Deciding Maxmin Reachability in Half-Blind Stochastic Games

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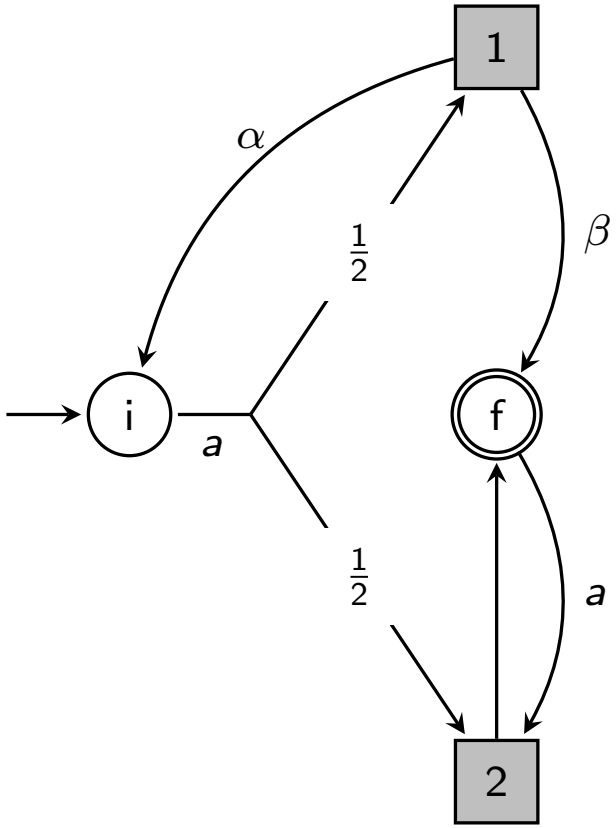


- Max vs Min for reachability
- Max has zero information
  - Picks finite words
- Min has perfect information
  - Picks behavioral strategies
- Probabilistic finite automata with an opponent

Question

For all $\epsilon > 0$ there exists a finite word for Max such that for all strategies for Min, the chance of reaching the state f is larger than $1 - \epsilon$?

Problem (Maxmin reachability problem)

Given a game decide whether

$$\underline{val}(s) = \sup_{w \in \Sigma_1} \inf_{\tau \in \Sigma_2} \mathbb{P}_s^{w,\tau}(F) = 1.$$

Maxmin reachability problem is **undecidable**.

Theorem

Maxmin reachability problem is decidable for leaktight half-blind games.

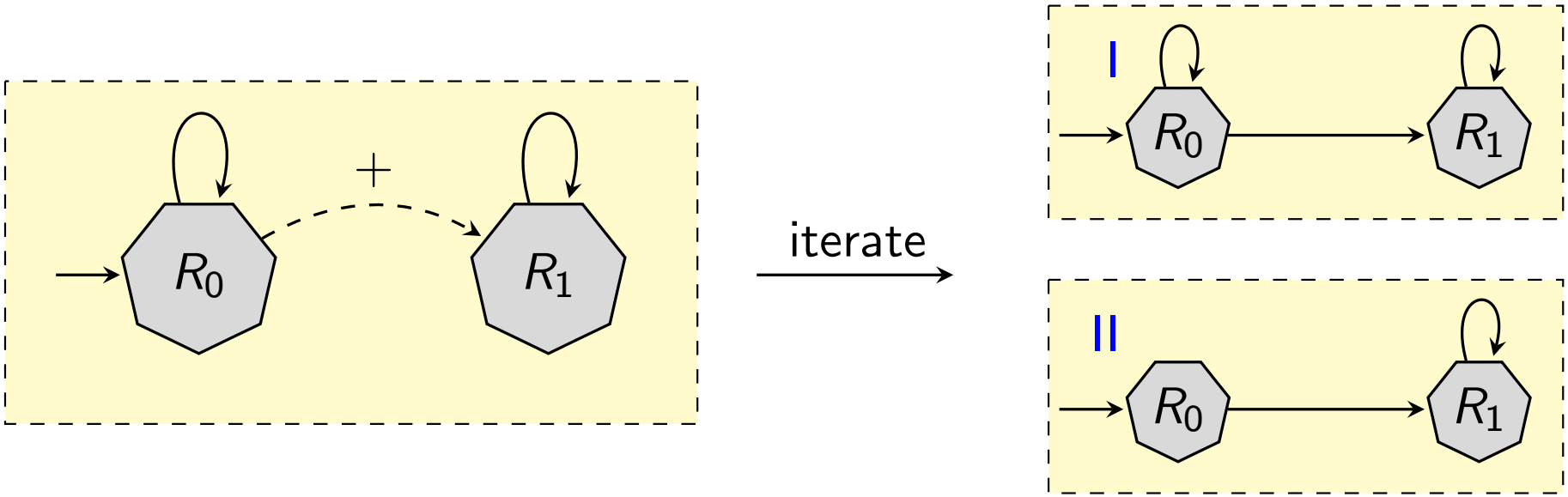
The notion of leaks comes from: Fijalkow, Gimbert, Oualhadj, 2012. **Deciding the Value 1 Problem for Probabilistic Leaktight Automata**

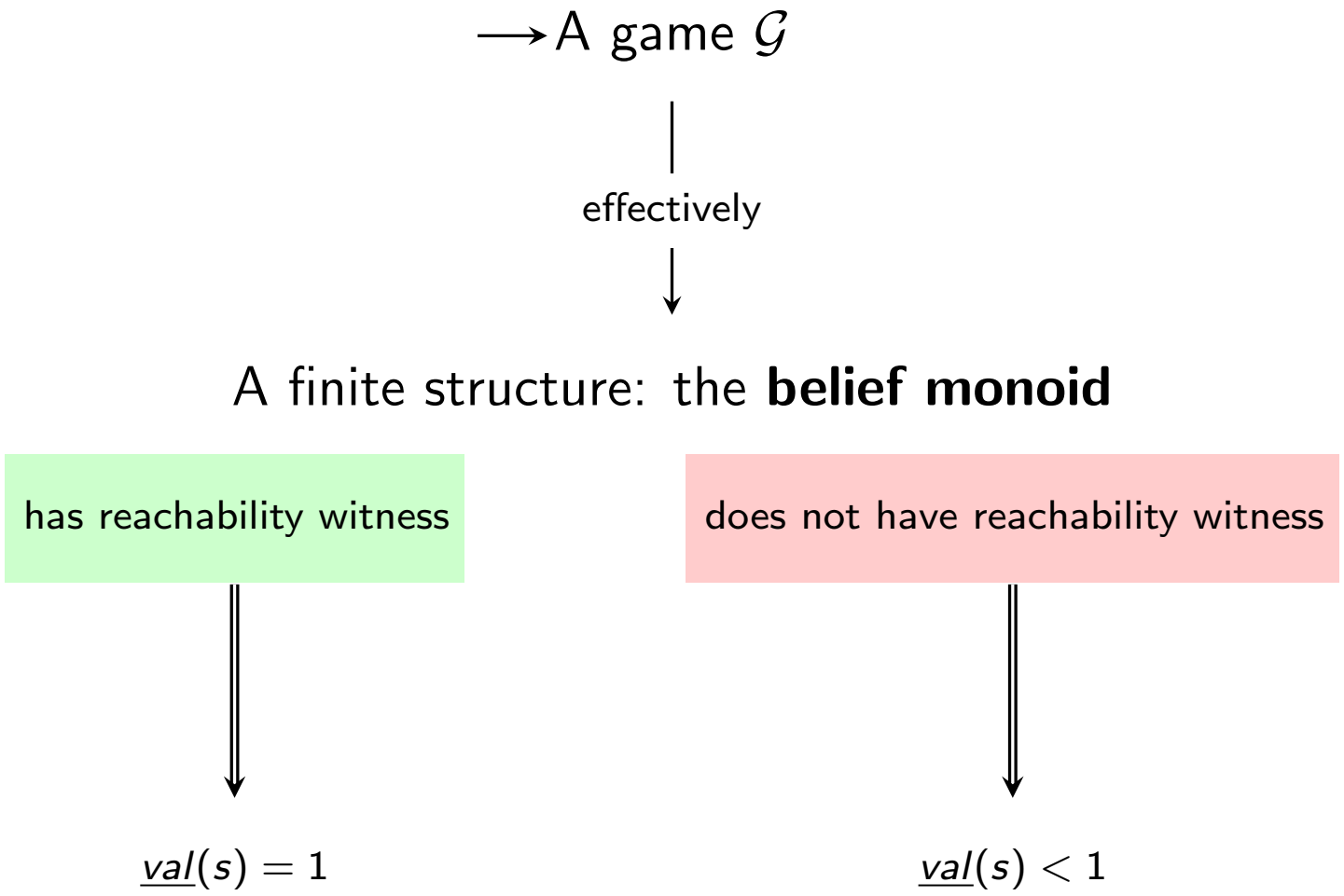
- Captures tightly the complications responsible for the undecidability of the value 1 problem
- Gives a robust class of PFAs with decidable value 1 problem

The leaktight class is robust:

- Fijalkow, 2015. Profinite techniques for probabilistic automata and the optimality of the markov monoid algorithm.
- Fijalkow, Gimbert, K, Oualhadj, 2015. Deciding the value 1 problem for probabilistic leaktight automata.

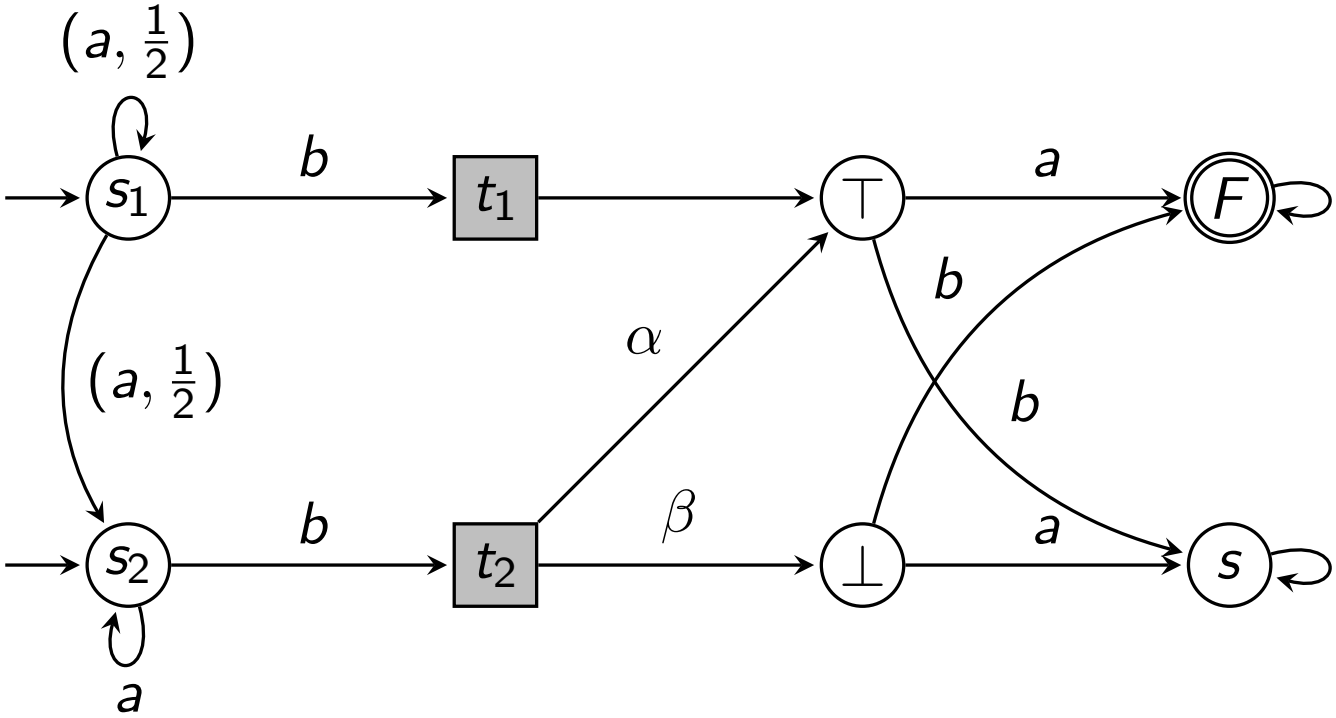
What are leaks?





For both implications the leaktight hypothesis is used.

- Elements of the belief monoid: sets of binary matrices abstracting the outcomes of the game
- Two operations:
  - Product, abstracting concatenation of two strategies for Max
  - Iteration, abstracting the possibility of iterating a word many times


$(a, \frac{1}{2})$
s_1
b
t_1
$\top$
a
F
b
α
$(a, \frac{1}{2})$
b
β
a
s_2
b
t_2
$\bot$
s
a

Thank you for your attention.