Seminator

A Tool for Semi-Determinization of Omega-Automata

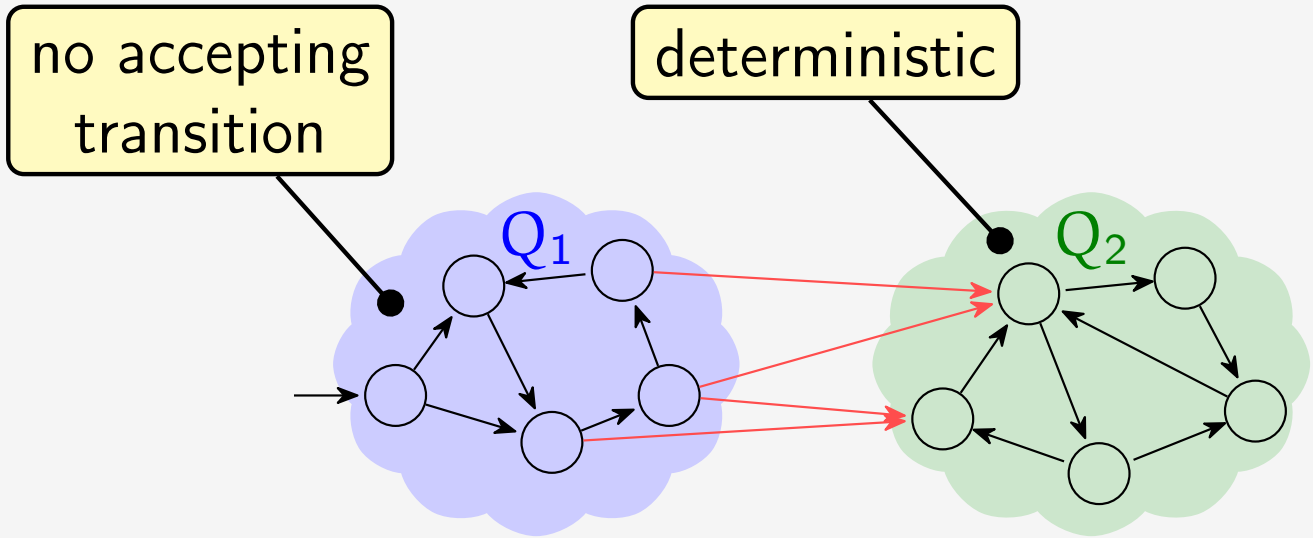
František Blahoudek[1] Alexandre Duret-Lutz[2]
Mikuláš Klokočka[1] Mojmír Křetínský[1]
Jan Strejček[1]

[1]Masaryk University, Brno, Czech Republic
[2]LRDE, EPITA, Le Kremlin-Bicêtre, France

May 11th 2017
LPAR-21
Maun, Botswana

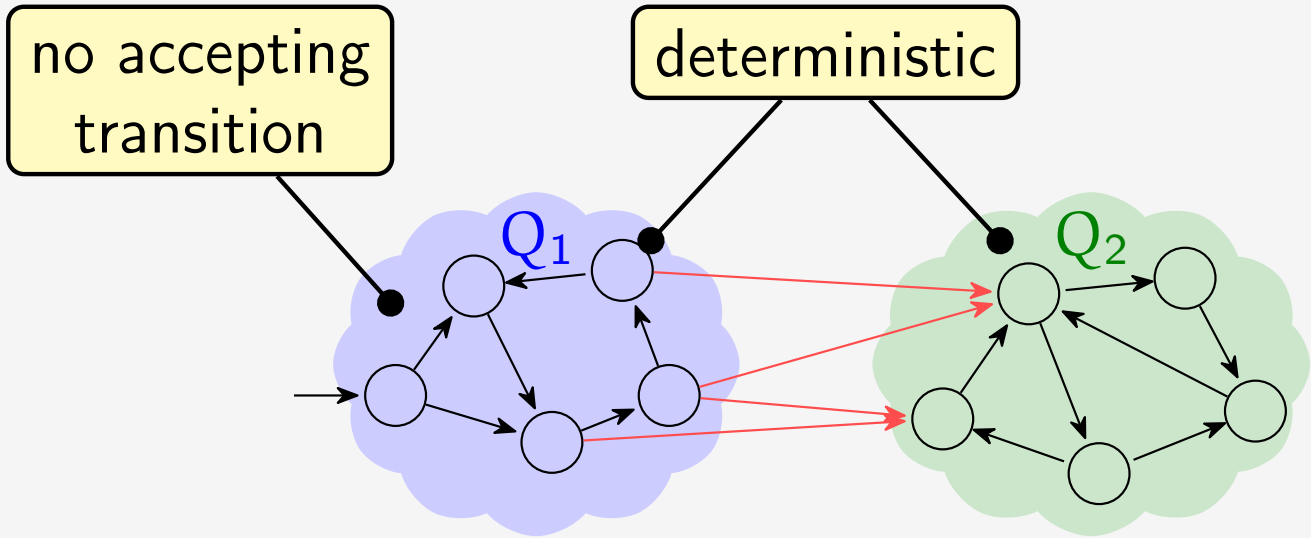
Semi-deterministic Büchi automata

- Büchi automata
- convention: accepting transitions [transition-based]
- also known as deterministic-in-the-limit, limit-deterministic



Semi-deterministic Büchi automata

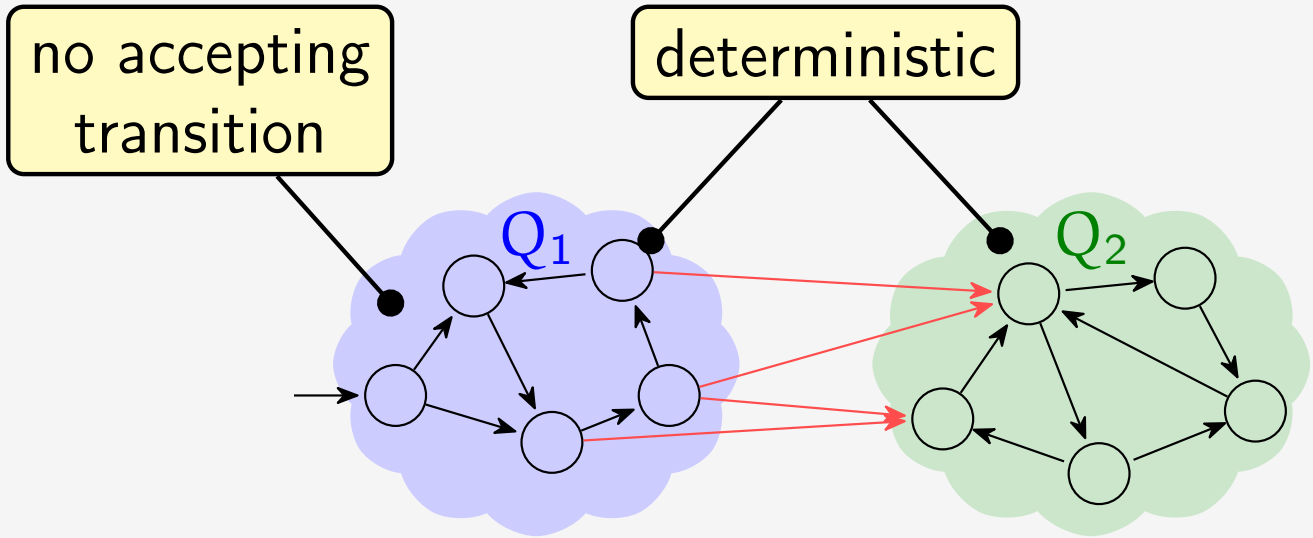
- Büchi automata
- convention: accepting transitions [transition-based]
- also known as deterministic-in-the-limit, limit-deterministic



- cut-deterministic: also Q_1 is determinsitic

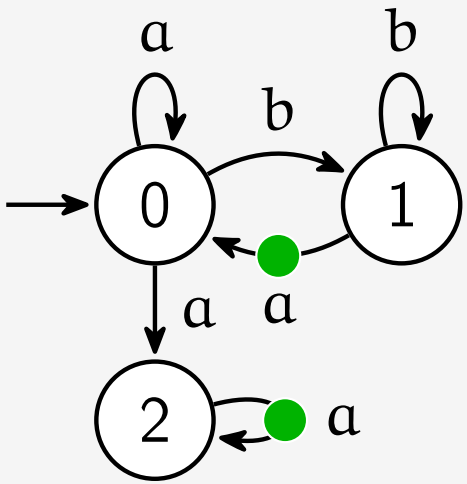
Semi-deterministic Büchi automata

- Büchi automata
- convention: accepting transitions [transition-based]
- also known as deterministic-in-the-limit, limit-deterministic

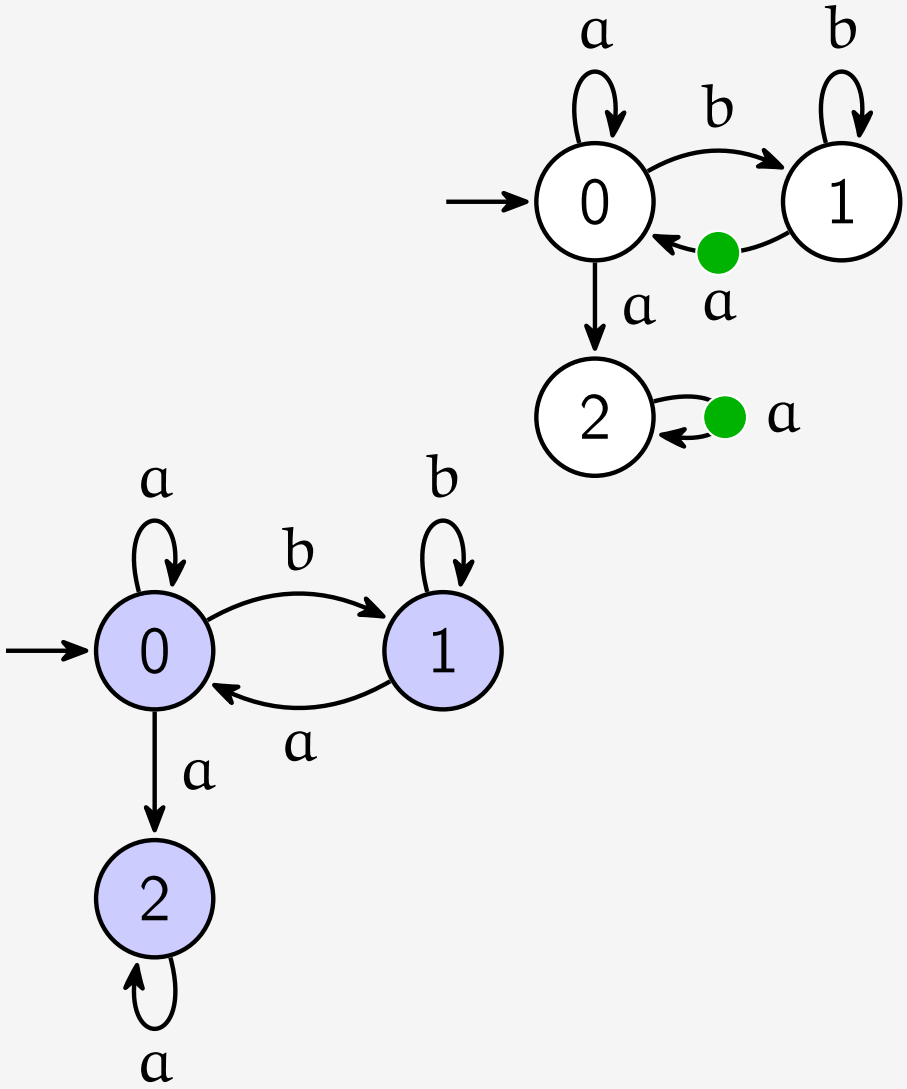


- cut-deterministic: also Q_1 is determinsitic
- motivation: probMC of Markov Decission Processes

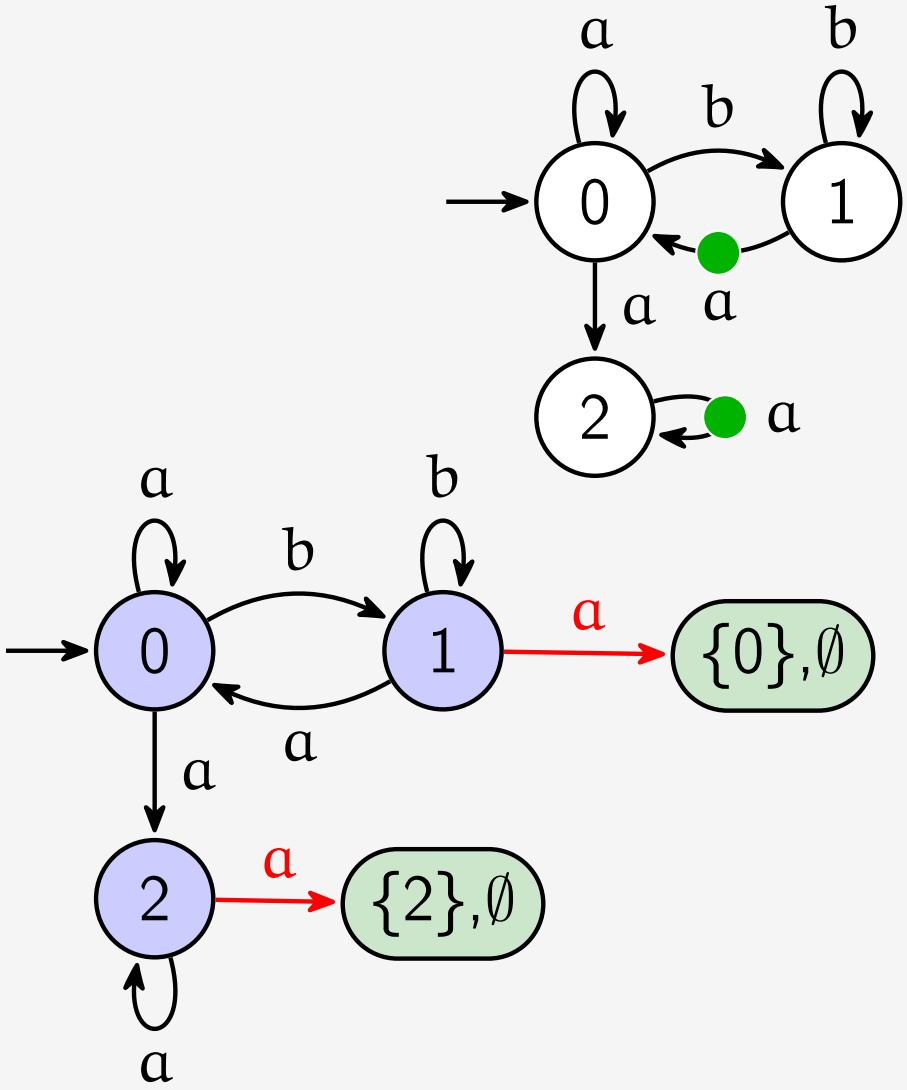
Semi-determinization [Courcoubetis, Yannakakis 88]



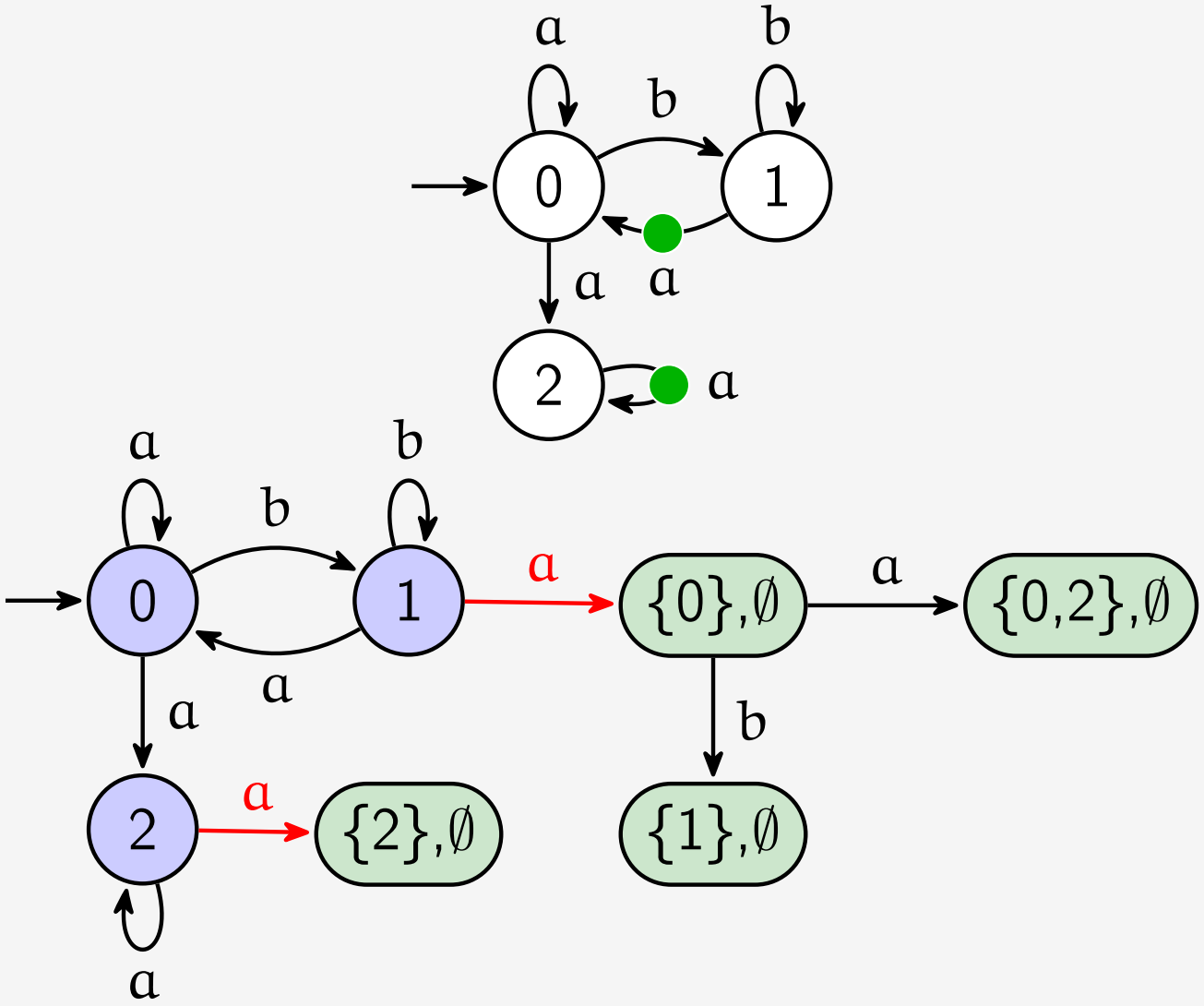
Semi-determinization [Courcoubetis, Yannakakis 88]



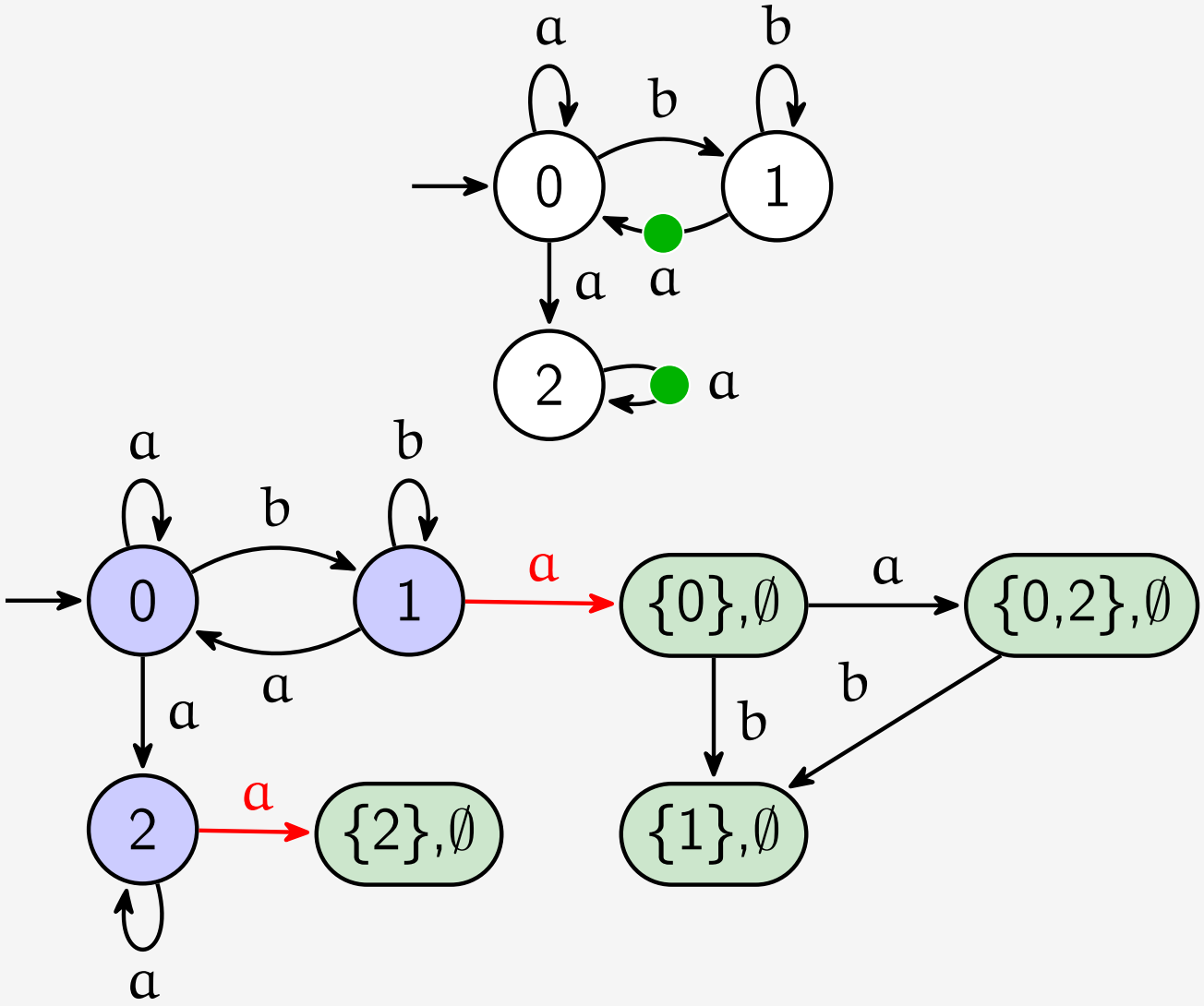
Semi-determinization [Courcoubetis, Yannakakis 88]



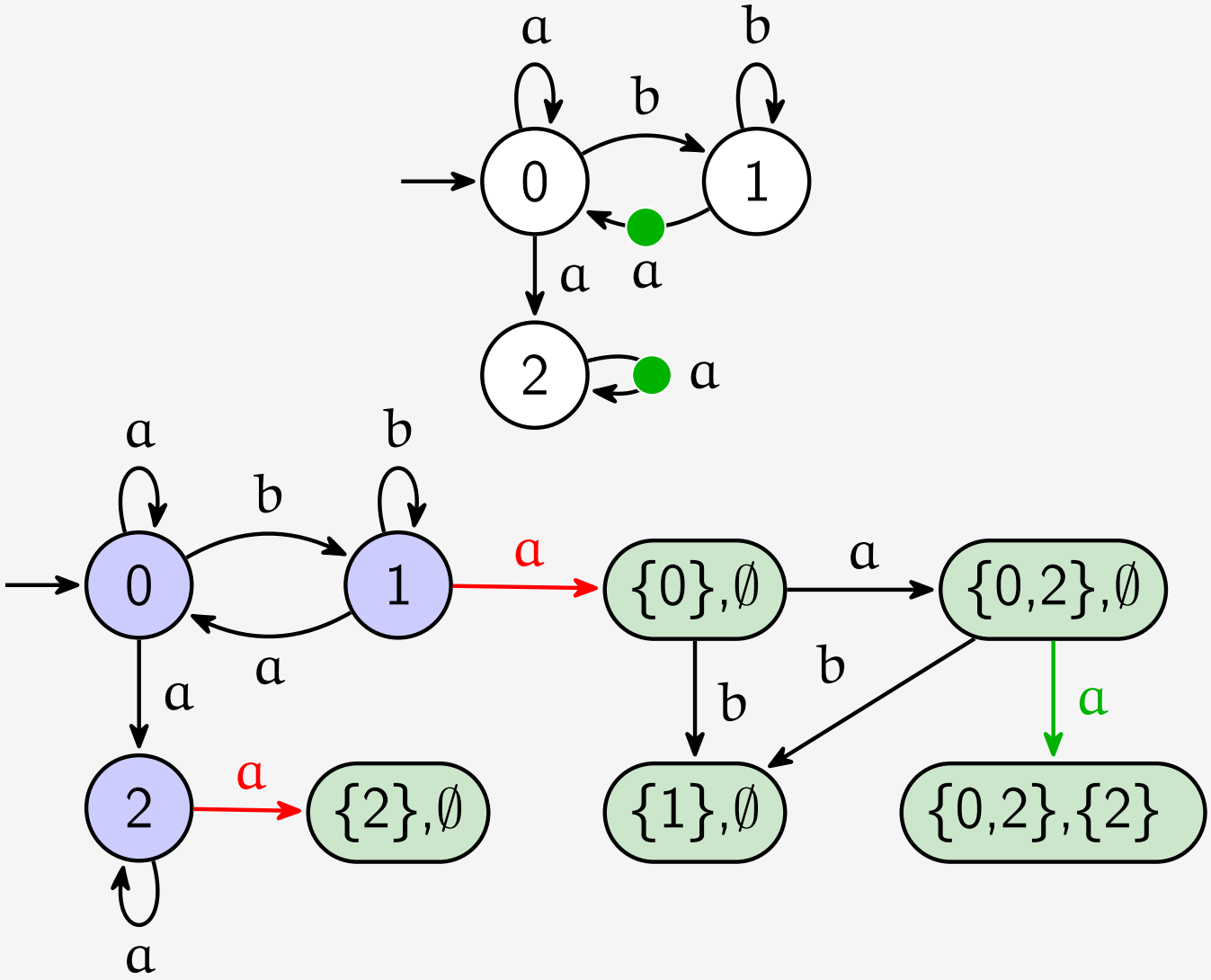
Semi-determinization [Courcoubetis, Yannakakis 88]



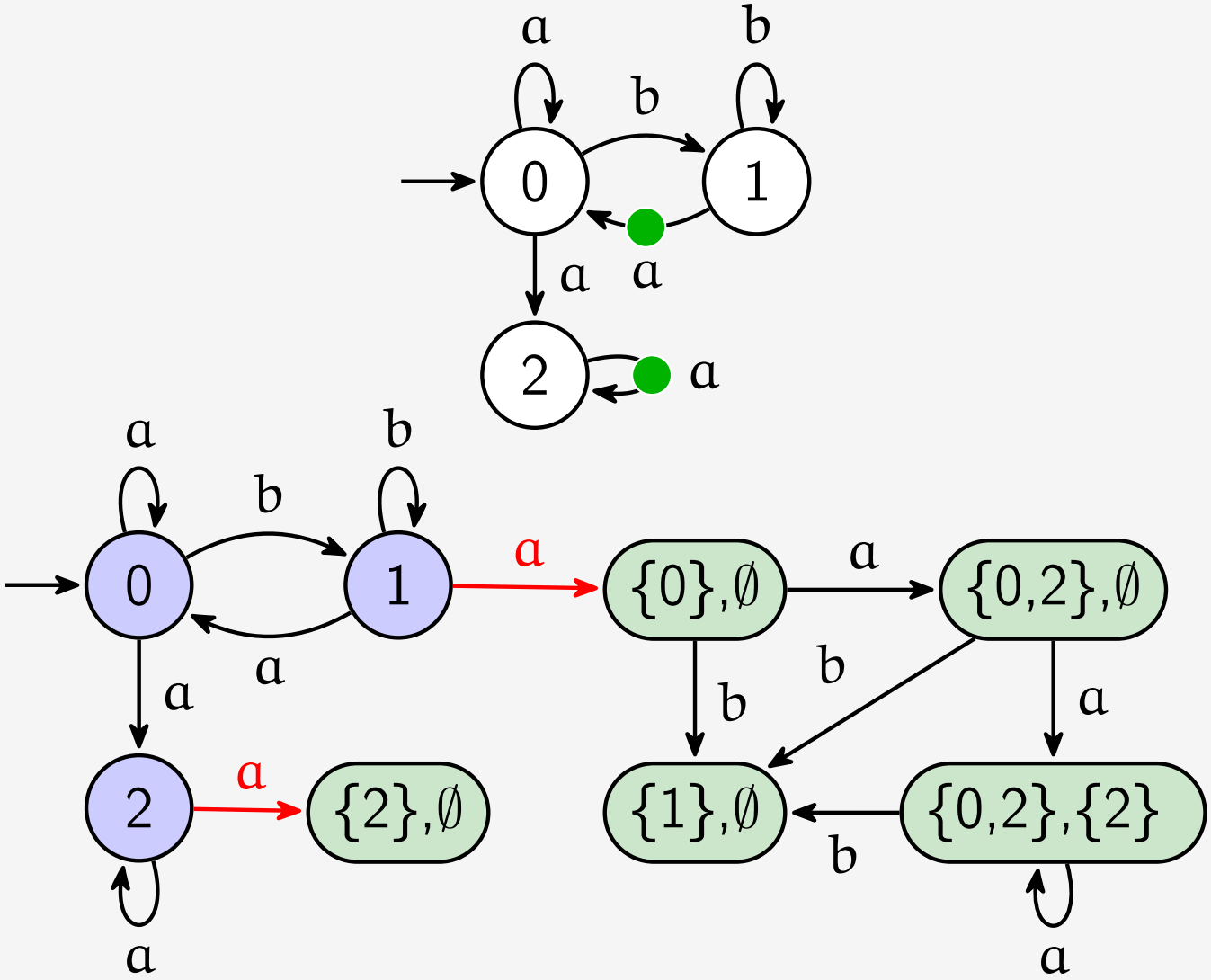
Semi-determinization [Courcoubetis, Yannakakis 88]



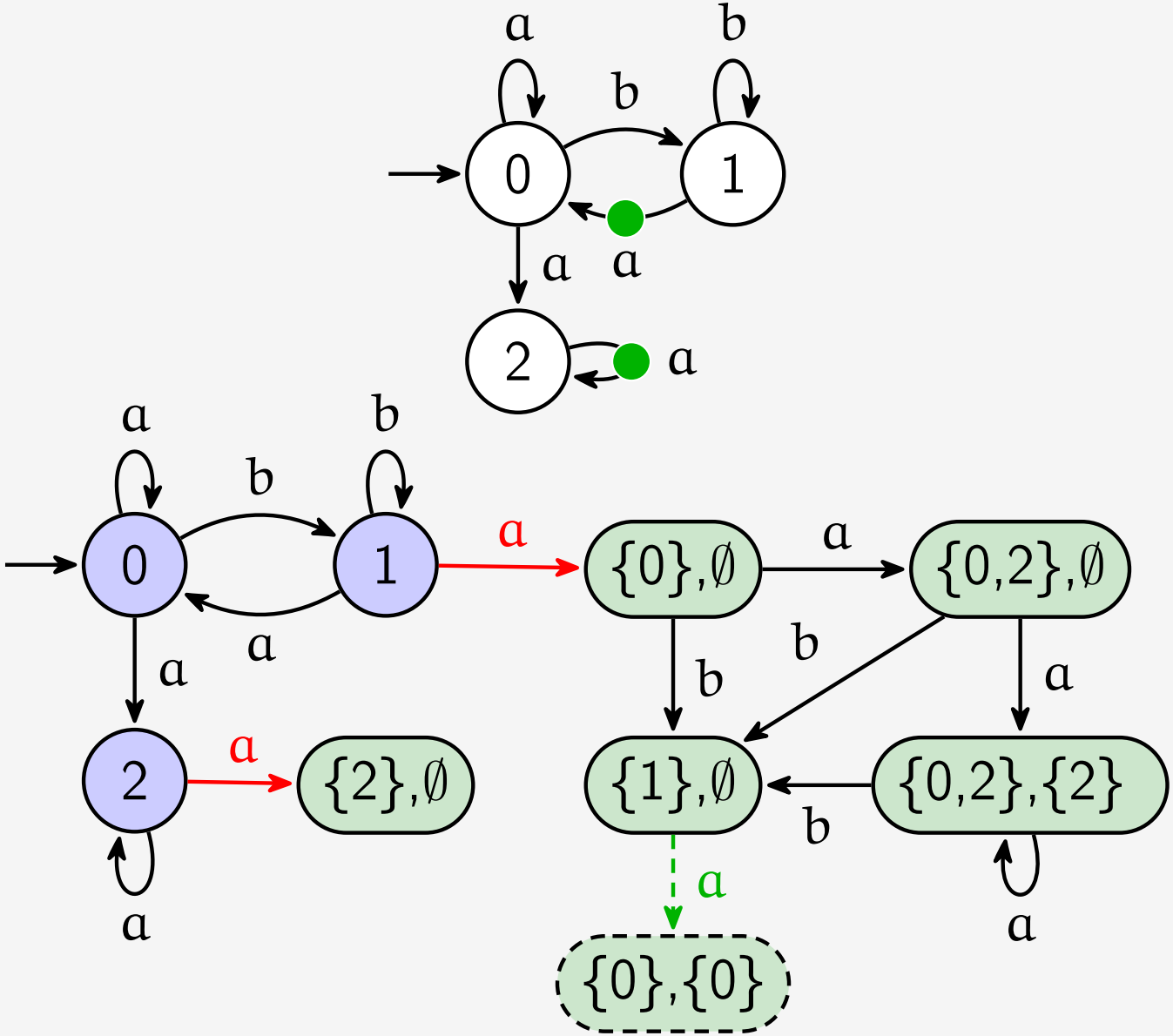
Semi-determinization [Courcoubetis, Yannakakis 88]



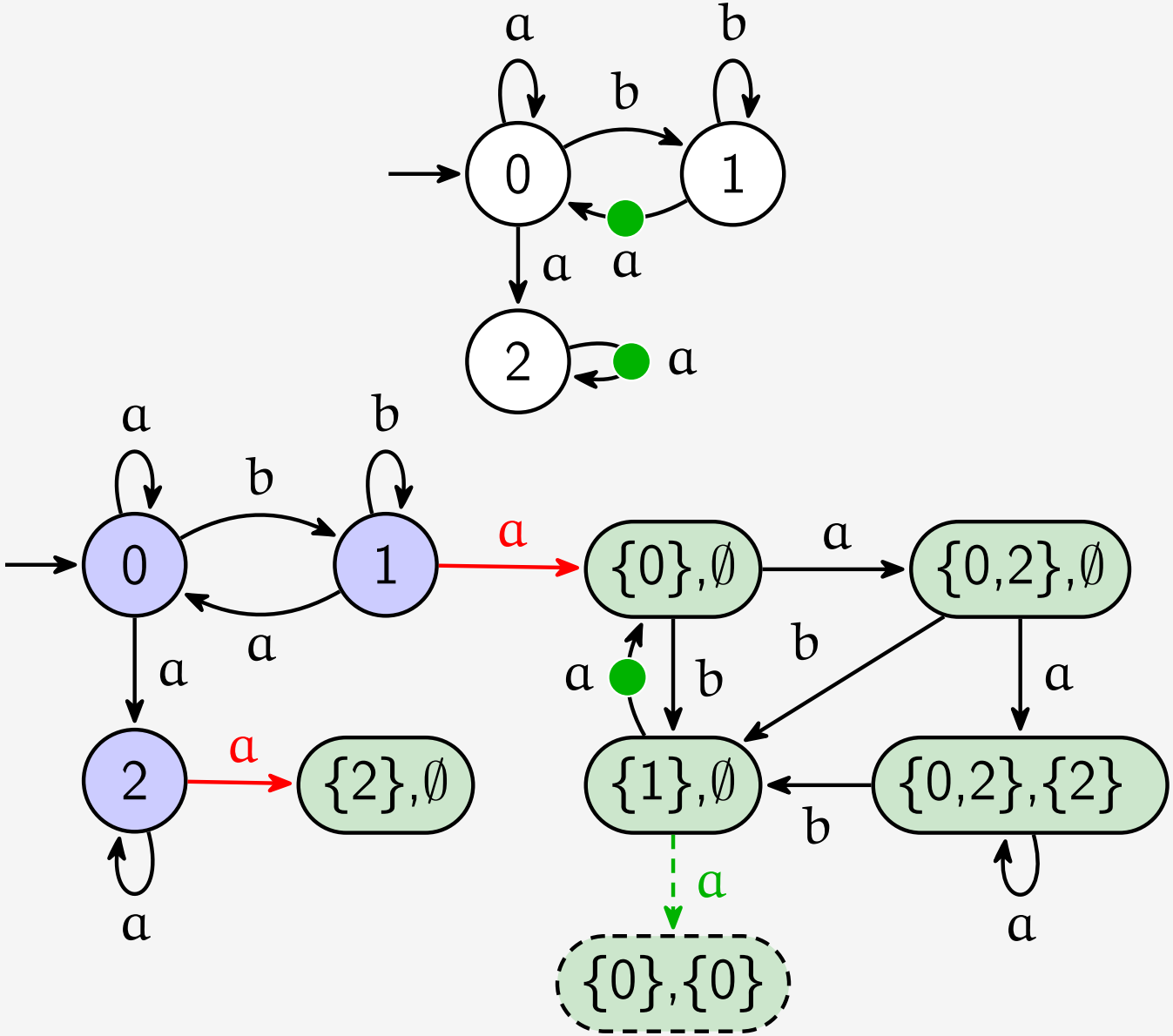
Semi-determinization [Courcoubetis, Yannakakis 88]



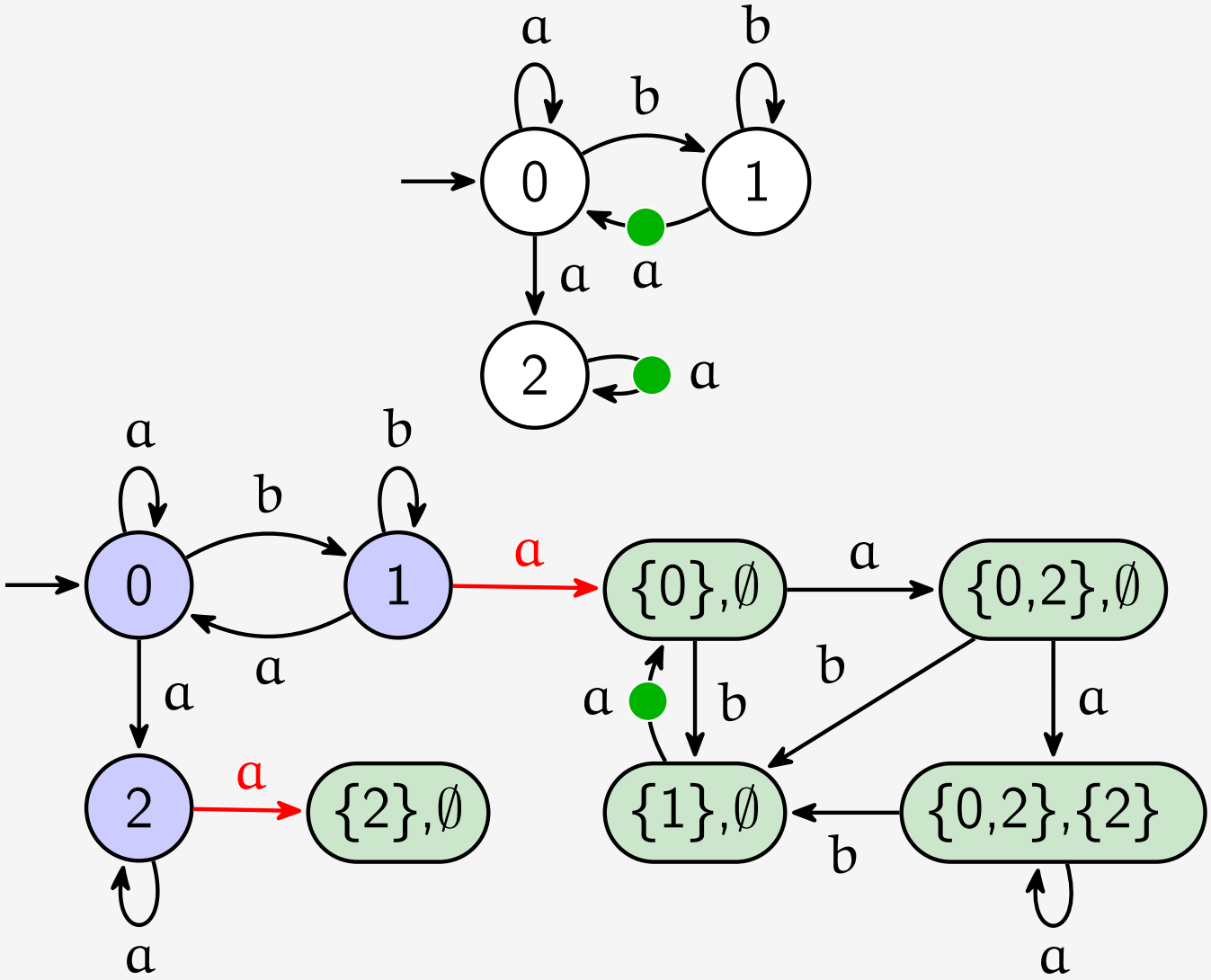
Semi-determinization [Courcoubetis, Yannakakis 88]



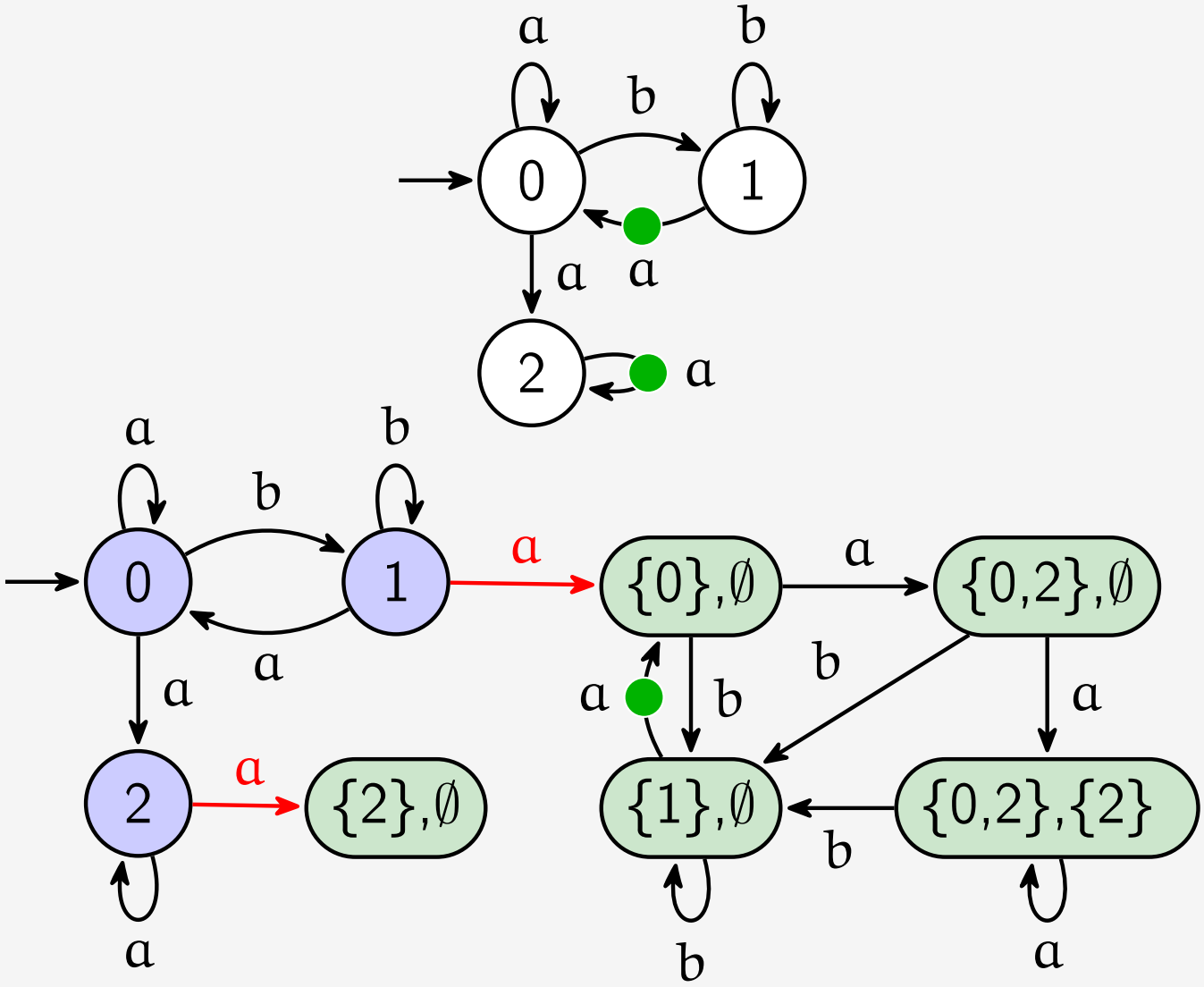
Semi-determinization [Courcoubetis, Yannakakis 88]



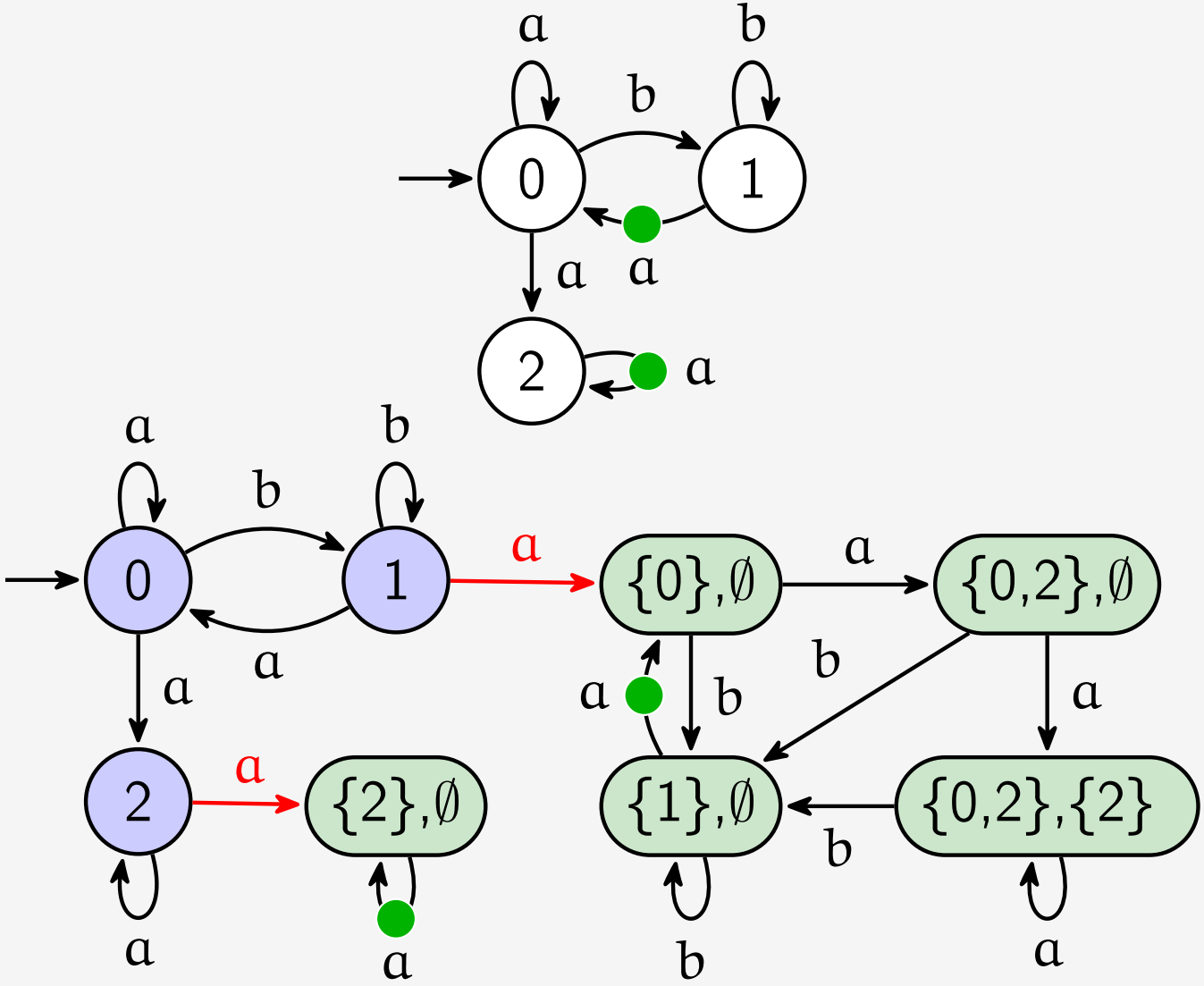
Semi-determinization [Courcoubetis, Yannakakis 88]



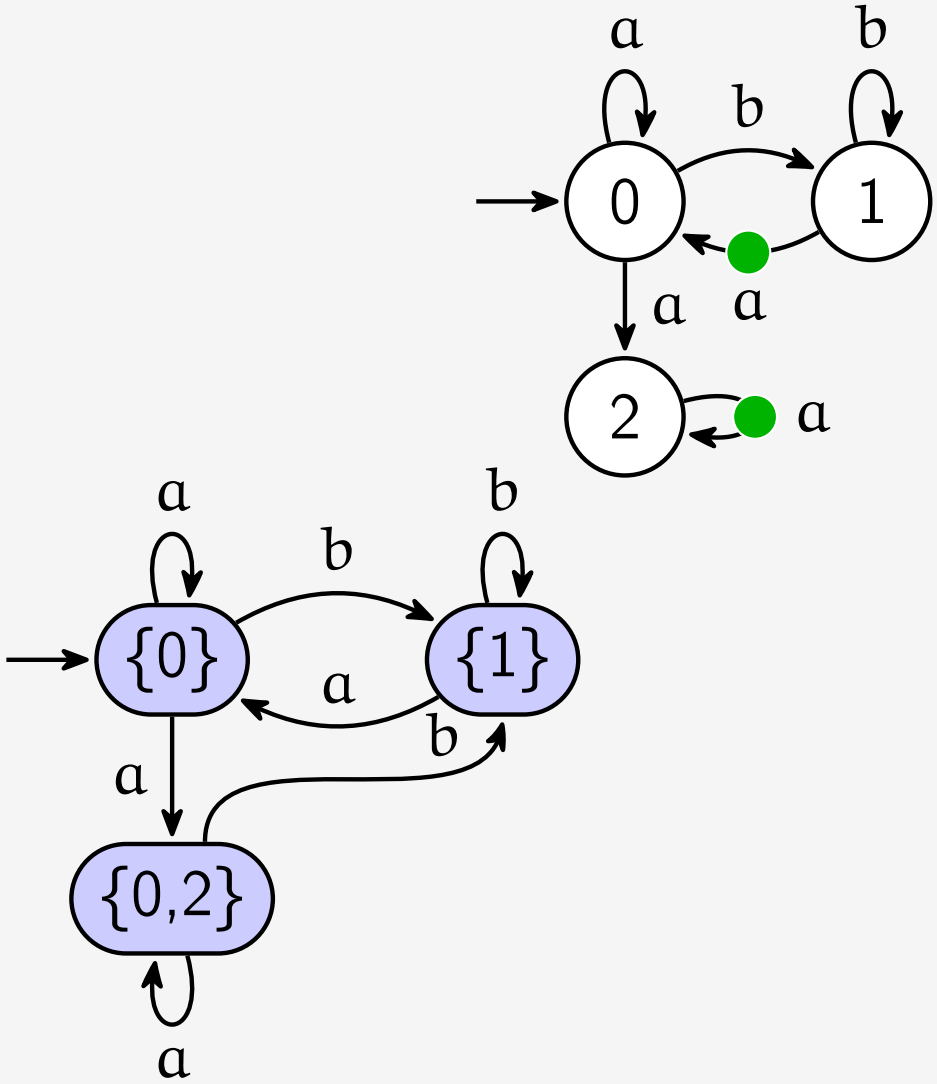
Semi-determinization [Courcoubetis, Yannakakis 88]



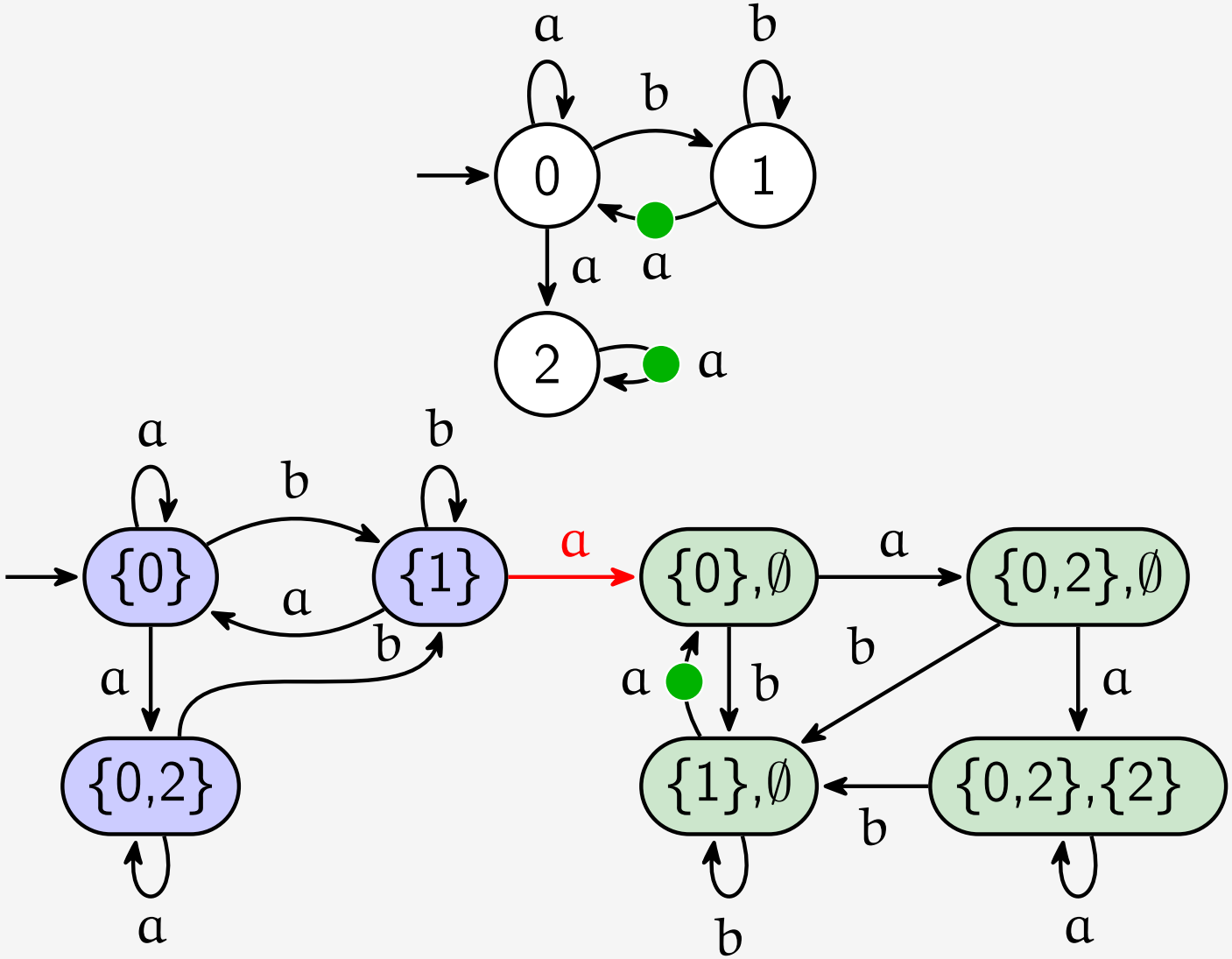
Semi-determinization [Courcoubetis, Yannakakis 88]



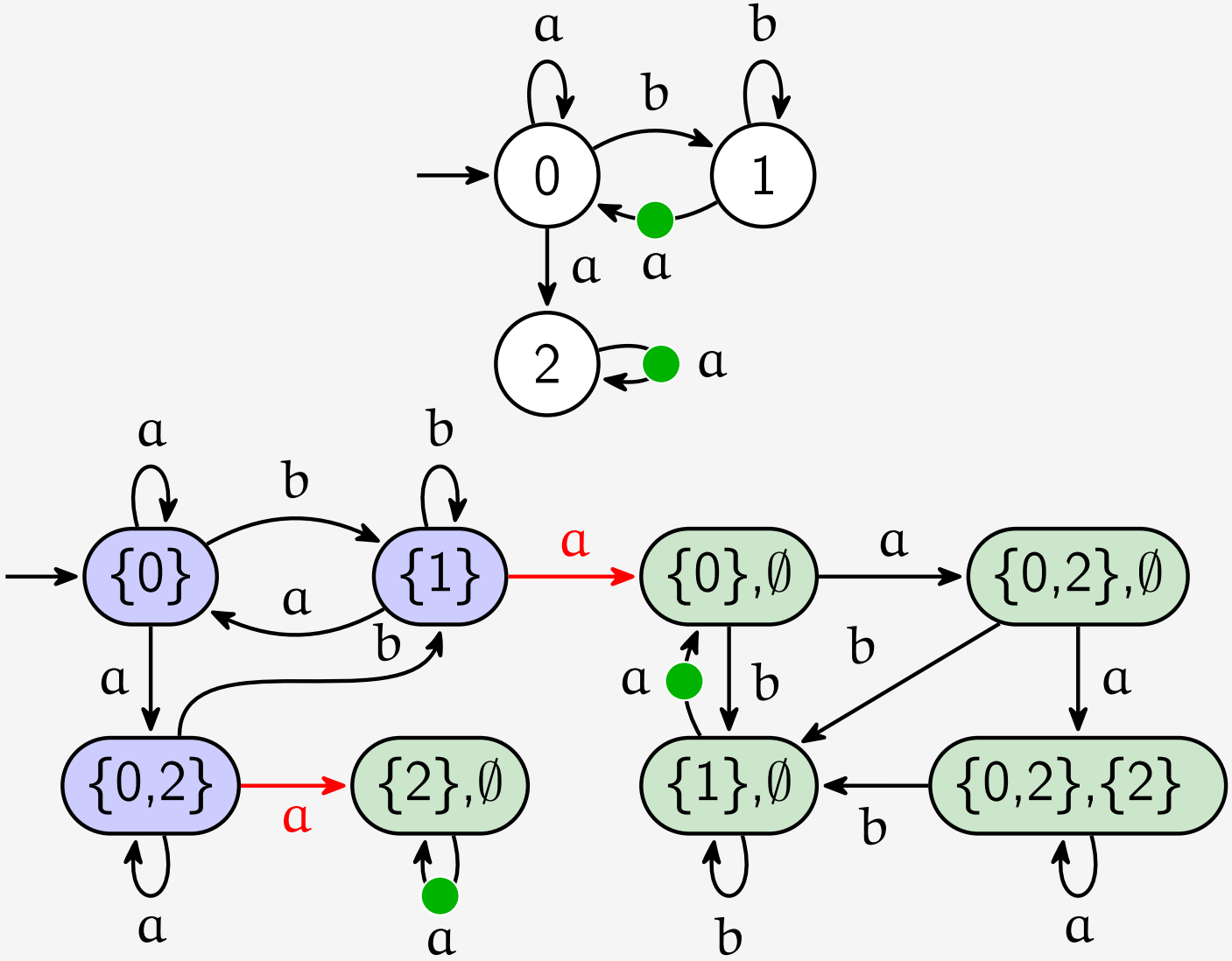
Cut-determinization



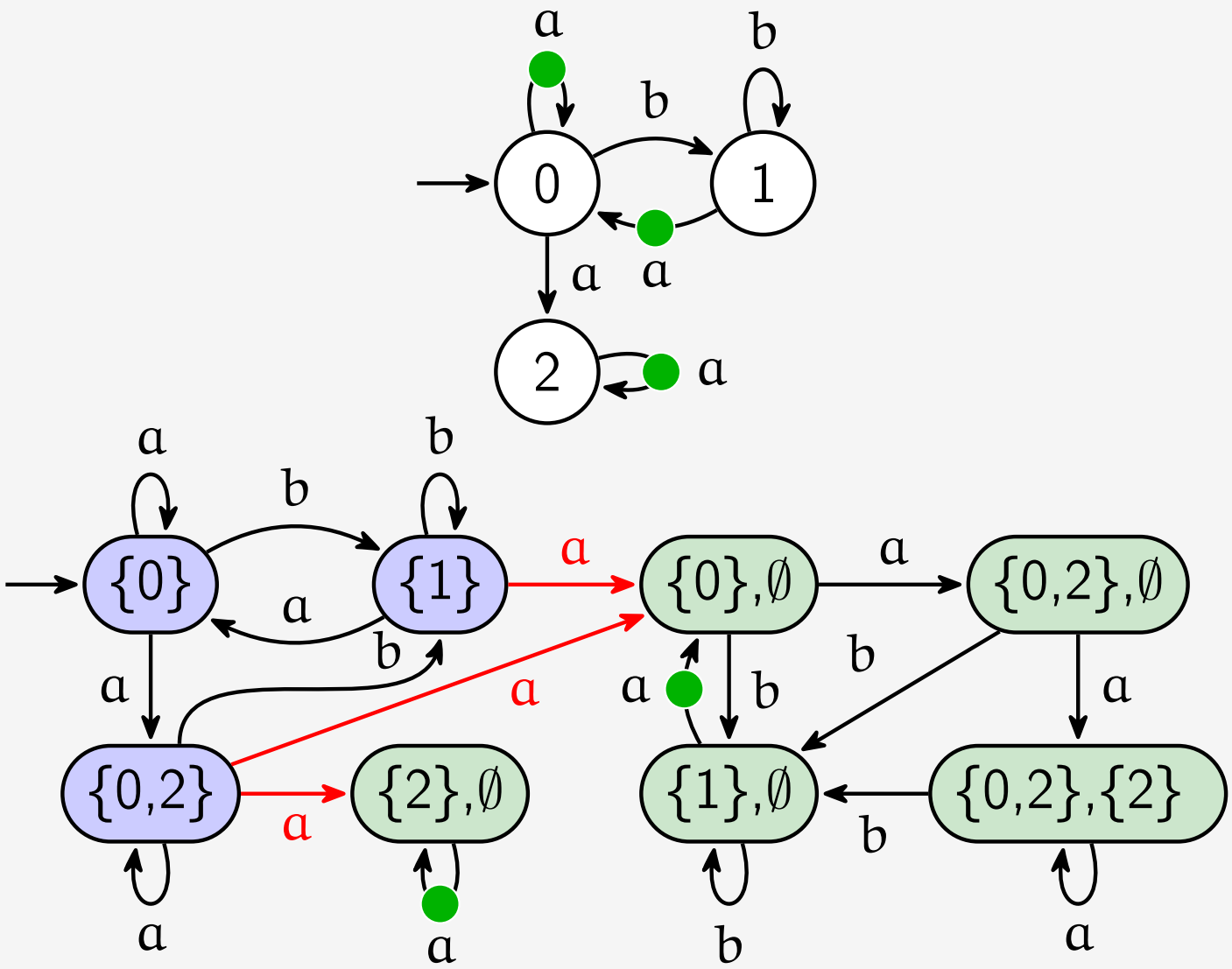
Cut-determinization



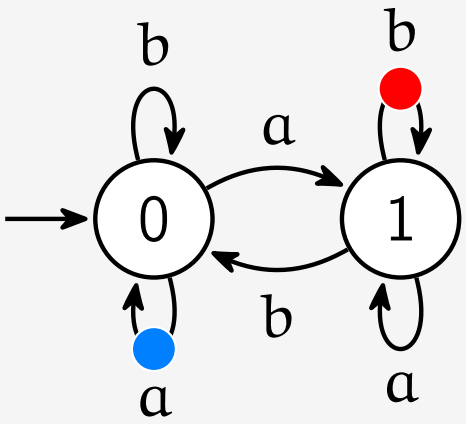
Cut-determinization



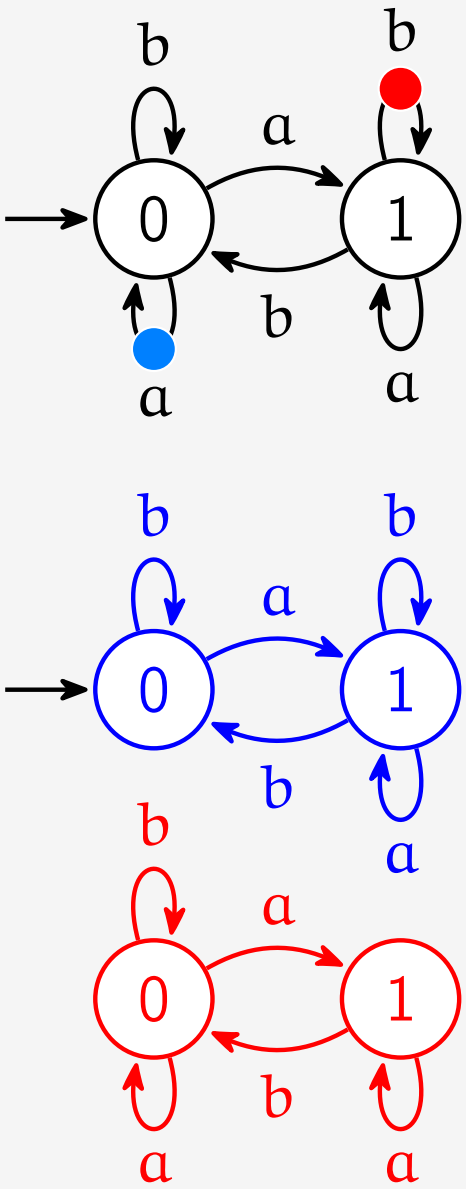
Cut-determinization



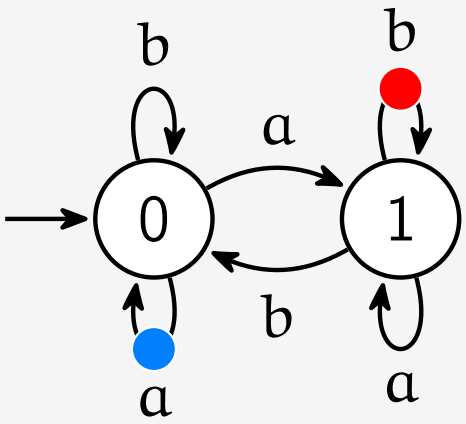
Generalized Büchi automata (TGBA)

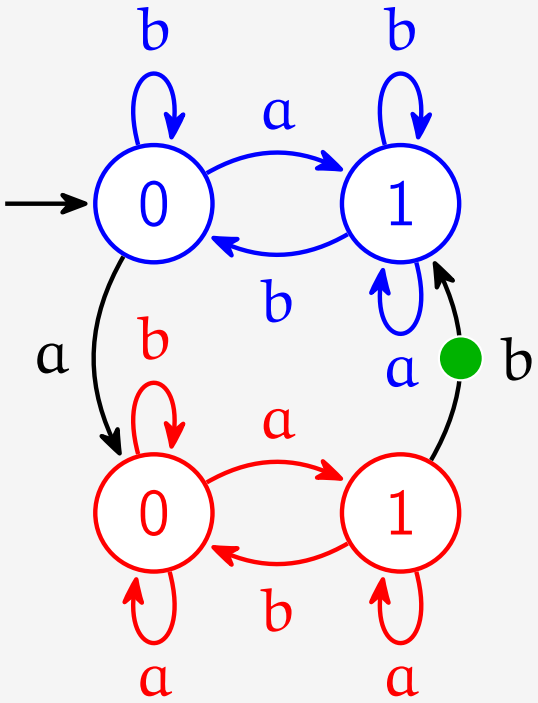


Generalized Büchi automata (TGBA)

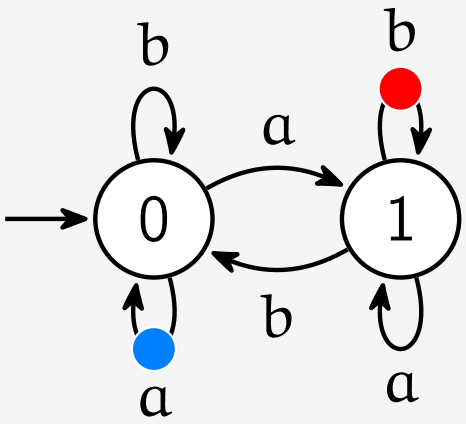


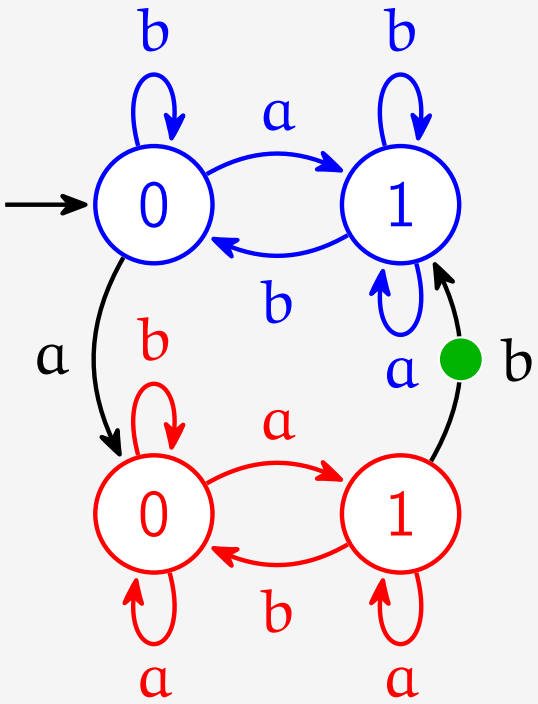
Generalized Büchi automata (TGBA)





Generalized Büchi automata (TGBA)

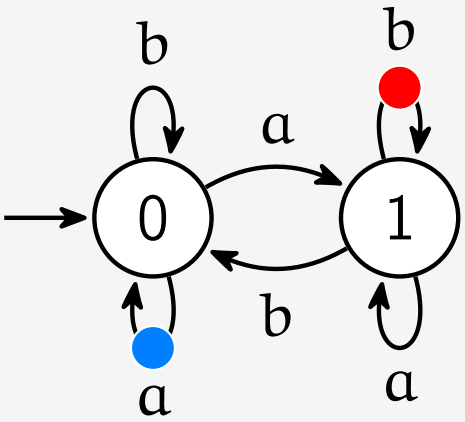


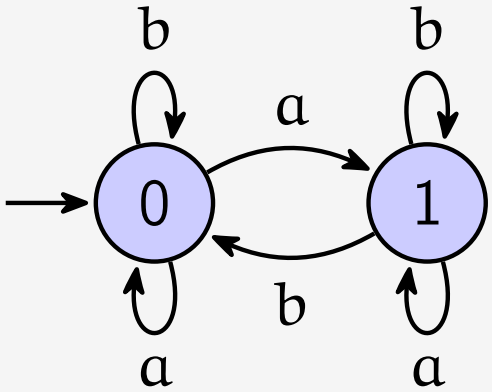


States reachable in corresponding semi-deterministic automaton:

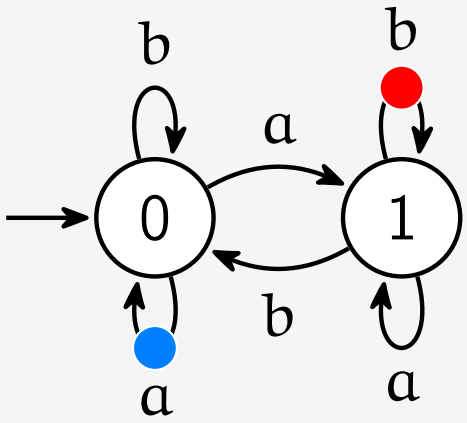
- $\{1\},\emptyset$
- $\{0,1\},\emptyset$
- $\{1,0\},\emptyset$
- $\{1,0,1\},\emptyset$
- $\{1,0,1\},\emptyset$
- $\{1,0,0\},\{1\}$
- $\{1,0,0\},\{1,0\}$
- $\{1,0,1\},\{1\}$
- $\{1,0,1\},\{0,1\}$

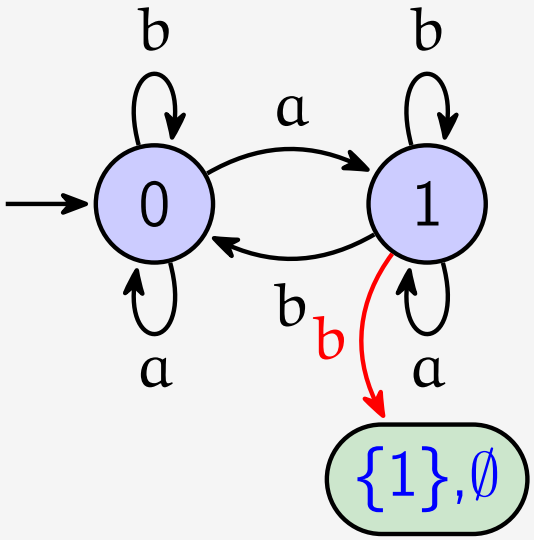
TGBA in Seminator



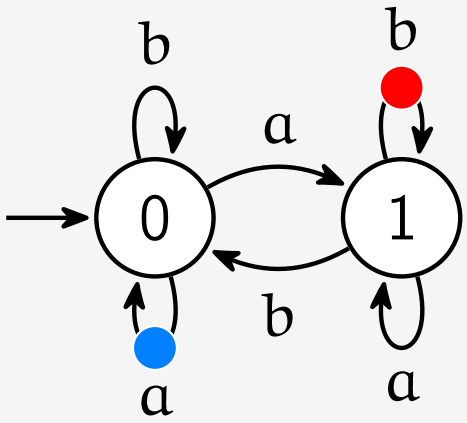


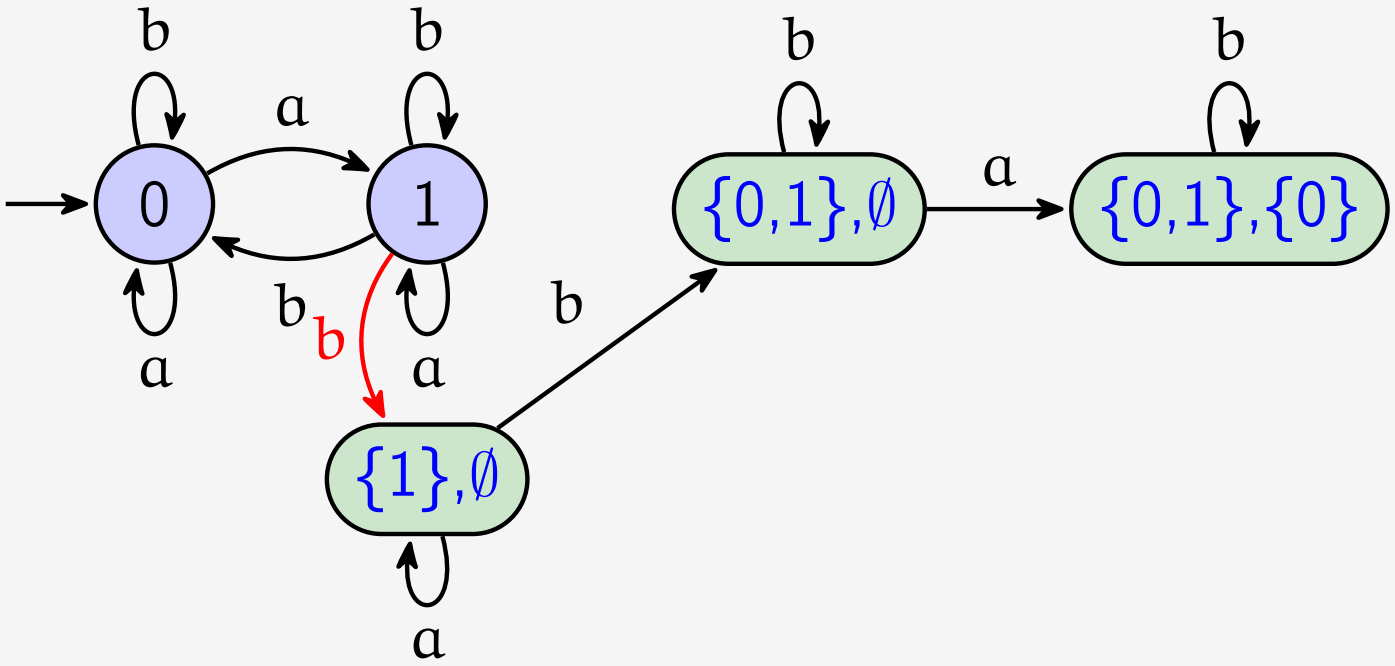
TGBA in Seminator



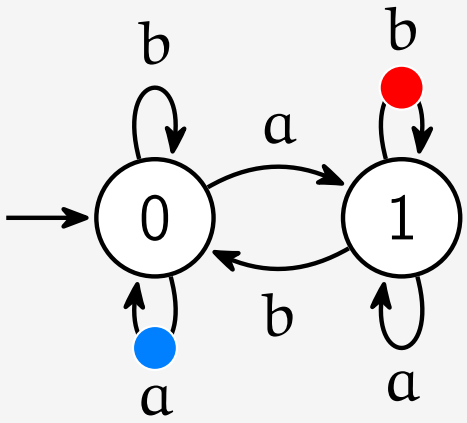


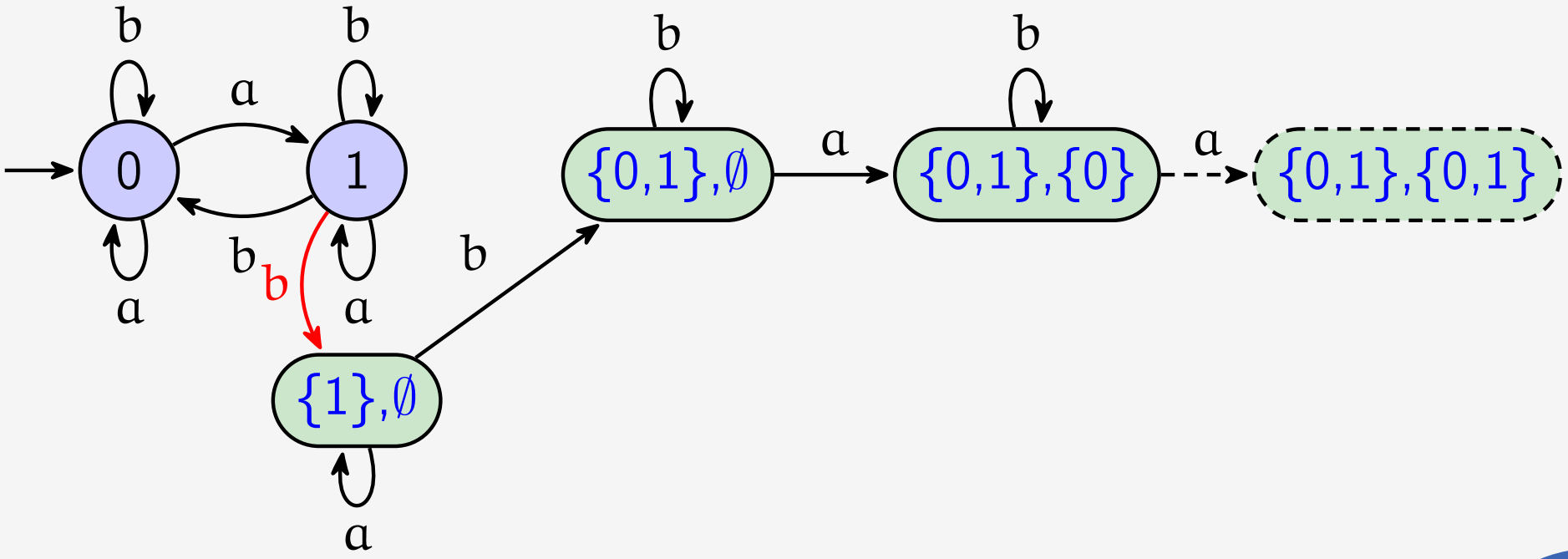
TGBA in Seminator



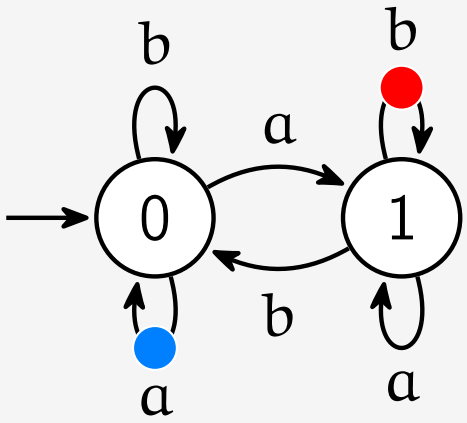


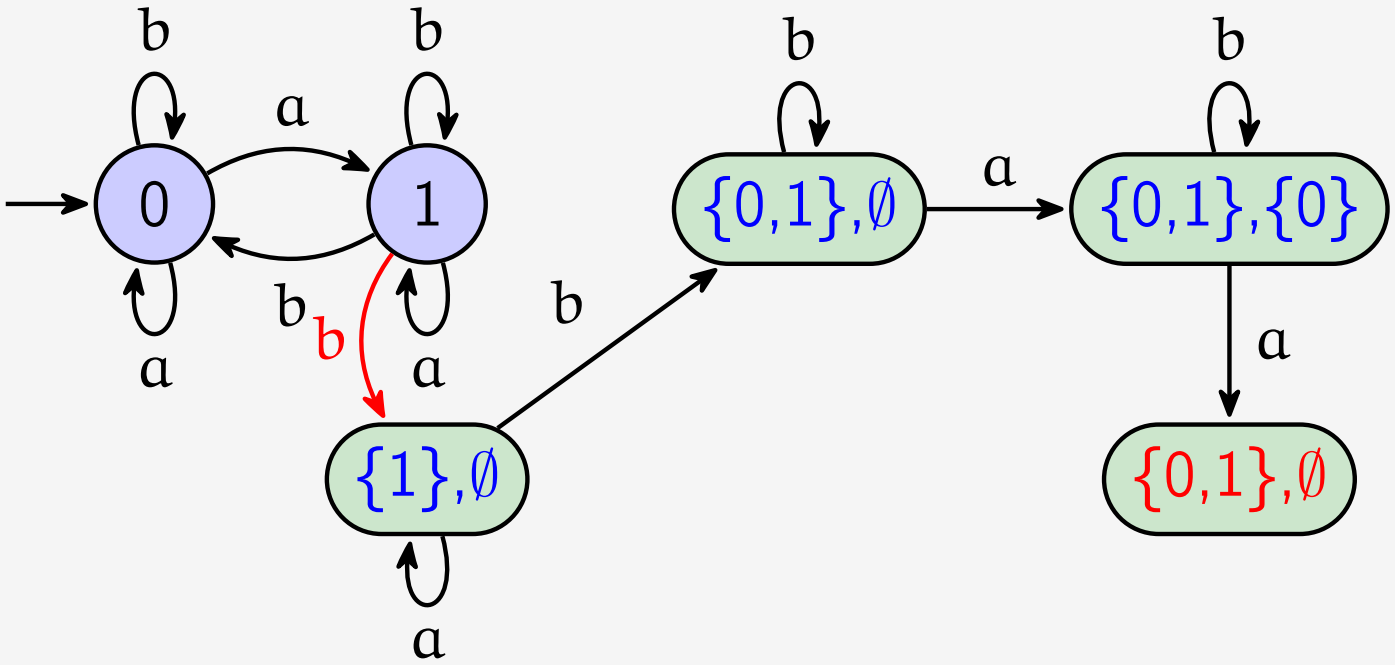
TGBA in Seminator



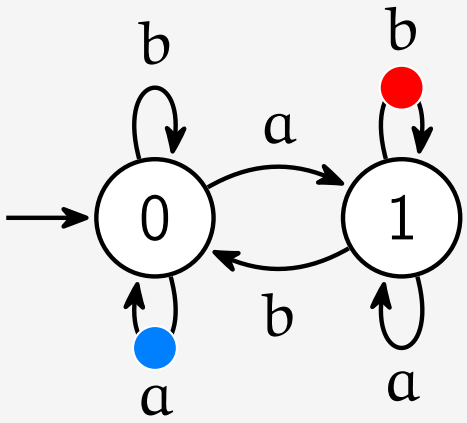


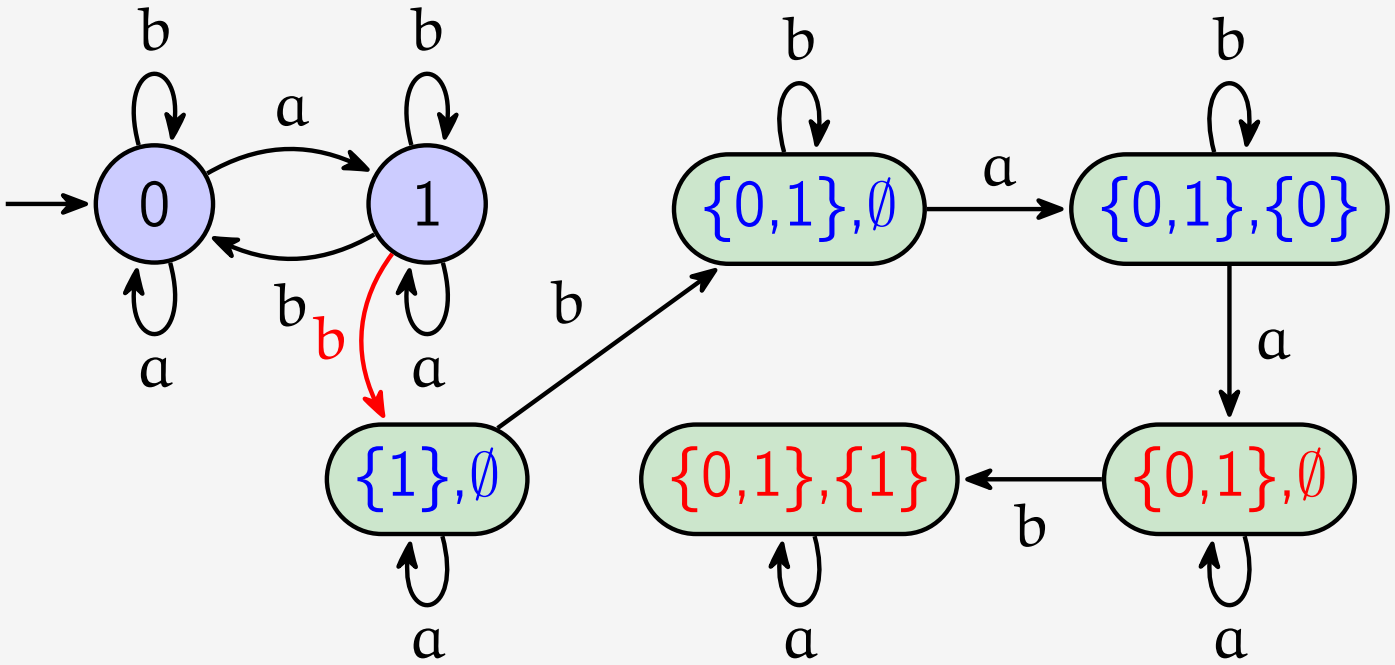
TGBA in Seminator



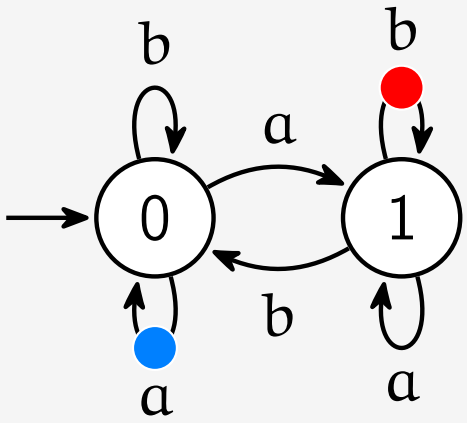


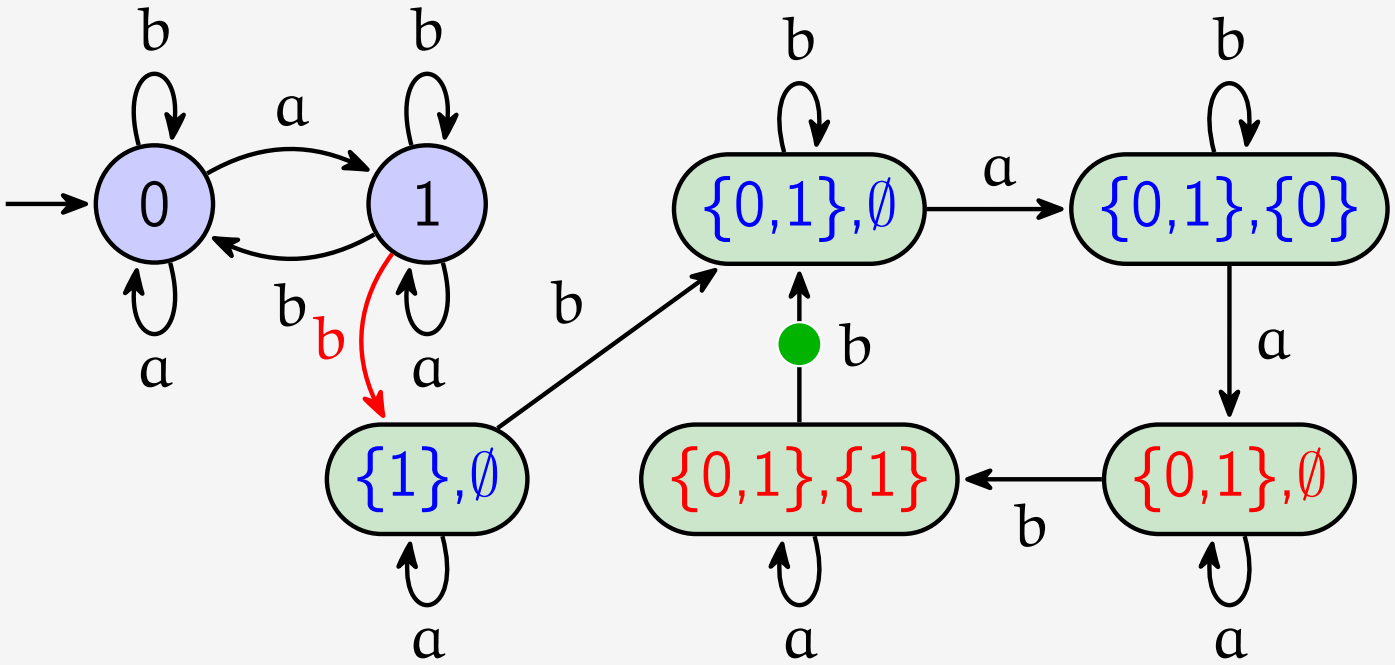
TGBA in Seminator





TGBA in Seminator



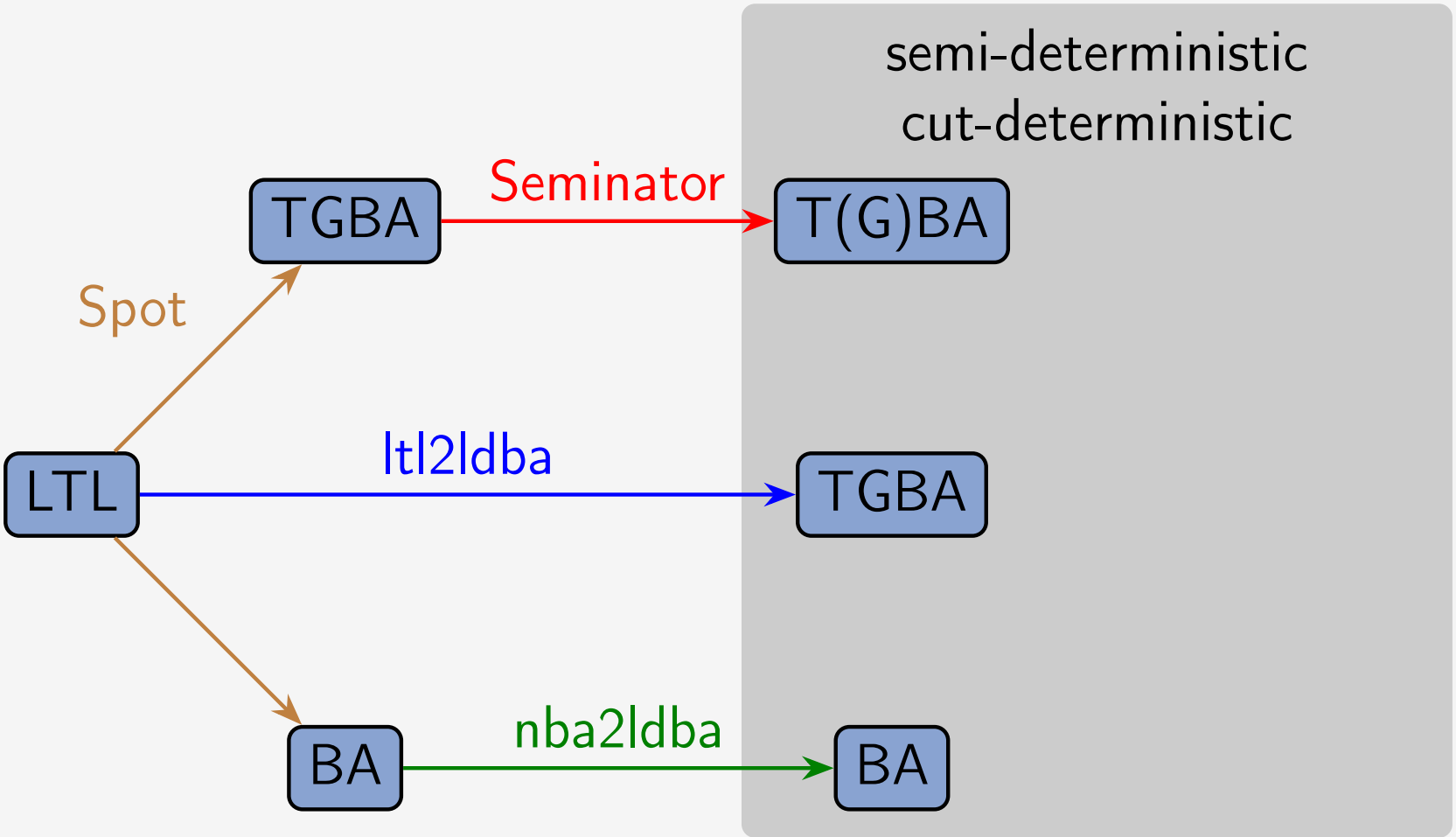


Experimental evaluation – tools

- Seminator: TGBA to semi- and cut-deterministic T(G)BA
- nba2ldba: BA to semi-deterministic BA (v1.0)
- ltl2ldba: LTL to semi- and cut-deterministic TGBA

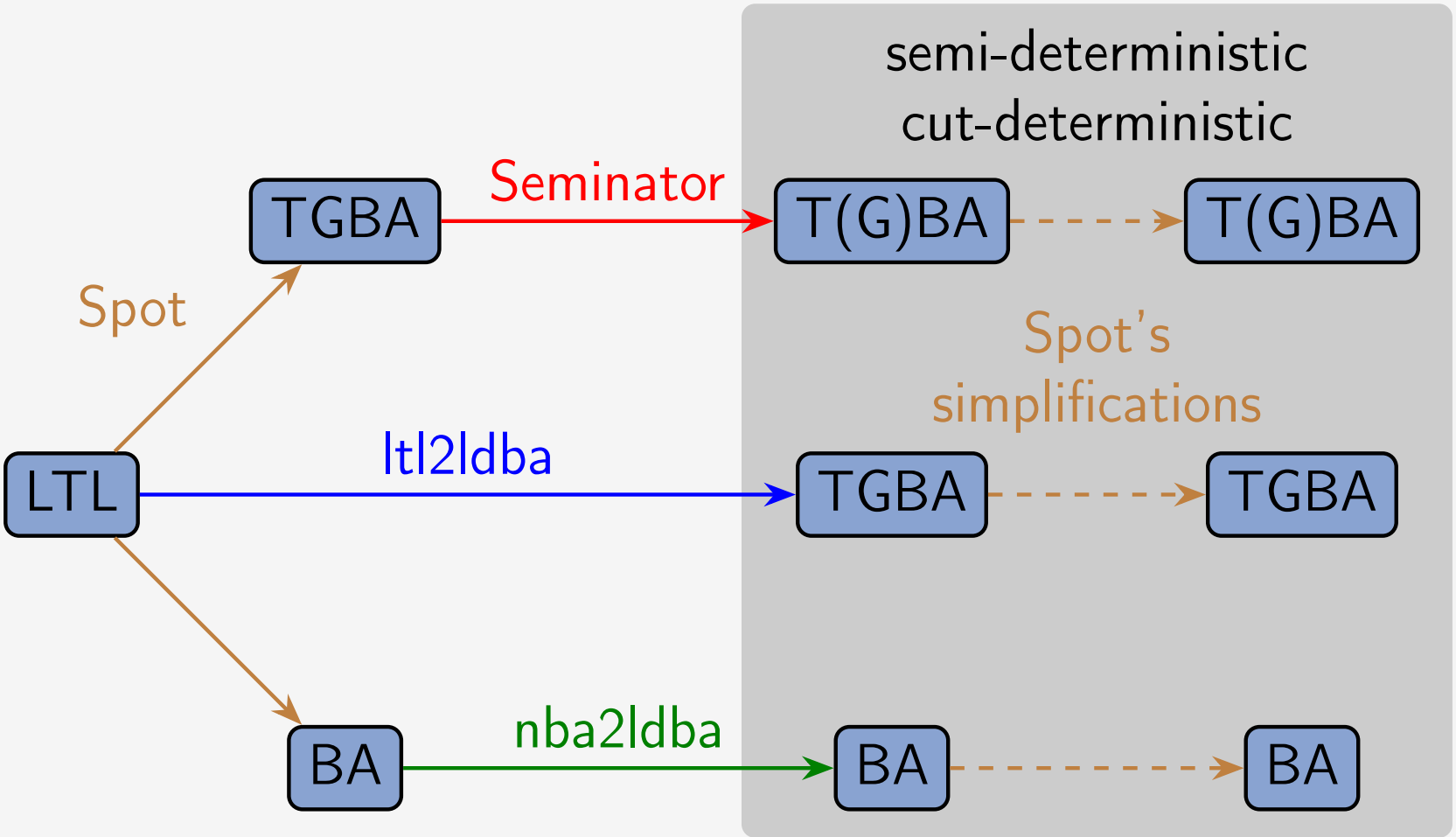
Experimental evaluation – tools

- Seminator: TGBA to semi- and cut-deterministic T(G)BA
- nba2ldba: BA to semi-deterministic BA (v1.0)
- ltl2ldba: LTL to semi- and cut-deterministic TGBA



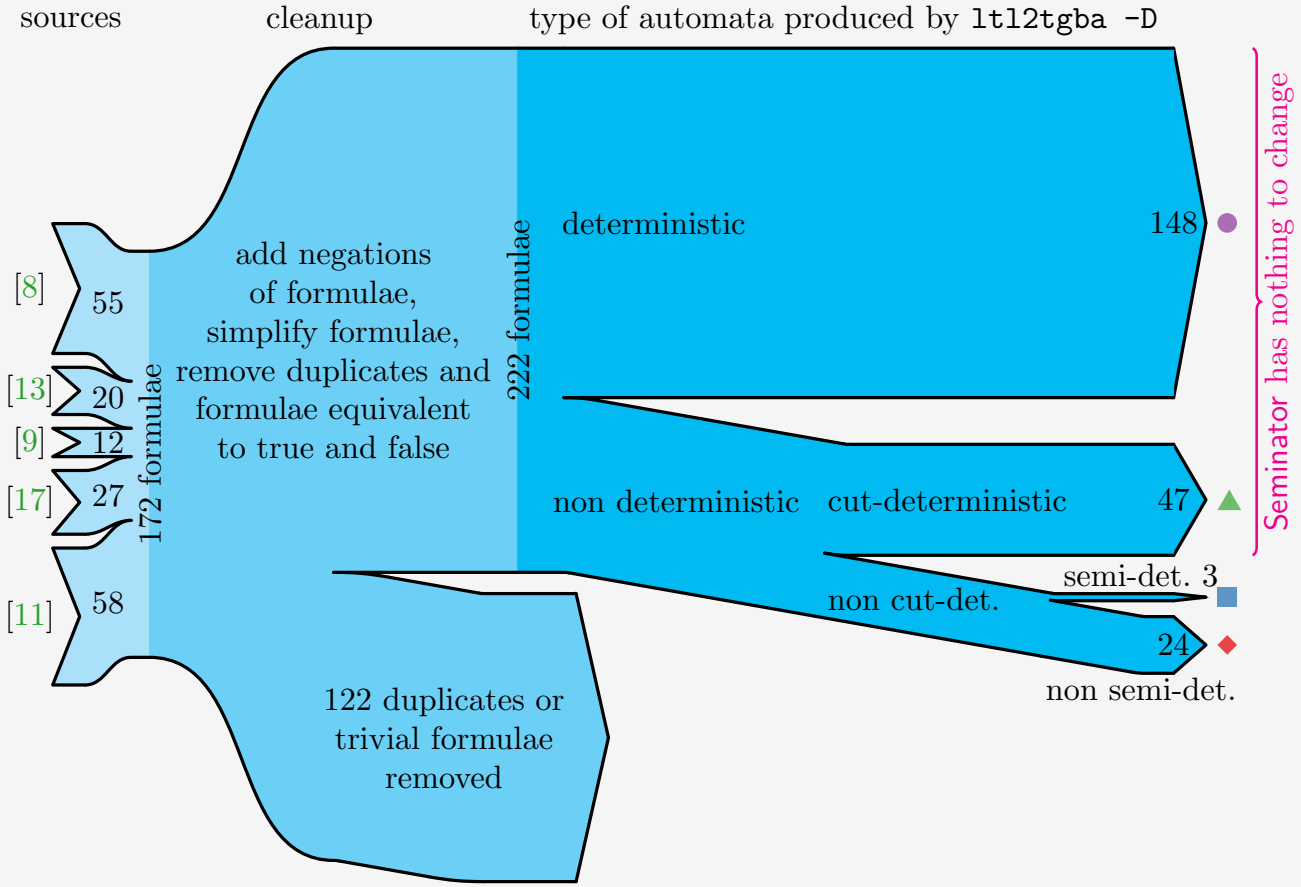
Experimental evaluation – tools

- Seminator: TGBA to semi- and cut-deterministic T(G)BA
- nba2ldba: BA to semi-deterministic BA (v1.0)
- ltl2ldba: LTL to semi- and cut-deterministic TGBA



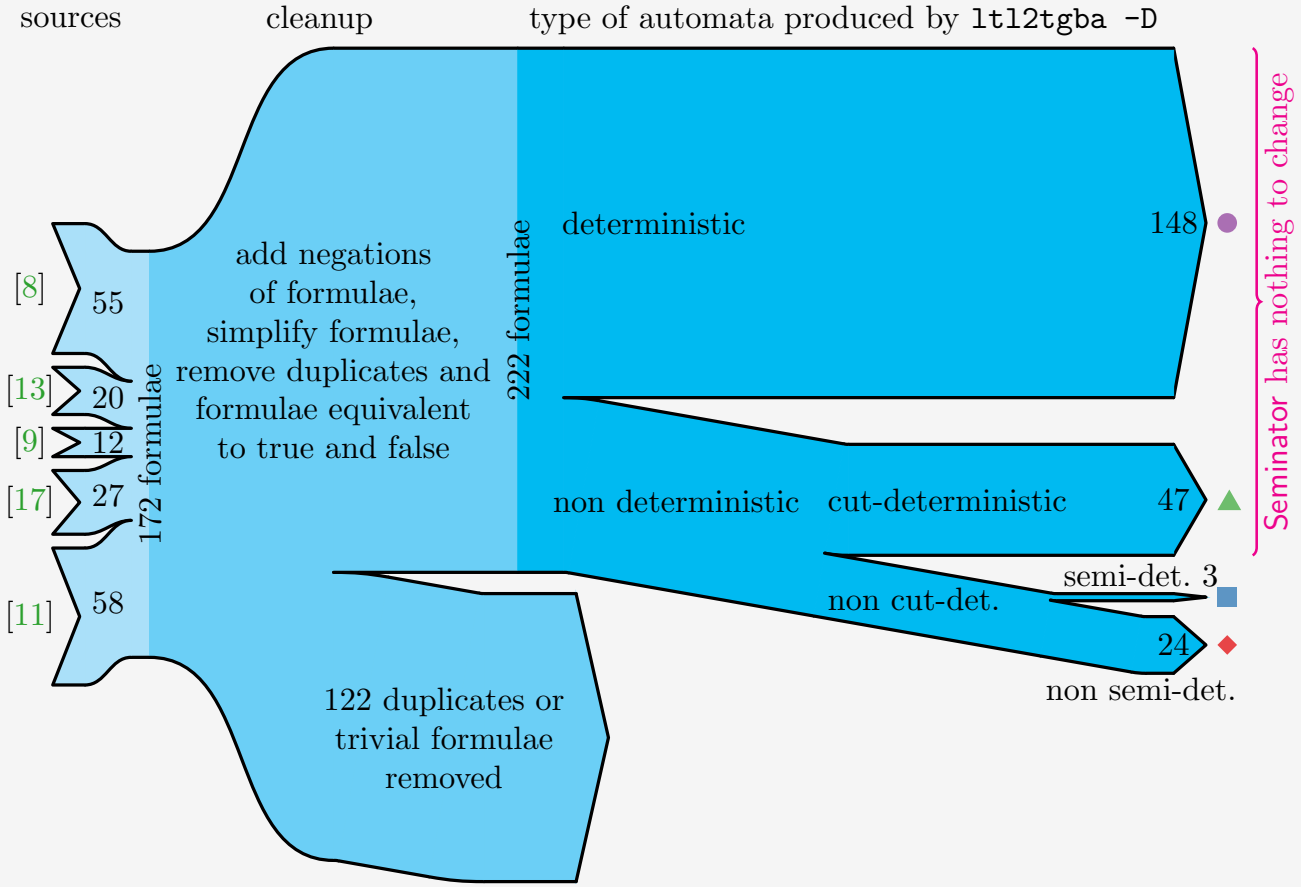
Experimental evaluation – benchmarks

1 LTL formulae from literature



Experimental evaluation – benchmarks

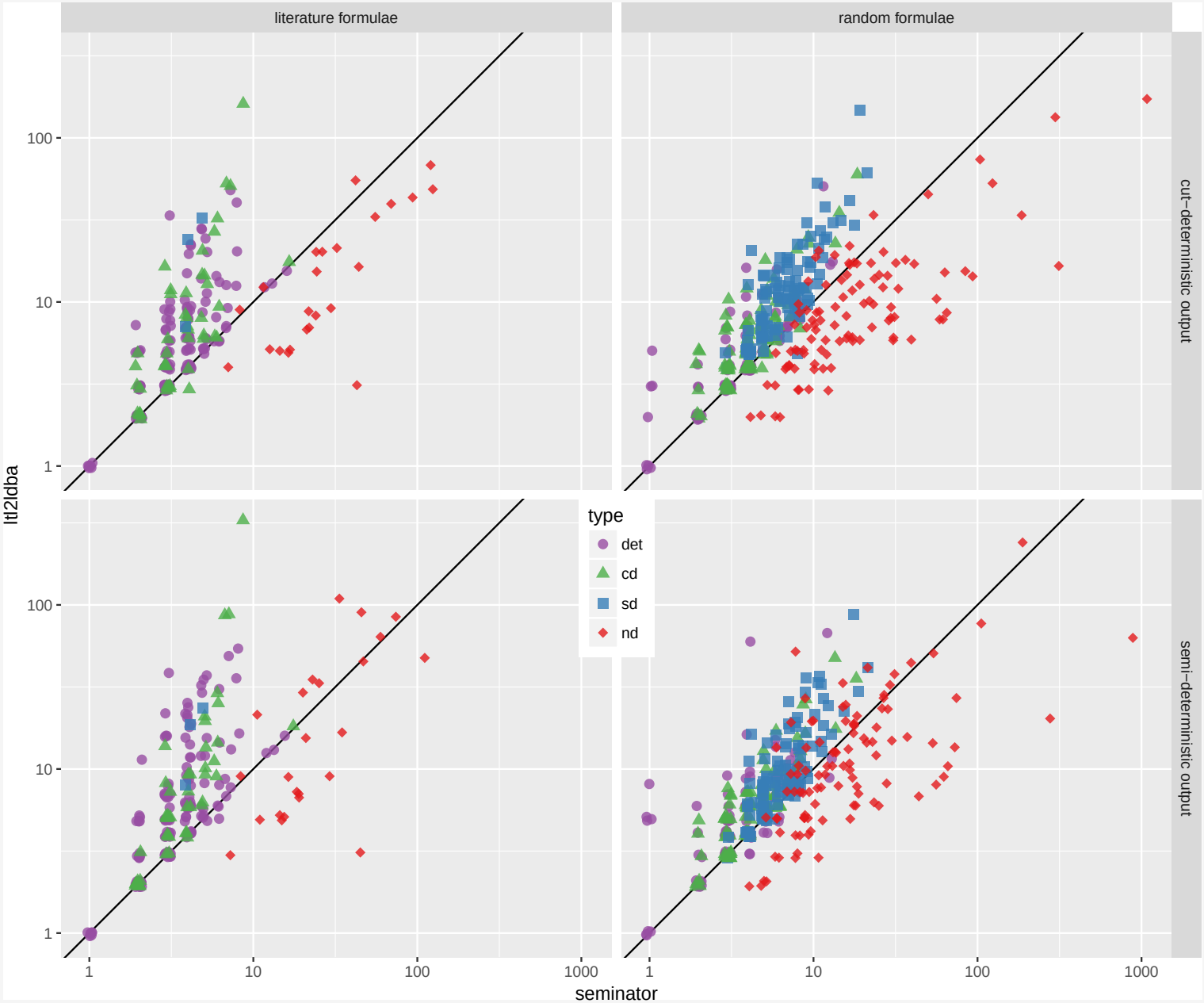
1 LTL formulae from literature



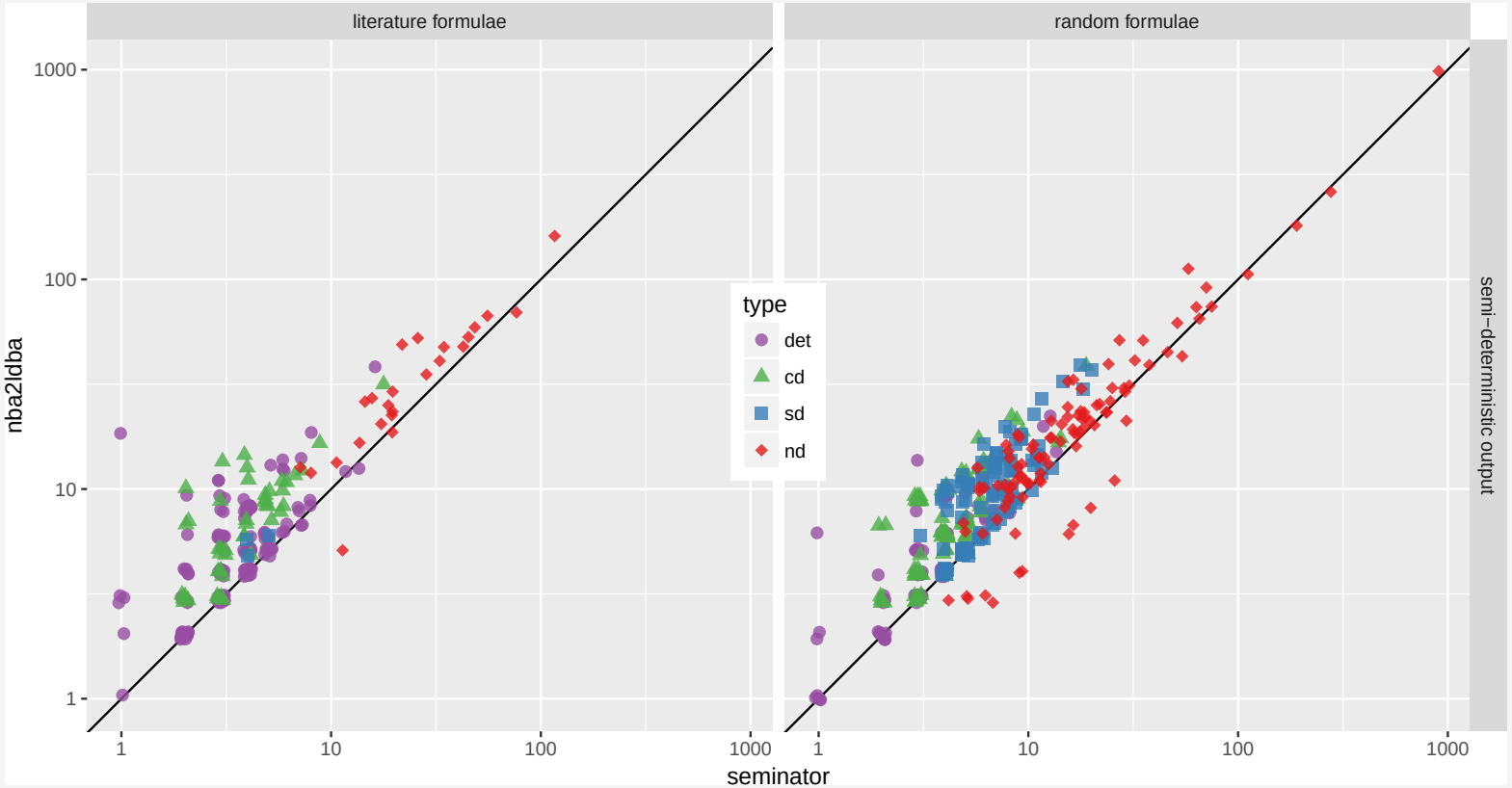
2 random LTL formulae

100 for each of the types ● det, ▲ cd, ■ sd, and ◆ nd

Seminator × ltl2ldba



Seminator × nba2ldba



Conclusion

Seminator:

- efficient semi-determinization of TGBA
- efficient cut-determinization of TGBA
- implemented in C++ using Spot
- `https://github.com/mklokocka/seminator`

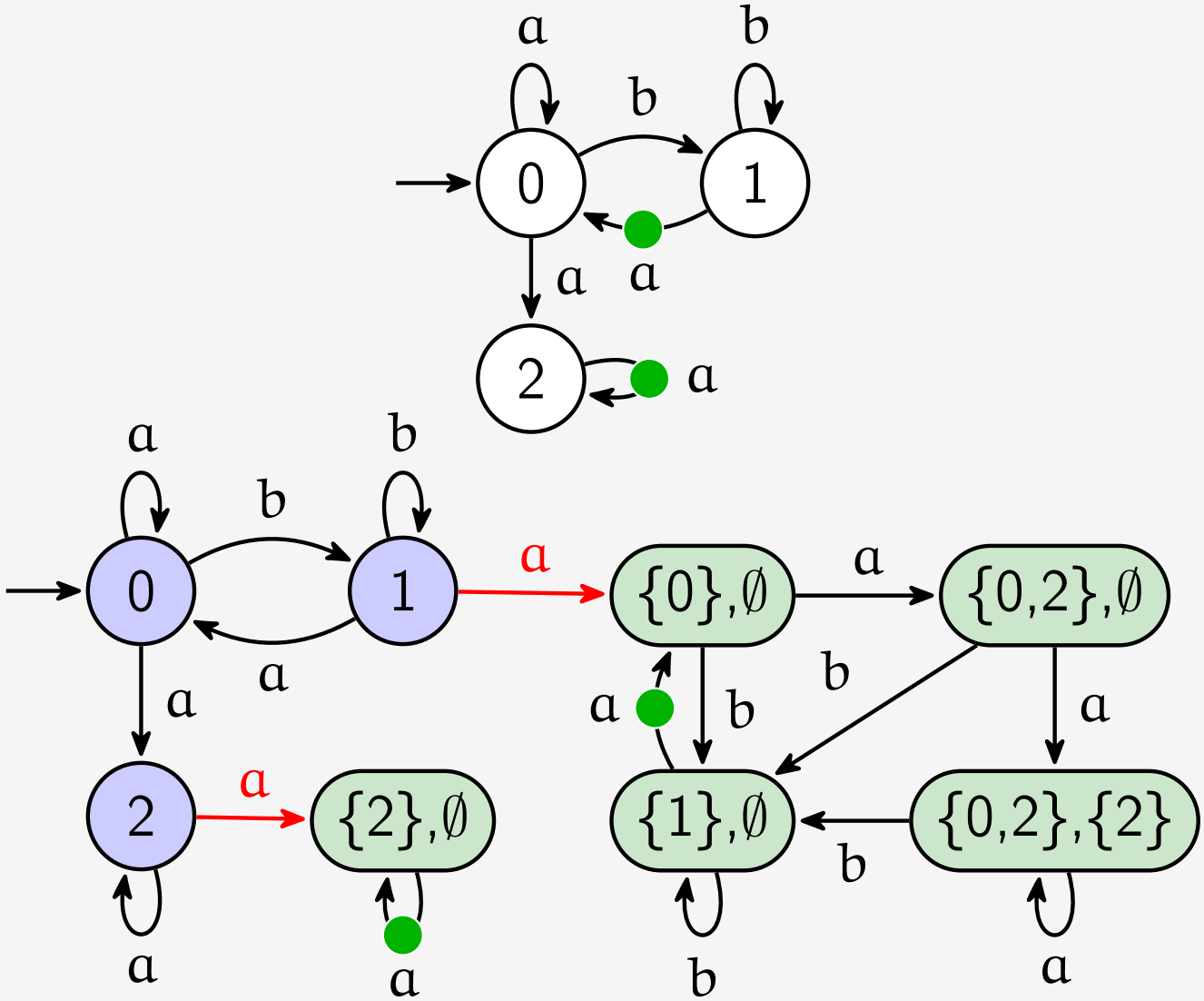
Conclusion

Seminator:

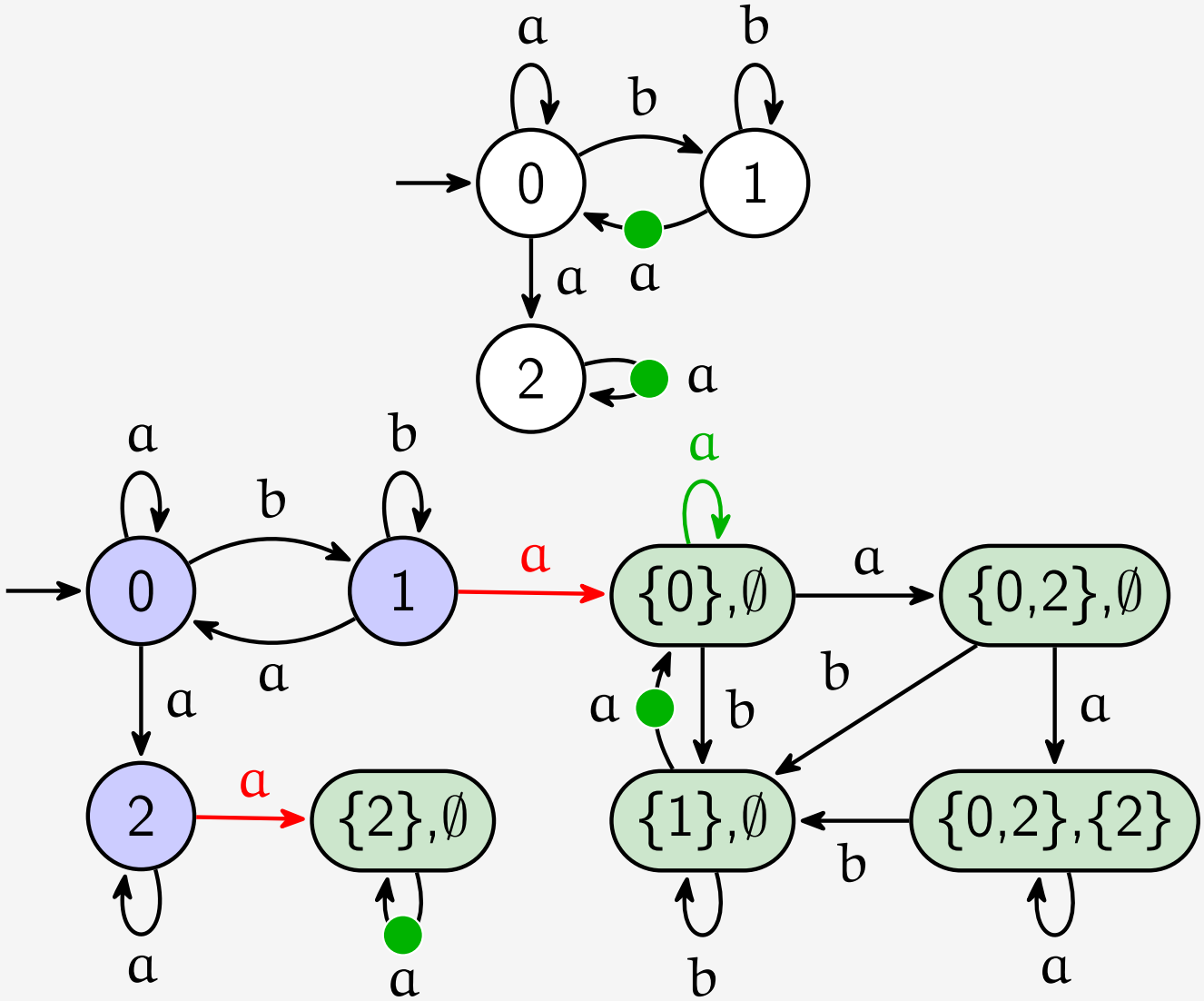
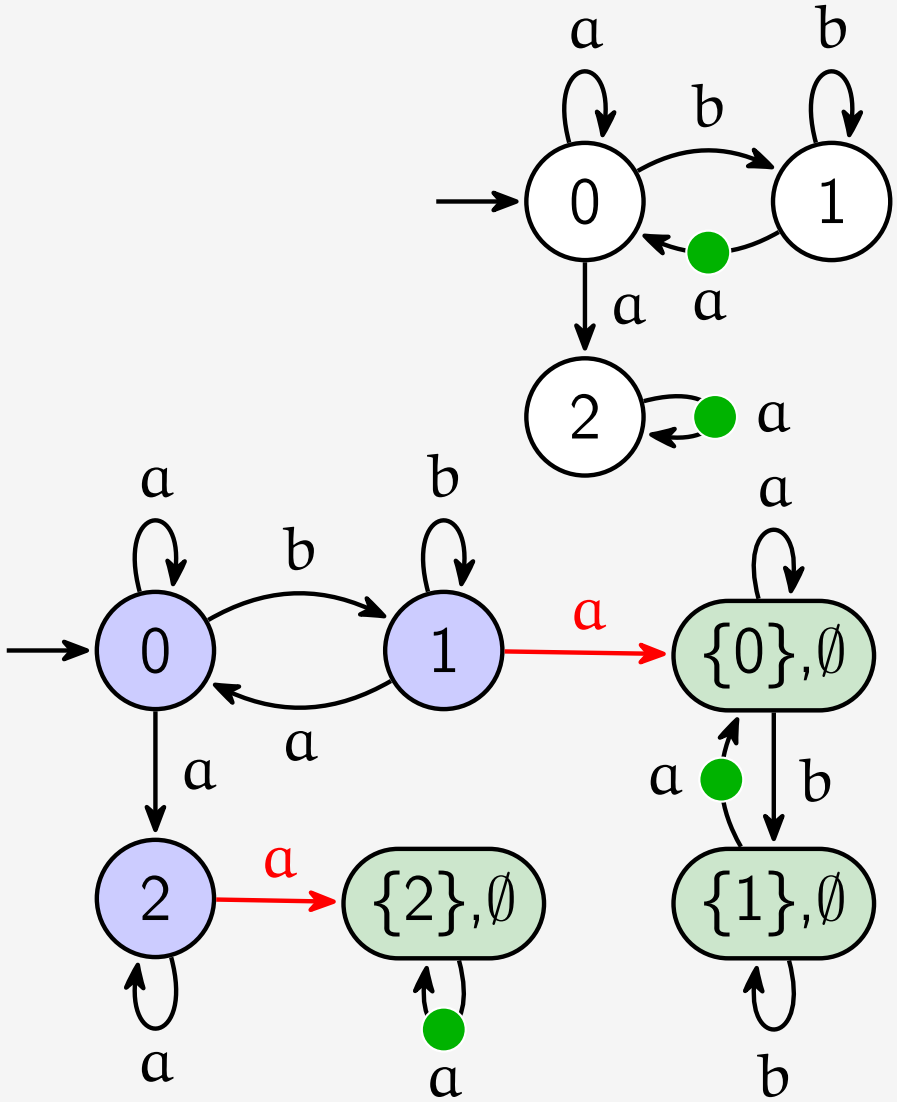
- efficient semi-determinization of TGBA
- efficient cut-determinization of TGBA
- implemented in C++ using Spot
- `https://github.com/mklokocka/seminator`
- outperforms nba2ldba
- competitive with ltl2ldba on many LTL formulae

What happened on LPAR

What happened on LPAR



What happened on LPAR



What happened on LPAR