HIGHLIGHTS
September 18th, 2020

Branching Immediate Observation Petri Nets

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joint work with Javier Esparza and Mikhail Raskin

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Reachability Problem

Reachability problem: Given a Petri net $\mathcal{N}$, and markings M_0 and M can marking M_0 reach marking M in $\mathcal{N}$?

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→ Study subclasses of Petri nets

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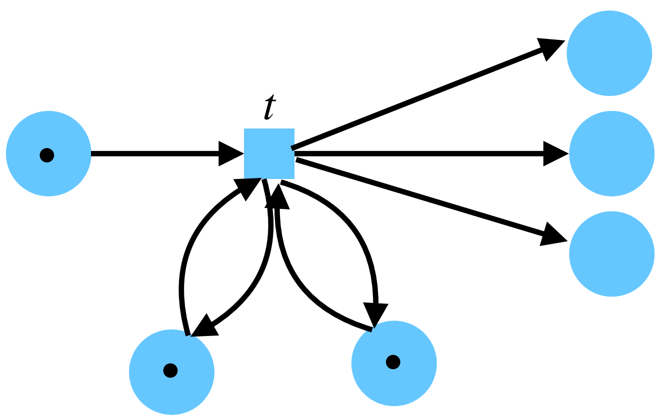
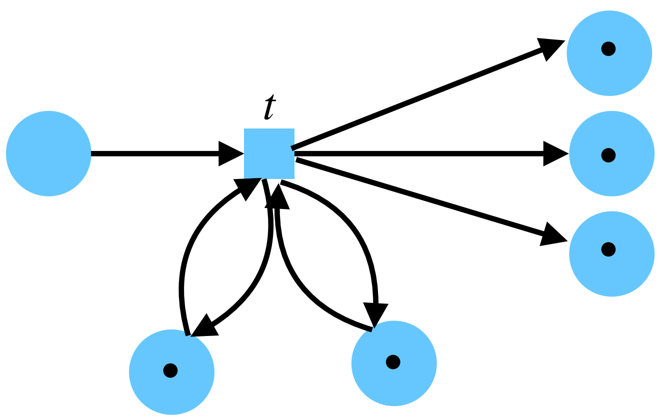
Study subclasses of Petri nets

Study **Branching Immediate Observation (BIO) nets!**

Branching Immediate Observation (BIO) nets



Branching Immediate Observation (BIO) nets



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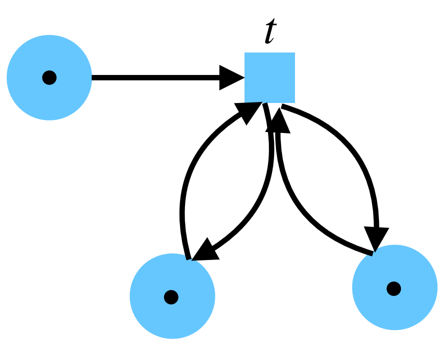

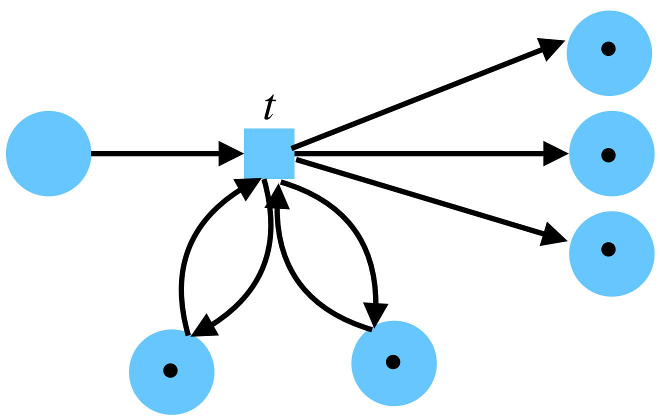

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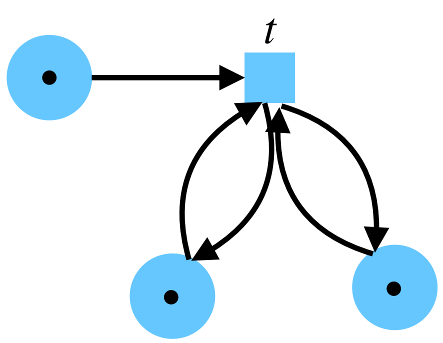

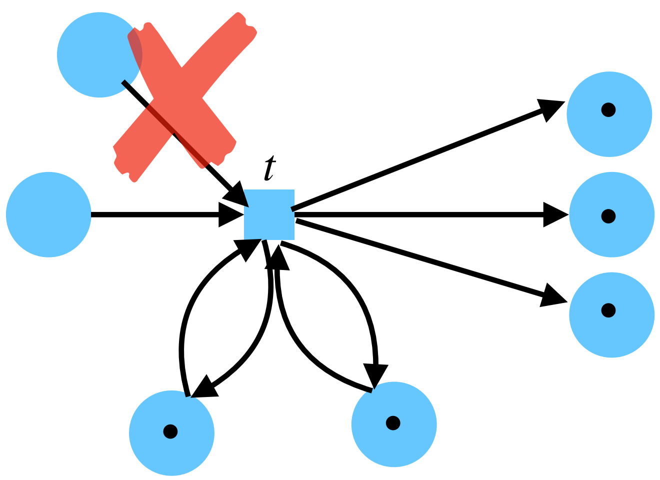

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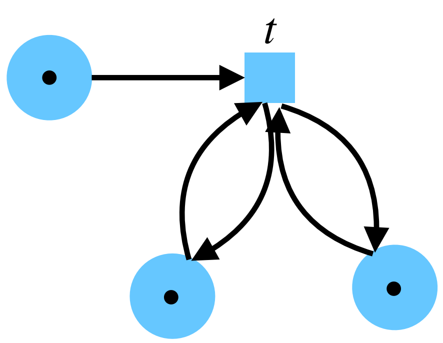

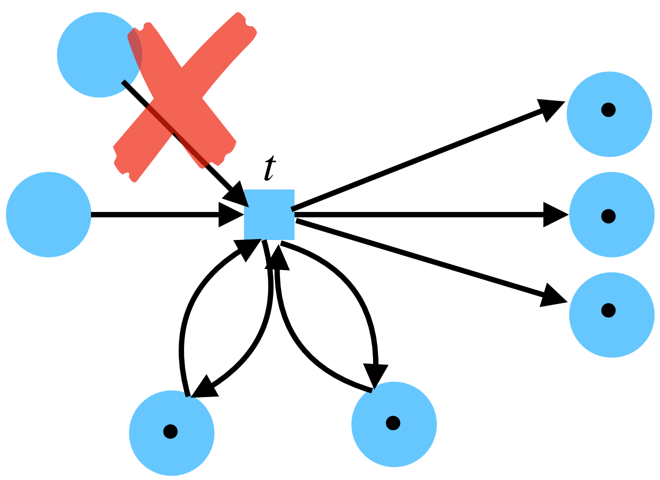

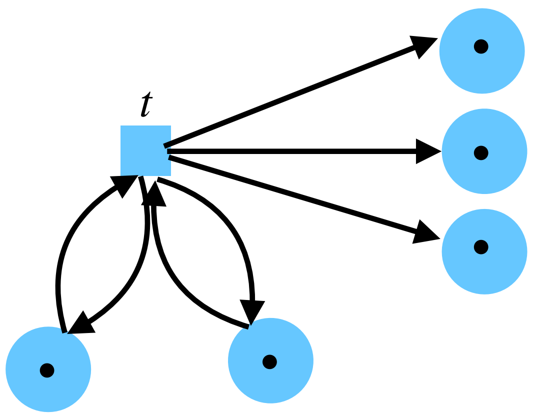

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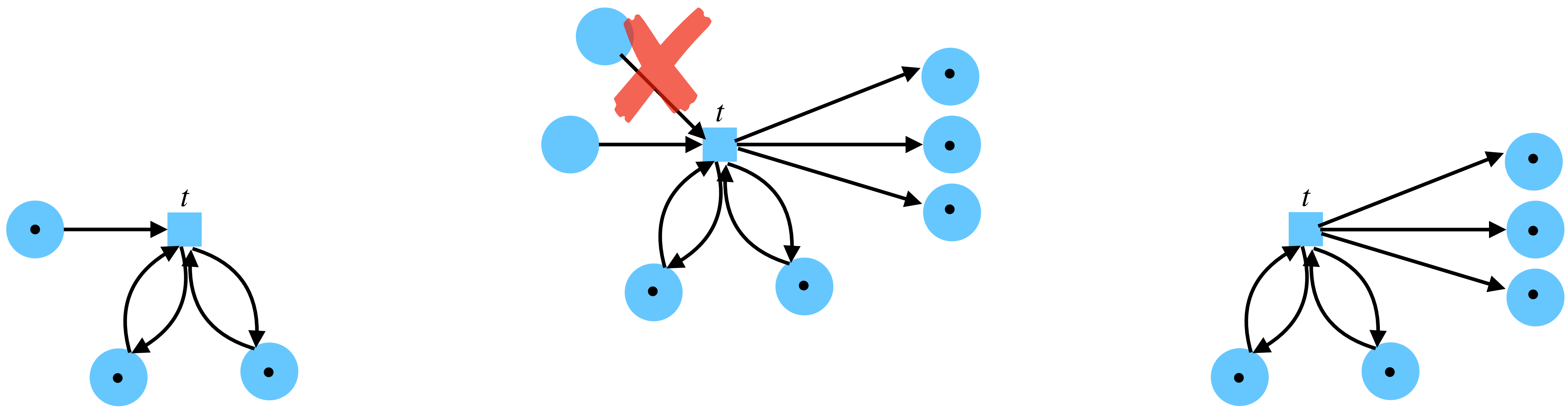

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$\equiv$ at most one “pure input” place

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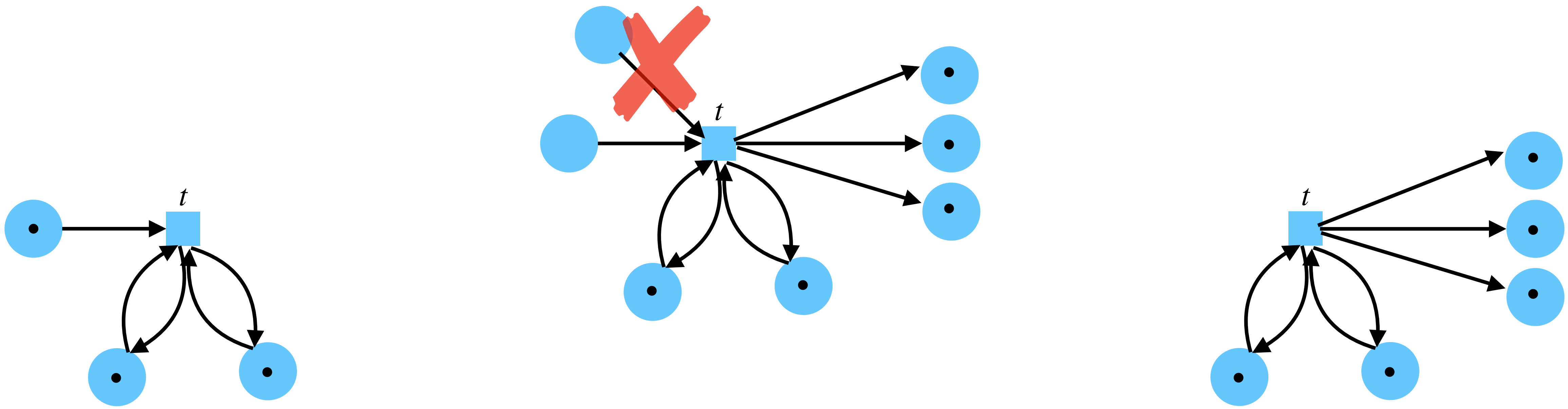

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Extend

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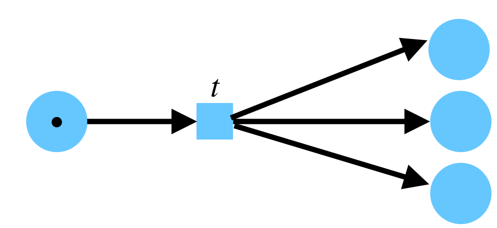
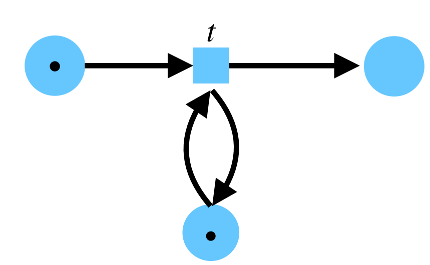


- IO nets:



Flatness

[Leroux, Sutre, '05]

flat $\exists$ sequence $t_1^* t_2^* \ldots t_l^*$ such that

$$M_0 \xrightarrow{*} M \text{ iff } M_0 \xrightarrow{t_1^{k_1} t_2^{k_2} \ldots t_l^{k_l}} M$$

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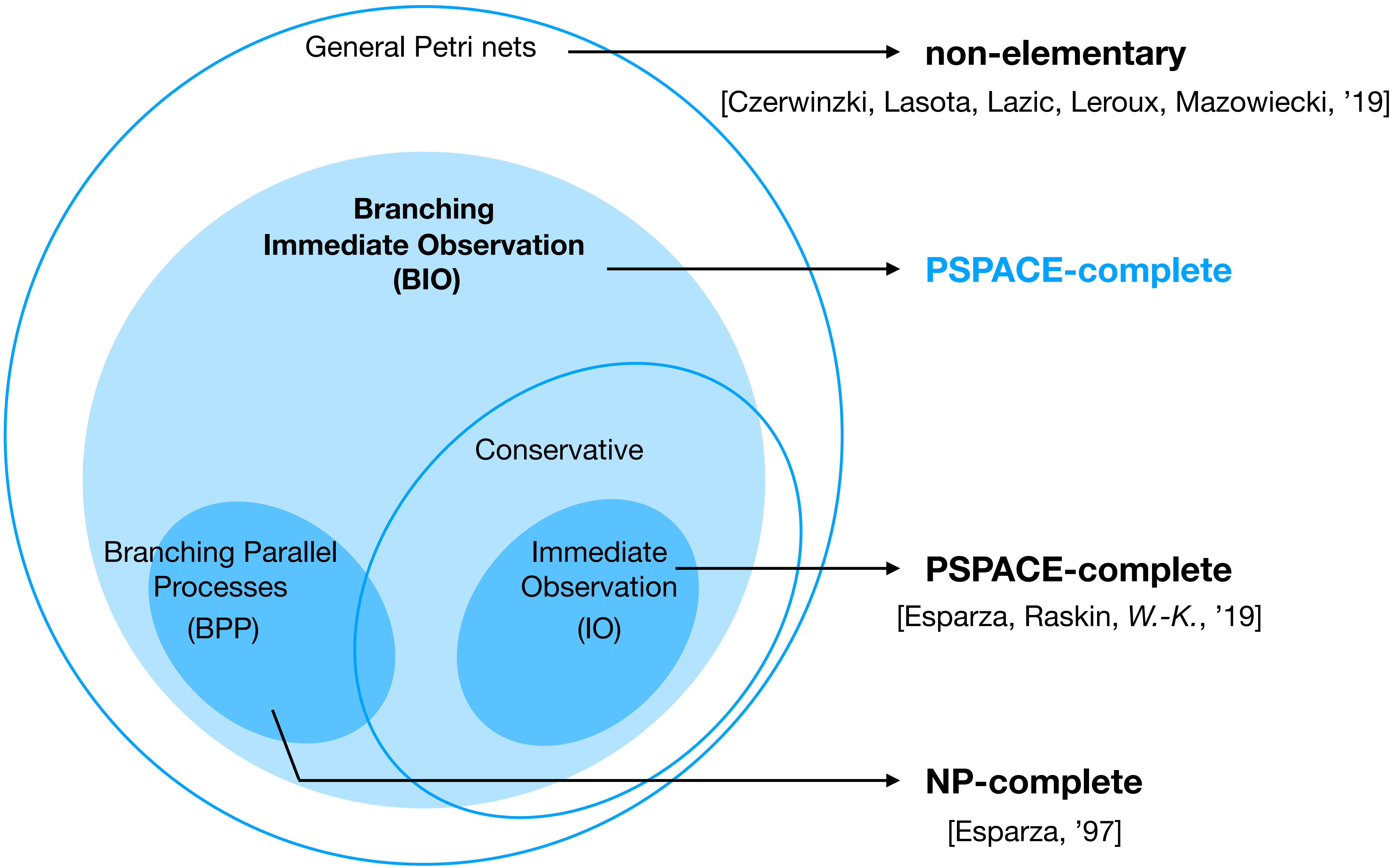
BIO nets

check **reachability properties** with
model checking **tools** that use acceleration techniques
e.g. FAST [Bardin, Finkel, Leroux, Petrucci, '03]

A strong class with simple reachability



A strong class with simple reachability

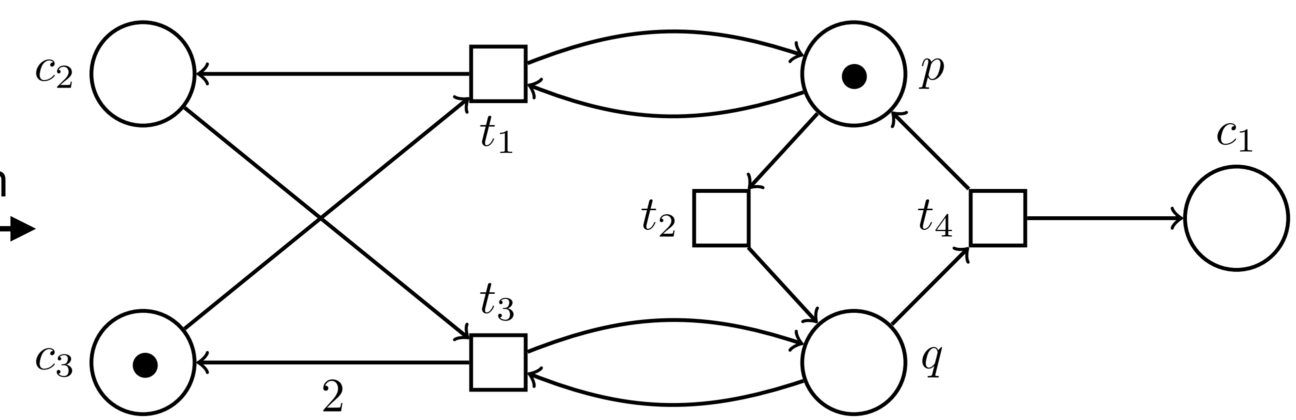
BIO nets can have **non-semilinear** reachability set

[Hopcroft, Pansiot, ’79] example of a 3-dimensional VASS

classic translation

VASS to Petri net

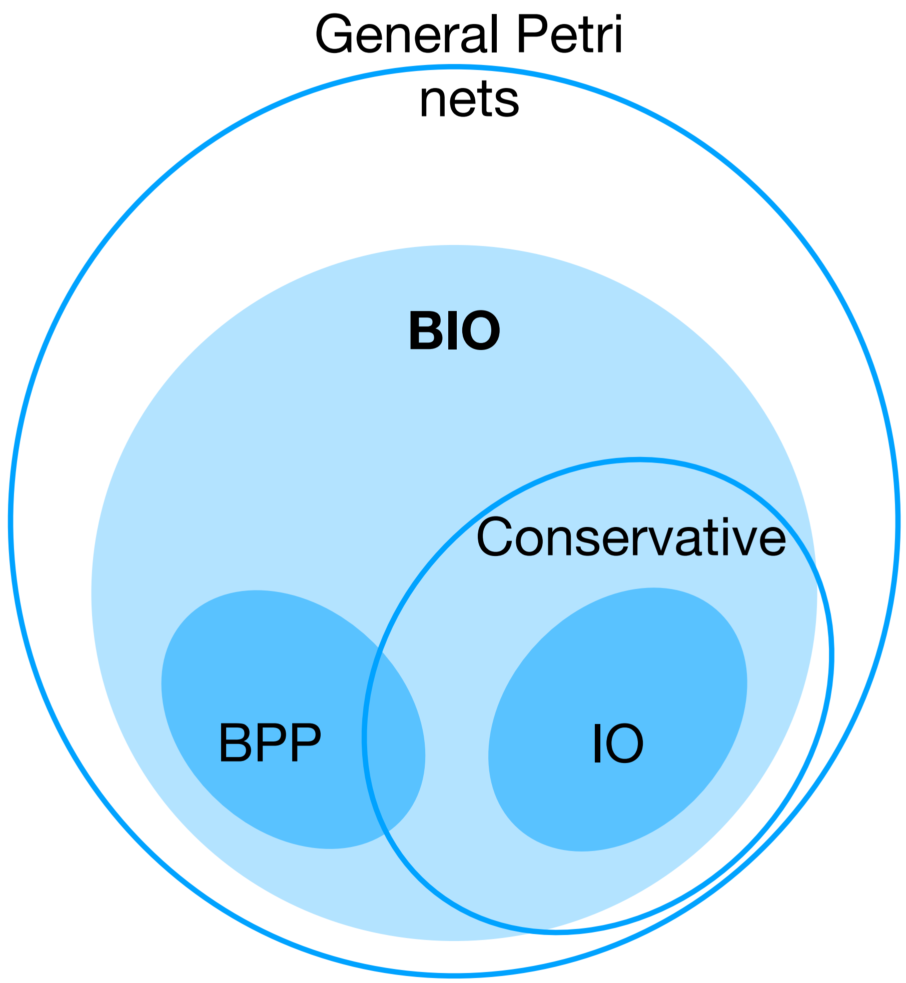
BIO net



$$c_2 + c_3 \leq 2^{c_1}$$

Branching Immediate Observation (BIO)

- unbounded (token creation and destruction)
- pre^***-flat** reachability relation → use of model-checking tools like FAST
- **PSPACE-complete** reachability problem
- **non-semilinear** reachability



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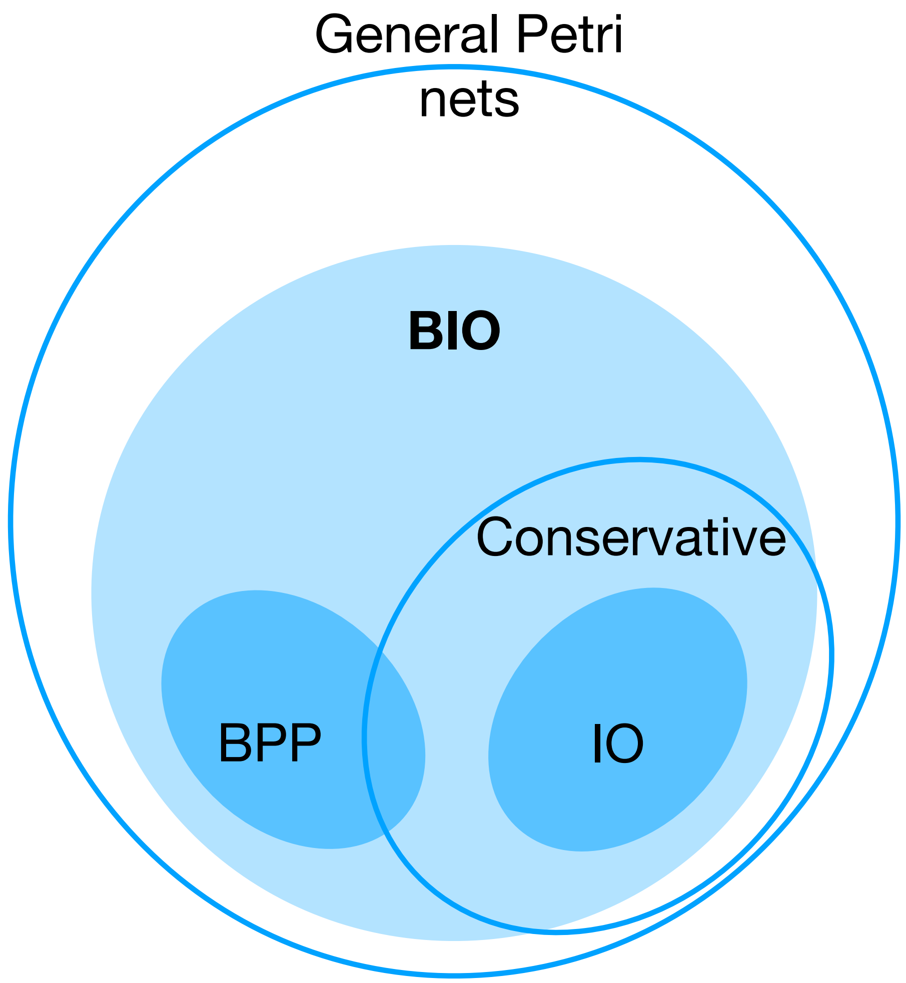

Open Problems:
- Applications for BIO nets (e.g. chemical reaction networks)
- Consequences of this result in other domains (data nets, process calculi, formal languages…)

Article: https://drops.dagstuhl.de/opus/volltexte/2020/12857/

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