

XABPs: Towards eXplainable Autonomous Business Processes

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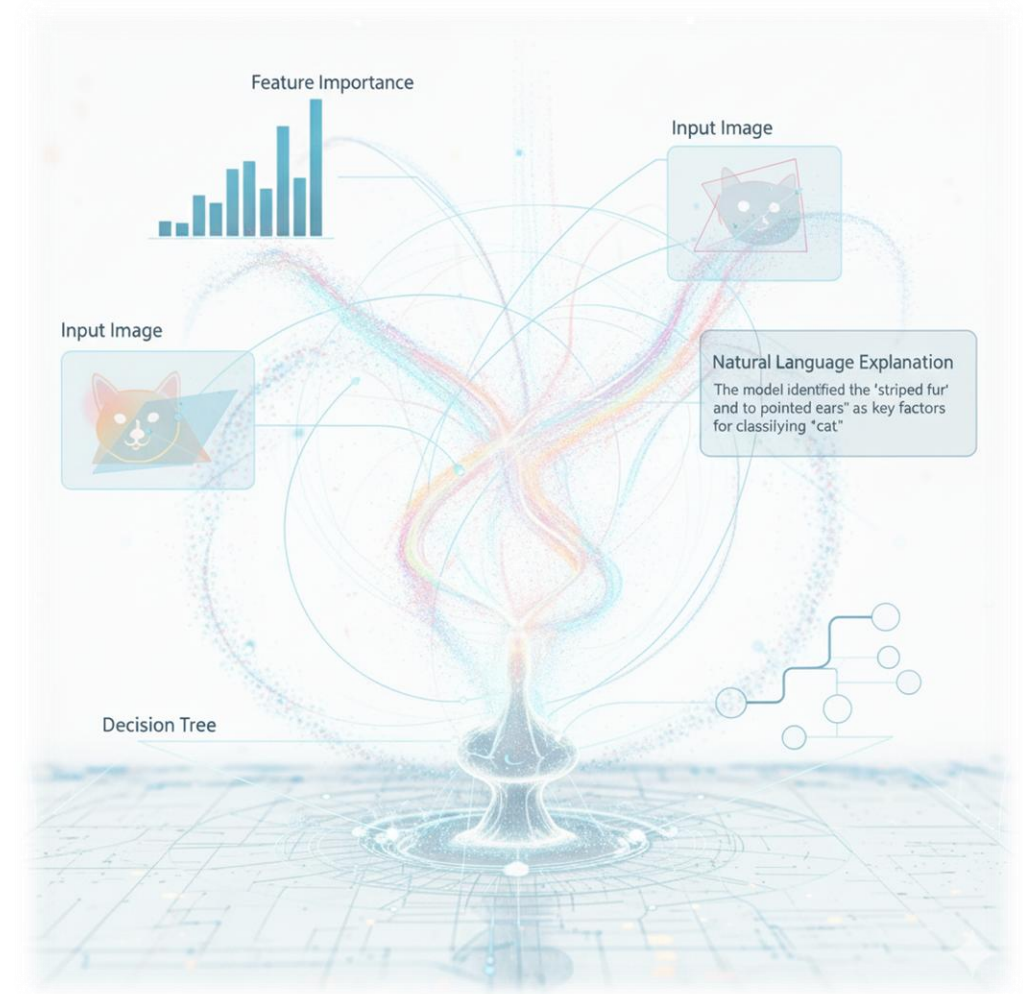
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- Background and Motivation
- Conceptual Model for XABPs
- Challenges
- Conclusion

Motivation

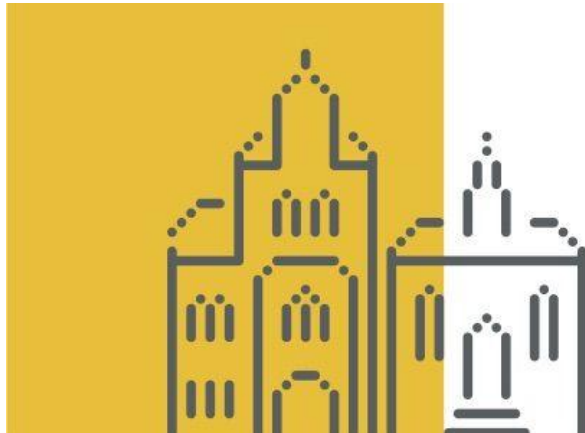
Ideation @ Dagstuhl

Dagstuhl Seminar 25192

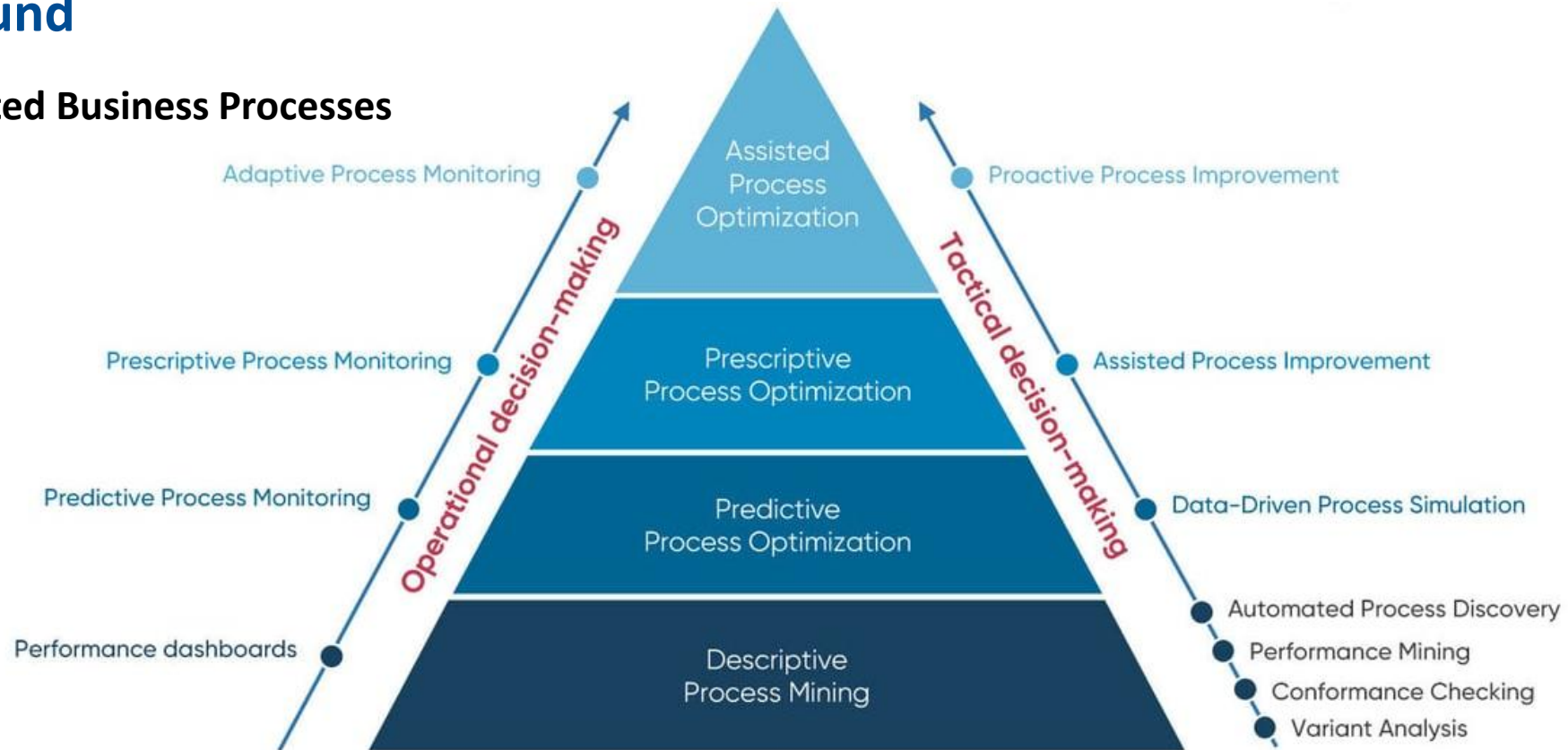
AUTOBIZ: Pushing the Boundaries of AI-Driven Process Execution and Adaptation

May 04 – May 09, 2025

<https://www.dagstuhl.de/25192>



AI-augmented Business Processes



Autonomous business processes := next generation of AI-Augmented business processes

- Self-executing, (pro)active, agentic, ...
- Leveraging advanced AI/ML
- Operate with minimal to no human intervention

<https://apomore.com/blog/enhancing-operational-excellence-with-augmented-business-process-management>

Motivation

Why Explainability?



"Responsible systems EU agenda" centers on creating sustainable and digital future ensuring systems are environmentally friendly, socially fair, and driven by trustworthy AI

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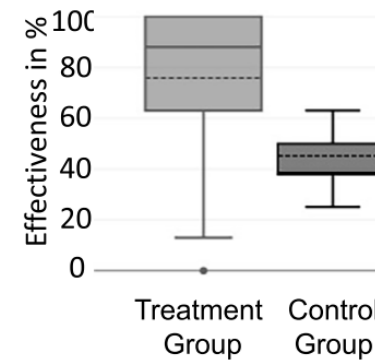
Concerns of ABPs:

- **Decreased Stakeholder Trust:**
 - Users, owners, customers may be hesitant to rely on AI-driven decisions they cannot understand
- **Bias:**
 - ABPs may perpetuate hidden biases of underlying AI/ML components, leading to discriminatory outcomes
- **Regulatory Compliance:**
 - Demonstrating compliance with acts like GDPR or the EU AI Act requires transparency
- **Hindered Accountability:**
 - If ABP causes unfair outcome, challenging to assign responsibility or implement corrective actions

Why Explainability?

Concerns of ABPs:

- **Missed Efficiency Gains:**
 - Humans can perform their tasks / collaboration with AI better if provided with AI rationale
 - Example: Proactive Adaptation of Software Systems [Metzger et al. 2024 @ ACM TAAS]
- **Difficulty in Debugging:**
 - Opacity makes it hard to identify failures or understand why a process is underperforming



➔ Need for **eXplainable**ABPs (XABPs)

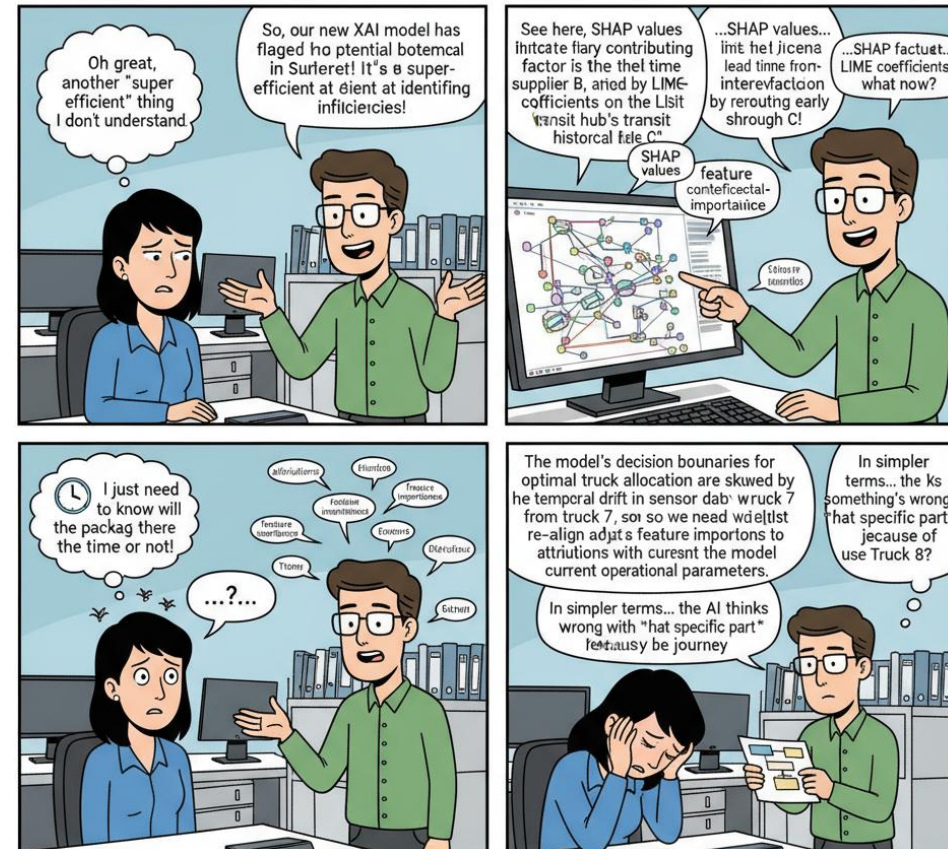
[Metzger et al. 2024 @ ACM TAAS: <https://doi.org/10.1145/3666005>]

[Kubrak et al. 2024 @ BPM: https://doi.org/10.1007/978-3-031-70396-6_23]

Limitations of State of the Art in XAI

XAI techniques are not enough!

- **Inability** to express business process model constraints
- **Failure** to capture the richness of contextual situations that affect process outcomes
- **Inability** to reflect causal execution dependencies among activities in the business process
- Explanations are often **nonsensical** or not interpretable for human users in a process context



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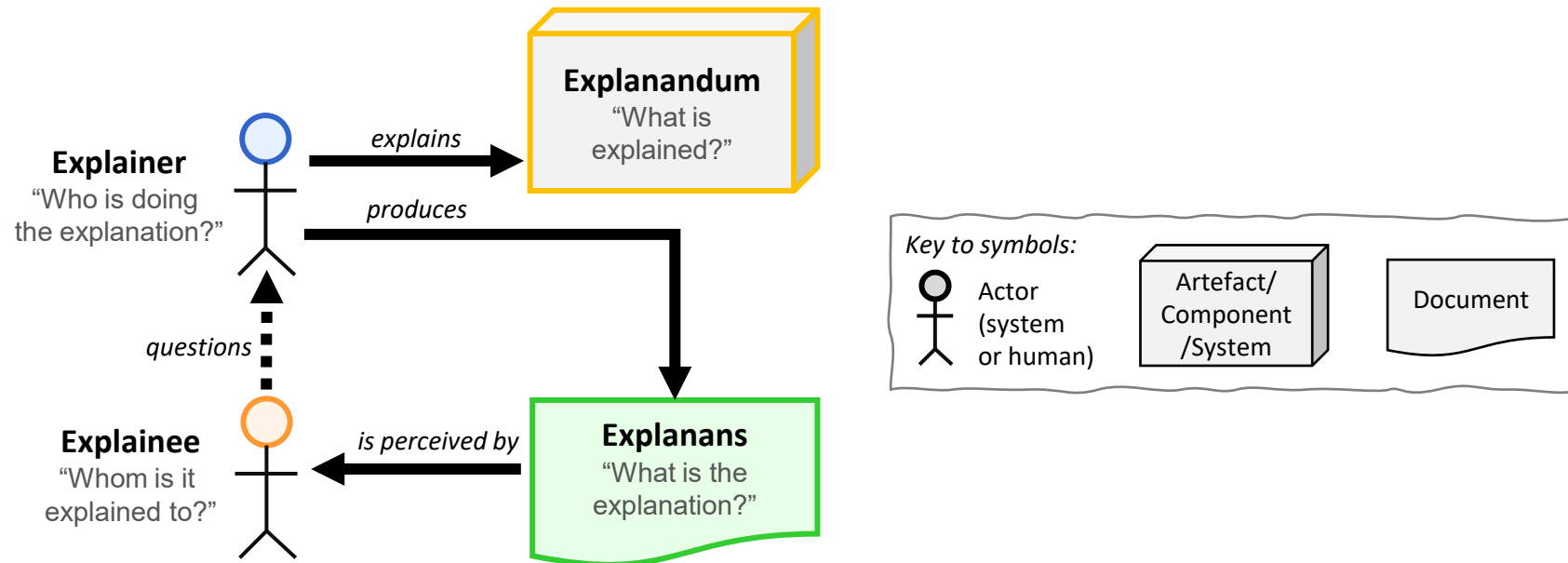
Core Concepts

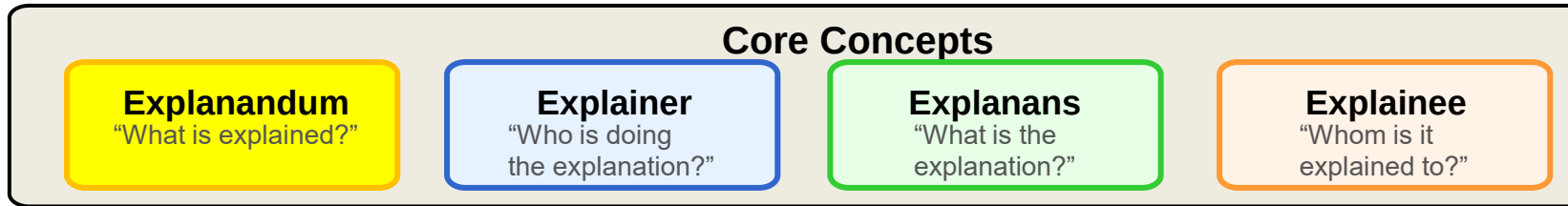
Explanandum
"What is explained?"

Explainer
"Who is doing
the explanation?"

Explanans
"What is the
explanation?"

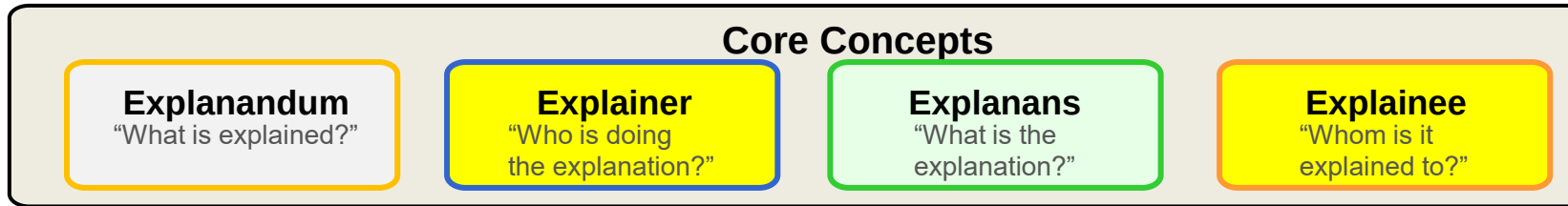
Explainee
"Whom is it
explained to?"





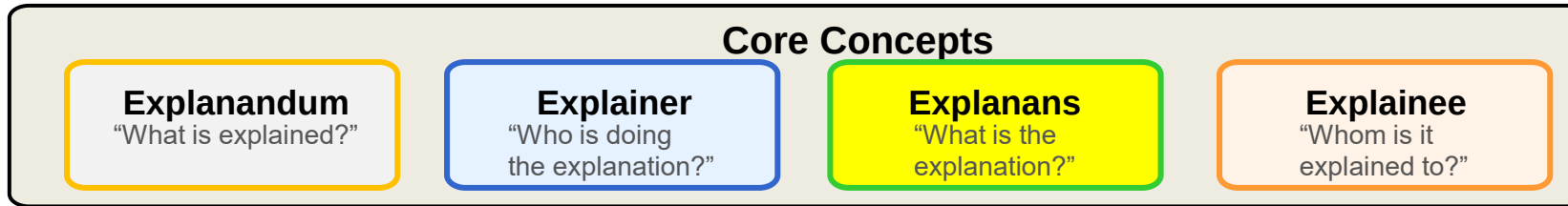
In XABPs, we must explain more than just the AI model:

- **AI Component:** "Why did the AI make this recommendation?" (Traditional XAI)
 - Example: "Why was an alarm raised for process event e1?"
- **Process Instance:** "Why did this specific execution follow this path?"
 - Example: "Why was this loan application rejected by the process?"
- **Process Model:** "Why is the process structured this way?"
 - Example: "Why do we have a credit history check as a decision point?"
- **Framed Autonomy Constraints:** "Why is the system allowed to behave this way?"
 - Example: "Why can the AI act without a human in the loop?"



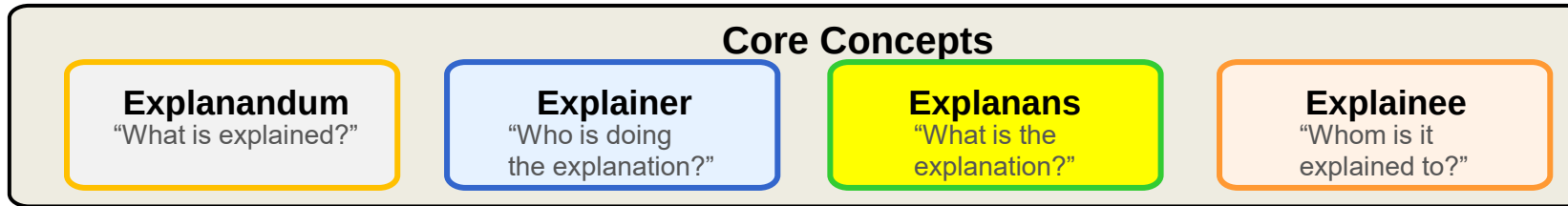
Explanations in XABPs involve a **wide range of actors**, both human and systemic

- **Explainers** (Who provides explanations?)
 - System Actors: AI Models/Agents, Monitoring Components, Connected Systems
 - Human Actors: Domain Experts, Supervisors, Trainers, Annotators
- **Explainees** (Who consumes explanations?)
 - Human Actors: End Users, Process Participants, Process Managers, Business Analysts, Compliance Officers
 - System Actors: The System Itself (for self-reflection), Connected Systems, other AI Agents



Explanans describes the "how" of the explanation, including its mechanism and timing:

- **Explanation Mechanism:** The technique used to generate the explanation
 - Feature Attribution: (e.g., SHAP, LIME)
 - Example-Based: (e.g., Prototypes, Counterfactuals)
 - Rule-Based: (e.g., Decision Trees)
 - Model Simplification: (e.g., Surrogate Models)
- **Time of Generation:** When the explanation is produced
 - Ex-ante: Before execution (to validate models)
 - Run-time: During execution (for human-in-the-loop oversight)
 - Post-hoc: After execution (for auditing or debugging)

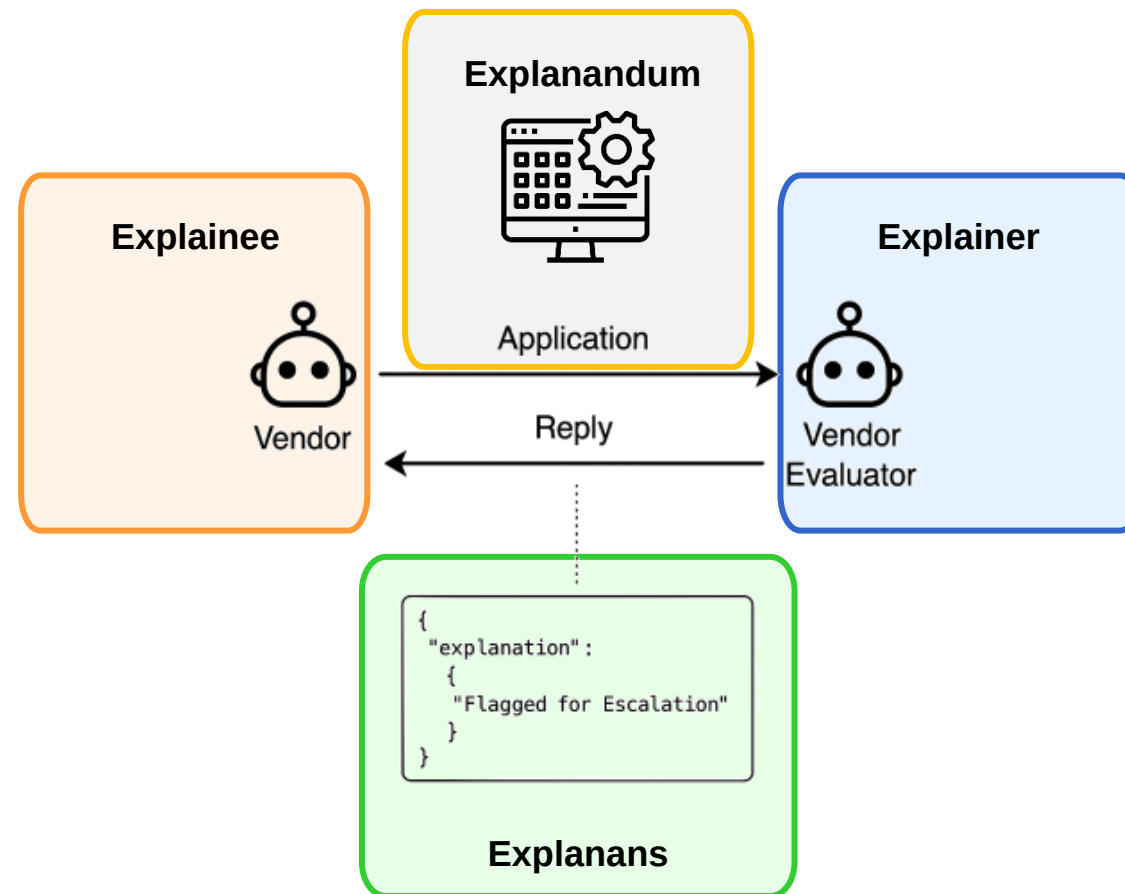


The delivery and assessment of explanation are also part of Explanans.

- **Presentation Format:** How the explanation is delivered to the explainee
 - Visual: Heatmaps, charts, dashboards
 - Verbal: Natural-language output, written rules, factual/counterfactual statements
- **Interaction Mode:** How the user interacts with the explanation
 - One-shot: Provided once, passively
 - Conversational: Interactive, iterative dialogue
- **Explanation Quality:** How the explanation is assessed
 - Technical Quality: Fidelity (accuracy), stability
 - User-centric Quality: Usefulness, meaningfulness, relevance

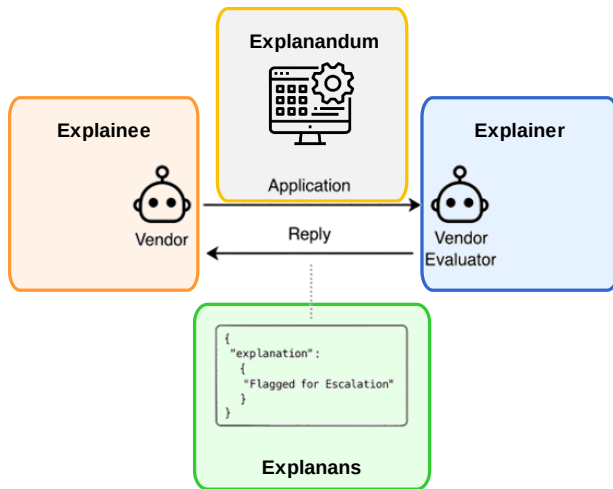
Example

Agentic BPM system for vendor procurement



Example

Agentic BPM system for vendor procurement



```
{
  "vendor": "Vendor D (GreenBox Logistics)",
  "total_score": 4.05,
  "threshold": 5.0,
  "status": "Flagged for Escalation",
  "explanandum": "Why did Vendor D receive an overall evaluation score below the acceptance threshold?",
  "explanans": {
    "technical_compliance": { "score": 3, "justification": ["No ISO cert", "No GDPR", "Unspecified hosting region"] },
    "delivery_timeline": { "score": 4, "justification": ["14-month timeline", "No mitigation plan"] },
    "price_competitiveness": { "score": 5, "justification": ["High cost", "No added value"] },
    "vendor_reputation": { "score": 4, "justification": ["Few references", "Early termination in 2022"] }
  },
  "explainability": {
    "techniques_used": ["causal-inference", "SHAP-style"],
    "causal_counterfactual": {
      "description": "Adding compliance would improve score to 6.3.",
      "predicted_score": 6.3
    },
    "feature_contributions": { "technical_compliance": -2.25, "delivery_timeline": -1.25 },
    "contribution_summary": "Compliance and timeline account for 87% of score gap."
  },
  "recommendation": {
    "summary": "Do not proceed without major revisions.",
    "required_improvements": ["Add ISO certification", "Specify hosting", "Shorten timeline"]
  }
}
```

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Explainee:

- How to effectively capture, specify, and resolve conflicts in user preferences for explanations (e.g., detail vs. conciseness)?

Explanandum:

- What is the full taxonomy of explanation subjects needed for ABPs, beyond AI models (e.g., process instances, autonomy constraints)?

Explainer:

- What new techniques are needed to generate explanations that account for causality and process-specific constraints?



Explanans:

- How to identify and communicate true causal explanations versus spurious correlations?
- How should explanations evolve over time based on new feedback or changing contexts (e.g., sensor data drift)?
- How to articulate actionable explanations (especially to other agents) that preserve autonomy and enable corrective action?
- How can we generate explanations for why certain behaviors did not occur?



Overarching:

- How do we assess explanation quality, balancing objective metrics (e.g., accuracy) with user-centric metrics (e.g., usefulness, actionability)?
- What benchmark datasets are needed to evaluate and compare XABP systems?
- How can we provide transparency without revealing privacy-sensitive information or business-critical intellectual property?



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Conclusion

The Situation: Autonomous Business Processes (ABPs) are a paradigm shift for BPM, but introduce significant risks related to trust, accountability, bias, and compliance

Our Proposal: We introduce the concept of eXplainable ABPs (XABPs), which can articulate the rationale behind their actions

Our Contributions:

- Conceptual Explainability model tailored for the BPM context
- Illustrative example using an Agentic BPM system
- Set of key research challenges to guide future work

The Path Forward: XAI techniques are insufficient
→ Process-aware explainability research needed

