

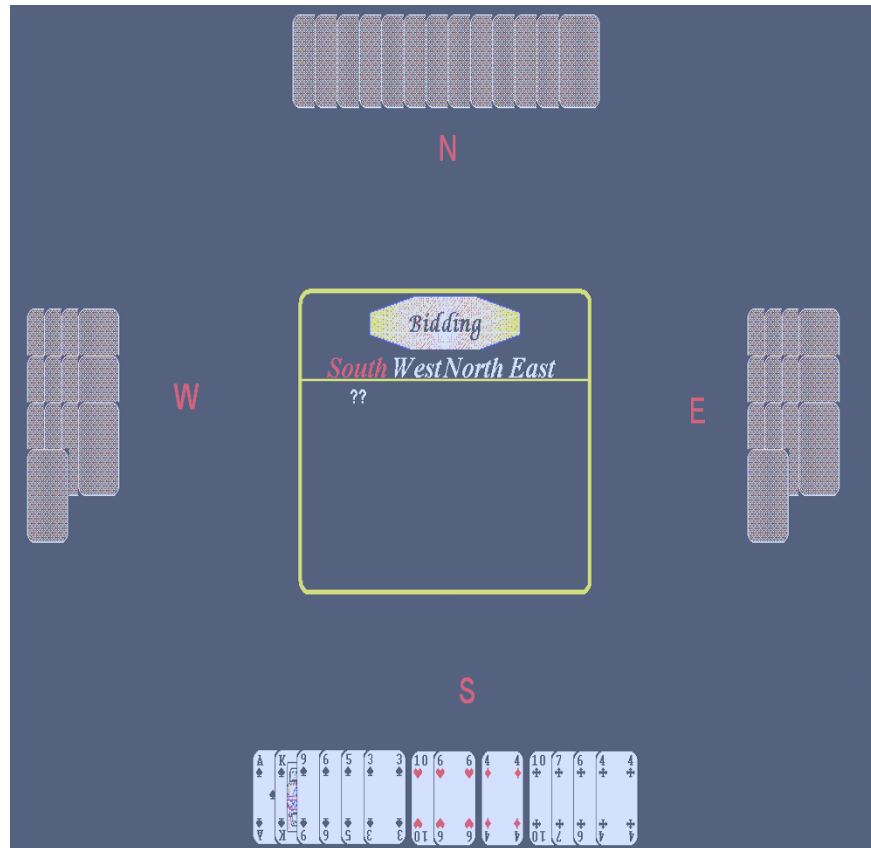
Collusion Detection in Online Bridge

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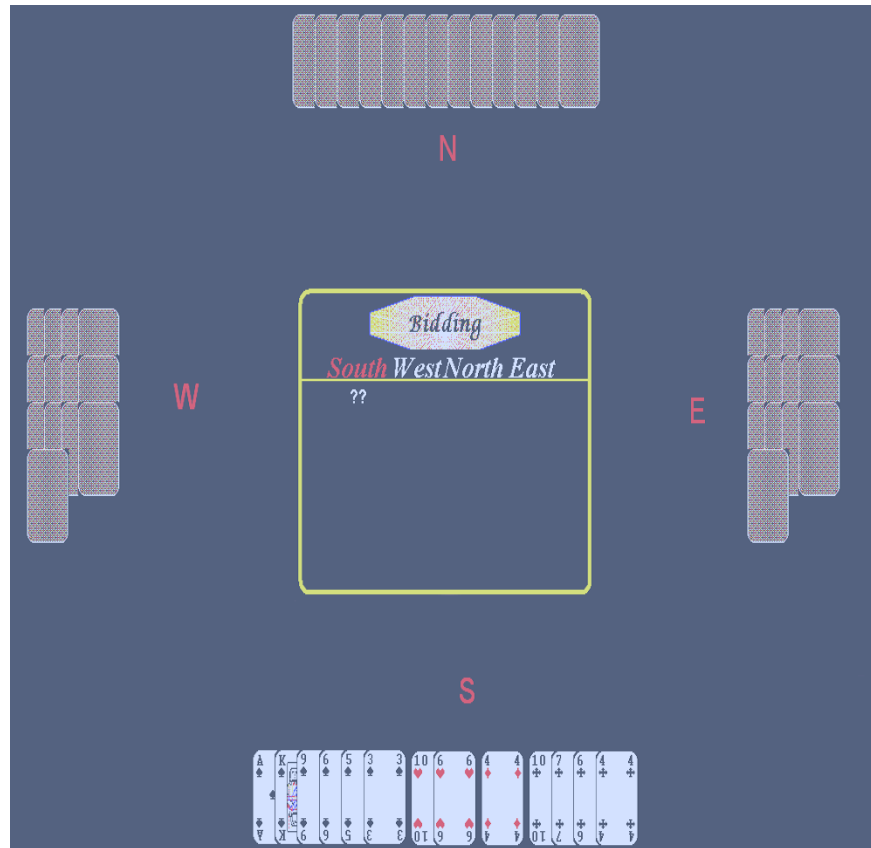


The Game of Contract Bridge



- 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)

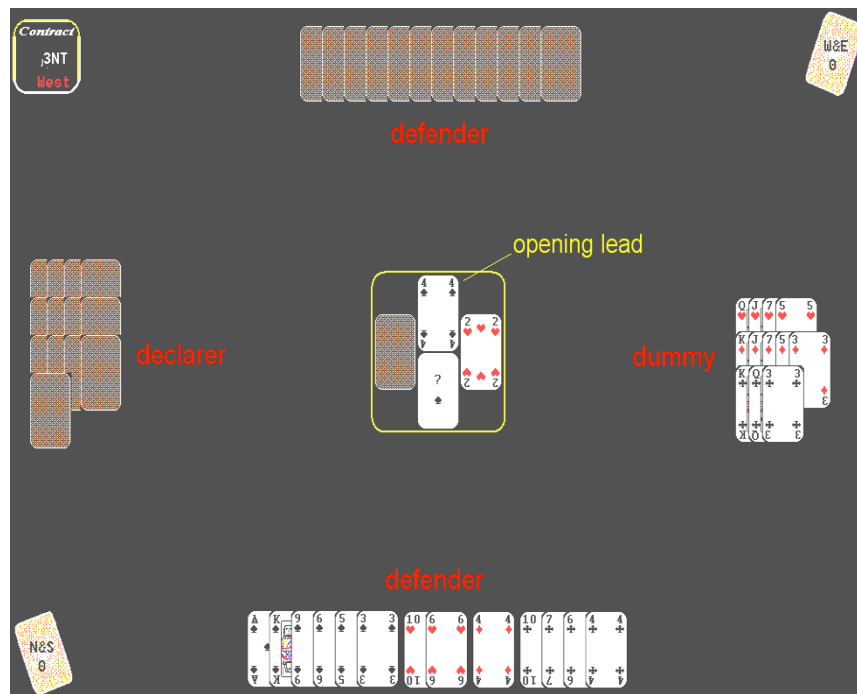
The Game of Contract Bridge



□ Stage 1: *bidding* (*auction*)

- compete to bid a *contract*
- each knows only cards held by herself
- exchange of *imperfect* info

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

Online bridge can be fun

The screenshot shows the Pogo Bridge game interface. At the top, there's a banner for 'Upgrade your Sim's PC!' with 'The Sims' logo. Below that, a green bar indicates 'You're rpsgo in Advanced > Mandarin Dynasty' and 'Free Offers'. The main content area is titled 'Choose a Table' and allows sorting by 'Availability' or 'Table #'. There are six tables listed:

- Table 35 - Waiting to Start: happytune... (Play buttons)
- Table 2 - Join this Game: mrzoro_ and ajain456_ (Play button)
- Table 3 - In Progress: gbustergiff, mmanas04, mihaill33, farcen_ (Watch buttons)
- Table 5 - In Progress: noctavia850, ply835, daniuchko, OldHolcomb (Watch buttons)
- Table 6 - In Progress: oblsk2, LUPARAA
- Table 9 - In Progress: bogomago, Vieri_#tkv

At the bottom, there's a 'Who's Here (130)' table and a chat window. A red arrow points to the 'Watch' button of Table 5, with the label 'observer' next to it.

Who's Here (130)	Rating	Table
-pooh-	1821	15
-stox-	1679	16
_zorzar	1830	1
Aakerdream	1619	13
AbeautifulMind9	1616	19

Chat window content:

```
LipsRidesAgain: 2 more@12
rrroxiehart: 2@ 23 please new. whoever
tried to join, come back...u loaded slow and
i accepted
happytune2002: 3@35
guglielmo56: prendi omaya
```

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 → a best possible contract
 - Card play: they know 100% cards when they are defenders
- Exchanging “mission-critical” info is often enough to defeat opponents

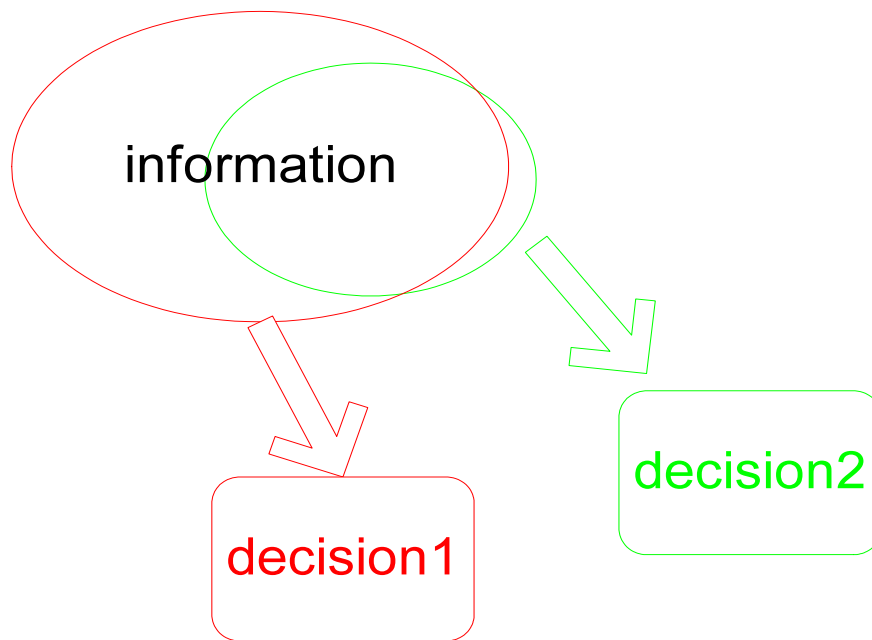
Who cares?

- **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

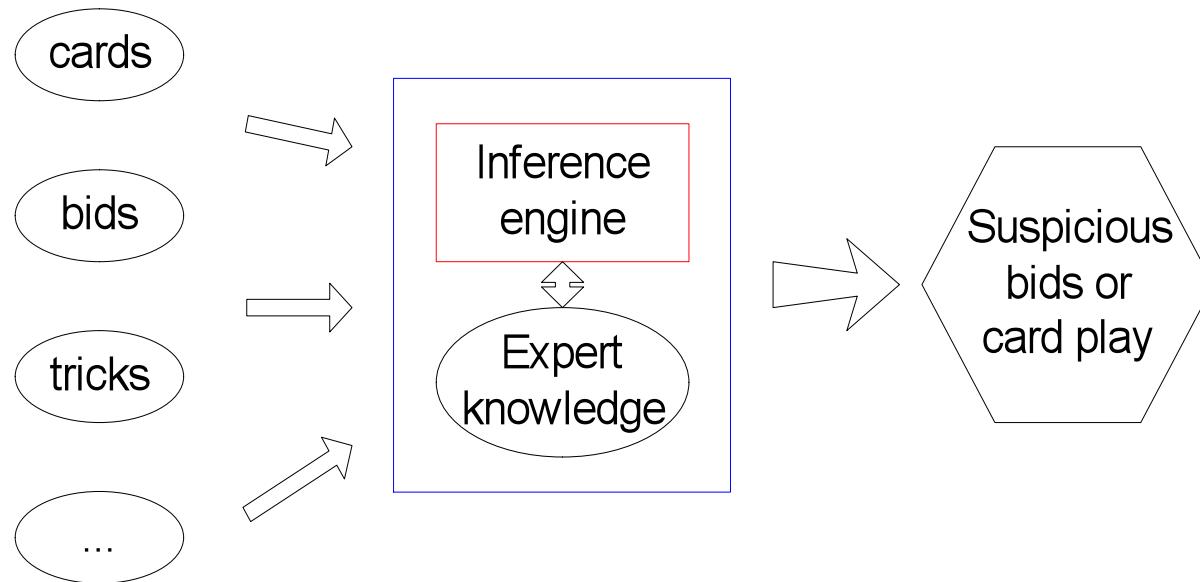
- ❑ Prevention does not work
- ❑ Face2face tournaments: analysing game records by human experts
 - Time-consuming and expensive, lack of scalability for online bridge
- ❑ Relying on tips from players whether somebody is cheating

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
 - **decision1** = **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*"

a: real action (the recorded bid or play)

A_h = {honest action candidates for **a**}

A_c = {collusive action candidates for **a**}

If (**a** ∈ **A_c**) ∧ (**a** ∉ **A_h**)

a suspicious signal recorded;

If (**a** ∈ **A_c**) ∧ (**a** ∈ **A_h**)

skip; #false negative!

Example: a collusive contract bid

North: ♠AKJ643 ♥92 ♦75 ♣KQ3			
<i>South West North East</i>			
Pass	1♥	Dble	2♥
2♠	Pass	Pass	Pass
South: ♠Q52 ♥864 ♦AJT86 ♣54			

$b5 \notin Bh$ but $b5 \in Bc$, so a collusive signal will be registered.



1. Identify declarer (S) and his contract bid $b5 = 2♠$
2. Does a bidding inference from the view of S : interprets bi ($i = 2, 3, 4$) to an inference set Ii as S may do
3. Generates a set of candidate bids in honest play $Bh = \{3♦\}$
4. Generates a set of candidates for collusive bid $Bc = \{2♠\}$

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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