

Problem Set  
Introduction to Contemporary Algorithms  
(Theory of Discrete Algorithms)  
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This is a take-home test. You can discuss with your friends, but it is strictly prohibited to make a copy (or a similar one) of another person's submission. Please submit your answers using A4 papers to the BOX at Building No. 8 by July 31, 2015. This is again a hard deadline and no late submissions will be considered.

1. Suppose that you are in a group of 15 people and you want to select a single leader. Design a mechanism that figures out if there is a person who has supports from at least 8 people (of course it does not have to identify that person). There is no third party and the mechanism should not leak information other than the yes/no answer. For instance, when such a person does not exist, information like the one that there is a person who does not have 8 or more supports but does have at least 5 supports, might leak. You should minimize such information leak.
2. Consider the bin packing problem that is a bit different from the standard one, namely, it is guaranteed that each item has a value at most 0.5. Design your algorithm exploiting this constraint and analyze the approximation ratio.
3. Consider the following simple gamble. A single game is just a flip of a fair coin (head or tail comes exactly with probability  $1/2$ ). You need to pay 100 yen for a single game and if you have a head you get 200 yen otherwise you get zero. You must do at least one game but you can quit the game anytime after that. Supposing that you have 1000 yen at the beginning, design your strategy of deciding when to quit (for instance do you quit or continue when you have had one head and one tail?)