Planned Research

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Outline

A Generic Approach to Coalition Formation

Coalitions are an important notion in cooperative game theory. Many stability concepts exist, but how do stable coalitions come about?

To study coalition formation from an algorithmic point of view, we introduced

- an abstract preference relation over coalition structures
  - instantiated with established preference relations to check intuitions and connections to existing concepts
- operators to merge and split coalitions
- an abstract notion of stability for coalition structures

and identified conditions under which

- stable coalition structures exist
- merge and split sequences terminate
- merge and split sequences reach a unique stable outcome

Extensions

We plan to add an underlying network structure between the players (representing e.g. friendship relations) which can

- determine which coalitions are feasible (e.g. only connected players), or
- induce preferences over coalitions (e.g. distance in friendship network)

Furthermore, preferences could be induced by comparison of player values, e.g. the Shapley value.

We plan to study these extensions and their relations to the existing results.

Outline

Distributed Game Playing

Setting:

- Abstractly, a game of incomplete information between distributed rational players
- Concretely, e.g. a distributed computation involving several independent processors (players)
- Communication is possible prior to choosing actions

Tasks:

- Study how rational players should behave before the actual game
- Design rational algorithms for pre-game communication and reasoning
- Implement and evaluate the results

$\rightsquigarrow$ Research area on the interface of game theory, distributed computing, epistemic logic, and security protocols

A Simple Example

	L	R
T	$3, 2$	$1, ?$
B	$2, 3$	$5, 2$

- Imagine you are the row player in the above game and you want to figure out what to play.

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- You ask column player for his payoff for (T, R), he replies "1".
- So, R is strictly dominated by L and can be eliminated.

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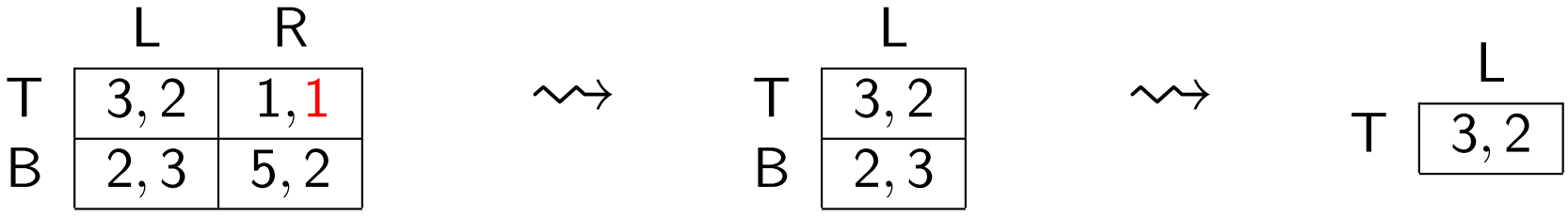

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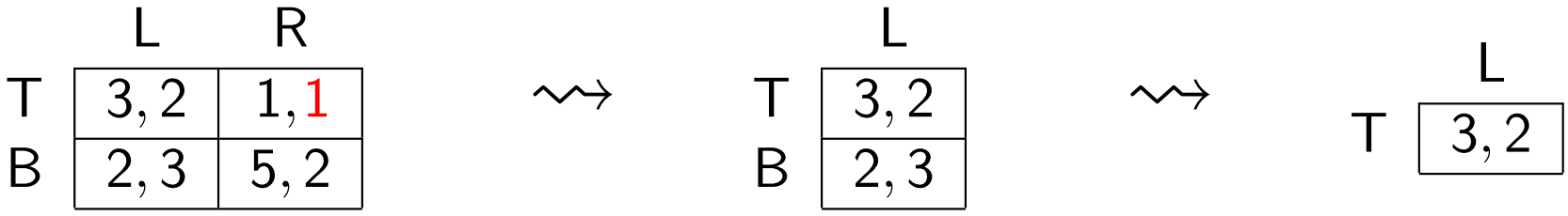

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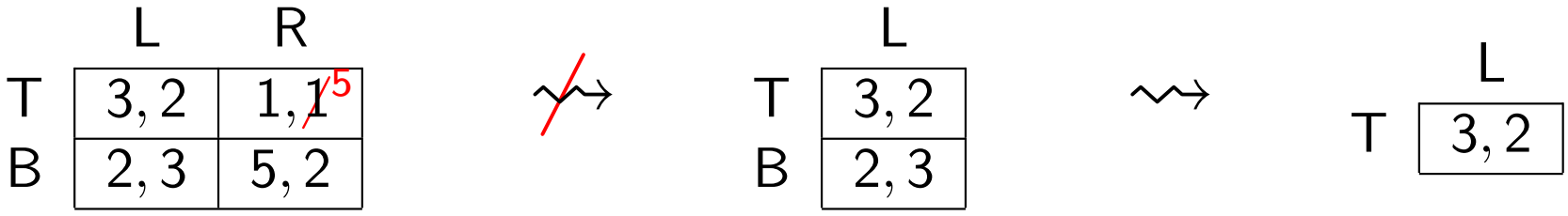

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- Now, B is strictly dominated by T and can be eliminated.
- Obviously, T is your rational choice, so you play it.
- Column player plays R and is happy that he could trick you into playing T.
  He obtains his best possible payoff and you your worst.

Some issues and complications

- Free or costly communication
  - $\rightsquigarrow$ Strategizing over communication acts
- Communication network properties
  - Topology: e.g. ring, hierarchical, arbitrary
  - Connections: static or dynamic, reliable or faulty
  - Communication: synchronous, asynchronous, broadcasting
- Levels of trust between the players:
  - (i) all information can be trusted
  - (ii) distance in "friendship network" determines trustworthiness
  - (iii) like (ii), but players may be actively malicious

  $\rightsquigarrow$ Possibilities to certify provided information, security protocols
- Reasoning about these issues and effects of communication
  - $\rightsquigarrow$ Implementing Dynamic Epistemic Logic

Outline

Weighted Propositional Formulas as Bidding Languages

- In combinatorial auctions, the set of possible bundles to bid on is intractable
- Bidding languages are used to express common bids in a succinct way
- One possibility: Weighted propositional formulas

$$\{(TV, 20), (VCR \wedge \neg TV, -10), (VCR \wedge TV, 80)\}$$

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- Reducing known P-complete problems provides more insights
- Satisfiable sets of Horn clauses seem most promising