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Genetic Process Mining

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Outline

- Process Mining
 - Motivation
 - Current Techniques
 - Contribution
- Genetic Algorithms
- Experiments and Results
- Conclusion and Future Work


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Motivation – Typical way to deploy a system

1. Get Ready
2. Travel by Train
3. EIS Starts
4. Have Drinks
5. Have Dinner
6. Go Home
7. Travel by Train




1. Get Ready
2. Travel by Train
3. EIS Starts
4. Give a Talk
5. Have Drinks
6. Have Dinner
7. Go Home
8. Travel by Train

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Motivation – Typical way to deploy a system



- Time consuming
 - Paper procedures
 - Meetings
- Error prone
 - Different people have different views about a same process
 - Information about the process may be incomplete

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Motivation – More possible cases in the log

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1. Get Ready
2. Travel by Train
3. EIS Starts
4. Give a Talk
5. Have Dinner
6. Go Home
7. Travel by Train

1. Get Ready
2. Travel by Car
3. EIS Starts
4. Have Drinks
5. Have Dinner
6. Go Home
7. Pay Parking
8. Travel by Car

1. Get Ready
2. Travel by Train
3. EIS Starts
4. Give a Talk
5. Have Drinks
6. Have Dinner
7. Go Home
8. Pay Parking
9. Travel by Car

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Motivation – Process Mining

Log

1. Get Ready
2. Travel by Car
3. EIS Starts
4. Have Drinks
5. Have Dinner
6. Go Home
7. Pay Parking
8. Travel by Car

Mining Techniques

Mined Model

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Motivation – Process Mining

- Before deployment
 - Objective picture of how the process has been executed
- After deployment
 - Feedback mechanism

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Current Techniques vs Constructs

- Sequence
- Splits
- Joins
- Loops
- Non-free Choice
- Invisible Tasks
- Duplicate Tasks

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Current Techniques vs Constructs

- Sequence ✓
- Splits ✓
- Joins ✓
- Loops ✓
- Non-free Choice ✗
- Invisible Tasks ✗
- Duplicate Tasks ✗


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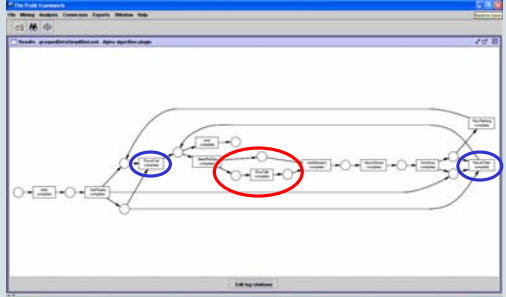
Current Techniques vs Constructs

- Sequence ✓
- Splits ✓
- Joins ✓
- Loops ✓
- Non-free Choice ✗
- Duplicate Tasks ✗
- Invisible Tasks ✗


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Current Techniques vs Constructs: The α -algorithm



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Current Techniques

- Problematic structural constructs
 - Non-free choice, invisible tasks, duplicate tasks
- Noise
 - Wrongly logged traces
 - Exceptional situations

Can we develop a mining algorithm that is able to tackle all structural constructs and noisy logs at the same time?


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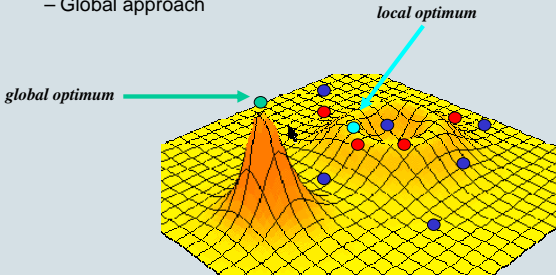
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Genetic Algorithms

- Global approach




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Genetic Process Mining (GPM)

Aim: Use genetic algorithm to tackle non-free choice, invisible tasks, duplicate tasks and noise.



Step	Description
I	Read event log
II	Build the initial population ●
III	Calculate fitness of the individuals in the population ● ●
IV	Stop and return the fittest individuals? ●
V	Create next population – use elitism and genetic operators ● ●

Internal Representation
Fitness Measure
Genetic Operators

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Genetic Process Mining (GPM)

- Demo
 - Genetic Miner plug-in
 - Tool at www.processmining.org

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Beta S

GPM – Fitness Measure

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GPM – Fitness Measure

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Beta S

GPM – Fitness Measure

Overgeneral solution

Punish for the amount of enabled tasks during the parsing!

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Beta S

GPM – Fitness Measure

Overspecific solution

Punish for the amount of duplicate tasks with common input/output tasks!

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Beta S

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Beta S

Experiments

- Simulation to generate the logs

Can the mined process generate all the behavior in the log?
How close is the behavior of the mined process to the original one?


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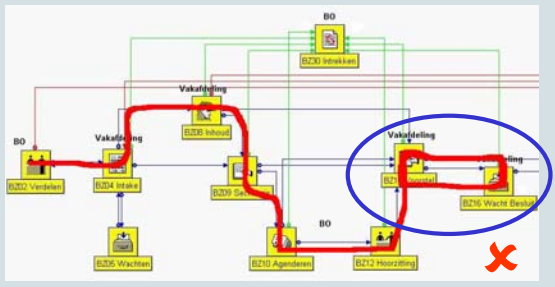
Experiments

- Case Study
 - Dutch municipality
 - Questions
 - How many cases are **compliant** with the original models?
 - What is the **most frequent path**?
 - What is the **average/maximum/minimum** throughput time of cases?
 - How much **time** is spent **between any two tasks** in the model?
 - How are the process models **actually being executed**?


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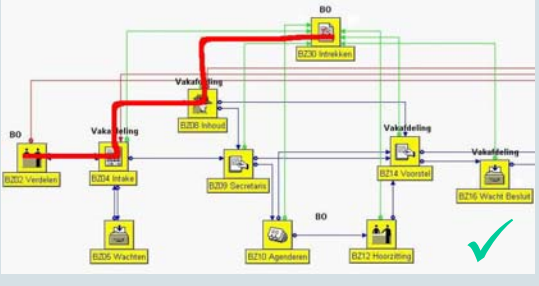
Bezwaar – 1st Most frequent path (19% cases)




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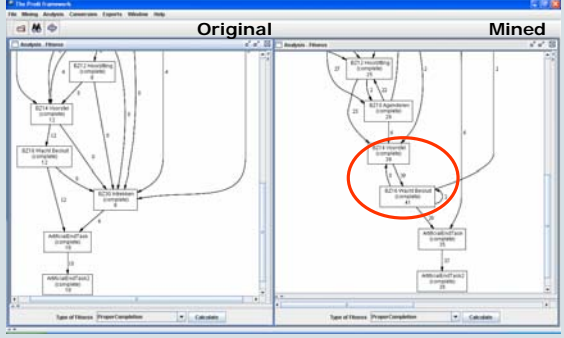
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Bezwaar – 2nd Most frequent path (11% cases)



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Conclusion and Future work

- Genetic algorithms can be used to mine process models
 - Global approach
 - Robust to noise
- Extend process mining algorithms to consider semantic information

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Thank you!



**Questions?
Comments?**

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