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Understanding process mining and how it works

Process mining is a business process analysis method that exploits historical and current event data to extract knowledge, patterns and insights (definition appendix 1) in order to improve operational efficiency, compliance and decision-making in various application areas. Process mining is based on the event log, which is a recorded trace of all activities or events occurring in an IT system. This is an essential data source for Process Mining, as it enables the flow of activities to be analyzed and patterns of behavior to be discovered. Process mining thus enables us to anticipate future corporate behavior and activities. The aim is to minimize human intervention in the analysis of business processes. The maturity level of a model refers to the degree of accuracy and reliability of a process model generated by Process Mining. A mature model is one that exhaustively and accurately captures the actual operation of the business process. There are 5 maturity levels: initial, reproducible, defined, managed and optimized (see Appendix 2 for definitions).

Introducing the Proactive Insight Engine

The person in charge of data processing must be able to examine and process each piece of data in depth, and must know approximately where the data flaw lies (e.g. in terms of efficiency or wasted time) that he or she is looking for. The result is the Proactive Insight Engine, which supports the human in charge of data processing. The Proactive Insight Engine is an intelligent monitoring solution that identifies problems before they affect users or the organization. This intelligent machine is made up of 4 main poles: PI Compliance, PI Machine Learning, PI Social, and PI Companion (definitions appendix 3) which provide real-time insights and recommendations to improve processes. The Proactive Insight Engine has been in existence since 2016.
The Proactive Insight Engine uses a variety of artificial intelligence and data analysis algorithms, such as machine learning, natural language processing (NLP), clustering, time series analysis, optimization and signal processing (definitions appendix 4). Process mining is a method for analyzing business processes, using data extracted from various sources such as databases, ERP or CRM systems (definitions appendix 5), as well as recorded specifications. It enables processes to be identified and modeled, then compared with predefined models to assess their conformity and uncover opportunities for improvement. To achieve this, various process mining tools such as ProM, Fluxicon, Celeonis and My-Invenio are used, offering functionalities such as process discovery, compliance checking and decision rule mining. Despite the advantages of each tool,

ProM is considered the most suitable for process mining needs, despite its potential user interface problems.

Relationship between Process Mining, Business Process Management and Artificial Intelligence

Process Mining lies at the convergence of several disciplines, including Artificial Intelligence (AI), Business Process Management (BPM) and data analysis. Artificial Intelligence (AI) is used in Process Mining to improve data analysis, detect anomalies, predict future behavior and provide recommendations for decision-making. AI techniques such as Machine Learning and deep neural networks (see Appendix 6 for definitions) are often used to improve the accuracy of models and forecasts.
Business Process Management (BPM) is a methodical approach to improving an organization's business processes by modeling, automating, monitoring and optimizing them. This generally involves human intervention to design, implement and manage processes. So unlike BPM, Process Mining is often automated and focuses on extracting knowledge from existing data to identify patterns, variations and opportunities for improvement in processes.

Identifying examples of Process Mining opportunities and their areas of application

Process Mining offers considerable potential for revealing valuable insights and driving significant improvements in various aspects of the business. The main opportunities offered by Process Mining are visualization of existing processes, detection of variations and anomalies, process optimization, predictive analysis and recommendations for action. Thanks to its capabilities, Process Mining has led (or will lead) to considerable advances in various fields. Here are just a few examples of the opportunities that have been, or will be, realized:

The healthcare sector is experiencing difficulties in detecting or anticipating chronic diseases, and in rationalizing patient care. Process mining techniques such as Random Forest, PALLA, Inductive Miner frequent, Careflow Miner, PMApp, ProM and pMineR are used in healthcare to extract process models from clinical diary data. They can be used to identify variations in treatments, analyze patient workflows, detect inefficiencies in clinical processes and optimize care delivery.
By combining these tools, healthcare professionals can gain valuable insights to improve quality of care, coordination between care providers and patient outcomes.

The fields of finance, human resources, healthcare, logistics, customer service, insurance and many others use RPAs (Robotic Process Automation) . In finance, for example, RPAs are used to automate accounting tasks, invoice management and payment processing. In the healthcare sector, RPAs can be used to automate patient file management and insurance claims processing. In short, RPAs can be applied in virtually any sector where repetitive, structured tasks can be automated to improve efficiency and reduce human error. Process mining plays a crucial role in complementing RPA by facilitating the identification of automation opportunities, assessing the performance of robots versus non-robot processes, and monitoring the impact of RPA initiatives on process performance indicators.

Process mining offers a major opportunity in the field of information systems (IS) auditing. Organizations are looking to streamline audit processes, improve efficiency and reduce reliance on manual intervention. By integrating process mining into IS audits, organizations can not only increase operational efficiency, but also enhance their ability to make data-driven decisions, anticipate risks and improve regulatory compliance, thereby contributing to their resilience in the face of cybersecurity threats and regulatory compliance challenges.

Identifying examples of process mining challenges, their areas of application and proposed solutions

Process mining, while a powerful method for extracting valuable information from log data, presents several challenges. These include managing data complexity, ensuring data quality, preserving the confidentiality of sensitive information, and interpreting and integrating results into existing business processes. Successfully overcome, these challenges can enable organizations to fully leverage the potential of process mining to improve their operations and efficiency.

Process mining faces specific challenges in the healthcare field, such as process variability, sensitive data quality and constant adaptation to changes in the field. It is difficult to rely solely on process mining to analyze healthcare data, as this approach is very new to the field. By overcoming these challenges and working closely with healthcare professionals, process mining can bring significant innovations in improving care and clinical processes. This challenge can also be found in other industries such as logistics and finance.

When it comes to business process mapping, the main challenge is the lack of accurate, interactive maps, comparable to today's navigation charts. Business management maps are generally not well understood by users. The proposed solution is the development of high-performance, interactive business process maps for better understanding and navigation of processes, adapted to various industries.

In the field of fraud detection, challenges include identifying anomalies and fraudulent behavior in the vast logs generated by ERP systems, often encountered in the financial and commercial sectors. Solutions involve the use of advanced analysis algorithms combined with probabilistic modeling techniques to proactively detect and prevent fraud.

Finally, in the field of risk management for major construction projects, challenges include the identification and assessment of unpredictable risks relevant to the construction and engineering sector. Proposed solutions involve the use of process mining and artificial intelligence techniques, such as Bayesian networks (definitions appendix 7), to model and predict risks, providing a data-driven decision support tool to improve project control.

Process mining presents many challenges for various industries, requiring specific solutions to overcome these obstacles and take full advantage of them.

Apprendix:

1. **Insight** = In Process Mining, an insight is a significant observation or understanding extracted from business process data, enabling the discovery of trends, anomalies or improvement opportunities for operational efficiency and decision-making.

2. initial, reproducible, defined, managed and optimized = Initial level: The process model is rudimentary and may lack detail, based on raw data. **Reproducible level:** The model becomes more consistent and reproducible, with key steps identified. **Defined level:** The model is more precise and detailed, identifying variants and interactions between activities. **Managed level:** Integrated into operations, the model is regularly updated to reflect real changes and assess performance. **Optimized level:** Continuously optimized, the model identifies inefficiencies and quickly adapts to changes to maximize efficiency.

3. PI Compliance, Machine Learning PI, Social PI, and PI Companion = Compilance PI: Identifies deviations from rules and regulations, providing real-time alerts to ensure compliance and reduce risk. **Machine Learning PI:** Uses machine learning algorithms to analyze data, detect patterns and anomalies, and provide recommendations for process improvement. **PI Social:** Analyzes user interactions and behaviors in social media and other platforms to identify customer trends, sentiments and needs, facilitating proactive response. **PI Companion:** Accompanies the user in data analysis, providing contextual suggestions and advice for better interpretation of insights and informed decision-making.

4. algorithms for machine learning, natural language processing (NLP), clustering, time series analysis, optimization and signal processing = Machine Learning Algorithms: These algorithms enable computers to learn from data and make predictions or decisions without being explicitly programmed. **Natural Language Processing (NLP):** NLP algorithms allow computers to understand, interpret, and generate human language, facilitating tasks such as translation, sentiment analysis, and text summarization. **Clustering Algorithms:** Clustering algorithms group similar data points together to identify patterns or clusters within datasets, helping in data exploration and segmentation. **Time Series Analysis Algorithms:** These algorithms analyze and model sequential data points over time to identify patterns, trends, and anomalies, aiding in forecasting and understanding temporal behavior. **Optimization Algorithms:** Optimization algorithms find the best solution among a set of possible solutions for complex problems, optimizing parameters or resources to achieve desired outcomes. **Signal Processing Algorithms:** Signal processing algorithms analyze, modify, or extract information from signals, such as audio, image, or sensor data, enhancing the quality or extracting relevant features for further analysis.

5. ERP and CRM systems = Enterprise Resource Planning (ERP) systems are integrated software solutions that manage core business processes, such as finance, HR, and inventory, across an organization, providing a centralized database and facilitating data flow and communication between departments. **Customer Relationship Management (CRM) systems** are software applications that help businesses manage interactions with current and potential customers, organizing customer data, tracking sales leads, and facilitating customer engagement to improve relationships and drive sales growth.

6. Machine Learning and deep neural networks = Machine Learning involves algorithms that enable computers to learn from data and make predictions, while **deep neural networks** are a type of ML model composed of multiple layers of interconnected nodes, capable of learning complex patterns and representations from large datasets.

7. Bayesian networks = A Bayesian network is a probabilistic graphical model that represents a set of random variables and their conditional dependencies using a directed acyclic graph (DAG). It is named after the Reverend Thomas Bayes, who formulated a theorem that provides a principled way of updating probabilities based on new evidence. In a Bayesian network, nodes represent random variables, and edges represent direct dependencies between them. The network encodes a joint probability distribution over the variables, allowing for efficient inference and reasoning under uncertainty.