

**Instructor: Dr. Sartaj Sahni**

**Summer, 2011**

Advanced Data Structures

(COP5536)

**Exam 03**

CLOSED BOOK

60 Minutes

Name:

UFID:

**PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY**

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

**Question 1 (12 points)**

Consider the following splay tree:

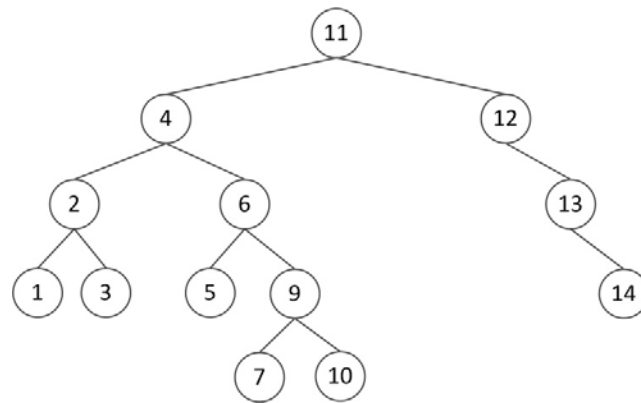


Figure 1

- 1) Perform a *delete* for the key 3 under the assumption that this is a *bottom-up* splay tree. Show each step. (6 points)

- 2) Perform a *split* from the tree of Figure 1 (not the resulting tree of part 1)) for the key 8 under the assumption that this is a *top-down* splay tree. Show each step. (6 points)

**Question 2 (14 points)**

A min radix priority search tree (RPST) can be defined as a set of pairs  $(x, y)$  over  $[0 \dots 63]$  of integers. Construct a min RPST by inserting the following pairs in the given order. Show the min RPST after each insertion.

$(12, 49), (30, 12), (20, 1), (60, 15), (25, 60), (11, 37), (49, 23)$



**Question 3 (10 points)**

You are given a Bloom filter that consists of  $m = 11$  memory bits and two hash functions  $f_1()$  and  $f_2()$  defined as below:

$$f_1(k) = (3 * k) \bmod m$$

$$f_2(k) = (2 * k) \bmod m$$

where  $k$  is a given key. Assume that all  $m$  bits of the Bloom filter are initially set to 0.

- 1) Show the Bloom filter bits following the insertion of the key 7, 12, 9. Show result after each insertion. (6 points)

2) How can the resulting filter return a "maybe" for a key that was not inserted? (4 points)

**Question 4 (14 points)**

- 1) Draw a clearly labeled suffix tree for the string *addaadd#*. (8 points)



- 2) For R-Tree which is usually used as a spatial database index:
- a) Briefly describe how to insert a node into R-Tree. (3 points)
  - b) How does Quadratic Split Method work? Show it with an example. (3 points)