Auctions in Action

- https://www.youtube.com/watch?v=ACKT5jWJHTI
- Cattle auction in Kansas
- They're bidding on the price of steers and hiefers in dollars per 100lb live weight

Auctions

- In a cattle auction
  - Lots of participants
  - With no central (price) control
  - Who need to find a price
- The same with the web
- Auctions work for both
- Ebay, Google ads best known
- Also: pricing grid computing resources, bandwidth, etc.

Real-world Auctions

- Expensive to run an auction and get the attention of multiple potential buyers in a short window
- Used for:
  - Works of art, other unusual items
  - Contract tenders
  - But not for most products and services
- Auctions become much cheaper to run online
  - Particularly if there is no human in loop

Auction Mechanisms

- There are lots of different kinds of auctions, which favor different outcomes
- Sometimes called mechanism design, creating an auction system can be highly mathematical
- Players (called Agents) in an auction have different motives and strategies
- Tightly related to game theory

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?

The Players: Who Knows What

- **Seller** does not know the **bidders**' valuations of the **thing**
- **Bidders** do not know each others' valuations
- Despite being self-interested and private, players must somehow find a price

Many kinds of auctions

- "Open" auctions
  - Everybody sees the bids
  - Ascending-price ("English" auction)
  - Descending-price ("Dutch" auction)
- "Sealed-bid" auctions
  - Bids are secret
  - First-price
  - Second-price ("Vickrey" auction)

Sealed Bid Auctions

- Sealed-bid, first-price
  - Everyone bids silently, at once
  - Highest bid wins, and pays bid price
- Sealed-bid, second-price ("Vickrey")
  - Everyone bids silently, at once
  - Highest bid wins, pays 2nd-place price

Analysis

- Open, ascending-price (English)
  - What is the bidder's likely strategy?
  - Who wins? What does the winner pay?
- Sealed-bid second-price auction
  - What is the bidder's likely strategy?
  - Who wins? What does the winner pay?

Analysis

- Open, ascending-price (English)
  - What is the bidder's likely strategy?
  - Bidder stays in until price is higher than bidder's value
  - Who wins? What does the winner pay?
- Sealed-bid second-price auction
  - What is the bidder's likely strategy?
  - 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

Sealed-Bid, 2nd-Price Analysis

- Sealed-Bid, 2nd-Price auctions
- How much should you bid?
- True value? More? Less?

Sealed-Bid, 2nd-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_k) if b_i > max(b_k)
  - 0 otherwise
- If $b_i > v_i$, bidder would pay more than she values it (with negative payoff)
- If $b_i < v_i$, bidder may fail to obtain object (0 payoff)
- Thus, best strategy is $b_i=v_i$

Sealed-Bid, 2nd-Price Analysis

- Moral of the story:
- In sealed-bid second-price auction, your bid does not directly impact what price you pay
- It determines *whether you get to pay*
- Same with an open/ascending ("English") auction, assuming you follow the optimal strategy
- Sometimes said that 2nd-price auction bidders are "truthful"

Sniping

- Some people on Ebay use software to "snipe" auctions
- At an appointed time immediately before time runs out, the software raises the sniper’s bid substantially
- Why does this seem ridiculous and why might people do it?
- What does this do to the Proxy Auction?

Sniping

- Some people on Ebay use software to "snipe" auctions
  - At an appointed time immediately before time runs out, the software raises the sniper’s bid substantially
  - Why does this seem ridiculous?
  - Why might people do it?

- Sniping effectively turns a Proxy Auction into a Vickrey Auction, because it "seals" bids

Sealed-Bid, 1st-Price Analysis

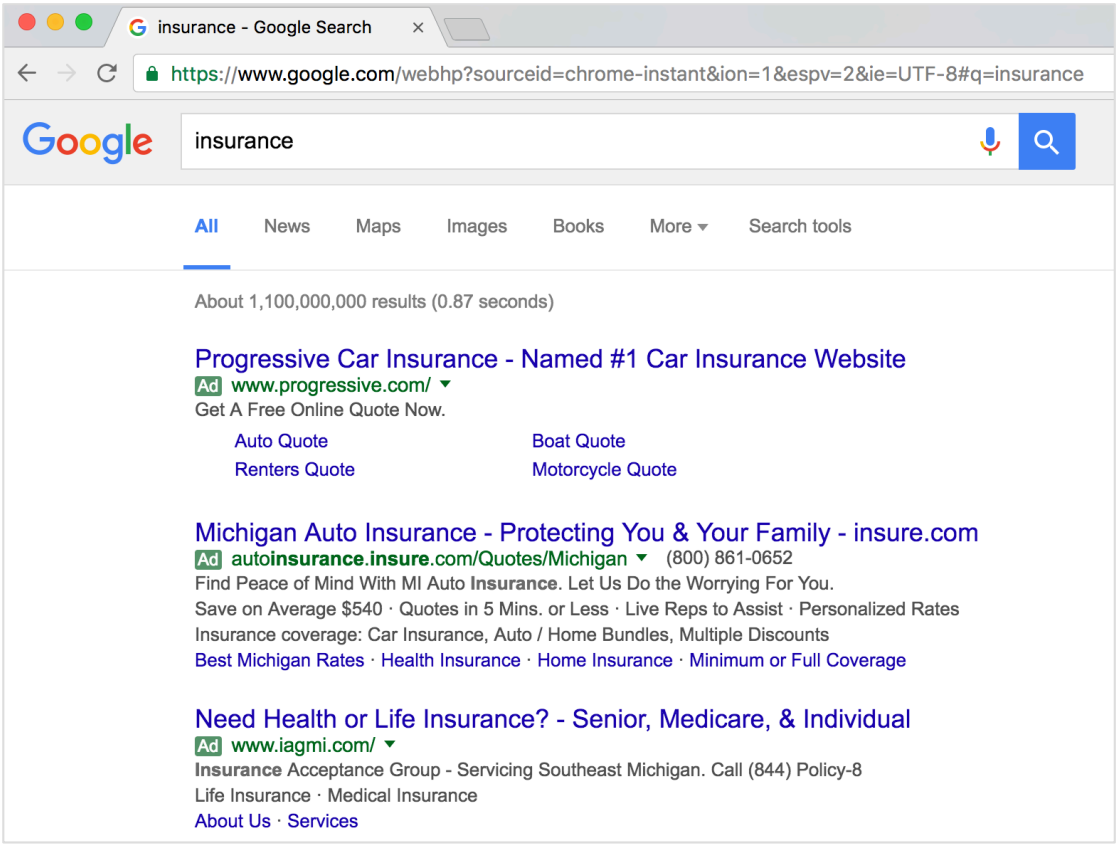
- Sealed-Bid, 1st-Price Analysis
- What is the bidder's likely strategy?

Sealed-Bid, 1st-Price Analysis

- Sealed-Bid, 1st-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

Pay-Per-Click (PPC) Auctions

- Auctions determine what ads you see



Most expensive ad words

#1

$935.71	best mesothelioma lawyer	LEGAL

#2-25

$425.70	dallas truck accident lawyer	LEGAL
$411.04	truck accident lawyer houston	LEGAL
$393.79	louisville car accident lawyer	LEGAL
$388.84	houston 18 wheeler accident lawyer	LEGAL
$381.65	san diego water damage	WATER DAMAGE
$377.70	are personal injury settlements taxable	LEGAL
$361.34	baltimore auto accident lawyer	LEGAL
$358.11	accident lawyer sacramento	LEGAL
$358.03	car accident lawyer phoenix	LEGAL
$350.42	car accident lawyers los angeles	LEGAL
$348.78	phoenix accident lawyer	LEGAL
$344.25	business phone service providers in my area	B2B
$338.98	san diego flood restoration	WATER DAMAGE
$332.58	los angeles car accident attorney	LEGAL
$326.85	mesothelioma compensation	LEGAL
$326.76	car accident lawyer in atlanta	LEGAL
$319.36	houston truck accident attorney	LEGAL

https://searchenginewatch.com/2016/05/31/the-most-expensive-100-google-adwords-keywords-in-the-us/

Pay-Per-Click (PPC) Auctions

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

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

Overture in Action

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

Overture in Action!

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  - "eecs485"

$1

$2

$3

Overture in Action!

- R2D2 is pos #1
  - He bids $3, pays $3 upon user click
- Neytiri is pos #2
  - She bids $2, pays $2 upon user click
- ET is pos #3
  - He bids $1, pays $1 upon user click

- What should R2D2 do?

Overture in Action!

- R2D2 is pos #1
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- Neytiri is pos #2
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- ET is pos #3
  - He bids $1, pays $1 upon user click

- What should R2D2 do?
- Decrease bid to $2.01, and save $0.99 per click

Overture in Action!

- R2D2 is pos #1
  - **He bids $2.01, pays $2.01 upon user click**
- Neytiri is pos #2
  - She bids $2, pays $2 upon user click
- ET is pos #3
  - He bids $1, pays $1 upon user click

- What should Neytiri do?
- Increase bid to $2.02: with just $0.02 more per click, she can get first position!!

Overture in Action!

- **Neytiri is pos #1**
  - **She bids $2.02, pays $2.02 upon user click**
- R2D2 is pos #2
  - He bids $2.01, pays $2.01 upon user click
- ET is pos #3
  - He bids $1, pays $1 upon user click

- What happens next?

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

Google Pay Per Click (AdWords)

- A few critical differences:
- Sealed-bid, 2nd-price auction
- Allowed Ebay-style "auto bidding" but other bids are not revealed

Google in Action!

- Neytiri is pos #1
  - She bids $3.00, but pays $2.01 upon click

- R2D2 is pos #2
  - He bids $2.00, pays $1.01 upon click
- ET is pos #3
  - He bids $1, pays minimum
- Great! But…

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 R2D2 changes his bid to $2.75?

Google in Action!

- Neytiri is pos #1
  - She bids $3.00, but pays $2.76 upon click.
  - Her cost increased due to R2D2!

- R2D2 is pos #2
  - He bids $2.75, still pays $1.01 upon click

- ET is pos #3
  - He bids $1, pays minimum

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

Other issues in auctions

- Google AdWords is not exactly a Vickrey (sealed 2nd-price) auction
  - Standard 2nd-price auctions sell one item
  - Google sells multiple items
  - It's a "Generalized Second Price" auction
  - Lacks some technical properties of Vickrey
- What if you want two items, but if you can't get them both, you want neither?
  - E.g., cotton candy machine + 32 tons of raw cotton candy

Other issues in auctions

- What if you can collude with other bidders?
- Example: spectrum bids
- Imagine you have a series of auctions for wireless spectrum
- ATT really wants City A. Verizon really wants City B.
- ATT can mess up Verizon by bidding up the price on B. And vice-versa.

Other issues in auctions

- Collusion: changing their bids to encode information
- E.g., if ATT wants to let everyone know that it is going after City A, it can put a company code on the end.

- Threats: ATT could announce which city it intends for the spectrum by tacking a city code on the end

Other issues in auctions

- E.g., if someone bids up the price of City A, then ATT can start bidding up the price on City B, AND attaching its own company code. If bids can be withdrawn, it can then withdraw its bid just to show the world it's screwing around.
- It also allows bidders to announce their identity if there's an implicit bargain to keep prices low. "Hey, this is ATT's city, so back off guys!"