

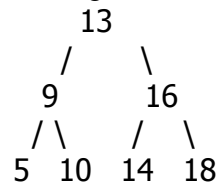
Top-20 Training Program (Tree Problems)

Apply the problem solving techniques discussed in class to solve the following problems.

Problem1: Floor & Ceil

Find an efficient algorithm to compute the floor and ceil of given element in a BST. Floor(x) refers to maximum element that is smaller than x. Ceil(x) refers to minimum element that is higher than x.

Input:



Output: Floor(17): 16 Ceil(17): 18
 Floor(10): 10 Ceil(10): 10

Problem2: All Dictionary-only Permutations

Given a String and Dictionary, write an efficient function to find all the permutations of string that are valid in given dictionary.

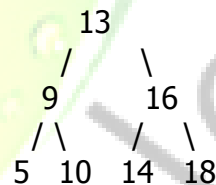
Function prototype:

```
void DisplayAllValidPermutations(String s, String dictionary)
//dictionary contains name of file that contains dictionary words
```

Problem3: BST to LIST

Find an efficient algorithm to convert Binary Search Tree into Circular Ordered Doubly linked list.

Input:



Output: 5 <-> 9 <-> 10 <-> 13 <-> 14 <-> 16 <-> 18

Problem4: IP Lookup by Country

Find an efficient algorithm to determine what country a given IP address is coming from. An ip-to-country.csv data file is given as input and available under assignments folder of algorithmica github repository. The data file has four fields (beginning of IP address range, ending of IP address range, two character country code, and country name). Assume that

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the IP addresses are non-overlapping. This requirement arises in applications like credit card fraud detection, spam filtering, auto-selection of language on a web site, and web server log analysis.

