Feedback — Balanced Search Trees

Help Center

You submitted this quiz on **Wed 7 Oct 2015 8:04 PM EDT**. You got a score of **2.60** out of **3.00**. You can attempt again, if you'd like.

```
To specify an array or sequence of values in an answer, separate the value
s in
the sequence by whitespace. For example, if the question asks for the firs
t
ten powers of two (starting at 1), then the following answer is acceptabl
e:

     1 2 4 8 16 32 64 128 256 512

If you wish to discuss a particular question and answer in the forums, ple
ase
post the entire question and answer, including the seed (which can be used
by
the course staff to uniquely identify the question) and the explanation (w
hich
contains the correct answer).
```

Question 1

```
(seed = 399392)
Consider the left-leaning red-black BST whose level-order traversal is:

    55 35 85 32 45 65 96 12 34 44 57 72 89

List (in ascending order) the keys in the red nodes. A node is red if the l
ink
from its parent is red. Your answer should be a sequence of integers, separ
ated
by whitespace.
```

You entered:

32 44 65 89

Your Answer		Score	Explanation
32 44 65 89	✔	1.00	
Total		1.00 / 1.00	

Question Explanation

The correct answer is: 32 44 65 89

The shape of a BST is uniquely determined by its level-order traversal.

To deduce which links are red, recall that the length of every path from the root to a
null link has the same number of black links; apply this property starting from nodes
at the bottom.

Question 2

(seed = 143149)
Consider the left-leaning red-black BST whose level-order traversal is

72 30 94 22 67 81 96 75 85 73 (red links = 73 81)

What is the level-order traversal of the red-black BST that results after inserting the following sequence of keys:

42 86 53

Your answer should be a sequence of 13 integers, separated by whitespace.

You entered:

72 53 94 30 67 81 96 22 42 75 86 73 85

Your Answer		Score	Explanation
72 53 94 30 67 81 96 22 42 75 86 73 85	✔	1.00	
Total		1.00 / 1.00	

Question Explanation

```
The correct answer is: 72 53 94 30 67 81 96 22 42 75 86 73 85

Here is the level-order traversal of the red-black BST after each insertio
n:

    72 30 94 22 67 81 96 75 85 73          ( red links = 73 81 )
42: 72 30 94 22 67 81 96 42 75 85 73       ( red links = 42 73 81 )
86: 72 30 94 22 67 81 96 42 75 86 73 85    ( red links = 42 73 81 85 )
53: 72 53 94 30 67 81 96 22 42 75 86 73 85 ( red links = 30 73 81 85 )
```

Question 3

```
(seed = 362737)
Which of the following statements about balanced search trees are true? Che
ck all that apply. Unless otherwise specified, assume that the 2-3 tree and
red-black BSTs are as described in lecture (e.g., 2-3 trees are perfectly b
alanced and red-black BST are left-leaning red-black BSTs with internal lin
ks colored either red or black).
```

Your Answer		Score	Explanation
☐ The order of growth of the minimum number of nodes in a red-black BST of height h is 2^(h/2).	✖	0.00	This is a bit tricky. Consider a 2-3 tree of height h with 3-nodes on the leftmost spine and 2-nodes everywhere else. The number of nodes is 1 + 3 + 7 + ... + (2^(h+1) - 1) = 2^(h+2) - h - 3. This corresponds to a red-black BST with 2^(h+2) - 3 nodes and height 2h.
☐	✔	0.20	It can be as high as 3^(h+1). Consider a 2-3 tree of height h

The order of growth of the maximum number of nodes in a red-black BST of black height h is 2^h.			in which every node is a 3-node. It has 1 + 3 + 9 + ... + 3^h ~ 1/2 3^(h+1) 3-nodes. The corresponding red-black BST has black height h and 3^(h+1) nodes.
☑ The maximum number of color flips triggered by inserting a key into a red-black BST on N nodes is ~ 2 lg N.	✖	0.00	If every other link on the path from a root to a leaf is red, then the length of the path is ~ 2 lg N and there will be ~ lg N color flips.
☑ Given the level-order traversal of a red-black BST, it is possible to reconstruct the red-black BST.	✔	0.20	We use this representation of red-black BSTs in some of the exercises.
☑ Applying a left rotation to a right-leaning red link maintains perfect black balance (i.e., every path from the root to a null link has the same number of black links).	✔	0.20	This is a key property of left rotation.
Total		0.60 / 1.00	

Question Explanation