Reaching Agreements

How do agents reaching agreements when they are self-interested?

The capabilities of negotiation and argumentation are central to beneficial agreements on matters of common interest.

- Convergence/guaranteed success
- Maximising social welfare
- Pareto efficiency
- Individual rationality
- Distribution
- Simplicity

Desirable properties of mechanisms:

Mechanism Design

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The mechanism defines the "rules of encounter" between agents.

Mechanism design is designing mechanisms so that they have certain desirable properties.

Given a particular protocol, how can a particular strategy be designed that individual agents can use?

Negotiation is governed by a particular mechanism or protocol.
Auction parameters

- Good types: private, public, correlated
- Winner determination: first-price, second-price
- Bids: open, sealed
- Auction formats: ascending, descending

2 Auctions

- English auctions
  - Most commonly known type of auction:
    - First-price
    - Open cry
    - Ascending
  - Dominant strategy is for agent to successively bid a small amount more than the current highest bid until it reaches their valuation.
  - Susceptible to:
    - Winner's curse
    - Shill

- Dutch auctions
  - Examples of open-cry descending auctions:
    - Dutch auctions
      - One-shot ascending descending
        - Bidding may be:
          - Open cry sealed bid
            - Bids may be:
              - First price, second price
              - Winner determination may be:
                - Correlated value
      - Goods can have
        - Auction parameters

2 Auctions

- Auctions
  - Bidders desire to minimise price.
  - In most settings the auctioneer desires to maximise the price.
  - To one of the bidders.
  - The goal of the auction is for the auctioneer to allocate the good auctioneer and a collection of agents known as the bidders.
First-price sealed-bid auctions are one-shot auctions:

- There is a single round.
- Bidders submit sealed bids for the good.
- The winner is the agent that made the highest bid.
- The winner pays the price of the second-highest bid.
- Good is awarded to the agent that made the highest bid.

Vickrey auctions are susceptible to antisocial behavior:

- Vickrey auctions are second-price, sealed-bid auctions.
- Bidding to your true valuation is a dominant strategy in Vickrey auctions.
- Good is awarded to the agent that made the highest bid; the price of the second-highest bid.
- Vickrey auctions are one-shot auctions.

Negotiation is the process of reaching agreements on matters of common interest. Any negotiation setting will have four components:

- A negotiation set: possible proposals that agents can make.
- A protocol.
- Strategies, one for each agent, which are private.
- A rule that determines when a deal has been struck and what the agreement deal is.

Negotiations usually proceed in a series of rounds, with every round making a proposal ad every round.

A negotiation deal is:

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- A negotiation set: possible proposals that agents can make.

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A TOD is a triple:

\[ \text{TOD} = (T, A, c) \]

where:

- \( T \) is the finite set of all possible tasks;
- \( A \) is the set of participant agents;
- \( c \) defines the cost of executing each subset of tasks:

\[ c : \mathcal{P}(T) \to \mathbb{R}^+ \]

A TOD is individual rational if it weakly dominates the conflict deal.

\[ \text{Deals } \in \text{TODs} \]

Note that:
- The utility of deal \( \Theta \) to agent \( i \) is:
  \[ \text{utility}(i, \Theta) = c(T \setminus \{i\}) \]
  and will be denoted \( \text{utility}(\Theta, i) \).
- The cost to deal \( \Theta \) is:
  \[ \text{cost}(\Theta) \]
  and will be denoted \( \text{cost}(\Theta) \).
- Given encounter \( \langle \mathcal{T}, \mathcal{A}, c \rangle \), a deal \( \ell \) will be an allocation of the tasks if:
  \[ \ell \cap \mathcal{T} \subseteq \mathcal{A} \]

The set of deals over which agents negotiate are those that are:

- Individual rational - makes agent better off.
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The Negotiation Set Illustrated

\[ \text{utility for agent } j \]
\[ \text{utility for agent } i \]
\[ \text{utility of conflict deal for } j \]
\[ \text{utility of conflict deal for } i \]

Deals on this line are Pareto optimal, hence in the negotiation set.

This circle delimits the possible deals space of all conflict deals.

\[ \text{The Negotiation Set} \]
The Monotonic Concession Protocol

Rules of this protocol are as follows:

Negotiation proceeds in rounds.

On round $u$, where $u > 0$, an agent must make a concession in some round $n < u$, then the agent is referred to by the other agent than the deal it proposed at time $n$. On any given round, an agent must make a concession that is less than the agreement is reached, then negotiation proceeds to another agreement is reached if one agent finds that the deal proposal of this protocol are as follows.

The Zeuthen Strategy

Three Problems:

The Zeuthen Strategy

Willingness to Risk Conflict

Just enough to change the balance of risk.

If an agent concede, then how much should it concede?

The agent least willing to risk conflict.

On any given round, who should concede?

What should an agent's first proposal be?

Nash Equilibrium Again...

The Zeuthen strategy is in Nash equilibrium: under the assumption that one agent is using the strategy, the other can do no better than

http://www.csc.liv.ac.uk/~mjw/pubs/imas/
Deception in T0Ds

Deception can benefit agents in two ways:

1. Phantom and Decoy tasks
2. Pretending that you have been allocated tasks you haven’t.

1. Hidden tasks
2. Pretending that you have been allocated tasks that you have not.

Deception in T0Ds
Concerned with the overall structure of the argument (rather than internal structure of the argument)