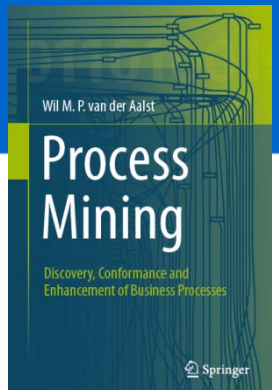
Process Mining: Data Science in Action

Discovering Data-Aware Petri Nets



prof.dr.ir. Wil van der Aalst
www.processmining.org

TU/e Technische Universiteit Eindhoven University of Technology

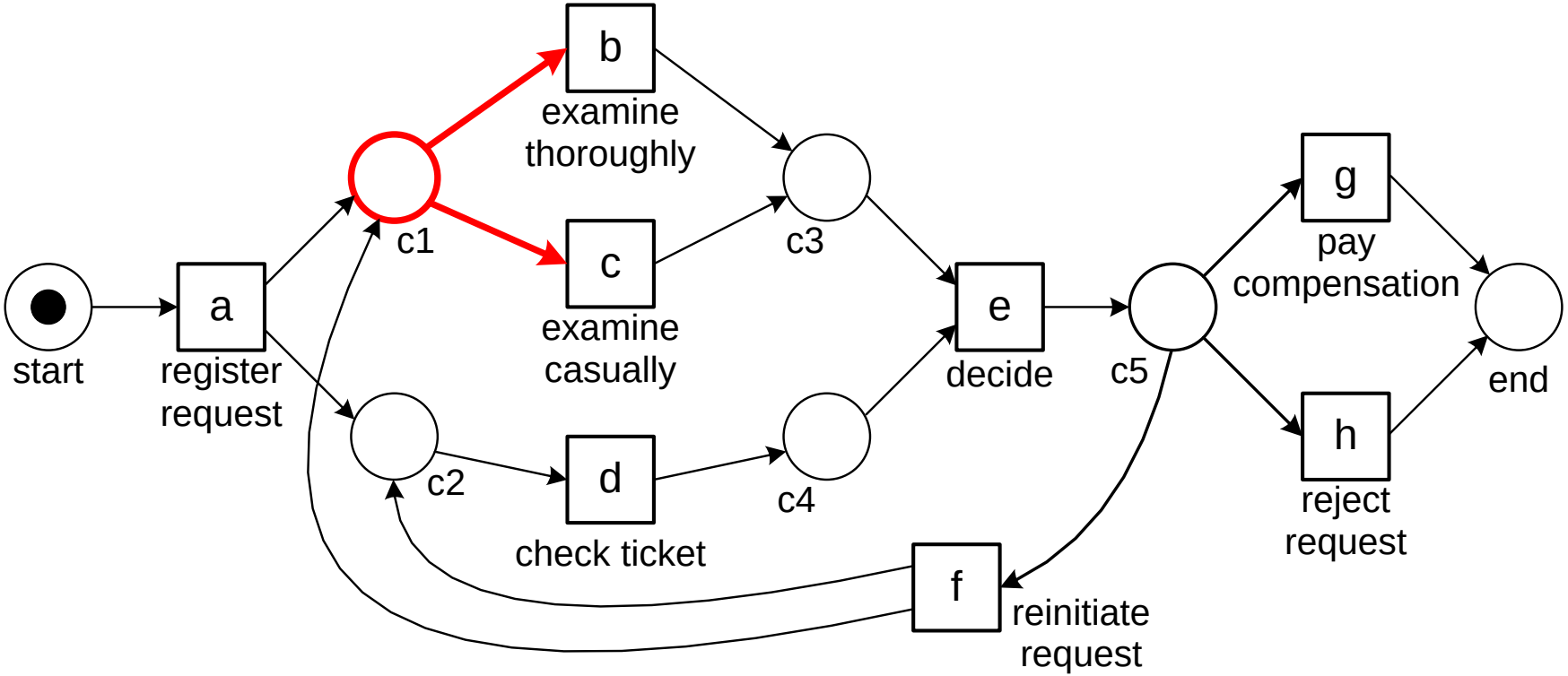
Where innovation starts

Mining Decision Points

just the starting point …

today's focus: discovering guards

Create guards for transitions b and c



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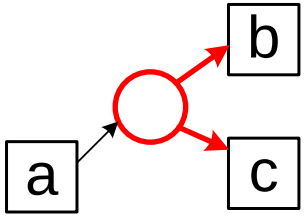
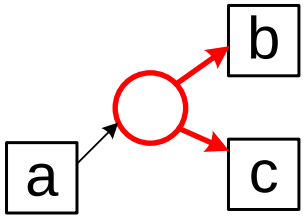


response variable: choice between b and c

predictor variables: attributes resource, customer, and amount of a (assumption)

case	activity	resource	time	customer	amount
1	a	John	8.11	silver	500
2	a	Mary	8.12	gold	800
2	d	Sue	8.32	gold	800
1	b	John	9.12	silver	500
3	a	John	9.45	silver	300
3	b	Mary	9.56	silver	300
1	d	John	9.45	silver	500
2	c	Mary	9.56	gold	800
3	d	Mary	10.43	silver	300
4	a	John	11.34	gold	850
4	c	John	11.57	gold	850
…	…	…	…	…	…



case	activity	resource	time	customer	amount
1	a	John	8.11	silver	500
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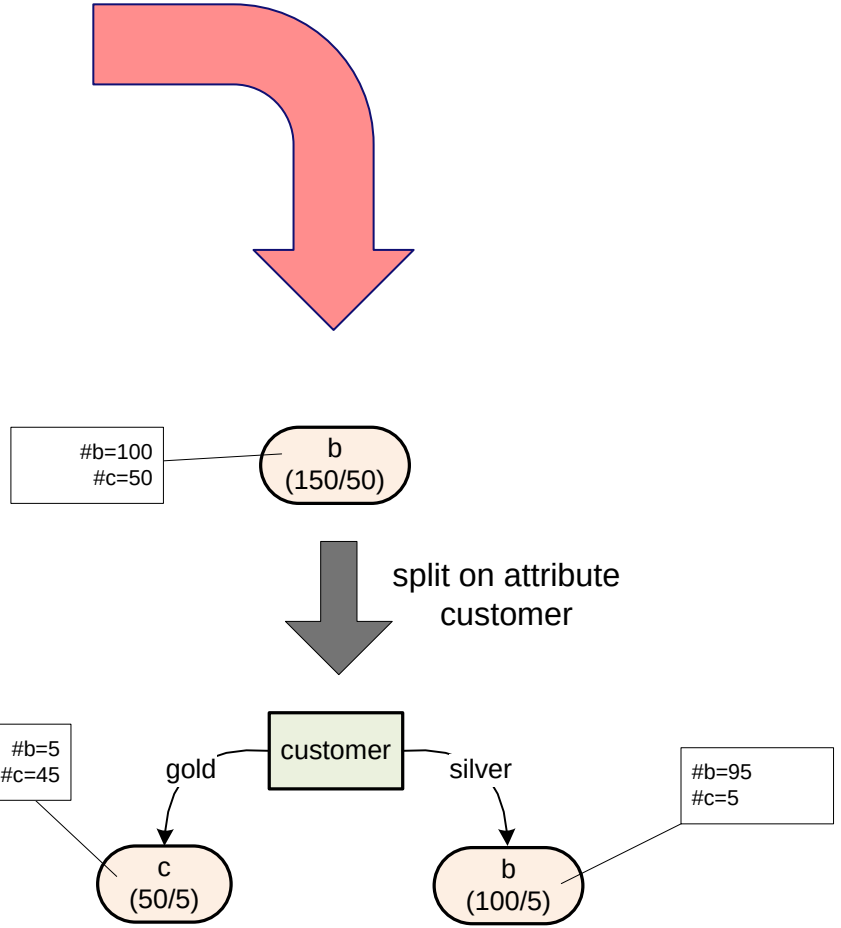
2	d	Sue	8.32	gold	800
1	b	John	9.12	silver	500
3	a	John	9.45	silver	300
3	b	Mary	9.56	silver	300
				ver	500
				ld	800
				ver	300
				ld	850
				ld	850
				.	…

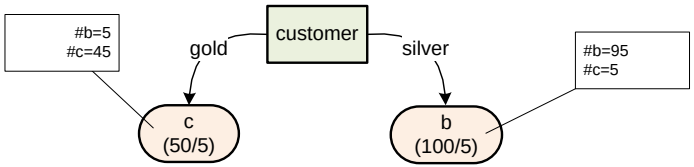
case	resource executing a	customer	amount	class
1	John	silver	500	b
2	Mary	gold	800	c
3	John	silver	300	b
4	John	gold	850	c
…	…	…	…	…

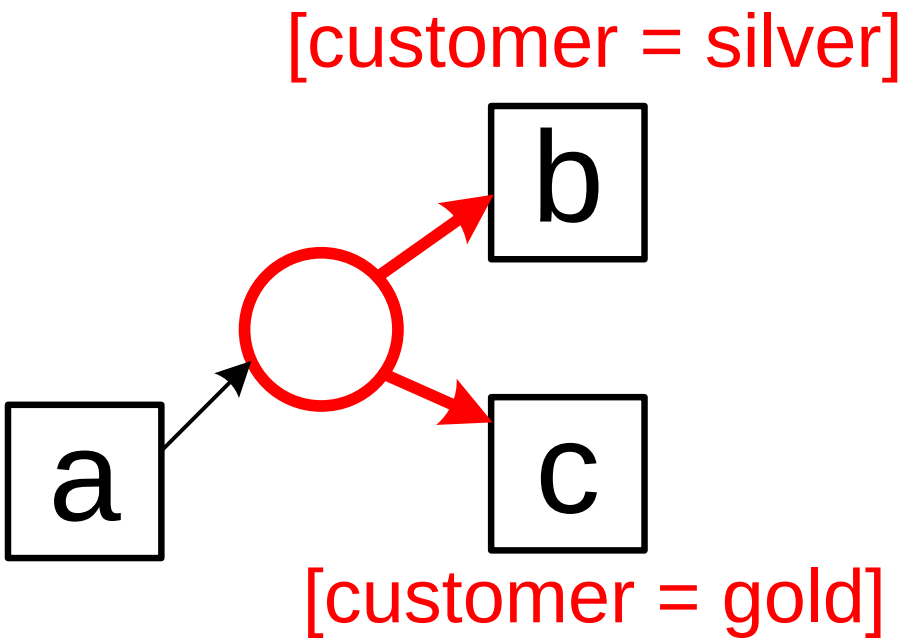
resource executing a	customer	amount	class
John	silver	500	b
Mary	gold	800	c
John	silver	300	b
John	gold	850	c
…	…	…	…



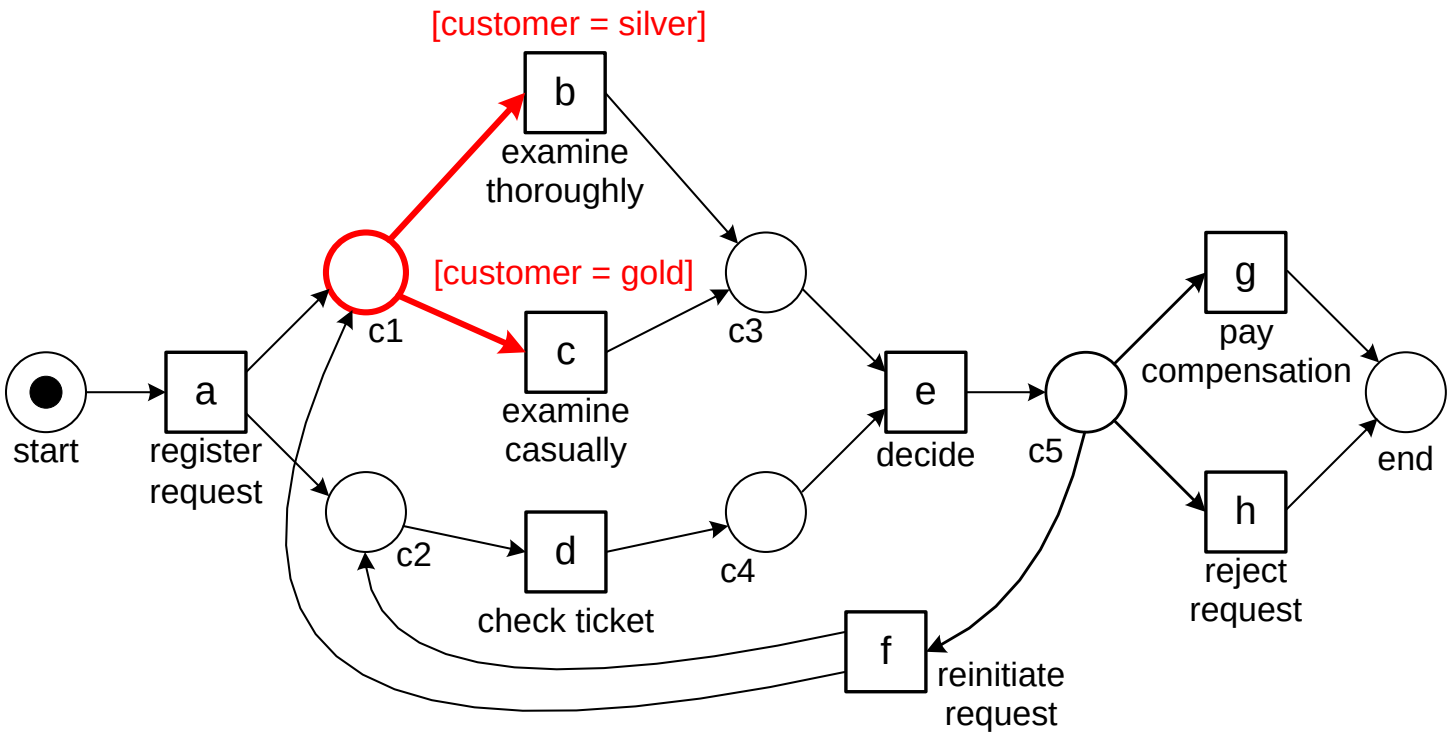
Add guards

case	resource executing a	customer	amount	class
1	John	silver	500	b
2	Mary	gold	800	c
3	John	silver	300	b
4	John	gold	850	c
…	…	…	…	…

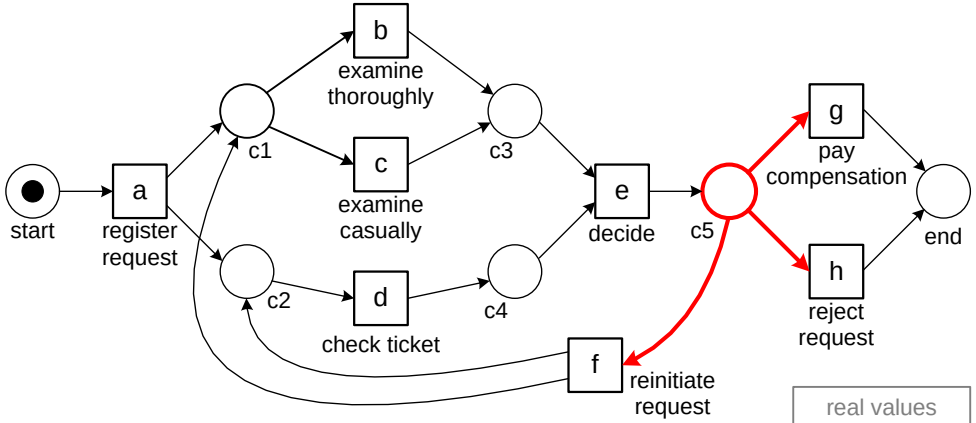


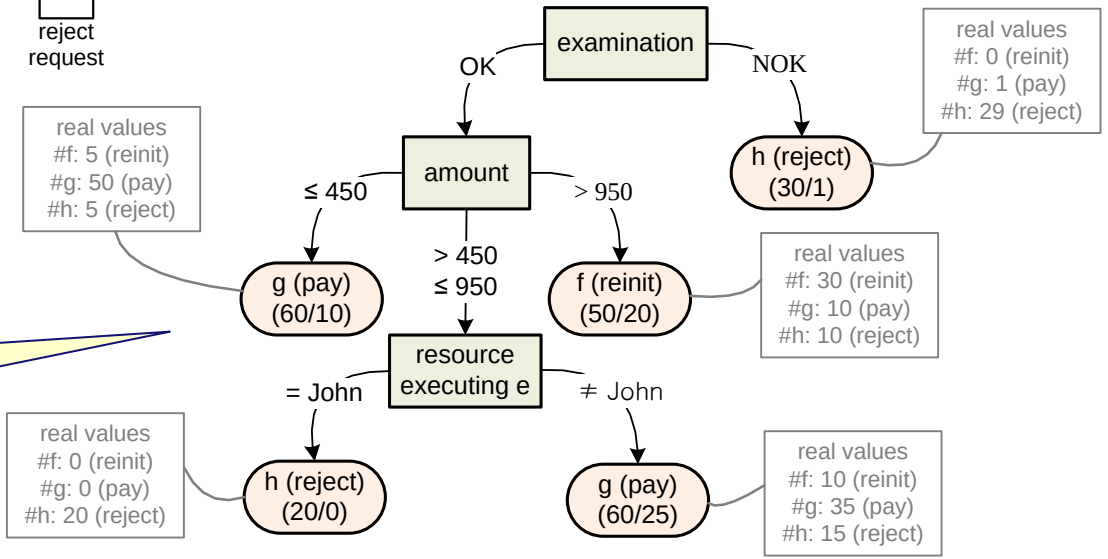


Data-aware process model



Question:
Create guards based on decision tree

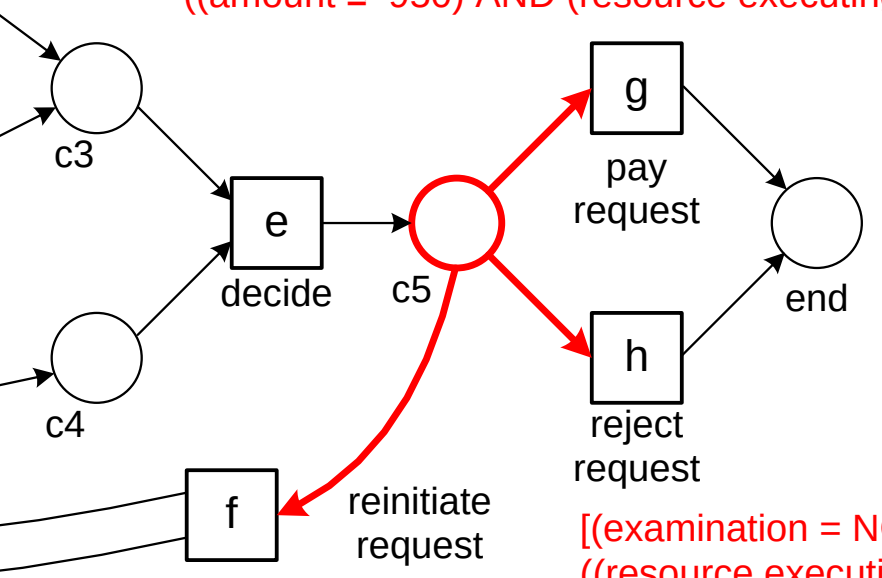




assume that this decision tree was learned for decision point

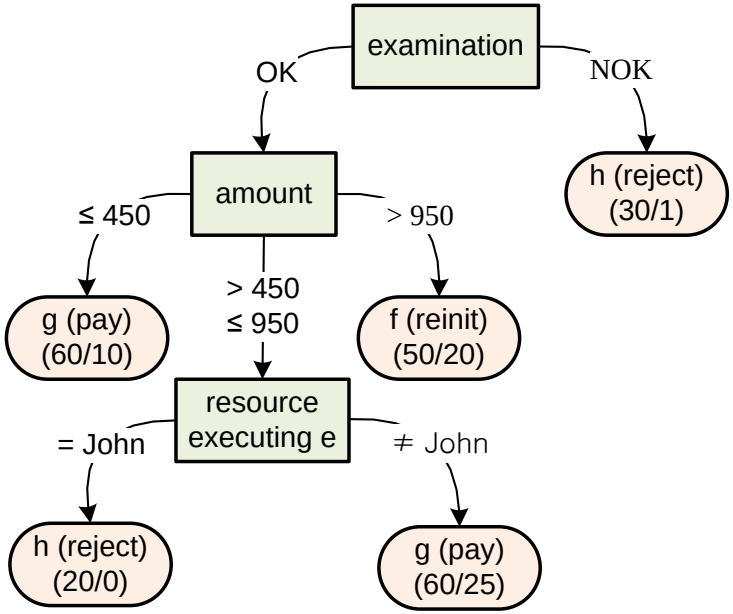
Answer

[(examination = OK) AND ((amount <= 450) OR ((amount ≤ 950) AND (resource executing e ≠ John)))]

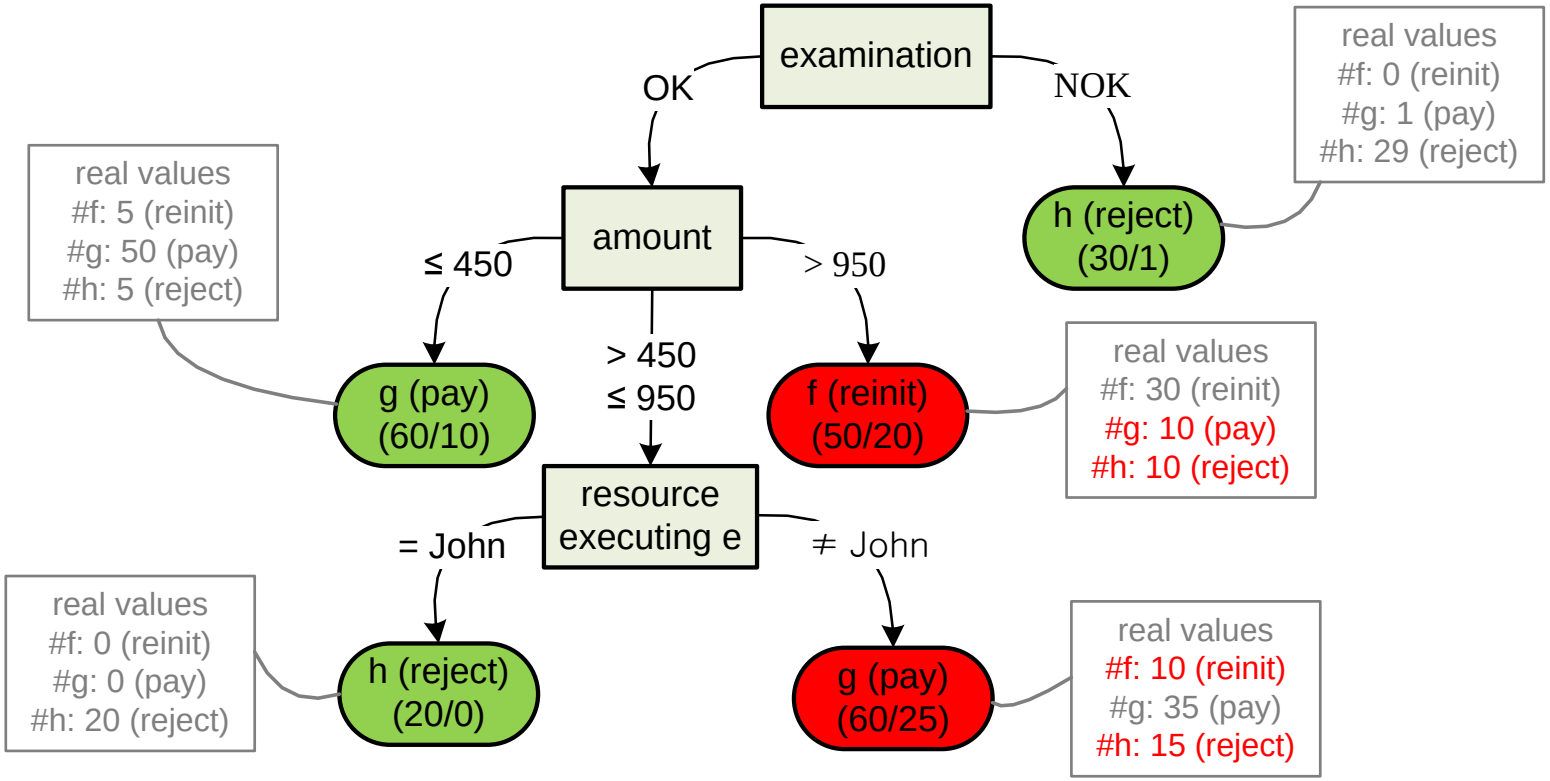


[(examination = OK) AND (amount > 950)]

[(examination = NOK) OR ((resource executing e = John) AND (450 < amount ≤ 950)]



Dealing with uncertainty
(red = no consensus)



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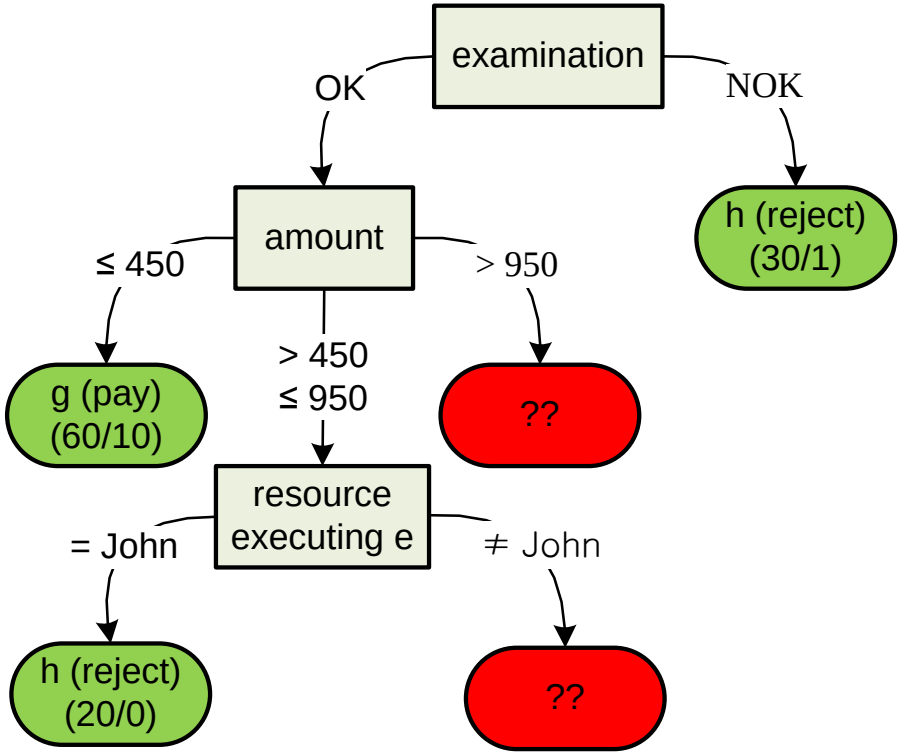
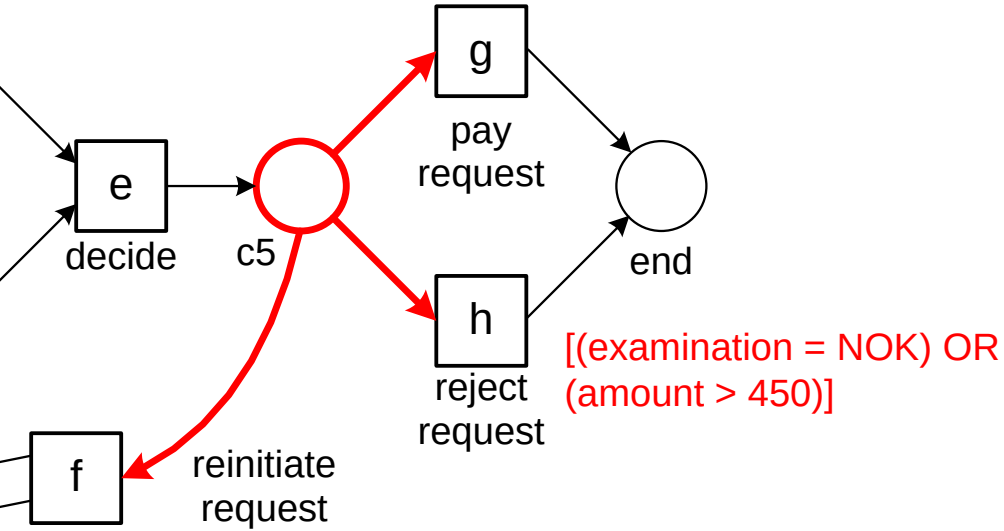
Non-deterministic guards



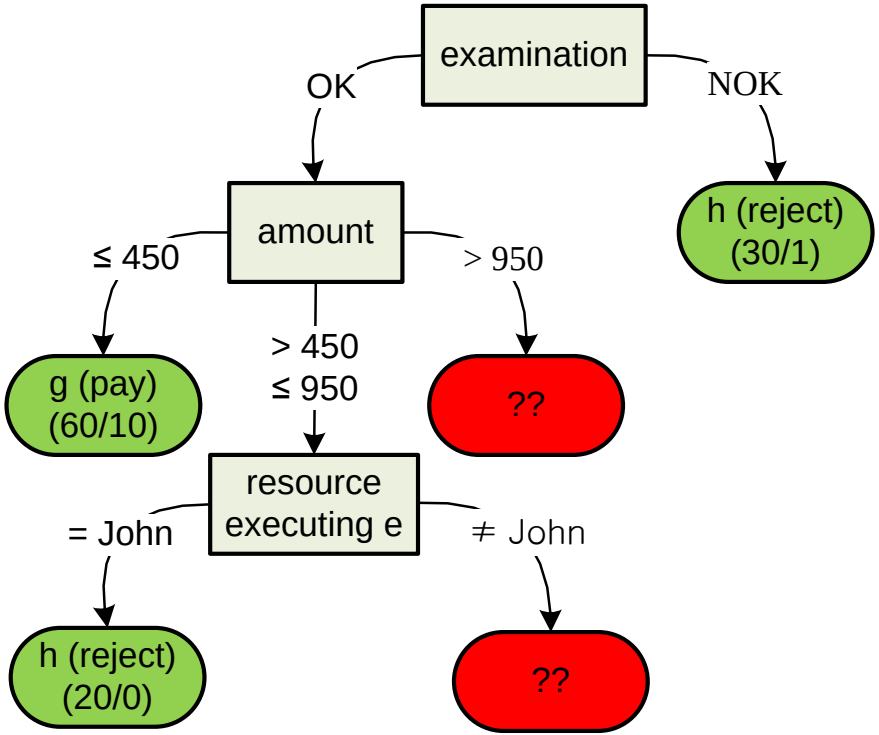
Non-deterministic guards
(conditions are weaker and overlapping)

[(examination = OK) AND ((amount ≤ 450) OR (amount > 950) OR (resource executing e ≠ John)))]



[(examination = NOK) OR (amount > 450)]

[(examination = OK) AND ((amount > 950) OR ((amount > 450) AND (resource executing e ≠ John)))]



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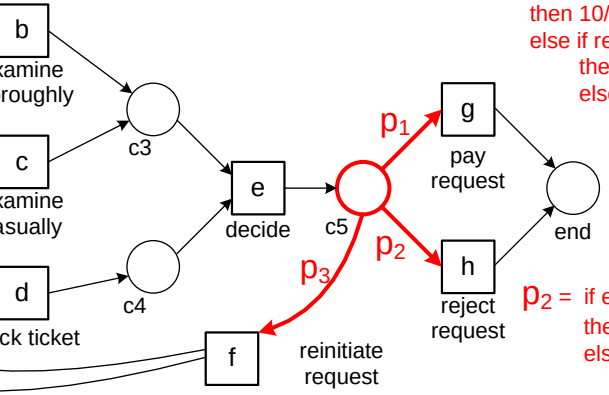
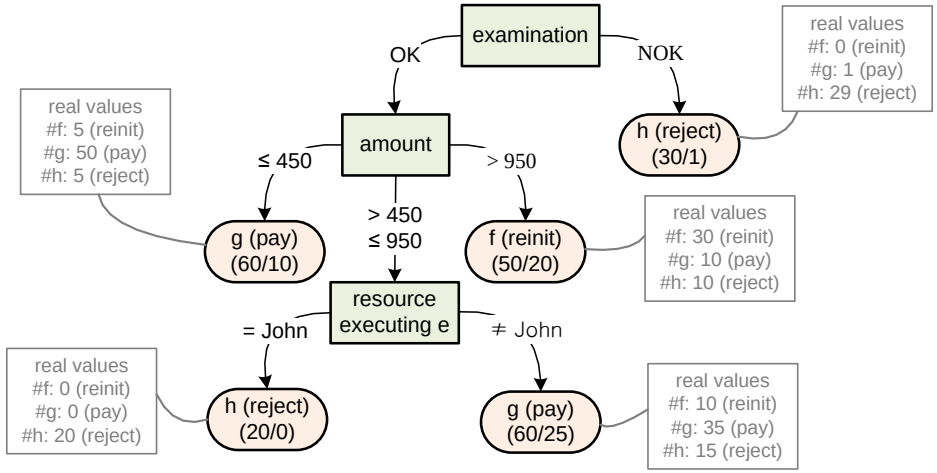
Data-dependent probabilities

p_1 = if examination = NOK
then 1/30
else if amount ≤ 450
then 50/60
else if amount > 950
then 10/50
else if resource executing a = John
then 0/20
else 35/60



p_2 = if examination = NOK
then 29/30
else if amount ≤ 450
then 5/60
else if amount > 950
then 10/50
else if resource executing a = John
then 20/20
else 15/60

p_3 = if examination = NOK
then 0/30
else if amount ≤ 450
then 5/60
else if amount > 950
then 30/50
else if resource executing a = John
then 0/20
else 10/60



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Data-dependent probabilities rather than guards

p_1 = if examination = NOK
then 1/30
else if amount ≤ 450
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else if amount > 950
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cuting a = John
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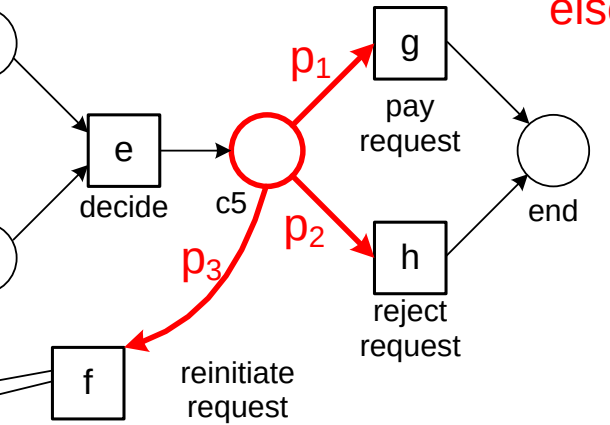
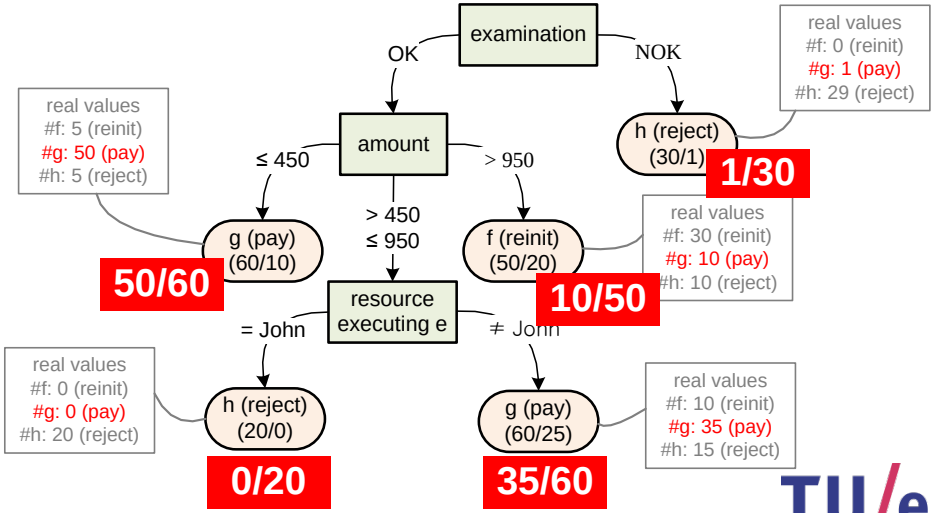
else 35/60





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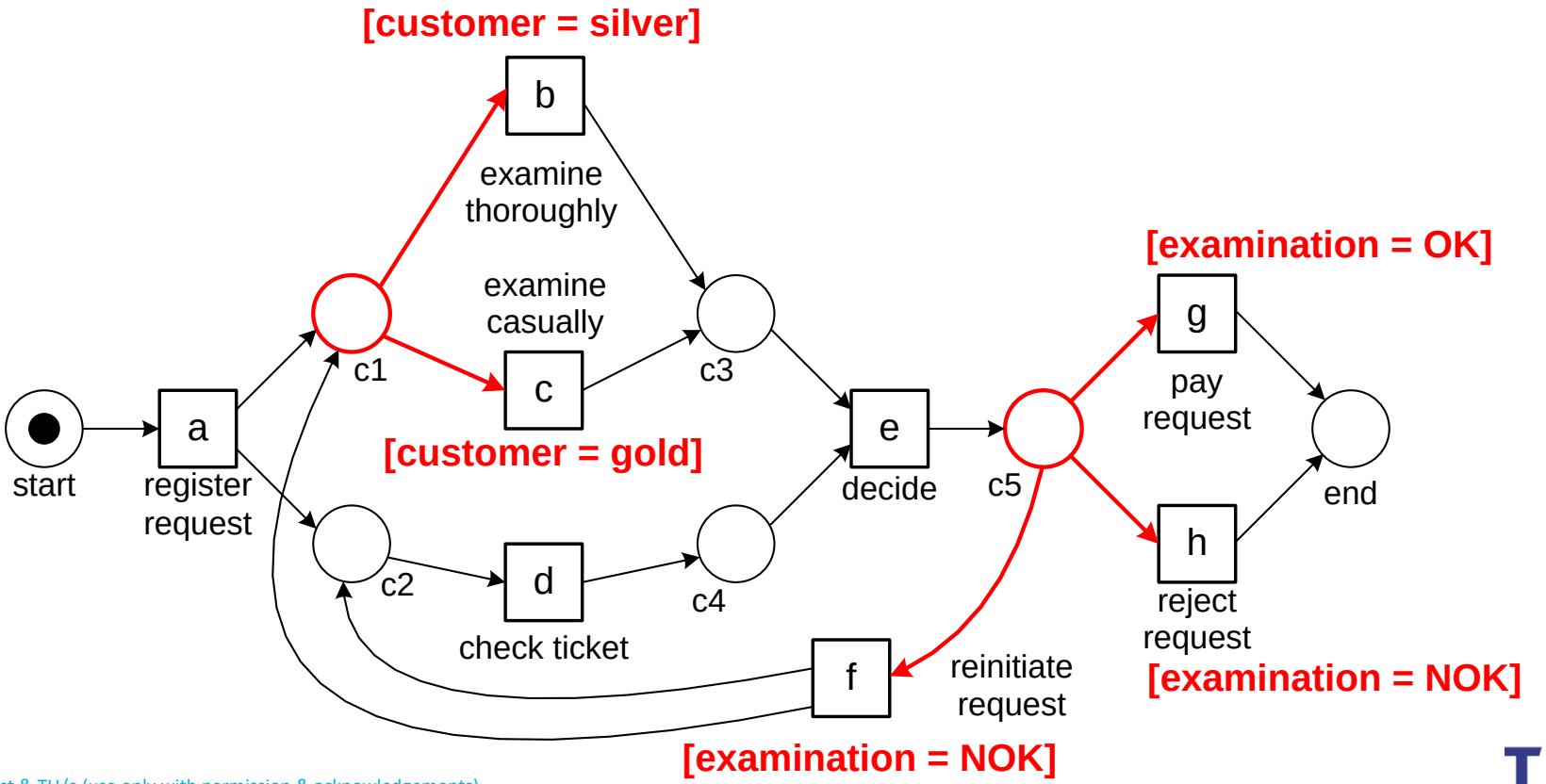
descriptive ≠ prescriptive

The guards discovered are describing what has happened rather than what should have happened.

Data-aware Petri net can also be used for conformance checking!



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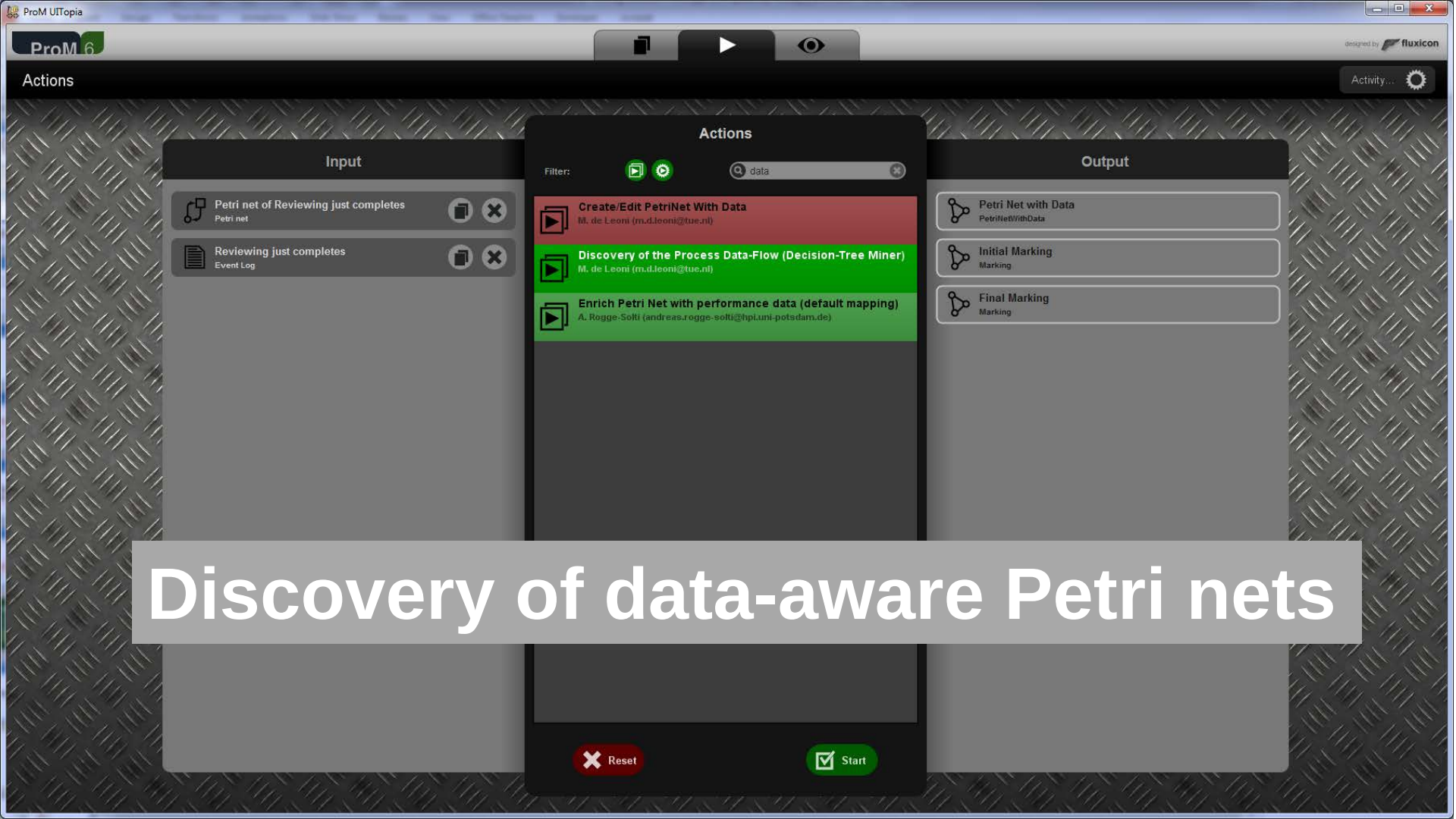
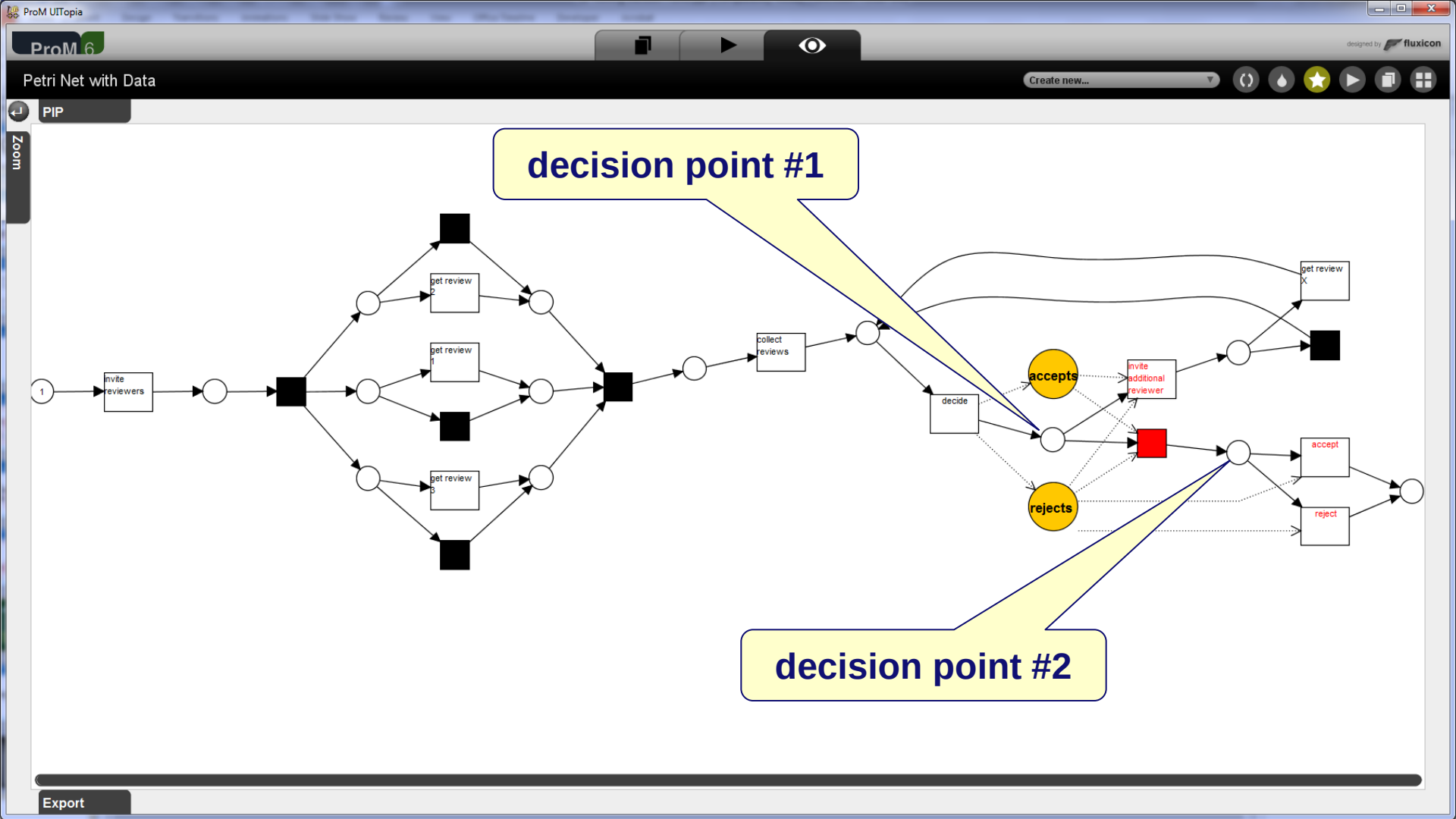
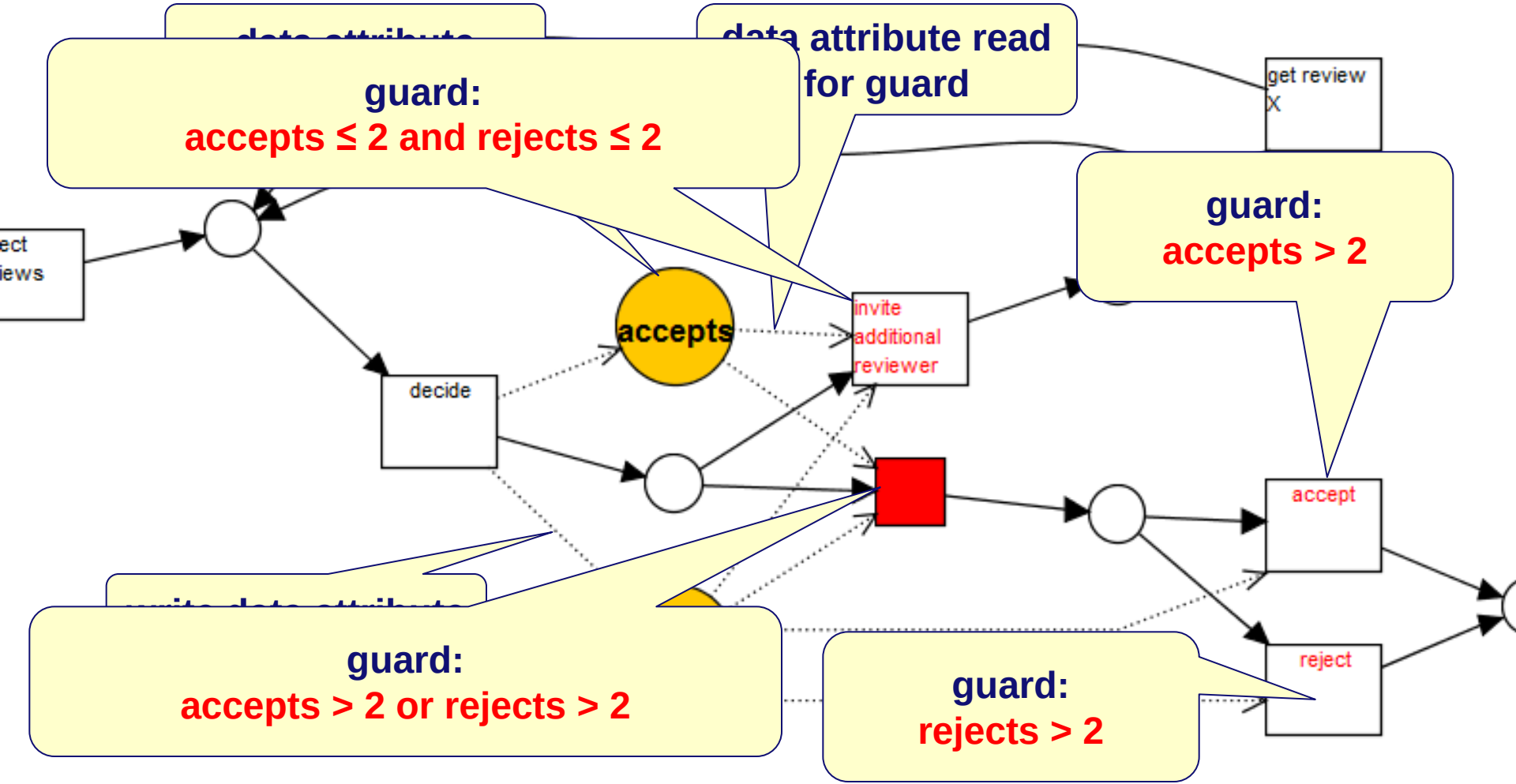
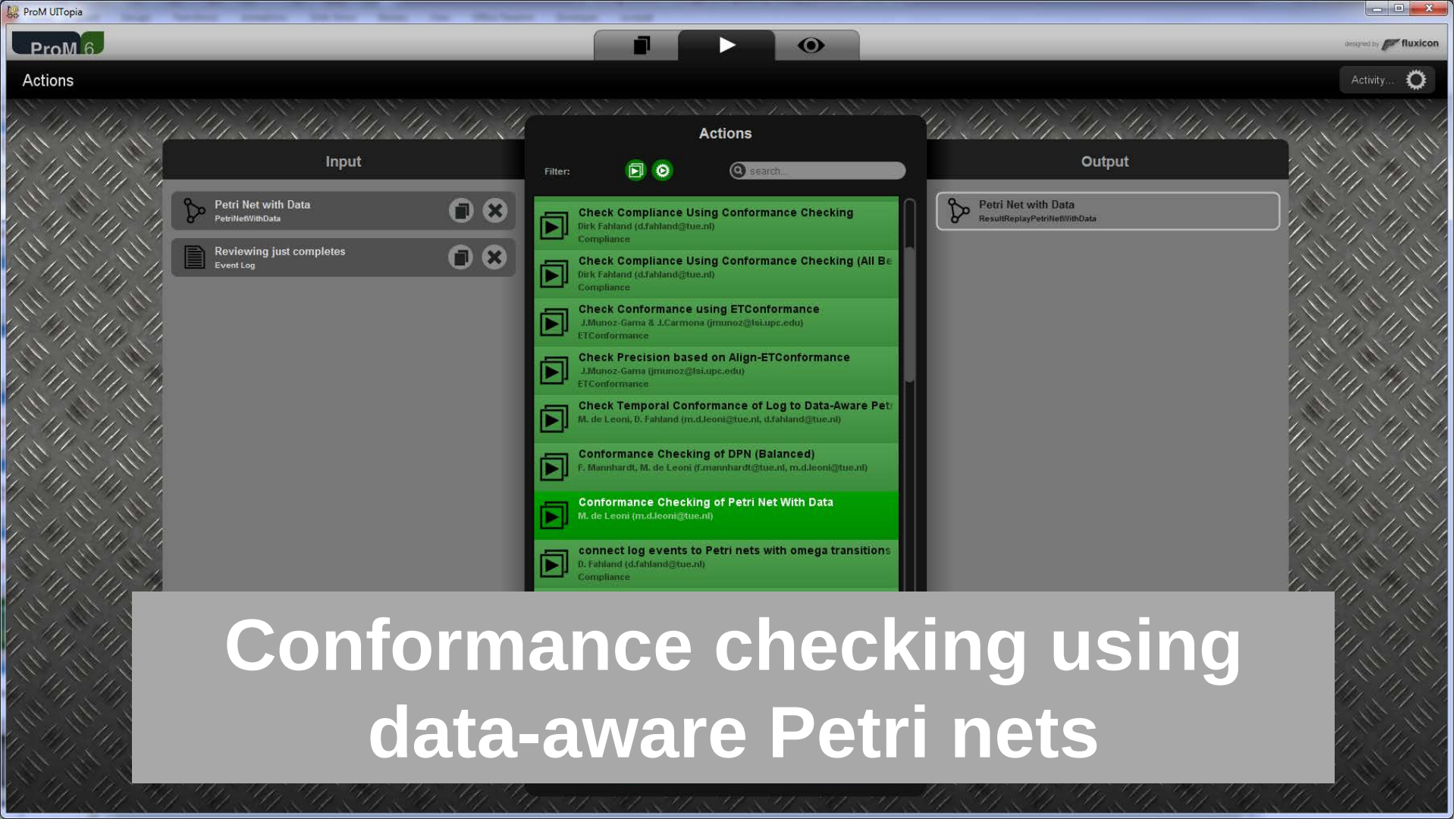

ProM UITopia
ProM 6
designed by fluxicon
Actions
Activity...
Input
Petri net of Reviewing just completes
Petri net
Reviewing just completes
Event Log
Actions
Filter:
data
Create/Edit PetriNet With Data
M. de Leoni (m.d.leoni@tue.nl)
Discovery of the Process Data-Flow (Decision-Tree Miner)
M. de Leoni (m.d.leoni@tue.nl)
Enrich Petri Net with performance data (default mapping)
A. Rogge-Solti (andreas.rogge-solti@hpi.uni-potsdam.de)
Reset
Start
Output
Petri Net with Data
PetriNetWithData
Initial Marking
Marking
Final Marking
Marking
Discovery of data-aware Petri nets


ProM UITopia
ProM 6
Petri Net with Data
Create new...
PIP
Zoom
decision point #1
decision point #2
1
invite reviewers
get review 2
get review 1
get review 3
collect reviews
decide
accepts
rejects
invite additional reviewer
get review X
accept
reject
Export


guard:
accepts ≤ 2 and rejects ≤ 2
data attribute read
for guard
get review
X
guard:
accepts > 2
ect
iews
accepts
invite
additional
reviewer
decide
accept
reject
guard:
accepts > 2 or rejects > 2
guard:
rejects > 2



Conformance checking using data-aware Petri nets


ProM UITopia
ProM 6
designed by fluxicon
Petri Net with Data
Create new...
ALIGNMENTS
Trace: 464
Fitness 0.00%
Trace: 465
Fitness 0.00%
Trace: 466
Fitness 0.00%
Trace: 467
Fitness 0.00%
Trace: 468
Fitness 0.00%
Trace: 469
Fitness 0.00%
Trace: 47
Fitness 0.00%
Trace: 470
Fitness 0.00%
Trace: 471
Fitness 0.00%
Trace: 472
Fitness 0.00%
Trace: 473
Fitness 0.00%
LEGEND
- Perfect Alignment Step (Move log and model)
- Missing Event (Move model only)
- Unobservable Event (Move model only)
- Wrong Event (Move log only)
- Wrong Data (Move log and move model with different data values)
COLOR THEME
Bright
SORTING
Fitness (Descending)
FILTERING
Filter by trace name
Filter by event name
Reset Filter
data-aware alignments

data mining

process mining

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Part I: Preliminaries

- Chapter 1: Introduction
- Chapter 2: Process Modeling and Analysis
- Chapter 3: Data Mining

Part II: From Event Logs to Process Models

- Chapter 4: Getting the Data
- Chapter 5: Process Discovery: An Introduction
- Chapter 6: Advanced Process Discovery Techniques

Part III: Beyond Process Discovery

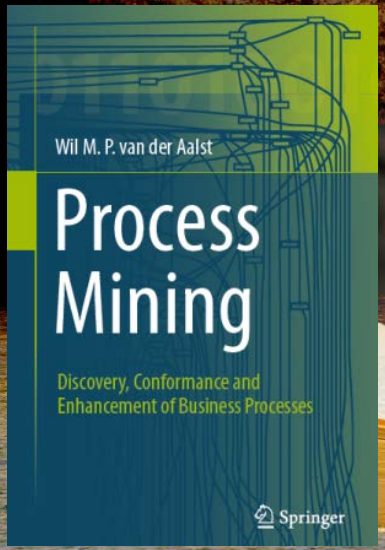
- Chapter 7: Conformance Checking
- Chapter 8: Mining Additional Perspectives
- Chapter 9: Operational Support

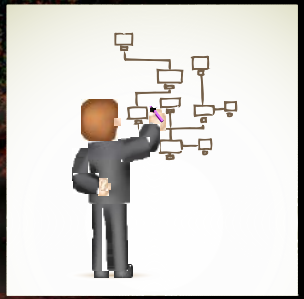
Part IV: Putting Process Mining to

- Chapter 10: Tool Support
- Chapter 11: Analyzing "Lasagna Processes"
- Chapter 12: Analyzing "Spaghetti Processes"

Part V: Reflection

- Chapter 13: Cartography and Navigation
- Chapter 14: Epilogue





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