1-31-08 Homework 2
CS 7520 Due: 2-12-08
Approximation Algorithms

Problem 1 (Knapsack)
Vazirani Problem 8.7 (Subset Sum Ratio)

Problem 2 (Bin Packing)
Vazirani Problem 9.7

Problem 3 (Set Cover)
(a) In your lecture notes of Jan 26, there is a greedy algorithm for set cover that achieves performance guarantee $H_k OPT$, where k is the cardinality of the largest set. The analysis in your lecture notes is for the case where the covering requirement of all elements is 1. Extend this algorithms and the analysis to the case where the requirements can be greater than 1, while achieving the same performance guarantee $H_k OPT$.
(b) In class on Jan 26 (see also lecture notes) we saw a randomized rounding algorithm for set cover, which returns a set cover with probability asymptotically approaching 1, and with expected size of the output set cover of size $O(\log nOPT)$, where n is the set of elements. Explain how you can design an algorithm which returns a setcover of size $O(\log nOPT)$, with probability asymptotically approaching 1. (Markov's inequality might be helpful, but be careful how to handle conditional probabilities).

Problem 4 (Gomory-Hu Trees)
Vazirani problems 4.3, 4.4, 4.5 and 4.6.

Problem 5 (Research Questions, Extra Credit)
For any of the problems we have discussed in class, define and motivate interesting extensions. It is not necessary that you can solve them at this point (but if you can, that's would be absolutely great), but so discuss the difficulties and/or hopes that you have for these problems.

As always, feel free (in fact, you are encouraged) to work in groups and/or consult the literature. However, please acknowledge your resources in your solutions, and write the solutions by yourselves. Unless you don't know it already, half of the understanding happens when we write things up...