

CS 6100 Homework 5

10 Points

Submit a paper copy at classtime.

Note, these exercises may be done in groups of one, two, or three. If more than one person is involved, list all the names on ONE set of answers. Groups may change throughout the term. *Working in groups is a BIG plus for you. Take advantage of it. If you work in groups, you must work in the group for the ENTIRE assignment. It is considered cheating if you work with someone else for some of the answers, but turn in an individual copy of the answers. It is an all or nothing situation. You can't work together on some questions and alone on some. Sometimes I see an individual whose name is listed in two groups. This is strictly forbidden and is considered cheating. You cannot work in two groups.*

1. This is a question about mechanism design in the context of combinatorial auctions. Suppose that the auctioneer can accept any combination of atomic bids from the same bidder, as long as bundles do not overlap (this is the so-called OR-language). Consider the following variation on the VCG mechanism, where payments are computed with respect to atomic bids rather than with respect to bidders: each bidder pays for each of their accepted bids the price offered, less a discount computed as the difference of the actual overall value and the overall value that would have been attainable without that bid. Is truth-telling still a dominant strategy for this modified mechanism? Either prove that it is or give an example that shows how the mechanism can be manipulated. (Adapted from a homework question set by T. Sandholm, Carnegie Mellon University, 2005.)

Clarification: A bundle is the set of all items wanted. A bundle is "atomic" if you must give the whole bundle to a person or none of it (a bundle cannot be divided). The question is saying to treat all bids from the same bidder as being distinct. VCG asks what price could have been achieved IF a bidder were not present. This variant of the problem asks what price could have been achieved IF A BID were not present. In other words, one bid from a bidder might influence the cost he/she pays for one of his other bids.

2. In voting, the Copeland rule selects the winner as the option with the largest Copeland index, which is the number of times an alternative beats other alternatives minus the number of times that alternative loses to other alternatives when the alternatives are considered in pair-wise comparisons. Ties could happen, in which case the tie wouldn't be counted as a win or a loss.

Prove that the Copeland rule is easy to manipulate. By manipulation we mean, once the mechanism is chosen, agents may not tell the truth about how they really feel if they think lying will help their real preference pattern be selected by the mechanism. **This proof of manipulation will take the form of an example.**

3. Multi-unit auctions. There are m identical items to be auctioned off to n players. Each player is single-minded (wants only the bundle specified) and wants q_i items at a value v_i (more than q_i items give the same value). Since the bidders are single-minded, the bids are of the form (p_i, b_i) where p_i is an integer in $1, \dots, m$ that indicates the number of items of interest and b_i is the bid for them (assume b_i are rational numbers).

Example: There are 50 identical items. The bids are as follows:

Bidder	Number	Value
A	11	19
B	16	15
C	24	58

D	3	9
E	18	36
F	27	62
G	13	22
H	8	15

- a. Is this problem a difficult one to solve in terms of complexity?
- b. Develop a simple greedy type algorithm which isn't optimal, but isn't too bad.
- c. Show how the problem would be solved using an A* algorithm. Show your work.