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**
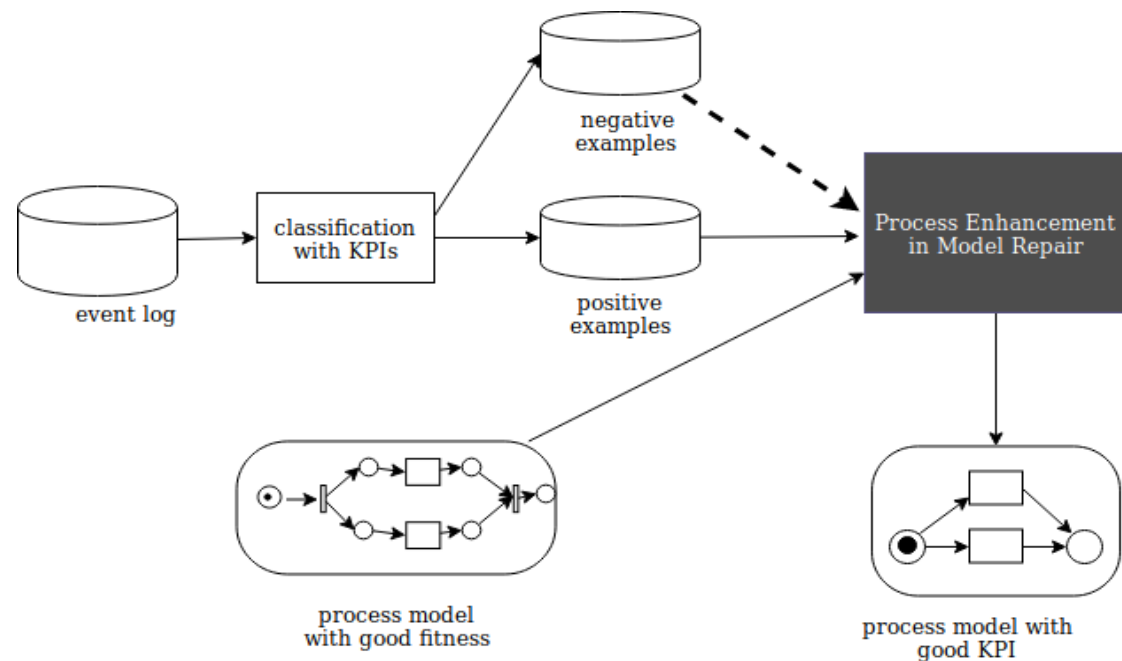 - Reference

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

Demo Representation

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

- **Evaluate Model**
  - Confusion matrix

Algorithm – generate dfg model

- ## **Directly-follows relation**

  - Existing model, positive and negative event log

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

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

after A, $|*|$ is the size of this set.

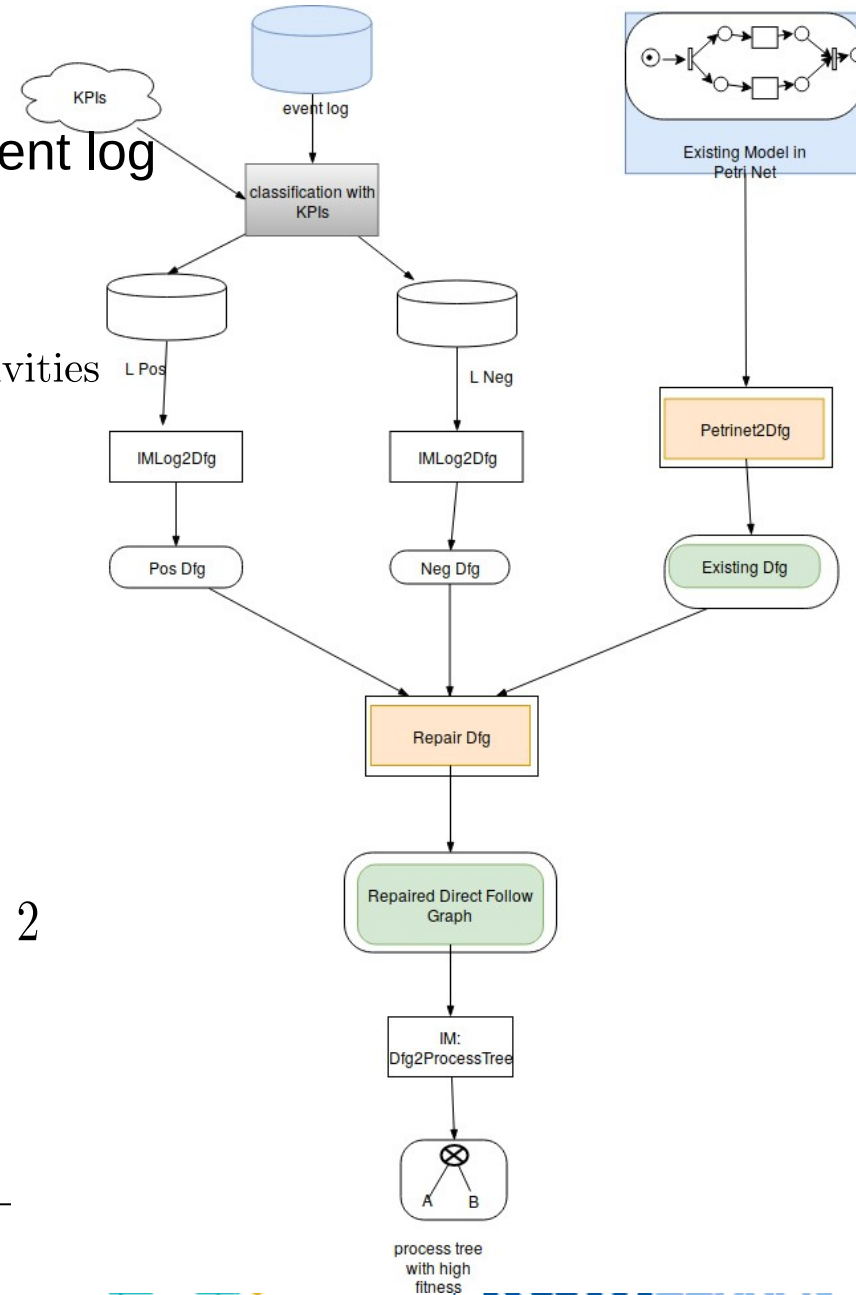C_{ext} is the control weight on existing model from Plugin.

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

$$W(E_{G_{neg}}(A, B)) = C_{neg} \bullet \frac{Cardinality_{neg}(E(A, B))}{Cardinality_{neg}(E(A, *))},$$
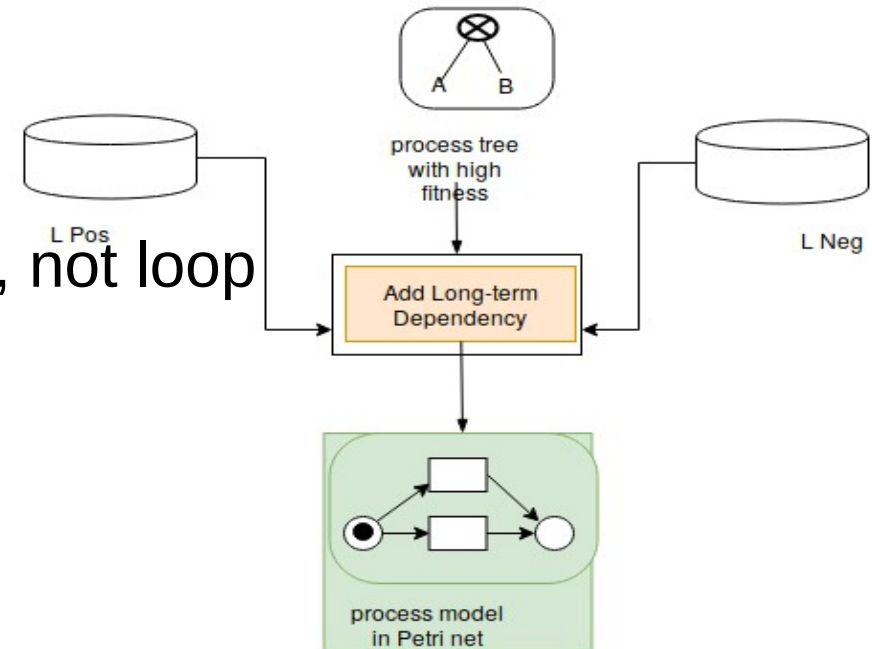
  - Keep this directly-follows relation if

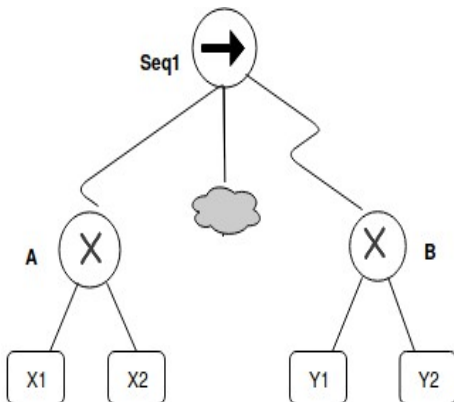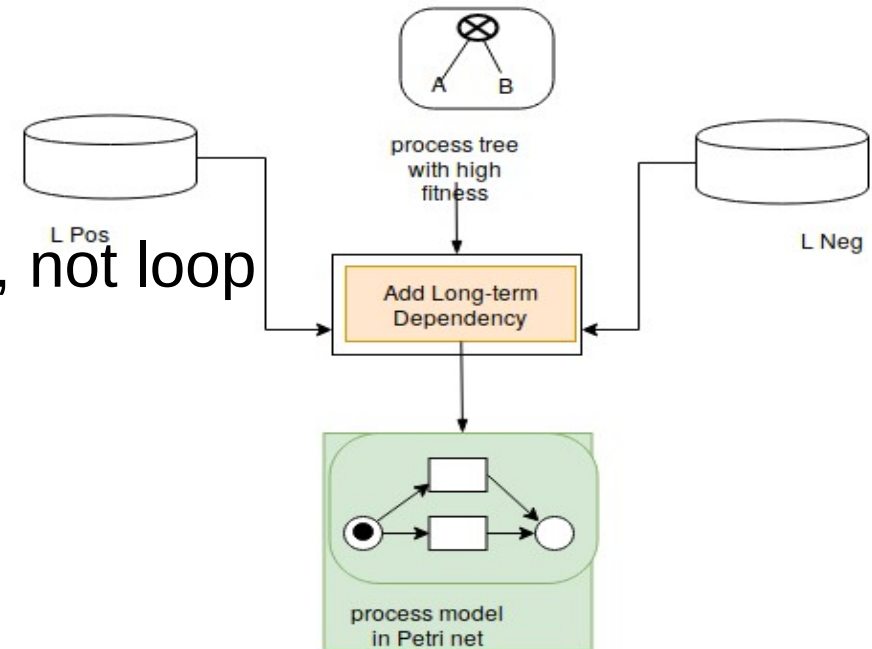$$W(A, B) > threshold, with -1 < W(A, B) < 2$$

  - Choose, threshold=0.5

Algorithm – add long-term dependency

- **Long-term dependency**
  - Choices Dependency
    - ✓ exclusive blocks => xor block, not loop
  - Relation xor branches
    - ✓ Significant correlation
  - Connected but not complete

Algorithm – add long-term dependency

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process tree with high fitness

L Pos

L Neg

Add Long-term Dependency

process model in Petri net

Seq1

A ⓧ   B ⓧ

X1 X2   Y1 Y2

Algorithm – add long-term dependency

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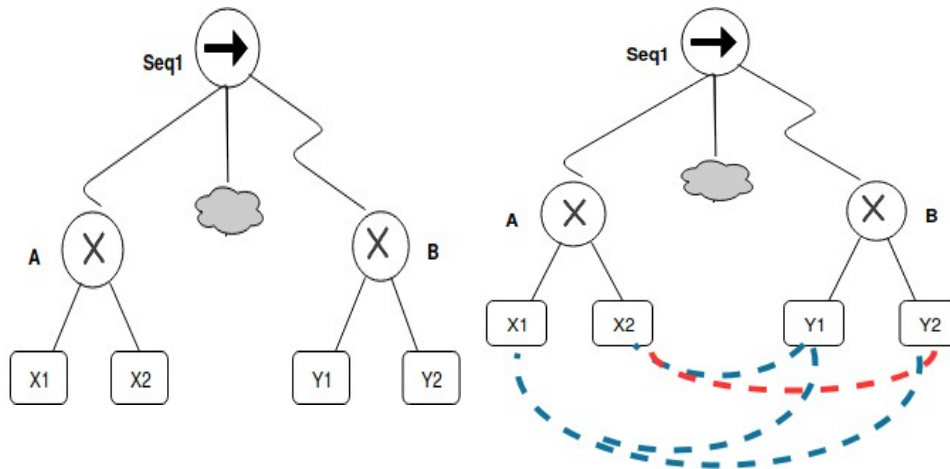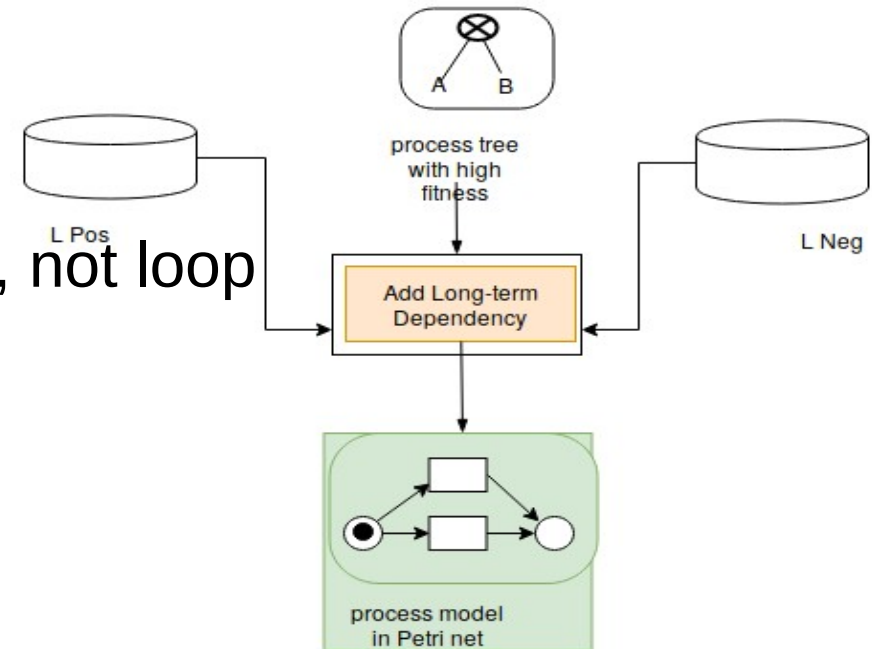
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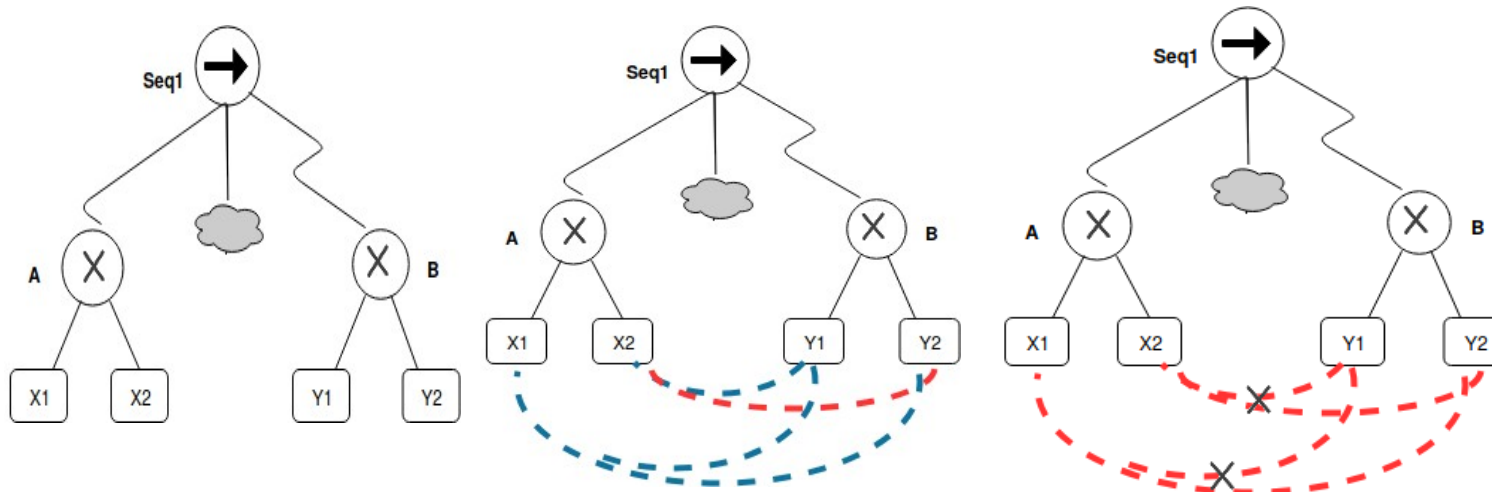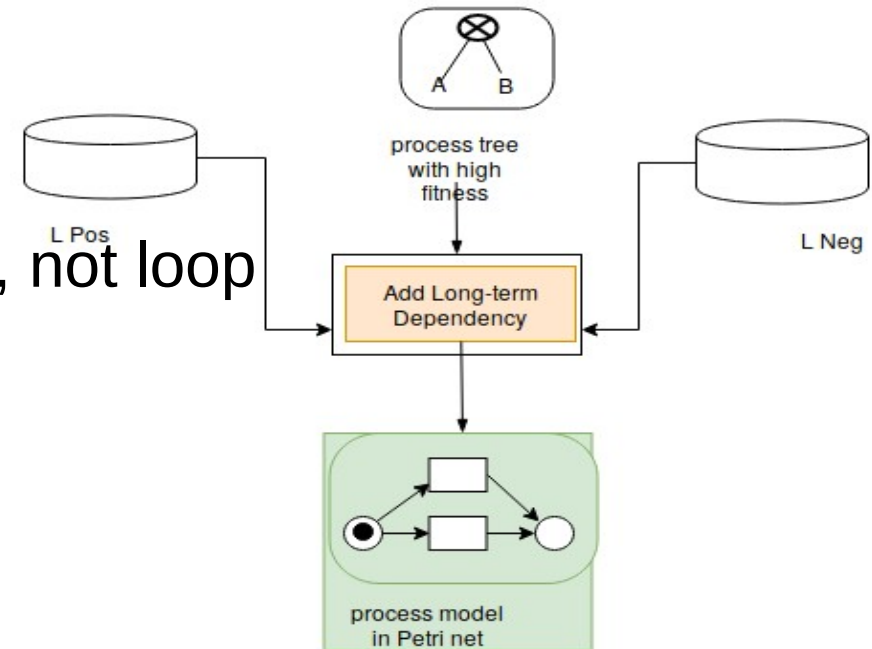
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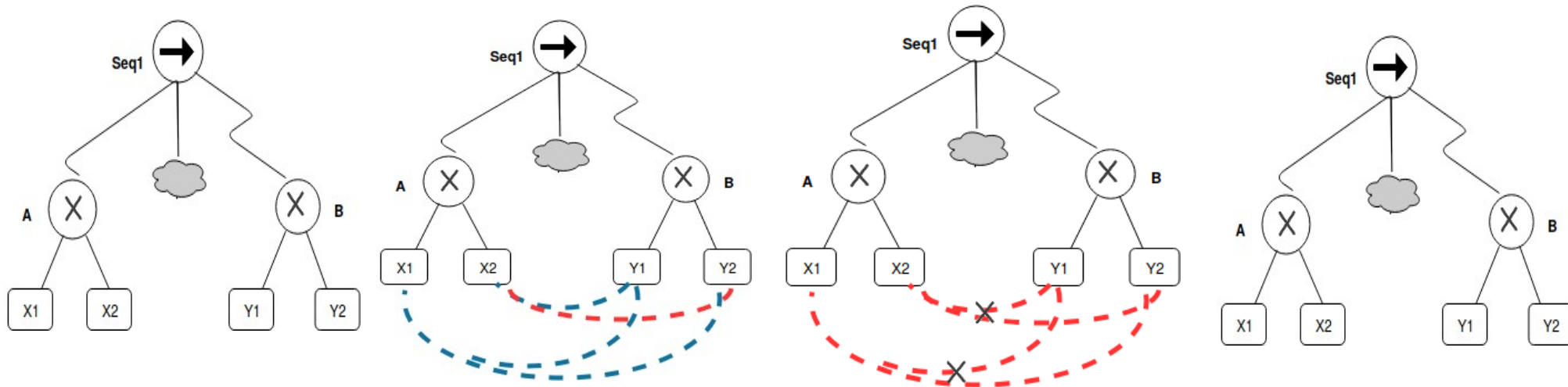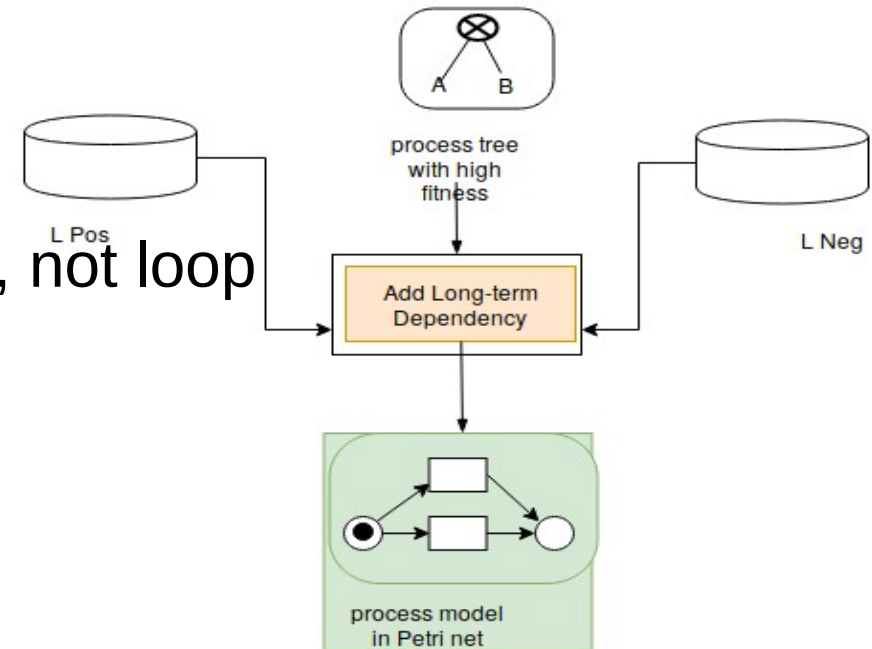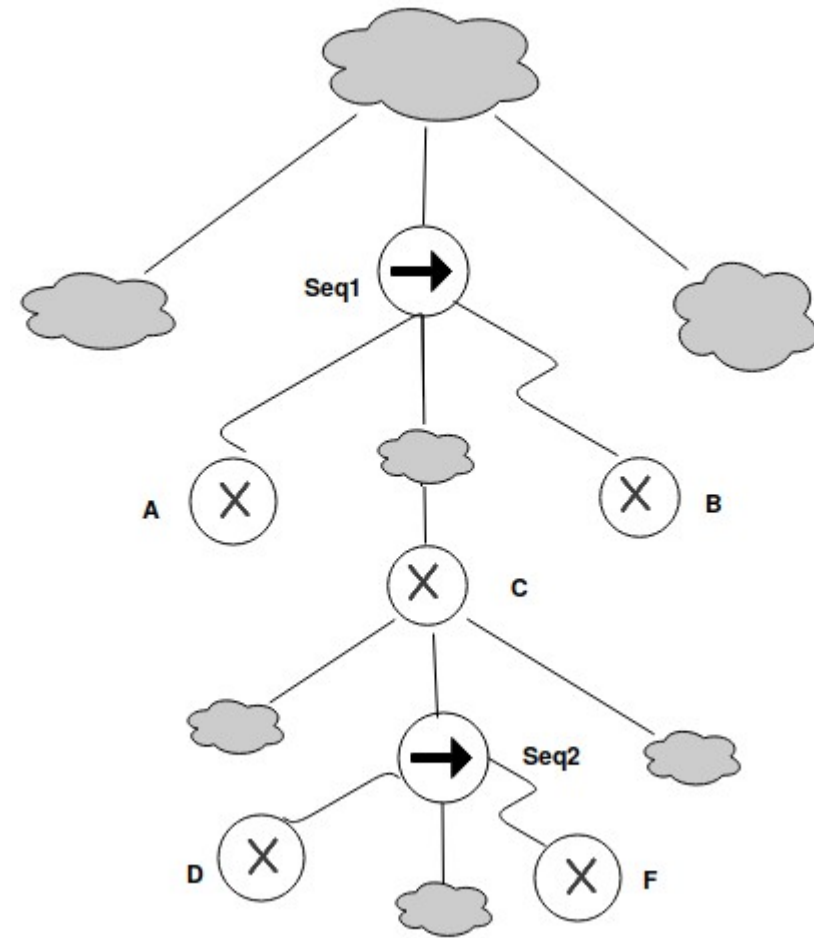
- **Long-term dependency**
  - Partial Order
    - Least Common Ancestor is Seq
      - A <C < B, D<F
    - In same level
      - A,B,C pair
      - D,F pair
  - Expressed On Petri net
    - Add silent transition
    - Add places

Algorithm – add long-term dependency

- **Rephrased Correlation**
  - New generated model, positive and negative event log

$$Wlt(XORB_X, XORB_Y) = Wltext(XORB_X, XORB_Y) + Wltpos(XORB_X, XORB_Y)$$
$$- Wltneg(XORB_X, XORB_Y), with$$

$$Wltext(XORB_X, XORB_Y) = C_{model} \bullet \frac{1}{|XORB_*|}, XORB_*$$

$$* \text{ is the set of all xor branches from } XORB_X$$

$$Wltpos(XORB_X, XORB_Y) = C_{pos} \bullet \frac{F_{pos}(XORB_X, XORB_Y)}{F_{pos}(XORB_X, *)}$$

$$Wltneg(XORB_X, XORB_Y) = C_{neg} \bullet \frac{F_{neg}(XORB_X, XORB_Y)}{F_{neg}(XORB_X, *)}$$
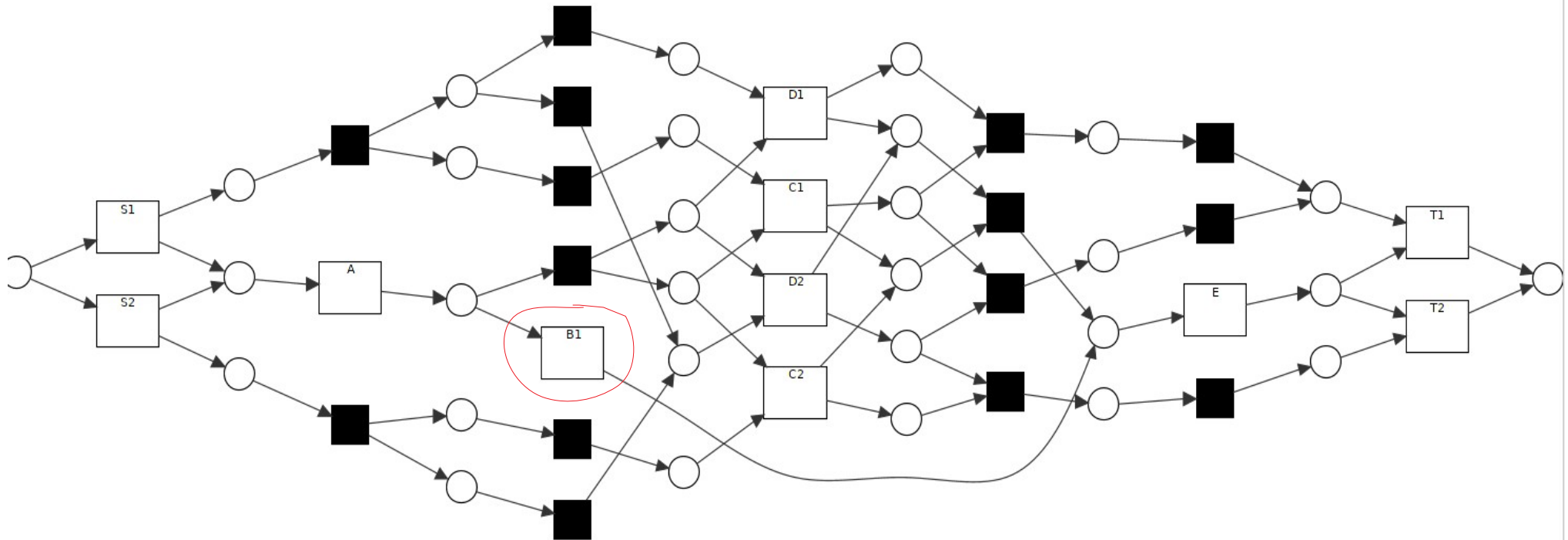
$$F_{pos}(XORB_X, XORB_Y), F_{neg}(XORB_X, XORB_Y) \text{ are the frequency}$$
$$\text{of coexistence of } XORB_X, XORB_Y$$

  - Significant Correlation

$$Wlt(XORB_X, XORB_Y) > \text{lt-threshold}, \quad with -1 < Wlt(XORB_X, XORB_Y) < 1.5$$

Chair of Process and Data Science

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Algorithm – Problem

- **Unsound model**
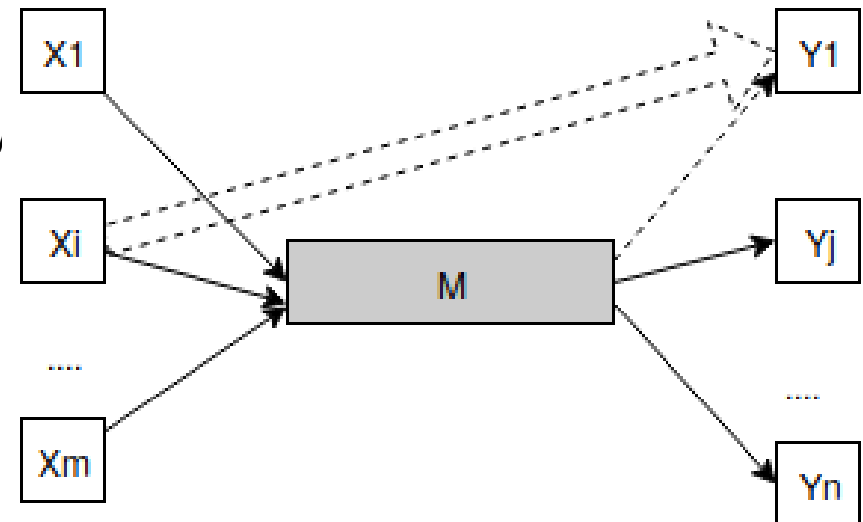
Algorithm – add long-term dependency

- **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?

$$\forall XORB_{Yj} \in B, if W(M, XORB_{Yj}) > threshold, \text{ there exists one } XORB_{Xi} \in B_A \text{ with}$$

$$Wlt(XORB_{Xi}, XORB_{Yj}) > \text{lt-threshold}$$

- **Situations**
    - Xor branch kept due to existing

      model, but not frequency in positive and negativ

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

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

      ==> keep lt
    - In positive and negative

      ==> how to decide ??

Appendix – references