Instructor: Dr. Sartaj Sahni
Summer, 2005

Advanced Data Structures
(NTU AD 711R)
Final Exam

CLOSED BOOK
90 Minutes

Name: _____

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. **For all problems, use only the algorithms discussed in class/text.**
2. **Write your name at the top of every exam sheet.**
3. **Write your answers directly on the exam question sheet.** You may use scrap paper (supplied by your proctor) for work, but these will not be graded.
4. All answers will be graded on correctness, efficiency, clarity, elegance and other normal criteria that determine quality.
5. The points assigned to each question are provided in parentheses.
6. You may use only a pen or a pencil. No calculators allowed.
7. Do not write on the reverse side of the exam sheet.
8. Do not write close to the margins since those areas do not always make it through when faxed.

Name:

1. (30) For B-trees,

   (a) (20) Construct a minimum height **B-tree of order-5** that contains the following key values with 7 (and possibly with other keys) in the root node.

   5, 15, 30, 0, 10 , 7, 35, 40, 45, 60, 25

   (b) (10) Delete the key 7 from the resulting *B-tree* of part (a). Show the tree following each deletion.

Name:

Continue work here if necessary.

Name:

2. (70) Consider the following splay tree:

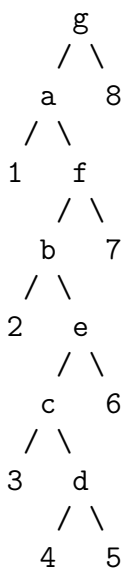

Figure 1. Splay Tree

(a) (35) Perform a search for element d under the assumption this is a *Top-down* splay tree. Show the tree(s) after each step of the splay.

(b) (35) Perform the following operation sequence on an initially empty splay tree under the assumption this is a *Bottom-up* splay tree. (Showing each step)

Insert(14), Insert(10), Insert(8), Insert(5), Insert(9), Insert(1)

Name:

Continue work here if necessary.

Name:

3. (50) For *Patricia*,

   (a) (40) Insert the following sequence of keys into an initially empty instance of Patricia:

   01000, 10010, 01011, 00111, 10101, 10100

   Draw the Patricia instance following each insertion.

   (b) (10) Delete key 00100 from Figure 2 below and draw the resulting Patricia instance.

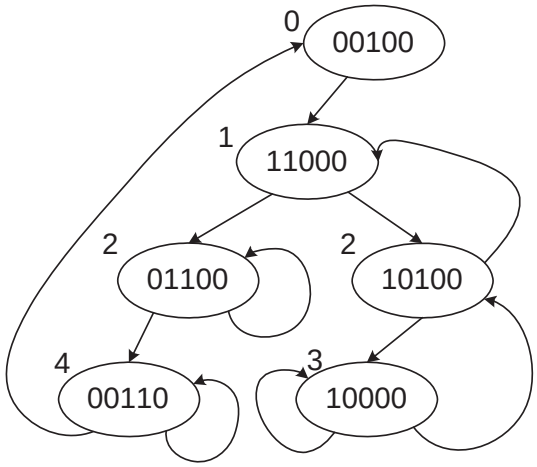

Figure 2. Patricia

Name:

Continue work here if necessary.

Name:

4. (30) 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.

Name:

Continue work here if necessary.

Name:

5. (70)

   (a) (35) Describe a *range tree* with 2 key fields (i.e., $k = 2$). Describe the data structure and explain how to search a key (x, y).

   (b) (35) You are given a $2^k \times 2^k$ binary image. Assume that we are using a *quadtree* to represent the image. Describe how to perform *counterclockwise* rotation by 90 degrees.

Name:

Continue work here if necessary.