CECS 528, In Class Assignment 1, August 31st, 2026, Dr. Ebert

Directions. All work should be shown on this sheet of paper which is to be turned in before the end of class. Each student should solve at least one problem and provide its handwritten solution. Note: each student is awarded the same amount of points which is equal to the sum of all points earned on the sheet.

Problem This problem is inspired by my supervisor at Arcadia Design Systems who told me "linear and log-linear [algorithms]: good. Anything else, be very careful how you use it". After an algorithm has been implemented and compiled in Python, suppose that, on average, a particular computer's cpu is capable of executing a single algorithm step in 5×10^{-10} seconds. The plan is to let the computer continuously run the program for 30 consecutive days. An instance of the problem is an array of n 64-bit integers and we want to calculate the size of the largest array that can be solved by the algorithm within this 30-day period. Over the past 50 years, remarkable progress has been made towards finding better algorithms for solving the problem. The original algorithm designed in 1962 required $T_1(n) = 2^{\log^4 n}$ algorithm steps for an array of size n. Then in 1985 there was a tremendous breakthrough that showed that the problem could be solve in a polynomial number of steps (namely, $T_2(n) = n^3$). Over the years the second algorithm was often refined to where in 2012 researchers discovered an algorithm that only requires $T_3(n) = n^{1.1}$ steps, and proved that this is optimal, i.e. any algorithm that solves the problem requires $\Omega(n^{1.1})$ steps.

Student 1. Your name: _____

Use the space below to solve for the largest array size that can be solved by the computer using an implementation of the 2012 algorithm. Please use as many significant digits as your calculator will allow. (10 pts)

Student 2. Your name: _____

Do the same for the 1985 algorithm. (10 pts)

Student 3. Your name: _____

Do the same for the 1962 algorithm. (10 points)