# Graph Theory

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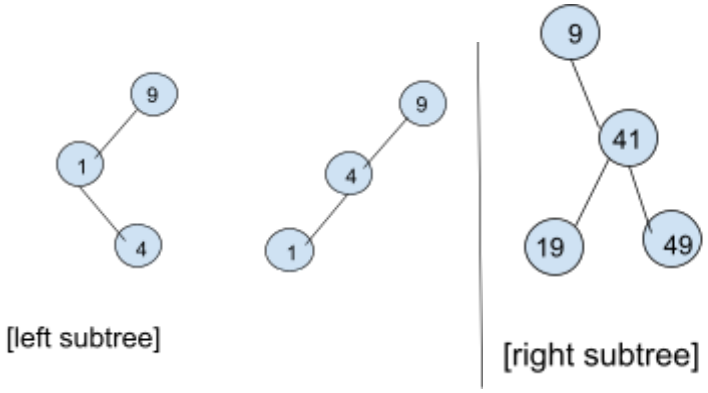
## Exercise 3.4.12 of [GYA]

How many different insertion sequences of the keys 1,4,9,19,41,49 are there that result in a balanced search tree?

Firstly, the definition of a balanced search tree is “for every vertex, the number of vertices in its left and right subtrees differ by at most one.”
Given this definition, the root should be 9 or 19. If this is the case, then the remaining 5 keys can be split evenly in the tree (3:2 or 2:3).

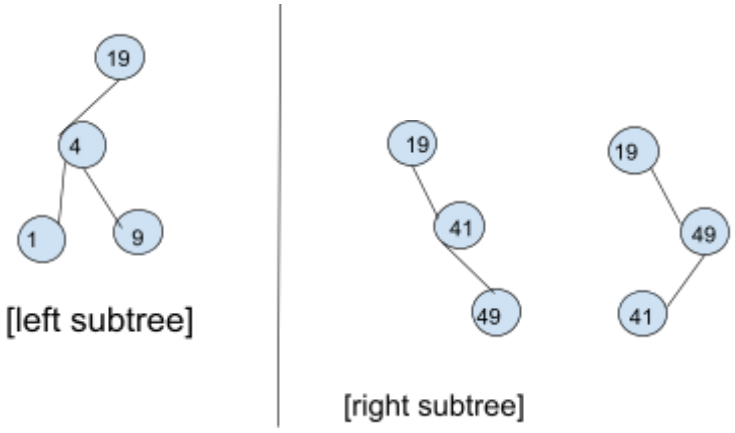
i) root = 9
The keys of the left subtree: 1, 4  2! = 2 ways
The keys of the right subtree: 19, 41, 49
one tree, two insertion sequences (41, 19, 49 and 41, 49, 19)

2 × 2= 4 ways




ii) root = 19
The keys of the left subtree: 1, 4, 9
one tree, two insertion sequences (1, 4, 9 and 1, 9, 4)
The keys of the right subtree: 41, 49  2! = 2 ways

2 × 2 = 4 ways



i) + ii) = 4 + 4 = 8

A. 8 ways

Example. [9, 1, 41, 4, 19, 49]