Midterm

CSE 101, Spring 2002

Issued Tuesday, May,7 in class.

State your answers legibly and concisely. Your solutions will be graded on correctness, elegance, **clarity** and originality. Your proofs should **avoid getting bogged down in too much detail**. Please use *staples* to fasten the pages. **Your handwriting must be legible.** Write your name and SID number at the top of every page. Every problem is 20 points.

Last Name:	
Fist Name:	
SID:	

Problem 1. Give asymptotic upper and lower bounds for $T(n)$ in the following recurrencies. Assume that $T(n)$ is constant for $n \leq 2$. Make your bounds as tight as possible and justify your answers.

$T(n) = T(9n/10) + n$

$T(n) = 7T(n/3) + n^2$

Problem 2. Prove that

$$\sum_{k=1}^{n-1} \frac{1}{k(k+1)} = 1 - \frac{1}{n}$$

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Problem 3. Write an algorithm in *pseudocode* describing how to merge two sorted arrays into a single sorted array.

Problem 4. Give an algorithm in *pseudocode* with worst-case running time $O(n \log n)$ to determine the number of inversions in an array A of n distinct integers. An inversion is a pair of indices $i < j$ such that $A(i) > A(j)$. For example, the array 13, 17, 11, 15 of four elements has the following three inversions: (1,3), (2,3), and (2,4). Hint: Use divide-and conquer and re-use the code from problem 3.

Problem 5. You are given a pile of thousands of telephone bills and thousands of checks sent in to pay the bills. (Assume telephone numbers are on the checks.) Find out who did not pay. Outline the fastest possible method of solving the problem and give its worst-case complexity.

Question 1	___/20
Question 2	___/20
Question 3	___/20
Question 4	___/20
Question 5	___/20
Total	___/50