Instructor: Dr. Sartaj Sahni
Spring, 2005

Advanced Data Structures
(COP 5536)
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.

1. (6) For B-trees,

   (a) (4) Construct a minimum height **B-tree of order-5** that contain the following key values with 7 in the root node
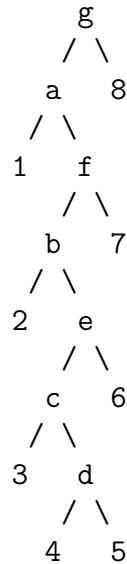
$$5, 15, 30, 0, 10 , 7, 35, 40, 45, 60, 25$$

   (b) (2) Delete the keys 7 from the resulting *B-tree* of part (a). Show the tree following each deletion.

Continue work here if necessary.

2. (12) Consider the following splay tree:

```
           g
          / \
        a   8
       / \
      1   f
         / \
        b   7
       / \
      2   e
         / \
        c   6
       / \
      3   d
         / \
        4   5
```

(a) (6) Perform a search for element d under the assumption this is a *Top-down* splay tree using two-level moves. Show the tree(s) after each step of the splay.

(b) (6) Perform the follow operation sequence on an initially empty splay tree under the assumption this is a *Bottom-up* splay tree using two-level moves. (Showing each step)

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

Continue work here if necessary.

3. (12) For *Patricia*,

    (a) (8) 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.

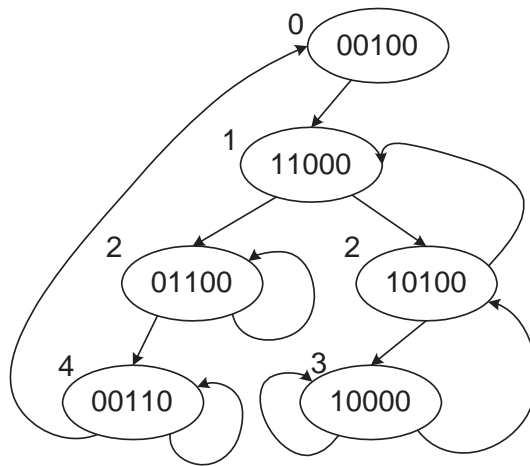   (b) (4) Delete key 10100 from Figure below and draw the resulting instance.

Figure 3. Patricia

Continue work here if necessary.

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.

Continue work here if necessary.

5. (14)

    (a) (8) 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) (6) 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.

Continue work here if necessary.