[Spring 2022] CSE 317: Design and Analysis of Algorithms [All sections]
Homework 3 (Bonus homework) | Due: May 20, 2022

Instructions: You should submit it handwritten on A4-size papers. Write your name, section, and ID clearly on top of every page as well as the total number of pages. Direct your all queries to the course staff (refer to syllabus for contact information and office hours).

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1. (5 points) Let A be an array of $n > 0$ distinct (pair-wise distinct) elements. Design a *randomized Las-Vegas algorithm* to select $m < n$ distinct elements (i.e., you cannot select same element multiple times) randomly from A. what is the expected running time complexity of your solutions?

2. (10 points) Let A be an array of $n > 0$ elements such that an element a is repeated for k times in A (where $0 < k < n$). Design a *randomized Las-Vegas algorithm* to find an index of the element a. What is the expected running time of your solution?

3. (5 points) Let A be an array of $n > 100$ distinct (pair-wise distinct) elements. Design a *randomized Monte-Carlo algorithm* to find an element a in A with worst-case running $\Theta(1)$. What is the probability of error in your solution?

4. (10 points) Let $A[1..n]$ be an array of n distinct numbers. If $i < j$ and $A[i] > A[j]$, then the pair (i, j) is called an *inversion* of A. Suppose that the elements of A form a *uniform random permutation* i.e., $\Pr\{A[i] > A[j]\} = 1/2$ for all $i < j$. Use indicator random variables to compute the expected number of inversions.
