

Survey of recent results for stochastic games

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Highlights, Paris

Stochastic Parity Games

- Two-player games on graphs with probabilistic transitions.
 - Player 1 and adversary player 2.
 - Transitions are stochastic.
- Objectives: ω -regular objectives specified as parity conditions.
- Synthesis of stochastic reactive systems.

Basic Models

- Perfect-information stochastic games.
 - Both players have perfect information about the history of the game.
- Partial-observation stochastic games.
 - One or both players have partial information about the history of the game.

Basic Questions

- **Qualitative analysis:** Does there exist a player-1 strategy to ensure the parity objective with probability 1 (almost-sure winning) against all strategies of player 2 ? Similar question for positive winning.
- **Quantitative analysis:** Does there exist a player-1 strategy to ensure the parity objective with probability at least λ , for $\lambda \in (0,1)$, against all strategies of player 2 ?

Old Results

- Perfect-information stochastic parity games.
 - Qualitative analysis: in $\text{NP} \cap \text{coNP}$ [CJH, CSL 03].
 - Quantitative analysis: in $\text{NP} \cap \text{coNP}$ [CJH, SOD04; Zie FOSSACS 04].
 - PTIME algorithm major open problem even in special cases like for quantitative analysis of reachability objectives; or qualitative analysis of deterministic games.

Models of Partial-observation Stochastic Games

- Probabilistic automata.
 - Blind one-player stochastic games.
- POMDPs.
 - One-player stochastic games.
- One-sided partial-observation stochastic games (OPG).
 - Player 1 partial and player 2 perfect (adversary is perfect).
- Two-sided partial-observation stochastic games (TPG).
 - Both players have partial observation.

Old Results: Partial-observation Stochastic Parity Games

Models	Qualitative	Quantitative
Prob. Aut.	Undecidable [BBG, FOSSACS 08]	Undecidable [Paz71]
POMDPs		
OPG		
TPG		

Open questions: Partial-observation Stochastic Parity Games

Existence of finite-memory strategies for player 1.

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Prob. Aut.	??	Undecidable [Paz71]
POMDPs	??	
OPG	??	
TPG	??	

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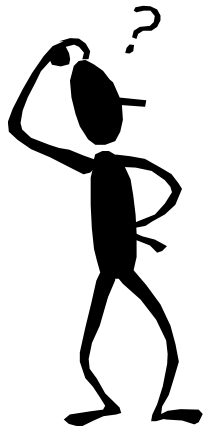
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TPG	Undecidable Infinite-memory for player 2. OPEN Finite-memory of player 2.	

Conclusion

- Models of stochastic games for synthesis of stochastic reactive systems.
- Partial-observation stochastic parity games: old negative results and recent positive results.

The end

Thank you !



Questions ?