The Complexity of Playing Durak

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IJCAI 2016, July 15
Few results

- 2-handed Whist with mirror suits is easy [Wästlund 2005]
- 6-handed Whist is hard [B. et al. 2013]
- 1-player and 2-player UNO are hard [Demaine et al. 2014]
- problems related to Set [Lampis and Mitsou 2014]
- problems related to Hanabi [Baffier et al. 2016]
Hardness is less understood than with board games
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There is more to say about tractability

- natural parameters to play with: #suits, #ranks, #hands
- *reasonably large* tractable fragments
- *suit decomposability*
How to play Durak?
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Durak means *idiot* in russian.

- **goal**: getting rid of all one’s cards.

- **round**: sequence of moves between the *attacker* and her opponent the *defender*. 
Attacker’s moves

Play a card that matches the rank of a card previously played.
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Defender’s moves

*Defend* by playing a card of higher rank in the same suit.
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And then, what happens?

- 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.
Decent heuristic in defense

- defend the attack until the end if possible
- accept the first attacking card otherwise
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Unfortunately . . .
Deciding if a defense is possible is NP-hard
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Weakness and well-covered weakness

- **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.
Strong suit
Strong suit
Strong suit
Strong suit
Strong suit
∀x_0 \exists x_1 \forall x_2 \exists x_3 \forall x_4 \ldots

s_0^1 s_0^2 s_1^3 s_1^4 s_2^1 s_2^2 s_3^3 s_3^4 s_4^1 s_4^2 s_4^3 s_w^1 s_w^2 s_1^{C_1} s_1^{C_1'} s_1^{C_1''} s_2^{C_2} s_2^{C_2'} s_2^{C_2''} s_3^{C_3} s_3^{C_3'} s_3^{C_3''} s_3^{C_3'''} s_4^{C_4} s_0^P s_d^{1,1} \ldots s_d^2 s_d^3 s_d^4
Open Questions

- Is single-suit Durak tractable?
- What about Durak with a bounded number of suits?
- Complexity of Durak with a bounded number of ranks?
- PSPACE-hardness not relying in the threshold.
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Thank you for your attention!