Homework 2

Due: Monday September 16 11:59pm

> *Summary of this homework: None of the answers needs computing or writing REAL code, you will need to write pseudocode and solve an equation, and evaluate all enumerations of a small set! If you need more than 2 hours you should talk to me.*

1. Consider the fake coin problem of having n coins where n is even and one of them is a fake and is known to be lighter than all the rest. Suppose you can call a function $w(x, y)$ which returns 0 if the mass of x and y are the same, $+1$ if x is heavier than y and -1 if x is lighter than y. The function has the weights of each coin from $i = 1, n$ but it is a private routine that you cant see, only use it. Here x, y are lists of numbers for the coins. For example, if $n = 4$ and $x = (1, 2)$, $y = (3, 4)$ then the function assumes you are comparing the weights of coins 1 and 2 with coins 3 and 4 from the original list of n coins.

   (a) Write pseudocode to describe a brute force approach to solving this problem. Explain why your code is a brute force approach. What do you think the efficiency of this algorithm is? Why?

   (b) Write pseudocode to describe a decrease and conquer approach to solving this problem.

2. Suppose we have two choices on how to solve a problem. The first approach is a Brute Force one which takes n^2 operations. For the second approach, we use a Transform and Conquer approach. We first transform the problem with an algorithm that takes $n^2 \log n$ operations and then solve it with an algorithm requiring n operations. If we perform one calculation then the Brute Force approach is more efficient. However, assume we perform the calculation m times. Determine the smallest value for m for which the Transform and Conquer approach is more efficient. Assume that we only have to do the transformation once.

3. Write out all steps for the brute force approach to solving the knapsack problem where we have a maximum weight of 10 lbs and we have the following items

   item # 1 has weight 4 lbs and value of $3
   item # 2 has weight 15 lbs and value of $11
   item # 3 has weight 2 lbs and value of $1
   item # 4 has weight 10 lbs and value of $8

   Show all possible combinations by creating a table of the following form:

Set of items	weight	value
$\{1\}$	4	3

   Indicate if the combination is not feasible. What is the solution to the problem?

Peter Beerli, September 2013