Process Mining: Organizational and Conformance Mining Algorithms

Ana Karla Alves de Medeiros

Eindhoven University of Technology
Department of Information Systems
a.k.medeiros@tue.nl
Process Mining

• Short Recap
• Discovery Techniques (Part 2)
  – Organizational Model
  – Social Network
• Conformance Techniques
  – Conformance Checker
  – LTL- Checker
• Summary
• Announcements
Process Mining

• **Short Recap**

• **Discovery Techniques (Part 2)**
  – Organizational Model
  – Social Network

• **Conformance Techniques**
  – Conformance Checker
  – LTL- Checker

• **Summary**

• **Announcements**
Types of Algorithms

“world”
- business processes
- people
- components
- machines
- organizations

models
- analyzes
- specifies
- configures
- implements

information system
- supports/controls
- analyzes
- records events, e.g., messages, transactions, etc.

(process) model
- discovery
- conformance
- extension

event logs
- Process Mining Tools

Process Mining Tools
Types of Algorithms

- Business processes
- People
- Machines
- Organizations

"World"

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Process mining tools
- Discovery
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Process model

Organizational model

Social network
Types of Algorithms

- Control-flow mining techniques

Organizational Model

Social Network

Process Model
Main Points Lecture 3

• The notion of a process instance is crucial!
• Ordering of tasks is the basic information
• Frequencies are important to handle noise
• Local approaches
  – $\alpha$-algorithm, Heuristics Miner
• Global approaches
  – Genetic Miner and Fuzzy Miner

Do you still remember why?
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organizational mining techniques

/process model

(event) model

Process Mining Tools

discovery conformance extension

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organizational model

social network

/event logs

process model

organizational model

social network

/faculteit technologie management
Organizational Mining Algorithms

- Aid in understanding and improving social and organizational structures
- Two types of algorithms
  - Organizational Model
    - Mining of roles and teams in organizations
    - Plug-in: Organizational Miner
  - Social Networks
    - Discovery of relationships among originators
    - Plug-ins: Social Network Miner and Analyze Social Network
Organizational Miner

• Main idea: Which originators are executing which tasks
  – Default mining
  – Doing Similar Tasks

• Methods to mine **roles**
  – Working together

• Methods to mine **teams**
Organizational Miner

• Main idea: Which performers are executing which tasks

• Methods to mine **roles**
  – *Default mining*
  – Doing Similar Tasks

• Methods to mine **teams**
  – Working together
Organizational Miner

- Main idea: Which performers are executing which tasks
- Methods to mine **roles**
  - Default mining
  - **Doing Similar Tasks**
- Methods to mine **teams**
  - Working together
Default Mining

Doing Similar Tasks
Organizational Miner

- Main idea: Which performers are executing which tasks

- Methods to mine **roles**
  - Default mining
  - Doing Similar Tasks

- Methods to mine **teams**
  - **Working together**
Organizational Miner

Why is the notion of process instances necessary to mine teams but unnecessary to mine roles?

Could you think of an algorithm to detect specialists/generalists for a given process? What is the main idea behind?
Social Network Miner

- **Aim:** Monitor how individual process instances are routed between originators

- **Metrics**
  - Handover of work
  - Subcontracting
  - Reassignment
  - Working together
  - Similar task
Social Network Miner

• Aim: Monitor how individual process instances are routed between originators

• Metrics
  – *Handover of work*
  – Subcontracting
  – Reassignment
  – Working together
  – Similar task
Social Network Miner

• Aim: Monitor how individual process instances are routed between originators

• Metrics
  – Handover of work
  – **Subcontracting**
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Social Network Miner

• Aim: Monitor how individual process instances are routed between originators

• Metrics
  – Handover of work
  – Subcontracting
  – **Reassignment**
  – Working together
  – Similar task
Social Network Miner

- Aim: Monitor how individual process instances are routed between originators
- Metrics
  - Handover of work
  - Subcontracting
  - Reassignment
  - Working together
  - Similar task

Based on ordering relations derived from a log!
Analyze Social Network

• Better graphical view for the results of the Social Network Miner
• Includes different metrics to measure centrality of nodes
• Example: subcontracting
Which testers have never subcontracted work?

Which testers subcontract the most?
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process Mining Tools

discovery conformance extension

Compliance Process Model

Auditing/Security

/device technologie management
Conformance Checker

• **Aim**
  – Assess how much a process model matches given process instances

• **Driving force**
  – Replay process instances in models

• **Types of diagnosis**
  – Fitness
  – Structural Appropriateness
  – Behavioral Appropriateness
Fitness

• Can the model replay the log?

How could we correct this model?
Fitness

- Can the model replay the log?
Structural Appropriateness

• Is the model overly complex?
Behavioral Appropriateness

- Another example
Behavioral Appropriateness

- Is the model precise enough?
LTL Checker

• Aim
  – Verify if process instances fulfill certain properties

• Driving force
  – Specification of properties in a language based on Linear Temporal Logics

• Example
  – Four-eyes principle
LTL Checker - Example
LTL Checker - Example

Does activity B occur after activity A occur?

Compute if there is an activity with name A and then, eventually there is an activity with name B.

Arguments:
- A of type set (cts.WorkflowModelElement)
- B of type set (cts.WorkflowModelElement)

Validate the parameters:

<table>
<thead>
<tr>
<th>A</th>
<th>set</th>
<th>Repair (Simple)</th>
<th>Repair (Complex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>set</td>
<td>Test Repair</td>
<td></td>
</tr>
</tbody>
</table>

LTL Checker

Checked formula: eventually_activity_A_then_B

Parameters:
A = ["Repair (Complex)", "Repair (Simple)"]
B = Test Repair

Correct process instances (1102)

name (nr similar)
1006 (1)
1127 (1)

Incorrect process instances (2)

```
Repair (Complex)
  start
  1970-01-24 09:05:00.000 +01:00

Repair (Complex)
  complete
  1970-01-24 09:16:00.000 +01:00

Originator = SolverC1
```

Originator = SolverC1

Visualize selected
LTL – Defining Formulae

A: invite reviewers
B: get review 1
C: time-out 1
D: get review 2
E: time-out 2
F: get review 3
G: time-out 3
H: decide
I: accept
J: reject
K: invite additional reviewer
L: get review X
M: time-out X

The diagram illustrates the process of collecting reviews and making decisions.
Can you define a formula to verify the four-eyes principle?
Summary

What are the three most important things you’ve learned today?
Summary

• Organizational mining plug-ins can discover
  – Roles/Teams in organizations
  – Social networks for originators

• Some metrics of social networks are based on ordering relations (e.g., the ordering relations used by the Alpha algorithm)

• Conformance Checker assesses how much a process model matches process instances

• LTL Checker uses logics to verify properties in event logs
Announcements

• Next lecture
  – Invited talk **Futura Technology**
    • Start-up company in the process mining area
    • Implemented the process mining component of the BPM Suite recently released by Pallas Athena (see press release at “news” in www.processmining.org)

• Course Material
  – See version 2 of Study Guide (posted on 18/2/2008)

• Assignments
  – If necessary, use tutorial to get familiar with the ProM tool