Name: _____

Homework #4: Intro/Algorithms (9 points)

Due to Gradescope by 11:45 PM on Thursday, September 9th

You need to submit a pdf to Gradescope; failure to assign questions to pages may result in a 10% deduction on your grade

Homework Goal: Practice using and critically thinking about algorithms in general and search & sort algorithms in particular; review terminology for these chapters

Zybooks + CS Basics

1. Section 1.2 in zyBook discusses several historical figures in computer science. Here are two other important people in computer science. Read about them online, and then write a short paragraph on each (3-5 sentences each) that describes what they have done for the computing revolution. The paragraph should be in your OWN words. (1 point)
    a. Donald Knuth

    b. Jean Bartik

2. Figure 1.4.4 in zyBook provides pictures of several places where embedded devices reside. Provide two other examples where embedded devices exist. (0.5 point)

3. Fill in the blanks: (1 point)

    Computer science is the study of _____.

    A(n) _____ is a set of step-by-step instructions for solving a problem.

    Pseudocode lies between _____ and _____.

Searching & Sorting

4. Match the following algorithms with their time complexity. (0.5 points)
   a. ___Binary search x. O(n)

   b. ___Sequential search y. $O(\log_2(n))$

   c. ___Selection sort z. $O(n^2)$

5. Use the following list in answering the following four questions: (1 point)

   [2, 5, 13, 21, 27, 29, 44, 58, 66, 93, 120]

   a. How many list elements will be compared to find 13 using linear search?

   b. How many list elements will be compared to find 13 using binary search?

   c. How many list elements will be compared to find 127 using linear search?

   d. How many list elements will be compared to find 127 using binary search?

6. Russia's population is approximately 145,968,457. Suppose we have a database with everyone's name and phone number in Russia, sorted by full name (first name, middle name, last name).

   In the worst case, how many comparisons would be needed to find the following item, using the best possible search algorithm? Justify your answer in each case. (1 point)

   a. Anastasia Petrova Kuzenetsov

   b. If the phone number 7 495 953-90-59 belongs to someone

7. Given a *large list* of items, should one ***always*** sort the list and then use binary search (versus just using linear search on the large list)? Justify your response. (1 point)

Following and Evaluating Algorithms

8. The following is Euclid's 2,300-year-old algorithm for finding the greatest common divisor (gcd) of two positive integers, I and J. (1.5 points)

Step	*Operation*
1	Get two positive integers as input; call the larger value *I* and the smaller value *J*
2	Divide *I* by *J*, and call the remainder *R*
3	If *R* is *not* 0, then reset *I* to the value of *J*, reset *J* to the value of *R*, and go back to Step 2
4	Print out the answer, which is the value of *J*
5	Stop

   a. Go through this algorithm using the input values 12 and 22. Label what step of the algorithm (1-4) you are on. After each step of the algorithm is complete, give the values of I, J, and R. Determine the final output of the algorithm.

      Step ___: I = ___, J = ___

      Step ___: I = ___, J = ___, and R = ___

      Step ___: I = ___, J = ___, and R = ___

      Step ___: I = ___, J = ___, and R = ___

      Step ___: I = ___, J = ___, and R = ___

      Step ___: I = ___, J = ___, and R = ___

      Step ___: Print J = ___

   b. Does the algorithm work correctly when the two inputs are 0 and 22? Describe exactly what happens and modify the algorithm so that it gives an appropriate **error message** if the smaller value is 0.

9. The following algorithm correctly determines whether summing a large list of random numbers exceeds 10,000. How might you improve the algorithm to make it more

efficient? (Hint: adding the numbers one-by-one is the same as “add all the numbers together”) (0.5 points)

Step 1: Initialize sum = 0.
Step 2: Start with the first number as the sum.
Step 3: Add the next element to the sum.
Step 4: Repeat step 3 until all numbers have been added.
Step 5: Compare sum with 10,000.

10. As a *separate document*, write pseudocode for folding an 8-1/2x11 sheet of paper into a paper airplane. Rather than turning this problem into Gradescope with the rest of this assignment, bring this to class Friday, Sept 10th. You will do a peer review on this algorithm similar to how you did for your initials algorithm. (1 point)