

Homework 3

100 points possible

You must turn in your homework in ps or pdf format

Be sure to include the names of your partners and how long you worked on the homework together. Remember that you must work with at least 2 other people to form a group of three and you must work for at least 2 hours together (minimum of 1 hour sessions).

1. (10 pts) Show that the maximum number of nodes in a binary search tree of height h is $(2^{h+1} - 1)$. A binary tree of height h with the maximum number of nodes is called a full binary tree. You may just show me a picture to show this property, however, remember that 1 example does not prove anything. Give a base case and sufficiently build upon that.

2. (10 pts) A full node in a binary tree is a node with two children. Prove that the number of full nodes plus one is equal to the number of leaves in a full binary tree. You may just show me a picture to show this property, however, remember that 1 example does not prove anything. Give a base case and sufficiently build upon that.

3. (10 pts) Draw an expression tree corresponding to the following expression:
$$(a + b) / (c - d * e) + f + g * h / i$$

4. (30 pts) Given the following numbers, 160, 8, 34, 110, 19, 212, 22, 55, 389, 48, 3, show the array at each pass or phase for each of the specified sorting techniques. Give the Big-Oh notation running time of each sorting algorithm.

- a. Insertion Sort
- b. Selection Sort
- c. Bubble Sort
- d. Radix Sort
- e. Merge Sort
- f. Quick Sort using the first element of each array/subarray as the pivot

5. (6 pts) An empty table has a capacity of 100, and you insert 6 entries with keys 100, 0, 1199, 1299, 1399, and 2. Using linear probing and the basic hash function (key mod size), where will these entries be placed in the table? Where will they be placed with double hashing (with $HF2 = 1 + (\text{key mod } 98)$)?

6. (6 pts) Use a hash table with size of 811 that uses separate chaining to specify where the following entries will be inserted. Use a basic hash function (key mod size). Insert 811, 0, 1623, 2435, 3247, and 2.

7. (9 pts) Use a hash table of size 11 and the basic hash function (key mod size). Insert the following items using quadratic probing, 2, 14, 21, 36, 70, 18, 47, 32, and 11.

8. (9 pts) Rehash the resulting table from the previous question to a table size of 23.