# Problem 988: Smallest String Starting From Leaf

## Problem Information

**Difficulty:** Medium
**Acceptance Rate:** 0.00%
**Paid Only:** No

## Problem Description

You are given the

root

of a binary tree where each node has a value in the range

[0, 25]

representing the letters

'a'

to

'z'

.

Return

the

lexicographically smallest

string that starts at a leaf of this tree and ends at the root

.

As a reminder, any shorter prefix of a string is

lexicographically smaller

.

For example,

"ab"

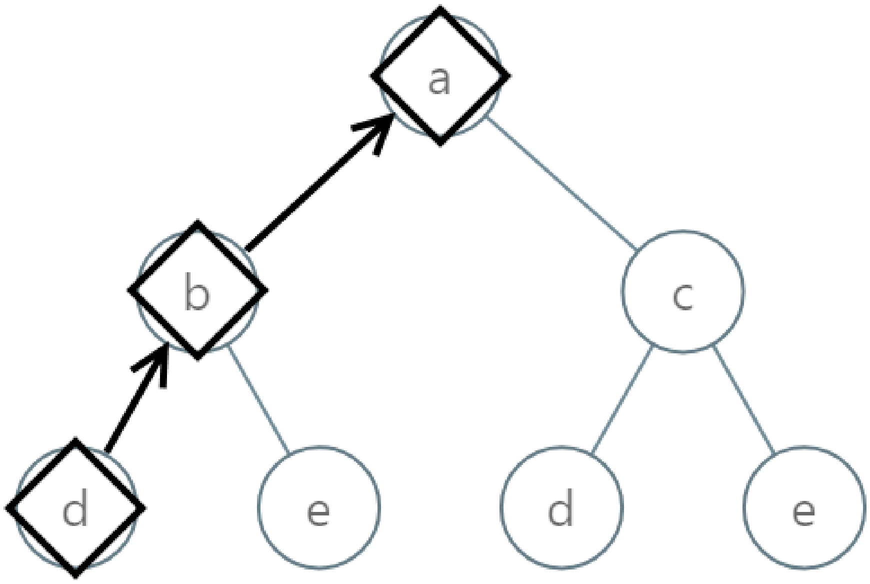
is lexicographically smaller than

"aba"

.

A leaf of a node is a node that has no children.

Example 1:



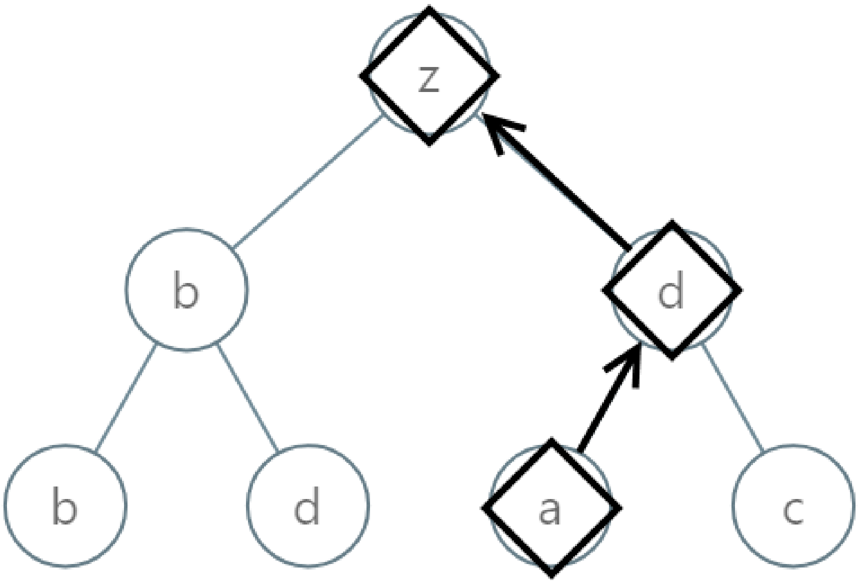
Input:

root = [0,1,2,3,4,3,4]

Output:

"dba"

Example 2:



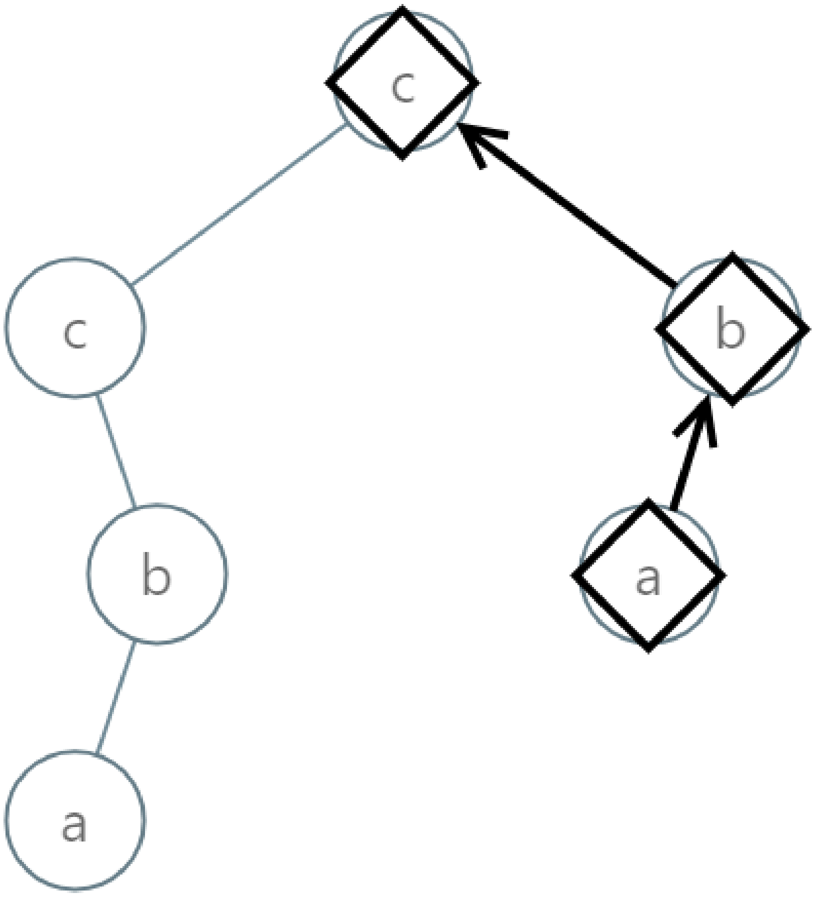
Input:

root = [25,1,3,1,3,0,2]

Output:

"adz"

Example 3:



Input:

root = [2,2,1,null,1,0,null,0]

Output:

"abc"

Constraints:

The number of nodes in the tree is in the range

[1, 8500]

.

0 <= Node.val <= 25

## Code Snippets

### C++:

```
/**
* Definition for a binary tree node.
* struct TreeNode {
* int val;
* TreeNode *left;
* TreeNode *right;
* TreeNode() : val(0), left(nullptr), right(nullptr) {}
* TreeNode(int x) : val(x), left(nullptr), right(nullptr) {}
* TreeNode(int x, TreeNode *left, TreeNode *right) : val(x), left(left),
right(right) {}
* };
*/
class Solution {
public:
string smallestFromLeaf(TreeNode* root) {

}
};
```

### Java:

```
/**
* Definition for a binary tree node.
* public class TreeNode {
* int val;
* TreeNode left;
* TreeNode right;
* TreeNode() {}
* TreeNode(int val) { this.val = val; }
* TreeNode(int val, TreeNode left, TreeNode right) {
* this.val = val;
* this.left = left;
* this.right = right;
* }
* }
*/
class Solution {
```

```
public String smallestFromLeaf(TreeNode root) {

}
}
```

**Python3:**

```
# Definition for a binary tree node.
# class TreeNode:
# def __init__(self, val=0, left=None, right=None):
# self.val = val
# self.left = left
# self.right = right
class Solution:
def smallestFromLeaf(self, root: Optional[TreeNode]) -> str:
```

**Python:**

```
# Definition for a binary tree node.
# class TreeNode(object):
# def __init__(self, val=0, left=None, right=None):
# self.val = val
# self.left = left
# self.right = right
class Solution(object):
def smallestFromLeaf(self, root):
"""
:type root: Optional[TreeNode]
:rtype: str
"""
```

**JavaScript:**

```
/**
* Definition for a binary tree node.
* function TreeNode(val, left, right) {
* this.val = (val===undefined ? 0 : val)
* this.left = (left===undefined ? null : left)
* this.right = (right===undefined ? null : right)
* }
*/
/**
```

```
* @param {TreeNode} root
* @return {string}
*/
var smallestFromLeaf = function(root) {

};
```

**TypeScript:**

```
/**
* Definition for a binary tree node.
* class TreeNode {
* val: number
* left: TreeNode | null
* right: TreeNode | null
* constructor(val?: number, left?: TreeNode | null, right?: TreeNode | null)
{
* this.val = (val===undefined ? 0 : val)
* this.left = (left===undefined ? null : left)
* this.right = (right===undefined ? null : right)
* }
* }
*/

function smallestFromLeaf(root: TreeNode | null): string {

};
```

**C#:**

```
/**
* Definition for a binary tree node.
* public class TreeNode {
* public int val;
* public TreeNode left;
* public TreeNode right;
* public TreeNode(int val=0, TreeNode left=null, TreeNode right=null) {
* this.val = val;
* this.left = left;
* this.right = right;
* }
* }
```

```
*/
public class Solution {
public string SmallestFromLeaf(TreeNode root) {

}
}
```

## C:

```
/**
* Definition for a binary tree node.
* struct TreeNode {
* int val;
* struct TreeNode *left;
* struct TreeNode *right;
* };
*/
char* smallestFromLeaf(struct TreeNode* root) {

}
```

## Go:

```
/**
* Definition for a binary tree node.
* type TreeNode struct {
* Val int
* Left *TreeNode
* Right *TreeNode
* }
*/
func smallestFromLeaf(root *TreeNode) string {

}
```

## Kotlin:

```
/**
* Example:
* var ti = TreeNode(5)
* var v = ti.`val`
* Definition for a binary tree node.
* class TreeNode(var `val`: Int) {
* var left: TreeNode? = null
* var right: TreeNode? = null
* }
*/
class Solution {
fun smallestFromLeaf(root: TreeNode?): String {

}
}
```

### Swift:

```
/**
* Definition for a binary tree node.
* public class TreeNode {
* public var val: Int
* public var left: TreeNode?
* public var right: TreeNode?
* public init() { self.val = 0; self.left = nil; self.right = nil; }
* public init(_ val: Int) { self.val = val; self.left = nil; self.right =
nil; }
* public init(_ val: Int, _ left: TreeNode?, _ right: TreeNode?) {
* self.val = val
* self.left = left
* self.right = right
* }
* }
*/
class Solution {
func smallestFromLeaf(_ root: TreeNode?) -> String {

}
}
```

### Rust:

```
// Definition for a binary tree node.
// #[derive(Debug, PartialEq, Eq)]
// pub struct TreeNode {
// pub val: i32,
// pub left: Option<Rc<RefCell<TreeNode>>>,
// pub right: Option<Rc<RefCell<TreeNode>>>,
// }
//
// impl TreeNode {
// #[inline]
// pub fn new(val: i32) -> Self {
// TreeNode {
// val,
// left: None,
// right: None
// }
// }
// }
use std::rc::Rc;
use std::cell::RefCell;
impl Solution {
pub fn smallest_from_leaf(root: Option<Rc<RefCell<TreeNode>>>) -> String {

}
}
```

### Ruby:

```
# Definition for a binary tree node.
# class TreeNode
# attr_accessor :val, :left, :right
# def initialize(val = 0, left = nil, right = nil)
# @val = val
# @left = left
# @right = right
# end
# end
# @param {TreeNode} root
# @return {String}
def smallest_from_leaf(root)

end
```

### PHP:

```
/**
* Definition for a binary tree node.
* class TreeNode {
* public $val = null;
* public $left = null;
* public $right = null;
* function __construct($val = 0, $left = null, $right = null) {
* $this->val = $val;
* $this->left = $left;
* $this->right = $right;
* }
* }
*/
class Solution {

/**
* @param TreeNode $root
* @return String
*/
function smallestFromLeaf($root) {

}
}
```

### Dart:

```
/**
* Definition for a binary tree node.
* class TreeNode {
* int val;
* TreeNode? left;
* TreeNode? right;
* TreeNode([this.val = 0, this.left, this.right]);
* }
*/
class Solution {
String smallestFromLeaf(TreeNode? root) {

}
}
```

### Scala:

```
/**
* Definition for a binary tree node.
* class TreeNode(_value: Int = 0, _left: TreeNode = null, _right: TreeNode =
null) {
* var value: Int = _value
* var left: TreeNode = _left
* var right: TreeNode = _right
* }
*/
object Solution {
def smallestFromLeaf(root: TreeNode): String = {

}
}
```

### Elixir:

```
# Definition for a binary tree node.
#
# defmodule TreeNode do
# @type t :: %__MODULE__{
# val: integer,
# left: TreeNode.t() | nil,
# right: TreeNode.t() | nil
# }
# defstruct val: 0, left: nil, right: nil
# end

defmodule Solution do
@spec smallest_from_leaf(root :: TreeNode.t | nil) :: String.t
def smallest_from_leaf(root) do

end
end
```

### Erlang:

```
%% Definition for a binary tree node.
%%
%% -record(tree_node, {val = 0 :: integer(),
%% left = null :: 'null' | #tree_node{},
%% right = null :: 'null' | #tree_node{}}).
```

```
-spec smallest_from_leaf(Root :: #tree_node{} | null) ->
unicode:unicode_binary().
smallest_from_leaf(Root) ->
.
```

### Racket:

```
; Definition for a binary tree node.
#|

; val : integer?
; left : (or/c tree-node? #f)
; right : (or/c tree-node? #f)
(struct tree-node
(val left right) #:mutable #:transparent)

; constructor
(define (make-tree-node [val 0])
(tree-node val #f #f))

|#

(define/contract (smallest-from-leaf root)
(-> (or/c tree-node? #f) string?)
)
```

## Solutions

### C++ Solution:

```
/*
* Problem: Smallest String Starting From Leaf
* Difficulty: Medium
* Tags: string, tree, graph, search
*
* Approach: String manipulation with hash map or two pointers
* Time Complexity: O(n) or O(n log n)
* Space Complexity: O(h) for recursion stack where h is height
*/
```

```
/**
* Definition for a binary tree node.
* struct TreeNode {
* int val;
* TreeNode *left;
* TreeNode *right;
* TreeNode() : val(0), left(nullptr), right(nullptr) {
// TODO: Implement optimized solution
return 0;
}
* TreeNode(int x) : val(x), left(nullptr), right(nullptr) {
// TODO: Implement optimized solution
return 0;
}
* TreeNode(int x, TreeNode *left, TreeNode *right) : val(x), left(left),
right(right) {
// TODO: Implement optimized solution
return 0;
}
* };
*/
class Solution {
public:
string smallestFromLeaf(TreeNode* root) {

}
};
```

### Java Solution:

```
/**
* Problem: Smallest String Starting From Leaf
* Difficulty: Medium
* Tags: string, tree, graph, search
*
* Approach: String manipulation with hash map or two pointers
* Time Complexity: O(n) or O(n log n)
* Space Complexity: O(h) for recursion stack where h is height
*/

/**
```

```
* Definition for a binary tree node.
* public class TreeNode {
* int val;
* TreeNode left;
* TreeNode right;
* TreeNode() {
// TODO: Implement optimized solution
return 0;
}
* TreeNode(int val) { this.val = val; }
* TreeNode(int val, TreeNode left, TreeNode right) {
* this.val = val;
* this.left = left;
* this.right = right;
* }
* }
*/
class Solution {
public String smallestFromLeaf(TreeNode root) {

}
}
```

### Python3 Solution:

```
"""
Problem: Smallest String Starting From Leaf
Difficulty: Medium
Tags: string, tree, graph, search

Approach: String manipulation with hash map or two pointers
Time Complexity: O(n) or O(n log n)
Space Complexity: O(h) for recursion stack where h is height
"""

# Definition for a binary tree node.
# class TreeNode:
# def __init__(self, val=0, left=None, right=None):
# self.val = val
# self.left = left
# self.right = right
```

```
class Solution:
def smallestFromLeaf(self, root: Optional[TreeNode]) -> str:
# TODO: Implement optimized solution
pass
```

### Python Solution:

```
# Definition for a binary tree node.
# class TreeNode(object):
# def __init__(self, val=0, left=None, right=None):
# self.val = val
# self.left = left
# self.right = right
class Solution(object):
def smallestFromLeaf(self, root):
"""
:type root: Optional[TreeNode]
:rtype: str
"""
```

### JavaScript Solution:

```
/**
* Problem: Smallest String Starting From Leaf
* Difficulty: Medium
* Tags: string, tree, graph, search
*
* Approach: String manipulation with hash map or two pointers
* Time Complexity: O(n) or O(n log n)
* Space Complexity: O(h) for recursion stack where h is height
*/

/**
* Definition for a binary tree node.
* function TreeNode(val, left, right) {
* this.val = (val===undefined ? 0 : val)
* this.left = (left===undefined ? null : left)
* this.right = (right===undefined ? null : right)
* }
*/
/**
```

```
* @param {TreeNode} root
* @return {string}
*/
var smallestFromLeaf = function(root) {

};
```

### TypeScript Solution:

```
/**
* Problem: Smallest String Starting From Leaf
* Difficulty: Medium
* Tags: string, tree, graph, search
*
* Approach: String manipulation with hash map or two pointers
* Time Complexity: O(n) or O(n log n)
* Space Complexity: O(h) for recursion stack where h is height
*/

/**
* Definition for a binary tree node.
* class TreeNode {
* val: number
* left: TreeNode | null
* right: TreeNode | null
* constructor(val?: number, left?: TreeNode | null, right?: TreeNode | null)
{
* this.val = (val===undefined ? 0 : val)
* this.left = (left===undefined ? null : left)
* this.right = (right===undefined ? null : right)
* }
* }
*/

function smallestFromLeaf(root: TreeNode | null): string {

};
```

### C# Solution:

```
/*
* Problem: Smallest String Starting From Leaf
* Difficulty: Medium
* Tags: string, tree, graph, search
*
* Approach: String manipulation with hash map or two pointers
* Time Complexity: O(n) or O(n log n)
* Space Complexity: O(h) for recursion stack where h is height
*/

/**
* Definition for a binary tree node.
* public class TreeNode {
* public int val;
* public TreeNode left;
* public TreeNode right;
* public TreeNode(int val=0, TreeNode left=null, TreeNode right=null) {
* this.val = val;
* this.left = left;
* this.right = right;
* }
* }
*/
public class Solution {
public string SmallestFromLeaf(TreeNode root) {

}
}
```

### C Solution:

```
/*
* Problem: Smallest String Starting From Leaf
* Difficulty: Medium
* Tags: string, tree, graph, search
*
* Approach: String manipulation with hash map or two pointers
* Time Complexity: O(n) or O(n log n)
* Space Complexity: O(h) for recursion stack where h is height
*/

/**
```

```
* Definition for a binary tree node.
* struct TreeNode {
* int val;
* struct TreeNode *left;
* struct TreeNode *right;
* };
*/
char* smallestFromLeaf(struct TreeNode* root) {

}
```

### Go Solution:

```
// Problem: Smallest String Starting From Leaf
// Difficulty: Medium
// Tags: string, tree, graph, search
//
// Approach: String manipulation with hash map or two pointers
// Time Complexity: O(n) or O(n log n)
// Space Complexity: O(h) for recursion stack where h is height

/**
* Definition for a binary tree node.
* type TreeNode struct {
* Val int
* Left *TreeNode
* Right *TreeNode
* }
*/
func smallestFromLeaf(root *TreeNode) string {

}
```

### Kotlin Solution:

```
/**
* Example:
* var ti = TreeNode(5)
* var v = ti.`val`
* Definition for a binary tree node.
* class TreeNode(var `val`: Int) {
```

```
* var left: TreeNode? = null
* var right: TreeNode? = null
* }
*/
class Solution {
fun smallestFromLeaf(root: TreeNode?): String {

}
}
```

### Swift Solution:

```
/**
* Definition for a binary tree node.
* public class TreeNode {
* public var val: Int
* public var left: TreeNode?
* public var right: TreeNode?
* public init() { self.val = 0; self.left = nil; self.right = nil; }
* public init(_ val: Int) { self.val = val; self.left = nil; self.right =
nil; }
* public init(_ val: Int, _ left: TreeNode?, _ right: TreeNode?) {
* self.val = val
* self.left = left
* self.right = right
* }
* }
*/
class Solution {
func smallestFromLeaf(_ root: TreeNode?) -> String {

}
}
```

### Rust Solution:

```
// Problem: Smallest String Starting From Leaf
// Difficulty: Medium
// Tags: string, tree, graph, search
//
// Approach: String manipulation with hash map or two pointers
// Time Complexity: O(n) or O(n log n)
// Space Complexity: O(h) for recursion stack where h is height

// Definition for a binary tree node.
// #[derive(Debug, PartialEq, Eq)]
// pub struct TreeNode {
// pub val: i32,
// pub left: Option<Rc<RefCell<TreeNode>>>,
// pub right: Option<Rc<RefCell<TreeNode>>>,
// }
//
// impl TreeNode {
// #[inline]
// pub fn new(val: i32) -> Self {
// TreeNode {
// val,
// left: None,
// right: None
// }
// }
// }
use std::rc::Rc;
use std::cell::RefCell;
impl Solution {
pub fn smallest_from_leaf(root: Option<Rc<RefCell<TreeNode>>>) -> String {

}
}
```

### Ruby Solution:

```
# Definition for a binary tree node.
# class TreeNode
# attr_accessor :val, :left, :right
# def initialize(val = 0, left = nil, right = nil)
# @val = val
# @left = left
# @right = right
# end
# end
# @param {TreeNode} root
# @return {String}
def smallest_from_leaf(root)

end
```

## PHP Solution:

```
/**
* Definition for a binary tree node.
* class TreeNode {
* public $val = null;
* public $left = null;
* public $right = null;
* function __construct($val = 0, $left = null, $right = null) {
* $this->val = $val;
* $this->left = $left;
* $this->right = $right;
* }
* }
*/
class Solution {

/**
* @param TreeNode $root
* @return String
*/
function smallestFromLeaf($root) {

}
}
```

## Dart Solution:

```
/**
* Definition for a binary tree node.
* class TreeNode {
* int val;
* TreeNode? left;
* TreeNode? right;
* TreeNode([this.val = 0, this.left, this.right]);
* }
```

```
*/
class Solution {
String smallestFromLeaf(TreeNode? root) {

}
}
```

### Scala Solution:

```
/**
* Definition for a binary tree node.
* class TreeNode(_value: Int = 0, _left: TreeNode = null, _right: TreeNode =
null) {
* var value: Int = _value
* var left: TreeNode = _left
* var right: TreeNode = _right
* }
*/
object Solution {
def smallestFromLeaf(root: TreeNode): String = {

}
}
```

### Elixir Solution:

```
# Definition for a binary tree node.
#
# defmodule TreeNode do
# @type t :: %__MODULE__{
# val: integer,
# left: TreeNode.t() | nil,
# right: TreeNode.t() | nil
# }
# defstruct val: 0, left: nil, right: nil
# end

defmodule Solution do
@spec smallest_from_leaf(root :: TreeNode.t | nil) :: String.t
def smallest_from_leaf(root) do
```

```

end
end
```

### Erlang Solution:

```
%% Definition for a binary tree node.
%%
%% -record(tree_node, {val = 0 :: integer(),
%% left = null :: 'null' | #tree_node{},
%% right = null :: 'null' | #tree_node{}}).

-spec smallest_from_leaf(Root :: #tree_node{} | null) ->
unicode:unicode_binary().
smallest_from_leaf(Root) ->
.
```

### Racket Solution:

```
; Definition for a binary tree node.
#|

; val : integer?
; left : (or/c tree-node? #f)
; right : (or/c tree-node? #f)
(struct tree-node
(val left right) #:mutable #:transparent)

; constructor
(define (make-tree-node [val 0])
(tree-node val #f #f))

|#

(define/contract (smallest-from-leaf root)
(-> (or/c tree-node? #f) string?)
)
```