CPS 196.2

Preference elicitation/iterative mechanisms

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Preference elicitation (auction)

“What would you buy if the price for A is 30, the price for B is 20, the price for C is 20?”

“v({A})?”

“30”

“v({A,B,C}) < 70?”

“Yes”

“v({B, C})?”

“gets {A}, pays 30”

“nothing”

“gets {B, C}, pays 40”
Benefits

• Less communication needed
• Agents do not always need to determine all of their preferences
  – Only where their preferences matter
Elicitation algorithms

• Suppose agents always answer truthfully
• Some elicitation algorithms will always choose the same winner as (say) the STV (instant runoff) rule
  – Elicitation algorithm for STV
• Design elicitation algorithm to minimize queries for given rule
• What is a good elicitation algorithm for STV?
• What about Bucklin?
An elicitation algorithm for the Bucklin voting rule based on binary search

[Conitzer & Sandholm 05]

- Alternatives: A B C D E F G H

- Top 4?  {A B C D}  {A B F G}  {A C E H}
- Top 2?  {A D}  {B F}  {C H}
- Top 3?  {A C D}  {B F G}  {C E H}

Total communication is $nm + nm/2 + nm/4 + \ldots \leq 2nm$ bits
(n number of voters, m number of candidates)
iBundle: an ascending CA [Parkes & Ungar 00]

• Each round, each bidder $i$ faces separate price $p_i(S)$ for each bundle $S$
  – Note: different bidders may face different prices for the same bundle
  – Prices start at 0
• A bidder (is assumed to) bid $p_i(S)$ on the bundle(s) $S$ that maximize(s) her utility given the current prices, i.e. that maximize(s) $v_i(S) - p_i(S)$ (straightforward bidding)
  – Bidder drops out if all bundles would give negative utility
• Winner determination problem is solved with these bids
• If some (active) bidder $i$ did not win anything, that bidder’s prices are increased by $\varepsilon$ on each of the bundles that she bid on (and supersets thereof), and we go to the next round
• Otherwise, we terminate with this allocation & these prices
Lower bounds on communication

- Communication complexity theory can be used to show lower bounds
  - “Any elicitation algorithm for rule r requires communication of at least N bits (in the worst case)”

- Voting [Conitzer & Sandholm 05]
  - Bucklin requires at least on the order of nm bits
  - STV requires at least on the order of n log m bits
    - Natural algorithm uses on the order of n(log m)^2 bits

- Combinatorial auction winner determination requires exponentially many bits [Nisan & Segal 06]
  - … unless only a limited set of valuation functions is allowed