Course Name:	Design and Analysis of Algorithms	Course Code:	CS2009
Degree Program:	BSCS	Semester:	Spring 2023
Due Date:	20 - 02 - 2023	Total Marks:	70
Section:	G, H, J	Page(s):	3
Exam Type:	Assignment 1		

Student : Name:_____ Roll No._____ Section:_____

Instruction/Notes:

Loop invariants

Use loop invariants to prove the correctness of the following algorithms

Note: Use the code given in this assignment.

Question 1:

Find Min

```
MINIMUM(A)
1   min = A[1]
2   for i = 2 to A.length
3       if min > A[i]
4           min = A[i]
5   return min
```

Question 2:

Bubble Sort

```
BUBBLESORT(A)
1   for i = 1 to A.length − 1
2       for j = A.length downto i + 1
3           if A[j] < A[j − 1]
4               exchange A[j] with A[j − 1]
```

Question 3:

Selection Sort

SELECTIONSORT(A)

$$1 \quad \textbf{for } j = 1 \; to \; A.\,length - 1$$
$$2 \qquad smallest\_index \; = j$$
$$3 \qquad \textbf{for } i = j + 1 \; to \; A.\,length$$
$$4 \qquad\qquad \textbf{if } A[i] < A[smallest\_index]$$
$$5 \qquad\qquad\qquad smallest\_index = i$$
$$6 \qquad\quad exchange \; A[j] \; with \; A[smallest\_index]$$

Designing Algorithms

Question 1:

Given an array of integers, replace each element of the array with product of every other element in the array without using / operator.

Question 2:

You are given an array of n elements, and you notice that some of the elements are duplicates; that is, they appear more than once in the array. Show how to remove all duplicates from the array in time O(n log n).

Question 3:

Given a sorted array of distinct integers A[1; : : : ; n], you want to find out whether there is an index i for which A[i] = i. Give a divide-and-conquer algorithm that runs in time O(log n).

Question 4:

You are given two sorted lists of size m and n. Give an O(log m + log n) time algorithm for computing the kth smallest element in the union of the two lists.

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