Lecture 15
Auctions

Administration

- Review:
  - PA6 due on Monday
  - PA7 goes out on Monday
  - I still have a bunch of graded midterms

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Auctions

- The Web often has:
  - Lots of participants
  - With no central control
  - Who need to find a price
- Auctions are the central method
- Ebay, Google ads best known. Also:
  - Pricing grid computing resources
  - Pricing bandwidth
  - Others

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Auctions

- Auctions can appear to be a fact of life, but there are lots of different kinds of auctions, which favor different outcomes
- Sometimes called *mechanism design*, creating an auction system can be highly mathematical
- Agents in an auction have different motives & strategies
- Tightly-related to game theory

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The Players

- There's a **seller**, and a set of **bidders**
- There's also a **thing** to sell
- Assume that **bidders** each know their valuation of the thing
  - A bidder will pay the valuation if necessary
  - Would like to pay less, if possible
  - Is this realistic?
- **Seller** does not know the **buyers'** valuations of the **thing**
- **Bidders** do not know each others' valuations
- Despite being self-interested and private, players must somehow find a price

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Many kinds of auctions

- Ascending bid, or "English" auction
  - Price goes up, until one bidder left
  - This is the kind of art auction that James Bond attends in movies; best-known type
- Descending bid, or "Dutch" auction
  - Price goes down, until someone bites
  - Used in Dutch flower auctions

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More auctions

- First price sealed bid auction
  - Winner pays his bid
  - Examples to come
- Second price sealed bid auction
  - Winner pays the 2nd place bid
  - Used by Ebay
  - Sometimes called a Vickrey auction

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First-price, sealed-bid

- Vahed bids $2

- Mike bids $1
- Vahed wins! Pays $2.00

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Second-price, sealed-bid

- Vahed bids $2

- Mike bids $1
- Vahed wins again! This time he pays $1.00, not $2.00

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Analysis

- Think about who wins, and how much the winner pays
- Ascending bid auction
  - What is the bidder's likely strategy?
  - Bidder stays in until price reaches bidder's value
  - Who wins? What does the winner pay?
- Sealed-bid second-price auction
  - What is the bidder's likely strategy?
  - For moment, assume bidder bids true value
  - Who wins? What does the winner pay?
- In both cases, winner is the bidder with highest value, pays 2nd-highest value

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Second-Price Analysis

- Bidding true value is always best
- v_i = i's value for the object
  b_i = i's bid for the object
- Payoff to bidder is:
  - v_i - max(b_j) if b_i > max(b_j)
  - 0 otherwise
- If $b_i > v_i$, bidder would pay more than he values it (with negative payoff)
- If $b_i < v_i$, bidder may fail to obtain object (with zero payoff)
- Thus, best strategy is $b_i = v_i$

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Second-Price Analysis

- In second-price auction, your bid does not directly impact what price you pay
- It determines whether to get to pay or not

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First-Price Analysis

- What is the bidder's likely strategy?
- Because the bid determines the price, bidding the true value may lead to overpayment
  - Bidders tend to underbid in a first-price auction

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Pay-Per-Click Auctions

- Consider the auction for ads that Overture used to run.
  - Overture was the first company to do text search ads. Even before Google! It was bought by Yahoo in 2003.

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Overture PPC Auctions

- Bidders can purchase "keywords"
  - Whenever a search user types *keyword*, then ads are displayed in descending order of bid. The high-bidder has "won" the auction.
  - If the user clicks on the ad, then high-bidder pays the search engine the bid price
  - User can click on many, or no, ads
- How should we determine bid price?
  - Overture: First-price sealed bid auction

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Overture in Action!

- Three parties bid on the best, most profitable keyword out there:
  - "eecs485"



$1 *$2* *$3*

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Overture in Action!

- VP Cheney is pos #1
  - He bids $3, pays $3

- Vahed is pos #2
  - He bids $2, pays $2

- Mike is pos #3
  - He bids $1, pays $1
- What should Cheney do?

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Cheney in Action!

- Cheney changes his bid to $2.01
  - He's going to save $0.99 with every click!

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Overture in Action!

- VP Cheney is pos #1
  - He pays $2.01

- Vahed is pos #2
  - He pays $2

- Mike is pos #3
  - He pays $1
- What should Vahed do?

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Vahed in Action!

- Vahed changes his bid to $2.02
  - With just $0.02 more, he's in the top position!

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Overture in Action!

- Vahed is pos #1
  - He pays $2.02

- VP Cheney is pos #2
  - He pays $2.01

- Mike is pos #3
  - He pays $1
- What happens next?

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Overture in Action!

- It's advantageous to change your bid rapidly
  - Pay enough to be on top, but no more
- Has some bad social effects: lots of time/money spent on bidding

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Google PPC (AdWords)

- A few critical differences
- Second-price sealed-bid auction
  - Allowed Ebay-style "autobidding"

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Google in Action!

- Vahed is pos #1
  - He bids $3.00, but pays $2.01

- VP Cheney is pos #2
  - He bids $2.00, pays $1.01

- Mike is pos #3
  - He bids $1, pays minimum
- Great! But…

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Google in Action!

- Unlike Overture, Google auction prices are kept secret. You don't know what other people bid.
- But you can guess. What if Cheney changes his bid to $2.75?

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Google in Action!

- Vahed is pos #1
  - He bids $3.00, but pays $2.76

- VP Cheney is pos #2
  - He bids $2.75, pays $1.01

- Mike is pos #3
  - He bids $1, pays minimum
- Vahed pays more; no change

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Google PPC (AdWords)

- More differences:
  - Displayed ads ranked by combination of bid amount and ad-quality
  - How do PPC motives differ from Ebay's?
  - Click-through rates are highly dependent on the ad text
- Google was originally the "cheap competitor" to Overture, then overtook

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Other issues in auctions

- I lied, slightly. Google AdWords is not exactly a Vickrey auction
  - Standard 2nd-price auctions sell one item
  - Google sells multiple items
  - It's a "Generalized Second Price" auction
  - Lacks some properties of Vickrey
- What if you want two items in successive items, but if you can't get them both, want nothing?
- What if you can collude with other bidders?
  - See spectrum bids

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