

THE COMPLEXITY OF PLAYING DURAK MTA SZTAKI Hungarian Academy of Sciences ÉDOUARD BONNET



INTRODUCTION

The complexity of board games has been quite extensively studied since the dawn of complexity theory. However, despite some works on Whist and Bridge [5, 2], Uno [3], and algorithmic questions related to Set [4] and Hanabi [1], there is few known about the computational complexity of card games. It is still a vastly unexplored line of research with connections to combinatorial game theory and parameterized complex-

ON DEFENDING AN ATTACK



WEAKNESS AND STRONG SUIT

• *weakness*: rank where one player has only cards dominated by cards of her/his opponent.



• *well-covered weakness*: weakness such that all the *dominating* cards are of rank not owned by the player with the weakness.

ity. We tackle the russian game **Durak** whose gameplay is significantly different from the card games mentioned above.

RULES OF DURAK

Simplified rules with 2 players, no trump suit, and an empty drawing pile:

• *goal*: getting rid of all one's cards.



• *round*: sequence of moves between the *attacker* and her opponent the *defender*.





• *strong suit*: only owned by one player.

ON FINDING OPTIMAL PLAY



• *attacker's moves*: play a card matching the rank of a played card.



• *defender's moves: defend* with a higher card in the same suit.



• if the defender ceases to defend, he takes all the cards in his hand; he remains the defender for the next round.



• otherwise, all the cards are discarded; defender/attacker switch roles.

OPEN QUESTIONS

- Is single-suit Durak tractable?
- What about Durak with a bounded

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RESULTS

- Deciding if one player can defend until the end is NP-hard.
- Deciding if one player has a winning strategy is PSPACE-complete.

Question for you: why is the game length polynomially bounded?

number of suits?

- In Durak with more than two players, games are not polynomially bounded. Is deciding if one player has a winning strategy still in PSPACE?
- Is deciding if one player can defend an attack in NP?
- What is the complexity of Durak with a bounded number of ranks?
- Removing the threshold feature in the **PSPACE-hardness** construction.

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