CPSC 455b: Written Homework Assignment #3

Due in class on Tuesday, April 16, 2002

These exercises are drawn from the following papers (all obtainable from http://pantheon.yale.edu/~sz38) and the related lectures and discussions in class:

- Feigenbaum, Papadimitriou, and Shenker, "Sharing the Cost of Multicast Transmissions"
- Jain and Vazirani, "Applications of Approximation to Cooperative Games"
- Kearns, Littman, and Singh, "Graphical Models for Game Theory"

Problem 1 (20 Points)
The MC mechanism for multicast cost sharing, like other VCG mechanisms we have studied, is strategyproof but not group-strategyproof. Give an infinite family of examples that demonstrates that it is not group-strategyproof.

Problem 2 (30 Points)
Recall that there is no strategyproof mechanism for multicast cost sharing that satisfies the NPT, VP and CS assumptions explained in the Feigenbaum-Papadimitriou-Shenker paper and is both efficient and budget-balanced. Show that there is no strategyproof mechanism that satisfies the NPT, VP, and CS assumptions, is efficient, and is approximately budget-balanced. Here, "approximately budget-balanced" means that there is a constant c such that the sum S of the cost shares of all the members of the receiver set R satisfies $S/c \le C(T(R)) \le c \cdot S$, where C(T(R)) is the cost of the min-cost tree that reaches all of R.

Problem 3 (20 Points)
Consider the definition of the multicast cost-sharing problem given on page 4 of the Jain-Vazirani paper and the list of seven "economic constraints" that such a mechanism might be required to satisfy. In the paragraph directly following this list, they say that they can satisfy constraint #1 within a factor of two; they also say that it is shown in the Feigenbaum-Papadimitriou-Shenker paper that it is NP-hard to satisfy condition #6 within any constant factor and that they "are going to put this condition aside." Why aren't these two statements contradictory?

Problem 4 (30 points)
Consider an n-agent, two-action game, as defined in the Kearns- Littman-Singh paper [KLS]. In general, there are exponentially many Nash equilibria. Suppose that the agents wish to find one that maximizes the sum of the payoffs to the n agents, using the abstract algorithm given in Section 4 of [KLS]. How can they ensure that the output is one of the desired Nash equilibrium? It is tempting to say that each agent should maximize his own payoff in the upstream pass, *i.e.*, each agent should choose a witness u to T(w,v)=1 that maximizes his own payoff. Unfortunately, this "solution" does not work. Give an example that demonstrates that it does not work. Your example should include a game graph, n matrices, a Nash equilibrium computed by the "solution," and a Nash equilibrium that maximizes the sum of the payoffs to the n agents.