A Petri net-based notation for normative modeling: *evaluation on deontic paradoxes*

16 June 2017, MIREL workshop @ ICAIL

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General Research Problem

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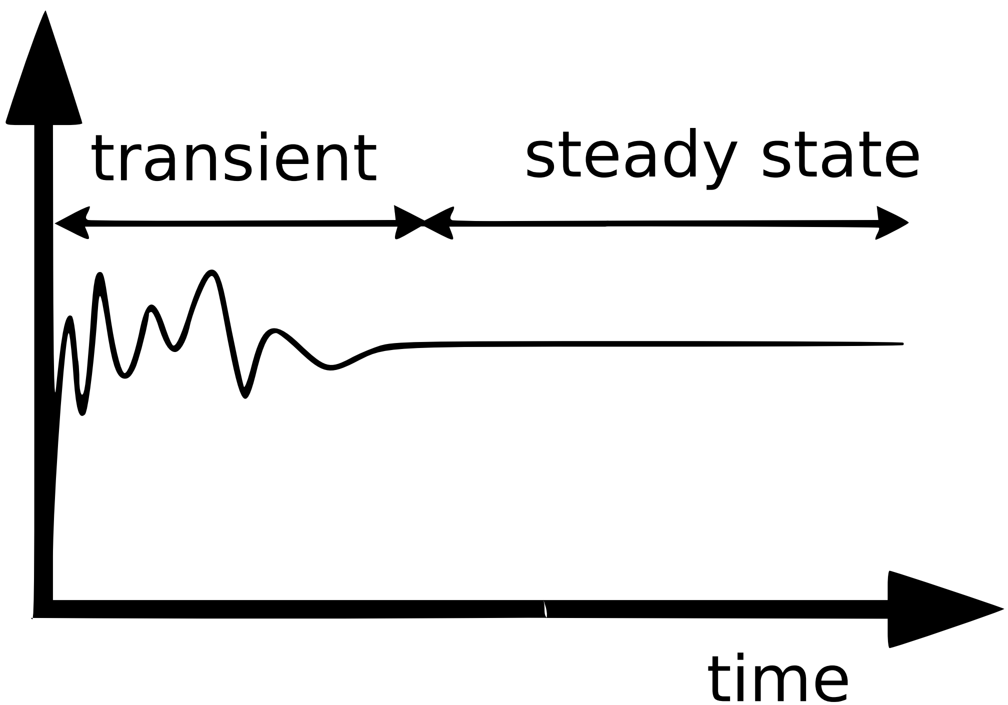
- Prototypical encounter: legal cases.
- More general but similar problem: *narrative interpretation.*

Looking for a notation

Steady states and transients

- Physical systems can be approached from steady state (equilibrium) or transient (non-equilibrium, dynamic) perspectives



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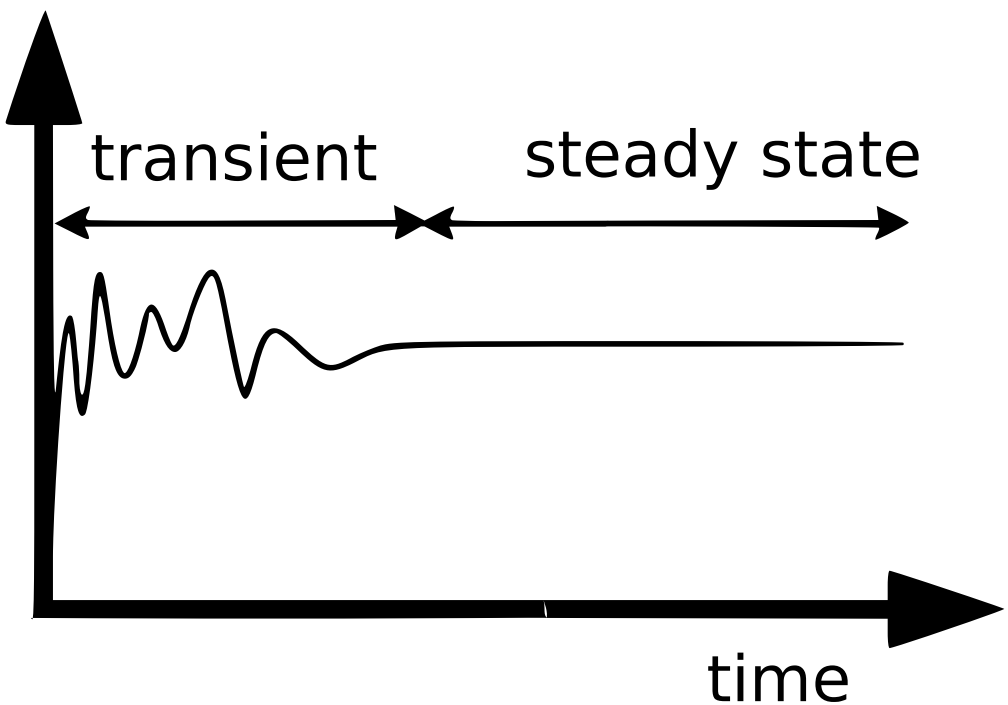

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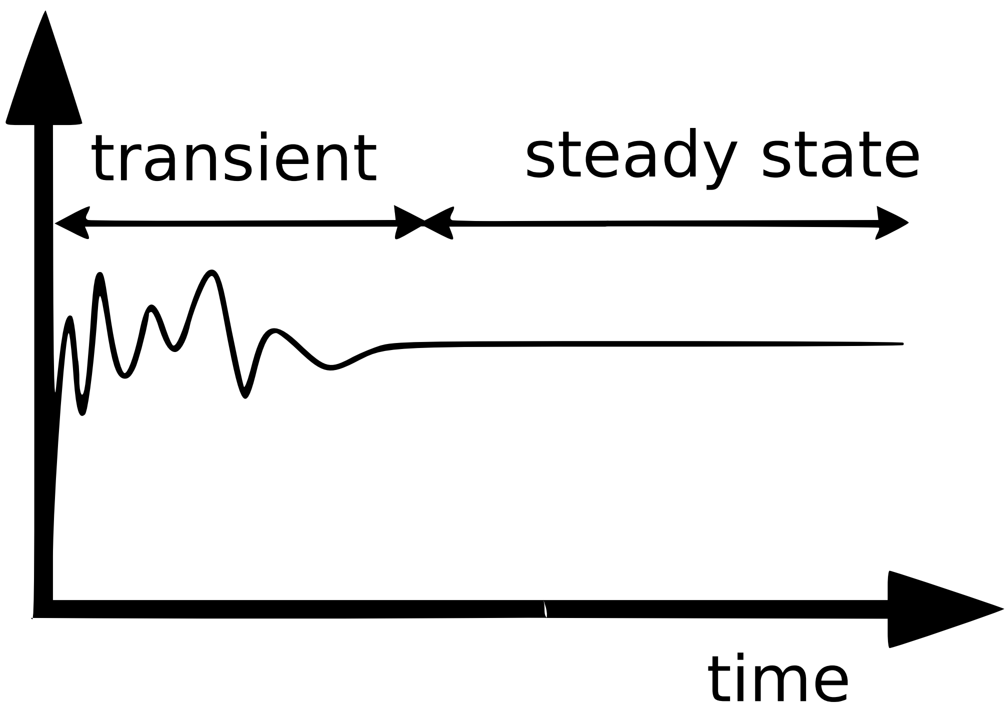

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  ex. **Ohm's Law**
  V = R * I

Specifying transients and steady states

- Possible analogies:
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    - Logic
    - Declarative programming

focus on
What

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focus on **What**

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Petri Nets!

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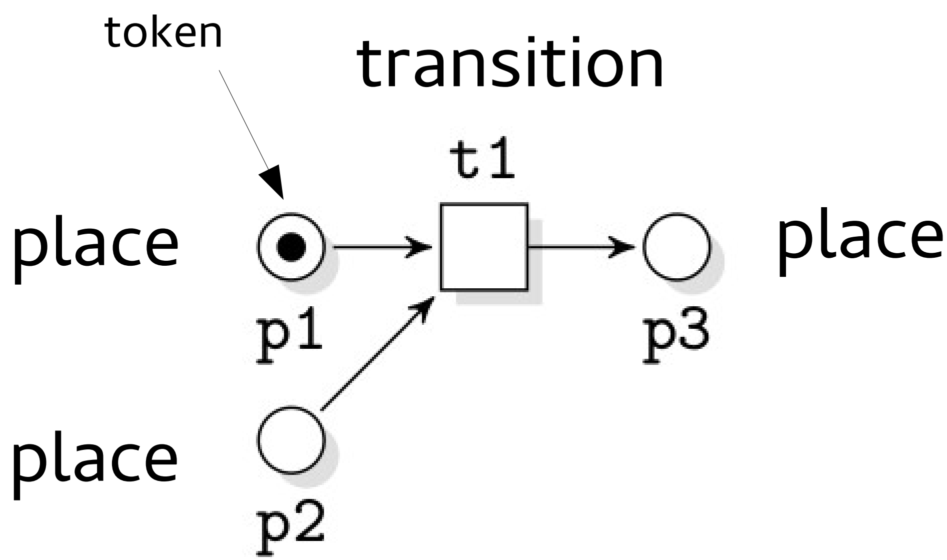
logic programming petri nets

→ LPPN

Petri Nets!

Logic Programming Petri Nets

procedural LPPN



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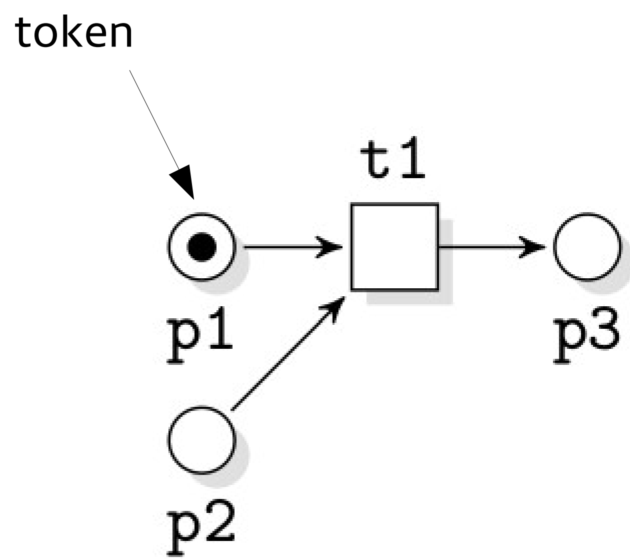

- *token game*: transition disabled. It cannot fire.

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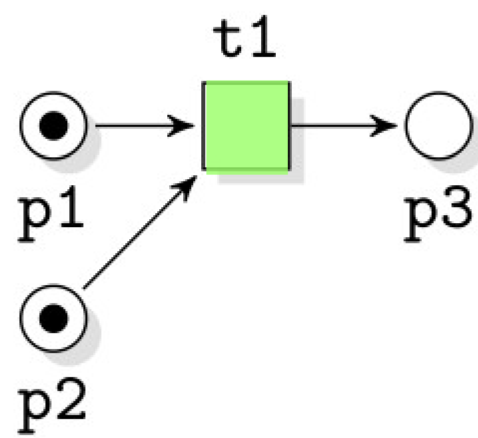

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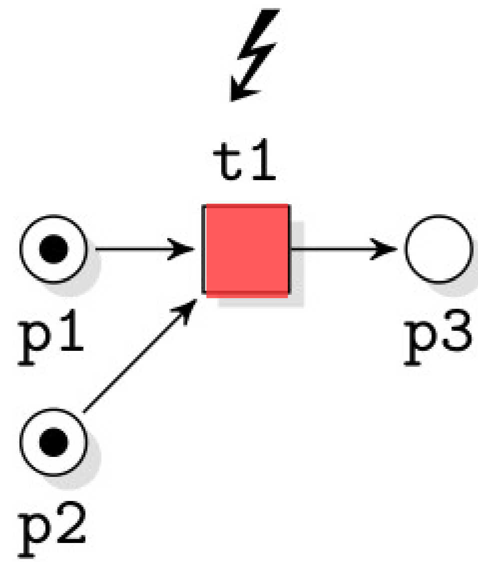
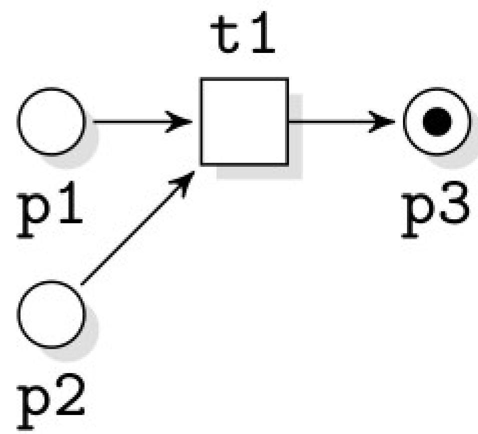


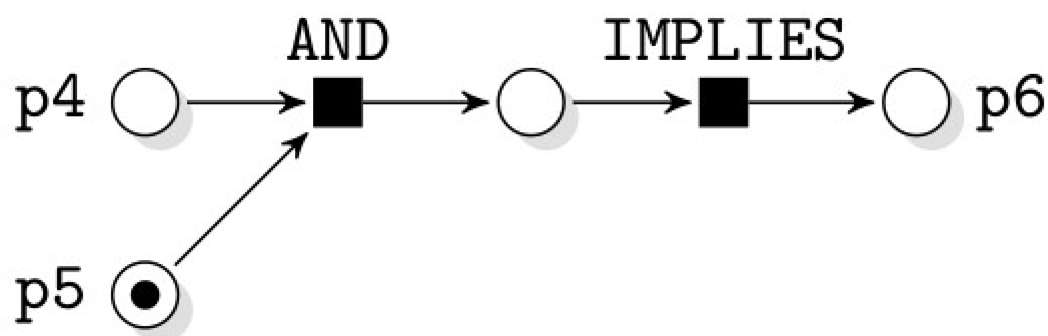
- *token game*: transition fires: it will consume tokens from the input places.

procedural LPPN



- *token game*: ...and produce tokens in the outputs.

declarative LPPN for places



- Equivalent to

  ASP/Prolog: `p6 :- p4, p5. p5.`

  FOL: $(p4 \wedge p5 \rightarrow p6) \wedge p5$

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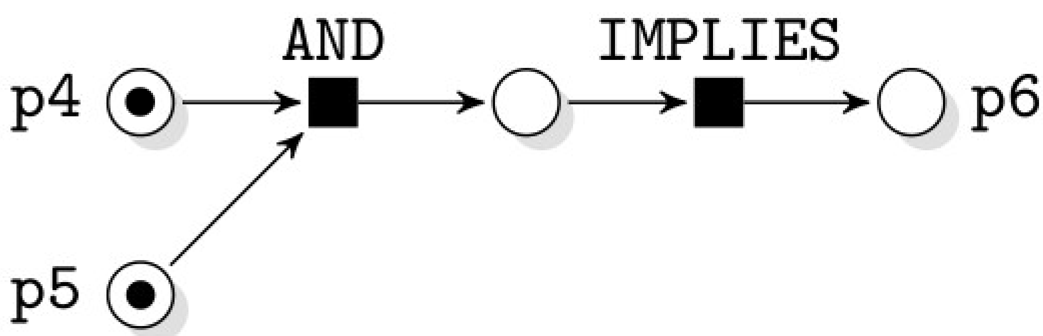

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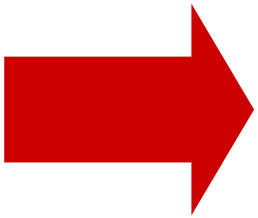

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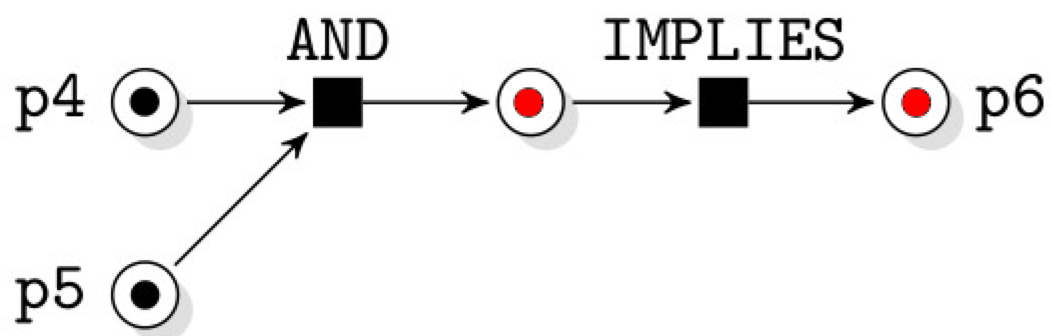

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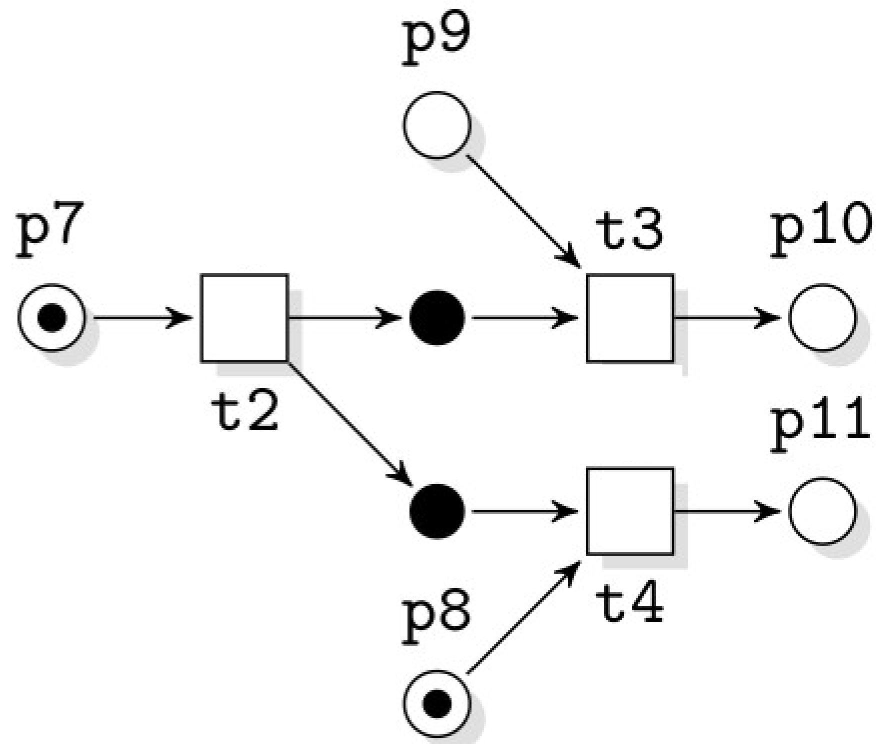

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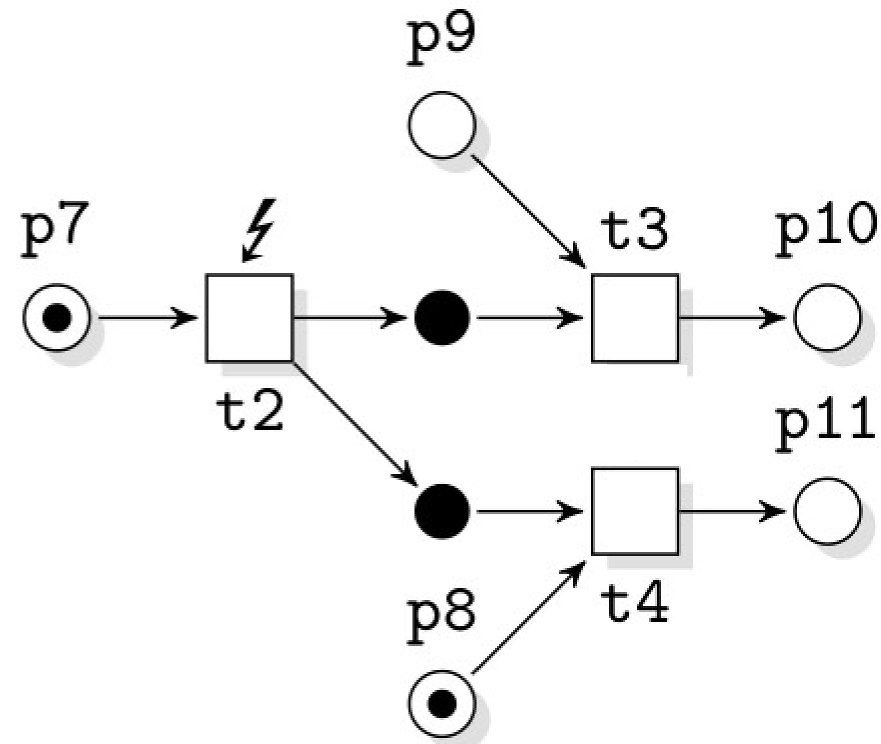

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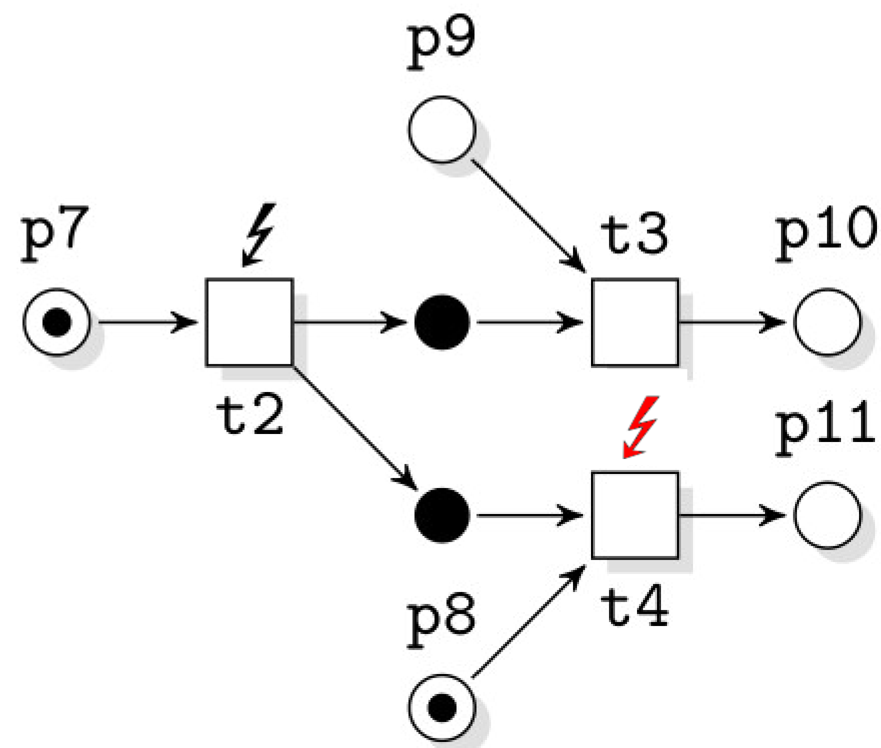

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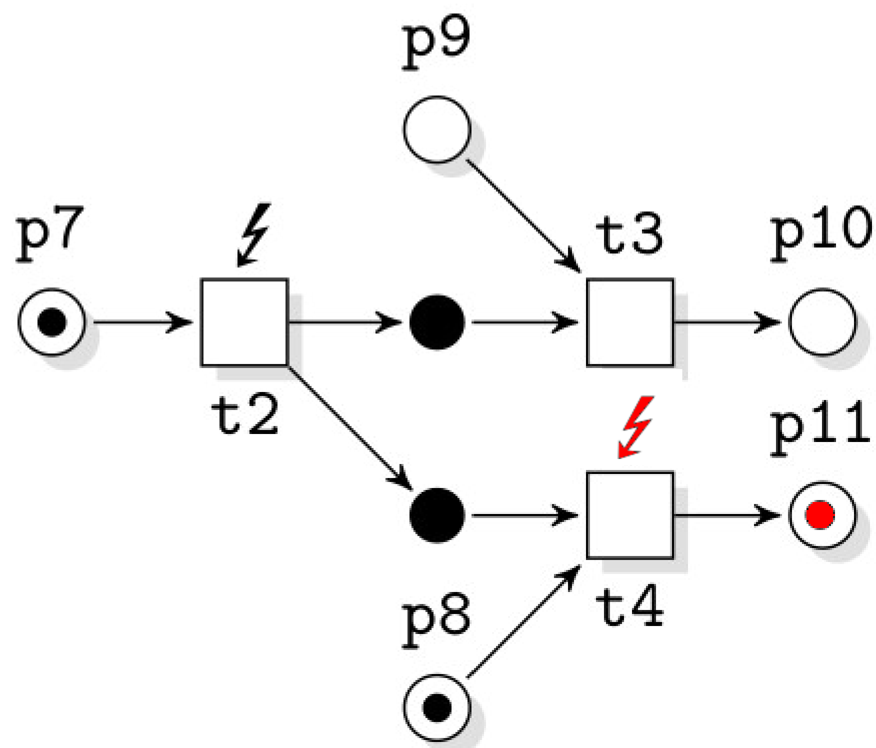

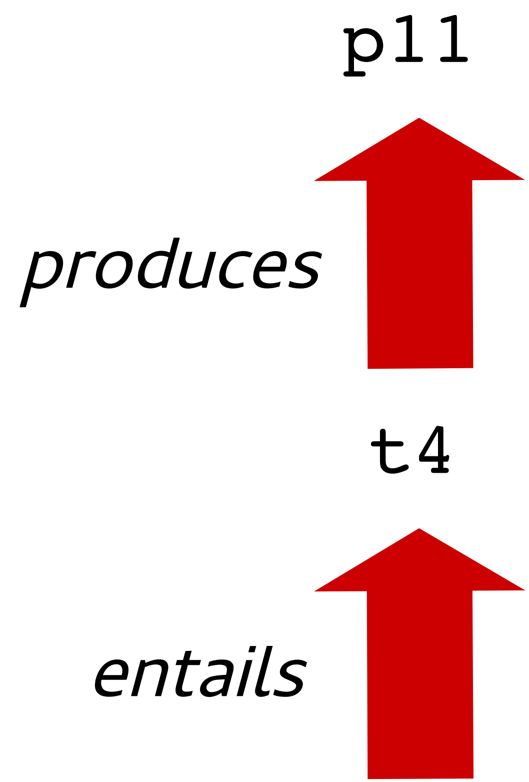

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- Contrary To Duty (CTD) structures:

  situations in which a primary obligation exists, and with its violation, a secondary obligation comes into existence.

- Common in e.g. compensatory norms.

A simple deontic paradox

- You are forbidden to cross the road.
- If you are crossing the road,
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```
obl(not cross)
if cross then obl(cross)
cross
```

```
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```

contradiction

You mustn't cross the road.

If you are crossing the road,
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- Usual solution: **preferences** amonst possible worlds.

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- Alternative solution:
  - implicit temporal meaning: *if you started crossing the road, finish to cross the road!*

→ Let us increase granularity of the model...

You mustn't cross the road. **Version 1**

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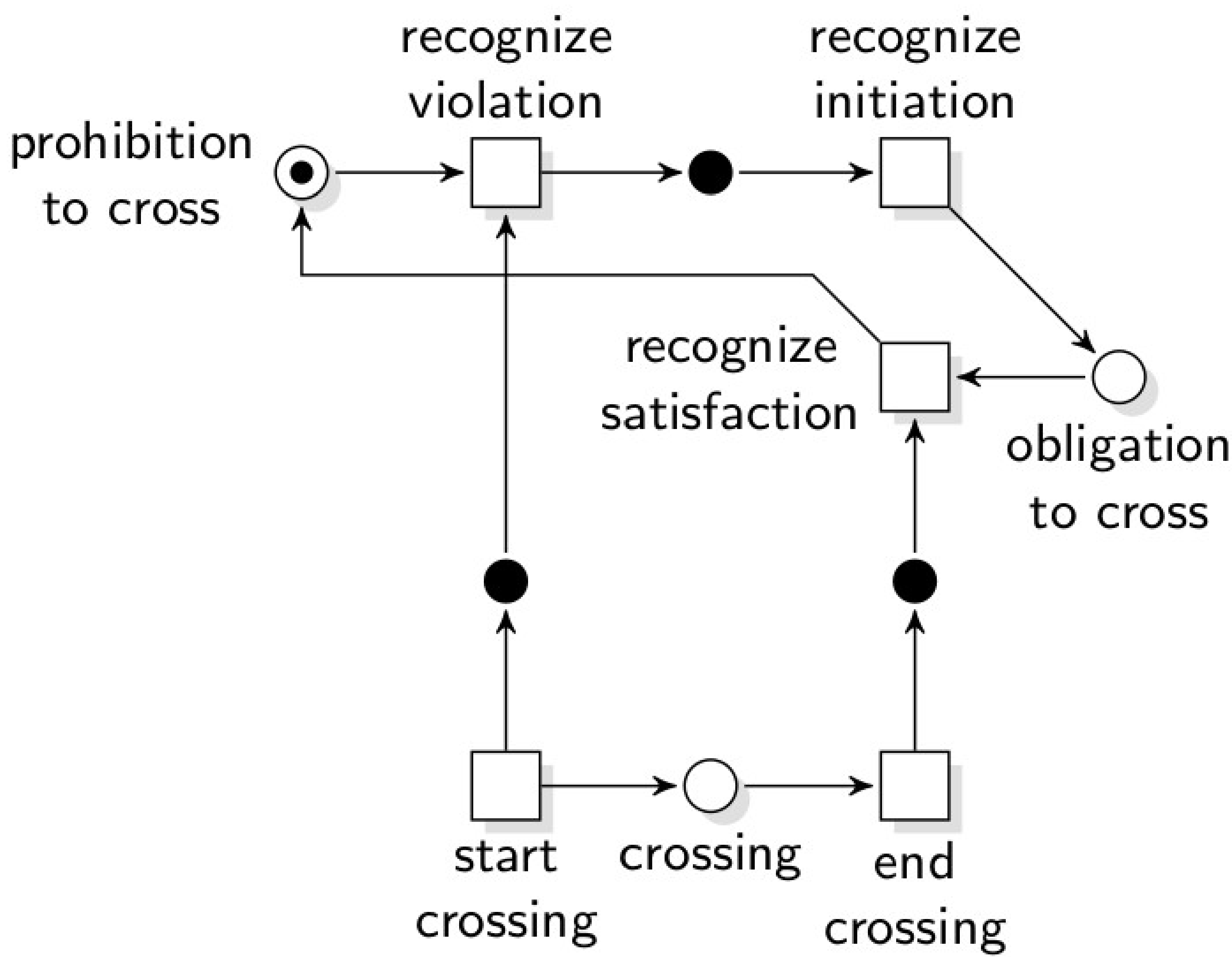

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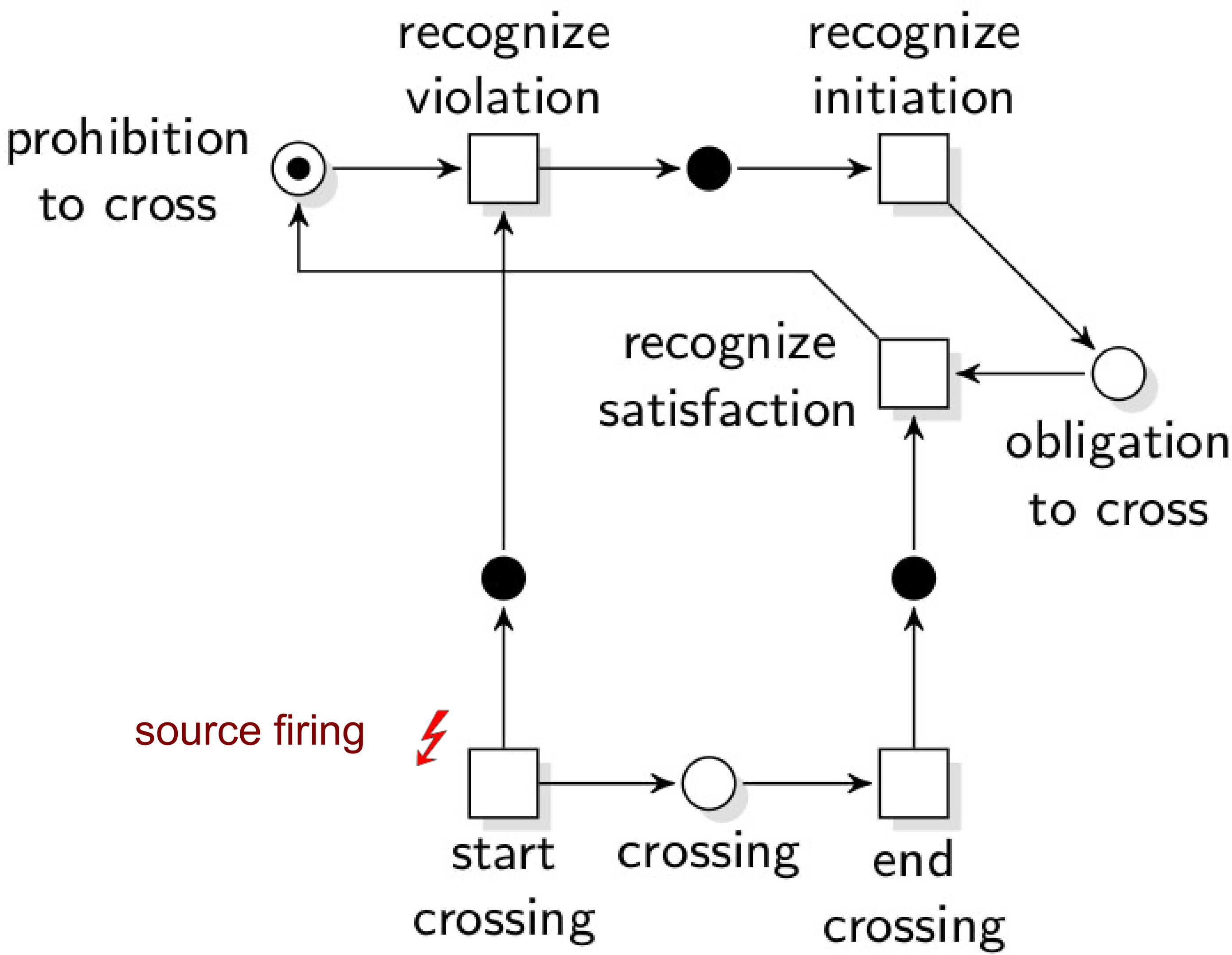
Version 1

- You start crossing.



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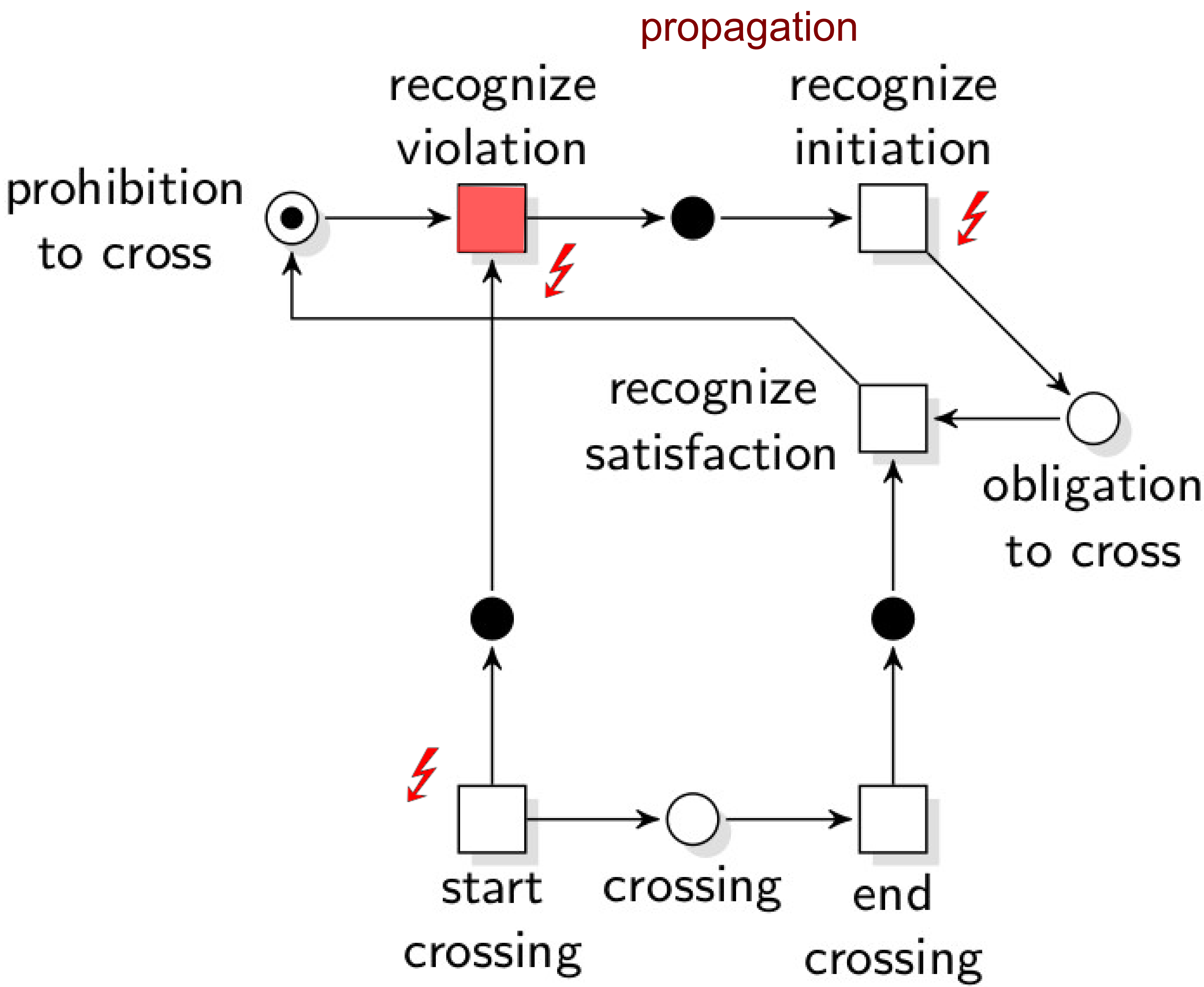

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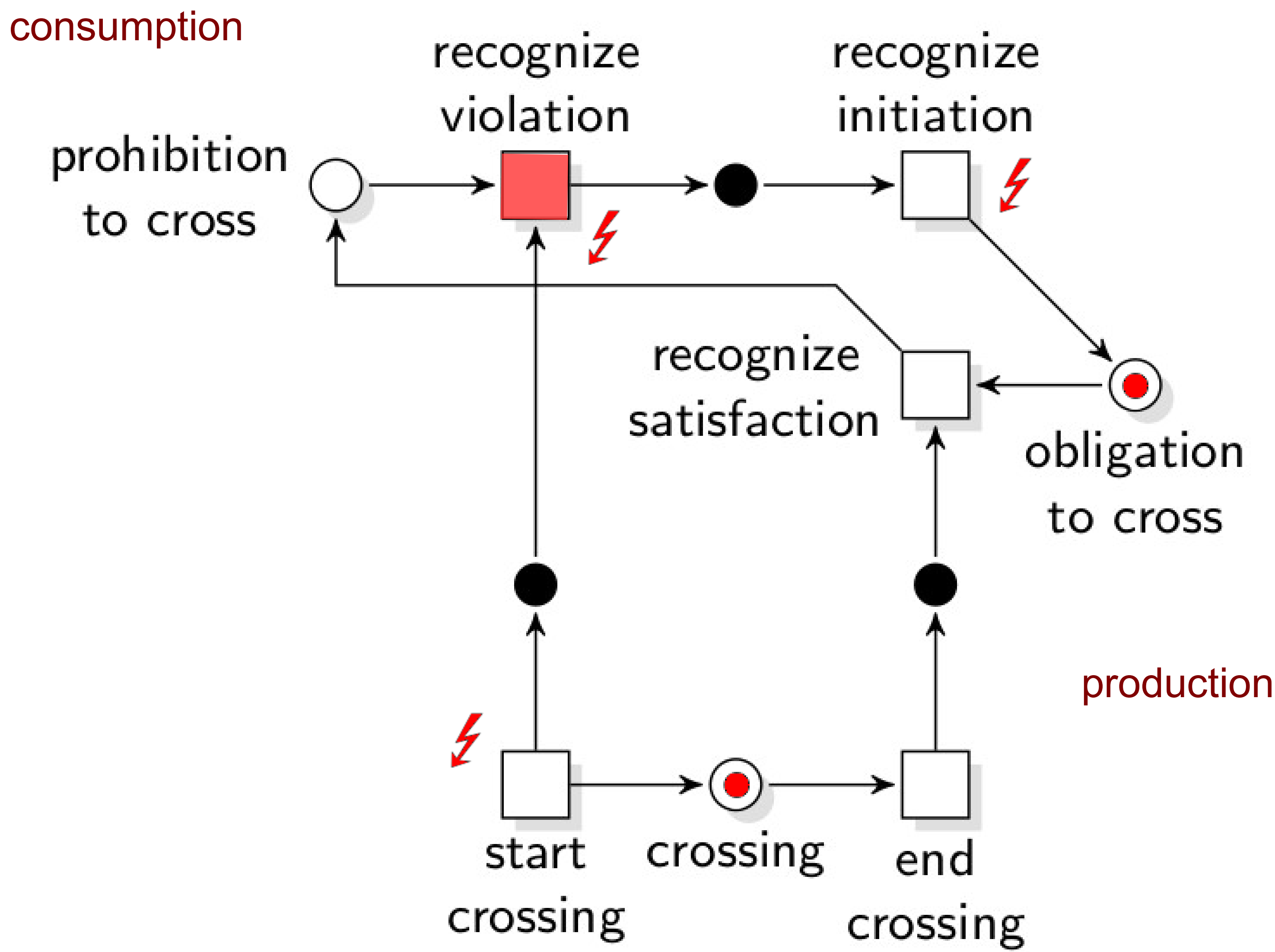

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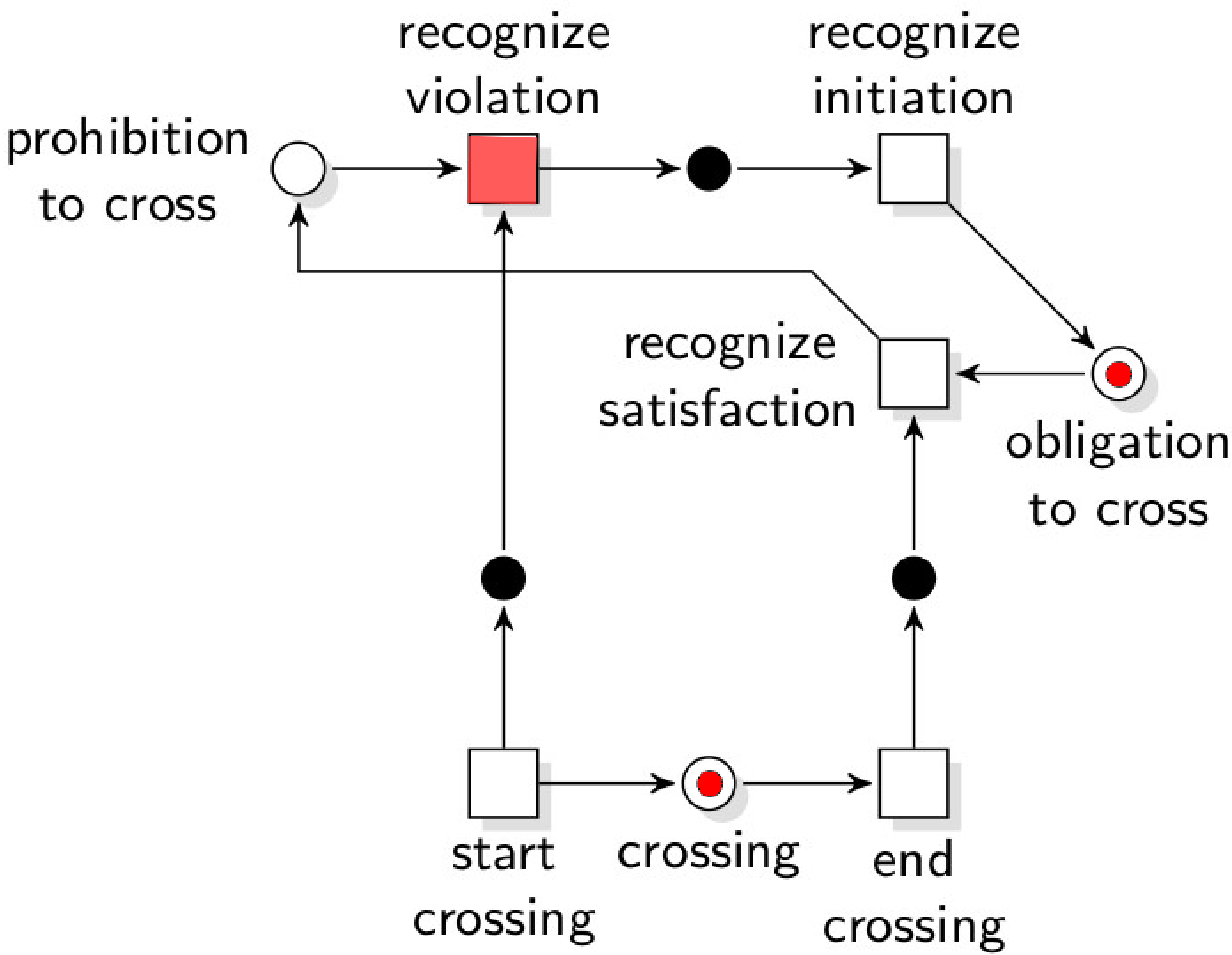

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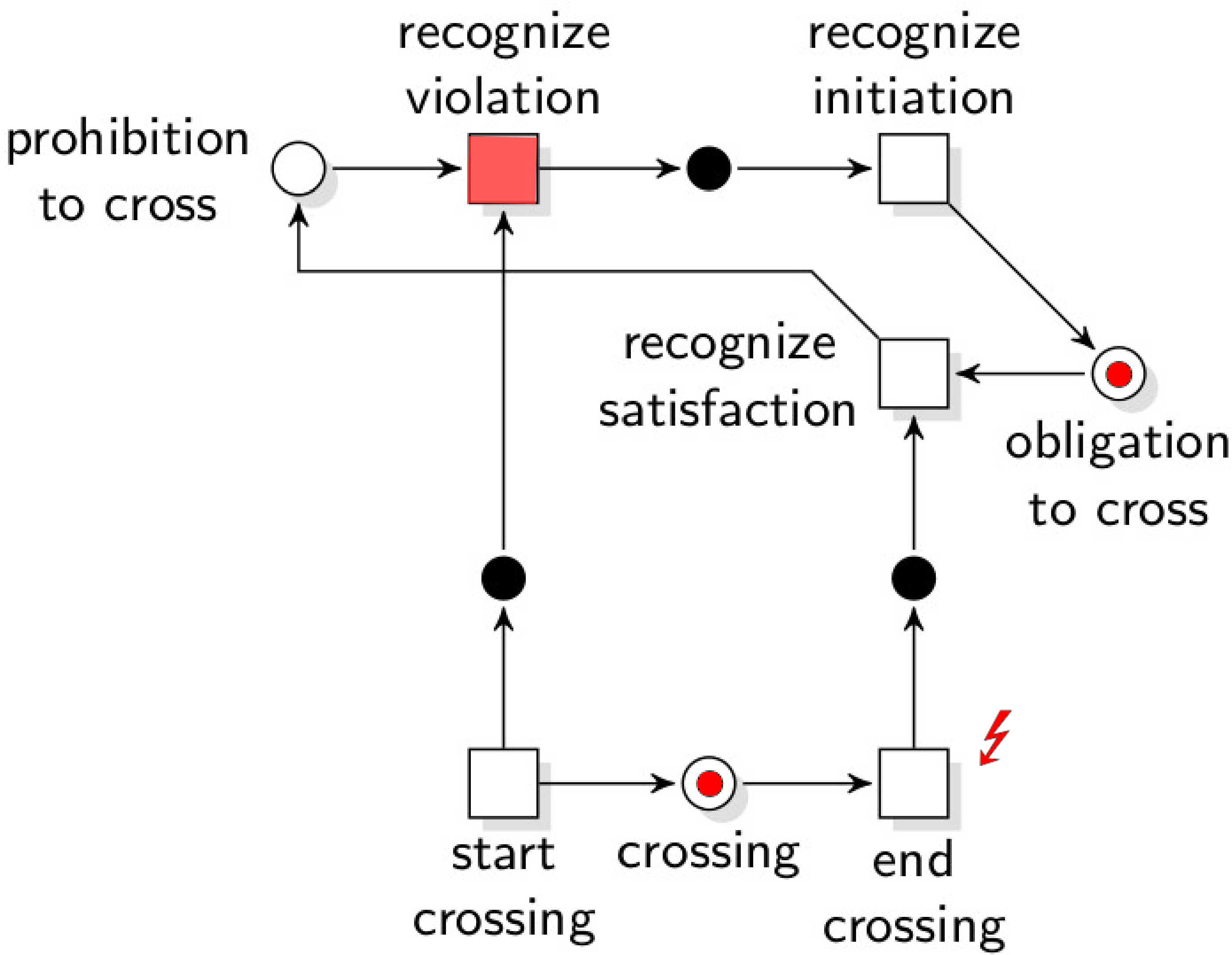

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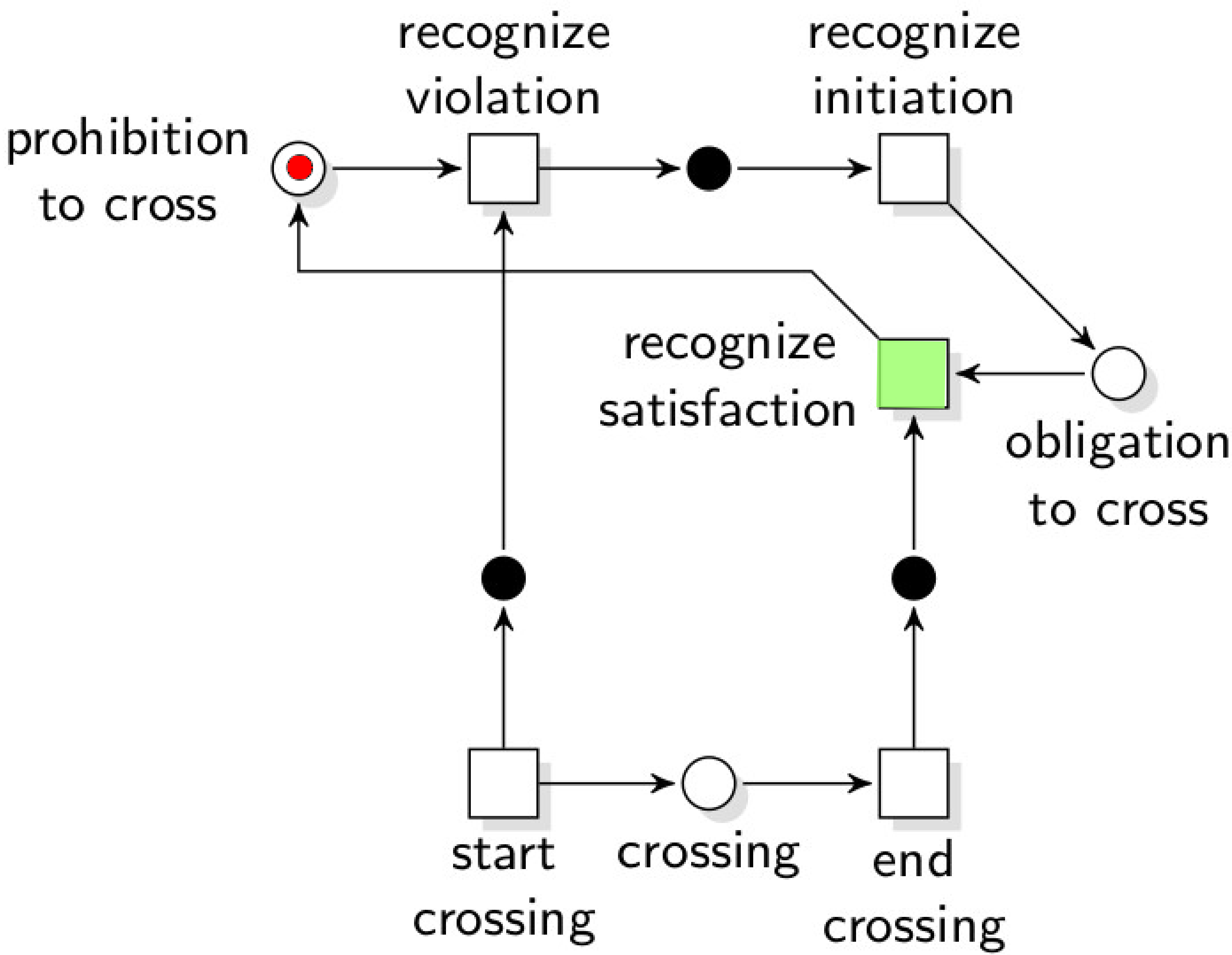

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Version 2

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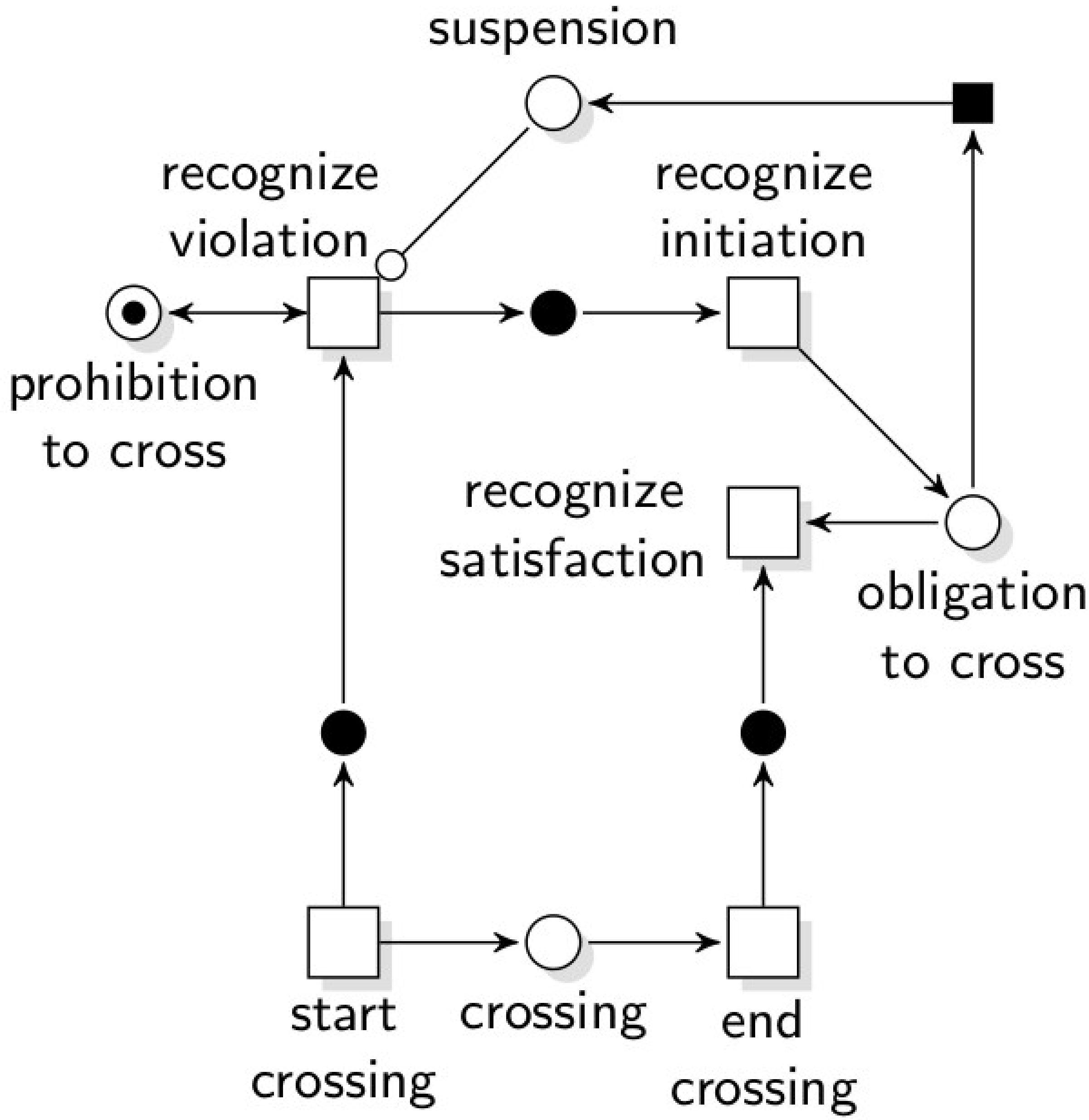

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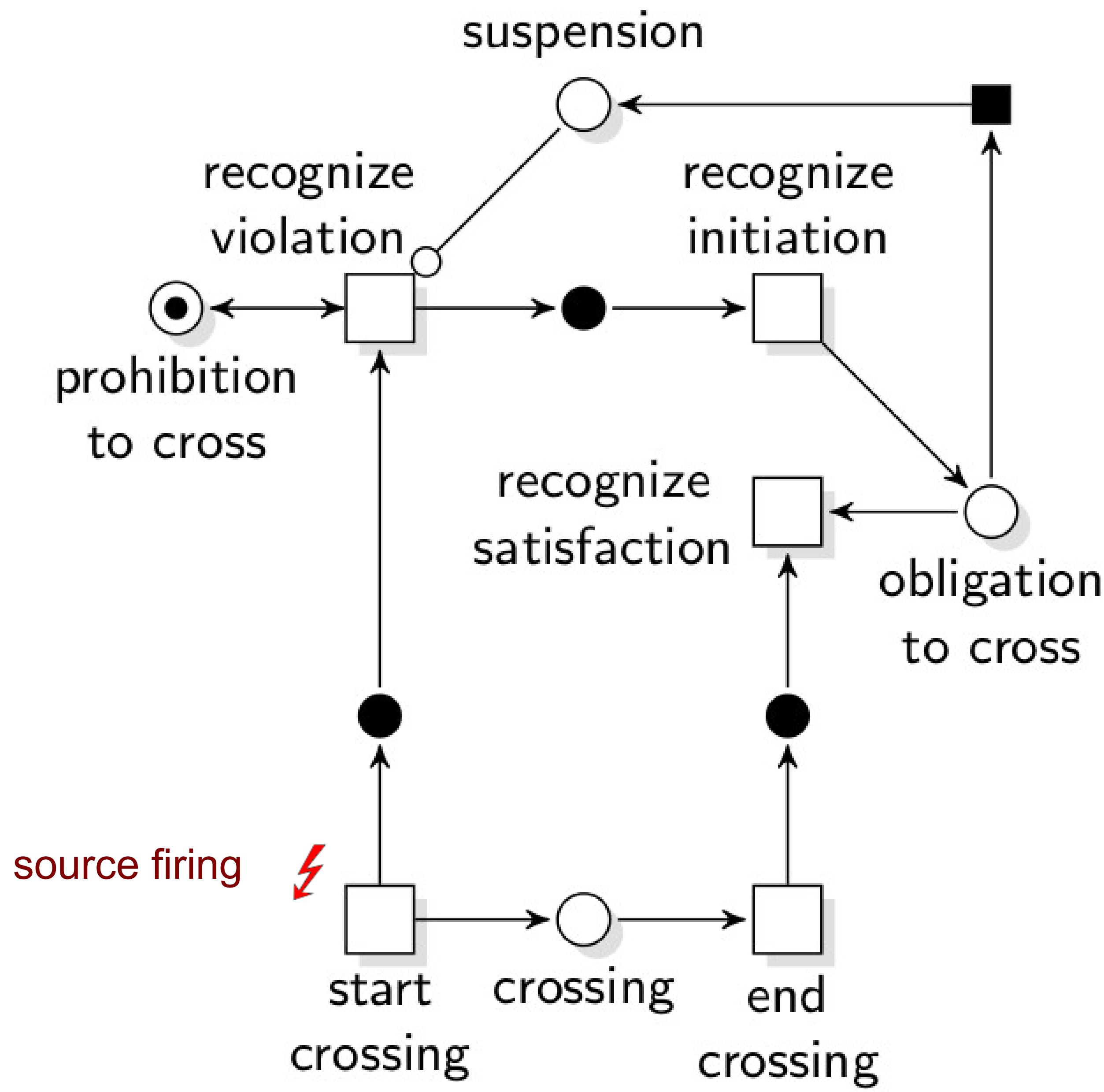

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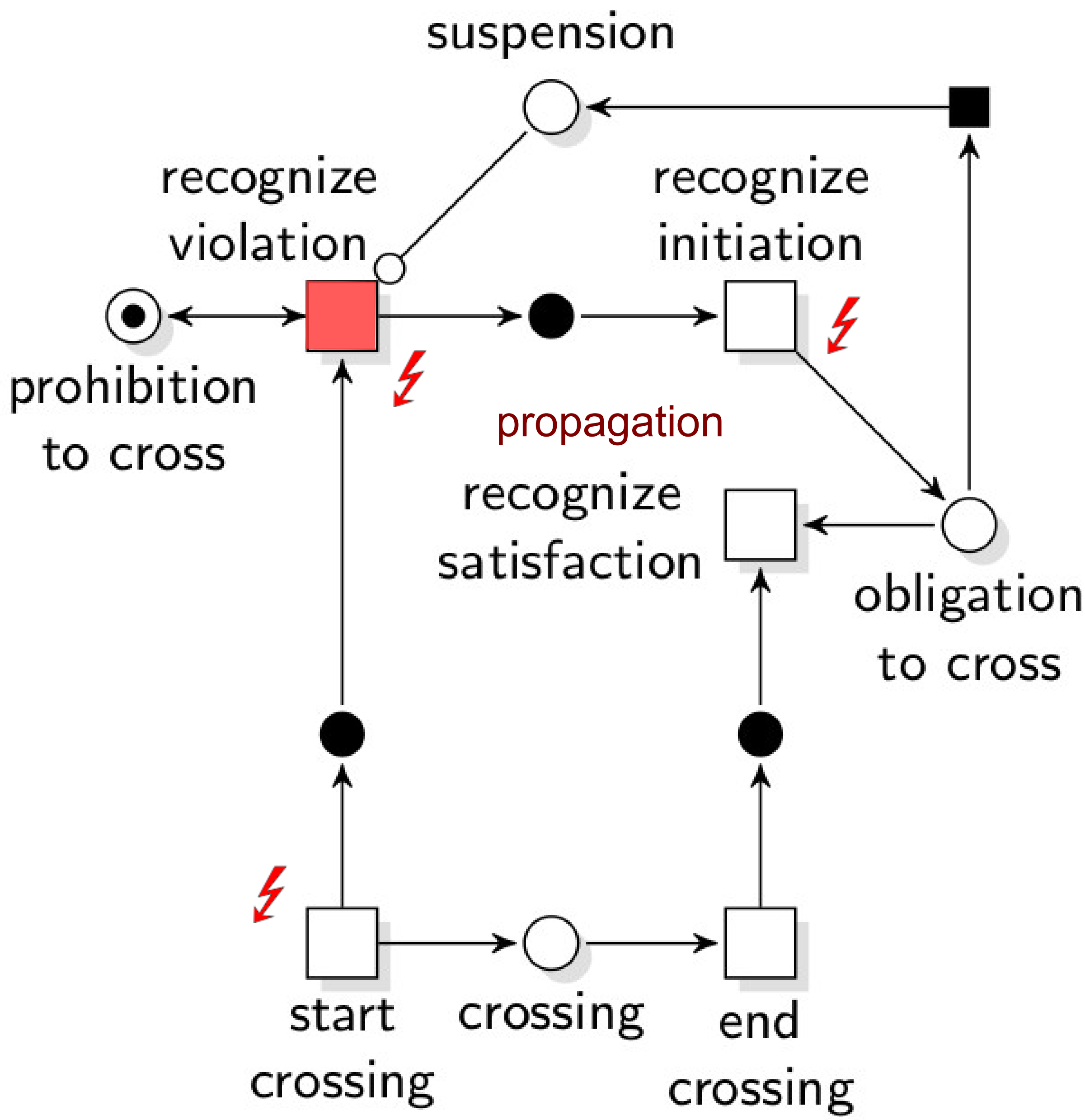

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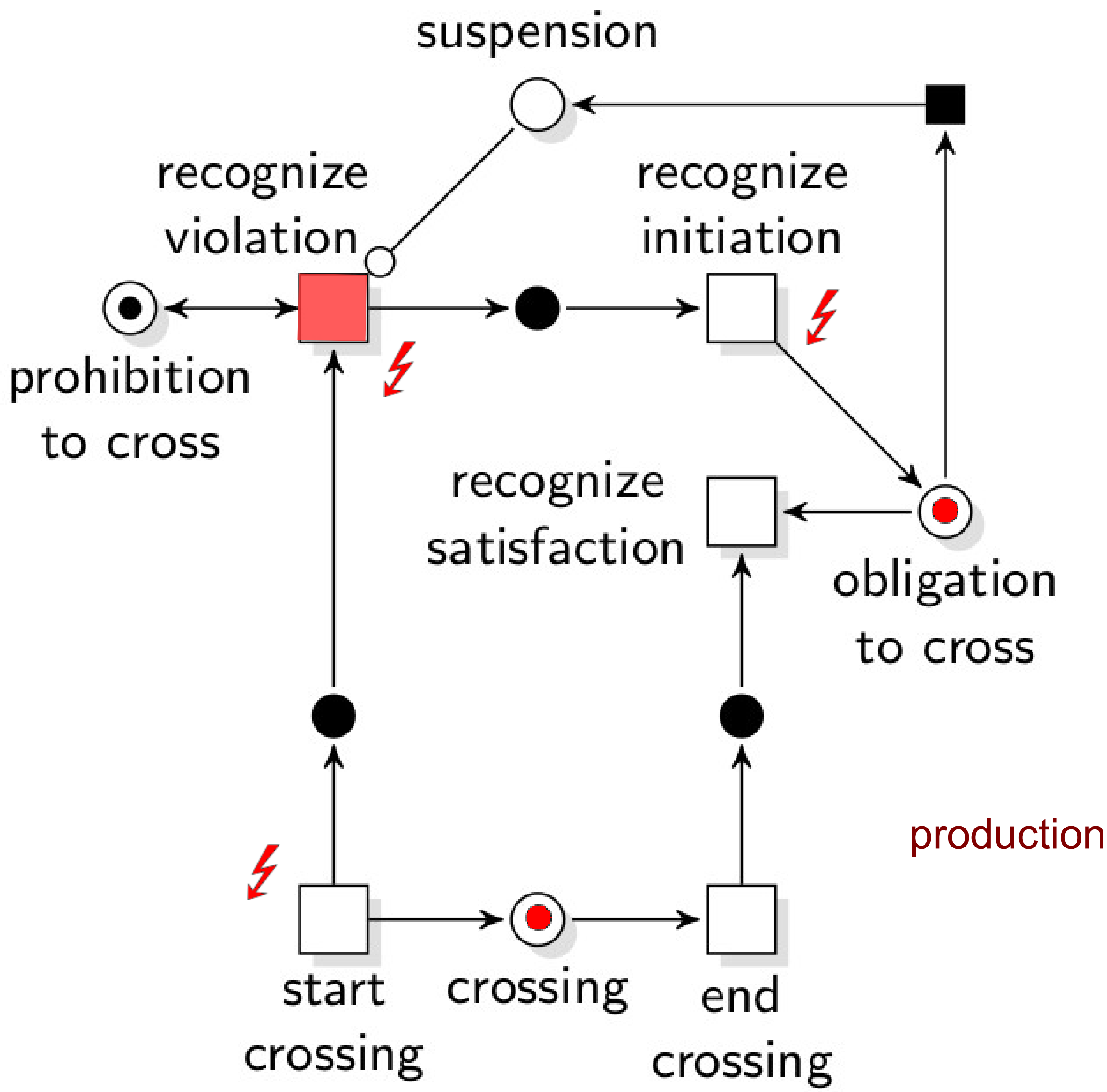

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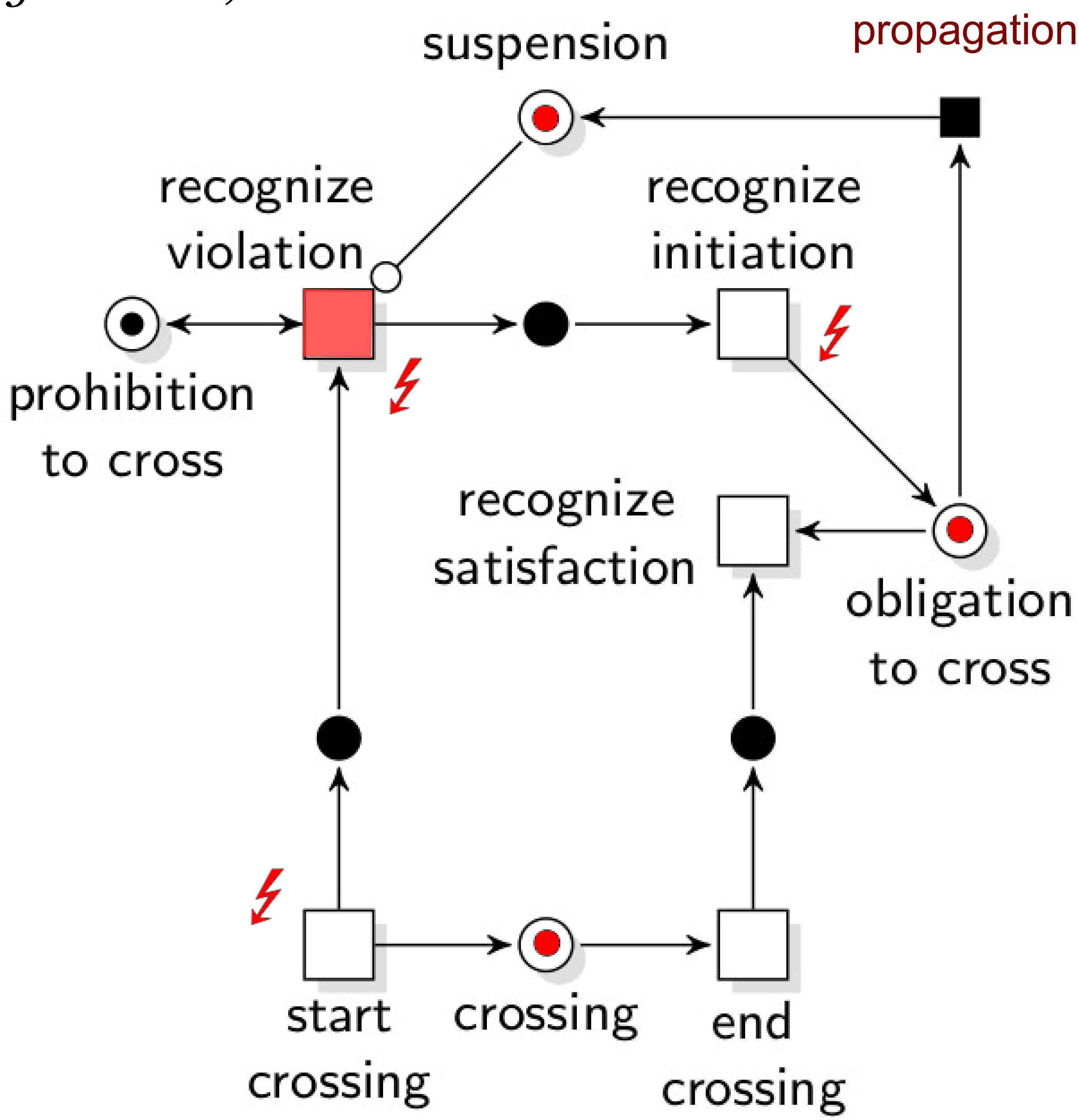

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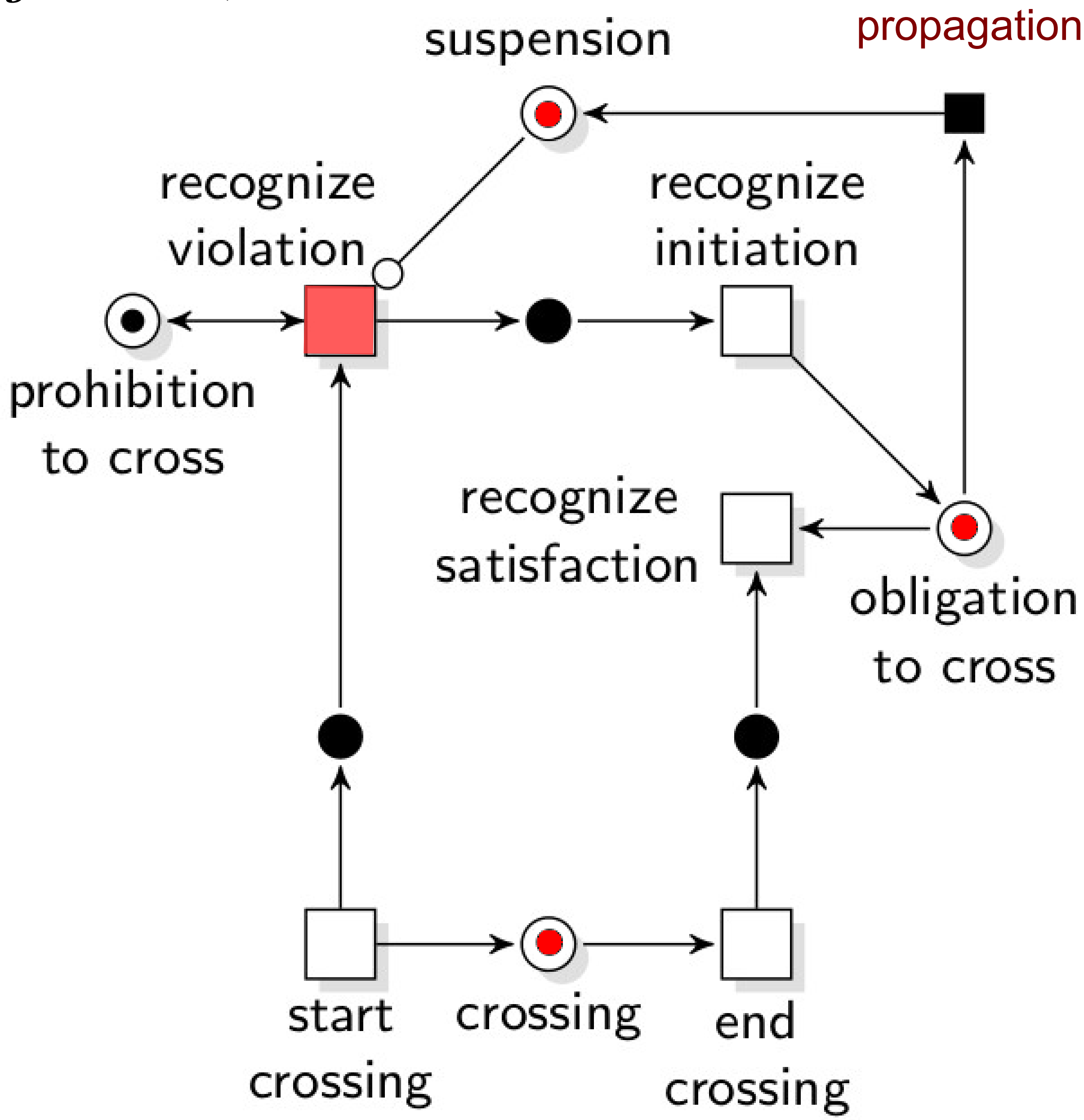

Obligation has higher priority (topology captures *salience*).

Gentle murderer

[Forrester, 1984]

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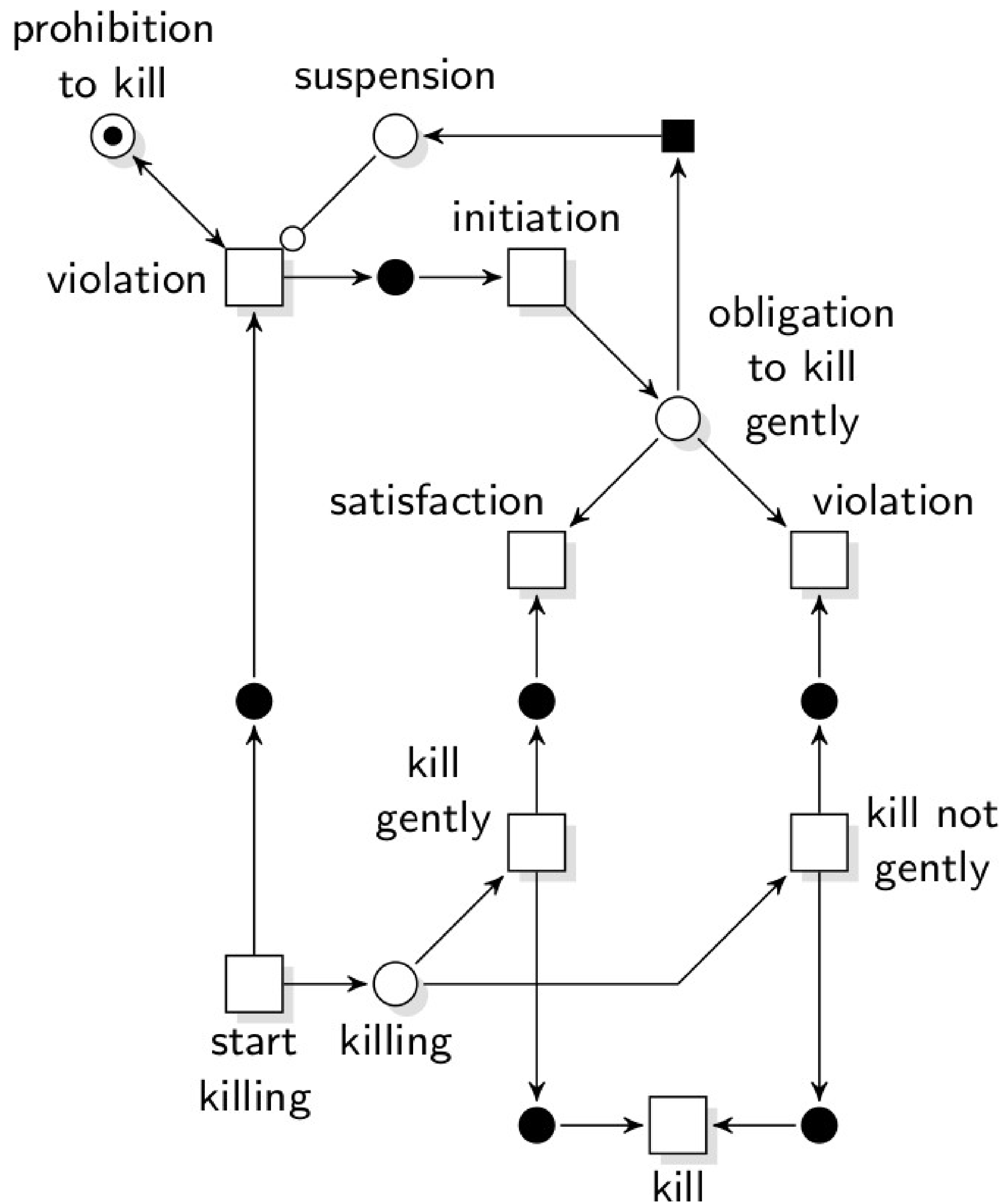

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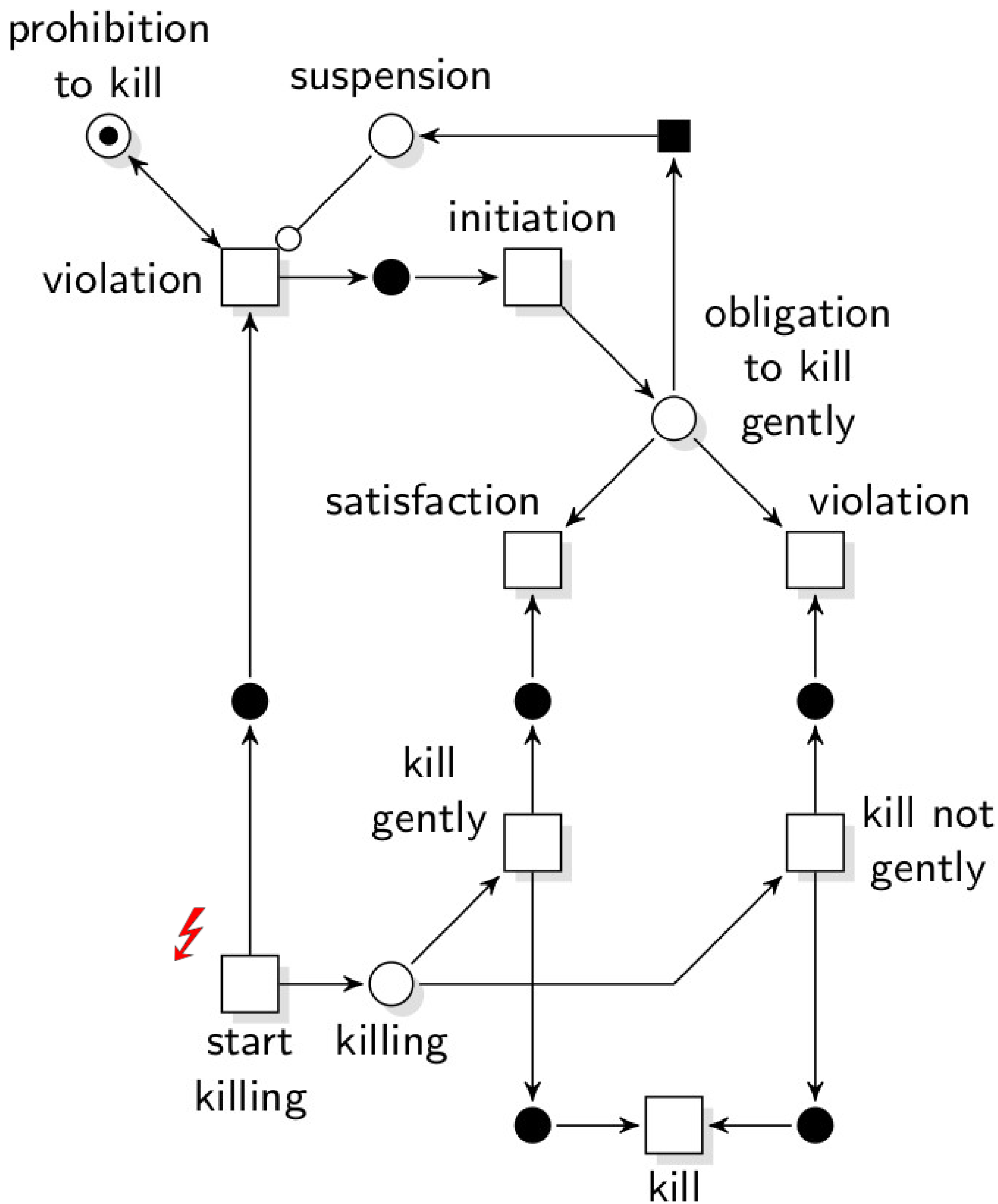

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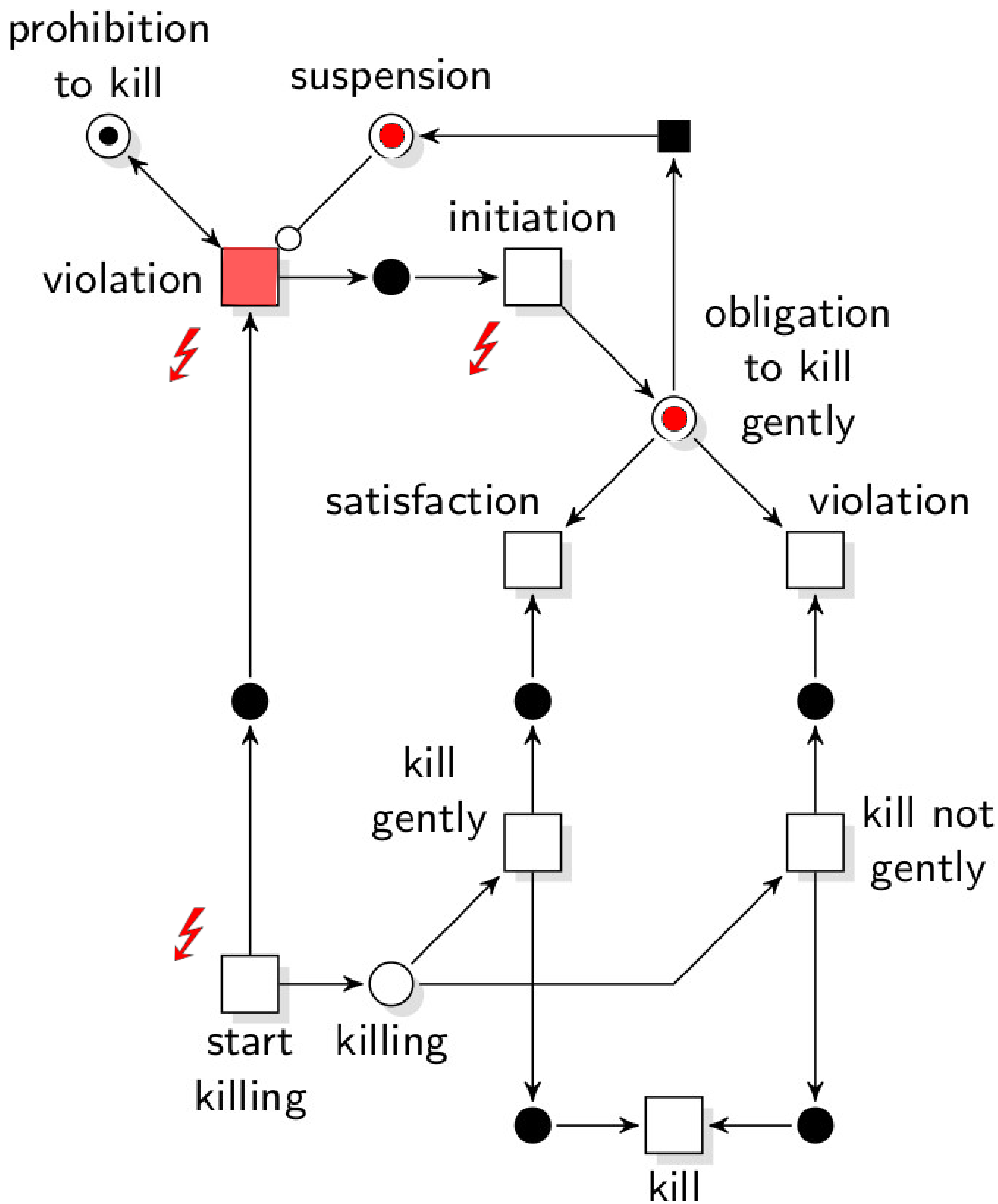

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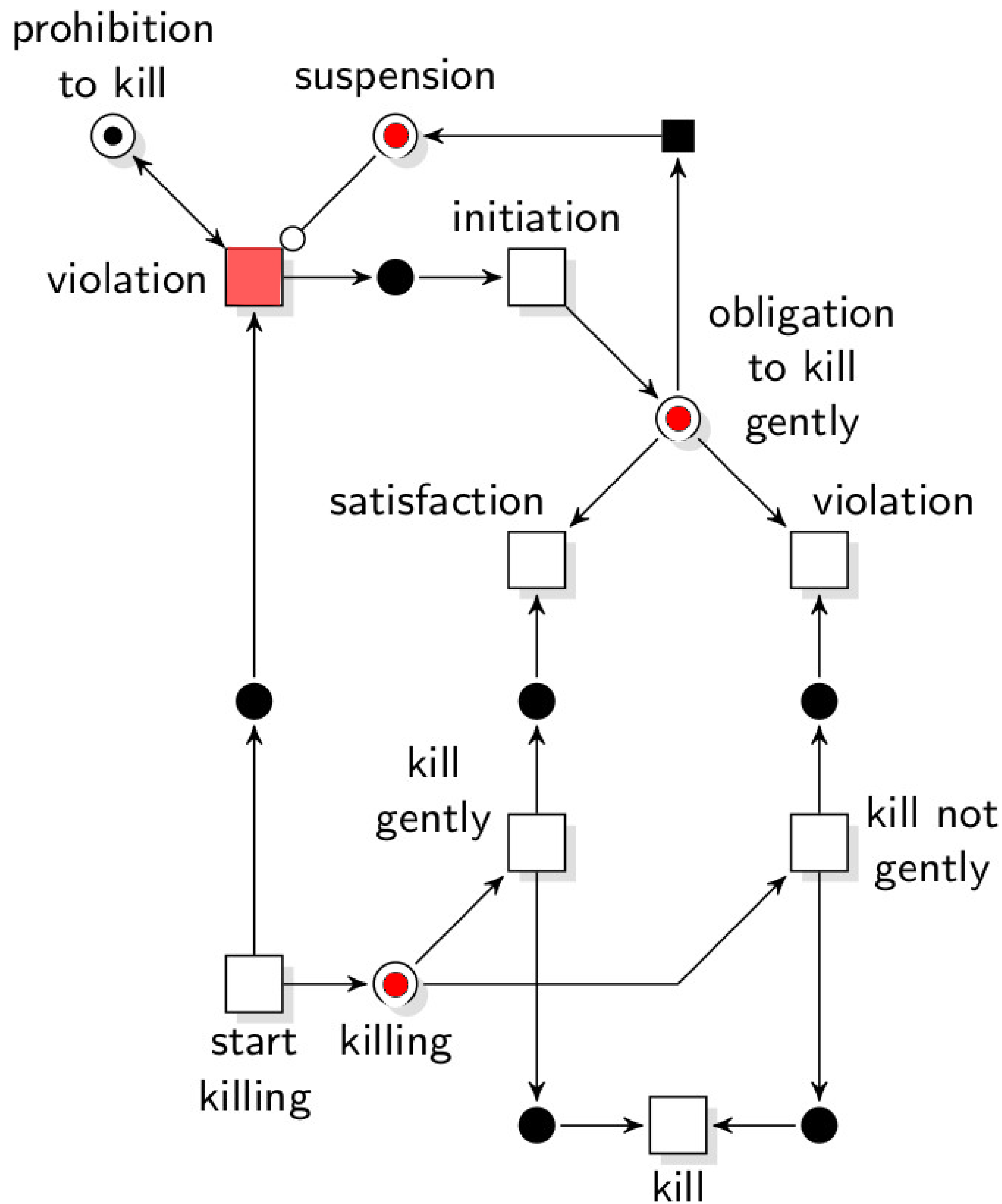

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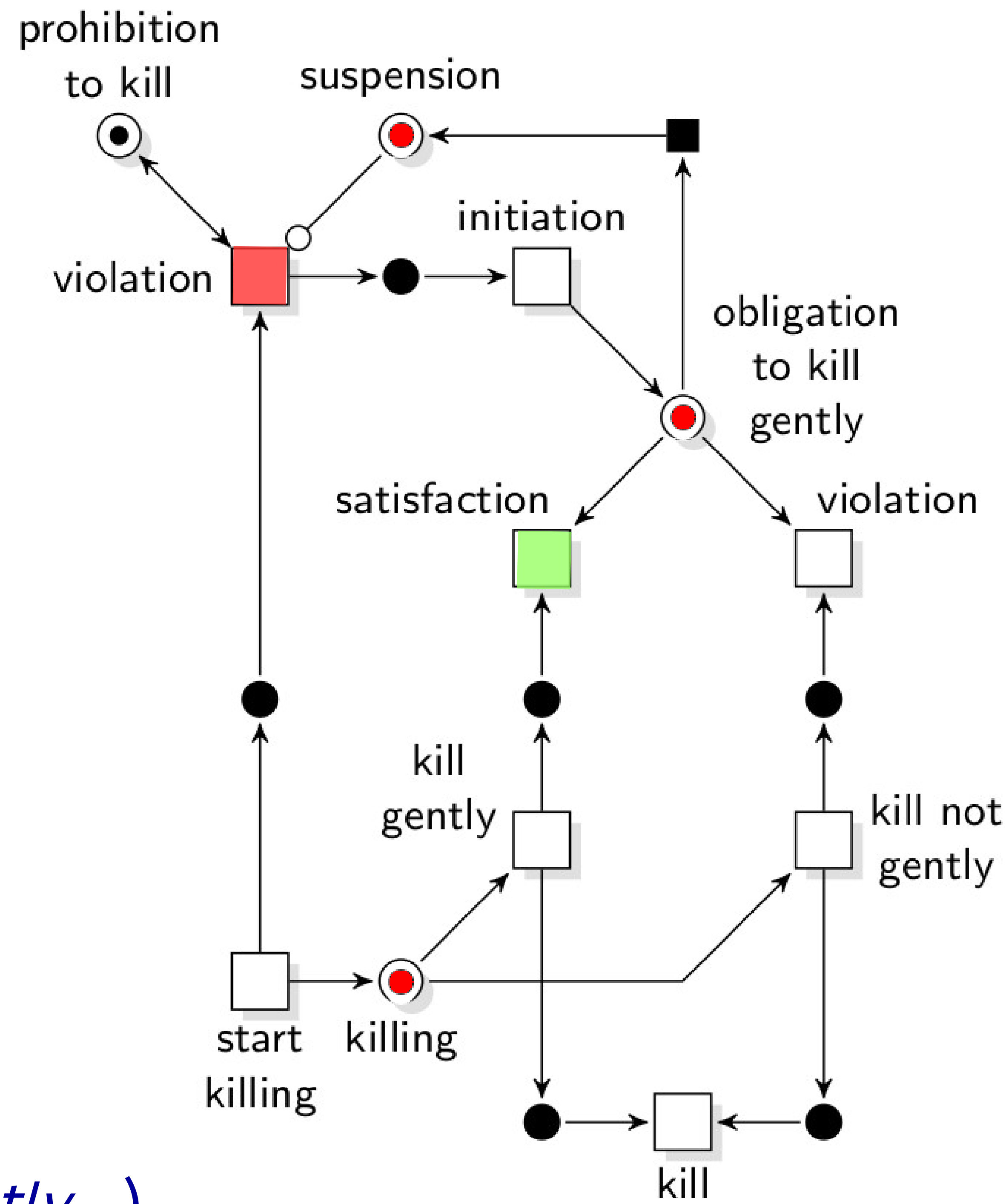

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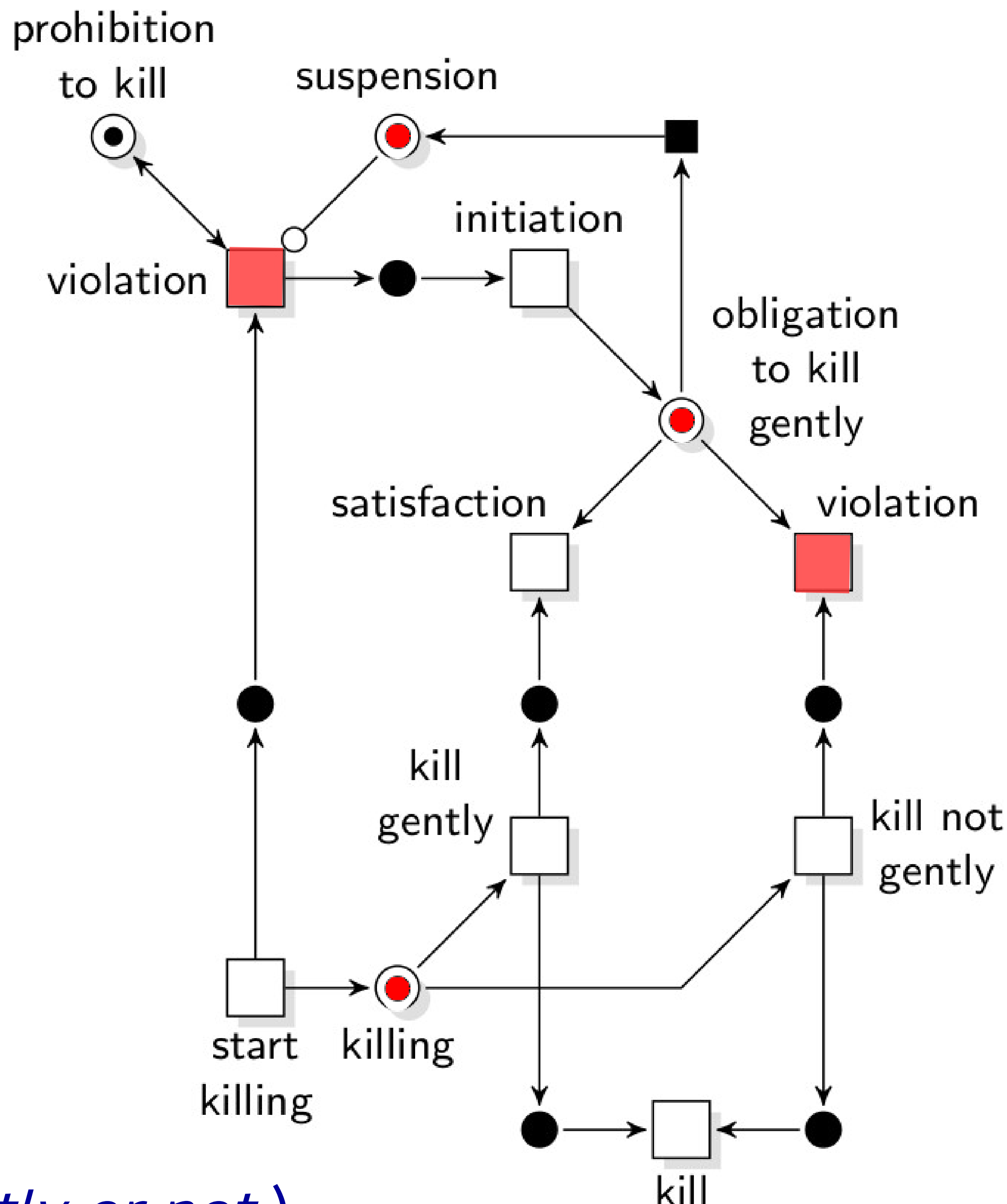

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  (*either he kills gently or not.*)

White fence

[Prakken & Sergot, 1996]

There must be no fence.
If there is a fence, it must be a white fence.
If the cottage is by the sea, there may be a fence.

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exception, implicit default

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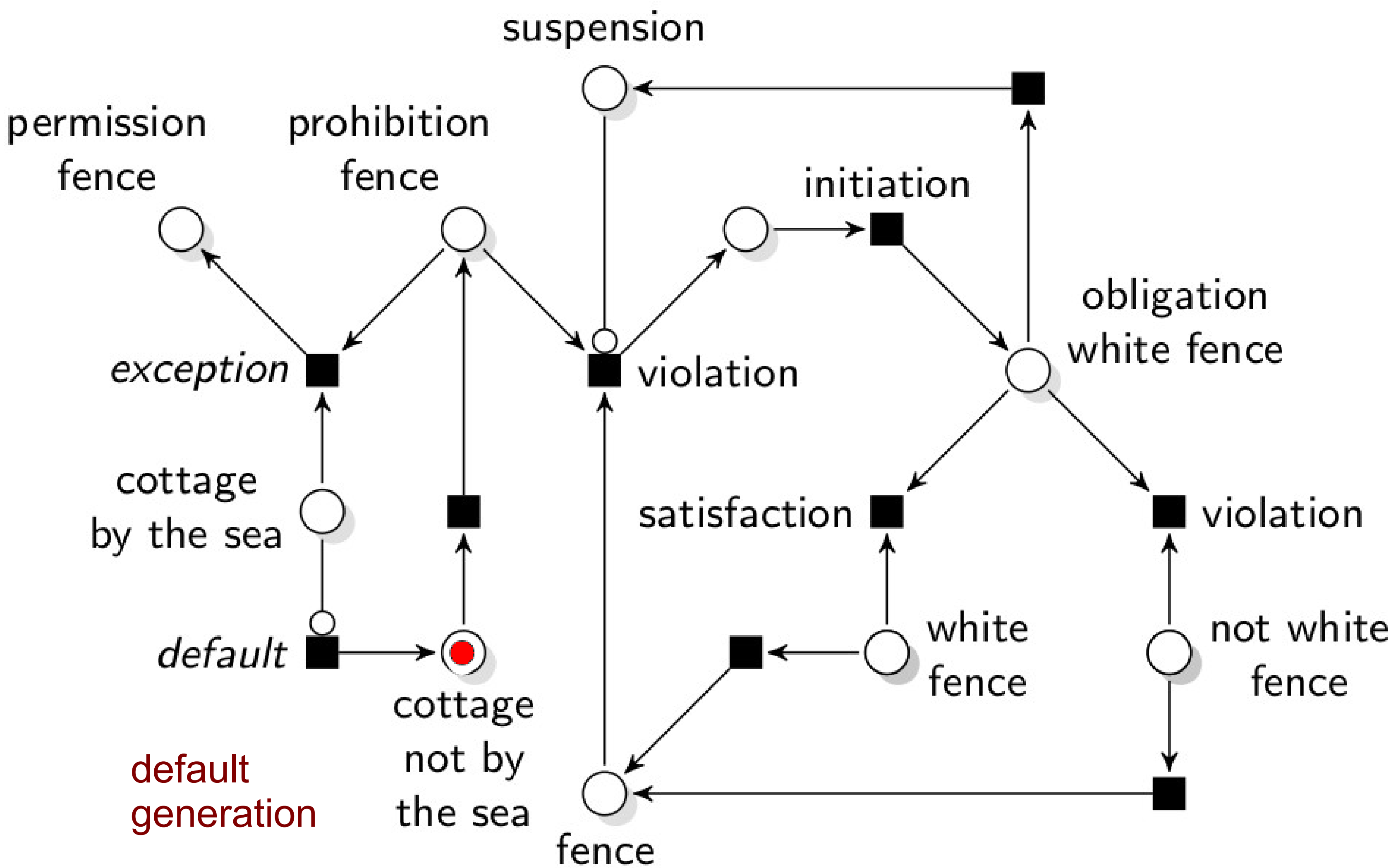

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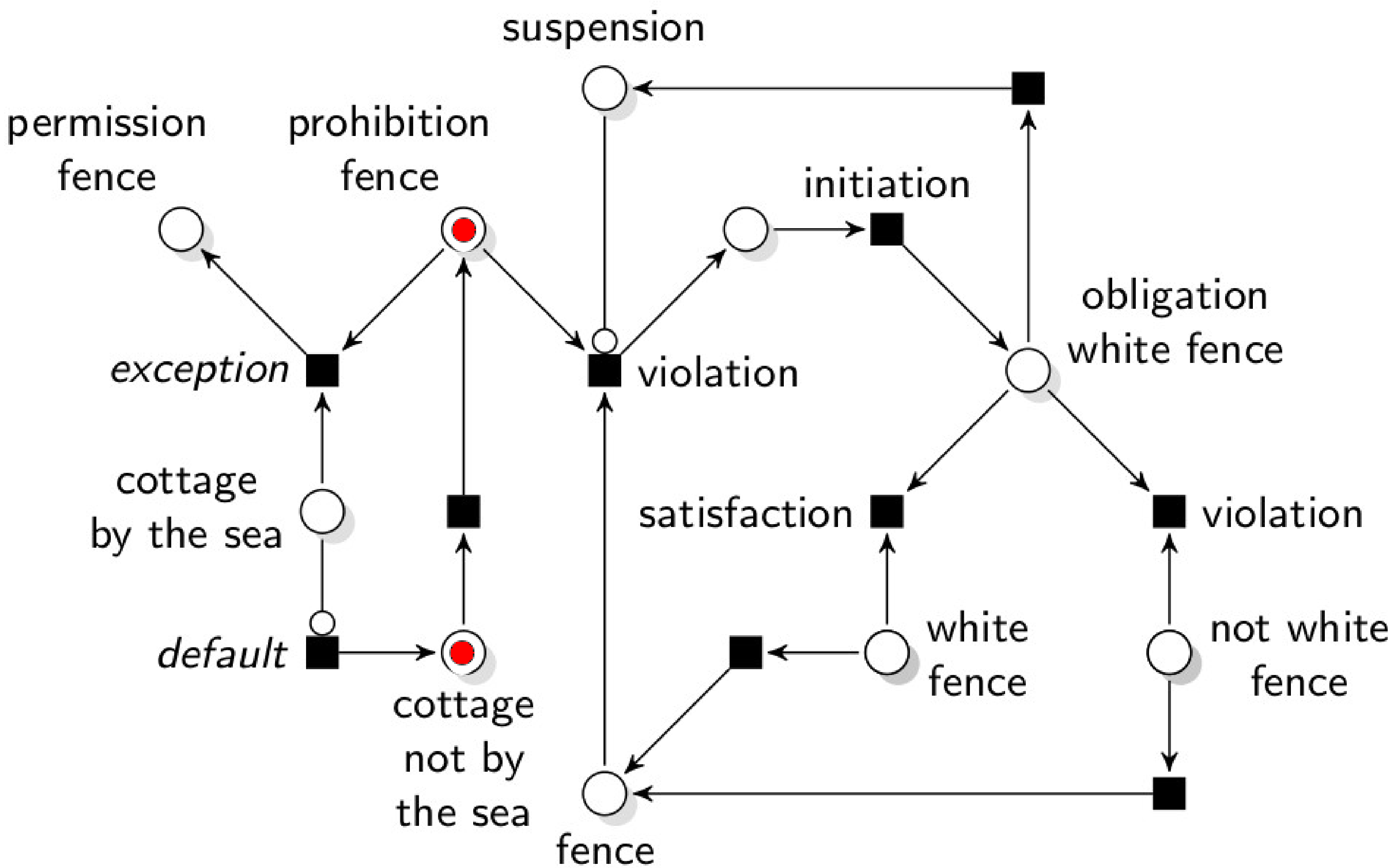

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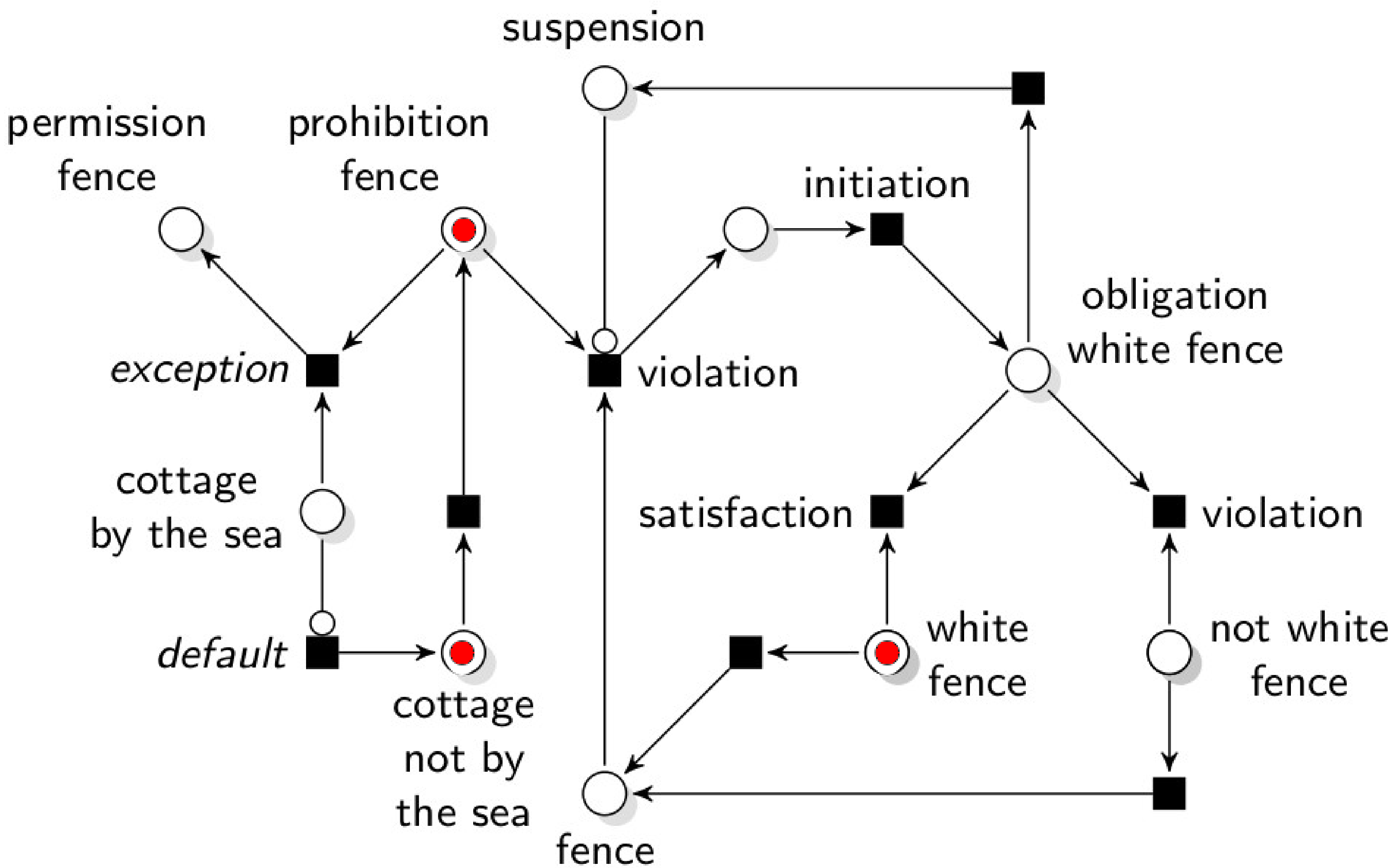

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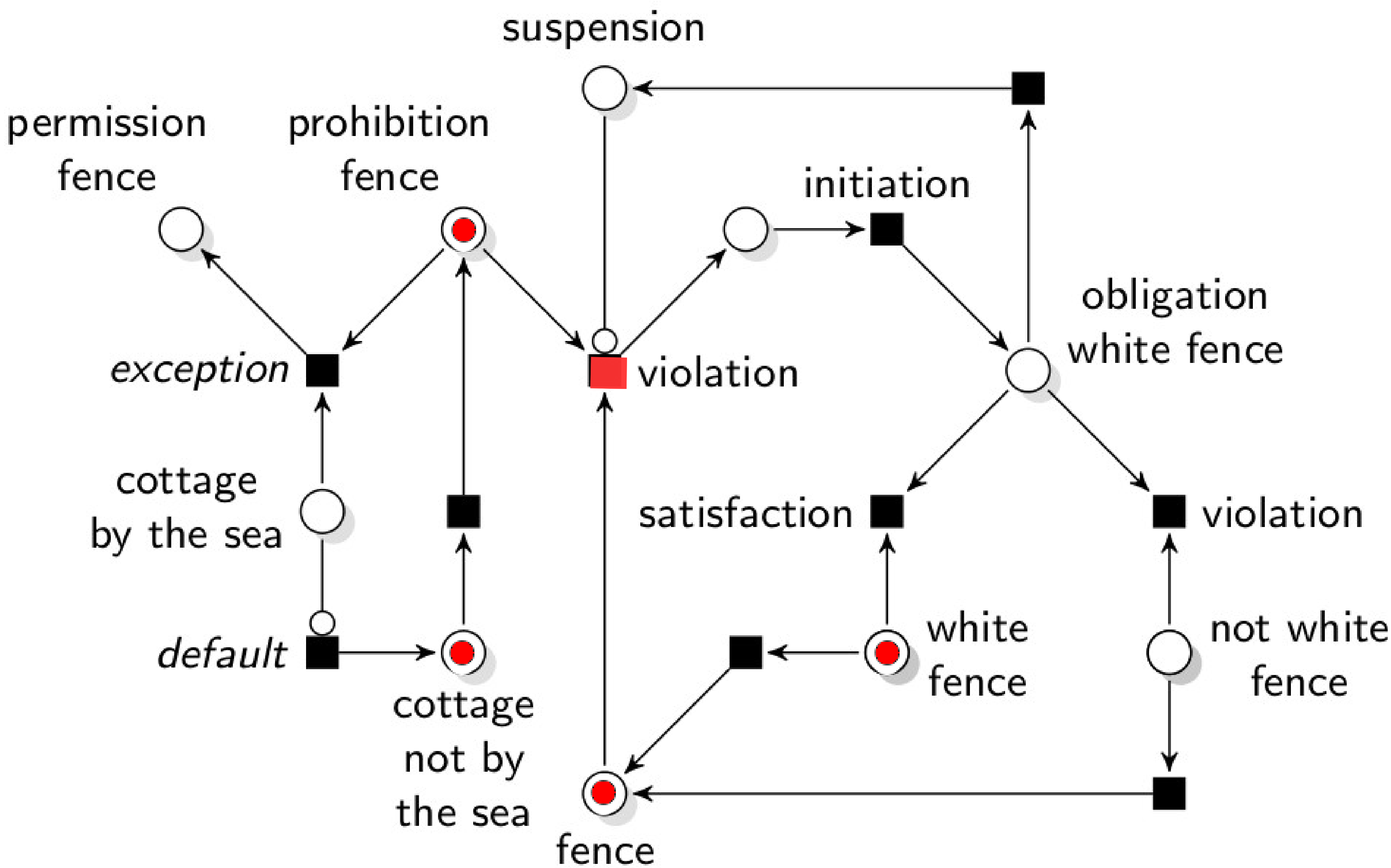

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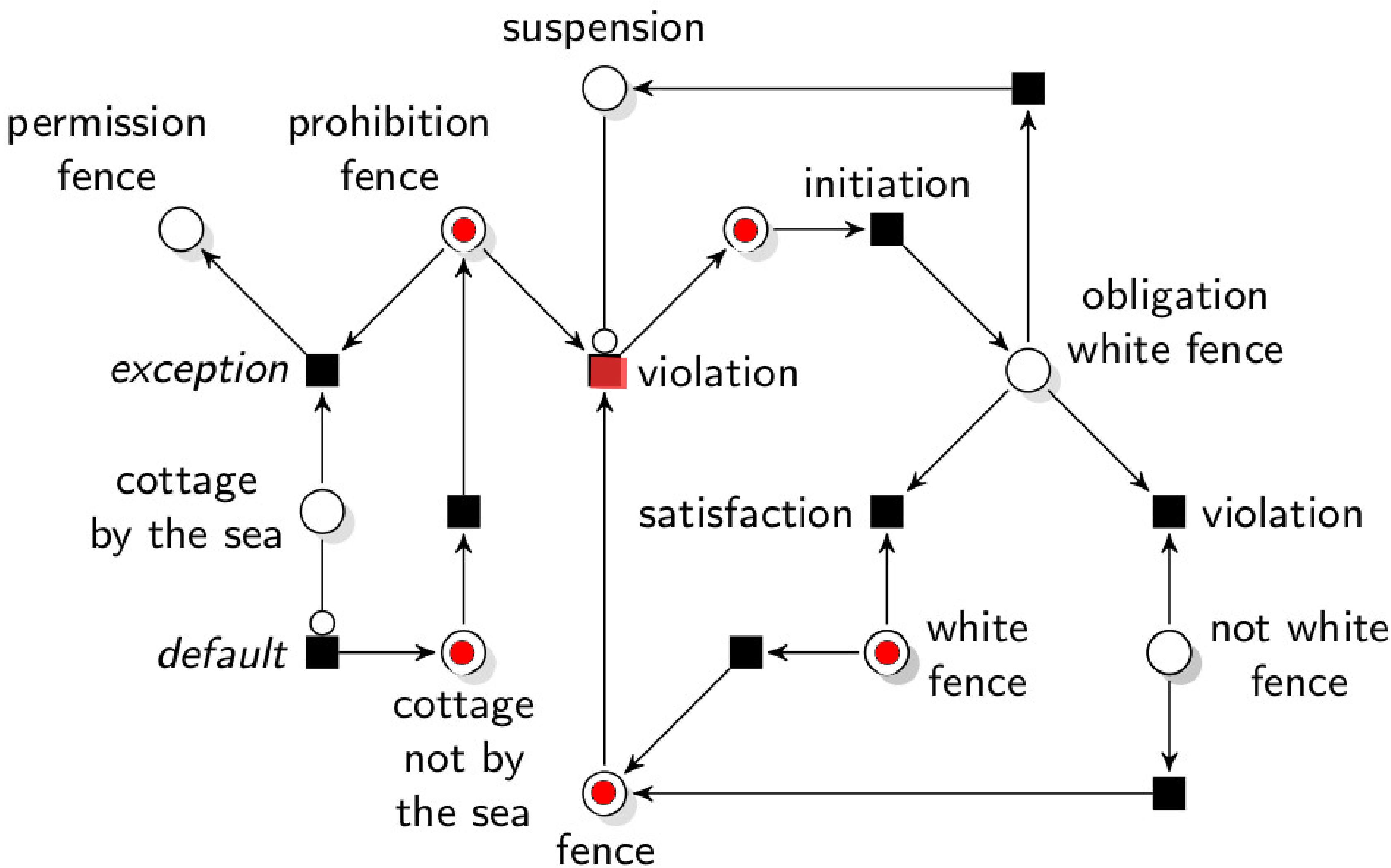

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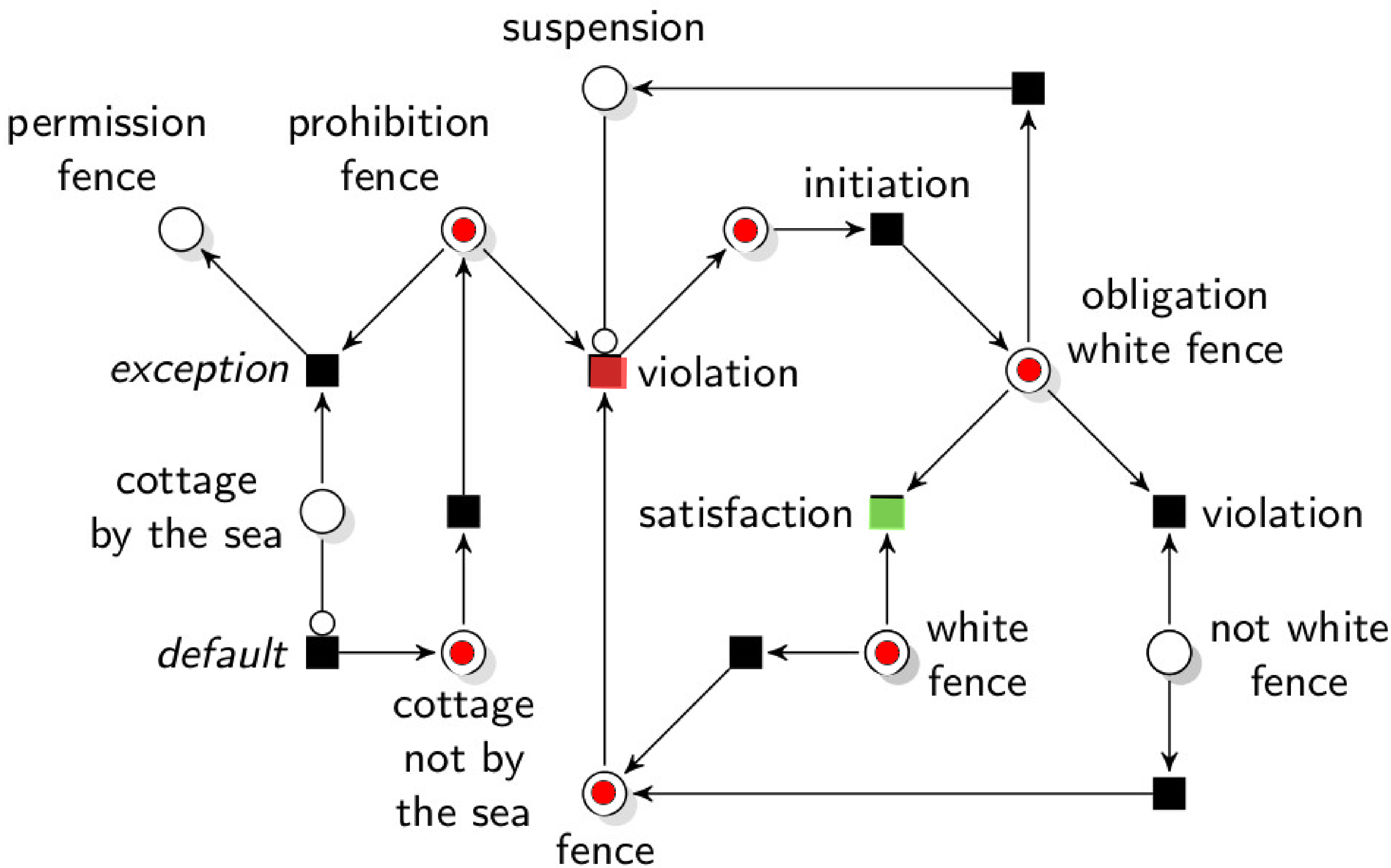

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Privacy Act

[Governatori, 2015]

- *The collection of personal information is forbidden, unless acting on a court order authorising it.*
- *The destruction of illegally collected personal information before accessing it is a defence against the illegal collection of the personal information.*
- *The collection of medical information is forbidden, unless the entity collecting the medical information is permitted to collect personal information.*

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If Forbidden A and A, then Obligatory B.
Forbidden D. If Permitted A, then Permitted D.

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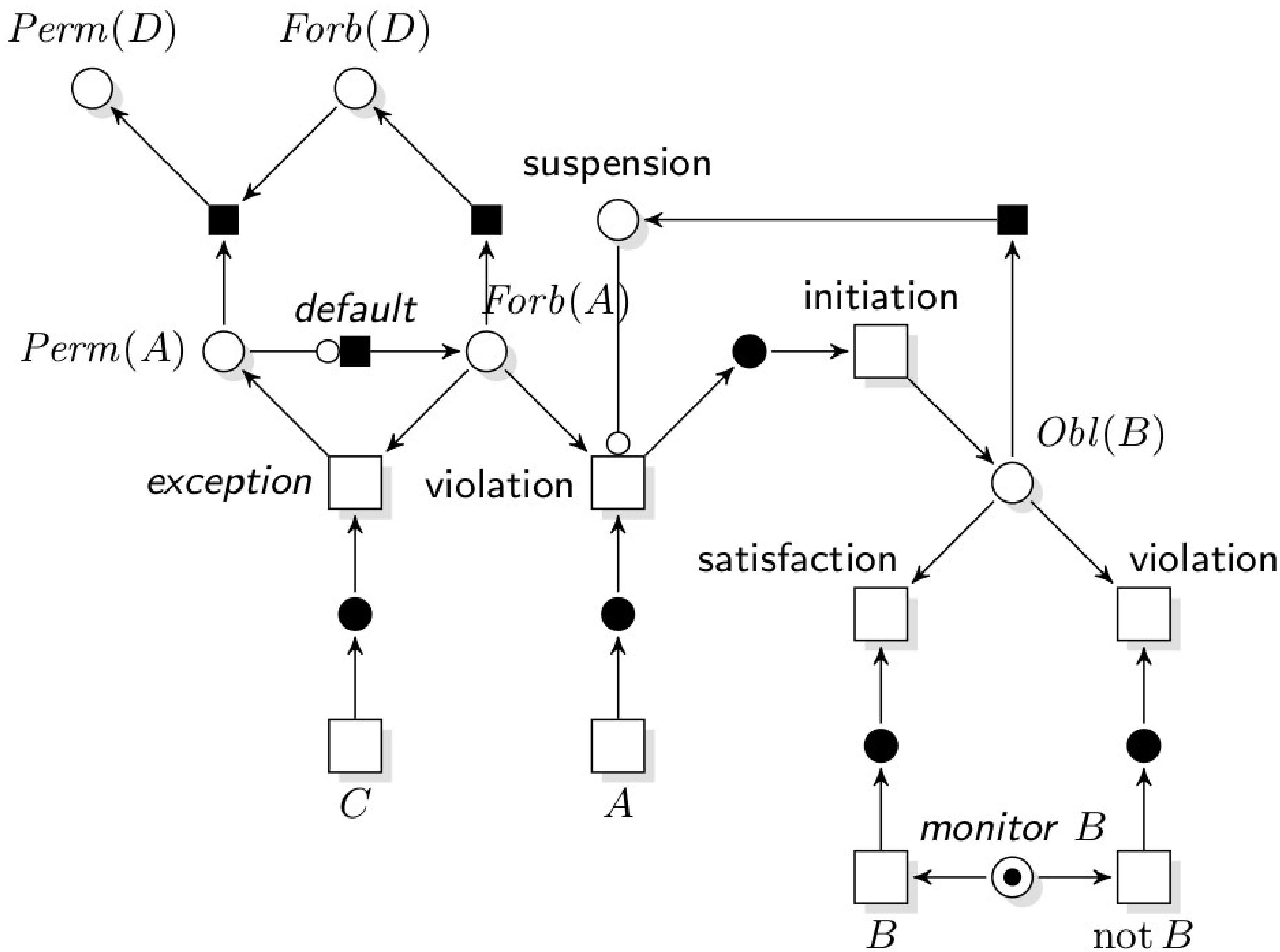

Privacy Act

[Governatori, 2015]

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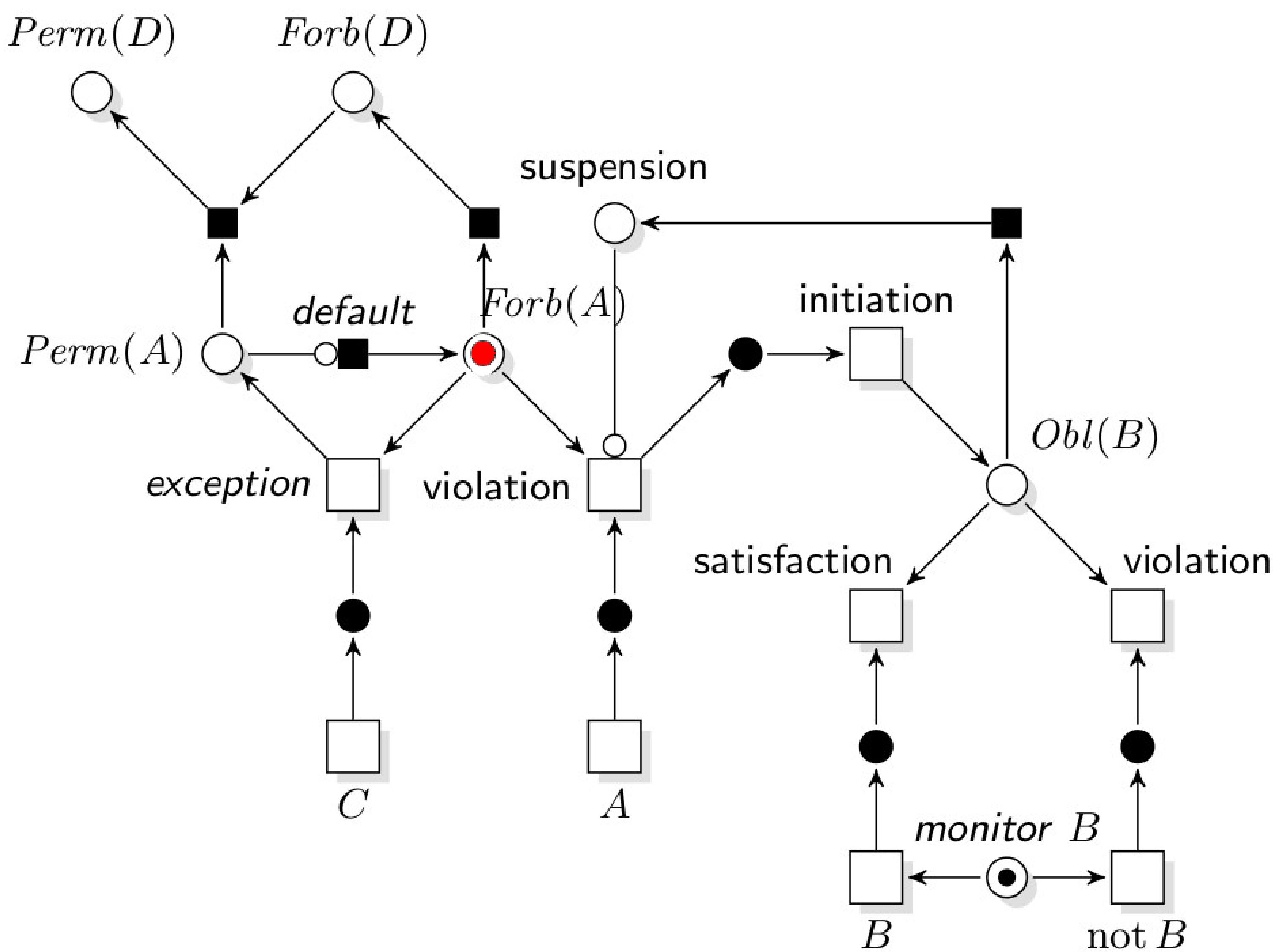

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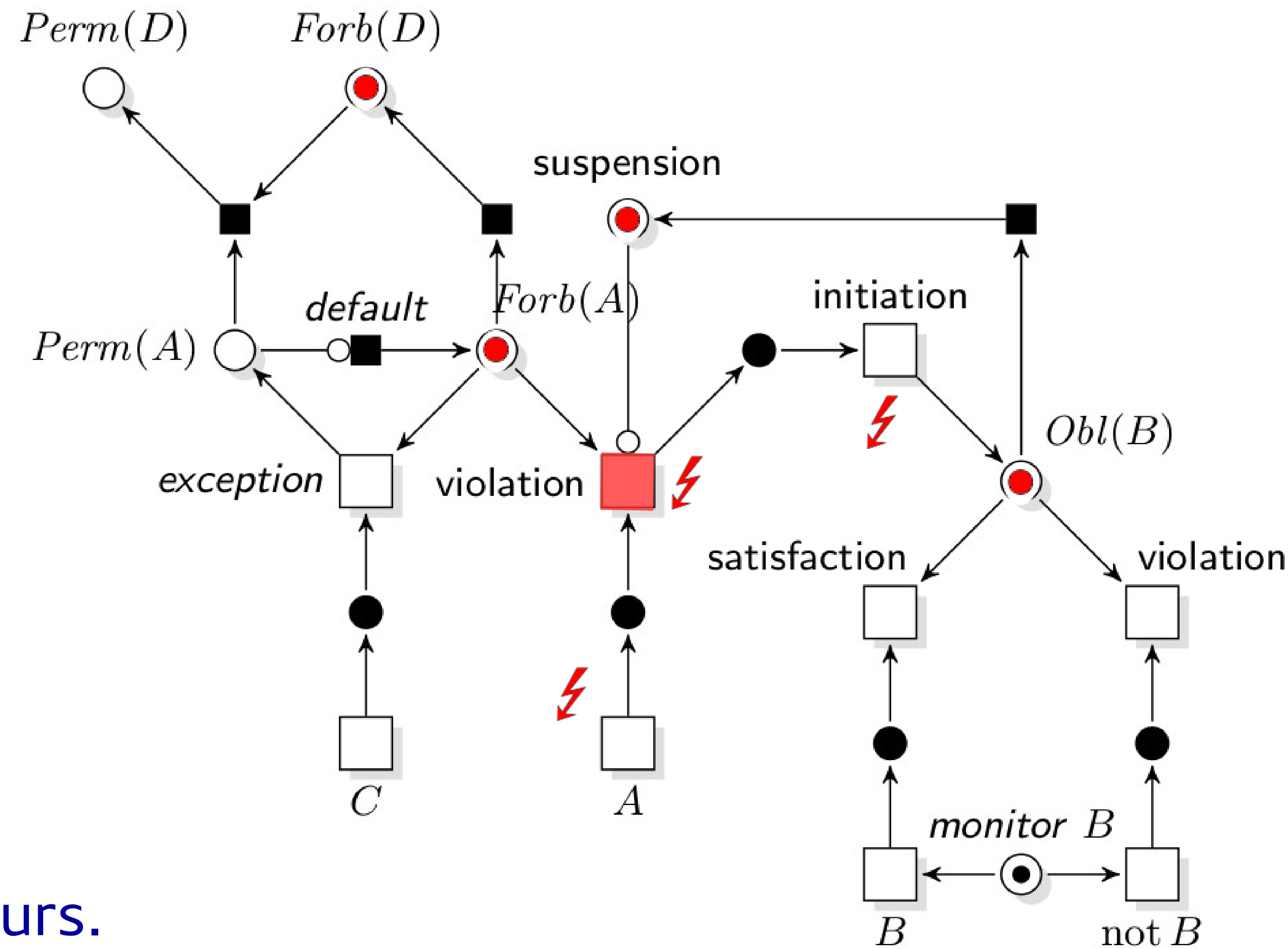

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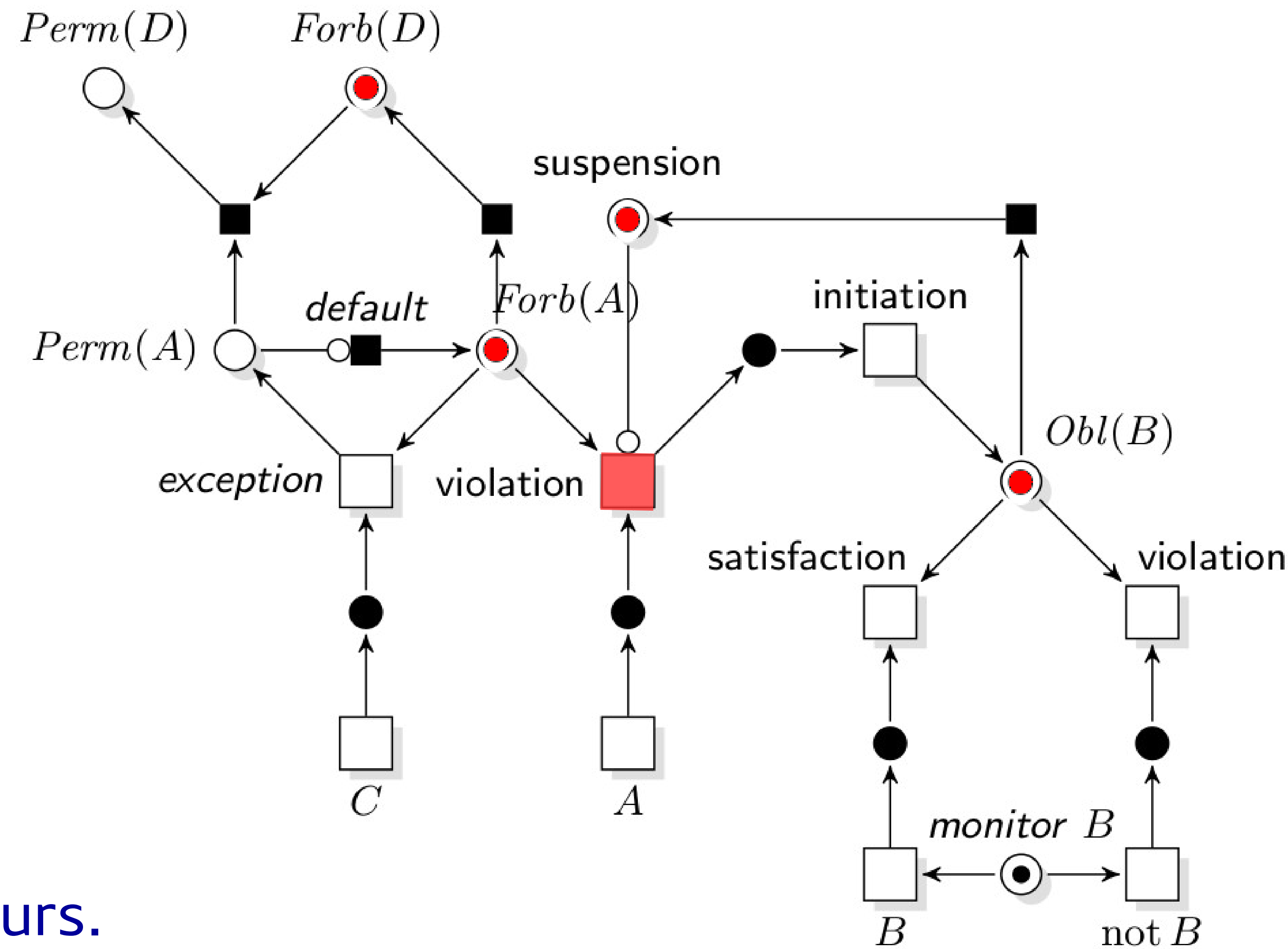

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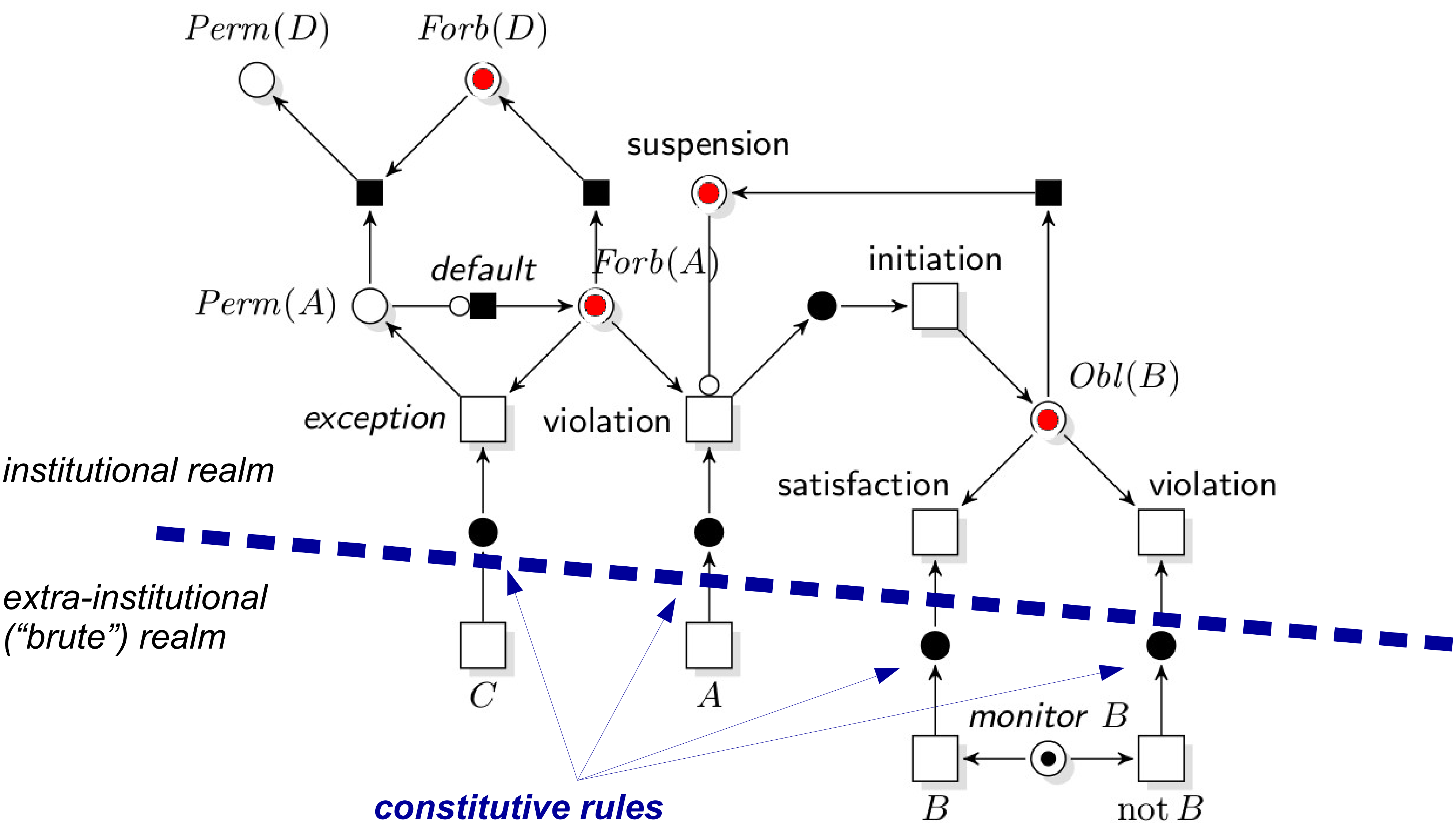
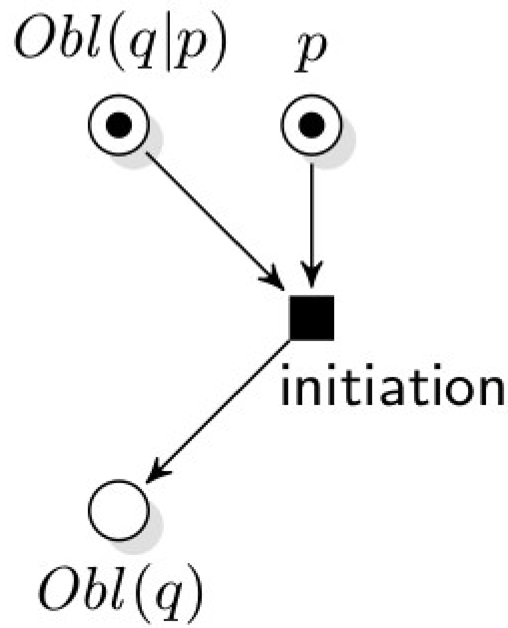


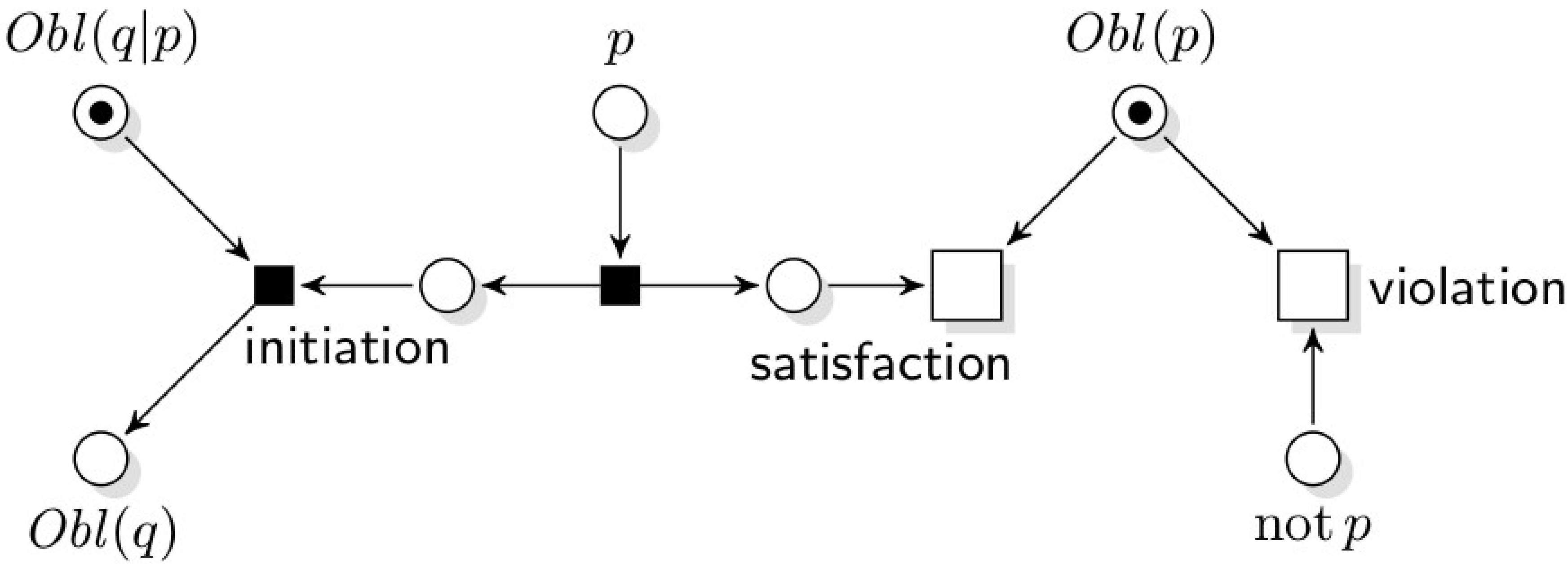
A bit further into deontic axioms

Factual detachment



$$p \wedge Obl\ (q|p) \rightarrow Obl\ (q)$$

Deontic detachment



$$Obl\ (p) \land Obl\ (q|p) \rightarrow Obl\ (q)$$

Not implied by LPPN! *It does not capture the **anticipation.***

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- *Bob's promise to meet you commits him to meeting you.*
- *It is obligatory that if Bob promises to meet you, he does so.*

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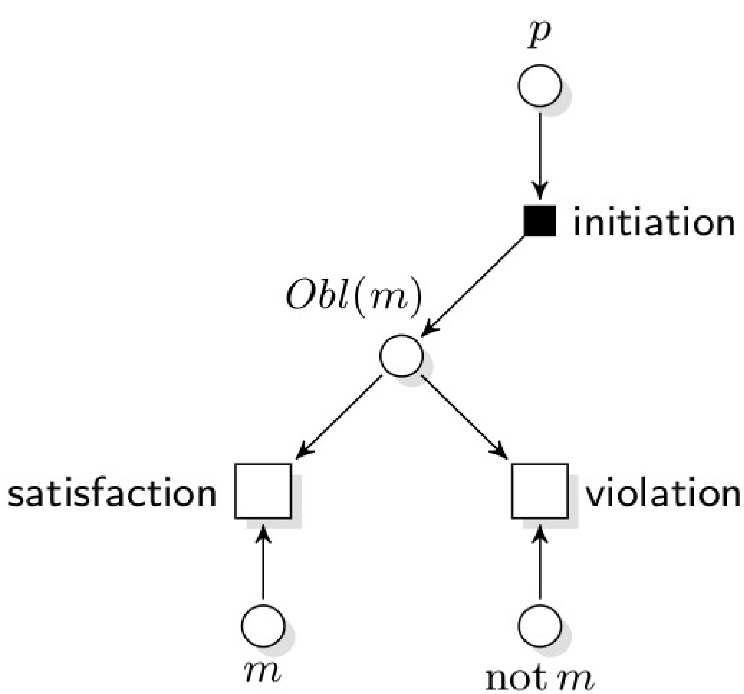

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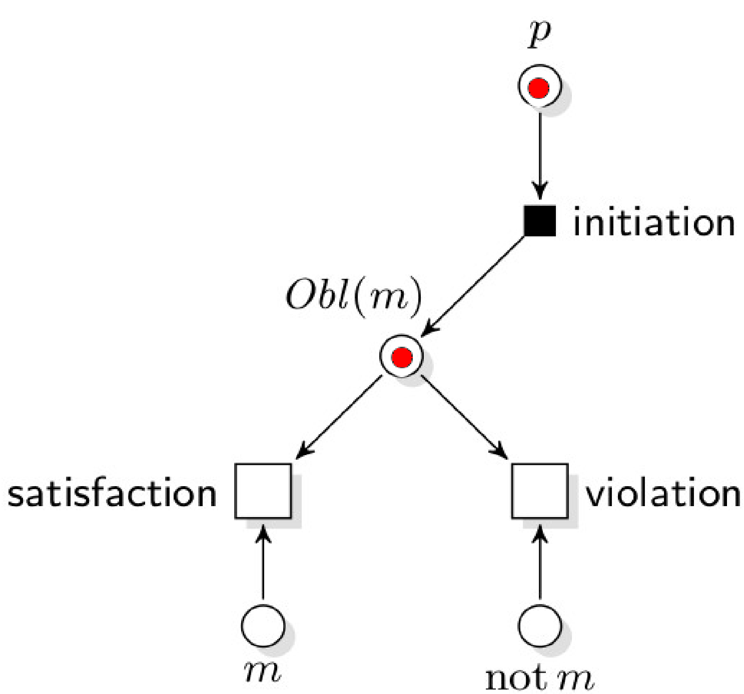

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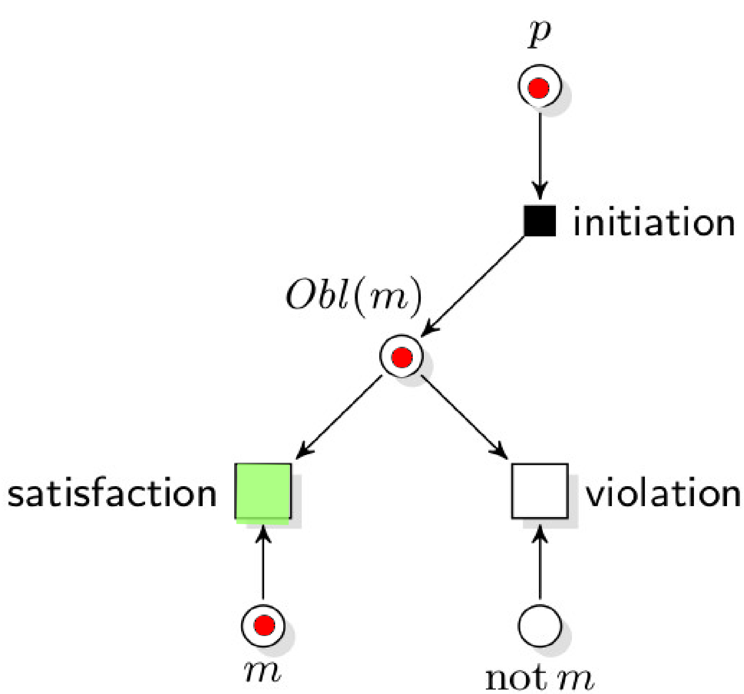

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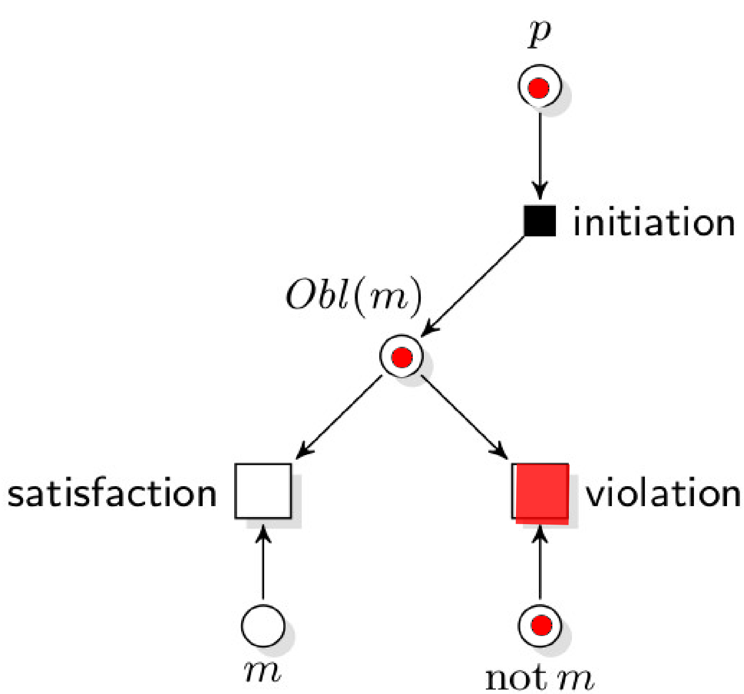

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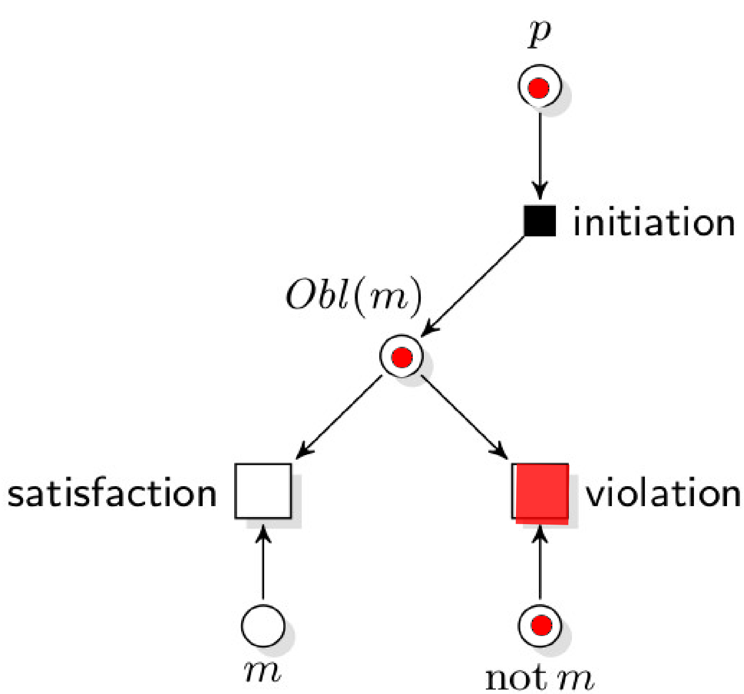

- p,
- either m, or ¬m

- *but what about ¬p?*

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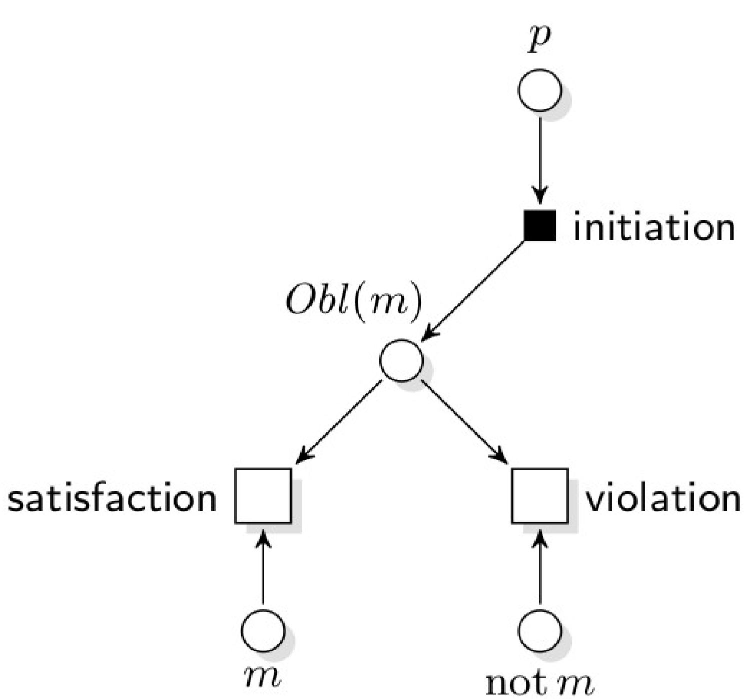

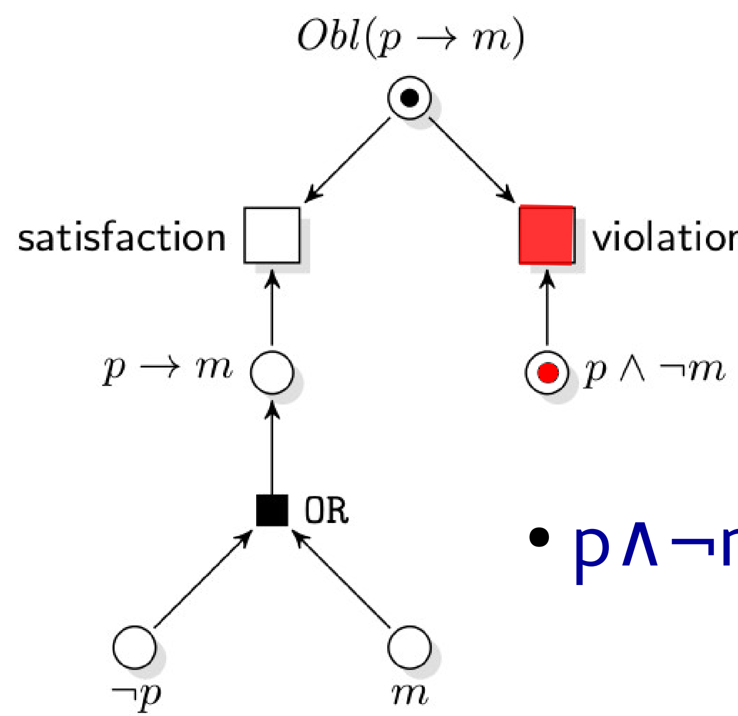

- $p \wedge \neg m$

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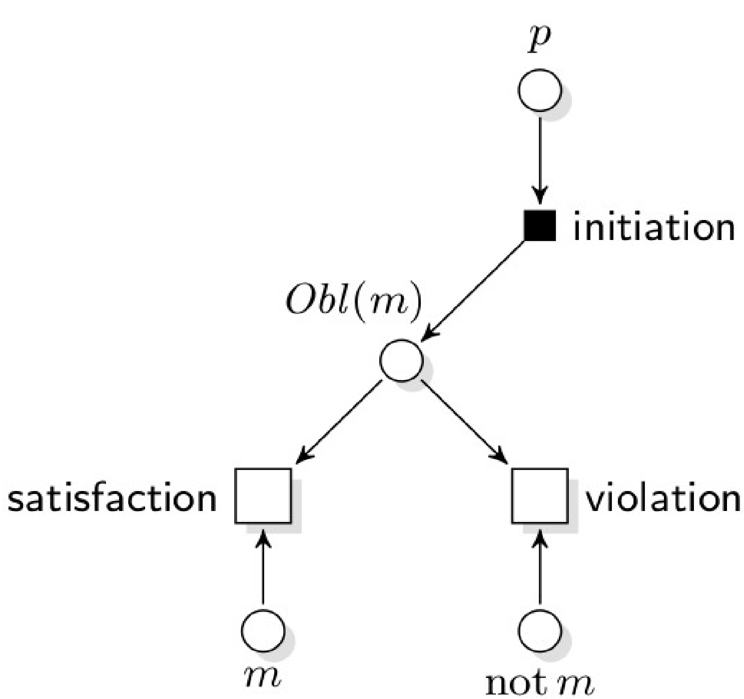

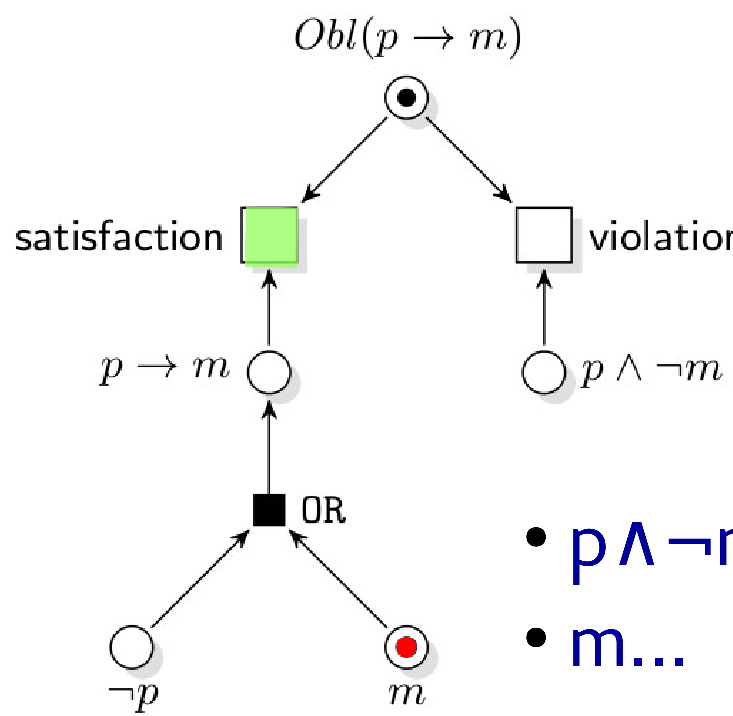

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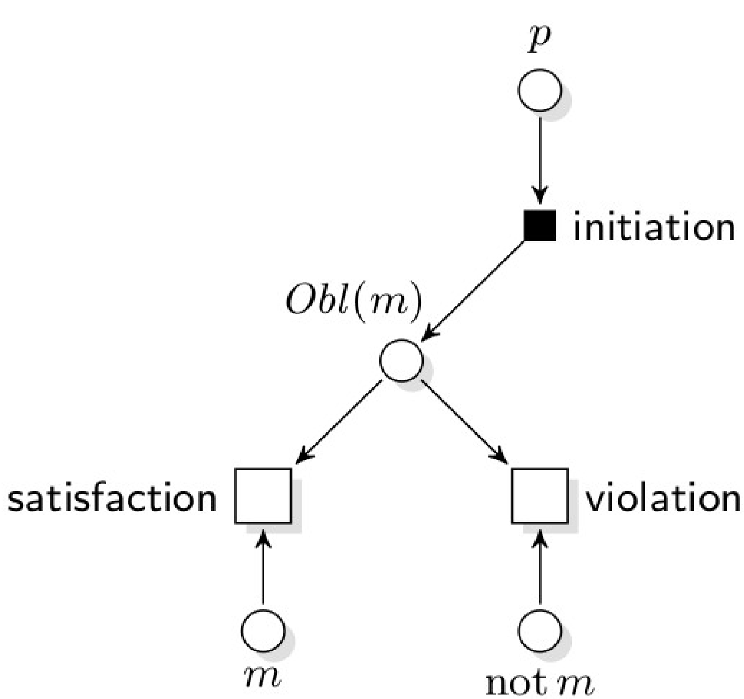

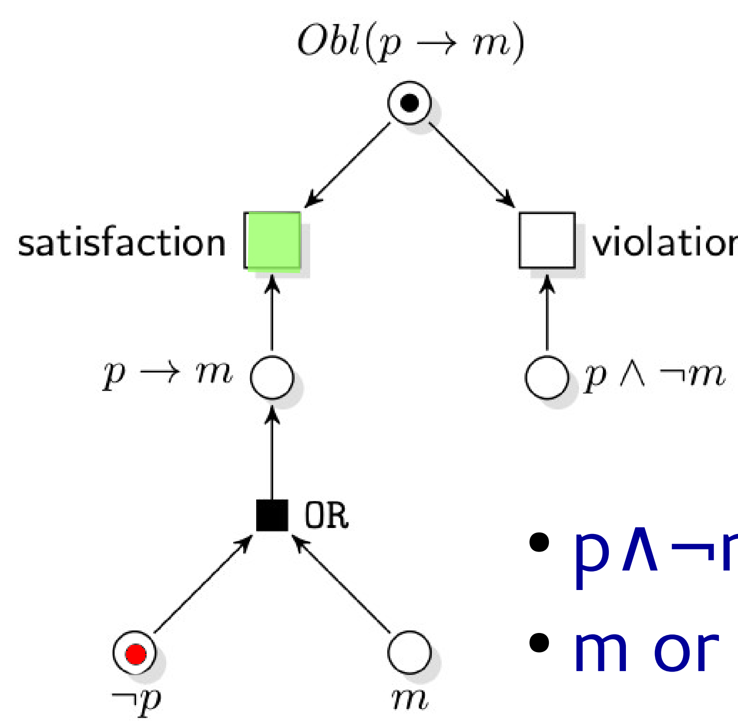

- p∧¬m
- m or ¬p

Chisholm's paradox

[Chisholm, 1963]

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- *Jones doesn't go.*

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[Chisholm, 1963]

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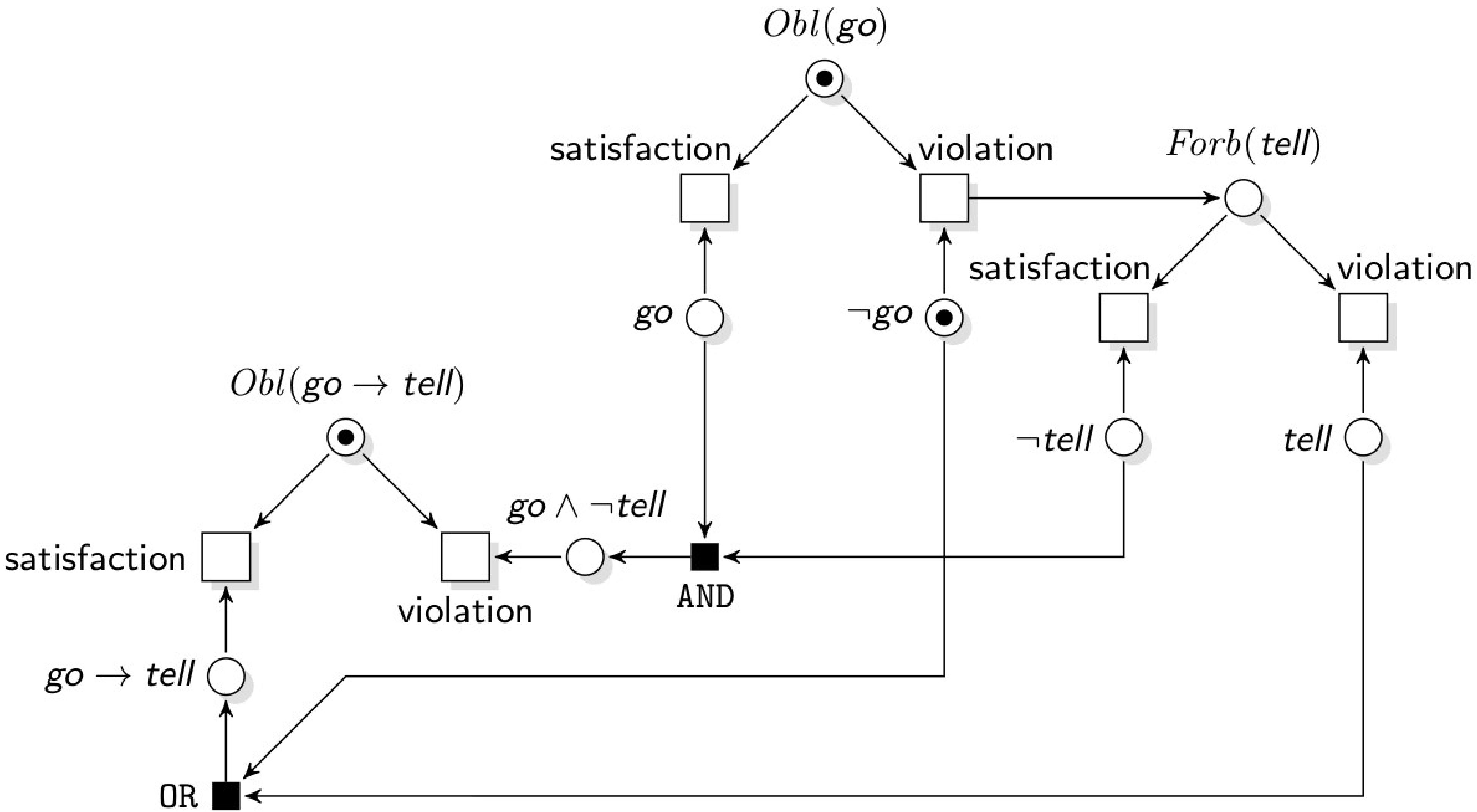

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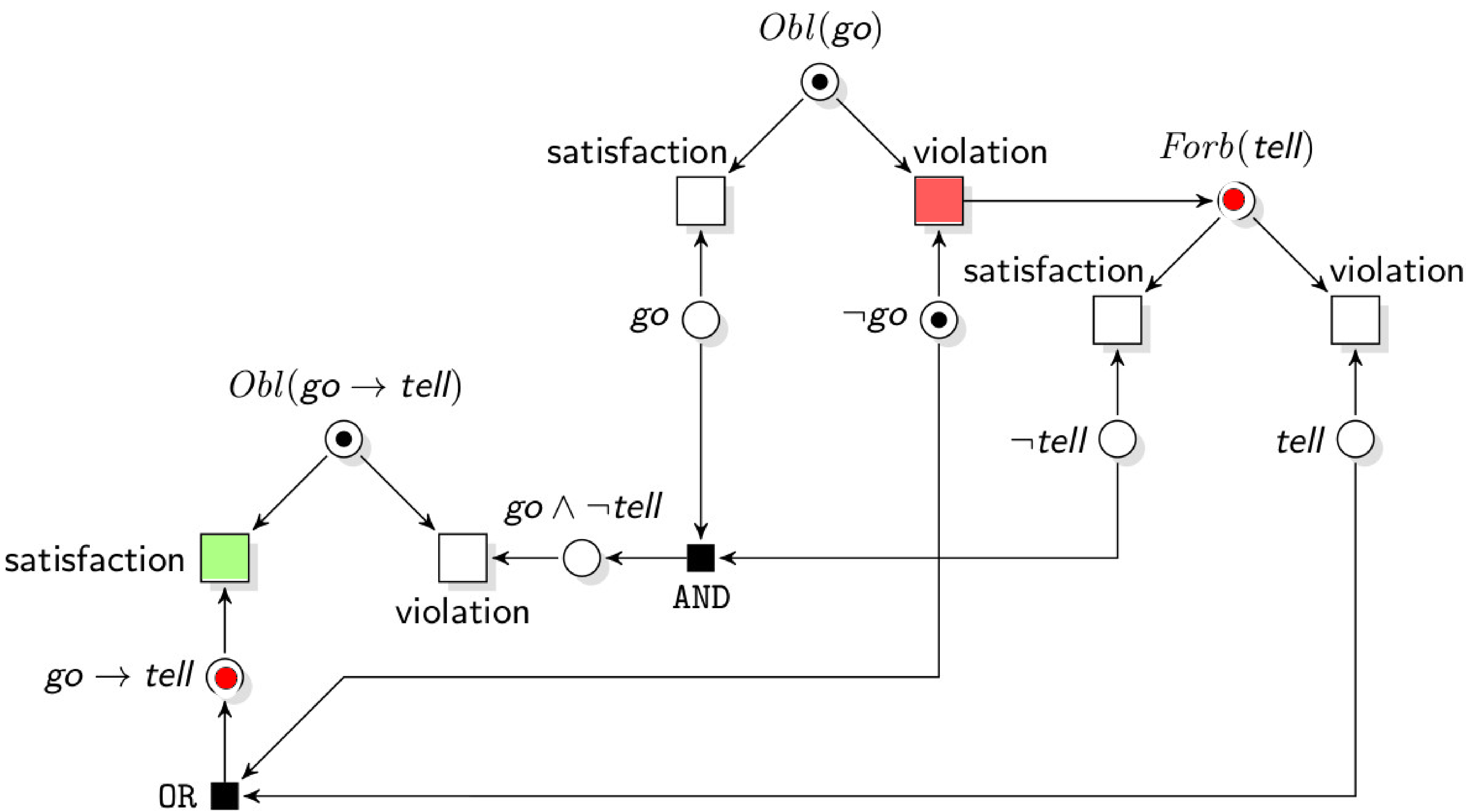

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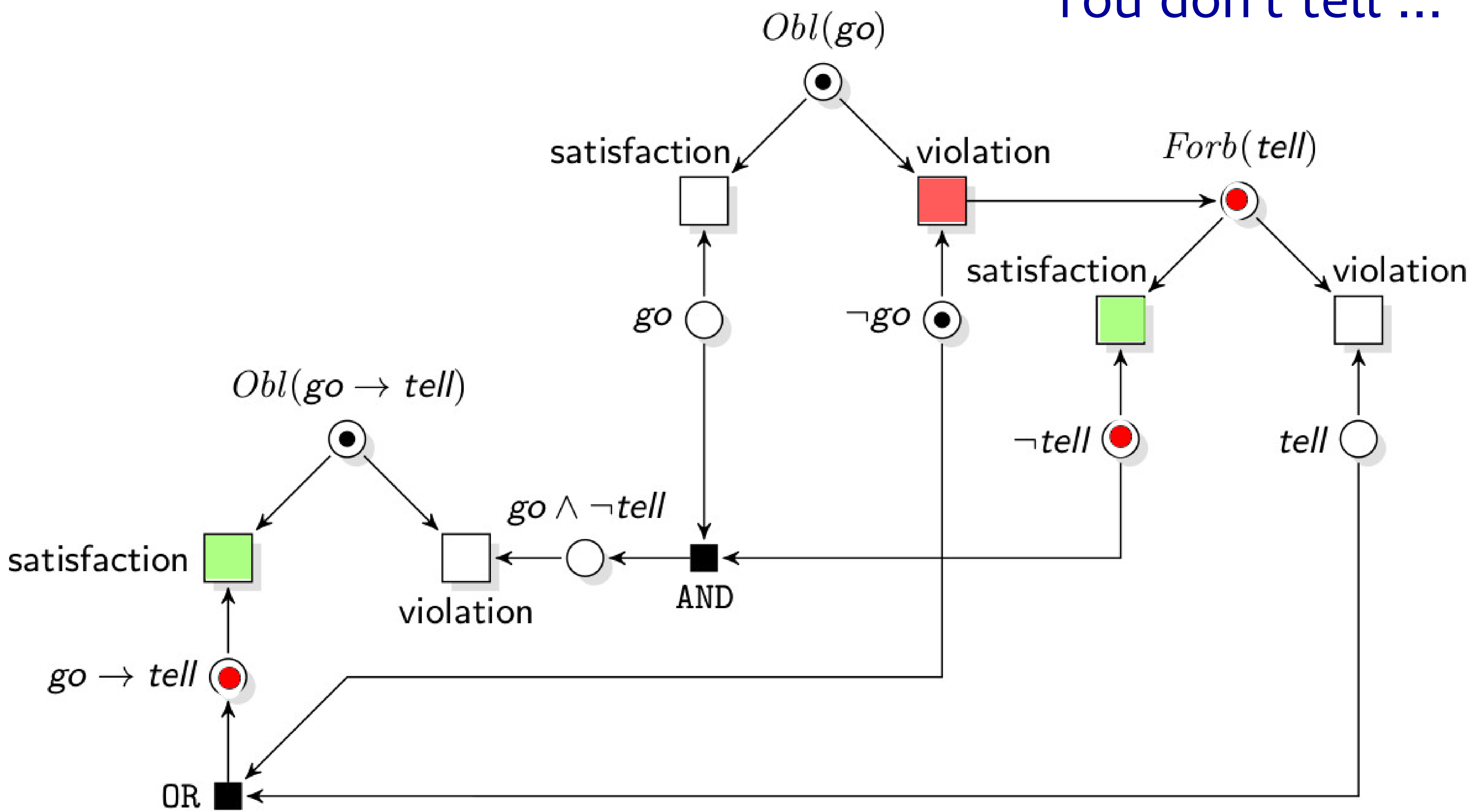

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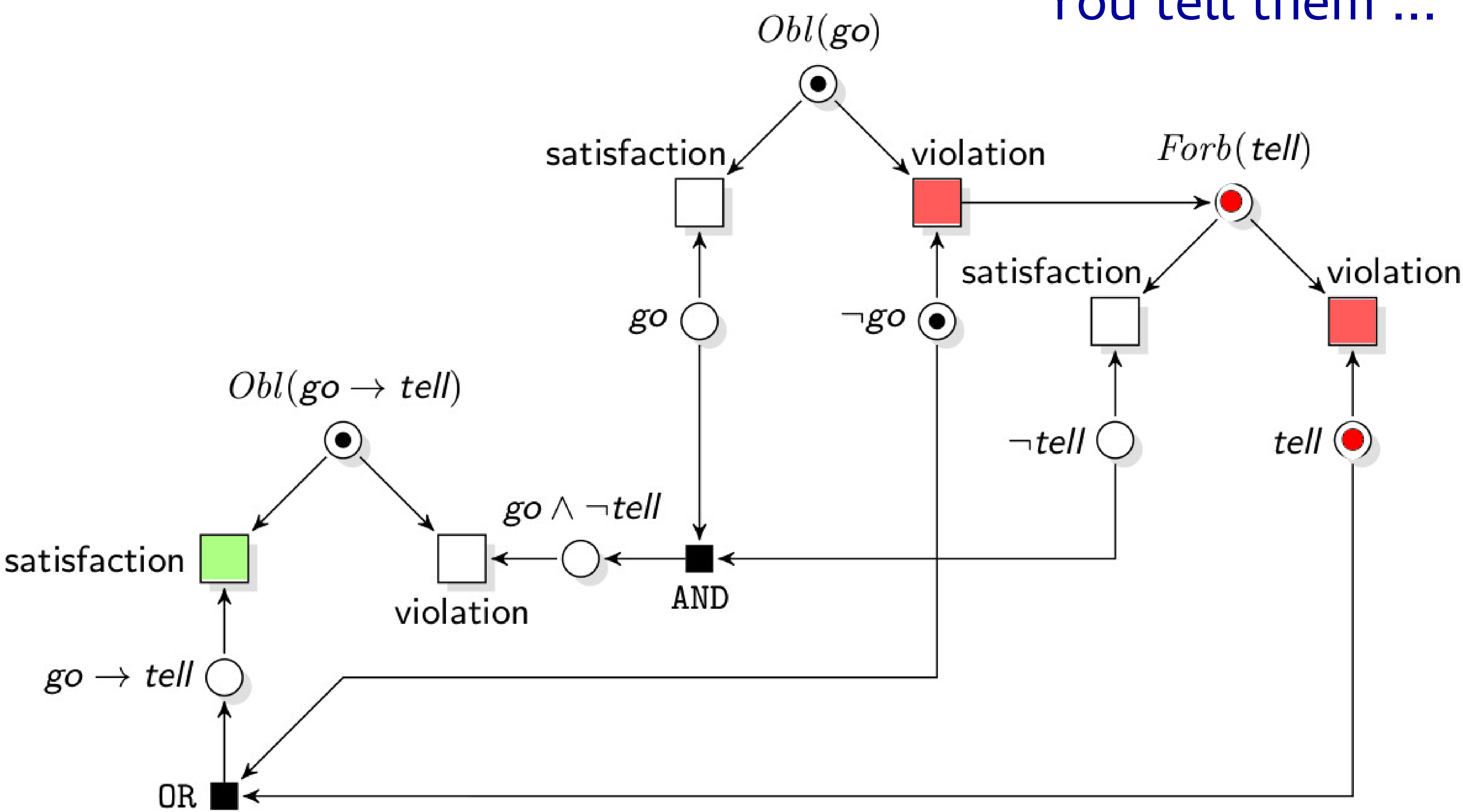

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  - visual notation (animation of models through simulation make them in principle more accessible)

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- ~ **minimal commitment** (cf. *input/output* logic)

$$\mathrm{Obl}\,(A) \wedge \mathrm{Obl}\,(B) \ \ ?? \ \ \mathrm{Obl}(A \wedge B)$$

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  - (perfect) verbs ~ transition/transition events
- Working hypothesis: does the locutor usually provide the right granularity to avoid the paradox?