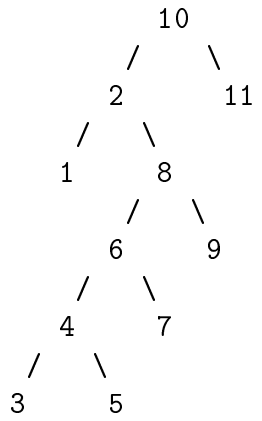
Advanced Data Structures (COP 5536 /NTU AD 711R)
Exam 3 (Dec. 13, 1999)
CLOSED BOOK
60 Minutes

NOTE All answers will be graded on correctness, efficiency, clarity, elegance and other normal criteria that determine quality. The points assigned to each question are provided in parentheses.

1. (8) For the following splay tree, perform the *split* operation with respect to the node with the key 4, showing each step.



2. (8) Construct a suffix tree for the string *aabcc#*, briefly describing each step.

3. (10) Construct a *min radix priority search tree* with range [0,22) by *inserting* the keys in the sequence : (4,6), (8,14), (3,3), (15,1), and (4,2). Now, *delete* the key (4,2) from the constructed tree.
   Show all steps. The elements x and y of a key (x,y) stand for the search and priority key values, respectively.

4. (12) Describe the *3-dimensional range tree* data structure.
   What are the *preprocessing* time, *space*, and *query* time complexities? Explain how you arrived at these complexities.

5. (12) You are given an n-by-n binary image where n is power of two. We are going to represent the image using a quadtree.

   (a) (4) Specify how to *locate* the leaf for the pixel $[i, j]$ by following a path from the root of the quadtree.

   (b) (4) Describe how you can *initialize* the quadtree.
   What is your *time complexity*?

   (c) (4) How can you *count* the number of white pixels from the initialized tree?