9th Central and Eastern European Software Engineering Conference in Russia - CEE-SECR 2013

October 23 - 25, Moscow

Constructing BPMN-models from Causal nets

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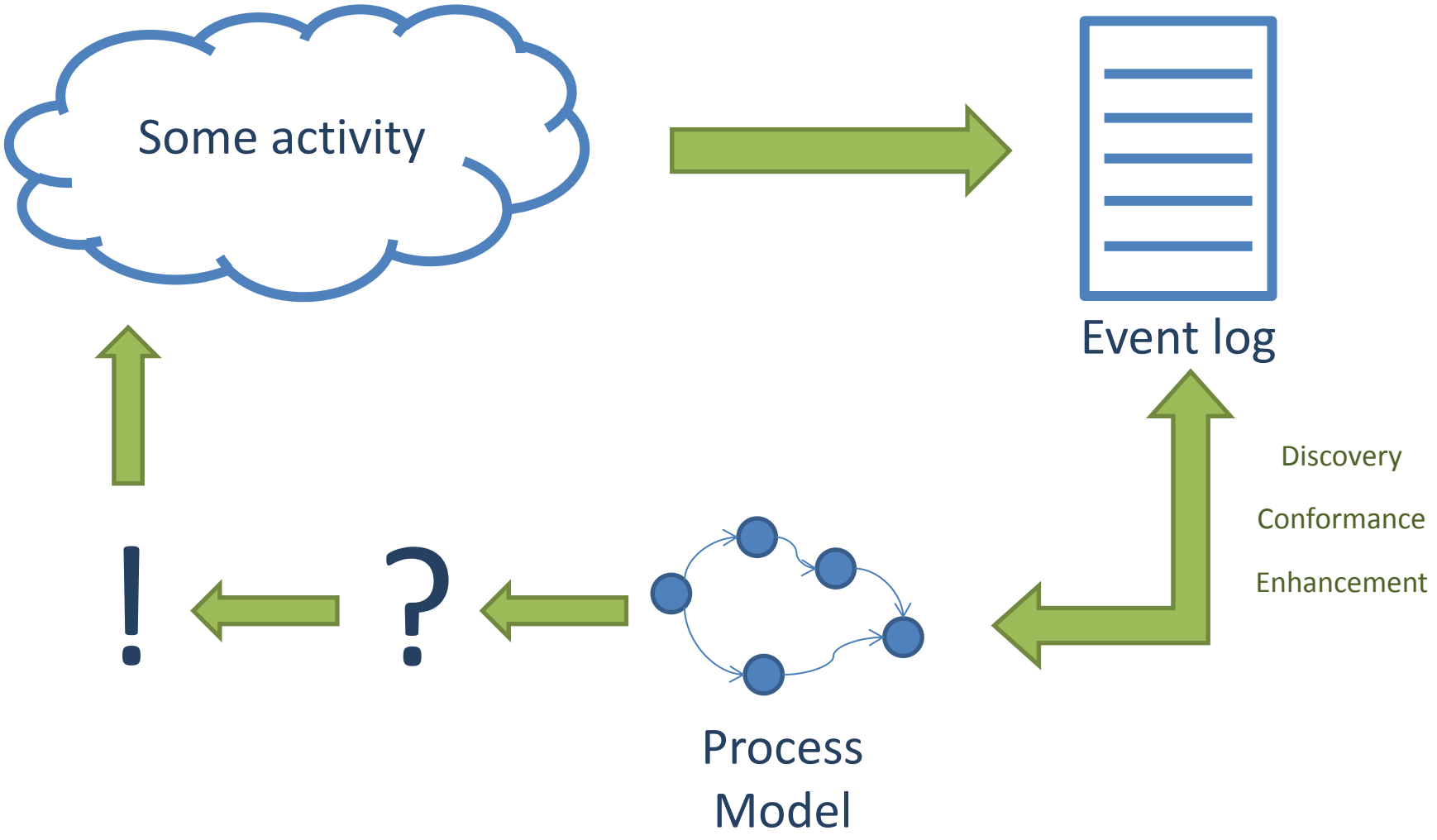
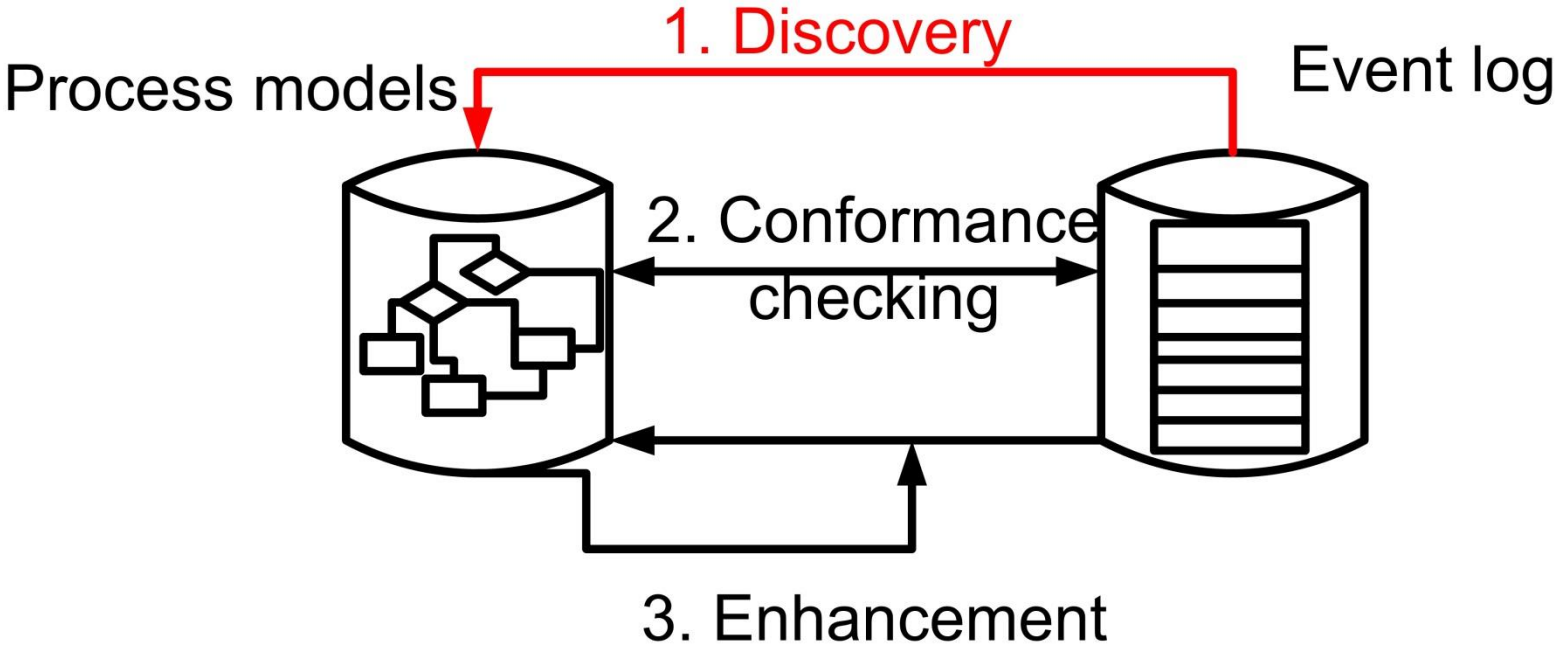
Process mining – what is it?

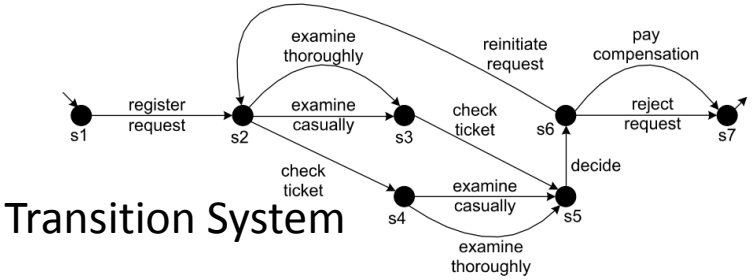


Process mining – 3 main problems

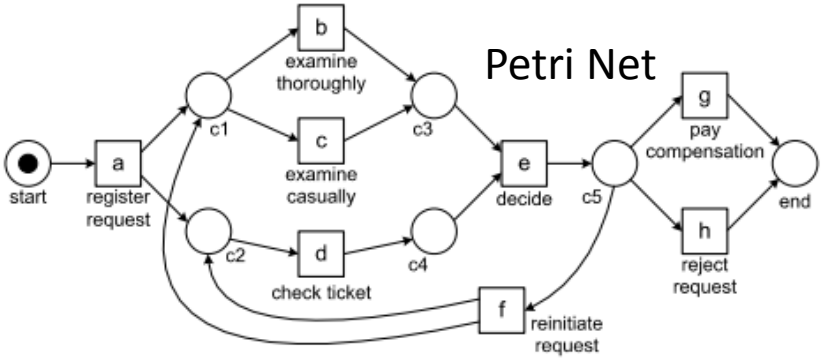
- Discovery – how can we obtain the process model?
- Conformance – how good is our model?
- Enhancement – how we can improve our model?



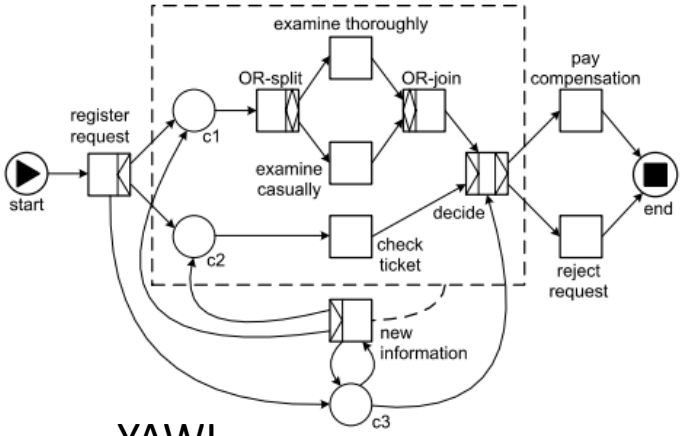
Variety of models



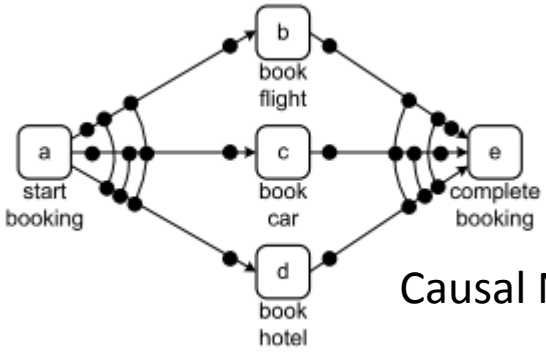
Transition System



Petri Net

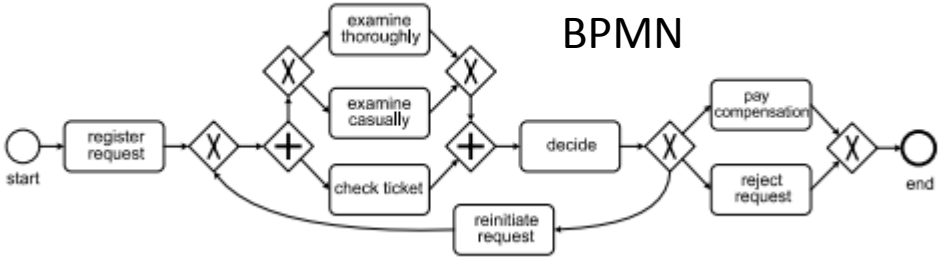


YAWL



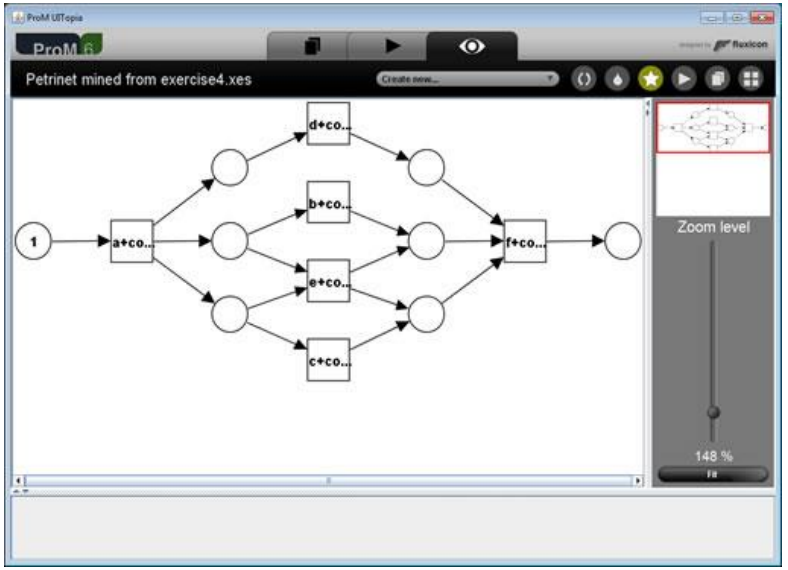
Causal Net

BPMN

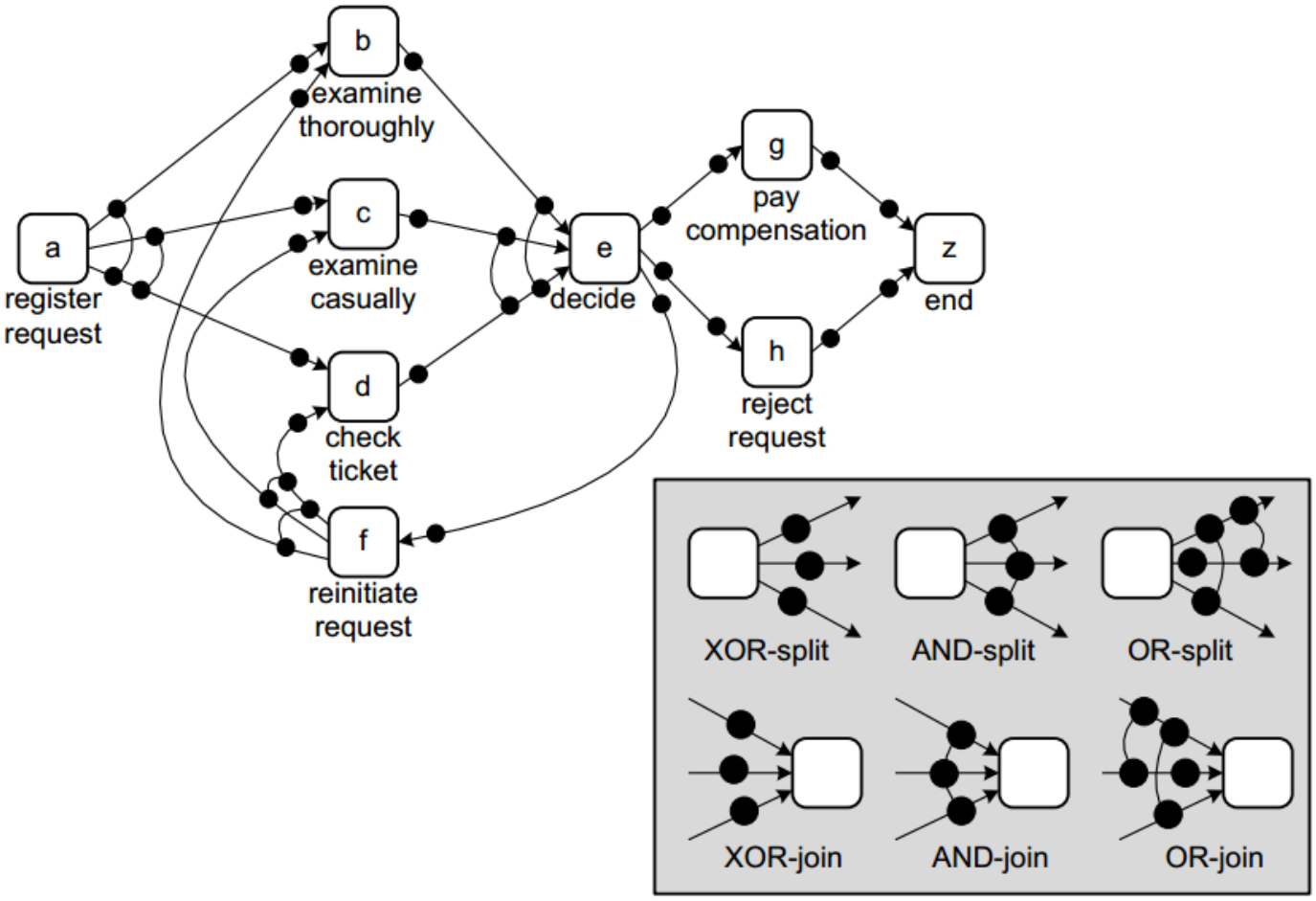


ProM

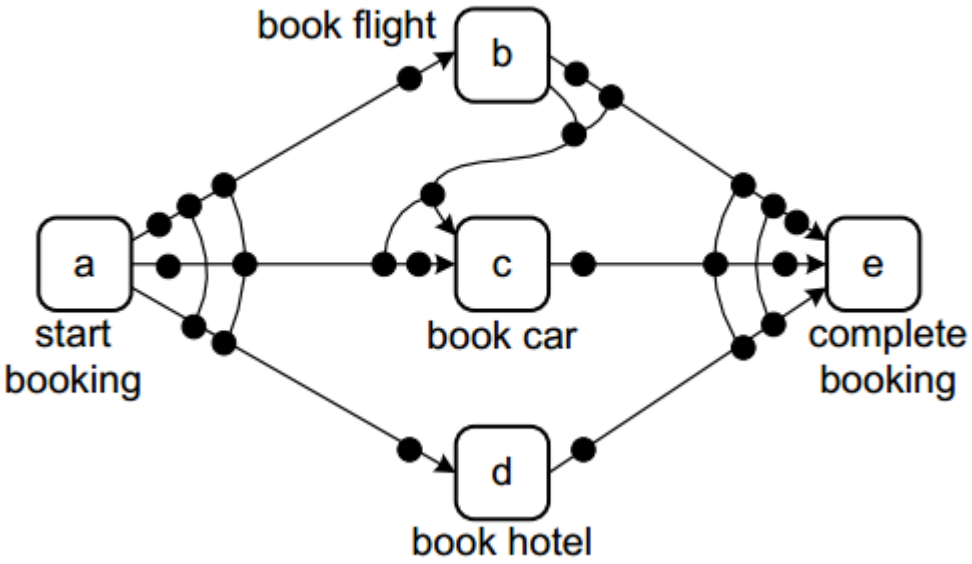
- Process-aware software system
- Plugin-based
- Supports a lot of models and operations
- Some plugins use Causal Nets as a result of the discovery



Causal Nets


a
register request
b
examine thoroughly
c
examine casually
d
check ticket
e
decide
f
reinitiate request
g
pay compensation
h
reject request
z
end
XOR-split
AND-split
OR-split
XOR-join
AND-join
OR-join

What is the point?



Valid sequences:

(a, b, e), (a, d, b, e), (a, b, d, c, e)

Invalid sequences:

(a, b, c, e), (a, d, e)

Why should we use yet another model?

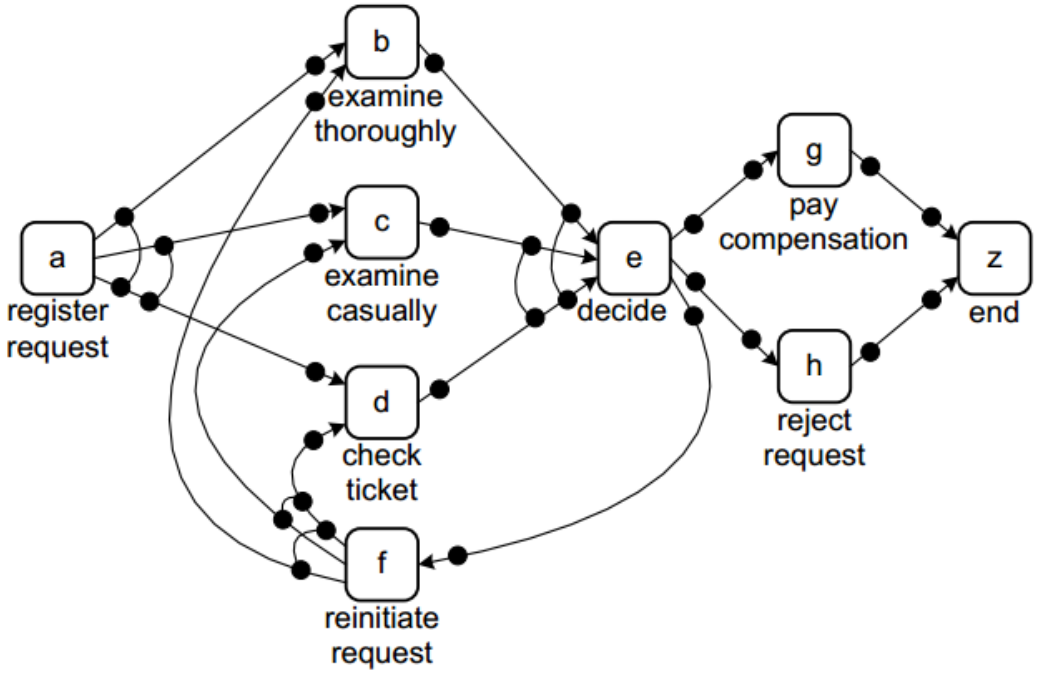
- High control flow expressivity
- Internally consistent: pay no attention to invalid sequences $\Longrightarrow$ no deadlocks, livelocks…
- Models AND, OR, XOR without additional elements

Formal definition

- Causal Net $C = (A, a_i, a_o, D, I, O)$, where:
- A – finite set of activities
- a_i – start activity
- a_o – end activity
- $D \subseteq A \times A$ – dependency relation
- $AS = \{X \subseteq \mathcal{P}(A) | X = \{\emptyset\} \vee \emptyset \notin X\}$
- $I \in A \rightarrow AS$ – set of possible input bindings
- $\mathrm{O} \in A \rightarrow AS$ – set of possible output bindings
- Start activity has no input bindings
- End activity has no output bindings
- All activities in graph (A, D) are on the way from a_i to a_o

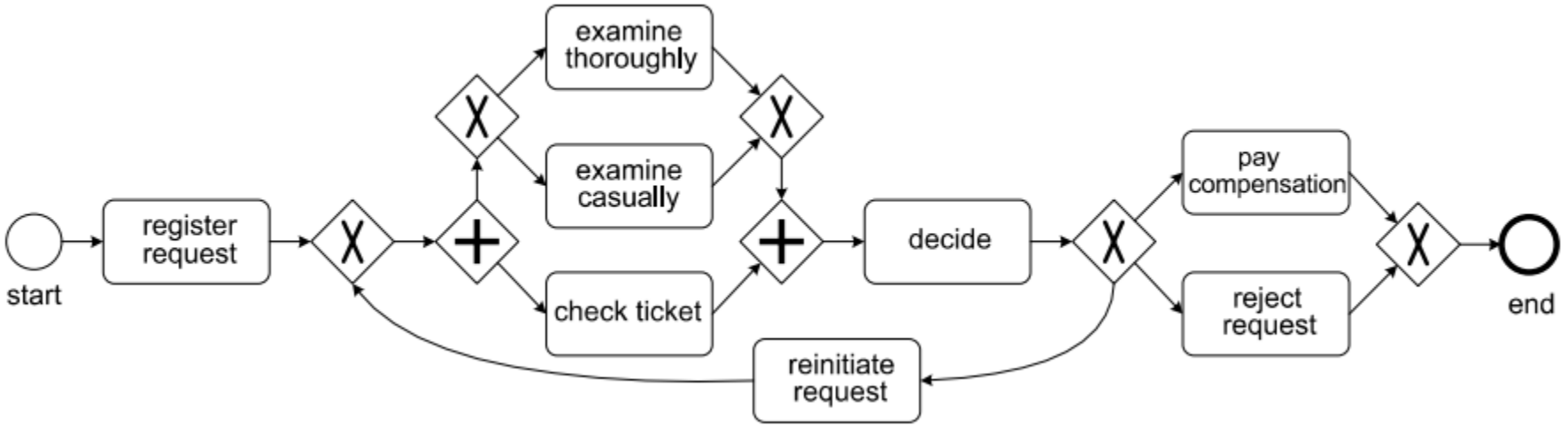
Why conversion is needed?

- Causal nets provide declarative semantics
- Presentation is low-level
- Presentation may be not so obvious



BPMN

- Higher-level language
- Allows to quickly understand process logic
- De facto standard
- Continuously supported and improving

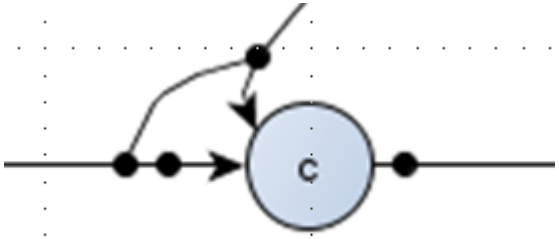


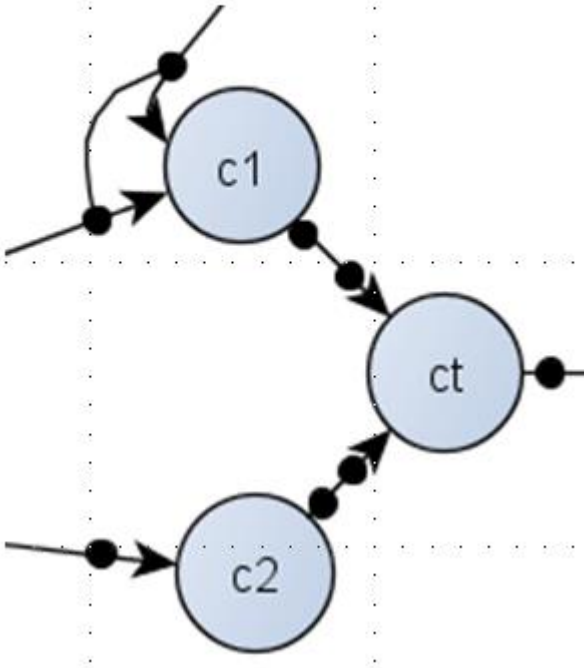
Constraints of conversion

- BPMN is a *free-choice* net, while C-net is more expressive in terms of control flow
- This fact is the reason of Causal net splitting necessity
- The conflict of declarative semantics and local-rules semantics
- Successful conversion criteria: C-net valid binding sequences $\Leftrightarrow$ BPMN valid firing sequences

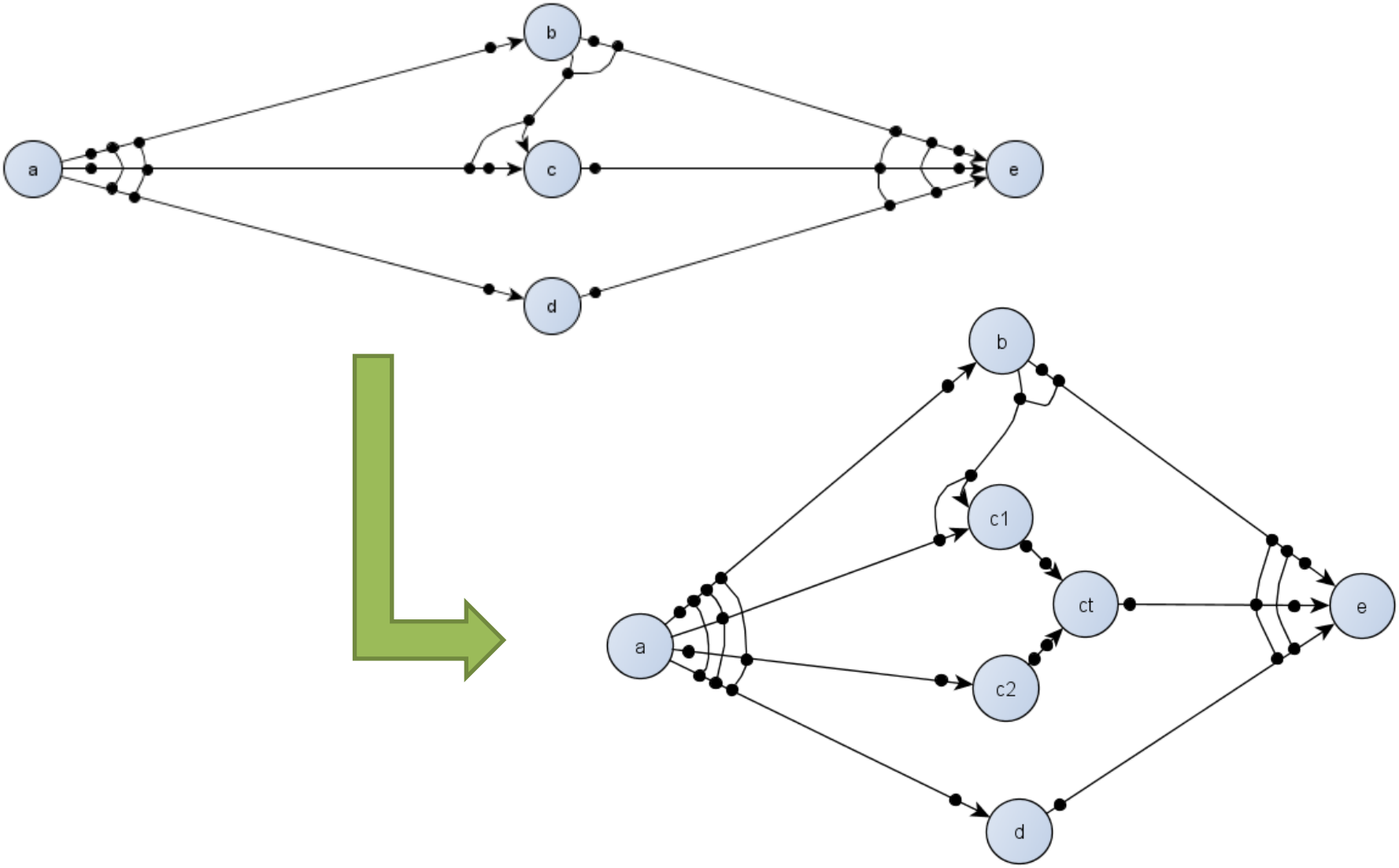
Preparing C-net: splitting

- Every activity is split into set of activity copies and terminal activity

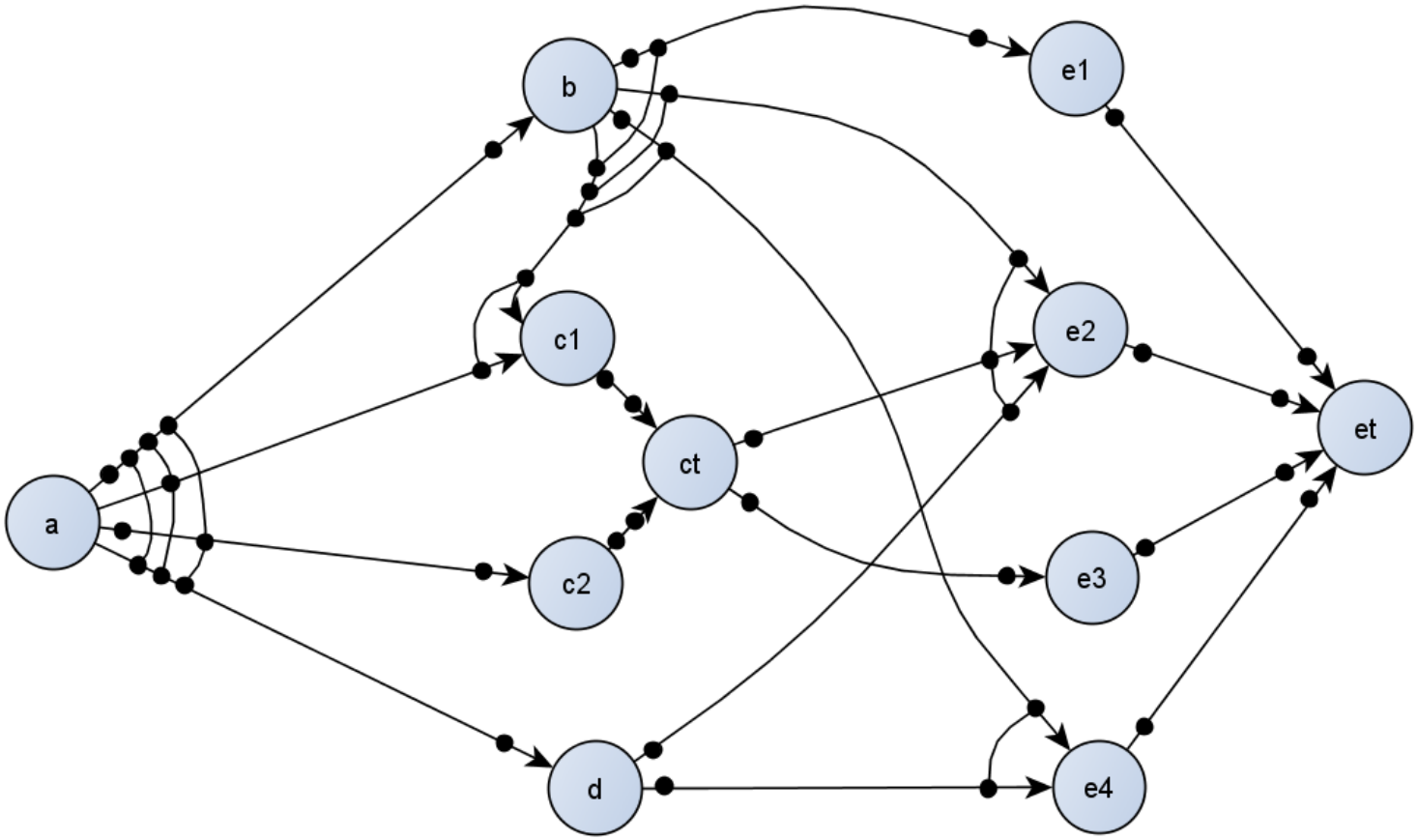




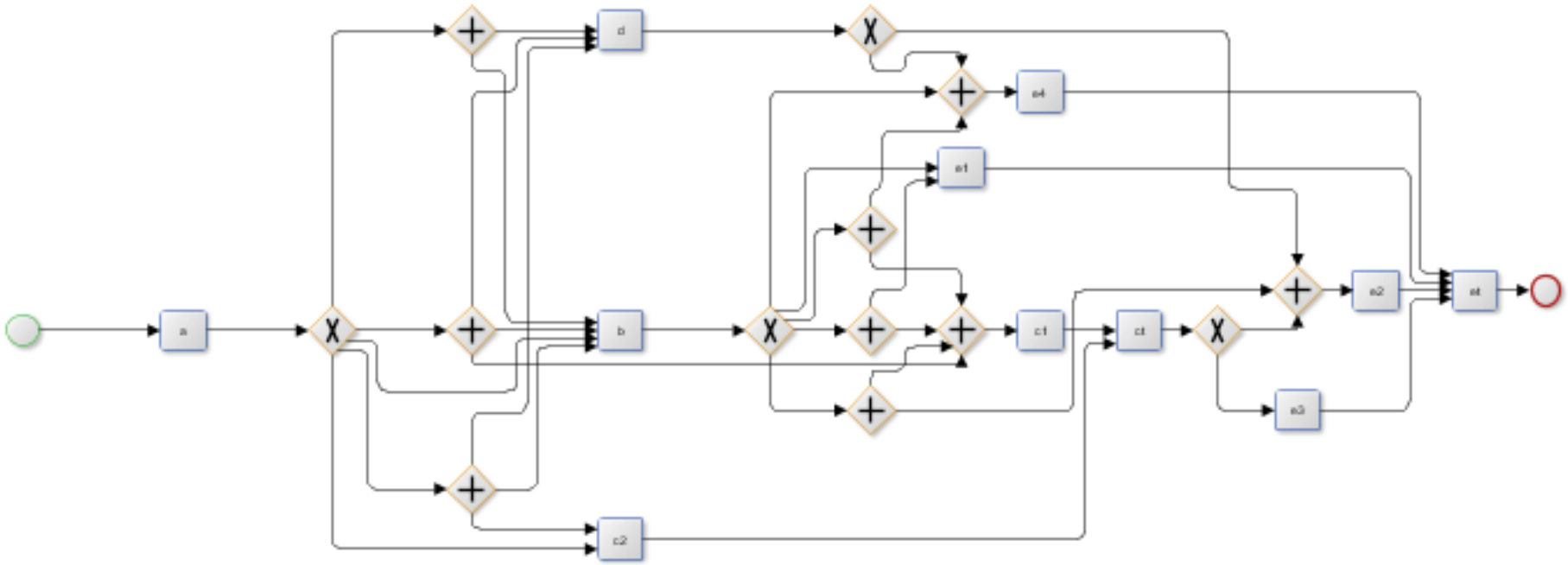
Splitting in action



Result of splitting



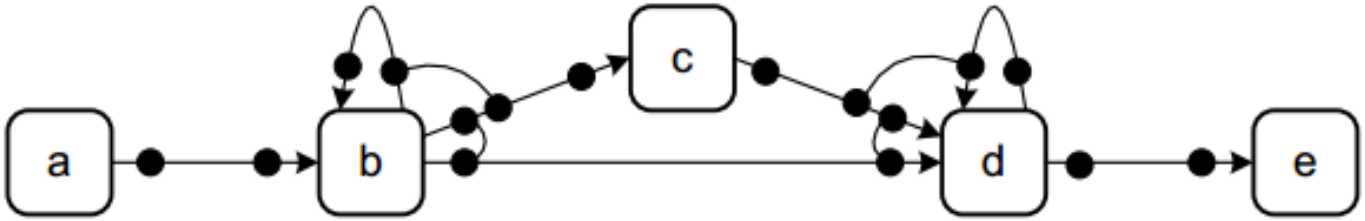
Conversion to BPMN

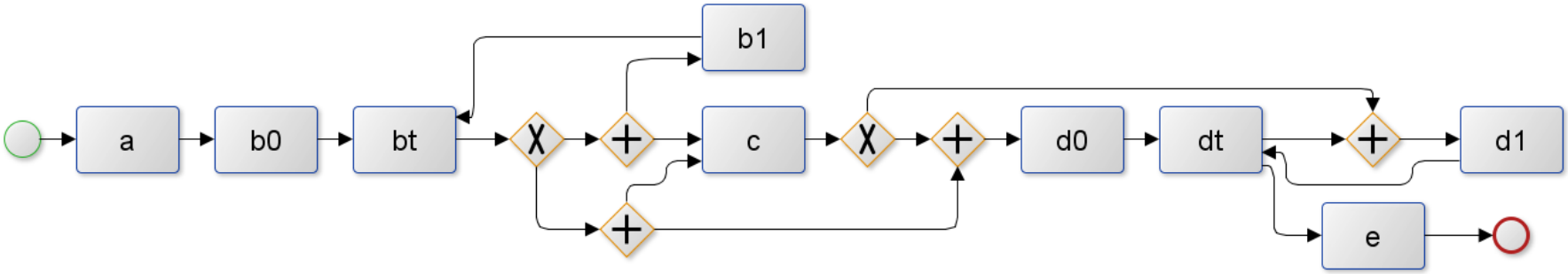


- This is not the result of modeling!!! Of course, model should be simplified
- Seeming complexity is the price for quite precise behavior from the C-net

What do we get?

- BPMN valid firing sequences correspond to valid binding sequences of Causal Net
- No additional valid sequences occurred





Applicability of conversion

- Plugin for ProM
- Enriches mathematical toolset – let's discover new models, methods and approaches!

References

- W.M.P. van der Aalst. Process Mining: Discovery, Conformance and Enhancement of Business Processes
- W.M.P. van der Aalst, A. Adriansyah, and B.F. van Dongen. Causal Nets: A Modeling Language Tailored Towards Process Discovery
- W.M.P. van der Aalst, K.M. van Hee, A.H.M. ter Hofstede, N. Sidorova, H.M.W. Verbeek, M. Voorhoeve, and M.T. Wynn. Soundness of Workflow Nets: Classification, Decidability and Analysis
- http://promtools.org – ProM

Thank you!