

Negotiation

9/12/09

2009
Master Course



Introduction to the Bargaining Problem

- A bargaining situation involves **two parties**, which can **cooperate** towards the creation of a commonly desirable surplus, over whose distribution both parties are in **conflict** [Serrano 2008]
- *Bargaining is the most common form of negotiation and plays a crucial role in automated negotiations*
- Bargaining is studied in depth both as **cooperative** problem [Nash 1953] and **non-cooperative** problem [Rubinstein 1982]

Introduction to the Bargaining Problem (2)

- The **alternating-offers** protocol [Rubinstein 1982] is considered the principal **protocol** for bilateral negotiations and it has received a lot of attention
 - **In economics**, to analyze human transactions [Osborne and Rubinstein 1990]
 - **In computer science**, to automate electronic transactions [Kraus 2001]

Alternating-Offers

- It is an **extensive-form** game in which agents **alternately** act,
 - e.g. **s** acts at $t=0$, **b** acts at $t=1$, **s** acts at $t=2$, and so on
- The model studied in computer science [Fatima 2002] is an extension of [Stahl 1972] and [Rubinstein 1982]
- **Game mechanism:**
 - The agent that acts at $t=0$ is a parameter of the protocol
 - Agents' allowed actions are:
 - **Offer** a value x
 - **Accept** the last opponent's offer
 - **Exit** the negotiation

Alternating-Offers

- **Agents' preferences:**
 - Agents have **opposite** preferences
 - Agents have **reservation values**, e.g.
 - Buyer's reservation value expresses the maximum price at which s/he would buy the item
 - Seller's reservation value expresses the minimum price at which s/he would sell the item

Alternating-Offers with deadlines

- **Agents' preferences:**
 - Agents have **opposite** preferences and **temporal discounting factors**
 - Agents have **reservation values**, e.g.
 - Buyer's reservation value expresses the maximum price at which s/he would buy the item
 - Seller's reservation value expresses the minimum price at which s/he would sell the item
 - Agents have **deadlines** and after these they strictly prefer not to reach any agreement rather than to reach

Auction: a NYSE definition

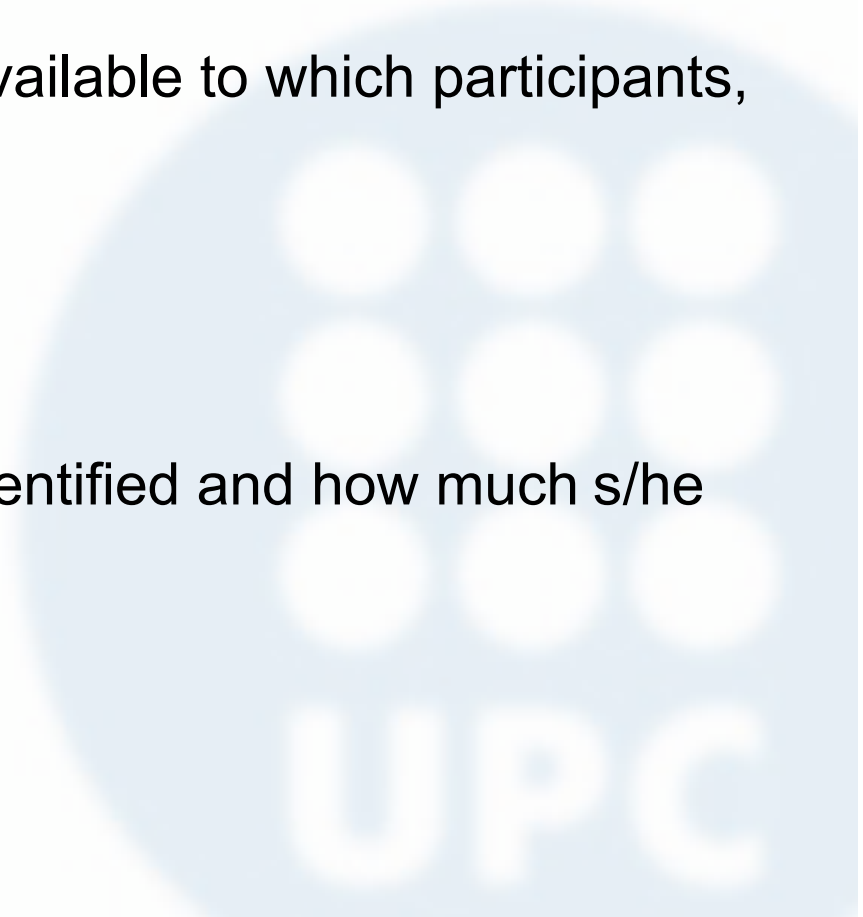
- A form of trading that takes place by verbal (or electronic) outcry of *bids* and *offers* by exchange members acting as agents for institutions or individual investors. Buy and sell orders meet directly on the trading floor, and prices are determined by their interplay of supply and demand.
- In contrast, in the over-the-counter market the price is determined by a dealer who buys and sells out inventory

Auction: a working definition

- Auctioning is a price setting mechanism based on a competitive bidding (tendering) process in which buyers present their offers to a group of sellers and the highest bidder (lowest tender) wins

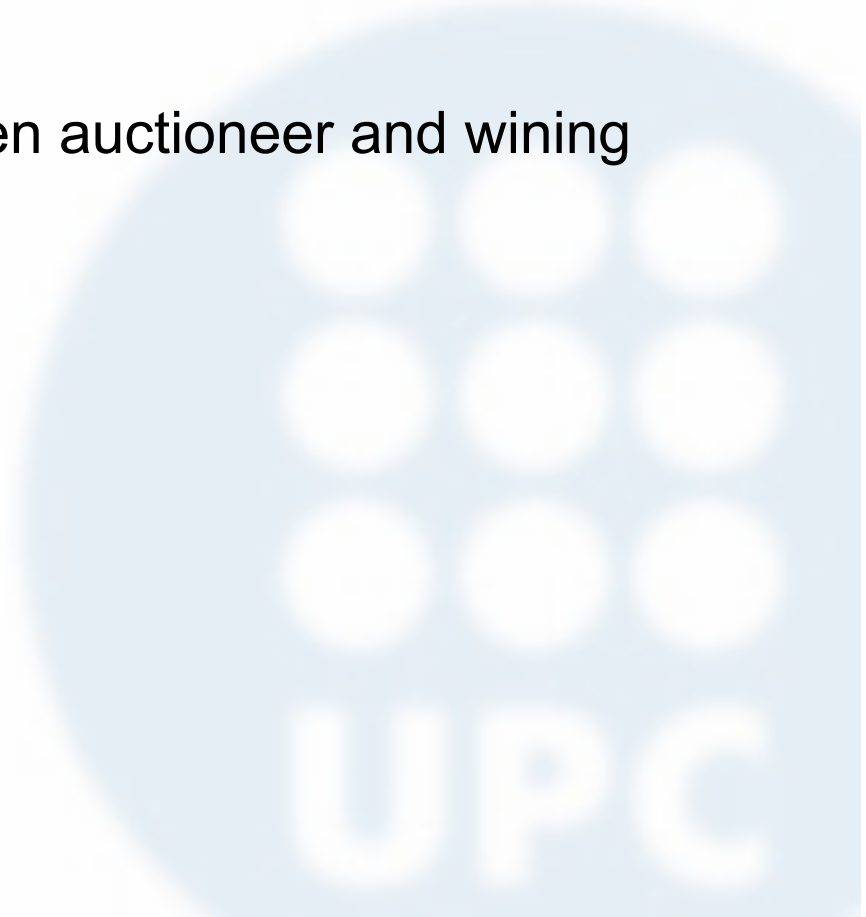
Auctioning conventions

- The eligibility of participants
- What information is made available to which participants, and when
- How bidding progress
- How the highest bidder is identified and how much s/he has to pay



Auctions

- Methods for allocating goods, tasks, resources, etc
- Participants: **Auctioneers** & **Bidders**.
- Enforced agreement between auctioneer and winning bidder.
- Efficient allocation process
- Easy to implement



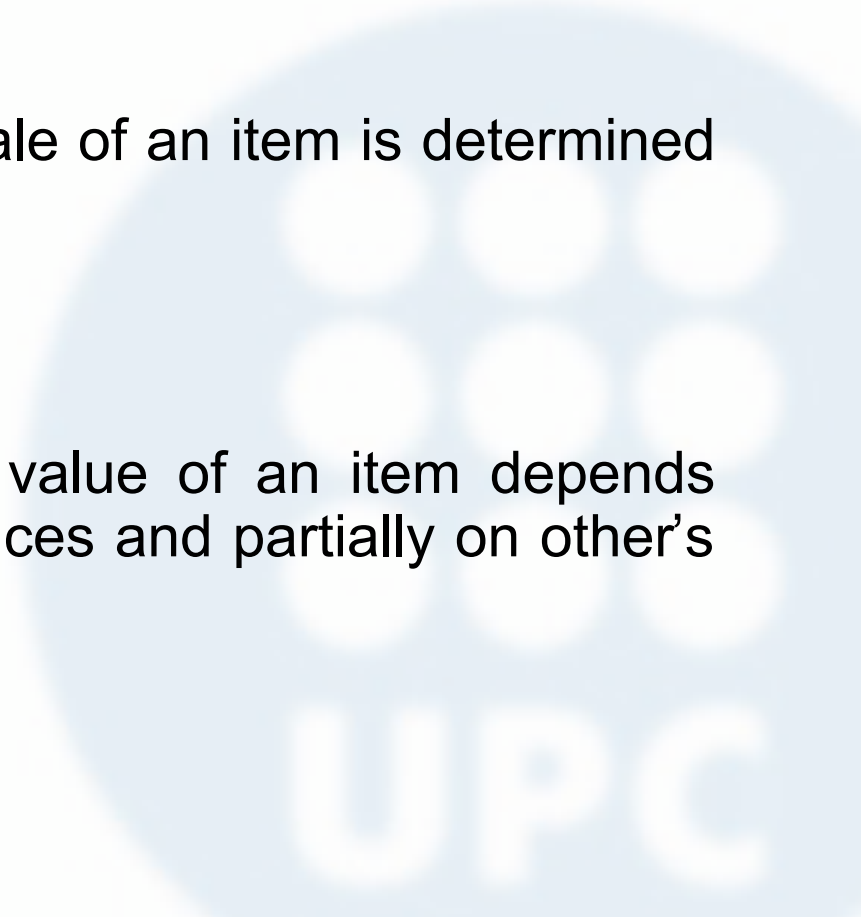
Auction settings

- There exist 3 types of settings in which the value of an item can be defined:
 - Private value
 - Common value
 - Correlated value



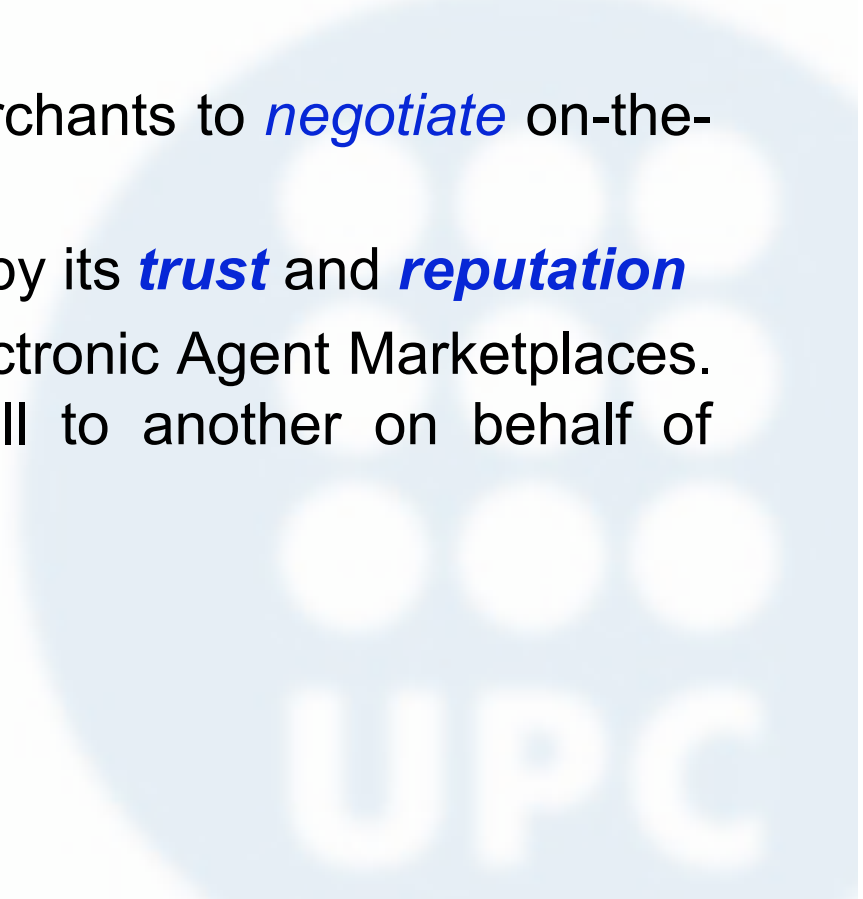
Auction settings

- **Private value:** value of the good depends only on the agent's own preferences
 - My aunt's apple-pie
- **Common Value:** Agent's value of an item is determined entirely by other's values
 - 1 Euro
- **Correlated value:** agent's value of an item depends partially on its own preferences and partially on other's values for it
 - Leonardo's manuscripts



Electronic Marketplace

- Electronic marketplaces are *agent-mediated institutions* that allow merchants to differentiate themselves from another merchants
- These institutions allow merchants to *negotiate* on-the-fly with potential consumers
- An institution is recognised by its *trust* and *reputation*
- An special case are the Electronic Agent Marketplaces. Where agents buy and sell to another on behalf of consumeres

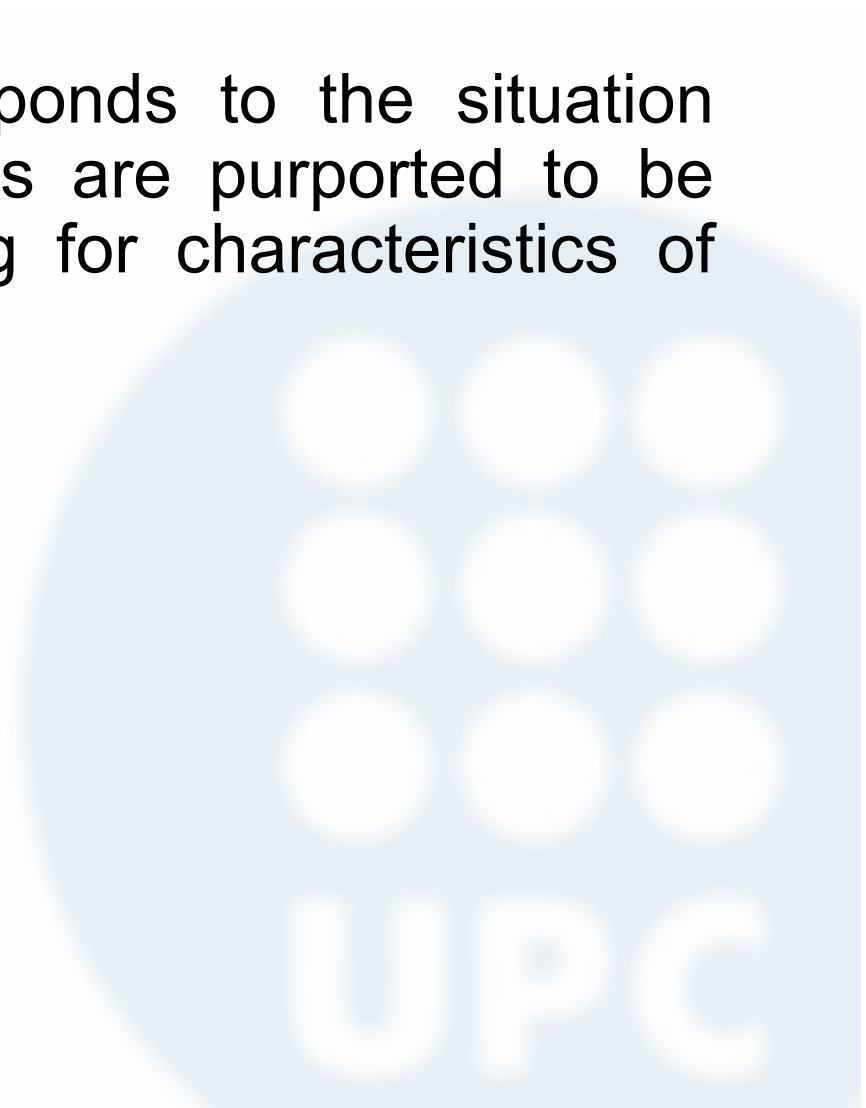


Auctions

- Trading in an auction from bidders (buyers) merely **to decide** on an appropriate price on which to bid and from auctioneers (sellers), essentially only **to choose** a moment when to submit their goods, these apparently simple decision **-if rational-** involve complex deliberative process

Auctions and Agents

- Auction trading corresponds to the situation where intelligent agents are purported to be ideally suited, requiring for characteristics of agenthood:
 - Reactivity
 - Stance (situatedness)
 - Sociability
 - Autonomy



Protocols

- Protocols are established to specify the legal for each agent in a given scenario.



Single-Attribute: English Auction

- The auctioneer announces the opening price.
- Every interested bidder can participate by offering a price which is higher than the current propose one.
- The winner is the bidder who offered the last bid and he pays his own bid.
- ***Dominant strategy***: always bid a small amount more than current highest bid, until private value price is reached.

Auction Protocols: English

- **Protocol:** Each bidder is free to raise his bid. When no bidder is willing to raise, the auction ends and the highest bidder wins the item at the price of his bid
- **Strategy:** Series of bids as a function of agent's private value, his prior estimates of other's valuations and past bids
- **Best Strategy:** In private value auctions, bidder's dominant strategy is always bid a small amount more than current highest bid, and stop when his private price is reached.

Auction Protocols: First-price sealed bid

- **Protocol:** Each bidder submits one bid without knowing other's bids. The highest wins the item at the price of his bid
 - Single round bid
- **Strategy:** Bid as a function of agent's private value and his prior estimates of other's values
- **Best Strategy:** No dominant strategy in general

Auction Protocols: Dutch

- **Protocol:** Auctioneer continuously lower the price until a bidder takes the item at the current price
- **Strategy:** Bid as a function of agent's private value and his prior estimates of other's values
- **Best Strategy:** No dominant strategy in general

Auction Protocols: Vickrey

- **Protocol:** Each bidder submits one bid without *knowing* other's bids. Highest bidder wins item at 2nd *highest* price
- **Strategy:** Bid as a function of agent's private value and his prior estimates of other's values
- **Best Strategy:** One's true valuation if you are in a single-shot private value auction with risk neutral bidders, a truthful auctioneer, and no possibility of *colluding*

English Auctions - **Japanese** variant

- All players know:
 - The current price of the item.
 - The number of players remaining.
- When a player quits he cannot come back.
 - The price at which a player quitted is known to everybody.
- ***Dominant strategy***: remain in auction till you reach your valuation (drop out at this point)

Classifying Auctions

- Interaction
 - Open-cry
 - Bulletin Board
 - Sealed-bid
- Bid Control
 - Dutch
 - Regular



Classifying Auctions

- Pricing
 - Discriminative
 - Non Discriminative
 - Vickrey
- Closing Rules
 - Deadline
 - Inactivity period
 - Price target



Auction Problems

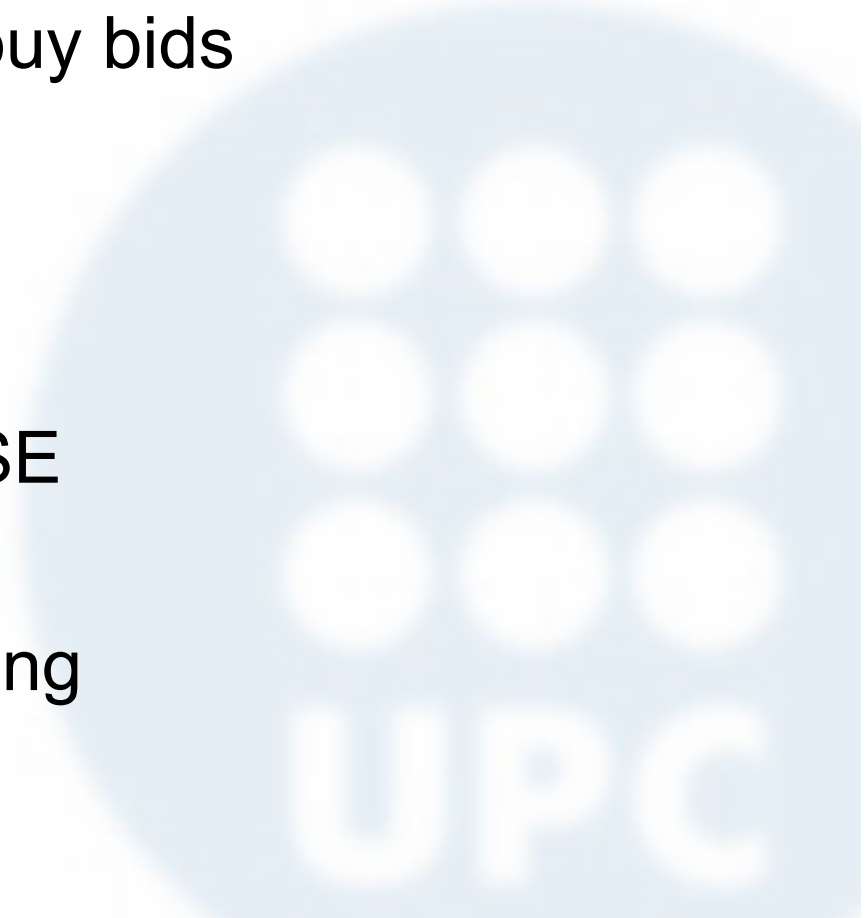
- Vulnerability to bidder collusion
 - Need to identify the coalition parties
- Vulnerability to shills
- Vulnerability to a lying auctioneer
 - Truthful auctioneer classically assumed

Auctioneer's other possibilities

- Bidding
 - Seller may bid more than his reservation price because truth-telling is not dominant for the seller even in the English or Vickrey protocol (because his bid may be 2nd highest and determine the price)
- Setting a minimum price
- Refusing to sell after the auction has ended

Continuous Double Auctions

- Continuously arriving items to be auctioned
- Continuously arriving buy bids
- Sale occurs $p_{\text{buy}} \geq p_{\text{sell}}$.
- Widely used, e.g. NYSE
- Strategic analysis lacking



Where Auctions are appropriate?

- Goods whose price is *volatile*
 - Highly differentiable through quality and availability (fish, wool, flowers, etc)
 - Valuation highly differentiated among potential purchasers (art)
 - Substitutive goods are also highly volatile (Treasury bills)
- Goods for which there is no reliable reference price: buyer valuation is unknown to the seller (low liquidity stock, Radios spectrum frequency allocation)
- Goods for which special transparency and expeditiveness conditions are needed (fiduciary purposes)

Auction rules at the *Llotja*

- In electronic mining, collisions are automatically detected and dealt with. In the *Llotja* the following rules are in use:
 1. Bidding turns have a fixed time step of X s
 2. All mining signals within a bidding turn are acknowledged
 3. If more than one mining signal is received within a bidding turn, a collision is declared
 4. If a collision is declared, the lot is re-auctioned with a price increment
 5. Price increment is a constant of 20%

Auction rules at the *Llotja* (ii)

- The *Llotja* guarantees that every box that is sold is paid to the original fisherman: *no-money, no mineing*
- Uniformity of lots
 1. The admitter's tagging. Every item is individually evaluated and tagged by a staff number
 2. The devolution and re-auctioning of tricked lots

Conclusions

- Efficient allocation
- Easily implementable in a distributed manner (among autonomous agents)
- Nontrivial
 - Important to understand merits and limitations
 - Unintuitive protocol may have better properties
- Choice of good auction protocol depends on the setting in which the protocol is used

NEGOTIATION



NEGOTIATION

