Collusion Detection in Online Bridge

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The Game of Contract Bridge

- A card game
- four persons at a table, traditionally named as East, South, West and North
- play in two teams (N-S vs. W-E)
Stage 1: bidding (auction)

- compete to bid a contract
- each knows only cards held by herself
- exchange of imperfect info
Stage 2: *card play*

- after a defender plays the first card, another player (i.e. *dummy*) exposes her cards to all 3 others
The Game of Contract Bridge

- Stage 2: *card play*
  - after a defender plays the first card, another player (i.e. *dummy*) exposes her cards to all 3 others

- A game of hidden info
  - (unlike chess, Go)
Online bridge can be fun
Or ... a pain

- Online, cheaters may collude to reveal hidden cards!
  - Via phone, ICQ, MSN etc.

- Collusive team has asymmetric info advantage:
  - Bidding: knowing 50+% card info $\Rightarrow$ a best possible contract
  - Card play: they know 100% cards when they are defenders

- Exchanging “mission-critical” info is often enough to defeat opponents
Who cares?

- **Players** – collusion ruins their game experience
- **Operators** – they lose customers/business when people feel being cheated and leave
- **ACBL** – online tournaments award official masterpoints
  - which are essential for climbing rank ladders -> Life Master
- **Researchers** – potentially not just a solution for a game
Countermeasure: state of the art

- Prevention does not work
- Face2face tournaments: analysing game records by human experts
  - Time-consuming and expensive, lack of scalability for online bridge
- Relying on tips from players whether somebody is cheating
Automated detection: rationale

- Detect the traces in game records left by collusive play
- Rationale: partial info and complete info don’t always lead to the same decisions
  - \( \text{decision1} = \text{decision2} \) not always true
1. Detecting suspicious bid or play

- Use AI inference techniques to detect suspicious bid or play (too good to be drawn from partial info)
An intuitive method

- The idea is to detect "illogical play"

\[ \textbf{a}: \text{real action (the recorded bid or play)} \]
\[ \textbf{A}_h = \{\text{honest action candidates for a}\} \]
\[ \textbf{A}_c = \{\text{collusive action candidates for a}\} \]

If \( a \in \textbf{A}_c \) \& \( a \notin \textbf{A}_h \),

a suspicious signal recorded;

If \( a \in \textbf{A}_c \) \& \( a \in \textbf{A}_h \),

skip; #false negative!
Example: a collusive contract bid

1. Identify declarer ($S$) and his contract bid $b_5 = 2\spadesuit$

2. Does a bidding inference from the view of $S$: interprets $b_i$ ($i = 2, 3, 4$) to an inference set $I_i$ as $S$ may do

3. Generates a set of candidate bids in honest play $B_h = \{3\heartsuit\}$

4. Generates a set of candidates for collusive bid $B_c = \{2\spadesuit\}$

$b_5 \notin B_h$ but $b_5 \in B_c$, so a collusive signal will be registered.
2. Player modeling

- The skill level of players matters
  - A beginner, a medium-level player or a top player can play the same hand significantly differently
  - Their play can all be honest, and reasonable (if judged according to their level)
3. Tackling the probabilistic nature

- No precise way to conclude that a single suspicious action is exclusively the result of collusion
- Other possibilities exist, e.g.:
  - lucky play (guess, gamble, or a mistake)
  - genius play
- There is a statistical property in collusion detection
  - the dimension of time: you cannot be lucky all the time
  - a player’s skill level
How good is this outlined approach to be?
Summary

☐ Contract bridge is a game of hidden info

☐ Collusion is a real security concern in online Bridge

☐ Outlined a possible detection approach
  ■ Research agenda and open problems in my paper

☐ A challenge: creating automated methods for detecting collusive bridge play with an accuracy that can be achieved by human experts.
Potential Impact

- Representative of a more general class of problems -- detecting the use of prohibited information in decision making.

- Other examples include
  - Detecting bid-rigging in procurement auctions
  - Detecting insider stock trading
  - Detecting employment discrimination

- Progress on this challenge would likely have a broader impact on a class of real societal problems
Potential Impact

- Interaction with computer security
- Collusion detection is similar to intrusion detection (which is extensively studied)
  - the same basic idea: differentiating between normal and abnormal behavior
  - main difference: expert knowledge
Potential Impact

- Intrusion detection people might find in collusion detection another application of their techniques.
- The study of collusion in bridge might also inform intrusion detection researchers.
Potential Impact

- Fun, too!
- Opportunity of reading and playing bridge game a lot -- all in the name of research 😊
Thank You!
Q?
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