Problem 1. Modify version 2 of counting sort algorithm from the course website by changing the last for loop to go from 1 to n instead of n to 1. Apply this modified counting sort algorithm to the following array of numbers, $A = [6, 0, 2, 0, 1, 3, 4, 6, 1, 3, 2]$ to sort it. Is this version of the algorithm, stable? Show the various arrays, and indicate the reason for stability or otherwise.

Problem 2. You are given twelve coins that are identical in appearance; either all are genuine or exactly one of them is fake. We do not know whether the fake coin is lighter or heavier than the genuine one. You have a two-pan balance scale without weights. Each weighing would yield either the coins are, $=, <, or >$ each other in weight. You may assume, $<$ means lighter in weight and $>$ means heavier in weight. You are required to find whether all the coins are genuine and, if not, to find the fake coin and establish whether it is lighter or heavier than the genuine ones. Use decision tree (display it) to solve the problem with the minimum number of weighings. Find the lower bound on the number of weighings and return the ceiling of the answer. What would be the lower bound on the number of weighings on 65 coins? (Don't draw a decision tree).

Problem 3. Sort the following set of words using Radix sort algorithm:

$li, gil, ex, ca, tic, do, is, su, a, cious, per, pi, fra, li.$

Once these words have been sorted, we will re-order the sorted list by rearranging the words based on the answers(numbers) to the following set of questions:

(a) What is the decimal equivalent of 1001.

(b) How many weeks are in 2*10! seconds?

(c) In a full binary tree, what is the number of children in each internal node?

(d) At time $T = 0$ someone told you a joke. You told it to 2 of your friends at time $T = 1$, subsequently at every minute each person told the joke to 2 of their friends. In just few minutes a total of 63 people, including yourself, (but not the one who told this to you), have heard the joke. If you were to construct a binary tree with each node being a person what would be its height? (by the way this is how rumors spread).

(e) Albert and Bernard want to find out Cheryl's birthday. How many possible dates does Cheryl give them?

(f) What is the first even length palindromic number?

(g) What is the first safe prime number?

(h) What is the smallest emirp?

(i) What is the only number spelled with the same number of letters as itself?

(j) What is the number of bits in a byte?

(k) How many even prime numbers are there?

(l) If you roll two die and add their face values, which sum has the highest probability?

(m) What is the first digit of pi?

(n) what is one-third of the answer to life, universe and everything?

In the order of the answers to the questions above, arrange the sorted list of words. For example, if our sorted list was a, ab, abc and the answers to the questions were $2, 3, 1$, we would rearrange the words as ab, abc, a. Once rearranged concatenate all the words into a single word (for our example, ababca). Use this word in a meaningful sentence.

Have fun!