Instructor: Dr. Sartaj Sahni
Fall, 2002

Advanced Data Structures
(COP 5536 /AD 711R)
Final Exam

CLOSED BOOK
120 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. (12) For B-trees,

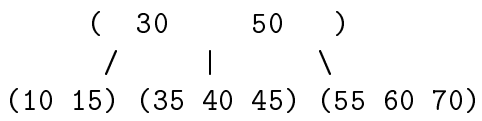


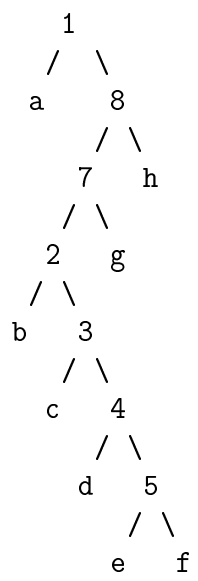
figure 1 B-tree of order 5.

(a) (4) Insert the keys 75 and 65 one at a time into the order-5 B-tree of figure 1. Show the new tree after each key is added.

(b) (4) How many disk access are needed to make each insertion ? (Assume that the tree is kept on a disk and one node may be retrieved at a time)

(c) (4) Delete the keys 15, 55 and 35, in this order, from the order-5 B-tree of figure 1. Show the tree following each deletion.

2. (10) Consider the following splay tree:



(a) (5) Perform a search for the key 5 under the assumption that this is a $bottom - up$ splay tree, show each step of the splay that is done.

(b) (5) Explain how a split with respect to key i is to be performed when key i is not present in a $top - down$ splay tree.

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. (6) Start with an empty min radix priority search tree ($RPST$) with the range [0,24). Peform *insert* operations into the RPST in sequence with the following keys: (10,12), (8,16), (3,4), (23,6), (13,18), (17,9). Show each step. The elements x and y of a key (x,y) stand for the search and priority key values, respectively.

5. (12)

   (a) (6) You are given an n-by-n binary image, where n is a power of two. Describe how to determine 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.