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Source:	google scholar ***Application of Neural Network Tools in Process Mining***
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Summary

Process Mining with Graph Methods:

Process mining is a method for discovering, analyzing, and monitoring processes in an objective manner. It converts log data from business information systems into insights and actions. The input for schema mining is a collection of sequences (traces), and the engine generates the general schema graph that encompasses the input set. The input for schema mining is an event log, which is a collection of event traces. The event log traces are generalized and integrated into a schematic graph.

The initial software systems for schema induction often employed a pattern matching approach to determine the common section in the phrases. In most cases, the induction followed a set of transformation rules established by human specialists. Current toolsets for process mining are dominated by graph or automata focused methods, which typically begin with the creation of a Direct Follower Graph, which is a graphical representation of the process.

The primary requirement for process automation is the availability of process models that can be converted into running systems. The required models can be discovered using process mining approaches that extract knowledge from information system event records.

Identification of the control-flow structures within the data sequences is necessary to develop a generalized mode. The control-flow patterns used in process modeling fall into eight categories, and the fundamental patterns that can be examined in the event log include: sequence,parallel split,synchronization,exclusive choice, and simple merge.

Standard Tools in Process Mining:

Process mining technologies use existing data from corporate information systems to produce dynamic visualizations of processes and to execute process mining tasks such as process discovery and conformance testing. ProM stands out as the initial framework designed to unify various process mining methods, this framework is adaptable in terms of input and output formats, allowing for simple implementation of process mining approaches.

A more complex tool is the open source PM4PY (Process Mining for Python.), which was created by the Fraunhofer Institute using Python and it supports a variety of input and output formats, as well as conformity checking, object-centric process mining, organizational network analysis, and recently PM4PY has incorporated integrations with OpenAI for instance with ChatGPT to facilitate automatic insights generation.

Process Mining with Neural Network Methods

Neural networks can be used in process mining to help with many elements of business process analysis and optimization. One of their applications is for predicting future occurrences in a business process.In terms of accuracy and generalization, deep learning surpasses conventional process mining methods such as Petri nets and BPMN (Business Process Modeling Notation)**.**

K. M. Hanga, Y. Kovalchuk, and M. M. Gaber endorse a strategy that merges the advantages of visually interpretable graph-based techniques with the precision of deep learning methods. The Recurrent Neural Network (RNN) architecture possesses the ability of offering the context for every subsequent prediction aiding in maintaining the decision-making state. Consequently, in this methodology, an LSTM (Long Short-Term Memory) model is initially utilized to determine the probabilities of each known event occurring in the subsequent process. These probabilities are subsequently leveraged to construct a graphical process model graph.

Another method done by E. Obodoekwe, X. Fang, and K. Lu who employed a convolutional neural network (CNN) to predict the next activity in an event trace. The approach initially recognizes spatial organization within the order of historical event sequences before converting them into 2D graphics. The photos are then trained with the CNN network to create a deep learning model capable of predicting the next activity in a continuous process. The practicality of the methodology was assessed using Helpdesk event logs, and the findings reveal that the proposed CNN-based method delivers highly accurate next activity prediction while being faster in training and inference than the LSTM-based approach (Long Short-Term Memory).

T. Shunin, N. Zubkova, and S. Shershakov attempt to identify patterns in event logs using a neural network. The approach uses an RNN's internal state as the intended transition system to describe the behavior in the log. One of the primary benefits of employing this methodology is its inherent ability to recognize and combine common behavioral components spread across the log, another advantage is that the models generated by the approach perfectly fit the event log.

Finally, D. Sommers, V. Menkovski, and D. Fahland used graph neural networks in process discovery. So they encode the discovery problem as a three-part graph:

1) The trace graph, which represents the event log, appears first in the graph.
2) The second portion of the graph is a candidate Petri-net, which could be a result model.
3) The third component of the network is the links that connect the trace graph's event nodes to transitions in the candidate model.

Their method is to use a series of neural networks, each of which takes a fragment of the graph as input and replicates a different stage in the progressive development of a Petri-net model from an event log.This approach was tested on synthetic and real-life data and compared to other methods, attaining the highest simplicity while outperforming the Inductive Miner, Heuristic Miner, and Split Miner methods in terms of F-score(it is a metric used to evaluate the performance of a Machine Learning model)