An Ordered Approach to Solving Parity Games in Quasi Polynomial Time and Quasi Linear Space

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Proposal. There has recently been a significant breakthrough on the problem of solving parity games: Calude et al. [1] have devised an algorithm that runs in quasipolynomial time and space. I would like to speak about some follow-up work [2], in which we showed that their approach can be implemented using value iteration, yielding an algorithm that runs in quasipolynomial time and polynomial space.

In the 10 minute talk, I would state the main results of the paper, and put them into context by contrasting them with the work of Calude et al. [1], and also the recent work of Jurdziński and Lazić [3].

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Abstract: Parity games play an important role in model checking and synthesis. In their paper, Calude et al. have shown that these games can be solved in quasi-polynomial time. We show that their algorithm can be implemented efficiently: we use their data structure as a progress measure, allowing for a backward implementation instead of a complete unravelling of the game. To achieve this, a number of changes have to be made to their techniques, where the main one is to add power to the antagonistic player that allows for determining her rational move without changing the outcome of the game. We provide a first implementation for a quasi-polynomial algorithm, test it on small examples, and provide a number of side results, including minor algorithmic improvements, a quasi bi-linear complexity in the number of states and edges for a fixed number of colours, and matching lower bounds for the algorithm of Calude et al.

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References

[1] C. S. Calude, S. Jain, B. Khoussainov, W. Li, and F. Stephan. Deciding parity games in quasipolynomial time. In *Proc. of STOC 2017*, page (to appear). ACM Press, 2017.

[2] J. Fearnley, S. Jain, S. Schewe, F. Stephan, and D. Wojtczak. An ordered approach to solving parity games in quasi polynomial time and quasi linear space. *CoRR*, abs/1703.01296, 2017.

[3] M. Jurdziński and R. Lazić. Succinct progress measures for solving parity games. *CoRR*, abs/1702.05051, 2017.