Problem 1: On input an array $A$ of $n$ elements, each of which is an integer in $[0..n^2]$, describe a simple method for sorting $A$ in $O(n)$ time.

*Hint: think of alternative ways of viewing the elements.*

Problem 2: You are given $n$ samples of a chemical compound. While they look identical, some of them have in fact been contaminated. You have a testing machine that given two samples can detect if they are the same or not. You also know that most of the samples (a majority of them) are identical. Find one of those identical samples making no more than $n$ tests with your machine (a.k.a. comparisons).

*Note: two samples might be identical but not belong to the majority of identical samples.*

Problem 3: Consider a phone book – its entries have several keys: last name, first name, address, and telephone number. They are sorted first by last name, then by first name, and finally by address. Design a variation of radix sort for sorting the entries in a phone book, assuming that you have available a procedure that sorts records on a single key. The running time of your algorithm should be of the same order as the running time of the procedure that sorts on a single key.