

# The Complexity of Playing Durak

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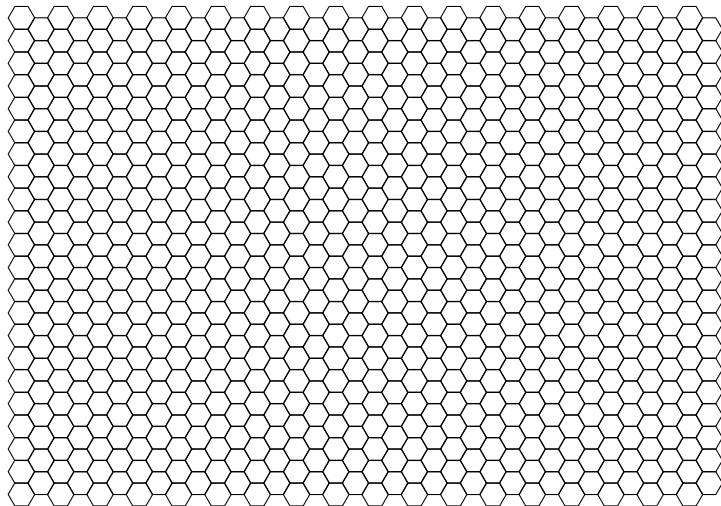
## Few results



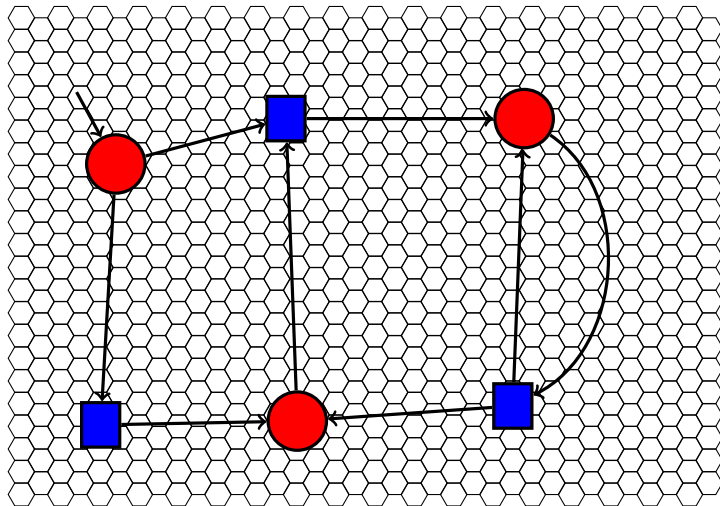
- ▶ 2-handed Whist with mirror suits is easy [Wästlund 2005]
- ▶ 6-handed Whist is hard [B. et al. 2013]
- ▶ 1-player and 2-player UNO are hard [Demaine et al. 2014]
- ▶ problems related to Set [Lampis and Mitsou 2014]
- ▶ problems related to Hanabi [Baffier et al. 2016]



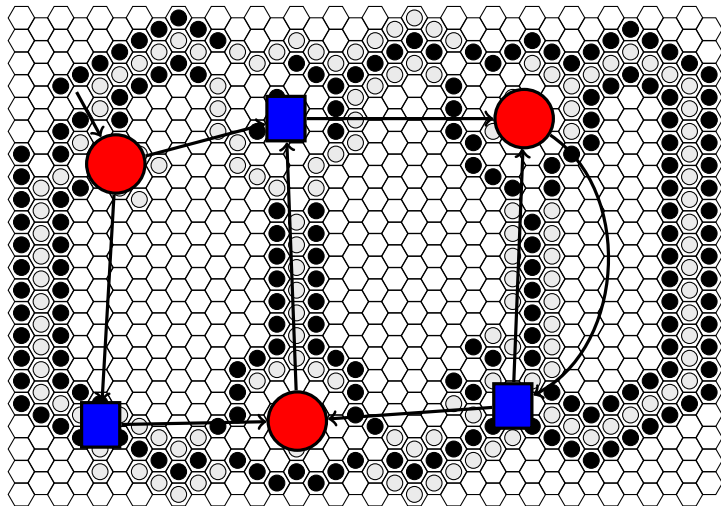
Hardness is less understood than with board games



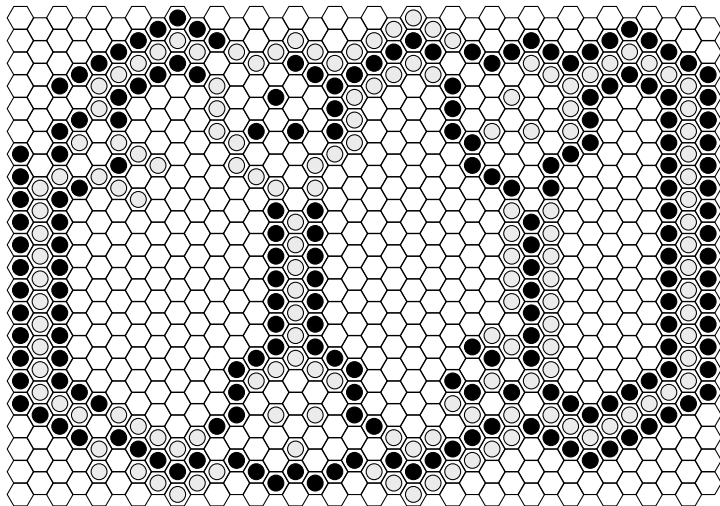
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## There is more to say about tractability



- ▶ natural parameters to play with: #suits, #ranks, #hands
- ▶ *reasonably large* tractable fragments
- ▶ *suit decomposability*

# How to play Durak?



## How to play Durak?

Durak means *idiot* in russian.

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



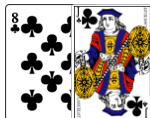
- ▶ *round*: sequence of moves between the *attacker* and her opponent the *defender*.



## Attacker's moves



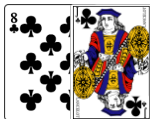
Play a card that matches the rank of a card previously played.



## Attacker's moves



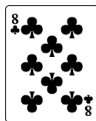
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## Defender's moves



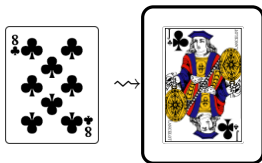
*Defend* by playing a card of higher rank in the same suit.



## Defender's moves



*Defend* by playing a card of higher rank in the same suit.



## 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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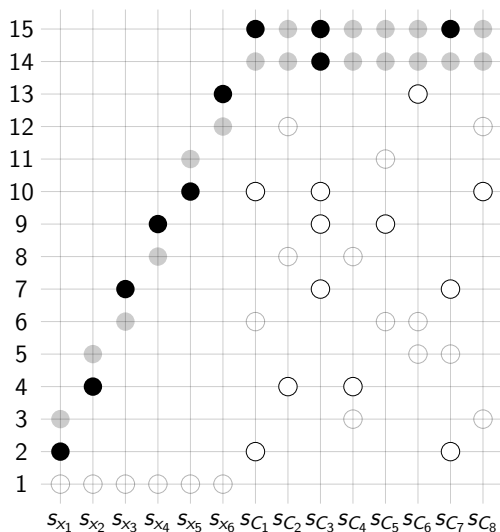
Unfortunately ...





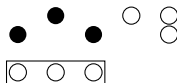


## Deciding if a defense is possible is NP-hard

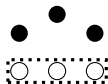


## Weakness and well-covered weakness

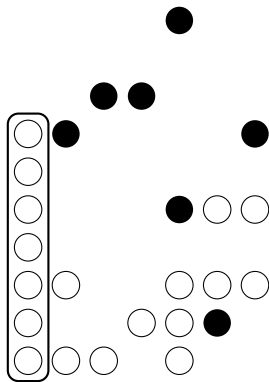
- ▶ *weakness*: rank where one player has only cards dominated by cards of her/his opponent.



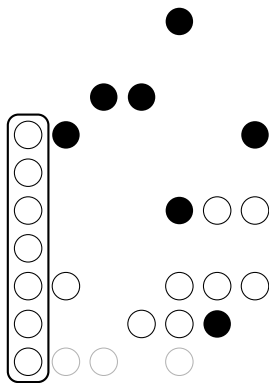
- ▶ *well-covered weakness*: weakness such that all the *dominating* cards are of rank not owned by the player with the weakness.



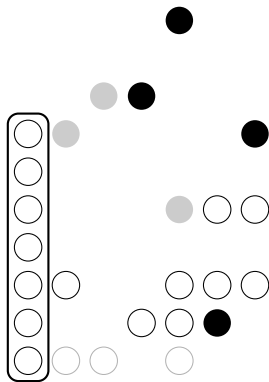
## Strong suit



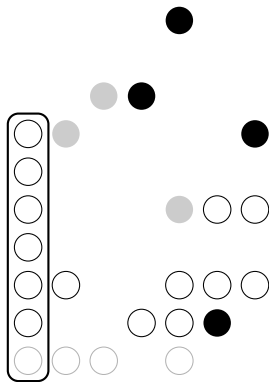
## Strong suit



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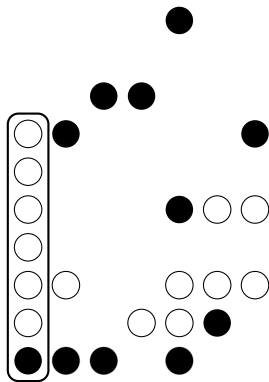


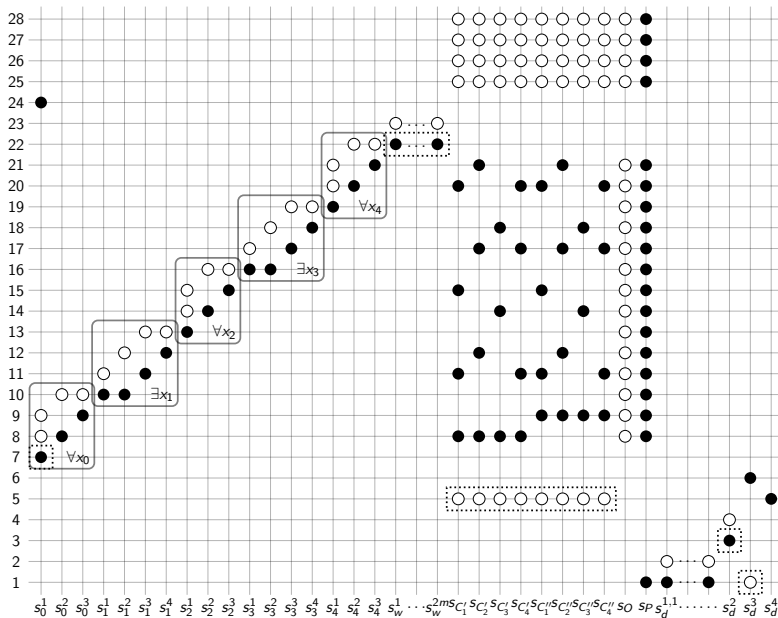
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## Open Questions



- ▶ 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!**