Arab Academy For Science and Technology & Maritime Transport

College of Engineering & Technology

Computer Engineering Department

EXAMINATION PAPER – Week 7

Course Title: Data Structures

Course Code: CC215

Date: Mon. Dec, 15-2014 Lecturer: Dr. Manal Helal

Time allowed: 60 mins Start Time: 10:30 a.m.

Student's name:	Reg.# :

Question #	Marks	
	Available	Actual
Trees	6	
Balanced Trees	6	
Hashing	8	
Total	**20**	
Lecturer	Name : Dr. Manal Helal	
	Signature :	
	Date:	

MPC6/1-1

Trees: **[6 points]**

1) Binary Search Trees

a. Show the result of inserting 5, 2, 8, 3, 1, 9, 7, 4 into an initially empty binary search tree.

b. Show the result of deleting the root.

Balanced Trees: **[6 points]**

2) Show the result of inserting 3, 1, 4, 6, 9, 2, 5, 7 into an initially empty AVL tree.

Hashing: **[8 points]**

3) Given input {4371, 1323, 6173, 4199, 4344, 9679, 1989} and a hash function $h(x) = (x \bmod 15)$, show the resulting

a. separate chaining hash table

b. hash table using linear probing

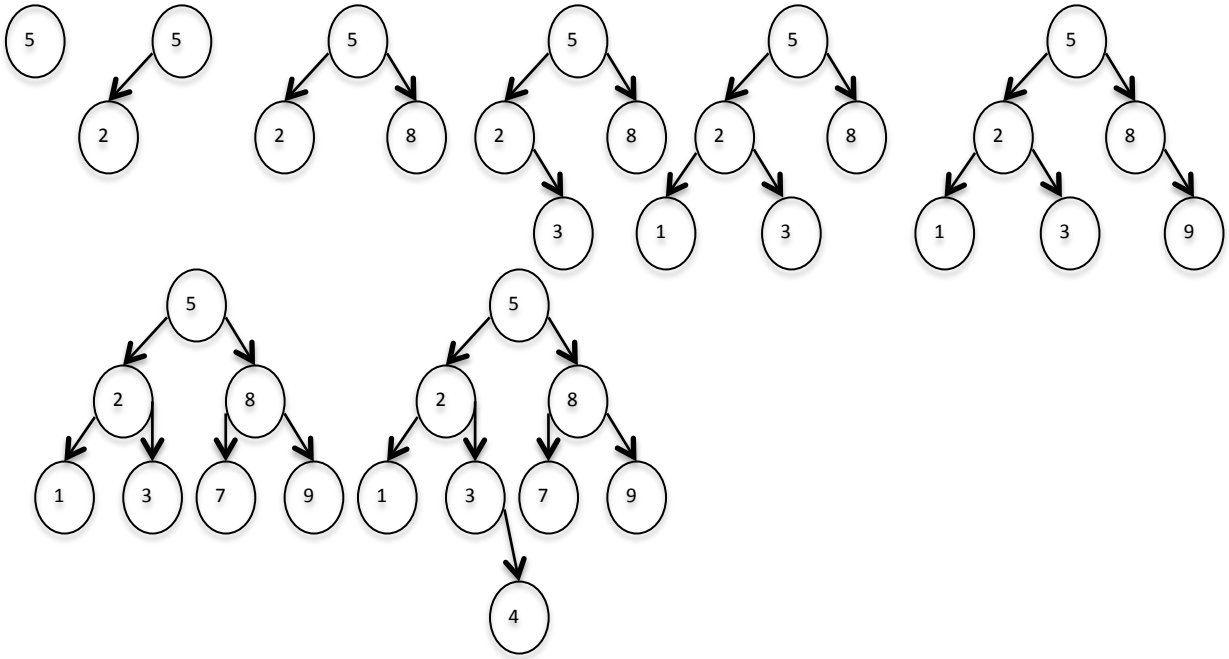
c. hash table using quadratic probing

d. hash table with second hash function $h_2(x) = 7 - (x \bmod 7)$

e. Show the result of rehashing to a table of size 21 using a hash function $h(x) = (x \bmod 21)$, with second hash function $h_2(x) = 19 - (x \bmod 19)$

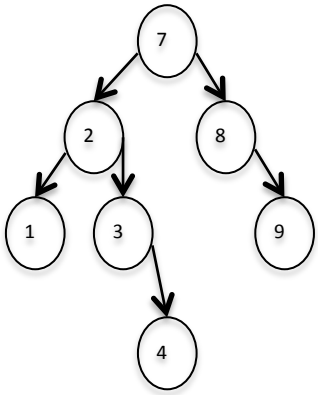
Solutions:

a. Show the result of inserting 5, 2, 8, 3, 1, 9, 7, 4 into an initially empty binary search tree.

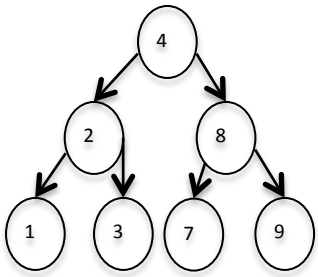


b) Show the result deleting the root.

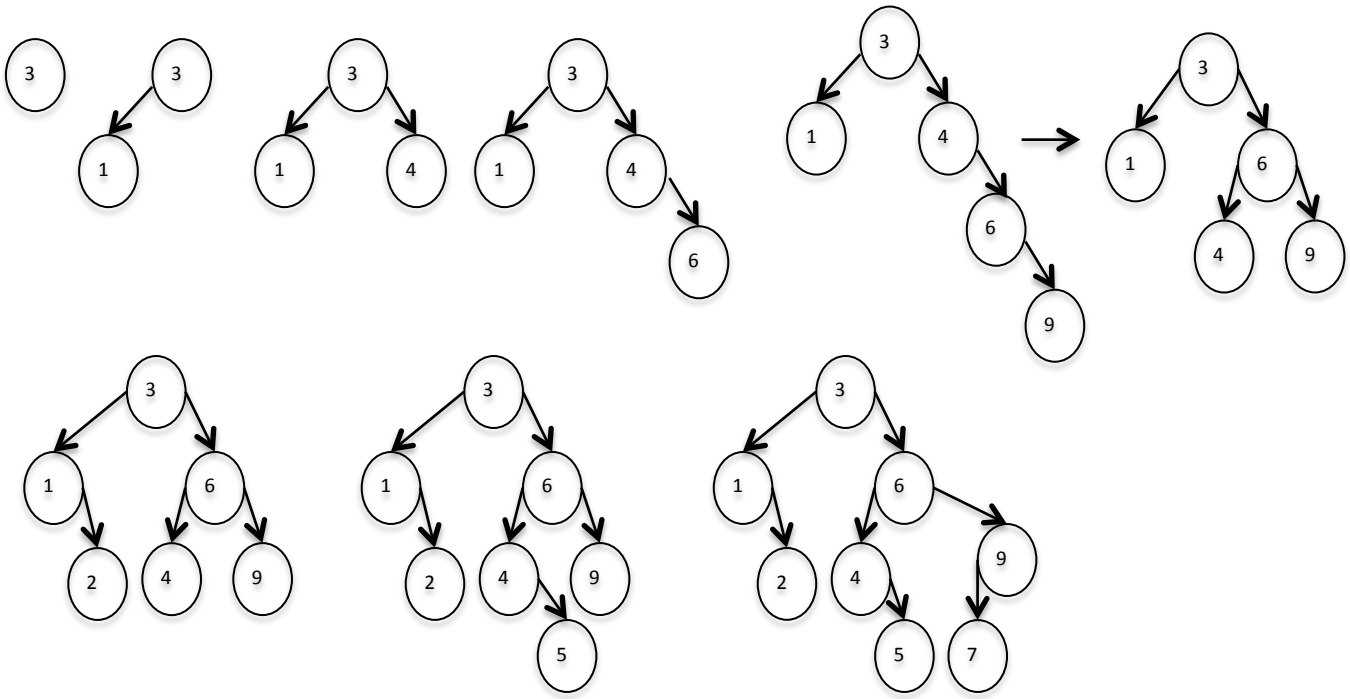
replacing with in order successor



or replacing with in order predecessor



2) Show the result of inserting 3, 1, 4, 6, 9, 2, 5, 7 into an initially empty AVL tree.



Given input {4371, 1323, 6173, 4199, 4344, 9679, 1989} and a hash function $h(x) = (x \bmod 15)$, show the resulting

a. separate chaining hash table

4371 mod 15 = ***6***

1323 mod 15 = ***3***

6173 mod 15 = ***8***

4199 mod 15 = ***14***

4344 mod 15 = ***9***

9679 mod 15 = ***4***

1989 mod 15 = ***9***

.. 3 ..	1323
4	9679
6	4371
8	6173
9	4344, 1989
..	
14	4199

b. hash table using linear probing

4371 mod 15 = ***6***

1323 mod 15 = ***3***

6173 mod 15 = ***8***

4199 mod 15 = ***14***

4344 mod 15 = ***9***

9679 mod 15 = ***4***

1989 mod 15 = 9

9+ 1 = ***10***

.. 3 ..	1323
4	9679
6	4371
8	6173
9	4344
10	1989
14	4199

c. hash table using quadratic probing

4371 mod 15 = ***6***

1323 mod 15 = ***3***

6173 mod 15 = ***8***

4199 mod 15 = ***14***

4344 mod 15 = ***9***

9679 mod 15 = ***4***

.. 3 ..	1323
4	9679
6	4371
8	6173
9	4344
10	1989
14	4199

1989 mod 15 = 9

1 iteration to place, $1^2 = 1$

9 + 1 = ***10***

d. hash table with second hash function $h_2(x) = 7 - (x \bmod 7)$

4371 mod 15 = ***6***

1323 mod 15 = ***3***

6173 mod 15 = ***8***

4199 mod 15 = ***14***

4344 mod 15 = ***9***

9679 mod 15 = ***4***

1989 mod 15 = 9

0	1989
.. 3 ..	1323
4	9679
6	4371
8	6173
9	4344
14	4199

$h_2(x) = 7 - (1989 \bmod 7) = 6$

1989 → 9 + 6 MOD 15 = ***0***

e. Show the result of rehashing to a table of size 21 using a hash function $h_1(x) = (x \bmod 21)$, with second hash function $h_2(x) = 19 - (x \bmod 19)$

4371 mod 21 = ***3***

1323 mod 21 = ***0***

6173 mod 21 = ***20***

4199 mod 21 = 20

$h_2(x) = 19 - (4199 \bmod 19) = 19$

4199 → 20 + 19 MOD 21 = ***18***

4344 mod 21 = 18

$h_2(x) = 19 - (4344 \bmod 19) = 7$

4344 → 18 + 7 MOD 21 = ***4***

9679 mod 21 = ***19***

1989 mod 21 = ***15***

0	1323
.. 3 ..	4371
4	4344
15	1989
18	4199
19	9679
20	6173