Instructor: Dr. Sartaj Sahni
Fall, 2003

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. (10) For B-trees,

   (a) (5) Construct an order-4 B-tree with height 3. All nodes of your B-tree should be 2 nodes.

   (b) (5) Delete the key value of the root node, showing each step.

2. (12) Consider the *splay tree*:

   (a) (6) Insert the following keys into an initially empty splay tree:

   $$1, 3, 5, 7, 2, 6, 4$$

   Show each step and use the *bottom-up* method.

   (b) (6) Discuss the advantages of using a splay tree over an ordinary binary search tree.

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

0100, 1011, 1001, 0111, 1010, 0001

(a) (8) Draw the Patricia instance following each insertion.

(b) (4) From the result tree of Part (a), *delete* the key 0100 and draw the resulting instance.

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

   (a) (5) Perform *insert* operations into an initially empty RPST in sequence with the following keys: (4,4), (25,8), (7,7), (10,17), (17,2), (7,5).
   Show each step. (Note: The elements x and y of a key (x, y) represents the *search* and *priority* key values, respectively.)

   (b) (3) *Delete* key (4,4) from the result RPST of Part (a).

5. (8) For the questions, answer briefly.

   (a) (3) What is a *quad-tree*? Describe the data structure and give an example of its application with your solution.

   (b) (5) What is a *range tree* with two key fields, i.e., $k = 2$? Describe the data structure and explain how to perform a *search* operation for a given key (x, y).