Instructor: Dr. Sartaj Sahni
Spring, 2002

Advanced Data Structures (COP 5536 /NTU AD 711R)
Final (May 2, 2002)

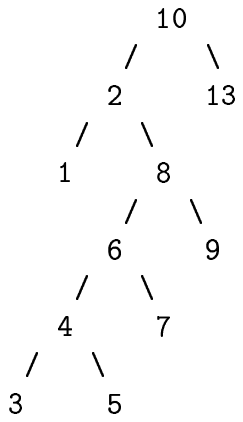
CLOSED BOOK
60 Minutes

Name: _____

NOTE:
1. **For all problems, use only the algorithms discussed in class/text.**
2. All answers will be graded on correctness, efficiency, clarity, elegance and other normal criteria that determine quality.
3. The points assigned to each question are provided in parentheses.

1. (8) What is the worst-case number of disk accesess that insert and delete operations can make on a B-tree. Assume that only one node can be fetched or written in one disk access; all nodes, once accessed, can be kept in the memory; and height of the tree is h. Show how you arrived at your answer.

2. Consider the following *top-down* splay tree:



(a) (4) *Insert* key 11 into the above splay tree, showing the resulting tree.

(b) (6) Perform the *split* operation with respect to the node with the key 4 to the result tree of (a), showing each step.

3. (10) Insert the following keys into an initially empty instance of Patricia:

   001000, 001010, 111110, 001011, 100000, 110010

   Draw the Patricia instance following each insertion. Then delete the key 111110, and draw the resulting instance. (show each step)

4. (10) For the min radix priority search tree (RPST) with the range [0,32),

   (a) (6) Peform *insert* operation into an initially empty RPST in sequence with the following keys: (6,6), (9,17), (4,4), (17,1), (6,3), (21,7). Show each step. The elements x and y of a key (x,y) stand for the search and priority key values, respectively.

   (b) (4) Delete (6,3) from the result RPST of part (a).

5. (12)

   (a) (6) You are given an n-by-n binary image, where n is a power of two. Describe how can you count the number of white pixels in the given image? Assume that the given image is represented by a *quad*-tree.

   (b) (6) You are given n points represented by a k-d tree. Describe an algorithm to find all points whose x coordinate is greater than a given value X and whose y coordinate is greater than a given value Y.