workflows

Nan Liu, Mohamed-Anis Koubaa, Andreas Schmidt, Karl-Uwe Stucky, Wolfgang Suess and Veit Hagenmeyer
Karlsruhe Institute of Technology, Germany

Keywords: Energy Data Management, FAIR Principles, Large Language Model, Ontology Embeddings, Ontology Alignment, Recommendation System.

Abstract: FAIR (Findable, Accessible, Interoperable, and Reusable) data publications are important for enabling open energy research across interdisciplinary domains. The realization of the FAIR principle for data still faces many challenges, such as the diversity of data formats, semantic heterogeneity, lack of formalized ontologies, and error-prone manual annotation of data. These challenges impede the effective sharing and integration of energy data. To address these issues, we propose an automated ontology term recommendation system based on ontology embedding and semantic similarity, aiming to facilitate FAIR data publication in energy research. Our recommendation system utilizes contextual embeddings to automate semantic annotation of heterogeneous energy datasets by linking data elements to predefined energy-specific ontologies and referring to the top-K most relevant ontology concepts. The proposed system is designed to significantly streamline the semantic annotation process for energy researchers, thereby accelerating the process of open energy research. For evaluation, we test our system on the SemTab Challenge 2024 dataset provided by the Ontology Alignment Evaluation Initiative (OAEI). The experimental results

show that our system improves the matching accuracy significantly compared to the baseline system.

Complete Paper #65

Automated Model/Schema Interoperability with ML/AI Approaches: A Survey

Joshua Ocansey¹, Yngve Lamo¹, Adrian Rutle¹, Fazle Rabbi² and Bahareh Fatemi²

¹ Western Norway University of Applied Science, Bergen, Norway

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Keywords: Model, Schema, Interoperability, ML, AI, Matching, Mapping, Alignment.

Abstract: Automated interoperability plays a pivotal role in managing heterogeneous artefacts across software engineering and data-intensive domains. While conventional approaches often depend on manual or rule-based methods, recent advances in machine learning (ML) and artificial intelligence (AI) present promising avenues for automating interoperability tasks such as matching, mapping, and alignment. However, existing surveys rarely provide a systematic account of how ML/AI techniques address structural and semantic heterogeneity. This paper presents a tertiary study and a critical synthesis of recent developments in AI-driven model interoperability. From a corpus of 82 contributions identified in 19 secondary studies, we selected and classified 19 primary papers that explicitly apply ML/AI methods. Using an extended feature model, we analyze these works along multiple dimensions, including artefact management, execution context, and learning techniques. We also identify key research challenges in explainability, generalization, transformation semantics, and conformance validation, offering a foundation for future research and tool development.

Complete Paper #131

Performance Improvement for an Intensive SPARQL-Based Application: The ERA Route Compatibility Check Tool

Daniel Doña, Oscar Corcho and Edna Ruckhaus
Universidad Politécnica de Madrid, Spain

Keywords: SPARQL, RDF, Query Performance.

Abstract: This paper addresses performance challenges in the European Union Agency for Railways (ERA) Route Compatibility Check (RCC) tool, a system that intensively uses SPARQL to query a large-scale knowledge graph. The application determines if a vehicle type is compatible with a railway route's characteristics, but a naïve approach of checking all route tracks leads to poor performance. To resolve this, we implemented and evaluated two performance improvement strategies: track aggregation and query parallelization. Track aggregation groups tracks with identical technical parameters to drastically reduce the number of evaluations during query execution, while parallel execution maximizes the throughput of the SPARQL endpoint. Our evaluation, comparing the optimised strategy against the naïve baseline, demonstrates a significant, approximately five-fold improvement in execution time for long routes. This work shows that combining data summarization with parallel execution is an effective approach for making SPARQL-intensive applications on large knowledge graphs performant and responsive.

Special Session - Session 2
16:45 - 18:15
Demo Track

CoopIS-DT
Room Andalucia 5

Complete Paper #12

BPFragmentODRL: A Web Tool for Generating ODRL Policies for Business-Process Fragments

Abderrahmane Maaradji and Zakaria Maamar
University of Doha for Science and Technology, Doha, Qatar

Keywords: Business Process, BPMN, Fragmentation, ODRL, Policy Generation.

Abstract: As organizations increasingly adopt distributed process execution models and cloud-based architectures, business processes are often decomposed into fragments that execute across different environments and systems. However, managing governance policies for these fragments remains a significant challenge, as existing approaches focus primarily on process-level policies without addressing the specific requirements of individual fragments. This paper presents BPFragmentODRL, an online tool for fragment policy generation in business processes that addresses this critical gap. The tool enables users to upload BPMN process models and automatically generate ODRL-compliant policies for process fragments using both template-based and LLM-based techniques. BPFragmentODRL supports multiple fragmentation strategies and provides policy consistency checking and metrics analysis. By enabling fine-grained governance at the fragment level, the tool facilitates compliance management, reduces policy conflicts, and supports the practical deployment of distributed business processes in modern enterprise environments.

Complete Paper #6

One Engine to Rule Them All: Executing Declarative Processes with CEP

Leo Poss and Stefan Schöning
University of Regensburg, Regensburg, Germany

Keywords: Declarative Process Execution, Complex Event Processing, Business Process Management, Event-Driven Architecture.

Abstract: We present a novel tool that directly executes MP-Declare process models on standard Complex Event Processing (CEP) engines, removing the need for middleware. By tightly integrating Business Process Management (BPM) and CEP, it supports flexible, declarative process execution over high-frequency IoT data. Its core innovation is a multi-level event abstraction framework that translates declarative constraints into optimized, executable CEP queries. This demonstrates how a unified engine paradigm simplifies architecture, significantly reduces latency, and enables the real-time enactment of event-driven processes, effectively bridging the abstraction gap between low-level events and high-level business logic, offering a scalable and responsive solution for process-aware systems.

Complete Paper #8

Data Asset Analyzer: A Feature-Wise Evaluation System

Vanilson Burégio¹, Belkacem Chikhaoui², Zakaria Maamar¹ and Amel Benna³

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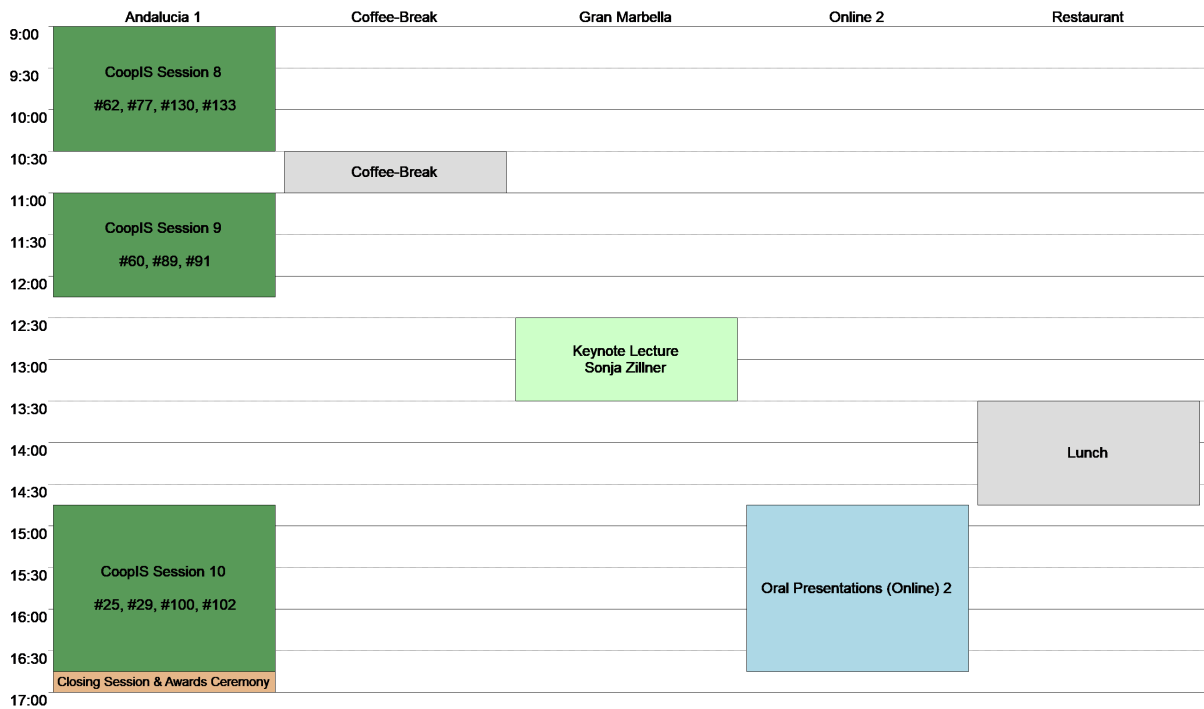
³ *Research Center for Scientific & Technical Information (CERIST), Algiers, Algeria*

Keywords: Data Assetization, Eligibility Scoring, Data Valuation, Interactive Visualization, Streamlit.

Abstract: This paper presents an implementation of the eligibility stopover featuring the data assetization journey framework. A feature-wise eligibility scoring model is introduced allowing to assess datasets' potential for assetization. The model evaluates data quality through completeness and uniqueness metrics while considering assetization efforts through missingness and preprocessing costs. The system is associated with an interactive Streamlit-based tool that provides real-time visualization of eligibility scores and dynamic data quadrants that is updated based on user-defined thresholds. The system's flexible interface also allows users to adjust scoring parameters and thresholds, enabling customized assessment based on specific organizational priorities and data characteristics. The evaluation shows that the system effectively identifies datasets with high assetization potential while providing immediate visual feedback on how different parameters affect eligibility assessment.

Wednesday Sessions: October 22

Wednesday Sessions: October 22 Program Layout



Session 8A
09:00 - 10:30
Access Control

CoopIS
Room Andalucia 1

Complete Paper #62

RDF Query Answering in the Presence of Access Restrictions

Maxime Buron¹, Hritika Kathuria², Ioana Manolescu² and George Siachamis²

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² *Inria & Institut Polytechnique de Paris, France*

Keywords: Semantic Web, Access Control, Query Answering.

Abstract: In this work, we explore algorithms for answering conjunctive RDF queries in the presence of RDFS ontologies and access control. We consider an access control setting where by default all users have access to the complete graph, and a *restriction* can forbid user u a user's access to specific IRIs. Here, restricting for user u the access to an IRI i entails that: no answer to a query by u may contain the IRI i ; no triple containing i can be used to compute an answer for a query by i , nor to entail such a triple via reasoning with the ontology. We present a set of query answering algorithms for this novel context, and prove that five among them are correct, i.e., sound and complete, with respect to both the ontology and the access restrictions in place. We have implemented all our algorithms and present experiments comparing their performance.

Complete Paper #130

Fed-DL: Federated Learning with Distributed Ledger for Social Demographic Equality

Jaya Pathak¹, Yash Pandey¹, Jagat Sesh Challa¹ and Amitesh Singh Rajput²

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² *Rajiv Gandhi National Cyber Law Centre, National Law Institute University, Bhopal, India*

Keywords: Federated Machine Learning, Blockchain, Secure Distributed Systems, Predictive Fairness, Access Control.

Abstract: Federated Learning has become a viable solution to train machine learning models on decentralized data without sharing sensitive information. Meanwhile, Blockchain ensures data integrity and transparency. In this work, we utilize the best of both worlds by implementing a distributed blockchain ledger within a federated learning system, named Fed-DL. Due to aggregation of non-IID data within federated setup, the model favors over-represented groups within clients. This introduces inequality in model's predictive performance across different demographics, resulting in bias within the system. The proposed federated learning framework based on smart contract filters irregular or false updates from clients that negatively impact predictive analysis within demographic groups. This framework is also effective in reducing the server traffic by allowing limited updates which are validated through consensus for model aggregation at the server. Fed-DL not only helps in protecting sensitive client's information but also fosters trust and equality among participants through transparency and record (updates) traceability. This approach enhances the overall quality of machine learning models while adhering to data protection laws and prompts fair and ethical practice. Results indicate that the proposed framework performs well in non-IID data scenarios and is also robust against poisoning

attacks.

Complete Paper #133

Towards User-Centric Authorization for Data Access, Sharing and Control

Florian Weingartshofer, Aya Mohamed and Marc Kurz

Department of Smart and Interconnected Living (SAIL), University of Applied Sciences Upper Austria, Hagenberg, Austria

Keywords: User-Centric Authorization, Access Control, Data Sharing.

Abstract: With the increasing demand and interest in users' data in various domains like energy and Internet of Things (IoT), access to these data should be protected, but also controlled by the user for transparent data access and sharing. Currently, there is no standard for user-centric authorization as in typical authorization and access control models due to challenges related to the different authorization processes and entities involved, which vary for each domain and use case. First, we explain user-centric authorization compared to traditional authorization and user consent along with related work. We propose a user-centric authorization approach to involve users in the authorization process to decide about access to their private data by requesters, share specific data with interested parties, and control even after granting the permission. Actors (e.g., user, requester, and data provider), resources (i.e., request and data), general states, and request structure are defined for the permission request, data access, and revoke processes. Our approach is implemented and applied within the *European Distributed Data Infrastructure for Energy (EDDIE)* project to access and share energy data. We provide a demo case, including implementation of the model and detailed steps from creating a permission request until getting a decision from the end-customer and receiving the requested energy consumption data. Finally, we discuss characteristics of our approach, such as multi-transparency, permission revocation, access audit, data granularity, and external termination.

Complete Paper #77

A Hybrid GAM-Based Model for Predicting Vulnerability Exploitation

Noufal Issa¹, Damas Gruska² and Loubna Ali²

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Keywords: Vulnerability, Prioritization, CVSS, EPSS, Hybrid GAM, Interpretability.

Abstract: Vulnerability management requires prioritizing which vulnerabilities to patch, since only a small fraction are ever exploited, and writing, testing, and installing patches can involve considerable resources, requiring companies to prioritize based on some notion of risk. Traditional severity scores, such as the Common Vulnerability Scoring System are often poor predictors of exploitation risk. Data-driven scores, such as the Exploit Prediction Scoring System, provide probabilities of exploitation, but still leave room for improvements. We propose a lightweight hybrid model using a Generalized Additive Model (GAM) that combines numeric features (CVSS base score, EPSS probability, age, reference count) with semantic text features (derived from the vulnerability description via Term Frequency–Inverse Document Frequency and Singular Value Decomposition). The GAM framework yields an interpretable, additive risk score without black-box explanations.

On a 2023 training set (with labels from CISA's KEV and public exploits), our model achieves significantly better precision-recall tradeoff than CVSS or EPSS alone. Tested on 2024 disclosures, our presented model consistently outperforms the baselines at nearly all recall levels.

Session 9A
11:00 - 12:15

Process Analytics and Technology III

CoopIS
Room Andalucia 1

Complete Paper #60

Extracting Object-Centric Event Logs from Incident Data Using Large Language Models

Ahmed Takiy Eddine Hamdi^{1,2}, Marwa Elleuch¹, Nassim Laga¹ and Walid Gaaloul²

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Keywords: Unstructured Data, Event Extraction, Object-Centric Event Log (OCEL), LLM.

Abstract: Incident monitoring is critical in industrial settings to prevent disruptions and optimize operations. While traditional equipment logs are often converted into XES-like event logs, these formats typically associate each event with a single case object and overlook valuable information from other sources, particularly, pre- and post-incident process logs. These additional logs frequently describe activities involving multiple related objects (e.g., hardware, software). OCEL (Object-Centric Event Log) standard can be used to represent events involving multiple, interconnected objects, thus offering a more comprehensive view of incident-related processes. However, pre- and post-incident data are often recorded in unstructured textual formats, whereas OCEL requires well-structured data in order to be properly populated. To bridge this gap, we introduce a method to extract events and objects from unstructured pre- and post-incident textual content that leverages Large Language Models (LLMs). Our approach is evaluated on real-world data from the data center domain demonstrating its effectiveness in enriching incident monitoring and providing a structured foundation for advanced incident prediction and analysis.

Complete Paper #89

Incremental Synchronization of BPMN Models and Documentations by Leveraging Structural Algorithms and LLMs

David Cremer¹, Benjamin Dalmás², Quentin Nivon¹ and Gwen Salaün¹

¹ Univ. Grenoble Alpes, CNRS, Grenoble INP, Inria, LIG 38000 Grenoble, France

² iGrafx, 35510 Cesson-Sévigné, France

Keywords: Process Modeling, Business Process Management (BPM), Text Synchronization, Large Language Models (LLMs).

Abstract: Maintaining consistency between business process models and their textual descriptions is critical for operational clarity, compliance, and communication. However, as process models evolve, updating documentation remains costly and error-prone. Existing methods often require manual rewriting or full text regeneration, discarding valuable domain-specific language. This paper presents an edit-based synchronization

approach that incrementally updates textual descriptions to reflect changes in Business Process Model and Notation (BPMN) diagrams while preserving unaffected content. We propose two complementary algorithms: the Longest Common Execution Subsequence (LCES) approach for balanced acyclic models, and a heuristic beam search for more complex structures with loops and unbalanced gateways. The resulting transformation steps are translated into structured prompts guiding a large language model to produce minimal, style-consistent revisions. A prototype system demonstrates high semantic accuracy and stylistic coherence across diverse process evolution scenarios.

Complete Paper #91

A Framework for Assessing Overcompliance and Undercompliance in Business Processes

Johannes Loebbecke and Stefanie Rinderle-Ma

Technical University of Munich, TUM School of Computation, Information, and Technology, Garching, Germany

Keywords: Process Compliance, Compliance Degree, Overcompliance, Undercompliance, Compliance Costs.

Abstract: Ensuring process compliance is critical for companies and organizations to avoid regulatory penalties, financial losses, and reputational damage. As a result, research has focused on detecting non-compliant instances where processes deviate from rules imposed on their execution and formalizing legal documents to enable automatic compliance verification. However, a crucial but overlooked phenomenon is overcompliance, where processes exceed what is required by regulations or policies, potentially leading to inefficiencies, increased operational costs, or overly rigid processes. While the reasons why companies overcomply with regulations have been extensively analyzed in environmental economics, overcompliance has been largely disregarded in process compliance, where compliance is often categorized as either violated or satisfied, and, at most, the degree of undercompliance is considered. We propose a formal framework for evaluating a degree of compliance, which specifically highlights the differences between perfect compliance, (maximal) undercompliance, and (maximal) overcompliance. Furthermore, we present a technique for estimating the costs associated with over and undercompliance. The approach is prototypically implemented and evaluated using real-world and synthetic event logs.

Keynote Lecture
12:30 - 13:30

CoopIS
Room Gran Marbella

Responsible AI Engineering through the Systematic Management of Generative AI Risks

Sonja Zillner

Siemens AG, Germany

Abstract: Artificial Intelligence (AI) presents significant opportunities for new business ventures within the industrial domain. However, its adoption introduces a broad spectrum of risk sources across dimensions such as cybersecurity, reliability, robustness, safety, transparency, or human oversight. Simultaneously, organizations are confronted with an increasing amount of digital and AI-based legislation in the international environment. This leads to a fragmented landscape of legal and risk-related requirements, often inconsistent, overlapping, and duplicated. This results in high uncertainty and bureaucratic burden during the development and deployment of AI products. To address these challenges, a systematic, responsible, and efficient approach is required to handle the complex legal requirements as well as the emerging wide range of risk sources. Responsible AI Engineering describes

such a systematic approach, enabling the efficient and innovative development of AI products while ensuring compliance with the complex and fragmented legal landscape. In this presentation, I will introduce the Siemens Generative Risk Management Process as an example of a responsible AI engineering approach. This demonstrates how organizations can drive AI innovation forward in a compliant and risk-aware manner.

Oral Presentations (Online) 2
14:45 - 16:45
Online II

CoopIS
Room Online 2

Complete Paper #134

Leveraging Data Augmentation and Siamese Learning for Predictive Process Monitoring

Sjoerd van Straten¹, Alessandro Padella² and Marwan Hassani¹

¹ Department of Mathematics and Computer Science, Eindhoven University of Technology, The Netherlands

² Department of Mathematics and Computer Science, University of Padua, Italy

Keywords: Data Augmentation, Siamese Learning, Training Under Label Scarcity.

Abstract: Predictive Process Monitoring (PPM) enables forecasting future events or outcomes of ongoing business process instances based on event logs. However, deep learning PPM approaches are often limited by the low variability and small size of real-world event logs. To address this, we introduce SiamSA-PPM, a novel self-supervised learning framework that combines Siamese learning with Statistical Augmentation for Predictive Process Monitoring. It employs three novel statistically grounded transformation methods that leverage control-flow semantics and frequent behavioral patterns to generate realistic, semantically valid new trace variants. These augmented views are used within a Siamese learning setup to learn generalizable representations of process prefixes without the need for labeled supervision. Extensive experiments on real-life event logs demonstrate that SiamSA-PPM achieves competitive or superior performance compared to the SOTA in both next activity and final outcome prediction tasks. Our results further show that statistical augmentation significantly outperforms random transformations and improves variability in the data, highlighting SiamSA-PPM as a promising direction for training data enrichment in process prediction.

Complete Paper #17

NarrativeMind: A Dynamic Neural-Symbolic Decoder for Culturally-Authentic Arabic Story Generation

Mossab Ibrahim¹, Pablo Gervás^{1,2} and Gonzalo Méndez^{1,2}

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² Instituto de Tecnología del Conocimiento, Universidad Complutense de Madrid, Madrid, Spain

Keywords: Arabic NLP, Neural-Symbolic Generation, Cultural Narrative Modeling, Dialectal Adaptation, Computational Storytelling.

Abstract: We introduce *NarrativeMind*, a previously-unexplored cooperative neural-symbolic decoder in Arabic NLP that dynami-

cally injects dialect-specific cultural constraints during generation. Our approach achieving +3.5 BLEU improvement over AraBERT (from 26.3 to 29.8) while reducing MSA bias by 58%, addressing the critical gap where traditional Arabic narrative systems inadequately capture the rhetorical sophistication embedded in morphologically complex literary forms.

The hybrid architecture seamlessly integrates classical Arabic structures into BLOOMZ's decoding through weighted interpolation, preserving essential rhetorical devices. For instance, it maintains □ (*saj'*) patterns in □ (wisdom in words, blessing in currency) and □ (*jinās*) wordplay as demonstrated in □ (the speaker said to the killer). Unlike rigid frameworks, *NarrativeMind* adapts fluidly across Modern Standard Arabic and six regional dialects, particularly benefiting under-resourced Maghrebi varieties.

Our real-time multi-dialect collaboration employs adaptive constraint weighting, optimizing both BLEU coherence and our novel *CulturalScore* metric. This metric derives from 2,500 expert-annotated templates spanning classical □ (*maqāmāt*) to contemporary □ (*hikāyāt sha'biyya*), ensuring comprehensive cultural representation.

MADAR corpus evaluation (n=12,000) demonstrates substantial improvements: BLEU scores reached 29.8 ± 0.4 versus 27.1 ± 0.3 for baselines, with dialectal accuracy achieving $\kappa = 0.76$ compared to 0.70. Human evaluation involving 15 linguists and 185 native speakers validates 82.5% cultural authenticity ($p < 0.01$), confirming effective cross-regional story co-creation while preserving dialectal integrity.

□ - Arabic text

Complete Paper #132

Data Integrity-by-Design: Combining Declarative Object-Centric Choreographies and Entity Relationship Models

Tilman Zuckmantel¹, Hugo A. López², Yongluan Zhou³, Boris Döder³ and Thomas Hildebrandt³

¹ University of Copenhagen, Denmark,

² Technical University of Denmark, Denmark

³ University of Copenhagen, Denmark

Keywords: N/A

Abstract: This work proposes a novel technique to align Object-Centric Process models and data integrity constraints from Entity-Relationship (ER) Diagrams, supporting data-dependent access control and guaranteeing data-integrity-by-design in the execution of a business process. Recent developments in process modelling and mining notations have highlighted how critical data objects affect the evolution of process models. Yet, few works have considered the integration of data relationships between data objects in object-centric modelling notations. As a consequence, object-centric process models (OCPM) may violate data-integrity and existential dependency constraints that are necessary for the deployment of models in information systems. We examine how OCPM can integrate access control, cardinality constraints, existential dependency, total participation, and structural integrity. In particular, we extend the semantics of one OCPM language, the Object-Centric Condition Response Choreographies (OC-DCR choreographies), to include explicit identities of actors and object deletion and extend the execution semantics to respect the ER model constraints. We illustrate the idea with a running example of an OC-DCR graph and an ER model for a small healthcare process.

Complete Paper #30

CodeASG: An Approach for Extracting Code Embeddings from Abstract Syntax Graphs

Alexandru-Gabriel Sîrbu and Gabriela Czubula

Babes-Bolyai University, Cluj-Napoca, Romania

Keywords: Code Embedding, Abstract Syntax Graph, Deep Learning, Graph Neural Network, Clustering.

Abstract: In programming languages, learning models often treat code as a natural language, causing them to learn syntax and semantics implicitly. The paper proposes, as a proof of concept, a new approach to generate source code embeddings based on Abstract Syntax Graphs, a more compact and less redundant representation than traditional ASTs, particularly at the leaf node level. Thus, a Graph Attention Network model is employed for learning to reconstruct ASGs and internalize structural information. To evaluate the quality of the resulting embeddings, the embedded data is clustered using *k*-means, DBSCAN, and Spectral Clustering, using the cosine similarity distance metric. Performance is assessed using silhouette scores, outperforming those achieved by state-of-the-art models such as CodeBERT and CodeT5 on the same task.

Complete Paper #112

Enhancing Suitable Tasks Selection for RPA Through Fuzzy AHP and AI Methods

Imen Korâani^{1,2}, Wiem Chebil^{1,3} and Sonia Ghannouchi^{1,4}

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² *Higher Institute of Computer Science and Telecommunications of Hammam Sousse, University of Sousse, Sousse, 4002, Tunisia*

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Keywords: Robotic Process Automation RPA, Fuzzy Analytic Hierarchy Process (Fuzzy AHP), Multi-Criteria Decision Analysis MCDA, Artificial Intelligence (AI).

Abstract: Currently, increasing attention is devoted to the digitization of operations and business processes in companies to provide more value to their customers. Organizations have started to adopt technological advancements, such as Robotic Process Automation (RPA), to optimize their operations and reduce the burden of repetitive, low-value tasks. RPA improves productivity by automating structured processes. To harness these benefits, organizations face the challenge of identifying process activities that are viable automation candidates. The goal of this work is to propose a richer RPA lifecycle by integrating Multi-Criteria Decision Analysis (MCDA) and Artificial Intelligence (AI). MCDA, and more specifically the fuzzy analytical hierarchy process (Fuzzy AHP), offers a structured method for prioritizing automation candidates while handling uncertainty in expert evaluations. AI further extends RPA's capabilities to more complex and unstructured tasks, enabling intelligent, adaptive automation. By combining these three approaches, we propose a smarter, data-informed framework to guide automation strategies and maximize the impact of RPA within organizations.

Session 10A
14:45 - 16:45CoopIS
Room Andalucia 1
Architecture and Management of Information Systems

Complete Paper #29

A Maturity Model for Blockchain Adoption in the Banking Industry

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Keywords: Maturity Models, Distributed Ledger Technology, Blockchain, FinTech, Delphi Method.

Abstract: Blockchain is an emerging technology that facilitates the elimination of intermediaries or third parties, thereby reducing costs and enhancing efficiency. Over the past decade, blockchain has been integrated across various industries, yet its wide-scale adoption within the financial industry remains uncertain. This paper seeks to aid financial institutions in adopting blockchain technology by developing a maturity model. This model is intended to assist organisations in assessing their current maturity level and charting a way forward towards a more enhanced adoption of the technology. We construct an initial model based on literature on existing maturity models in other fields of study. Subsequently, we refine the model through the Delphi approach which is a qualitative, systematic, and iterative panel method. We conduct the Delphi method in three rounds with experts in the field, yielding a final maturity model and a corresponding questionnaire which allows financial institutions to conduct a self-assessment of their blockchain adoption capabilities. We discuss the validity of the model and provide a proof of concept through a self-assessment exercise by a participating institution. The panel participants and contributing institutions concurred that the resulting maturity model and the corresponding self-assessment questionnaire are relevant and useful tools for the purpose of assessing their current maturity and informing future actions to enhance their blockchain adoption capabilities.

Complete Paper #100

A Method for Automated Deployment Architecture Reconstruction from Heterogeneously Nested Deployment Models

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Keywords: Software Architecture, Deployment Models, Architecture Reconstruction, Model-Driven Software Engineering.

Abstract: Deploying large-scale software systems often requires combining multiple different deployment technologies by creating heterogeneously nested deployment models, for example, using Kubernetes manifests within a Terraform configuration file. If such nested models need to be manually analyzed regarding the architecture of the final deployment, immense technical expertise in different technologies is required. Moreover, current automated architecture reconstruction approaches do not consider such heterogeneously nested deployment models. Therefore, we present a rule-based method that automatically transforms a given deployment model into a technology-agnostic, graph-based architecture model while considering heterogeneously nested deployment models. We applied the method in a case study to reconstruct the deployment architectures from six deployment

models of three reference applications using different combinations of the technologies Ansible, Kubernetes, Terraform, Helm, Bash, and Docker. The case study shows that many architectural aspects can be reconstructed generically, but some parts need custom or semantic analysis transformation rules.

Complete Paper #25

Inferring a Hierarchical Input Type for Plug-and-Play SQL

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Keywords: Plug-and-Play, SQL, Query Guards, Guard Inference.

Abstract: Plug-and-play queries simplify the process of writing SQL queries. In plug-and-play SQL a programmer uses a query guard to specify a query's input type. The input type is the shape of the data needed by a query. The input type can be matched to a database's schema to determine whether the query can be safely evaluated. Plug-and-play queries are portable, easier to write, and are type safe. But plug-and-play queries depend on the programmer to provide an input type. Since the programmer could err in sketching the input type this paper shows how to *infer* the input type from the query itself, thereby removing the need for manual construction. We consider two cases for inferring the input type: with and without knowledge of the database's schema. Knowing the schema can help to prune the input type, making it smaller and more flexible. This paper describes the inference algorithm.

Complete Paper #102

Boosting the Entity-Relationship Model for Document-Oriented Databases

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Keywords: Document Database, Data Modeling, Entity-Relationship.

Abstract: The growing adoption of NoSQL document-oriented databases, such as MongoDB, has introduced new paradigms for managing data with flexibility and scalability. These characteristics make document models suitable for applications that involve heterogeneous data sources and evolving information needs. Current design methodologies often lack formal support, covering only a subset of Entity-Relationship (ER) constructs or relying on general-purpose notations like UML, which are not optimized for database design. In this work, we propose ER_d , a revised version of the ER model to support the conceptual design of document-oriented databases. ER_d extends the classical ER framework to capture the hierarchical and flexible nature of document structures, enabling a more accurate and semantically rich representation of data. We define a set of translation rules that map conceptual constructs into typical document patterns like embedding, referencing, and polymorphism.

Closing Session & Awards Ceremony
16:45 - 17:00

CoopIS
Room Andalucia 1

Author Index

Abdallah, B.	25	Gaaloul, W.	38	Ocansey, J. T.	33
Abdallah, H.	33	Garda, M.	24	Padella, A.	39
Abid, M.	24	Gervás, P.	39	Pandey, Y.	37
Agostinelli, S.	22	Ghadhab, L.	21	Parkin, L.	33
Aguiar, C. D.	23	Ghalibafan, S.	29	Pathak, J.	37
Ajili, S.	24	Ghannouchi, S. A.	40	Peña, J.	21
Ali, L.	37	Gruska, D.	37	Pobitzer, P.	32
Ali, M. A.	22	Guermouche, N.	31	Poss, L.	31, 34
Amor, M.	21				
Aryal, S.	41	Hähner, J.	23	Rabbi, F.	33
Avignone, A.	41	Hüller, M.	23	Raita, C.-S.	29
Awanyo, C.	31	Hagenmeyer, V.	33	Rajput, A. S.	37
Ayadi, N. Y.	23	Halfeld-Ferrari, M.	23	Ramusat, Y.	32
Ayedi, S.	29	Hamdi, A. T. E.	38	Reichert, M.	22
		Hammes, S.	32	Resinas, M.	21
Bahloul, A.	29	Hasić, F.	40	Rinderle-Ma, S.	22, 24, 30, 38
Baklouti, M.	24	Hassani, M.	39	Rossi, B.	32
Bangui, H.	32	Hehnle, P.	22	Ruckhaus, E.	33
Becker, S.	40	Hildebrandt, T. T.	39	Rula, A.	24
Belle, G.	29	Horcas, J. M.	21	Rutle, A.	33
Ben Abdallah Ben Lamine, S.	25	Hotte, R.	24		
Ben Hadj Boubaker, N.	23			Sîrbu, A.-G.	40
Ben Messaoud, M.	21	Ibrahim, M.	39	Sadeghianasl, S.	29
Ben Said, I.	29	Iftikhar, N.	29	Sai, C.	30
Benna, A.	34	Iqbal, D.	32	Salaün, G.	38
Bhowmick, S. S.	41	Issa, N.	37	Sboui, S.	24
Bianchini, D.	24			Schönig, S.	31, 34
Bouhamoum, R.	25	Jenhani, I.	21	Schmidt, A.	33
Bravo, A.	21			Schumann, F.	22
Breitenbücher, U.	40	Küble, R.	23	Siachamis, G.	37
Breuillard, H.	31	Kadem, A.	29	Smedt, J.	40
Bunce, D.	29	Kanoun, O.	25	Soulet, A.	33
Burégio, V.	34	Kathuria, H.	37	Stucky, K.-U.	33
Burger, M.	32	Khan, F. A.	22	Suess, W.	33
Buron, M.	37	Kodia, Z.	23	Swami, S.	41
		Korâani, I.	40		
Chaabane, M. A.	29	Koubaa, M.-A.	33	Tobis, J.	22
Chabin, J.	23	Ktari, J.	25	Torlone, R.	41
Chaieb-Chakchouk, F.	24	Kurz, M.	37	Tran, V.	32
Challa, J. S.	37			Trinh, M. H.	29
Chebil, W.	40	López, H. A.	39		
Chen, S.	30	Laga, N.	38	van der Aalst, W.	30
Cheour, R.	24, 25	Lamo, Y.	33	van Detten, J. N.	31
Chikhaoui, B.	34	Leemans, S. J. J.	31	van Straten, S.	39
Chiusano, S.	41	Li, W.	30	Vestergaard, A.	29
Corcho, O.	33	Lin, Y.-C.	29	Vianney, M. K.	31
Cremer, D.	38	Liss, L.	31	Voigt, D.	24
Custura, S.-O.	21	Liu, A.	29		
Czibula, G.	40	Liu, N.	33	Wald, L.	32
		Loebbecke, J.	24, 38	Wang, L.	23
Düdder, B.	39	Lu, J.	30	Weingartshofer, F.	37
Dalmas, B.	38			Weller, M.	40
de Leoni, M.	22	Méndez, G.	39	Westgaver, A. M.	40
Debruyne, C.	32	Maamar, Z.	32, 34	Wrede, E.	31
Dechambenoit, G.	31	Maaradj, A.	34	Wynn, M. T.	29
del-Rio-Ortega, A.	21	Mangler, J.	22, 24		
Dilmi, M. D.	24	Manolescu, I.	37	Xiao, G.	30
Doña, D.	33	Markhoff, B.	33		
Duchateau, J.	32	Melchiori, M.	24	Zech, P.	32
Dumas, M.	22	Michael, J.	32	Zghal, H.	25
Dyreson, C.	41	Milani, F.	22	Zhang, Y.	29
		Mkaouer, M. W.	21	Zhou, Y.	39
El Outa, F.	31	Mohamed, A.	37	Zhu, D.	29
Elleuch, M.	38	Musicante, M. A.	23	Zuckmantel, T.	39
Fatemi, B.	33	Nguyen, S.	32		
Fiori, A.	41	Nivon, Q.	38		
Flores, B.	21	Norouzifar, A.	30		
Fuentes, L.	21				

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