**473 Levitin problems and hints   HW 08**

**Problems 1:  (15)  5.3.8 [4.4.7]**

8. a. Draw a binary tree with 10 nodes labeled 0, 1, ..., 9 in such a way that the inorder and postorder traversals of the tree yield the following lists: 9, 3, 1, 0, 4, 2, 7, 6, 8, 5 (inorder) and 9, 1, 4, 0, 3, 6, 7, 5, 8, 2 (postorder).

b. Give an example of two permutations of the same $n$ labels $0, 1, .., n - 1$ that cannot be inorder and postorder traversal lists of the same binary tree.

c. Design an algorithm that constructs a binary tree for which two given lists of $n$ labels $0, 1, .., n - 1$ are generated by the inorder and postorder traversals of the tree. Your algorithm should also identify inputs for which the problem has no solution.

Author's Hints:

8. Find the root's label of the binary tree first, and then identify the labels of the nodes in its left and right subtrees.

**Problem 2:  (5) 5.3.11 [4.4.10]**

11. *Chocolate bar puzzle*   Given an $n$-by-$m$ chocolate bar, you need to break it into $nm$ 1-by-1 pieces. You can break a bar only in a straight line, and only one bar can be broken at a time. Design an algorithm that solves the problem with the minimum number of bar breaks. What is this minimum number? Justify your answer by using properties of a binary tree.

Author's Hints:

11. Breaking the chocolate bar can be represented by a binary tree.

**Problem 3:  (5) 5.4.9 [4.5.9]**

9. V. Pan [Pan78] has discovered a divide-and-conquer matrix multiplication algorithm that is based on multiplying two 70-by-70 matrices using 143,640 multiplications. Find the asymptotic efficiency of Pan's algorithm (you can ignore additions) and compare it with that of Strassen's algorithm.

Author's Hints:

9. The recurrence for the number of multiplications in Pan's algorithm is similar to that for Strassen's algorithm. Use the Master Theorem to find the order of growth of its solution.

**Problem 4: (10)** 5.5.3 [4.6.2]

3. Consider the version of the divide-and-conquer two-dimensional closest-pair algorithm in which, instead of presorting input set $P$, we simply sort each of the two sets $P_l$ and $P_r$ in nondecreasing order of their $y$ coordinates on each recursive call. Assuming that sorting is done by mergesort, set up a recurrence relation for the running time in the worst case and solve it for $n = 2^k$.

Author's Hints:

3. Recall (see Section 5.1) that the number of comparisons made by mergesort in the worst case is $C_{worst}(n) = n\log_2 n - n + 1$ (for $n = 2^k$). You may use just the highest-order term of this formula in the recurrence you need to set up.

**Problem 5: (5)** 5.5.7 [4.6.6]

7. Explain how one can find point $p_{max}$ in the quickhull algorithm analytically.

Author's Hints:

2. We traced the algorithms on smaller instances in the section.

**Problems 6-8:** Not from textbook

3. ( 5)          Which permutation immediately follows 37246510 in lexicographic order?
              Show how you use the algorithm from Day 18 class to get your answer.

4. ( 5)          If the permutations of the numbers 0-7 are numbered from 0 to 8!-1,
              what is the (lexicographic ordering) sequence number of the permutation 37246510?

   ( 5)          Which permutation of 01234567 is number 25000 in lexicographic order?