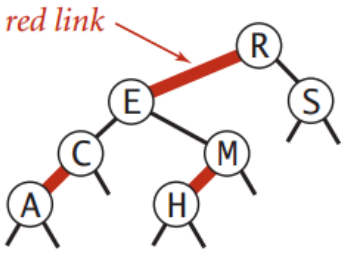
COS 226 – Data Structures and Algorithms
Fall 2014 – Flipped Lecture Section
Individual/small group worksheet
Week 6 – 10.04.14
Topics covered: LLRB, hashing

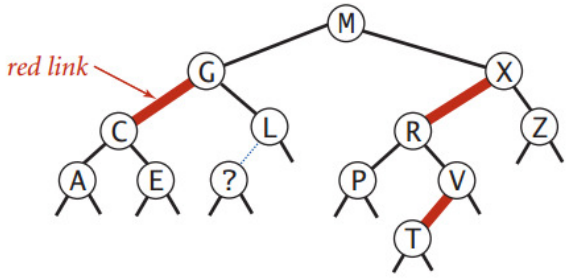
Instructions: This worksheet covers 2-3 trees, LLRBs and hashing. Read the worksheet first (before viewing the videos) and understand what type of questions needs to be answered. As you watch videos, if you find the answer to a problem, write the answer here and if possible in salon, so you can share it with others. Also be sure to make some comments/questions on salon.

1. LLRB - Consider the following LLRB.



(a) add key P and then add key Z and show the resulting tree after insertions
(b) How many total left rotations, right rotations and color flips are performed to insert these two keys?

2. Consider the following LLRB



(a) Which one of the keys below can be in the node marked?

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

(b) Add the key U to the LLRB above and draw the tree

3. Insert the keys E A S Y Q U E S T I O N in that order into an initially empty table of M=5 lists using separate chaining. Use the hash function 11k % M to transform k^{th} letter of the alphabet to a number.

4. Suppose that 10,000 strings of length 5 (all strings are formed using alpha characters) are inserted into a linear probing hash table (of size = 10000) using the function, hash (key) = sum of the characters in the key (note that each key is 5 characters long).
   a. What is the load factor of the hash table?
   b. What is the probability of a collision after 125 keys are inserted into the table?

5. Match up the following algorithms with function on right. You can use a letter more than once or not at all.

___ *Min* height of a binary heap with N keys.	A. ~ 1
___ *Max* height of a binary heap with N keys.	B. $\sim \frac{1}{2} \lg N$
___ *Min* height of a 2-3 tree with N keys.	C. $\sim \log_3 N$
___ *Max* height of a 2-3 tree with N keys.	D. $\sim \ln N$
___ *Min* height of left-leaning red-black BST with N keys.	E. $\sim \lg N$
___ *Max* height of left-leaning red-black BST with N keys.	F. $\sim 2 \lg N$
___ *Min* height of a weighted quick union tree with N items.	G. $\sim 2 \ln N$
___ *Max* height of a weighted quick union tree with N items.	H. $\sim N$

6. Suppose that the following keys are inserted into a hash table in some order

key	hash
A	5
B	2
C	5
D	1
E	4
F	1
G	3

(a) Give the contents of the linear-probing array if the keys are inserted in alphabetical order: A, B, C, D, E, F, G

(b) Which of the following could be the contents of the linear-probing array if the keys are inserted in some other order?

I.

0	1	2	3	4	5	6
A	F	D	B	G	E	C

II.

0	1	2	3	4	5	6
F	A	D	B	G	E	C

III.

0	1	2	3	4	5	6
C	A	B	G	F	E	D