

# Collusion Detection in Non-cooperative Game Theory Tournaments

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## Game Theory

- The study of interactions between self-interested agents according to an action/ payoff scheme
- Non-cooperative implies agents are “independent” (i.e. no explicit group definition)
- Applications exists in many fields – economics, biology, psychology, sociology, political science, etc.

## Game Theory Tournaments

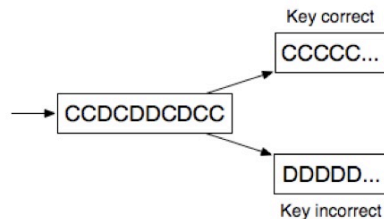
- Iterated Prisoner’s Dilemma – the Prisoner’s Dilemma game repeated an unspecified number of times

	C	D
C	3, 3	0, 5
D	5, 0	1, 1

- Original tournament results – Tit-for-tat
- Recent tournament results – Master/Slave

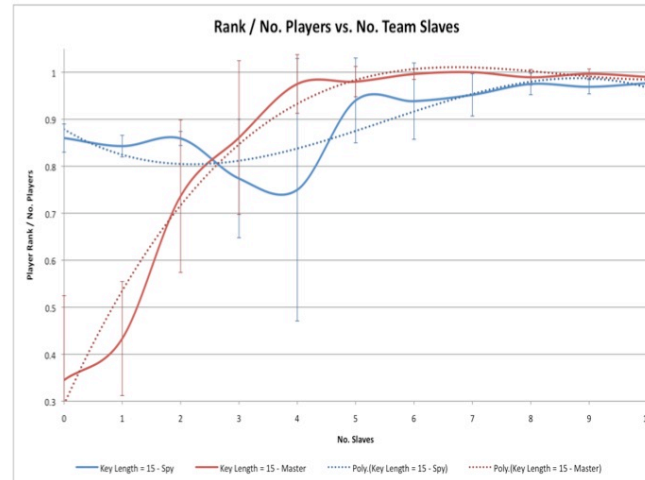
## Master/Slave Teams

- One Master per team, the rest are Slaves
- Each agent type has a unique key
- Play the key and adapt accordingly



## Problem

- If teams are not allowed, how can their presence be detected?
- How can we identify colluding agents?
- What can be done to limit team effectiveness?
  - Infiltrate and exploit
  - Disqualify from tournament



## Approaches

- Agent level
  - Identify the key and/or look at the key distribution density
  - Look for patterns of behavior
- Tournament/System level
  - Find agent subgroups with high levels of cooperation and payoff
  - Look for patterns of behavior
- Modeling
  - Model agent’s internal logical structure
  - Agent complexity may require Turing machine model

## Supporting Work

- Work done on Agent level solution viability
- Several assumptions
  - Key length known (optimal length proposed)
  - Team agents employ lazy verification
  - No noise

## Additional Questions

- How can the Master/Slave design be modified to minimize detection?
- How does tournament design impact team performance?
- What other team designs exist?

## References

Axelrod, R. (1984). *The evolution of cooperation*. Basic Books.

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