Introduction to Multi-Agent-Programming

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Exercise Sheet 10

Due: January 25th, 2010

Exercise 10.1 (Nash-Equilibria in Mixed Extensions (1.5pt, written))

Consider the zero-sum game of Rock-Paper-Scissors-Well as a variant of Rock-Paper-Scissors. Two players make a hand gesture displaying a rock, a paper, scissors, or a well at the same time. If they show the same gesture nobody wins, otherwise rock beats scissors, scissors beat paper, and paper beats rock. The well beats scissors and rock, while paper beats the well.

(a) Formulate the game as a strategic game $G = (N, A, u_i)$. You can give the utility function in matrix-form.

(b) Do Nash-Equilibria in pure strategies exist? How about mixed-strategies and why?

(c) Calculate the Nash-Equilibria in mixed strategies or show that none exist.

Exercise 10.2 (Voting (0.5pt, written))

There are two alternative drinks for a party, wine or beer. 66 participants voted for the drinks. The results was calculated according to Borda protocol, in which the preferred drink gets 2 points, the other gets 1 point. Consequently, wine gets 94 points; beer gets 104 points. What are the results if the voting is counted by binary and plurality protocols? Why?
You only need to do this exercise, if you did not do it as Exercise 7.3.

Exercise 10.3 (Combinatorial Auctions (1.5pt, written))

An auctioneer is selling five items $M = \{a, b, c, d, e\}$. There are seven bids, $B_1 = (\{a, b\}, 9)$,$B_2 = (\{b, e\}, 12)$,$B_3 = (\{c, d, e\}, 10)$,$B_4 = (\{c\}, 6)$, $B_5 = (\{a, c\}, 13)$,$B_6 = (\{b, c, e\}, 16)$,$B_7 = (\{b, d, e\}, 18)$. The auctioneer wants to find the "Optimal Winners".

(a) **Branch-on-items (0.5pt, written)**
Please draw the search tree without any dummy bids; please draw the search tree with the dummy bids (each dummy bid gets the price 3).

(b) **Branch-on-bids (0.5pt, written)**
Please draw the search tree and the bid graph at each node.

(c) **Heuristic search (0.5pt, written)**

The heuristic function is

$$h(n) = \sum_{i \in A} \min_{j | i \in S_j} \frac{p_j}{|S_j|}$$

where n is a node in the search tree; A is unallocated items; S_j is the item set in a bid; p_j is the price for S_j. In addition to the defined seven bids, there are 13 extra: $B_8 = (\{b, e\}, 8)$, $B_9 = (\{c, e\}, 12)$, $B_{10} = (\{e\}, 8)$, $B_{11} = (\{a, b, d, e\}, 25)$, $B_{12} = (\{a\}, 5)$, $B_{13} = (\{d, e\}, 15)$, $B_{14} = (\{b, c, d, e\}, 20)$, $B_{15} = (\{a, e\}, 9)$, $B_{16} = (\{d\}, 6)$, $B_{17} = (\{b, c\}, 17)$, $B_{18} = (\{b\}, 7)$, $B_{19} = (\{b, d, e\}, 25)$, $B_{20} = (\{a, d, e\}, 19)$.

Use the "branch on bids" with the defined heuristic to compute the solution, please show the process (you don't need to draw a tree).