CS 531: Homework 1, Fall 2024
Due September 3, 2024 at 3:00 PM

Study Group [1]

Provide the names of the members of your study group. If you do not have a study group but wish to join one, write ”None, but I want to join one,” and if you do not wish to join a study group write ”None, and I do not want to join one.”

Policies [9]

1. What dates and times are the exams for CS 531 this semester? Are there planned alternate exams? What is the policy for a missed midterm? A missed final? [3]
2. How many homework drops are provided in this class? Is partial credit provided for late solutions? [3]
3. What are the potential consequences for failure to turn in or stow an electronic device during an assessment? Answer by copying and pasting below the relevant paragraph on the course website beginning ”During every exam: all calculators ...” [3]

Algorithm Design [30]

1. Describe an algorithm that sorts a stack of pancakes by diameter. The only operation you are allowed to perform on the stack is to place a spatula under a pancake of your choice in the stack, then flip the substack of pancakes above your spatula. Your algorithm should take $O(n)$ flips. Argue its correctness and number of flips. Can you adapt this algorithm to sort a list on a normal computer in $O(n)$ time? Why or why not? [10]
2. An inversion in a list $[A_0, \ldots, A_{n-1}]$ is a pair (i, j) of indices with $i < j$ but $A_i > A_j$. Describe an $O(n \log n)$ time algorithm to count the number of inversions in a list. Argue its correctness and runtime. [10]
3. A peak element of a list $[A_0, \ldots, A_{n-1}]$ is an element greater than its neighbors. (Note that elements A_0, A_{n-1} have exactly one neighbor each.) Describe an $O(\log n)$ time algorithm to return the index of any peak element. (It can be proven that some peak element exists for every nonempty list.) Argue its correctness and runtime. [10]

Asymptotics [30]

1. Solve the following recurrence relations using any method you know. Show your work. [20]
   (a) $T(n) = 8T(n/2) + n^2$
   (b) $T(n) = 2T(\sqrt{n}) + 1$
   (c) $T(n) = 4T(n/3) + n^2$

(d) $T(n) = 3T(n/3) + n$

2. Prove that for all $\epsilon > 0$, we have $\log x = O(x^{\epsilon})$. [10]