Topic 1: Graph Layouting Algorithms and their Applicability to Process Mining

Visualizations play a critical role in process mining by making results accessible to users unfamiliar with technical or process-specific details. Directly-Follows Graphs (DFGs) are commonly used for this purpose, visualizing entire processes and their execution variations. While most process mining tools offer visualization options for DFGs, significant differences exist in the implementation of the underlying layout algorithms. With increasing interest in visual analytics in process mining, understanding the effectiveness of these algorithms is essential.

This seminar thesis aims to identify and analyze layout algorithms used for visualizing DFGs in process mining tools and research. The participant should describe how these algorithms function, their advantages, and disadvantages. Additionally, layout and visualization algorithms from related fields, such as general graph visualization, should be compared for their potential applicability to process mining.

Literature:

[1] Mennens, R. J., Scheepens, R., & Westenberg, M. A. (2019). A stable graph layout algorithm for processes. Computer Graphics Forum, 38(3), 725–737.
[2] Berti, A., Van Zelst, S. J., & van der Aalst, W. M. P. (2019). Process mining for python (PM4Py): Bridging the gap between process- and data science. arXiv preprint arXiv:1905.06169.
[3] Sonke, W., Verbeek, K., Meulemans, W., et al. (2018). Optimal algorithms for compact linear layouts. IEEE Pacific Visualization Symposium, 1–10.

Topic 2: Theories on Process Mining

Process mining research has traditionally focused on technical innovations, such as the development of new algorithms. However, with the increasing maturity of the field, research is now shifting towards understanding its organizational value. Theoretical models from information systems and related domains are essential to explain how process mining is adopted, implemented, and utilized within organizations. Such theories can provide insights into the socio-technical dynamics of process mining, including its impact on decision-making, organizational culture, and process improvement initiatives. They help to identify why some organizations successfully leverage process mining while others face challenges, offering practical guidance for overcoming these obstacles.

The goal of this seminar thesis is to analyze existing research on theoretical models for process mining. Given the likely limited availability of literature, the participant may extend the scope to related disciplines, such as business intelligence, to explore relevant theoretical frameworks.

Literature:

[1] Vom Brocke, J., Jans, M., Mendling, J., & Reijers, H. A. (2021). A five-level framework for research on process mining. Business & Information Systems Engineering, 1–8.
[2] Badakhshan, P., Wurm, B., Grisold, T., Geyer-Klingeberg, J., Mendling, J., & Vom Brocke, J. (2022). Creating business value with process mining. The Journal of Strategic Information Systems, 31(4), 101745.
[3] Mendling, J., Jans, M., & Sahling, K. (2024). Structuring empirical research on process mining at the individual level using the Theory of Effective Use (forthcoming).

Topic 3: Theory of Effective Use and its Applicability to Process Mining

The Theory of Effective Use (TEU) is a framework within Information Systems (IS) research that explains how various factors influence and contribute to the effective utilization of a system. It is applicable to any system involving user-system interactions and has been extensively tested in empirical studies. Since process mining tools, such as Celonis and ProM, also involve user-system interactions, TEU is potentially relevant to the field. However, its explicit adaptation and application to process mining remain unexplored.

The goal of this seminar thesis is to provide a detailed overview of the existing literature on TEU in IS research and assess its potential applicability to process mining. The participant should differentiate between IS fields and contexts where TEU has been applied, highlighting similarities and differences. Special attention should be given to studies that utilize TEU in empirical research. In the second part, the thesis should analyze how TEU can be applied to process mining, comparing it to other research contexts like business intelligence.

Literature:

[1] Burton-Jones, A., & Grange, C. (2013). From use to effective use: A representation theory perspective. Information Systems Research, 24(3), 632–658.
[2] Trieu, V. H., Burton-Jones, A., Green, P., & Cockcroft, S. (2022). Applying and extending the theory of effective use in a business intelligence context. MIS Quarterly, 46(1), 645–678.

Topic 4: LLM Applications for Business Process Management

Large Language Models (LLMs) have introduced transformative possibilities in Business Process Management (BPM), enabling innovative capabilities in process understanding, automation, and optimization. LLMs can analyze unstructured data, such as textual process descriptions, to generate actionable insights. They also support conversational interfaces, making BPM tools more accessible through natural language queries, and enhance predictive analysis by identifying trends, bottlenecks, and risks based on historical data.

The goal of this seminar thesis is to compile a comprehensive overview of LLM applications in BPM. Participants should focus on analyzing existing literature with attention to concrete tasks automated by LLMs, the data utilized for these tasks, and the evaluation methods applied. The emphasis should be on realized applications rather than speculative possibilities, providing a detailed picture of the current state of this rapidly evolving field.

Literature:

[1] Estrada-Torres, B., del-Río-Ortega, A., & Resinas, M. (2024). Mapping the landscape: Exploring large language model applications in Business Process Management. In International Conference on Business Process Modeling, Development and Support, 22–31.
[2] Kourani, H., Berti, A., Schuster, D., & van der Aalst, W. M. (2024). Process modeling with large language models. In International Conference on Business Process Modeling, Development and Support, 229–244.
[3] Grohs, M., Abb, L., Elsayed, N., & Rehse, J. R. (2023). Large language models can accomplish business process management tasks. In Business Process Management Workshops, 453–465.

Topic 5: Agentic Process Mining

Traditional process mining techniques often treat processes as deterministic systems, where behavior is driven by control-flow logic, case attributes, and resource allocations. However, this view overlooks the agentic nature of process participants—individuals or systems who exhibit autonomy, intentions, goals, and adaptive behavior in response to contextual factors. Agentic Process Mining refers to the emerging area that integrates notions of agency into process analysis, recognizing that actors within a process are not merely passive executors of tasks but make decisions, adapt strategies, and influence process outcomes dynamically.

The goal of this seminar thesis is to explore how agency—particularly human or intelligent system agency—is modeled and analyzed in the context of process mining. The student should investigate (1) How agency is defined and operationalized within process mining, (2) Which data sources and modeling techniques are used to capture agentic behavior (e.g., cognitive models, goal modeling, multi-agent simulation, or reinforcement learning), (3) How incorporating agency influences traditional process mining tasks (e.g., discovery, conformance, prediction, or simulation).

In addition, the participant should evaluate how agentic perspectives complement or challenge conventional process mining assumptions and suggest a categorization of existing approaches. If the body of literature is too narrow, the topic may be extended towards other research fields that make use of agent-based approaches in consultation with the supervisor before the first milestone.

Literature:

[1] Kirchdorfer, L., et al. (2024). AgentSimulator: An agent-based approach for data-driven business process simulation. International Conference on Process Mining, 97-104.
[2] Berti, A., et al. (2024). Re-thinking process mining in the AI-based agents era. arXiv preprint arXiv:2408.07720.
[3] Vu, H., et al. (2025). Agentic Business Process Management: The Past 30 Years and Practitioners' Future Perspectives. arXiv preprint arXiv:2504.03693.

Topic 6: Knowledge Graphs in Process Mining

Process mining traditionally focuses on extracting and analyzing process behavior from event logs, often without leveraging the rich contextual and semantic information that surrounds process execution. Knowledge graphs provide a flexible and expressive way to represent relationships between entities such as activities, resources, documents, goals, and organizational roles. By integrating event data with structured domain knowledge, knowledge graphs can enhance process understanding, enable semantic queries, and support advanced reasoning tasks.

The goal of this seminar thesis is to explore how knowledge graphs are constructed and used in process mining. The participant should investigate: (1) How knowledge graphs are derived from process execution data, process models, and external sources (e.g., ontologies, enterprise data), (2) Which use cases are supported (e.g., semantic process discovery, conformance checking, root cause analysis), and (3) How knowledge graph technologies are integrated with process mining tools and methods.

The thesis should also evaluate the benefits and challenges of knowledge graph-based approaches, such as scalability, interpretability, and integration with existing process mining platforms.

Literature:

[1] Rott, J., et al. (2023). Breaking down barriers with knowledge graphs: Data integration for cross-organizational process mining. International Conference on Process Mining, 499-512.
[2] Fahland, D. (2022). Process mining over multiple behavioral dimensions with event knowledge graphs. Process Mining Handbook, 274-319.
[3] Klijn, E. L., Mannhardt, F., & Fahland, D. (2022). Aggregating event knowledge graphs for task analysis. International Conference on Process Mining, 493-505.

Topic 7: Business Process Interdependencies: Techniques for Identifying and Analyzing Process Interdependencies

In many organizations, business processes do not operate in isolation but are part of a larger system of interconnected activities. These interdependencies may involve shared data, common resources, timing constraints, or coordination rules between processes. Understanding these relationships is essential for improving efficiency, ensuring compliance, and supporting adaptability.

This seminar project aims to explore the theoretical concept of interdependencies and its application in the field of process mining. This includes examining how interdependencies are defined and understood in the context of business processes within organizations. The project will further investigate how process interdependencies are identified and classified in existing research. It will summarize current approaches, highlight different types of interdependencies, and review implemented solutions in process mining that address or leverage these connections.

Literature:

[1] Fleig, C., Augenstein, D., & Maedche, A. (2018). KeyPro - A decision support system for discovering important business processes in information systems. Information Systems in the Big Data Era, 90-104.
[2] Lubane, L., & Kirikova, M. (2025). Interdependency-aware business process prioritization for process improvements. BPMDS, 36-52.
[3] Li, J., et al. (2012). A business process-driven approach for requirements dependency analysis. Business Process Management, 200-215.
[4] Meyer, A., Pufahl, L., Fahland, D., & Weske, M. (2013). Modeling and enacting complex data dependencies in business processes. Business Process Management, 171-186.

Topic 8: Tabular Machine Learning in Process Mining

Event logs used in process mining are naturally structured as tabular data, with each row representing an event and columns capturing attributes such as case identifiers, activities, timestamps, and resources. While suitable for many process mining tasks, the tabular structure is not directly compatible with most standard machine learning models, which typically require preprocessing to produce needed fixed-size inputs. This adds complexity to the analysis and can affect the interpretability of the results.

This seminar project focuses on researching and summarizing existing literature on tabular machine learning in general, as well as its current applications in process mining. The objective is to understand how existing machine learning techniques are adapted for tabular data, what solutions have already been developed and applied in the context of process mining, and to identify open research questions and opportunities in this area.

Literature:

[1] Kohli, R., et al. (2024). Towards quantifying the effect of datasets for benchmarking: A look at tabular machine learning. *ICLR Workshop*s
[2] Shwartz-Ziv, R., & Armon, A. (2022). Tabular data: Deep learning is not all you need. *Information Fusion*, 81, 84-90.
[3] Borisov, V., et al. (2022). Deep neural networks and tabular data: A survey. *IEEE Transactions on Neural Networks and Learning Systems*, 35(6), 7499-7519.
[4] Somvanshi, S., et al. (2024). A survey on deep tabular learning. arXiv preprint arXiv:2410.12034.

Topic 9: Empirical Studies on Cognitive Aspects in Process Mining

Most research in process mining has traditionally focused on algorithmic contributions, developing new methods for gaining insights into process data. These technical advances are unquestionably important, but they overlook as aspect that is critical for the organizational utility and success of process mining: Users need to perceive, interpret and use the results generated by process mining algorithms. Studies on cognitive aspects in process mining address this gap by investigating how humans perceive, understand, and interact with process mining outputs. This includes challenges such as interpreting complex process models, identifying relevant deviations, and making decisions based on the insights provided. Empirical studies in this area help reveal common misunderstandings, cognitive limitations, and usability issues that can undermine the effectiveness of process mining in practice.

The goal of this seminar thesis is to provide a complete overview of existing empirical studies on cognitive aspects in process mining. Therefore, the seminar participant is expected to analyze existing literature of empirical research on cognitive aspects in process mining, with a focus on used methods and sub-areas of process mining in focus.

Literature:

[1] Sorokina, E., Soffer, P., Hadar, I., Leron, U., Zerbato, F., & Weber, B. (2023). PEM4PPM: A cognitive perspective on the process of process mining. Business Process Management, 465-481.
[2] Ammann, J., Lohoff, L., Wurm, B., & Hess, T. (2025). How do process mining users act, think, and feel? An explorative study of process mining use patterns. Business & Information Systems Engineering.
[3] Zerbato, F., Soffer, P., & Weber, B. (2021). Initial insights into exploratory process mining practices. Business Process Management, 145-161.