FAME

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WEBINAR SERIES

December 2nd, 2024

14:00-15:00 CET

IBM

This Project has received funding from the European Union´s Research and Innovation programme under grant Agreement no 101092639

SAX

Processes Explained

FAME

Unlocking The Mystery of Business Processes with AI-empowered Situation Aware eXplainability (SAX)

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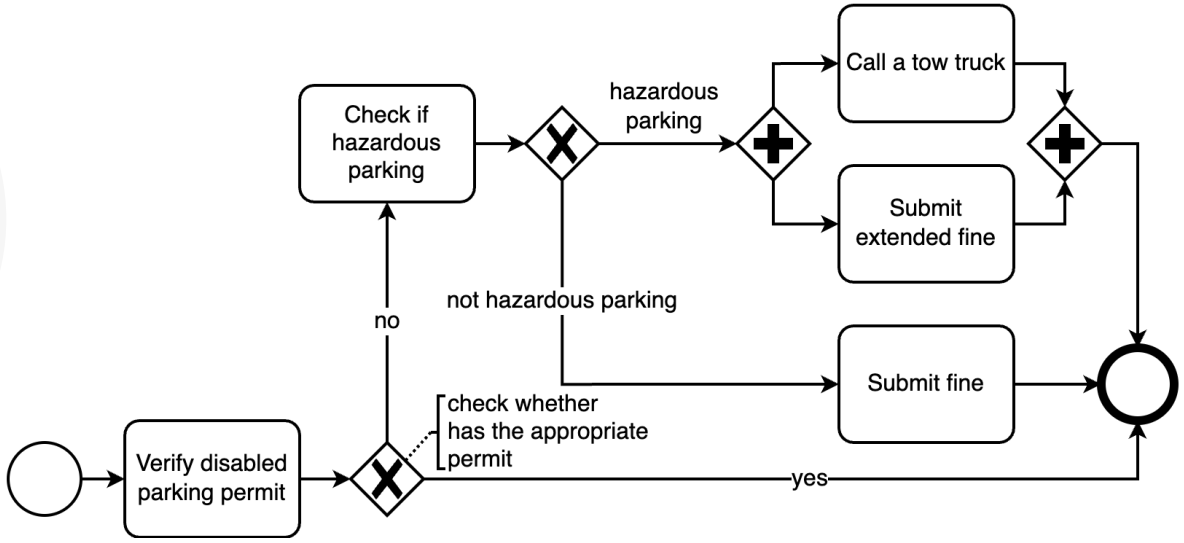
What is a business process?

"A collection of tasks that are executed in a specific sequence to achieve some business goal, such as producing a service or product for customers".

Source: *Mathias Weske. 2012. Business Process Management: Concepts, Languages, Architectures (2nd ed.).*

A process model is a **graphical representation** of a **business process.**



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Business Process Management (BPM)

A discipline that uses various methods to discover, model, analyze, measure, improve, and optimize business processes [*Gartner*]

- In recent years, BPM technologies have evolved driven by advances in AI, machine learning, and other so-called intelligent technologies.
- This raises the challenge of ensuring the **trustworthiness** of AI.

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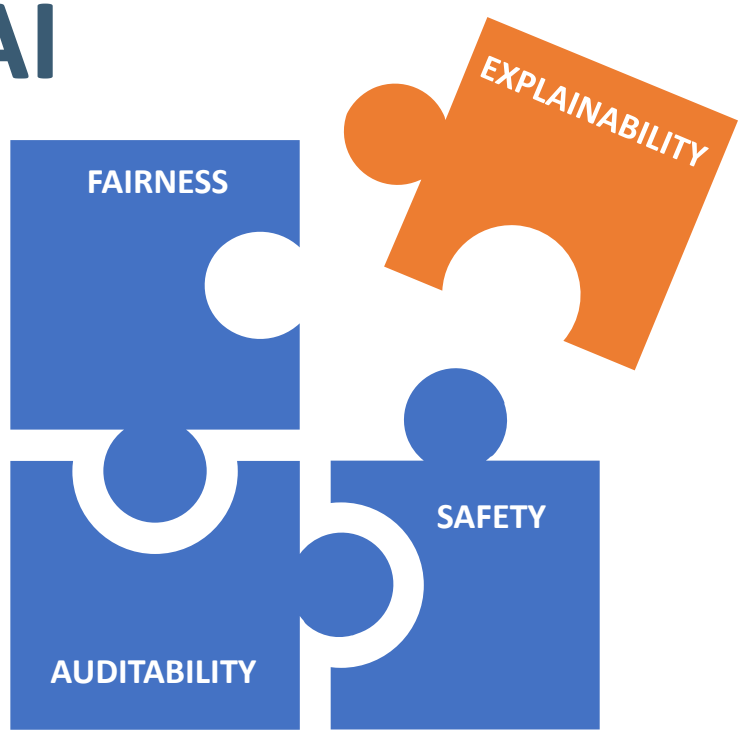
Trustworthy AI



FEAS principle – Toreini at al. *The Relationship between Trust in AI and Trustworthy Machine Learning Technologies*. In Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency

Our focus is on explainable AI (XAI) of business processes

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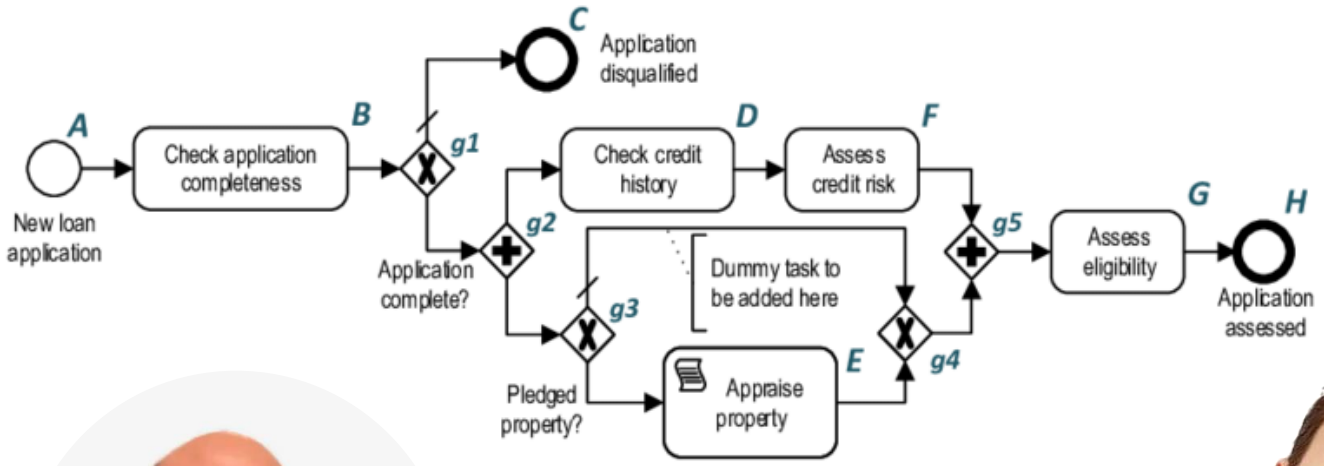
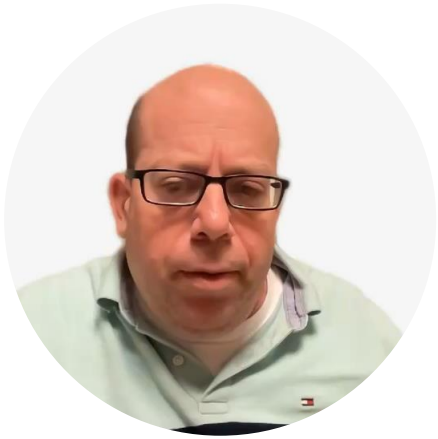
How well can we address user questions related to conditions in business processes?

Mortgage application business process scenario





Why was my mortgage application rejected?

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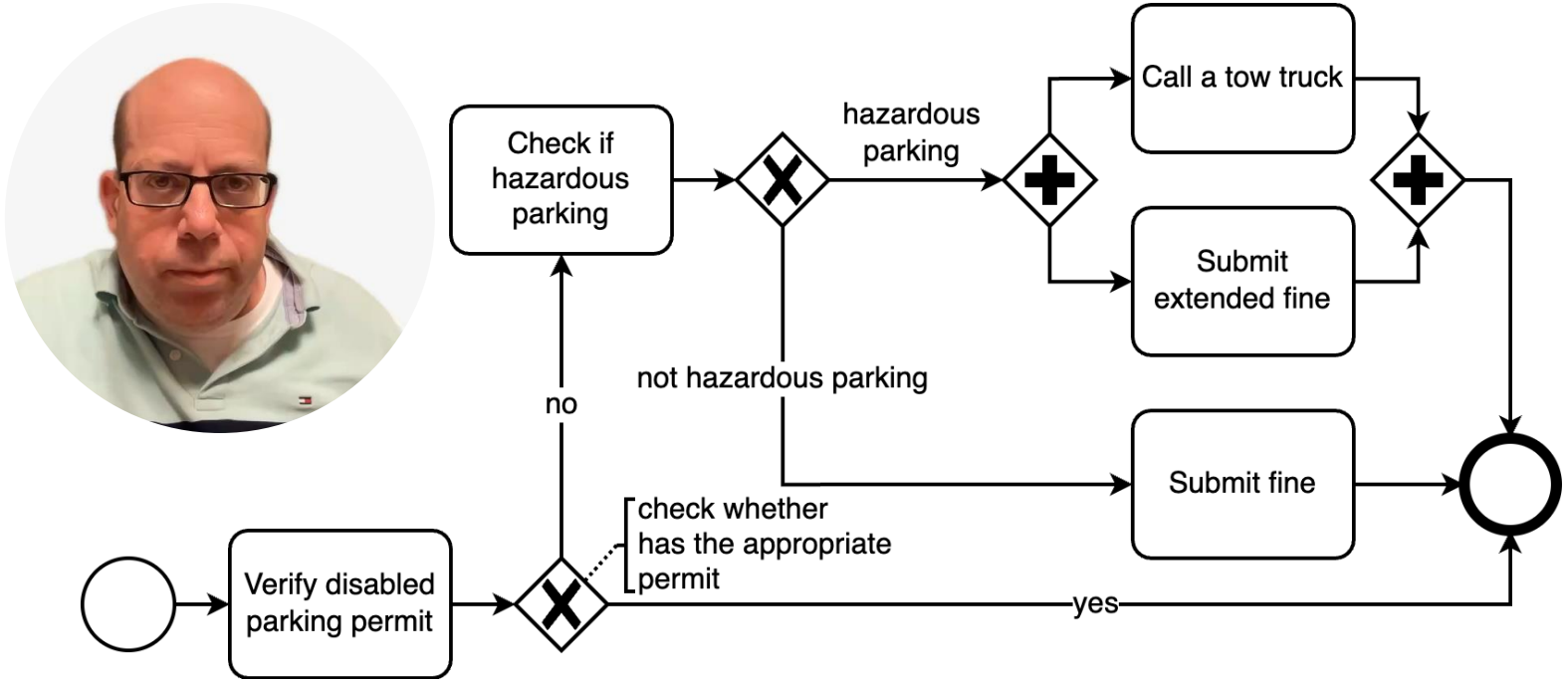
How well can we address user questions related to conditions in business processes?

Hazardous parking (fine tickets) business process scenario



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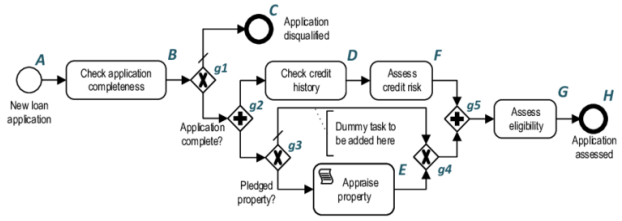
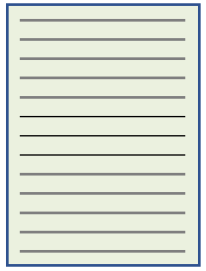
XAI for business processes –
State of the Art (SotA)

Mortgage application business process scenario

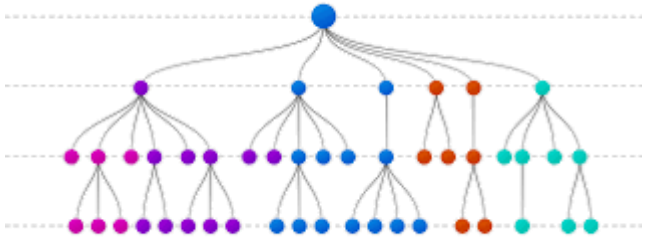


Process model

execution events



Process log

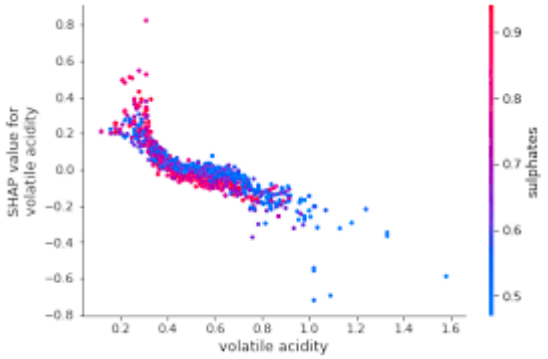


Machine learning (ML) model (surrogate)

prediction

Amount	Risk	Credit_score	Decision
1173	0.3	397	Accept

t_i



Explainability (XAI) model

Explanation

Process log (T) is a set of traces t
t = {<case ID, timestamp, event payload>}

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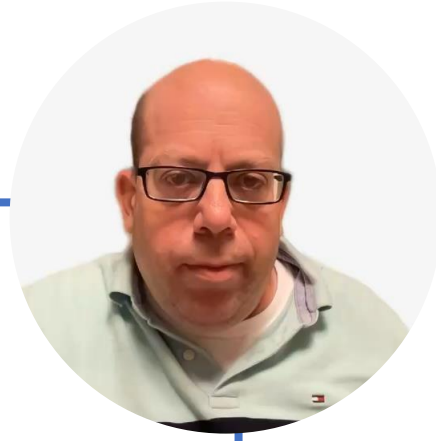
What are the problems with the State-of-the-Art explainability for business processes?



Many of the explanations fail to

- **express the business** *process model constraints*
- **include the richness of** *contextual situations* **that affect process outcomes**
- **reflect the** *true causal execution dependencies* **among the activities in the business process**
- **make sense and be** *interpretable* **to human users**

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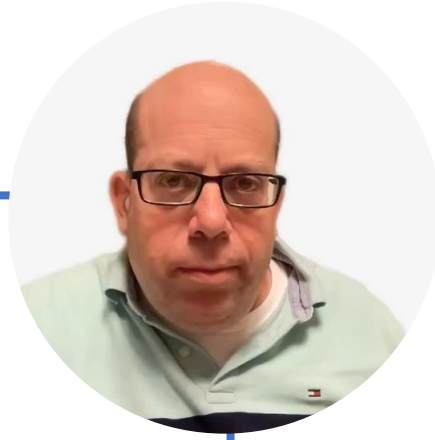

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Situation Aware eXplainability (SAX)

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Unlocking the power of SAX

Processes Explained

SAX is a suite of technologies developed by IBM Research as part of the FAME EU project to address the above shortcomings, with the aim of generating explanations about business process conditions by leveraging recent AI advancements.

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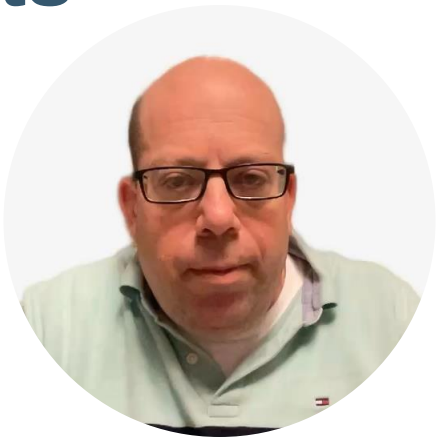
Many of the explanations fail to express the business process model constraints

The 



Today’s explanations about process execution conditions can sometimes include irrelevant information that doesn’t reflect the actual process model.

Example: Delving into the delayed handling of mortgage applications, using XAI may involve feeding demographic information (e.g., age) into the prediction model, which would then appear as part of the explanation—even if it doesn't truly affect the processing time.

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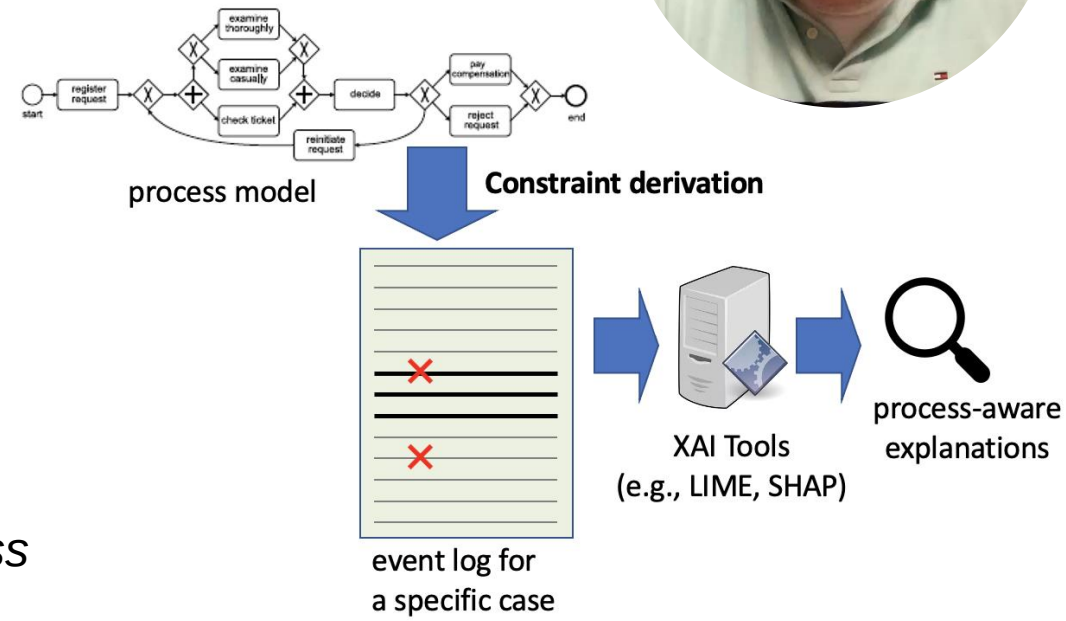
Many of the explanations fail to express the business process model constraints

SAX Processes Explained

Approach

Extensions to XAI techniques (e.g., LIME/SHAP) to systematically constraint the explanation space for process-awareness to produce correct and adequate explanations as they conform the BP model they rely on.

Example: The attribute “age” is not shown as a factor in the explanation.



Paper: *Model-informed LIME Extension for Business Process Explainability*
PMAI2022@IJCAI2022

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Situation Aware eXplainability (SAX)

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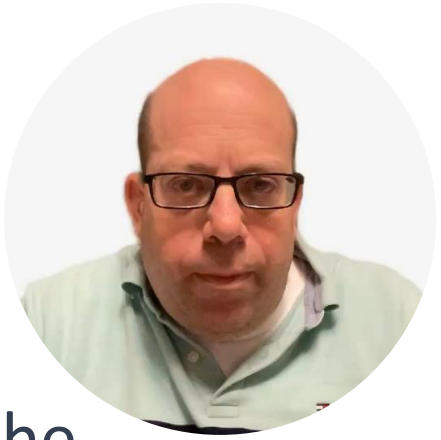
Many of the explanations fail to include the richness of contextual situations that affect process outcomes



Today’s explanations do not include situations that can affect the process outcomes and decisions

Example: Delving into the delayed handling of mortgage applications using only XAI may overlook important information, such as a new guideline to reject an application if it remains in the system for more than 5 days (the situation).

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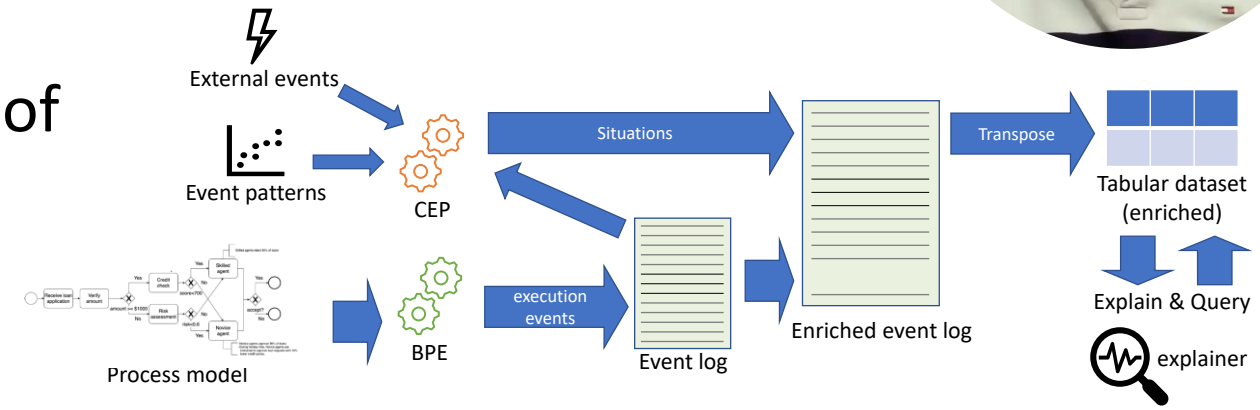
Many of the explanations fail to include the richness of contextual situations that affect process outcomes

SAX Processes Explained

Approach

Leveraging techniques of complex event processing (CEP) for the sake of enriching the process log with situation/context related data.

Example: Detecting *MoreThan5DaysInTheSystem* situation.



Paper: *Situation-aware eXplainability for Business Processes enabled by Complex Events*
AI4BPM workshop @BPM2022

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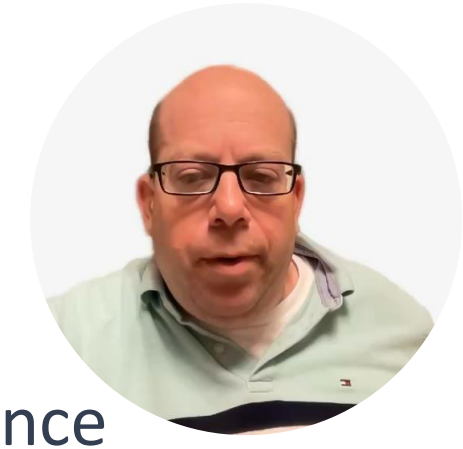

The 

Today's process mining techniques consider only time precedence among activities and not causal execution dependencies.

Example:

Email activity usually occurs before Archive activity in the event log (but archiving is not **caused** by emailing)

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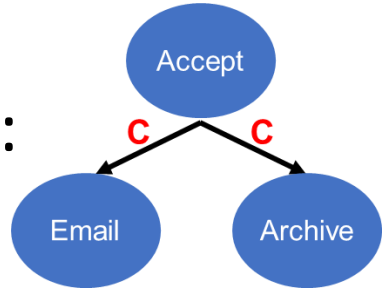
Many of the explanations fail to reflect the true causal execution dependencies among the activities in the business process

SAX Processes Explained

Approach

Leveraging and adapting causal discovery techniques to the **timing** of the activities in the process log to reveal causal dependencies **among their executions (Causal Process AI)**.

Example:



The “Accept” activity causes both “Email” and “Archive” activities, therefore adding more resources to “Email” to finish earlier won’t necessarily mean that “Archive” will finish earlier.

Paper: *The WHY in business processes* (under revision)

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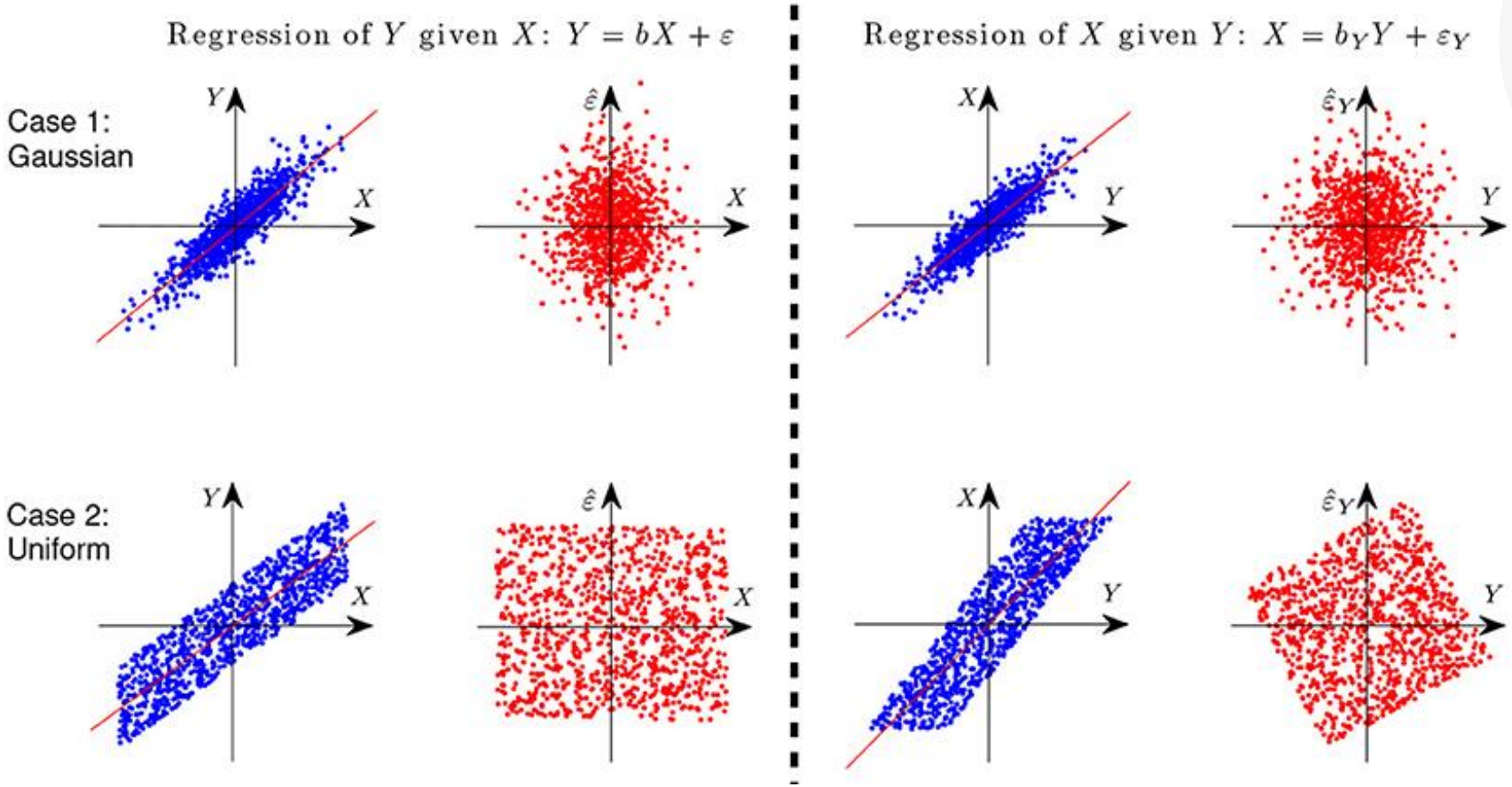
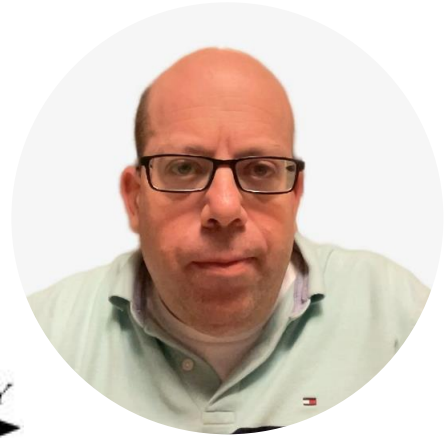
Can we distinguish X $\overset{c}{\rightarrow}$ Y vs. Y $\overset{c}{\rightarrow}$X
The LiNGAM method





Projecting from the general case of linear relationship between variables to the cause of time execution relationship between activities in a process

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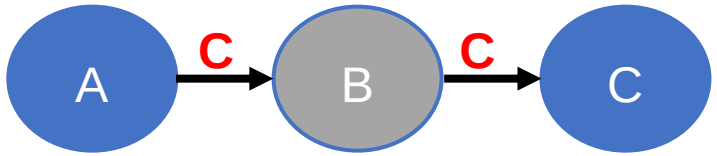
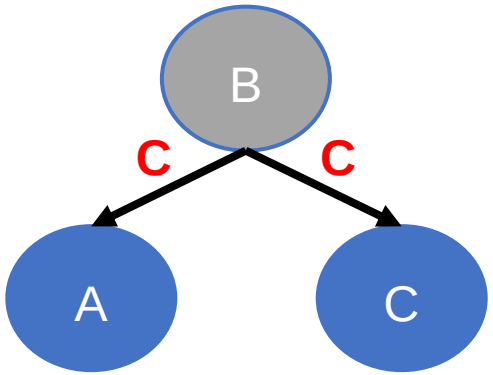
Background – Causal discovery

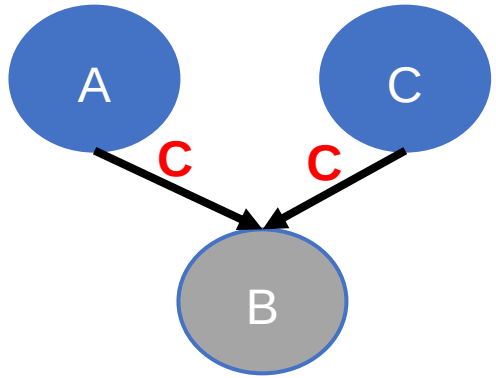
Causal dependency in causal graphs –
There are three causal relationship patterns or junctions that constitute the building blocks for any causal net structure



Mediator



Confounder



Collider

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Causal Process AI - Why is this important?

causal relationships are relationships between the data describing a *cause* and an *effect*, for which the cause is an event that contributes to the production of another event, the effect.

Associative relationships used today to discover the process model, are not enough to develop the causal understandings necessary to inform intervention recommendations.

Interventions are critical for process improvements as they enable to answer questions such as:

What would happen to the eventual outcome or execution time in a given process if a certain activity is expedited or postponed?

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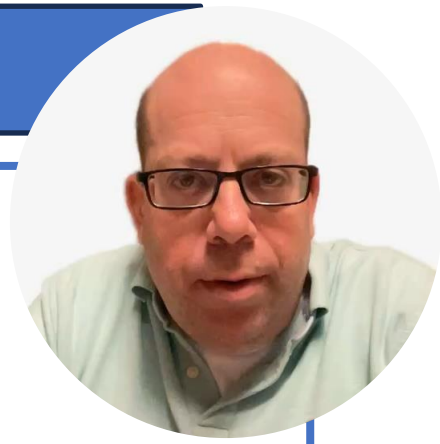
Situation Aware eXplainability (SAX)



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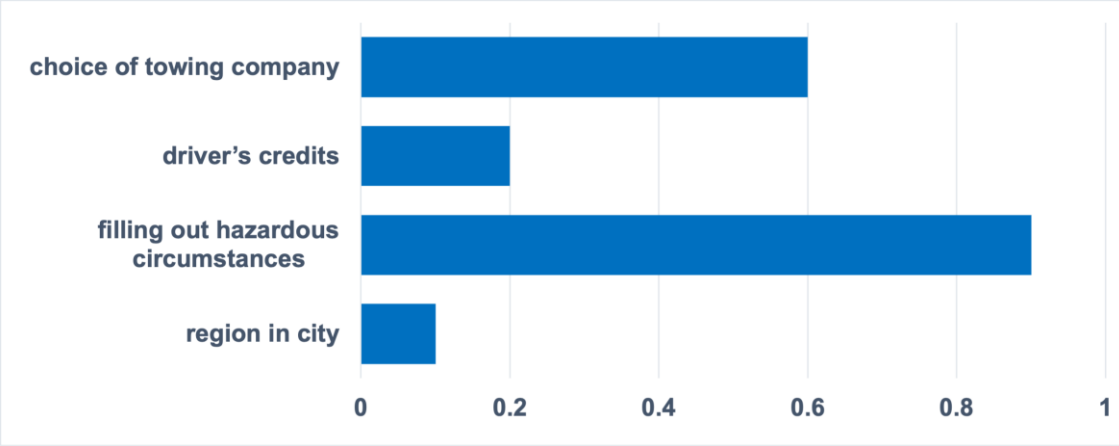
Many of the explanations fail to make sense and be interpretable to human users

The 

Today, explanations provided by XAI techniques tend to be uninterpretable to users.

Example:
The factors affecting the processing of fines issued to vehicles parked in hazardous areas.



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Many of the explanations fail to make sense and be interpretable to human users

SAX
Processes Explained

Approach

Employ the power of an LLM to highlight the important part of the various knowledge we have about the process and articulate it in a natural language form.

Example:

The “Submit extended fine” activity, particularly the time intensive documentation of hazardous circumstances with a high importance value of 0.9, is the primary cause of delay in fine processing.

Paper: *How well can large language models explain business processes?* (under revision)

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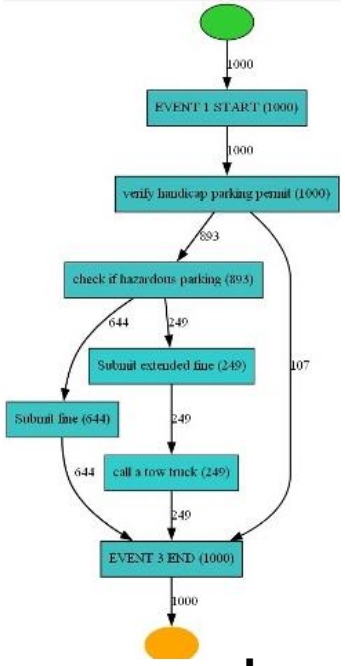
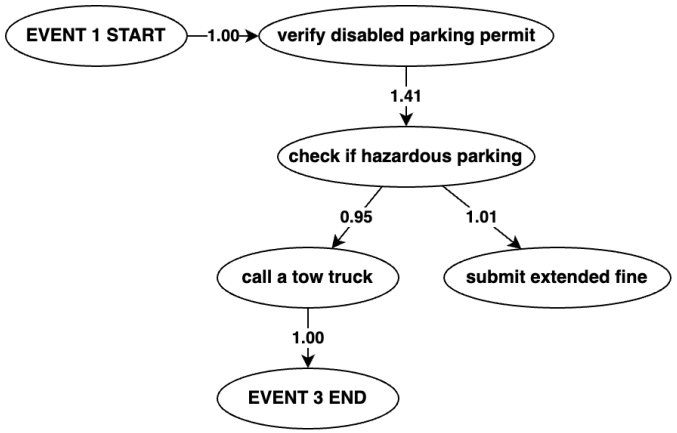
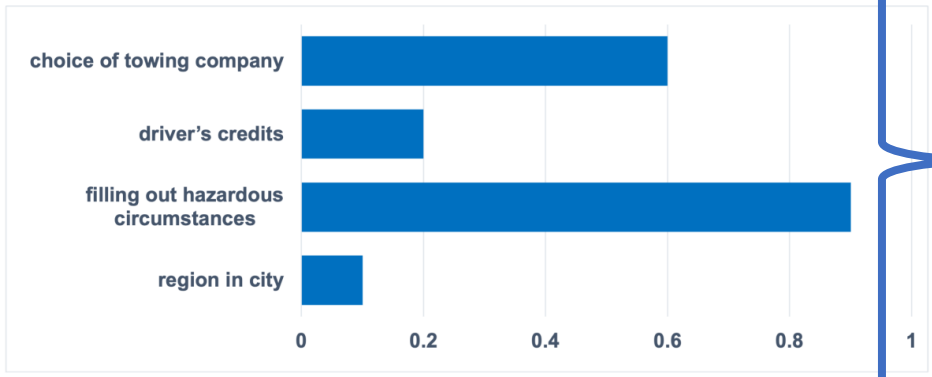
SAX idea - “Form”, “Blend”, “Interpret” (FBI)



process knowledge



causal knowledge



XAI knowledge

knowledge ingredients

“Why does the processing of fines in hazardous location take so long?

Large Language Model (LLM)

explanation

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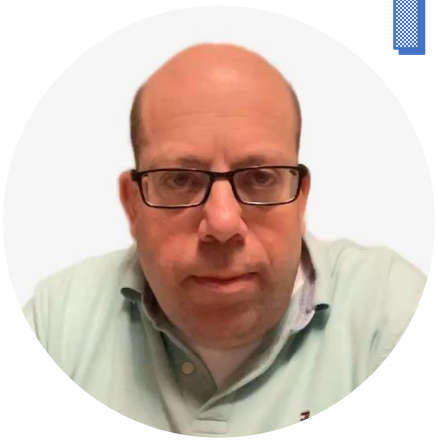
SAX4BPM library



Core Services:

- ►Causal4process
- ►ContextEnrichment
- ►X4Process
- ►NLP4X

* Accessible at: https://github.com/IBM/sax4bpm

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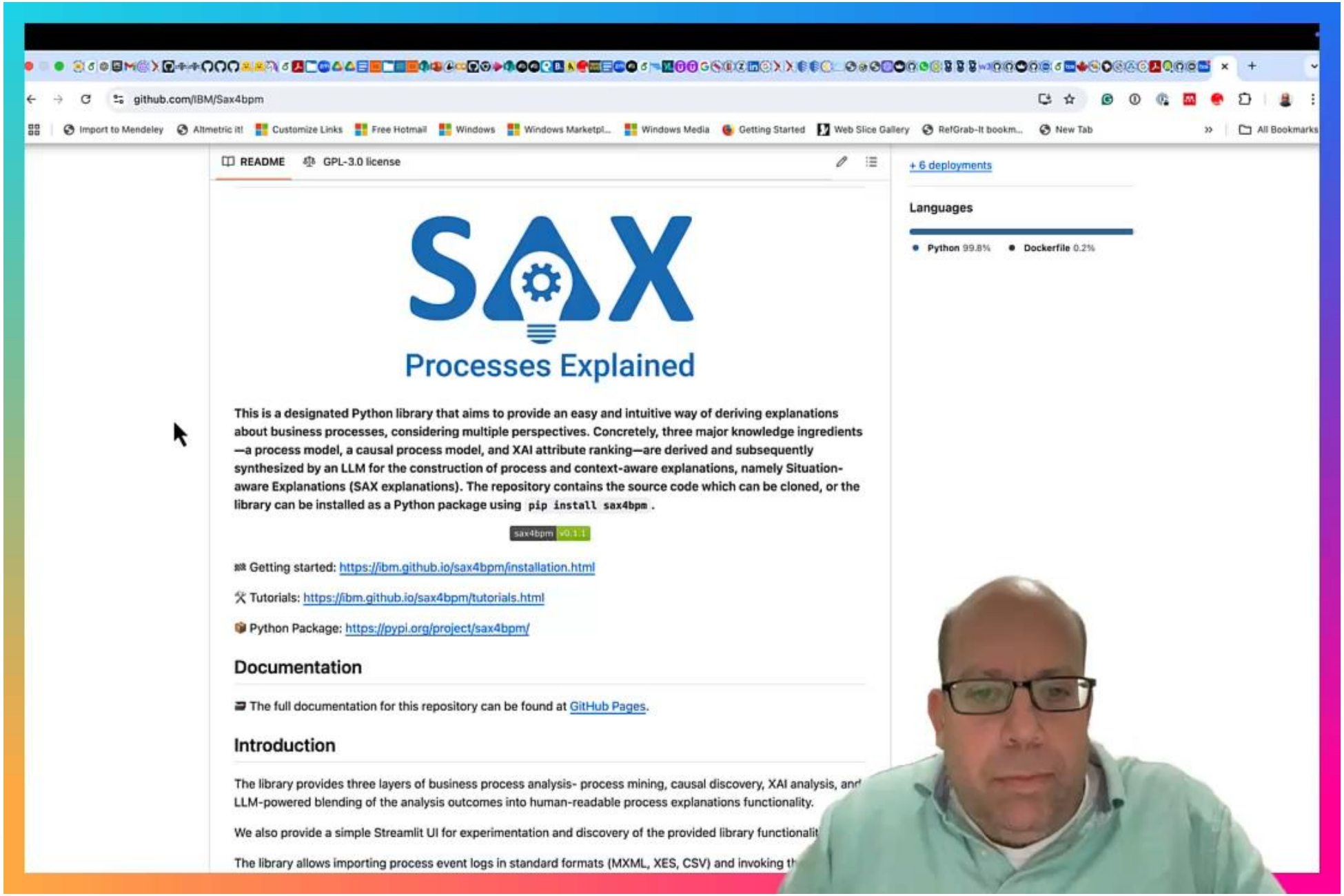
github.com/IBM/Sax4bpm
README
GPL-3.0 license
+ 6 deployments
Languages
Python 99.8%
Dockerfile 0.2%
SAX
Processes Explained
This is a designated Python library that aims to provide an easy and intuitive way of deriving explanations about business processes, considering multiple perspectives. Concretely, three major knowledge ingredients —a process model, a causal process model, and XAI attribute ranking—are derived and subsequently synthesized by an LLM for the construction of process and context-aware explanations, namely Situation-aware Explanations (SAX explanations). The repository contains the source code which can be cloned, or the library can be installed as a Python package using pip install sax4bpm .
sax4bpm v0.1.1
Getting started: https://ibm.github.io/sax4bpm/installation.html
Tutorials: https://ibm.github.io/sax4bpm/tutorials.html
Python Package: https://pypi.org/project/sax4bpm/
Documentation
The full documentation for this repository can be found at GitHub Pages.
Introduction
The library provides three layers of business process analysis- process mining, causal discovery, XAI analysis, and
LLM-powered blending of the analysis outcomes into human-readable process explanations functionality.
We also provide a simple Streamlit UI for experimentation and discovery of the provided library functionalit
The library allows importing process event logs in standard formats (MXML, XES, CSV) and invoking th

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Federated Decentralized Trusted Data Marketplace for Embedded Finance

FAME

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