FBK PDI Activity Report

Report period: June 2016 - January 2017

PDI Work Package involvement

- WP1 - Foundations of organizational modeling
- WP2 - Management of event logs
- WP3 - Hybrid monitoring
- WP4 - Inference of accurate predictions
- WP5 - Case studies

WP2

Management of event logs (M1 - M24)

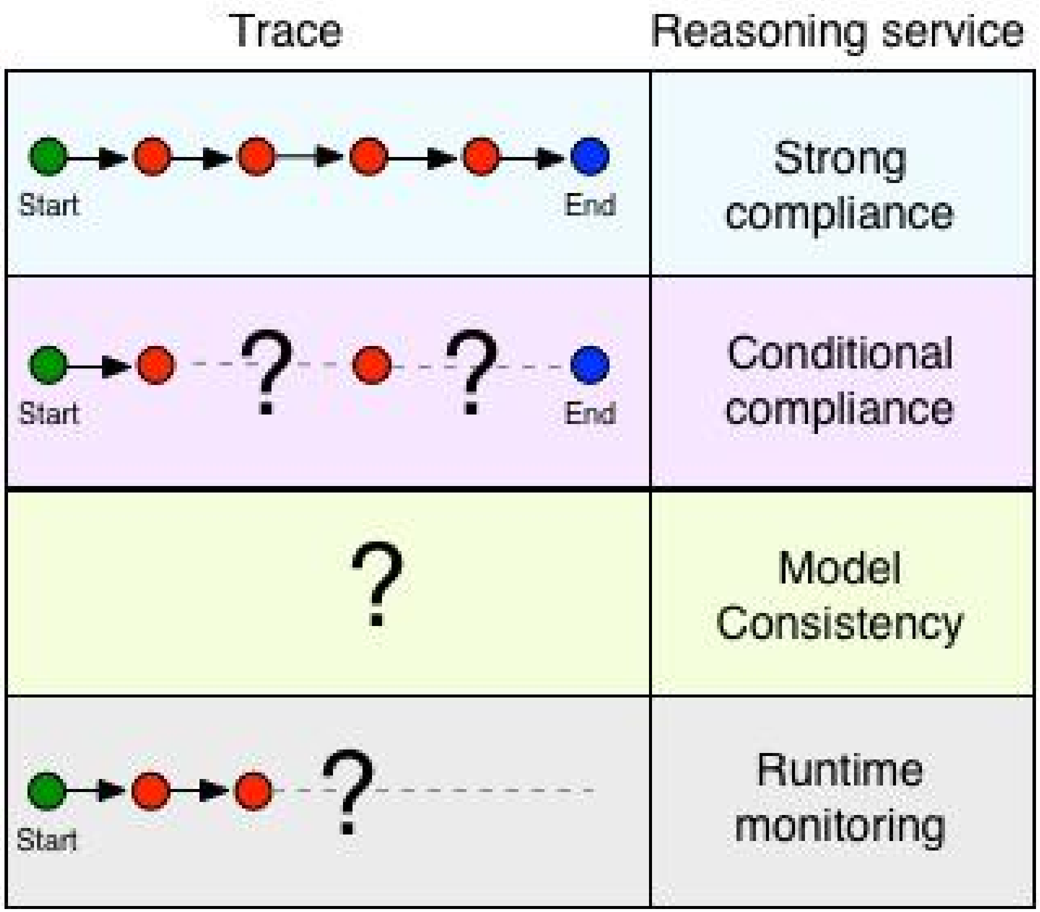
WP2 objective (from DoW)

Development of a comprehensive conceptual framework for the **extraction of** (possibly incomplete) **multi-dimensional event logs** from the legacy data sources of an organization.

Tasks: PDI current focus

- **T2.1** Definition of a language for the end-user modeling of log mappings. [D2.1, M6]
- **T2.2** Development of a combined framework for event log extraction by enriching OBDA with log mappings. [D2.1, M6; D2.2, M18]
- **T2.3** Management of incomplete logs. [D2.2, M18]
- **T2.4** Development of an architectural extension of the ProM OS backbone towards KOS. [D2.3, M24]

T2.3 incomplete logs: problems



Incomplete logs: approaches

- Abduction-based (ECAI ‘16, AI*IA ‘16);
- Planning-based.

Incomplete logs: abduction

An abductive logic program is a triple (KB, A, IC) where:

- KB is a static knowledge base;
- A is a special set of predicates, called *abducibles*;
- IC is a set of integrity constraints.

Given a goal G, the abductive reasoning looks for $\Delta \subseteq A$ such that:

$$KB \cup \Delta \models G \cup IC$$

The set Δ is referred as the *abductive explanation*.

Incomplete logs: abduction

$$KB \cup \Delta \models G \cup IC$$

- Process model ⇒ IC
- Partial trace ⇒ KB
- G ⇒ ∅
- Δ ⇒ trace completion

The (first-order logic based) framework is expressive enough to take into account **data** (currently: time).

Incomplete logs: planning

An action language defines a dynamic domain D by means of:

- *Fluents*;
- *actions*;
- *rules*;

A planning problem is a triple:

- dynamic domain D;
- initial state;
- goal, i.e., the final state.

The solution is a sequence of actions from initial to final state.

Incomplete logs: planning

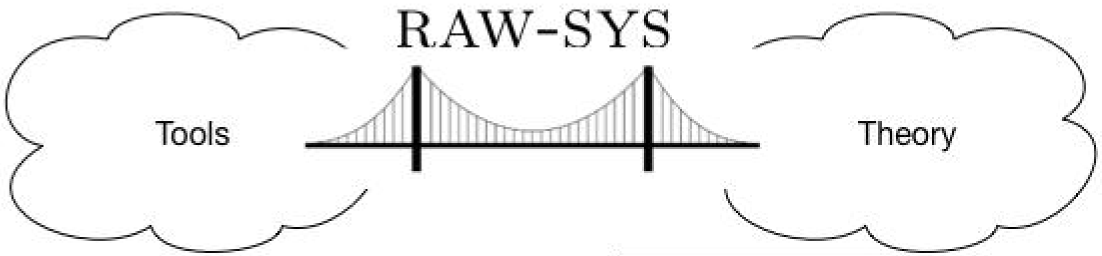
- Fluents ⇒ process states;
- actions ⇒ process activities;
- rules ⇒ workflow + **partial trace**;
- initial state ⇒ process initial state;
- final state ⇒ process final state.

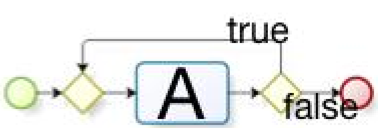
Data (variables) can be encoded as process states.

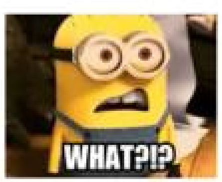
The role of data

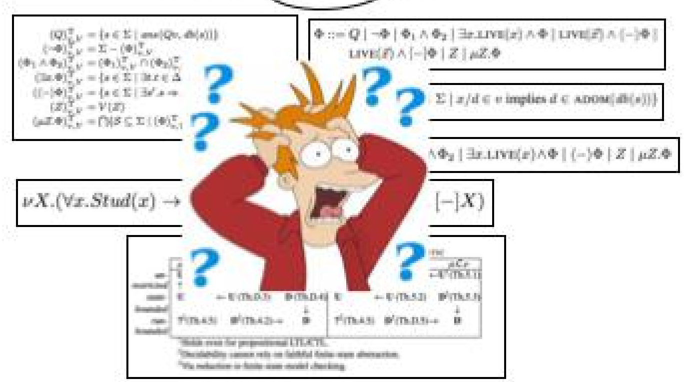
Events in the trace can carry a complex payload.

We need an **expressive** and **intuitive** data-aware process model.





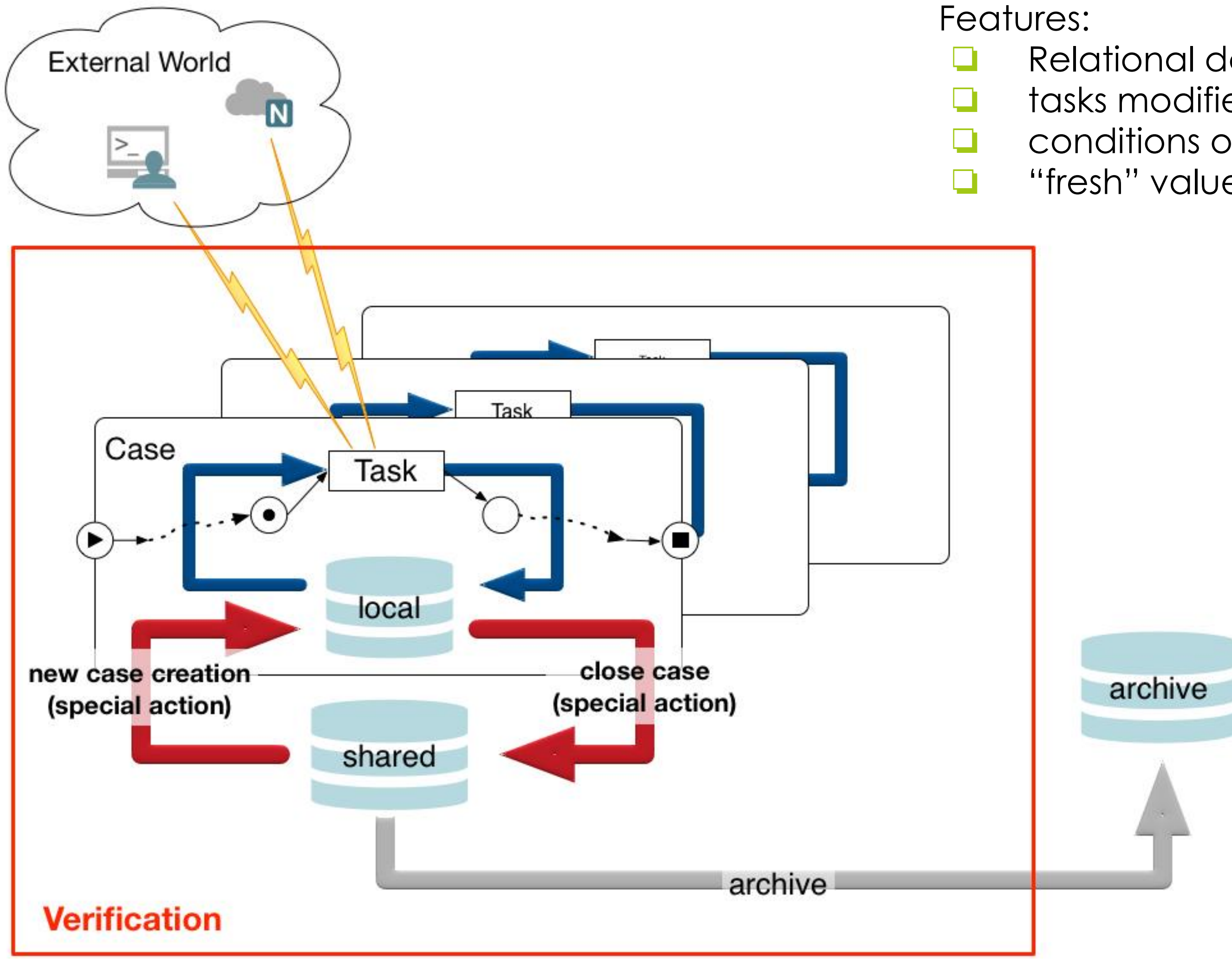




Relational-AWare SYStems

Features:

- Relational data model;
- tasks modifies data;
- conditions on data;
- "fresh" values can be introduced.



WP3

Hybrid Monitoring (M12 - M36)

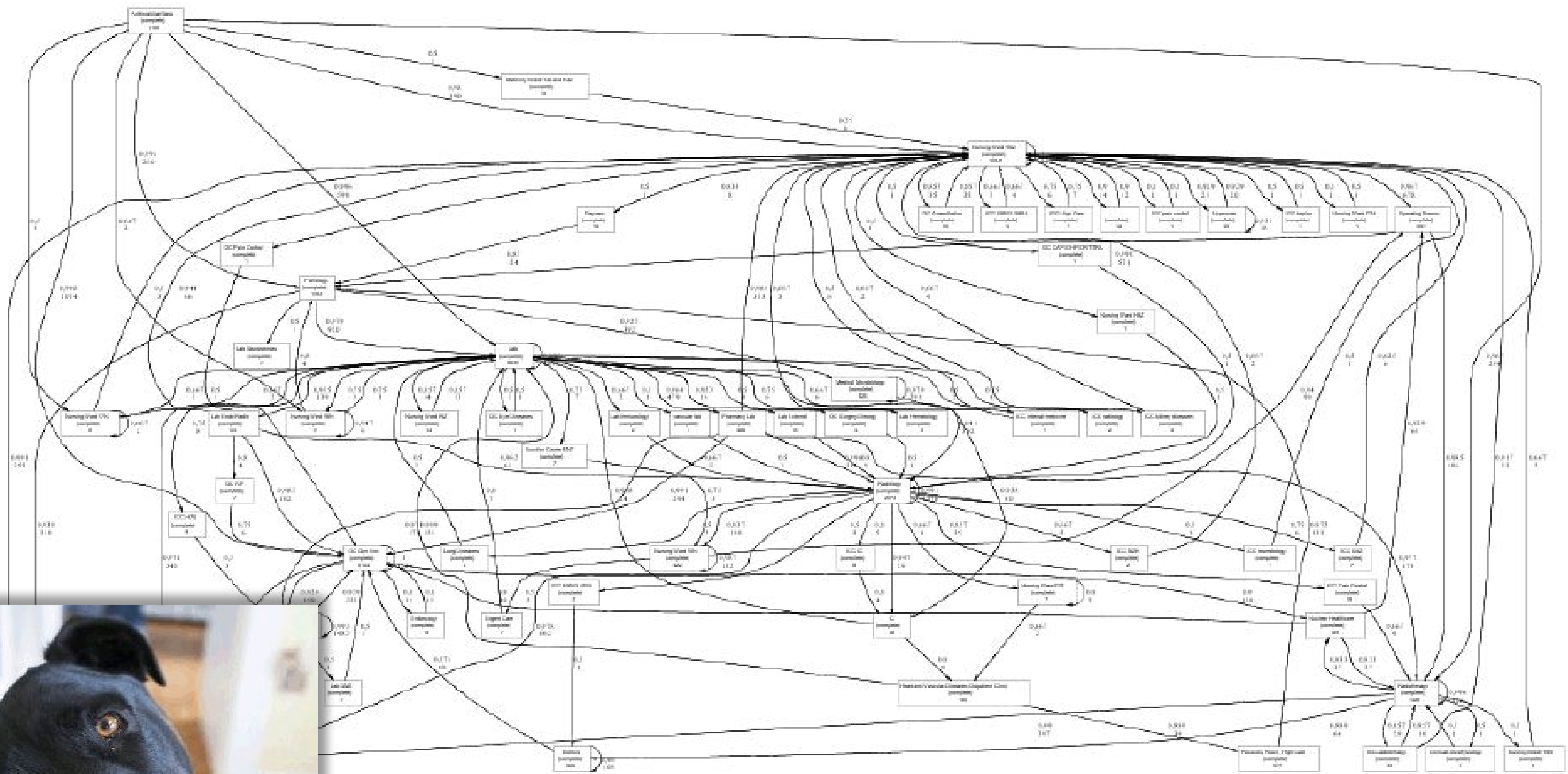
WP3 objective (from DoW)

Definition and development of mechanisms for the **hybrid monitoring** (combining *symbolic and statistical*) of processes.

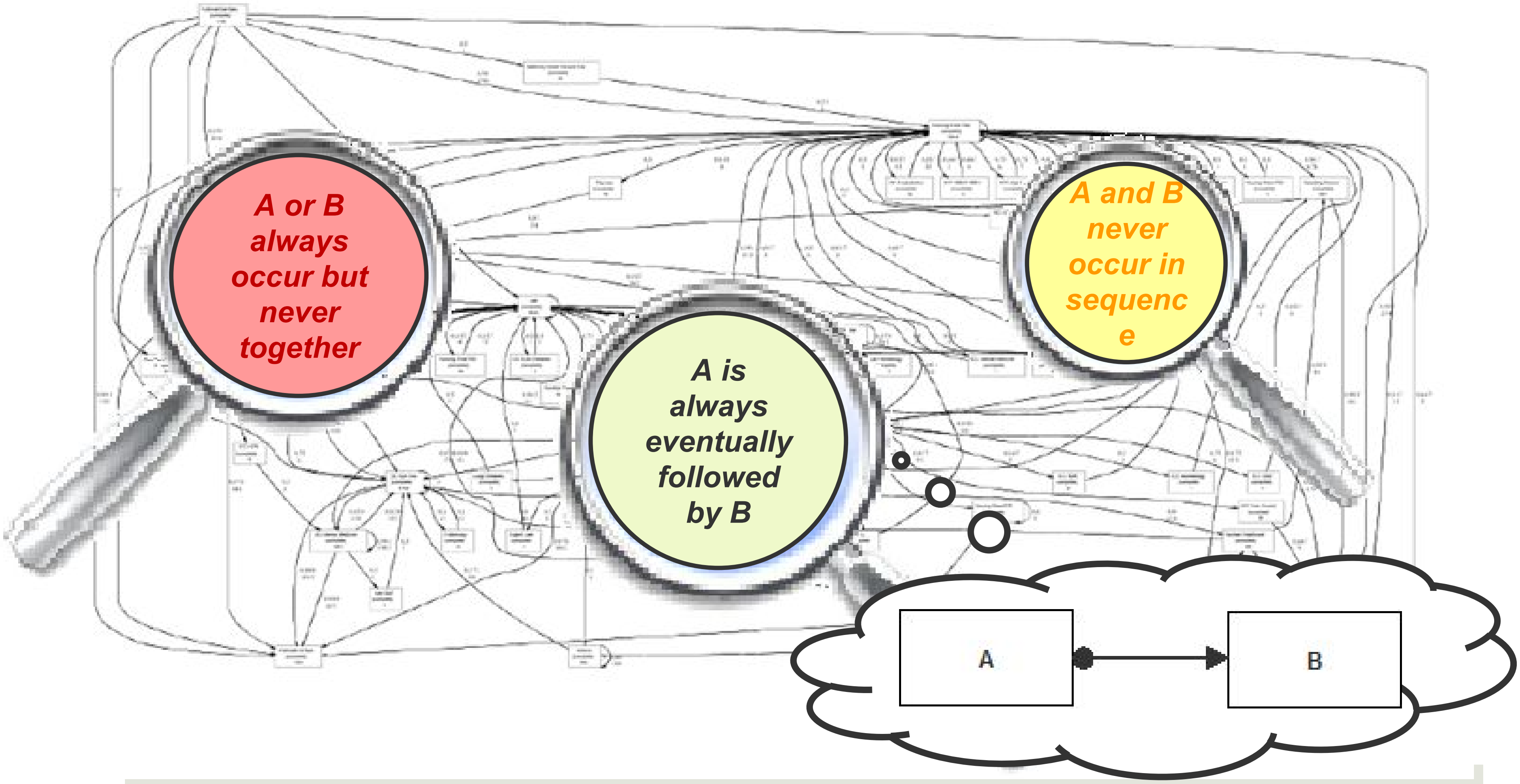
Tasks: PDI current focus

- **T3.1** Definition of a framework to combine symbolic and statistical approaches for process monitoring. [D3.1, M24]
- **T3.2** Analysis and tuning of existing machine learning techniques for hybrid monitoring approaches. [D3.2, M30]
- **T3.3** Extracting symbolic representations of properties from data. [D3.3, M36]
- **T3.4** Concept drift detection. [D3.3, M36

T3.3: Spaghetti-like proc models



Declarative process discovery

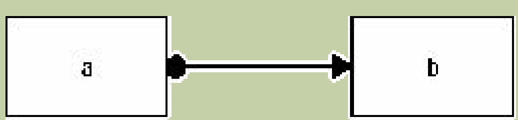


What is already there?

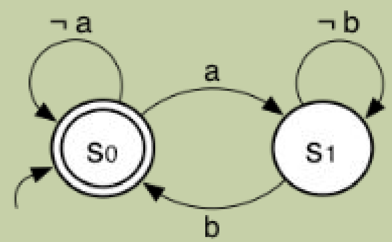
Declare Miner

Apriori Algorithm

{a, b}



Automata-based constraint check

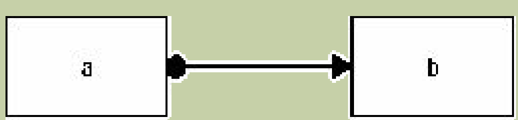


A new approach

Faster Miner (EDOC'16)

Apriori Algorithm

{a, b}



Sequence-based

Apriori Algorithm

$\mathcal{L}$ on Σ

<a b c j b b d a>
<a b b c d a>
<a b b i i a c f>
<a j j e e>
<a b b c j e f b>

Frequent activity sets

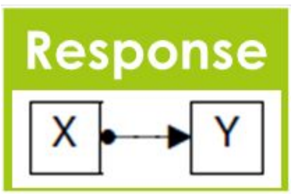
$A_1, A_2, \dots, A_n \subseteq \Sigma^*$

$A_k = \{a, b\}$

- **Support**: percentage of traces containing the set of activities
- Frequent Activity Set → **high support** (> supp_threshold)

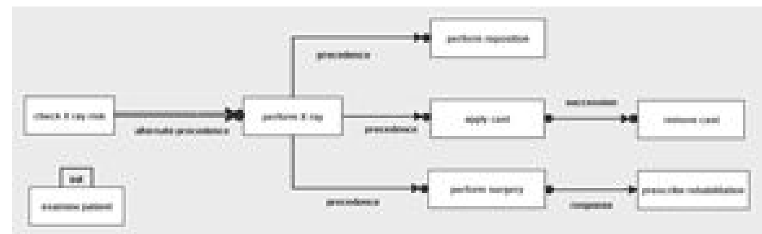
Sequence Analysis

Frequent activity set instantiated on a Declare template



(a,b)
(b,a)
(a,c)
(d,a)
(a,j)
(j,a)
…

Frequently satisfied constraints



- An algorithm for each Declare template
- Further optimizations: Pruning and Multithreading

Open Points

- Deliverable format and submission
- ProM plugin for log incompleteness

References

- [ECAI'16] Chesani, De Masellis, Di Francescomarino, Ghidini, Mello, Montali, Tessaris: Abducing Workflow Traces: A General Framework to Manage Incompleteness in Business Processes. ECAI 2016: 1734-1735
- [AI*IA'16] Chesani, De Masellis, Di Francescomarino, Ghidini, Mello, Montali, Tessaris: Abducing Compliance of Incomplete Event Logs. AI*IA 2016: 208-222
- [CILC'16] Chesani, De Masellis, Di Francescomarino, Ghidini, Mello, Montali, Tessaris: AbducingWorkflow Traces: a General Framework to Manage Incompleteness in Business Processes, CILC2016

References

- [AAAI'17]De Masellis, Di Francescomarino, Ghidini, Montali, Tessaris. *Add Data into Business Process Verification: bridging the gap between theory and practice*. Conference on Artificial Intelligence, AAAI 2017, (to appear).
- [EDOC'16] Kala, Maggi, Di Ciccio, Di Francescomarino: Apriori and Sequence Analysis for Discovering Declarative Process Models. EDOC 2016: 1-9