COSC 3100 Spring 2012, Homework 1, Due on 26th
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1 Problem 1

There are \( n \) lockers in a hallway, numbered sequentially from 1 to \( n \). Initially all the locker doors are closed. You make \( n \) passes by the lockers, each time starting with locker \( #1 \). On the \( i \)th pass, \( i = 1, 2, \ldots, n \), you toggle the door of every \( i \)th locker: if the door is closed, you open it; if it is open, you close it. After the last pass, which locker doors are open and which are closed? How many of them are open? Express the solution to the problem as an algorithm (in pseudocode). [Hint: Try with, say 10 doors, by hand and see what is going on.] Try to make the algorithm as efficient as possible.

2 Problem 2

Algorithm 1: Comparison Counting Sort

\[ \text{Algorithm 1 ComparisonCountingSort}(A[0..n-1]); \]
\[ \text{Input: } \text{Array } A[0..n-1] \text{ of integers}; \]
\[ \text{Output: } \text{Array } S[0..n-1] \text{ of } A's \text{ elements sorted} \]

\begin{verbatim}
for \( i \leftarrow 0 \) to \( n-1 \) do
    \( \text{Count}[i] \leftarrow 0 \)
end for

for \( i \leftarrow 0 \) to \( n-2 \) do
    for \( j \leftarrow i+1 \) to \( n-1 \) do
        if \( A[i] < A[j] \) then
            \( \text{Count}[j] \leftarrow \text{Count}[j] + 1 \)
        else
            \( \text{Count}[i] \leftarrow \text{Count}[i] + 1 \)
        end if
    end for
end for

for \( i \leftarrow 0 \) to \( n-1 \) do
    \( S[\text{Count}[i]] \leftarrow A[i] \)
end for

return \( S \)
\end{verbatim}
2.1 Apply this algorithm to sorting the list 60, 35, 81, 98, 14, 47

2.2 Is this algorithm stable? [Hint: try with a list where one element is repeated.]

2.3 Is this algorithm in-place?