

## **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: Graph Neural Networks in Process Mining**

The term “Graph Neural Networks (GNNs)” refers to a collection of machine learning techniques that operate on graph-structured input and learn representations of nodes, edges, or entire graphs. These techniques have seen widespread adoption in various fields, such as knowledge graphs, recommender systems, and language modeling. In process mining, the inherent graph-like nature of process models - such as directly-follows graphs and Petri nets – and of object-centric event data present a compelling opportunity for leveraging GNNs.

The goal of this seminar thesis is to investigate the application of GNNs in the process mining field through a structured literature review. This should include an analysis of what process mining tasks GNNs have been applied to and how they compare to alternative solutions (e.g., recurrent neural networks or non-machine learning approaches). The thesis should also explore any specific challenges that arise when employing GNNs with process data.

### **Literature:**

- [1] Sommers, D., Menkovski, V. & Fahland, D. (2023). [Supervised learning of process discovery techniques using graph neural networks](#). Information Systems 115, 102209.
- [2] Stierle, M., Weinzierl, S., Harl, M., & Matzner, M. (2021). [A technique for determining relevance scores of process activities using graph-based neural networks](#). Decision Support Systems 144, 113511.
- [3] Elyasi, K. A., van der Aa, H., & Stuckenschmidt, H. (2024). [PGTNet: A Process Graph Transformer Network for Remaining Time Prediction of Business Process Instances](#). In: Advanced Information Systems Engineering, 124–140.

### **Topic 3: 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-Klingenberg, 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 4: 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 5: 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 6: Process Mining Case Studies**

Process mining has been extensively researched in academia and increasingly applied in practice, yet the two domains have often evolved in parallel. Many research contributions in process mining remain theoretical or conceptual, with only a limited number directly addressing practical challenges or achieving adoption in real-world settings. Conversely, the application of process mining in industry often focuses on immediate problem-solving and business outcomes, without fully leveraging advancements in academic research.

Scientific case studies in real organizational settings represent one possible approach to better integrating research and practice, and several process mining case studies have been conducted over the years. The goal of this thesis is to compile a comprehensive overview of these case studies, categorizing them based on the process mining tasks applied (e.g., process discovery and conformance checking) and the industries and/or process types involved.

### **Literature:**

- [1] Leemans, S. J. J., Poppe, E., & Wynn, M. T. (2019). [Directly follows-based process mining: Exploration & a case study](#). International Conference on Process Mining, 25–32.
- [2] De Weerd, J., Schupp, A., Vanderloock, A., & Baesens, B. (2013). [Process mining for the multi-faceted analysis of business processes - A case study in a financial services organization](#). Computers in Industry 64(1), 57–67.

## **Topic 7: Inter-case Effects in Process Mining**

Most existing process mining techniques assume that each case instance is a separate process execution, influenced only by case-specific features such as attributes or control-flow decisions. This isolated perspective neglects potential inter-case effects, where the progression of one case is influenced by events or conditions in other cases. Such effects often arise due to shared resources, which are typically responsible for executing multiple cases within the same process.

The goal of this seminar thesis is to explore techniques that account for inter-case effects in process mining. The participant should identify (1) the types of inter-case effects and the process perspectives they impact, (2) methods for measuring these effects and incorporating them as features, and (3) the applications of these inter-case features, such as discovery, prediction, or enhancement. Additionally, the thesis should propose a framework for categorizing inter-case features and discuss how they can be effectively used in process mining approaches.

### Literature:

- [1] Grinvald, A., Soffer, P., & Mokryn, O. (2021). [Inter-case properties and process variant considerations in time prediction: A conceptual framework](#). In International Conference on Business Process Modeling, Development and Support, 96-111.
- [2] Senderovich, A., et al. (2017). [Intra and inter-case features in predictive process monitoring: A tale of two dimensions](#). In Business Process Management, 306-323.
- [3] Dubinsky, Y., Soffer, P., & Hadar, I. (2023). [Detecting cross-case associations in an event log: Toward a pattern-based detection](#). Software and Systems Modeling, 22, 1755–1777.
- [4] Evron, Y., et al. (2024). [Inter-instance data impacts in business processes: A model-based analysis](#). arXiv preprint arXiv:2401.16584.