Tutorial 12 & 13 Trees

1. Given a binary tree of size 76, what is the minimum number of levels it can contain? What is the maximum number of levels?

[**NOTE**: Size of a binary tree is the number of nodes in the tree.]

Minimum:

7 levels

Maximum:

7 levels (if there is one node per level)

1. What is the maximum number of nodes possible in a binary tree with 5 levels?

2^5-1 = 31

31 nodes

1. Given the following binary trees:

Chart, line chart

Description automatically generated

*(Content from Reference Text: Data Structures & Algorithms using Python. Rance D. Necaise, Wiley, 1st Edition, 2011)*

* 1. Indicate all the structure properties that apply to each tree: **full**, **perfect** and

**complete**.

a) Full binary tree

b) Perfect binary tree

c) binary tree

d) binary tree

e) binary tree

* 1. Determine the **size** of each tree.

[**NOTE**: Size of a binary tree is the number of nodes in the tree.]

a) 7

b) 15

c) 14

d) 7

e) 11

Determine the **height** of each tree.

[**NOTE**: Height of a binary tree is the maximum **depth** of any node in the tree.]

a) 3

b) 3

c) 7

d) 3

e) 3

* 1. Determine the **width** of each tree.

[**NOTE**: Width of a binary tree is the number of nodes on the level containing the most nodes.]

a) 2

b) 8

c) 2

d) 3

e)

Consider the following binary tree:

Shape

Description automatically generated

*(Content from Reference Text: Data Structures & Algorithms using Python. Rance D. Necaise, Wiley, 1st Edition, 2011)*

* 1. Show the order that the nodes will be visited in the following tree traversal methods:
     1. Pre-order traversal

14, 78, 39, 52, 83, 17, 9, 41, 2, 60, 23, 4, 19

* + 1. In-order traversal

39, 78, 17, 83, 9, 52, 41, 14, 60, 2, 4, 23, 19

* + 1. Post-order traversal

39, 17, 2, 39, 52, 60, 23, 83, 41, 4, 19, 17, 9

* + 1. Breadth-first traversal  
       14, 78, 2, 39, 52, 60, 23, 83, 41, 4, 19, 17, 9
  1. Identify all of the leaf nodes.

39, 17, 9, 41, 60, 19

* 1. Identify all of the interior nodes.

14, 78, 52, 83, 2, 23

* 1. List all of the nodes on level 4.

17, 9

* 1. List all of the nodes in the path to each of the following nodes:
     1. 83

14, 78, 52, 83

* + 1. 39

14,78,39

* + 1. 4

14, 2, 23, 4

* + 1. 9

14, 78, 52, 83, 9

* 1. Consider node 52 and list the node’s:
     1. Descendants

83 17 9 41

* + 1. Ancestors

14 78

* + 1. Siblings

39

* 1. Identify the depth of each of the following nodes:
     1. 78
     2. 41
     3. 60
     4. 19

1. A binary search tree is created when the numbers are inserted in the following order:

30, 63, 2, 89, 16, 24, 19, 52, 27, 9, 4, 45

Draw the binary search tree.

Diagram

Description automatically generated

***-- End of Tutorial --***