UNIVERSITEIT VAN PRETORIA
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COS 212 Tutorial 4: Version A

- 09/03/2012
- 50minutes
- 3 questions for a total of 27 marks.

Name:_____

Student/staff Nr:_____

Marker (office use):_____

Question 1 Balancing ..... (8 marks)

1.1 Write the pseudo code to perform a `left` rotation of a node N about its parent P. (3)

Answer: Something along the lines of

Solution:

```
if P is not the root (i.e. P has a parent)
        P's parent becomes the parent on N (N replaces P)
P. right = N.left
N.left = P
```

1 mark for doing something about the grandparent

1 mark for each one of the assignments (swapping of trees)

1.2 Rewrite the DSW algorithm's `createBackbone` pseudo code so that a backbone will be created where the largest element in the tree will be the root of the backbone. (4)

Solution: The idea is that left rotations are performed instead of right rotations. Look for the following (capital letters are the differences from the textbook):

```
tmp = root
while(tmp != null)
        if tmp has a RIGHT child (textbook says left)
                rotate child about tmp
                set tmp to the original RIGHT child
        else tmp = tmp.LEFT
```

Answer:

1.3 In the DSW algorithm's `createPerfectTree` phase, only every second node in the backbone is rotated about its parent to create a new tree, except for the very last node in the backbone, why is this? (1)

Answer:

Solution: Will cause the tree to become lopsided to the left again.

Question 2 AVL Trees ..... (13 marks)

2.1 Insert the following keys, in the given order, into an initially empty AVL tree. Only draw your final tree: (3)

`65,64,63,62,61,70,80,90,95,99`

Answer:

Solution: 1 Tree is balanced

1 Correct root

1 is a BST

2.2 After an insert operation on an AVL tree causes any node's balance factor to change, could the node's balance factor be used to determine into which subtree the insert occurred? Motivate your answer. (1)

Answer:

2.3 Assume three nodes in an AVL tree, N,P and G. N is the right child of P which in turn is the left child of G. Initially N,P and G have the balance factors 0, 0 and -1 respectively. An insertion occurs in the left subtree of node N.

a) Rebalance the tree by completing the following, substituting the numerals for either N, P or G: (4)

Rotate (i) about (ii) and then (iii) about (iv)

Answer:

b) What is the balance factor for N after the rotation of the previous question has been completed? (1)

Answer:

2.4 When a rotation needs to be performed in an AVL tree, the choice of which nodes take part and the order in which they rotate matters. Why is this? (1)

Answer:

> **Solution:** If done incorrectly we will end up with an unbalanced tree. Correct rotations lead to tree being as balanced as possible.

2.5 Assume the tree in figure 1 is an AVL tree, redraw the tree after the node `222` has been deleted. (3)

Answer:

Solution: 1 222 is replaced by 250 as 100's right

1 For node 81: 81 is child of 50 AND left child 77 AND right is 100

1 For node 77: left is 60 AND right is 78

Question 3 Self Restructuring Trees ..... (6 marks)

3.1 The naive approach for the `moving to the root` strategy for self-restructuring trees suggests that an accessed node simply be rotated about its parents until it is the root. Discuss the problem with this strategy. (2)

Answer:

3.2 Assume the tree in figure 2 is to be used for splaying. Draw the final tree after an access to node 16 has occurred. (4)

Solution: 2 For heterogeneous splay of 16

2 for homogeneous splay of 16

Answer:

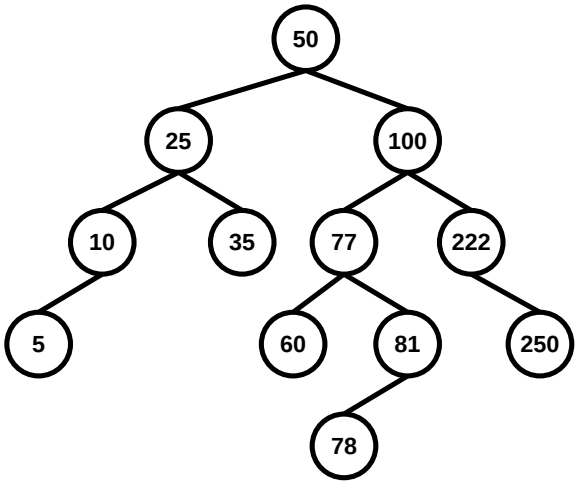

Figure 1: AVL Tree

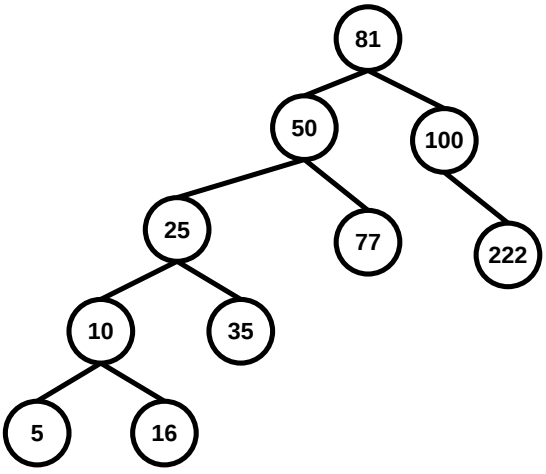

Figure 2: Splay Tree