



FACULTY OF SCIENCE

ACADEMY OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

MODULE	CSC03A3/CSC3A10 COMPUTER SCIENCE 3A
CAMPUS	AUCKLAND PARK CAMPUS (APK)
ASSESSMENT	(2,4) TREE EXAMPLES MEMO

DATE: 2022-05-13

SESSION: Practice

ASSESOR(S):

PROF D.T. VAN DER HAAR
MR R. MALULEKA

DURATION: 37 MINUTES

MARKS: 31

Please read the following instructions carefully:

1. Answer **all** the questions
2. Write *cleanly* and *legibly*.
3. You may use a non-programmable calculator to answer the questions.
4. This paper consists of 6 pages.

QUESTION 1

(a) Consider the following (2,4) tree provided below. Draw the (2,4) tree state after each of the following operations. If the tree is rebalanced draw the state before and after it being balanced. (15)

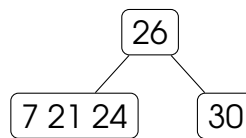
1. Insert nodes that contain the following keys: (inserted one-by-one, in the given order)

49, 43, 6, 35, 1, 32

2. Delete nodes that contain the following keys: (removed one-by-one, in the given order)

35, 26, 7, 30, 32

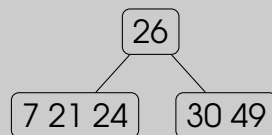
The 2-4 tree is in the current state (leaf nodes are not shown, however they are assumed to exist):

**Solution:**

Insert Sequence = (49, 43, 6, 35, 1, 32)

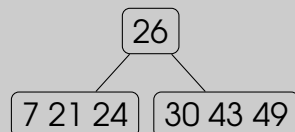
Insert 49

(1 mark):



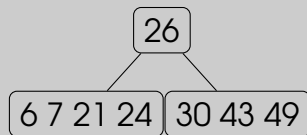
Insert 43

(1 mark):

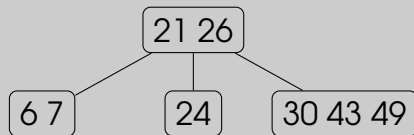


Insert 6

(1 mark):

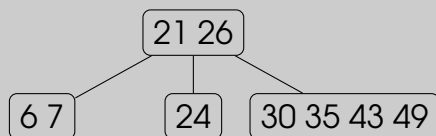


<<Rebalancing>> (2 marks):

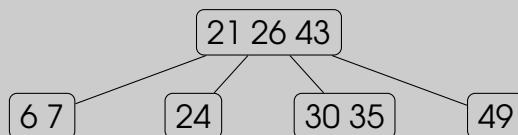


Insert 35

(1 mark):

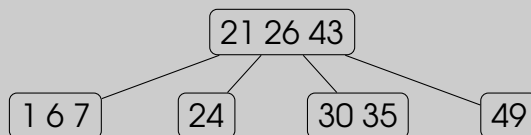


<<Rebalancing>> (2 marks):



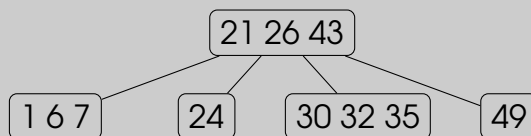
Insert 1

(1 mark):



Insert 32

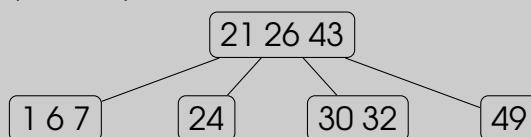
(1 mark):



Delete Sequence = (35, 26, 7, 30, 32)

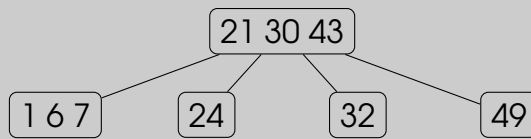
Remove 35

(1 mark):



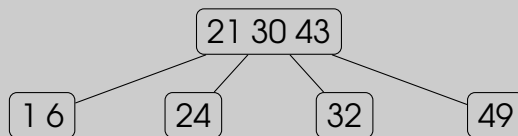
Remove 26

(1 mark):



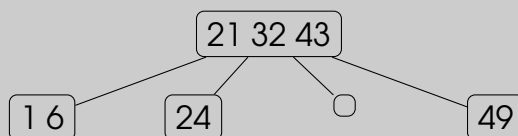
Remove 7

(1 mark):

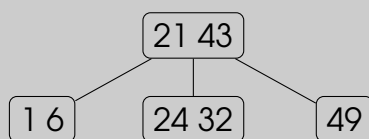


Remove 30

(1 mark):

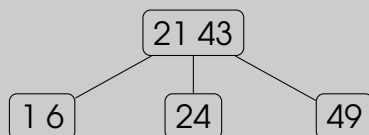


<<Rebalancing>>:



Remove 32

(1 mark):



Total: 15 marks

(b) Consider the following (2,4) tree provided below. Draw the (2,4) tree state after each of the following operations. If the tree is rebalanced draw the state before and after it being balanced. (16)

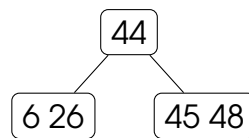
1. Insert nodes that contain the following keys: (inserted one-by-one, in the given order)

40, 16, 9, 4, 1, 33, 25

2. Delete nodes that contain the following keys: (removed one-by-one, in the given order)

9, 16, 33, 6, 26

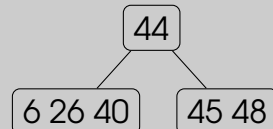
The 2-4 tree is in the current state (leaf nodes are not shown, however they are assumed to exist):

**Solution:**

Insert Sequence = (40, 16, 9, 4, 1, 33, 25)

Insert 40

(1 mark):

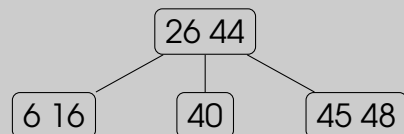


Insert 16

(1 mark):

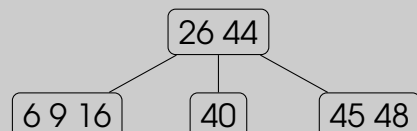


<<Rebalancing>> (2 marks):



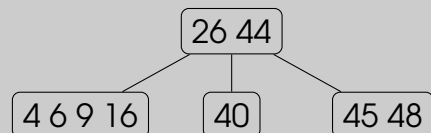
Insert 9

(1 mark):

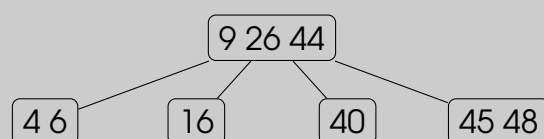


Insert 4

(1 mark):

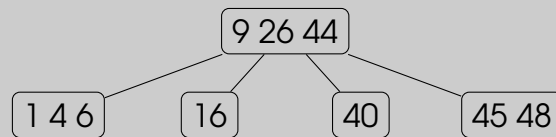


<<Rebalancing>> (2 marks):



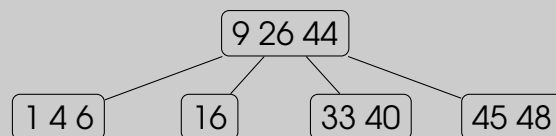
Insert 1

(1 mark):



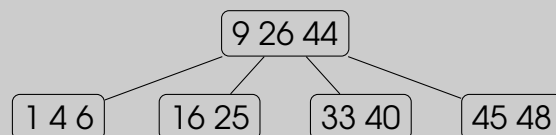
Insert 33

(1 mark):



Insert 25

(1 mark):



Delete Sequence = (9, 16, 33, 6, 26)

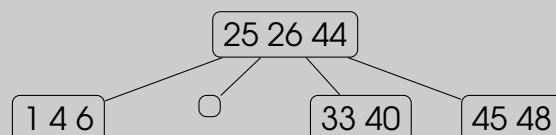
Remove 9

(1 mark):



Remove 16

(1 mark):

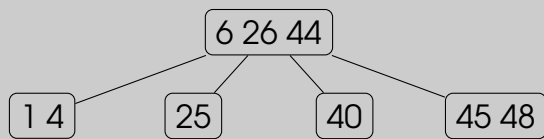


<<Rebalancing - transfer>>:



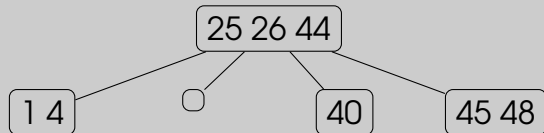
Remove 33

(1 mark):

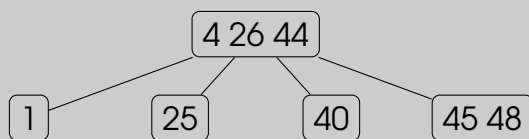


Remove 6

(1 mark):

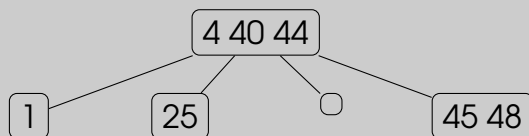


<<Rebalancing - transfer>>:

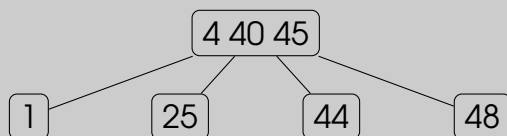


Remove 26

(1 mark):



<<Rebalancing - transfer>>:



Total: 16 marks

Total: 31

— End of paper —