Master Thesis Report

Process Enhancement by Incorporating Negative Instances in Model Repair

Final Report

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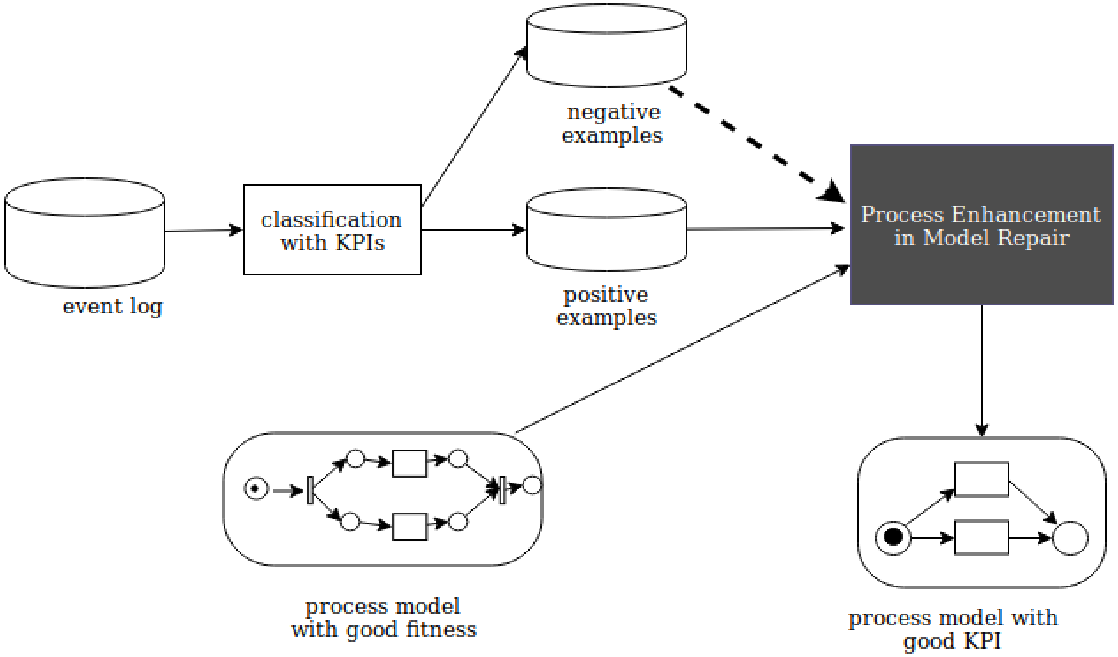
Outlines

- **Problem Review**
- **Demo Presentation**
- **Algorithm & Implementation**
  - Add long-term dependency
  - Create dfg model
- **Evaluation**
- **Appendix**
  - Aided Plugin
    - ✓ Assign labels
    - ✓ Edit Process Tree
  - Reference

Problem Introduction

- **Description**
  - Given event log, process model and KPIs, how to incorporate negative KPIs outcomes to repair the process model for better performance?
- **Input**
  - Event log
  - Existing process model
  - KPIs
- **Output**
  - Repaired process model


event log
classification with KPIs
negative examples
positive examples
Process Enhancement in Model Repair
process model with good fitness
process model with good KPI

Demo Representation

- **Repair Model**
  - Sequence
  - And
  - Nested xor

- **Evaluate Model**
  - Confusion matrix

Algorithm – add long-term dependency

- **Long-term dependency**
  - On Petri net
  - Choices Dependency
    - ✓ exclusive blocks => xor block, not loop
  - Partial Order
    - ✓ Least Common Ancestor is Seq
    - ✓ In same level
  - Relation xor branches
    - ✓ Significant correlation
  - Connected not complete

Algorithm – add long-term dependency

- **Correlation**
  - Supported Connection

$$SC(XORB_X, XORB_Y) = F_{pos}(XORB_X, XORB_Y) - F_{neg}(XORB_X, XORB_Y),$$

$$with F_{pos}(XORB_X, XORB_Y), F_{neg}(XORB_X, XORB_Y) \text{are the frequency}$$

$$\text{of coexistence of} XORB_X, XORB_Y$$

  - Significant Correlation if

$$SC(XORB_X, XORB_Y) > \text{lt-threshold}$$

- Disadvantages:
  - ✓ Generate unsound model
    - Some xor branches kept from the existing model but with no frequency in event log, no long-term dependency shows to make model unsound

Algorithm – add long-term dependency

- **Rephrased Correlation**
  - Existing model, positive and negative event log
  - Normalized Correlation

$$\begin{aligned}
Wlt(XORB_X, XORB_Y) &= Wltext(XORB_X, XORB_Y) + Wltpos(XORB_X, XORB_Y) \\
&- Wltneg(XORB_X, XORB_Y), with \\
W_ltext(XORB_X, XORB_Y) &= \frac{1}{|XORB_{Y*}|}, XORB_{Y*} \\
&\text{is the set of all xor branches from } XORB_X \\
Wltpos(XORB_X, XORB_Y) &= \frac{F_{pos}(XORB_X, XORB_Y)}{F_{pos}(XORB_X, *)} \\
Wltneg(XORB_X, XORB_Y) &= \frac{F_{neg}(XORB_X, XORB_Y)}{F_{neg}(XORB_X, *)}
\end{aligned}$$

Algorithm – generate dfg model

- **Directly-follows relation**
  - Existing model, positive and negative event log

$$W(A,B) := W(E_{G_{ext}}(A,B)) + W(E_{G_{pos}}(A,B)) - W(E_{G_{neg}}(A,B)), with$$

$$W(E_{G_{ext}}(A,B)) = \frac{1}{|Y*|}, \text{*the set of all possible activities after A}$$

$$W(E_{G_{pos}}(A,B)) = \frac{Cardinality_{pos}(E(A,B))}{Cardinality_{pos}(E(A,*))},$$

$$W(E_{G_{neg}}(A,B)) = \frac{Cardinality_{neg}(E(A,B))}{Cardinality_{neg}(E(A,*))},$$

  - Keep this directly-follows relation if

$$W(A,B) > threshold$$

Algorithm – add long-term dependency

- **Key Problem to Solve**
  - Given a process tree, a pair of xor block A,B, the obligatory part between A,B are M, what's the relation of threshold and lt-threshold, such that?

$$\forall XORB_Y \in B, if W(M, XORB_Y j) > threshold, \text{then there exists one } XORB_X i \in B_A \text{ with}$$

$$Wlt(XORB_X i, XORB_Y j) > \text{lt-threshold}$$

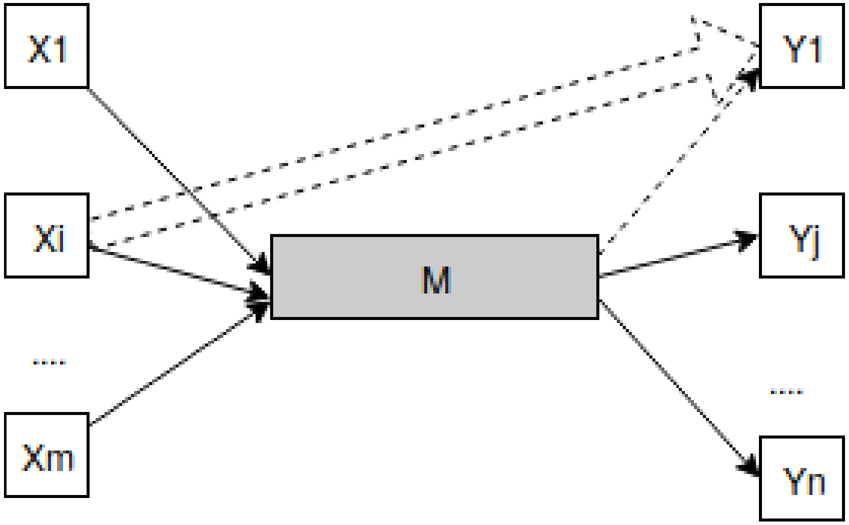
- **Situations**
  - Lt-dependency only kept from existing model, not showing in positive and negative

    ==> add lt dependency on it
  - Only lt in negative

    ==> choose the rest parts to connect
  - Only in positive

    ==> keep lt
  - In positive and negative

    ==> how to decide ??



Appendix – References

- **Assign Labels**

- **Edit Process Tree**

Appendix – references