

No Enterprise AI Without Process Intelligence!

Using Process Mining as the Lens to Address Performance and Compliance Problems

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Abstract. AI is transforming industrial operations, but its success hinges on understanding and optimizing business processes. Despite recent breakthroughs in generative AI, it remains difficult to apply AI and ML when facing data in enterprise information systems. In these settings, one needs to deal with dynamic end-to-end processes. Process mining serves as the lens through which AI can be effectively applied in enterprise settings, ensuring that AI-driven solutions address real-world performance and compliance challenges. Without this process-aware perspective, it is impossible to apply AI and ML.

This tutorial, to be presented at the 28th European Conference on Artificial Intelligence (ECAI 2025), shows how process mining unveils the hidden dynamics of operational processes, enabling mainstream AI and ML techniques. Data-driven approaches such as automated process discovery, conformance checking, and predictive analytics are explained using a range of examples. By detecting process-related problems such as a bottleneck or frequent deviation, process mining serves as the lens to address performance and compliance problems. These techniques are widely applied in manufacturing, finance, logistics, and healthcare. Through real-world examples, participants will gain a practical roadmap for integrating process mining into AI initiatives.

Designed for AI researchers, data scientists, and industry practitioners, this tutorial provides the essential tools to bridge the gap between AI and enterprise reality-transforming data into actionable intelligence for robust, responsible, and efficient AI adoption.

Keywords: process mining, process discovery, industrial AI, machine learning, conformance checking, temporal pattern mining, event data.

Format: Half-day tutorial supported by data sets and software

Expected number of attendees: 50

1 Description of the Tutorial

Process mining has emerged as a pivotal discipline that bridges the gap between process science and data science, evolving significantly since its inception in the late 1990s. The discipline of process mining has been instrumental in addressing fundamental questions about actual vs. assumed processes, identifying bottlenecks and deviations,

and predicting performance and conformance problems. Concurrently, amazing breakthroughs have been achieved in Artificial Intelligence (AI) and Machine Learning (ML). However, it is not so easy to apply AI and ML in an enterprise setting. Industrial applications tend to focus on a single task and not end-to-end processes. *This tutorial delves into the symbiotic relationship between these domains, emphasizing how process mining serves as a conduit between data-centric analysis and process-centric understanding.* The ultimate goal of the tutorial is to show that process mining provides the lens to apply AI and ML and improve processes in manufacturing, finance, logistics, and healthcare. Participants will get a good understanding of state-of-the-art process mining techniques and will be able to apply this knowledge with limited effort.

Participants will explore foundational concepts of process mining, including process discovery, conformance checking, and enhancement. Building upon these foundations, the tutorial will illustrate how AI and ML techniques can be tailored to enrich process mining endeavors. For instance, decision mining leverages ML to uncover decision rules within processes, while predictive analytics forecasts future process behaviors.

The session will also address challenges inherent in aligning AI models with process data, such as handling non-parametric distributions and ensuring model interpretability. By examining recent advancements, including the application of generative AI in process modeling, attendees will gain insights into the evolving landscape of process mining research.

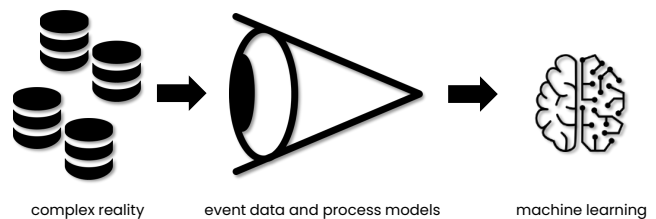


Figure 1. Process mining serves as the lens to enable AI and ML for improving end-to-end processes. It offers unique opportunities to apply existing AI techniques and develop new ones.

Designed for AI researchers, data scientists, and industry practitioners, this tutorial offers a comprehensive roadmap to effectively

integrate AI and ML techniques within process mining frameworks. Through real-world examples and interactive discussions, participants will be equipped to transform raw data into actionable intelligence, driving robust and efficient process improvements.

2 Outline of the Tutorial

These are the topics to be addressed in the half-day tutorial:

1. Introduction to Process Intelligence and Process Mining

- Definition and significance
- Historical context and evolution
- Core components: event logs, cases, activities
- Software tools
- Industry adoption

2. Foundational Techniques in Process Mining

- **Process Discovery**
 - Alpha algorithm & Heuristic miner
 - Inductive miner
- **Conformance Checking**
 - Aligning event logs with process models
 - Detecting deviations and compliance issues
- **Process Enhancement**
 - Performance analysis
 - Model augmentation with additional data

3. Interplay Between Process Mining and Machine Learning

- Overview of AI and ML in the context of process analysis
- Challenges in integrating ML with process data
- Tailoring ML models for process mining applications

4. Advanced Topics

- **Decision Mining**
 - Creating situation tables
 - Extracting decision rules from processes
 - Utilizing classifiers
- **Predictive Process Monitoring**
 - Creating situation tables for performance questions
 - Forecasting future process states
 - Implementing predictive models for proactive interventions
- **Object-Centric Process Mining (OCPM)**
 - Moving from case-centric to object-centric
 - Advantages of OCPM
- **Generative AI in Process Modeling**
 - Leveraging large language models for process model generation
 - Case studies

5. Challenges and Considerations

- Data quality and preprocessing
- Ensuring model interpretability and trustworthiness
- Addressing ethical and compliance concerns

6. Practical Applications and Case Studies

- Real-world implementations in various industries
- Lessons learned and best practices

7. Future Directions in Process Mining and AI Integration

- Emerging research areas
- Potential technological advancements
- Open challenges and opportunities for innovation

3 Supporting Material

The tutorial will provide ready-to-use data sets and open-source software. Participants are encouraged to apply the concepts introduced in this course. Next to providing Python-based software, the Celonis platform is used to illustrate industrial-scale applications.

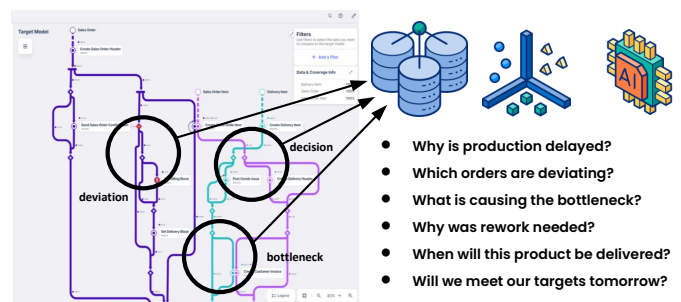


Figure 2. Using automatically discovered process models and normative models or constraints as the lens to create problem-centric ML-ready data, AI techniques can be used to answer a wide range of questions and trigger corrective actions.

Related material:

- W.M.P. van der Aalst. Object-Centric Process Mining: Unraveling the Fabric of Real Processes. Mathematics, 11(12):2691, 2023.
- W.M.P. van der Aalst. Process Mining: Data Science in Action. Springer-Verlag, Berlin, 2016.
- W.M.P. van der Aalst and J. Carmona, editors. Process Mining Handbook, volume 448 of Lecture Notes in Business Information Processing. Springer-Verlag, Berlin, 2022.

4 Target Audience

No prior knowledge of process mining is needed. The assumption is that participants have basic computer science skills and are familiar with common Artificial Intelligence (AI) and Machine Learning (ML) concepts. The topic aims to address a mixed audience. This includes:

- Introduce an established subdiscipline of AI/ML that participants may not be aware of.
- Provide new challenges for AI/ML experts, broadening the scope of applications.
- Trigger participants to apply and develop AI/ML techniques in industrial applications.
- Provide a compact overview of approaches connecting process science and data science.

5 About the Presenter

Prof.dr.ir. Wil van der Aalst is a full professor at RWTH Aachen University, leading the Process and Data Science (PADS) group. He is also the Chief Scientist at Celonis and part-time affiliated with the Fraunhofer-Institut für Angewandte Informationstechnik (FIT). Currently, he is also deputy CEO of the Internet of Production (IoP) Cluster of Excellence, co-director of the RWTH Center for Artificial Intelligence, and speaker of the RWTH ICT Profile Area. Until December 2017, he was the scientific director of the Data Science Center Eindhoven (DSC/e) and led the Architecture of Information Systems group at the Technische Universiteit Eindhoven (TU/e). He was also on the Board of Governors of Tilburg University from 2015 until 2023. Since 2003, he has been an adjunct professor at Queensland University of Technology.

He is commonly known as the “Godfather of Process Mining” and one of the leading experts in the field of data science, making him the ideal candidate for such a tutorial.

Fellowship and Awards

- 2024** Second highest ranked computer scientist in Germany, and 9th highest-ranked computer scientist in the world (Research.com 2024 ranking)
- 2022** Elected member of acatech (German National Academy of Science and Engineering), Germany
- 2021** IEEE Fellow Institute of Electrical and Electronics Engineers (IEEE)
- 2020** ACM Fellow Association for Computing Machinery (ACM)
- 2020** IFIP Fellow International Federation for Information Processing (IFIP)
- 2020** Elected member of the North Rhine-Westphalian Academy of Sciences, Humanities and the Arts, Germany
- 2018** Alexander-von-Humboldt Professor Award (five million euro), Germany
- 2013** Distinguished University Professor of TU/e (Only five professors had this special position at Eindhoven University of Technology)
- 2008** Elected member of the Royal Holland Society of Sciences and Humanities (Koninklijke Hollandsche Maatschappij der Wetenschappen), NL
- 2014** Elected member of the Royal Netherlands Academy of Arts and Sciences (Koninklijke Nederlandse Akademie van Wetenschappen), NL
- 2011** Elected member of Academia Europaea (The Academy of Europe)
- 2013** Honorary guest professor at Tsinghua University, Beijing, China
- 2012** Honorary doctorate from Hasselt University, Hasselt, Belgium
- 2015** Honorary professorship from Higher School of Economics, Moscow, Russia
- 2000-now** Over 35 best paper and most influential paper awards (BPM, SoSym, ATPN, ICPM, BIS, etc.)

Publication Record

Google Scholar H-index: 184, more than 157.000 citations <https://scholar.google.com/citations?user=aSZYyxIAAAAJ>
DBLP 296 journal papers, 649 conference/workshop papers <https://dblp.uni-trier.de/pid/a/WilMPvanderAalst.html>
Scopus H-index: 124, more than 65.000 citations <https://www.scopus.com/authid/detail.uri?authorId=7007153024>

Teaching record

Some of the university course given over the last 10 years (Bachelor and Master Level): Elements of Machine Learning and Data Science, Business Process Intelligence, Introduction to Data Science, Advanced Process Mining, Business Process Management Systems, Workflow Automation and Simulation, Introduction to Process Mining, Perspectives on Data Science, Business Information Systems, Systems Engineering. The courses are *consistently evaluated positively by students* (between 1.0 and 1.5 on a scale from 1 to 5 with 1 being the highest). Some of the *elective* courses are taken by over 500 students per year.

Van der Aalst also gave tutorials at various conferences (BPM, Caise, Petri Nets, etc.), organized several summer schools (e.g., the Process Mining Summer School in Aachen, July 2022), and also regularly provides professional training to people in industry. The applicant also developed several online courses. He created the Coursera course “Process Mining: Data Science in Action” with *over 175.000 participants*. Recently, he created three new edX courses: “A Hands-On Introduction to Process Mining”, “Basic of Data Science”, and “Object-Centric Process Mining”.

Van der Aalst also wrote the standard textbook on process mining (“Process Mining: Data Science in Action”) and recently edited the “Process Mining Handbook” (2022).

Contact Details

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6 Information for Communication Purposes

A two-sentence description of the tutorial

AI is revolutionizing industrial operations, but its effectiveness depends on understanding business processes, where process mining plays a crucial role in making AI-driven solutions practical and compliant. This tutorial at ECAI 2024 will equip AI researchers, data scientists, and industry practitioners with process mining techniques to integrate AI into real-world enterprise settings, enhancing efficiency and decision-making.

A two-paragraph description of the tutorial

Despite advances in generative AI, applying AI and ML in enterprise systems remains challenging due to complex, dynamic process and data scattered over multiple systems and tables. Process mining bridges this gap, ensuring AI solutions tackle real-world performance and compliance issues. This tutorial at ECAI 2025 explores how process mining uncovers hidden operational dynamics, enabling AI-driven insights. Key techniques like automated process discovery, conformance checking, and predictive analytics will be demonstrated through real-world examples across manufacturing, finance, logistics, and healthcare.

Designed for AI researchers, data scientists, and industry professionals, this session provides a practical roadmap for integrating process mining into AI initiatives - turning enterprise data into actionable intelligence for smarter, responsible, and efficient AI adoption.

A brief bio for website

Prof.dr.ir. Wil van der Aalst is a full professor at RWTH Aachen University, leading the Process and Data Science (PADS) group. He

is also the Chief Scientist at Celonis, part-time affiliated with the Fraunhofer FIT. His research interests include process mining, data science, machine learning, process management, and simulation. Wil van der Aalst has published over 1100 articles and books. According to Research.com, he is the second highest-ranked computer scientist in Germany and ranked 9th worldwide. According to Google Scholar, he has an H-index of 184 and more than 157.000 citations. Van der Aalst is an IFIP Fellow, IEEE Fellow, and ACM Fellow, and he received honorary degrees from the Moscow Higher School of Economics (Prof. h.c.), Tsinghua University, and Hasselt University (Dr. h.c.). He is also an elected member of the Royal Netherlands Academy of Arts and Sciences, the Royal Holland Society of Sciences and Humanities, the Academy of Europe, the North Rhine-Westphalian Academy of Sciences, Humanities and the Arts, and the German Academy of Science and Engineering. In 2018, he was awarded an Alexander-von-Humboldt Professorship.

Photo for website



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