
HO CHI MINH UNIVERSITY OF SCIENCE
FACULTY OF INFORMATION TECHNOLOGY
SOFTWARE ENGINEERING DEPARTMENT
ADVANCED PROGRAM IN COMPUTER SCIENCE
COURSE: **DATA STRUCTURE**
LECTURER: Dr. ĐINH BÁ TIẾN

**WEEK 04**

# 2-3 TREE & 2-3-4 TREE

- TRƯƠNG PHƯỚC LỘC
- HỒ TUẤN THANH

HCMC, 2016

# TABLE OF CONTENTS

# 1 Paper assignments

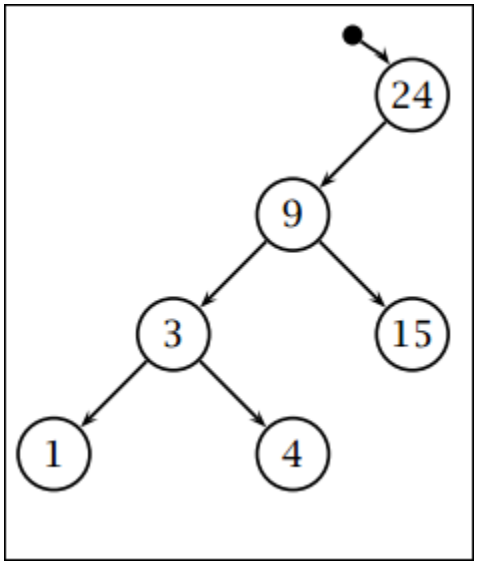
*As its title, you should complete these exercises on papers.*

*Note that you have to write your id and your fullname at the left-top corners of papers and the page numbers at the right-bottom corners of papers.*

1. Draw the BST the result when you insert items with keys.

   E A S Y Q U E S T I O N

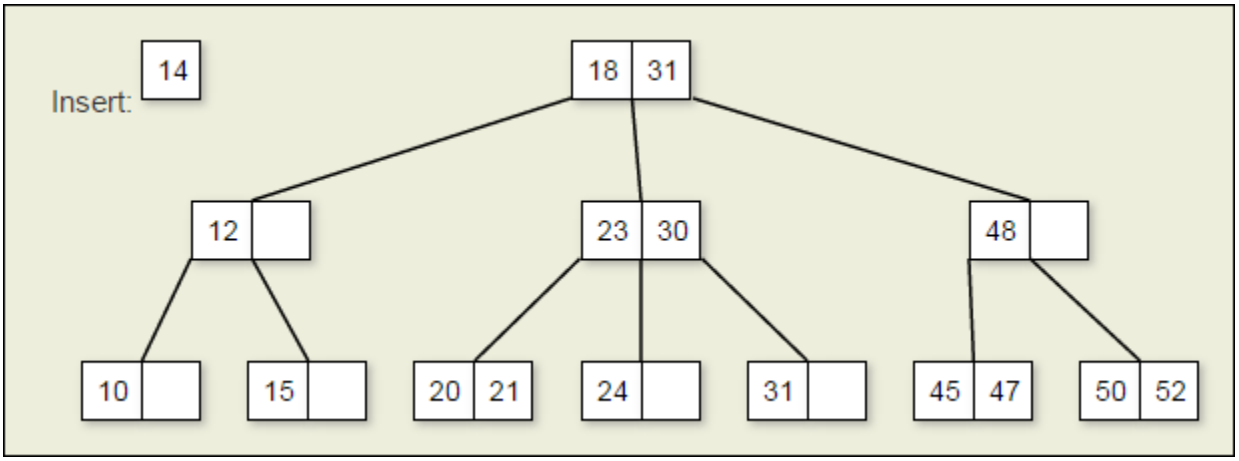
2. Suppose we have integer values between 1 and 1000 in a BST and we want to search for 363. Which of the following can not be the sequence of keys examined. Why?
   a. 2 252 401 398 330 363
   b. 399 387 219 266 382 381 278 363
   c. 3 923 220 911 244 898 258 362 363
   d. 4 924 278 347 621 299 392 358 363
   e. 5 925 202 910 245 363
3. Consider the following BST.



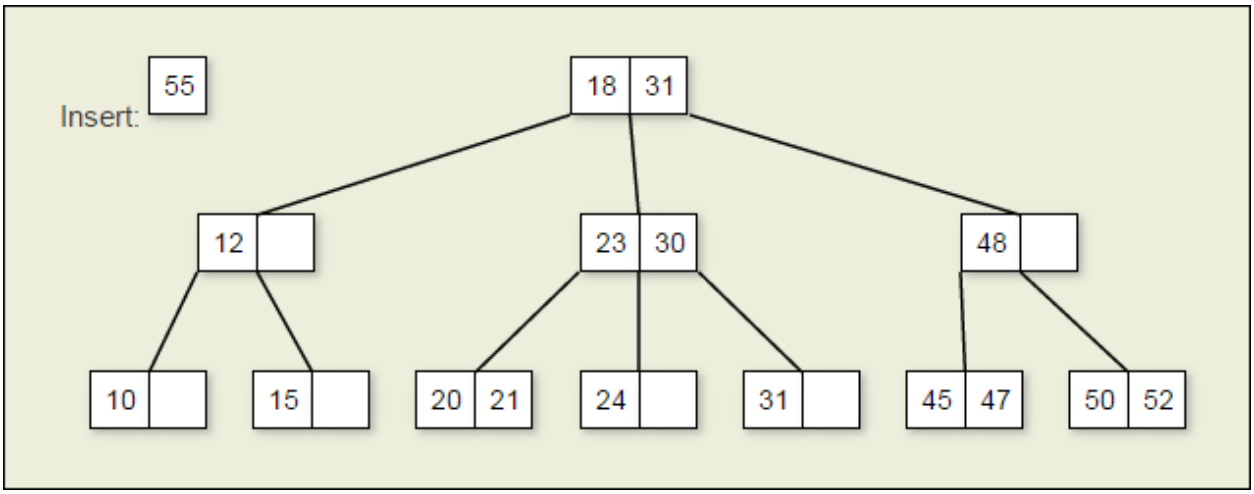

   a. List all possible insertion orders of the keys that could have produced this BST.
   b. Draw the same BST after the insertion of keys: 6, 45, 32, 98, 55, and 69, in this order.
   c. Draw the BST resulting from the deletion of keys 9 and 45 from the BST resulting from question 5b.

d. Write an insertion order of the keys remaining in the BST after question 5c that would produce a balanced tree (i.e., a minimum-height tree).

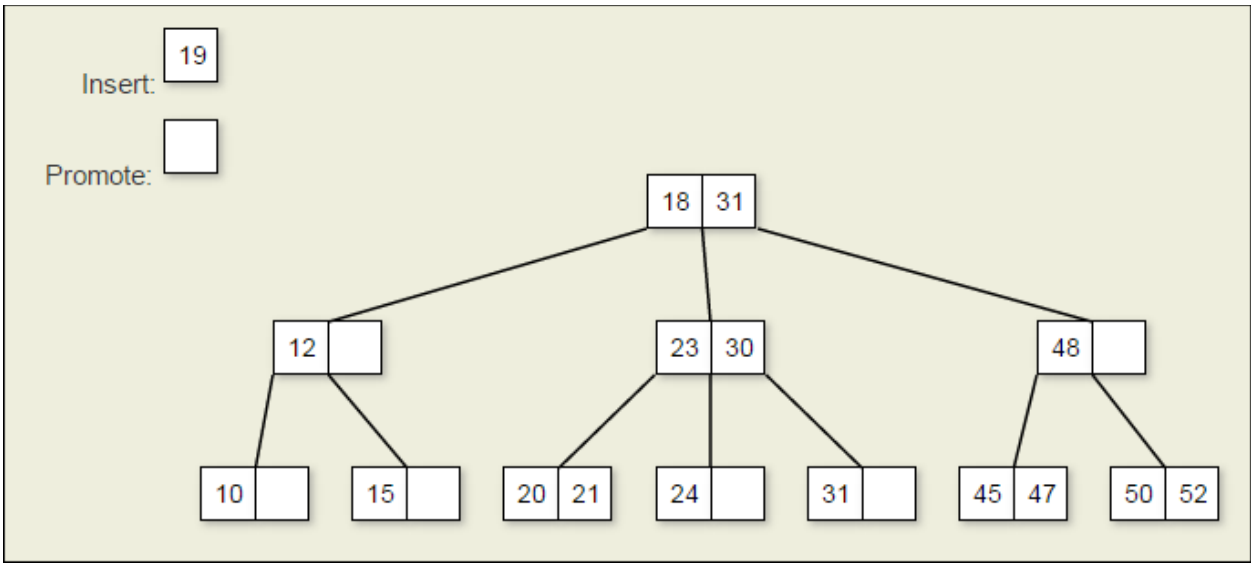
4. Insert 14 into the following 2-3 tree




5. Insert 55 into the following 2-3 tree




6. Insert 19 into the following 2-3 tree




7. Insert 10, 30, 60, 20, 50, 40, 70, 80, 15, 90, 100 into
    a. A 2-3 tree
    b. A 2-3-4 tree

## 2 Coding assignments

Write a program with the following features:

1. Init a 2-3 tree of integer numbers.
2. Input a list of integer numbers and create a 2-3 tree to store them.
3. Output the tree (in-order)
4. Find the width of the tree. The width is equal to the maximum number of nodes in a level.
5. Find the min value of the tree.
6. Find the max value of the tree.
7. Find the height of the tree.