LTAT.05.025

Business Process Mining

Lecture 1: Introduction

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About this course

Summary

• This course introduces process mining techniques, including automated process discovery, conformance checking, performance analysis, business rules mining, and predictive process monitoring.
• We will introduce concrete tools and we will apply these tools to answer business questions using real-life datasets.

Related courses

• Business Process Management
  • Broad introduction to the art and science of managing business processes
• Business data analytics
  • Techniques for customer analytics, product analytics and related questions
• Business Analysis
  • Identifying and analyzing business problems and opportunities that can be addressed via IT solutions
Structure of the course

13 lecture + 11 practice sessions covering:

• Automated Process Discovery
• Conformance and Performance Mining
• Analysis of process variants
• What-if analysis
• Predictive Process Monitoring

Team Project

• Analysis of a real-life dataset and questions posed by a business user
• Project report and a presentation of the results
Grading

Four assignments (25 points in total)
- ≈ 10 hours per homework ≈ 40 hours in total

Project (25 points)
- ≈ 40 hours

Exam (50 points)
- Analysis of an event log using process mining techniques
- Open-book and open-laptop
- Minimum exam score: 20 out of 50
Readings and resources

• Course material posted on course Web page
  • https://courses.cs.ut.ee/2022/pm

• Slack workspace
  • https://ut-procmin-2022.slack.com
  (the link to enrol in the Slack workspace was sent to you via the study information system)

• References
  • Dumas, La Rosa, Mendling & Reijers: *Fundamentals of Business Process Management (second edition)*, Springer 2018 (chapters 1, 6, 7, 11)
What is a Business Process?
Business processes
PO received

Obtain PO

Check & confirm PO

Package products

Load truck

Notify shipment

Issue invoice

Match payment

Payment made

PO issued

Schedule delivery

Unload truck

Issue delivery receipt

Check invoice

Schedule payment

Goods arrived
A business process is...

a chain of events, activities and decisions
...involving a number of actors and objects,
....triggered by a need
and leading to an outcome that is of value to a customer.

Examples:
• Order-to-Cash
• Procure-to-Pay (aka Purchase-to-Pay)
• Application-to-Approval
• Issue-to-Resolution
“My washing machine doesn’t work…”

Negative outcomes (value-reducing):
• Fault not repaired in a timely manner
• Fault repaired but customer pays more than expected

Positive outcomes (value-adding):
• Fault repaired immediately with minor intervention
• Fault repaired, covered by warranty
What is Business Process Management (BPM)?
BPM – A Discipline for Improving Performance

Rummler’s Framework

Business Environment
- Economy
- Regulatory
- Culture

Assets & Resources
- Financial
- Human Resources
- Technology
- Materials

Organisation
- Performance Planning
- Performance Management

Business Process
- Function A
- Function B
- Function C

Stakeholders

Value

Customers

Competitors
If you had to choose between two services, you would typically choose the one that is:

• F…
• C…
• B…
Process performance

If you had to choose between two services, you would typically choose the one that is:

• Faster
• Cheaper
• Better
Process performance

Three dimensions of process performance

• Time
• Cost
• Quality
Improving process performance

1. Customer arrived
2. Greet & seat
3. Bring menu
4. Take order
5. Serve meal
6. Present bill
7. Issue invoice
8. Customer paid
How would you improve this process?

- Outsource to Customer
- Standardize
- Eliminate Cooking
- Invest and Build
- Re-sequence
- Eliminate Waiters
- Automate
Business Process Management (BPM)

Body of principles, methods and tools to design, analyze, execute and monitor business processes, with the aim of improving their performance.
If the purchase order is confirmed, then ... an invoice is emitted and the goods are shipped.
What is Process Mining?
Purpose of Process Mining

Analysis and improvement of business processes

… based on data about business process executions in practice
What is Process Mining?

• Organizations use enterprise systems to support their business operations, including:
  • ERP systems that support production, delivery or payroll processes
  • CRM systems that support marketing, sales or customer service processes.
• These systems record data that about the processes they support, including order-to-cash, purchase-to-pay, etc.
• Process Mining is a family of techniques that use data recorded by enterprise systems to discover and analyze the business processes supported by these systems, in order to identify performance and conformance issues, trace down their root causes, and find optimization opportunities.
How does Process Mining work?

01. Process Logging
   The systems supporting the execution of the business process are configured to record events capturing the execution of tasks in the process.

02. Data Collection
   This business process execution data needs to be transformed into “Event Logs”. Correct time-stamps and activity names are essential.

03. Data Preparation
   The data is extracted and prepared by data engineers (IT side) based on business requirements.

04. Process Mining
   Automated process discovery and other types of analysis can then be used to discover and analyze the process.
<table>
<thead>
<tr>
<th>Case ID</th>
<th>Timestamp</th>
<th>Activity</th>
<th>Resource</th>
<th>Loan goal</th>
<th>Requested amt</th>
<th>Offered amt</th>
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</thead>
<tbody>
<tr>
<td>C001</td>
<td>18-10-2016:10:00:02</td>
<td>Check completeness</td>
<td>Sue</td>
<td>Mortgage</td>
<td>100 000</td>
<td>-</td>
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<td>C001</td>
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<td>Mortgage</td>
<td>100 000</td>
<td>-</td>
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<td>C001</td>
<td>19-10-2016:15:09:00</td>
<td>Calculate risk score</td>
<td>Bob</td>
<td>Mortgage</td>
<td>100 000</td>
<td>-</td>
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<td>C001</td>
<td>20-10-2016:09:13:34</td>
<td>Make offer</td>
<td>Mike</td>
<td>Mortgage</td>
<td>100 000</td>
<td>70 000</td>
</tr>
<tr>
<td>C001</td>
<td>25-10-2016:09:00:03</td>
<td>Make offer</td>
<td>Mike</td>
<td>Mortgage</td>
<td>100 000</td>
<td>80 000</td>
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<td>20-10-2016:09:20:00</td>
<td>Check completeness</td>
<td>Sue</td>
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<td>-</td>
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<tr>
<td>C002</td>
<td>20-10-2016:09:23:06</td>
<td>Check credit history</td>
<td>Sue</td>
<td>Car</td>
<td>15 000</td>
<td>-</td>
</tr>
<tr>
<td>C002</td>
<td>22-10-2016:10:09:01</td>
<td>Calculate risk score</td>
<td>Elsa</td>
<td>Car</td>
<td>15 000</td>
<td>-</td>
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<tr>
<td>C002</td>
<td>24-10-2016:13:13:32</td>
<td>Reject application</td>
<td>Elsa</td>
<td>Car</td>
<td>15 000</td>
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<td>C003</td>
<td>02-11-2016:08:35:03</td>
<td>Check completeness</td>
<td>Maria</td>
<td>Mortgage</td>
<td>35 000</td>
<td>-</td>
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<tr>
<td>C003</td>
<td>04-11-2016:16:22:21</td>
<td>Ask for additional data</td>
<td>Maria</td>
<td>Mortgage</td>
<td>35 000</td>
<td>-</td>
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<td>C003</td>
<td>10-11-2016:08:56:55</td>
<td>Check credit history</td>
<td>Maria</td>
<td>Mortgage</td>
<td>35 000</td>
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</tbody>
</table>
Process Mining

historical data

live data

process mining algorithms

actionable process knowledge

Enterprise systems, IoTs...

process model
Automated Process Discovery

Process map
(w/t frequency overlay)

BPMN model
(w/t frequency overlay)
Process Mining

historical data

live data

Enterprise systems, IoTs...

process mining algorithms

actionable process knowledge

process model

performance measurements
Performance Mining

Process map with duration overlay

Process performance dashboards
Process Mining

enterprise systems, IoTs…

historical data

live data

process mining algorithms

actionable process knowledge

process model

performance measurements

conformance report
Conformance Checking

Modeled process (to-be)
Expected duration: 2 days

Real process (as-is)
Actual duration: 5 days, max: 12 days
Process Mining

Enterprise systems, IoTs...

process mining algorithms

historical data

live data

actionable process knowledge

process model

performance measurements

conformance report

differences, root causes
Variant Analysis

Simple repairs

Complex repairs
What-If Process Mining

Simulating what-if scenarios

1. Discover as-is model
2. Modify model & define simulation scenario
3. Run simulation
4. Analyze the simulation outputs
5. Repeat for alternative scenarios

As-is model

What-if model
Process Mining

historical data

live data

Enterprise systems, IoTs...

process mining algorithms

actionable process knowledge

process model

performance measurements

conformance report

differences, root causes

predictions
How likely is it that a running process will become “deviant”?

- Will it end up in a negative outcome?
- Will it fail to meet its SLAs in the next 24 hours?
- Will it generate abnormal effort, costs or rework?
Structure of the Course

Week 2: Performance Measurement & Dashboards

Week 3: Concepts and Capabilities

- Process mining
  - Automated discovery
  - Conformance Checking
  - Performance Mining
  - What-If Process Mining
  - Predictive monitoring

Week 4: Extract-Transform-Load for Process Mining
Week 5: Declarative Process Mining
Week 6: Process Mining Algorithms
Week 7: Process Mining In Practice
Week 8: Course Recap and Future Trends