Assignment #5: "树"算：概念、表示、解析、遍历

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2024 spring, Complied by 刘思瑞 2100017810

说明：

1）The complete process to learn DSA from scratch can be broken into 4 parts:

Learn about Time complexities, learn the basics of individual Data Structures, learn the basics of Algorithms, and practice Problems.

2）请把每个题目解题思路（可选），源码Python, 或者C++（已经在Codeforces/Openjudge上AC），截图（包含Accepted），填写到下面作业模版中（推荐使用 typora https://typoraio.cn ，或者用word）。AC 或者没有AC，都请标上每个题目大致花费时间。

3）提交时候先提交pdf文件，再把md或者doc文件上传到右侧“作业评论”。Canvas需要有同学清晰头像、提交文件有pdf、"作业评论"区有上传的md或者doc附件。

4）如果不能在截止前提交作业，请写明原因。

编程环境

操作系统：macOS Ventura 13.4.1 (c)

Python编程环境：Spyder IDE 5.2.2, PyCharm 2023.1.4 (Professional Edition)

C/C++编程环境：Mac terminal vi (version 9.0.1424), g++/gcc (Apple clang version 14.0.3, clang-1403.0.22.14.1)

1. 题目

27638: 求二叉树的高度和叶子数目

http://cs101.openjudge.cn/practice/27638/

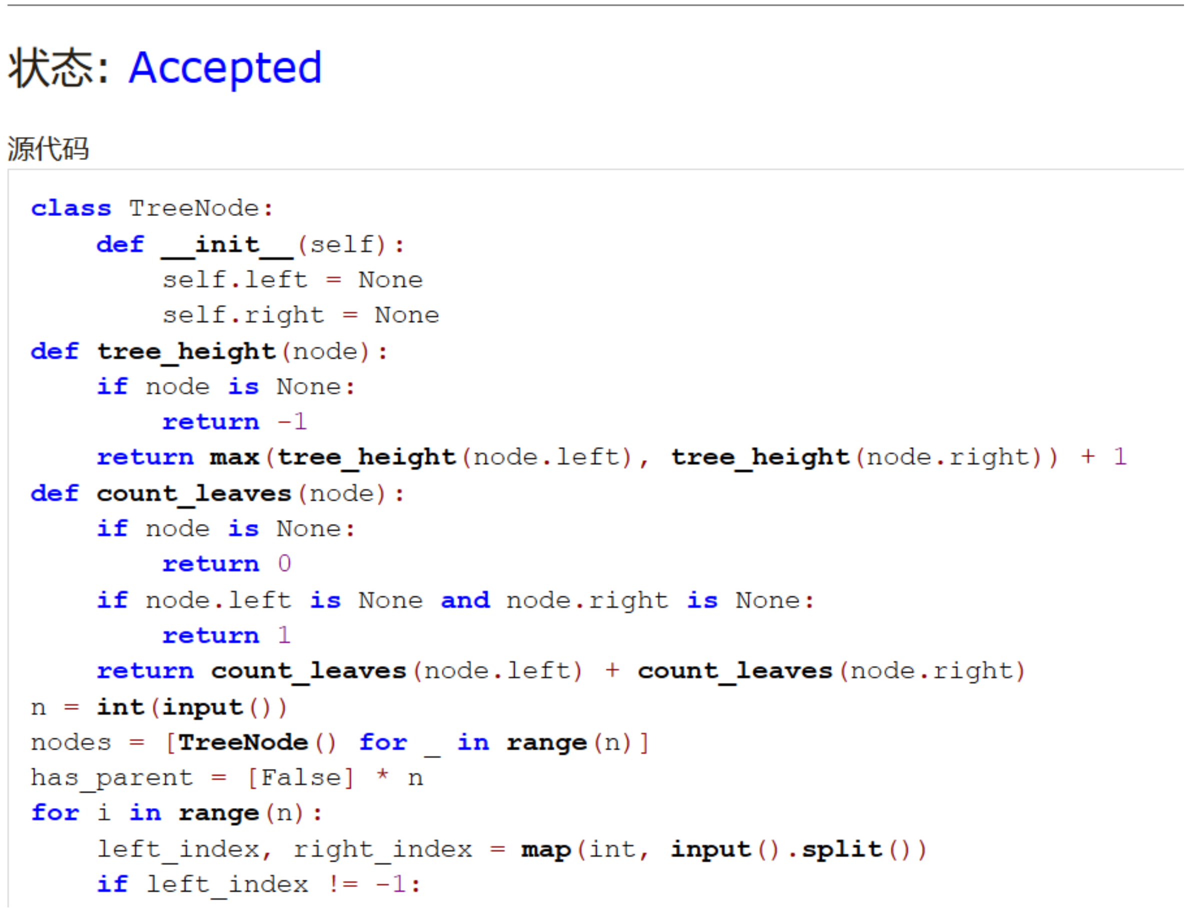
思路：

写一个类然后二叉树遍历

代码

```python
class TreeNode:
    def __init__(self):
        self.left = None
        self.right = None
def tree_height(node):
    if node is None:
        return -1
    return max(tree_height(node.left), tree_height(node.right)) + 1
def count_leaves(node):
    if node is None:
        return 0
    if node.left is None and node.right is None:
        return 1
    return count_leaves(node.left) + count_leaves(node.right)
n = int(input())
nodes = [TreeNode() for _ in range(n)]
has_parent = [False] * n
for i in range(n):
    left_index, right_index = map(int, input().split())
    if left_index != -1:
        nodes[i].left = nodes[left_index]
        has_parent[left_index] = True
    if right_index != -1:
        #print(right_index)
        nodes[i].right = nodes[right_index]
        has_parent[right_index] = True
root_index = has_parent.index(False)
root = nodes[root_index]
height = tree_height(root)
leaves = count_leaves(root)
print(f"{height} {leaves}")
```

代码运行截图



状态: Accepted

源代码

```python
class TreeNode:
    def __init__(self):
        self.left = None
        self.right = None
def tree_height(node):
    if node is None:
        return -1
    return max(tree_height(node.left), tree_height(node.right)) + 1
def count_leaves(node):
    if node is None:
        return 0
    if node.left is None and node.right is None:
        return 1
    return count_leaves(node.left) + count_leaves(node.right)
n = int(input())
nodes = [TreeNode() for _ in range(n)]
has_parent = [False] * n
for i in range(n):
    left_index, right_index = map(int, input().split())
    if left_index != -1:
```

24729: 括号嵌套树

http://cs101.openjudge.cn/practice/24729/

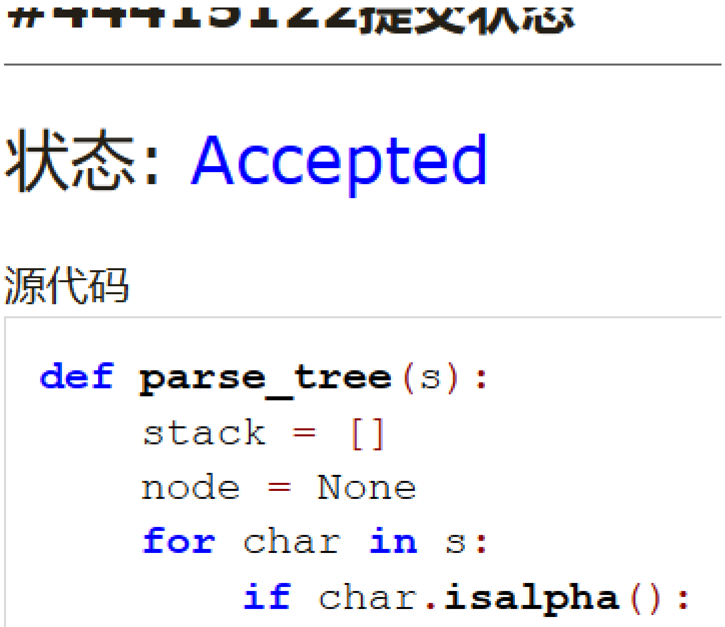
思路：

用括号判断进出栈

代码

```python
def parse_tree(s):
    stack = []
    node = None
    for char in s:
        if char.isalpha():
            node = TreeNode(char)
            if stack:
                stack[-1].children.append(node)
        elif char == '(':
            if node:
                stack.append(node)
                node = None
        elif char == ')':
            if stack:
                node = stack.pop()
    return node


def preorder(node):
    output = [node.value]
    for child in node.children:
        output.extend(preorder(child))
    return ''.join(output)

def postorder(node):
    output = []
    for child in node.children:
        output.extend(postorder(child))
    output.append(node.value)
    return ''.join(output)
def main():
    s = input().strip()
    s = ''.join(s.split())
    root = parse_tree(s)
    if root:
        print(preorder(root))
        print(postorder(root))
    else:
        print("input tree string error!")

if __name__ == "__main__":
    main()
```

代码运行截图



#44415122提交状态

状态: Accepted

源代码

```
def parse_tree(s):
    stack = []
    node = None
    for char in s:
        if char.isalpha():
```

02775: 文件结构“图”

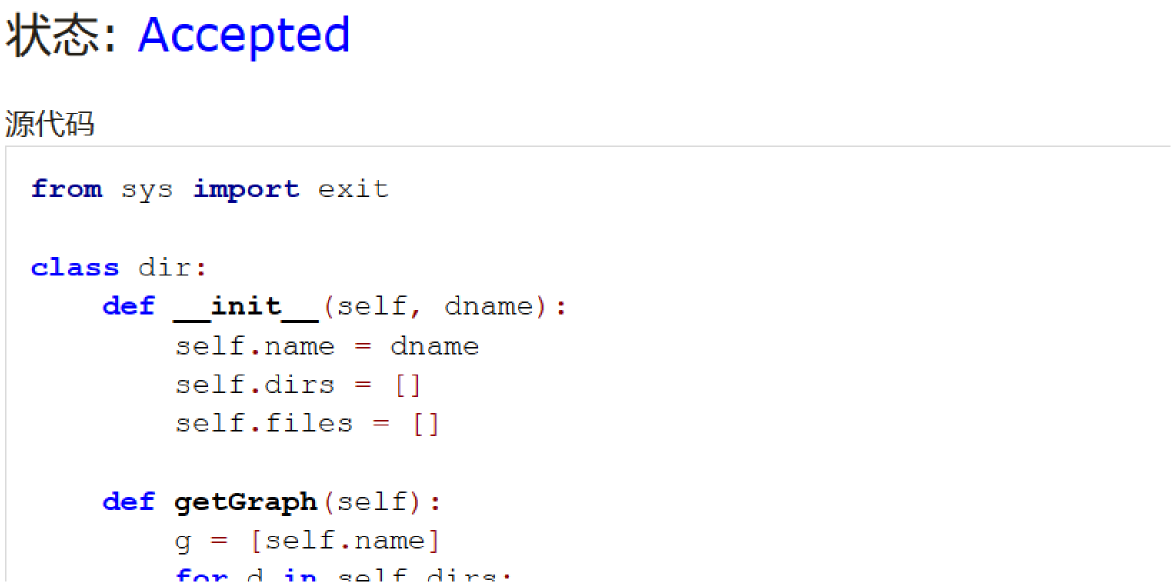
http://cs101.openjudge.cn/practice/02775/

思路：

代码

```python
from sys import exit

class dir:
    def __init__(self, dname):
        self.name = dname
        self.dirs = []
        self.files = []

    def getGraph(self):
        g = [self.name]
        for d in self.dirs:
            subg = d.getGraph()
            g.extend(["|     " + s for s in subg])
        for f in sorted(self.files):
            g.append(f)
        return g

n = 0
while True:
    n += 1
    stack = [dir("ROOT")]
    while (s := input()) != "*":
        if s == "#": exit(0)
        if s[0] == 'f':
            stack[-1].files.append(s)
        elif s[0] == 'd':
            stack.append(dir(s))
            stack[-2].dirs.append(stack[-1])
        else:
            stack.pop()
    print(f"DATA SET {n}:")
    print(*stack[0].getGraph(), sep='\n')
    print()
```

代码运行截图



状态: Accepted

源代码

```python
from sys import exit

class dir:
    def __init__(self, dname):
        self.name = dname
        self.dirs = []
        self.files = []

    def getGraph(self):
        g = [self.name]
        for d in self.dirs:
```

25140: 根据后序表达式建立队列表达式

http://cs101.openjudge.cn/practice/25140/

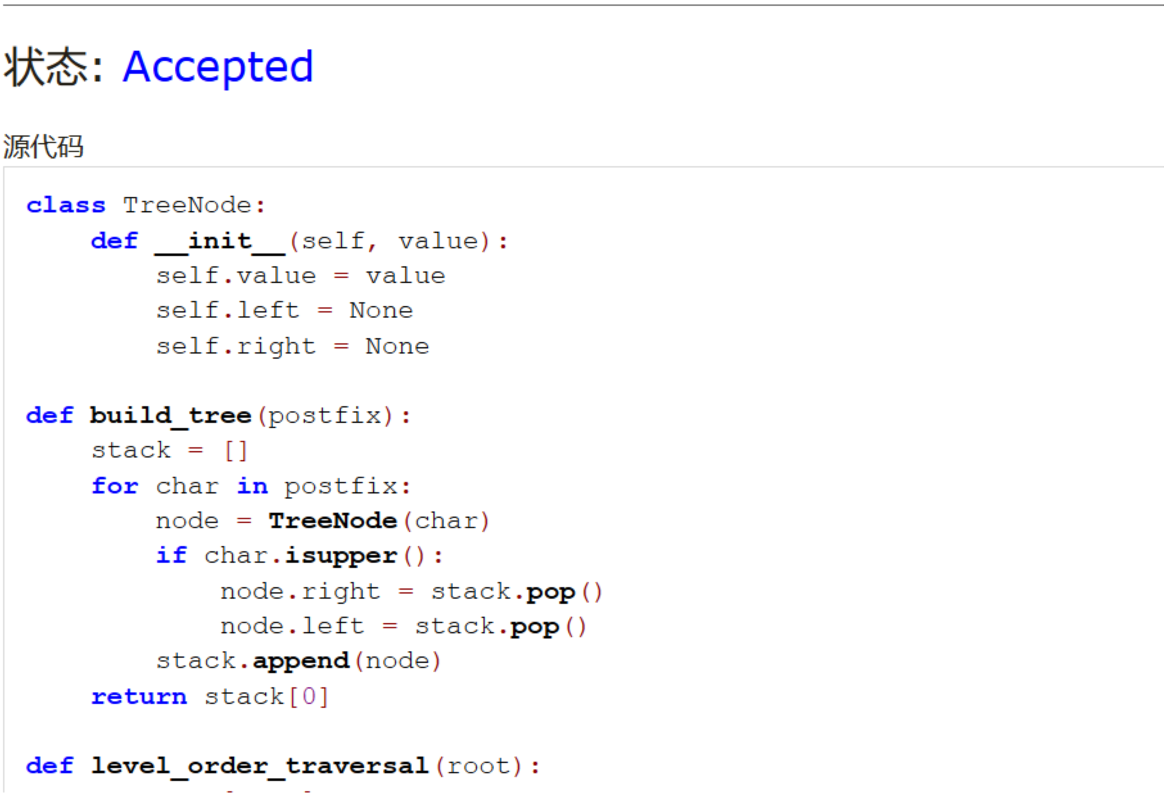
思路:

遍历树的结构

代码

```python
class TreeNode:
    def __init__(self, value):
        self.value = value
        self.left = None
        self.right = None

def build_tree(postfix):
    stack = []
    for char in postfix:
        node = TreeNode(char)
        if char.isupper():
            node.right = stack.pop()
            node.left = stack.pop()
        stack.append(node)
    return stack[0]

def level_order_traversal(root):
    queue = [root]
    traversal = []
    while queue:
        node = queue.pop(0)
        traversal.append(node.value)
        if node.left:
            queue.append(node.left)
        if node.right:
            queue.append(node.right)
    return traversal

n = int(input().strip())
for _ in range(n):
    postfix = input().strip()
    root = build_tree(postfix)
    queue_expression = level_order_traversal(root)[::-1]
    print(''.join(queue_expression))
```

代码运行截图



状态: Accepted

源代码

```
class TreeNode:
    def __init__(self, value):
        self.value = value
        self.left = None
        self.right = None

def build_tree(postfix):
    stack = []
    for char in postfix:
        node = TreeNode(char)
        if char.isupper():
            node.right = stack.pop()
            node.left = stack.pop()
        stack.append(node)
    return stack[0]

def level_order_traversal(root):
```

24750: 根据二叉树中后序序列建树

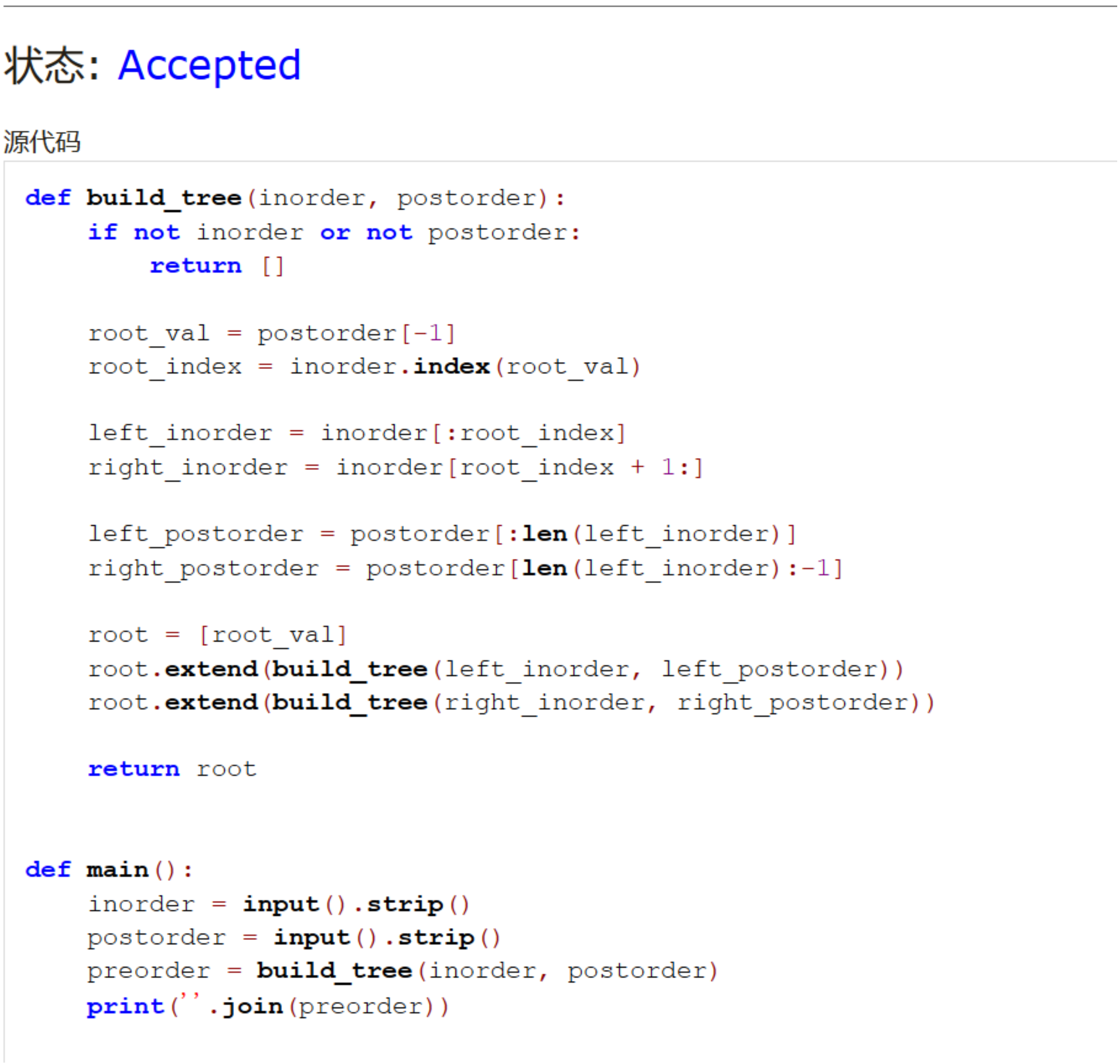
http://cs101.openjudge.cn/practice/24750/

思路：

代码

```python
def build_tree(inorder, postorder):
    if not inorder or not postorder:
        return []

    root_val = postorder[-1]
    root_index = inorder.index(root_val)

    left_inorder = inorder[:root_index]
    right_inorder = inorder[root_index + 1:]

    left_postorder = postorder[:len(left_inorder)]
    right_postorder = postorder[len(left_inorder):-1]

    root = [root_val]
    root.extend(build_tree(left_inorder, left_postorder))
    root.extend(build_tree(right_inorder, right_postorder))

    return root


def main():
    inorder = input().strip()
    postorder = input().strip()
    preorder = build_tree(inorder, postorder)
    print(''.join(preorder))


if __name__ == "__main__":
    main()
```

代码运行截图



状态: Accepted

源代码

```
def build_tree(inorder, postorder):
    if not inorder or not postorder:
        return []

    root_val = postorder[-1]
    root_index = inorder.index(root_val)

    left_inorder = inorder[:root_index]
    right_inorder = inorder[root_index + 1:]

    left_postorder = postorder[:len(left_inorder)]
    right_postorder = postorder[len(left_inorder):-1]

    root = [root_val]
    root.extend(build_tree(left_inorder, left_postorder))
    root.extend(build_tree(right_inorder, right_postorder))

    return root


def main():
    inorder = input().strip()
    postorder = input().strip()
    preorder = build_tree(inorder, postorder)
    print(''.join(preorder))
```

22158: 根据二叉树前中序序列建树

http://cs101.openjudge.cn/practice/22158/

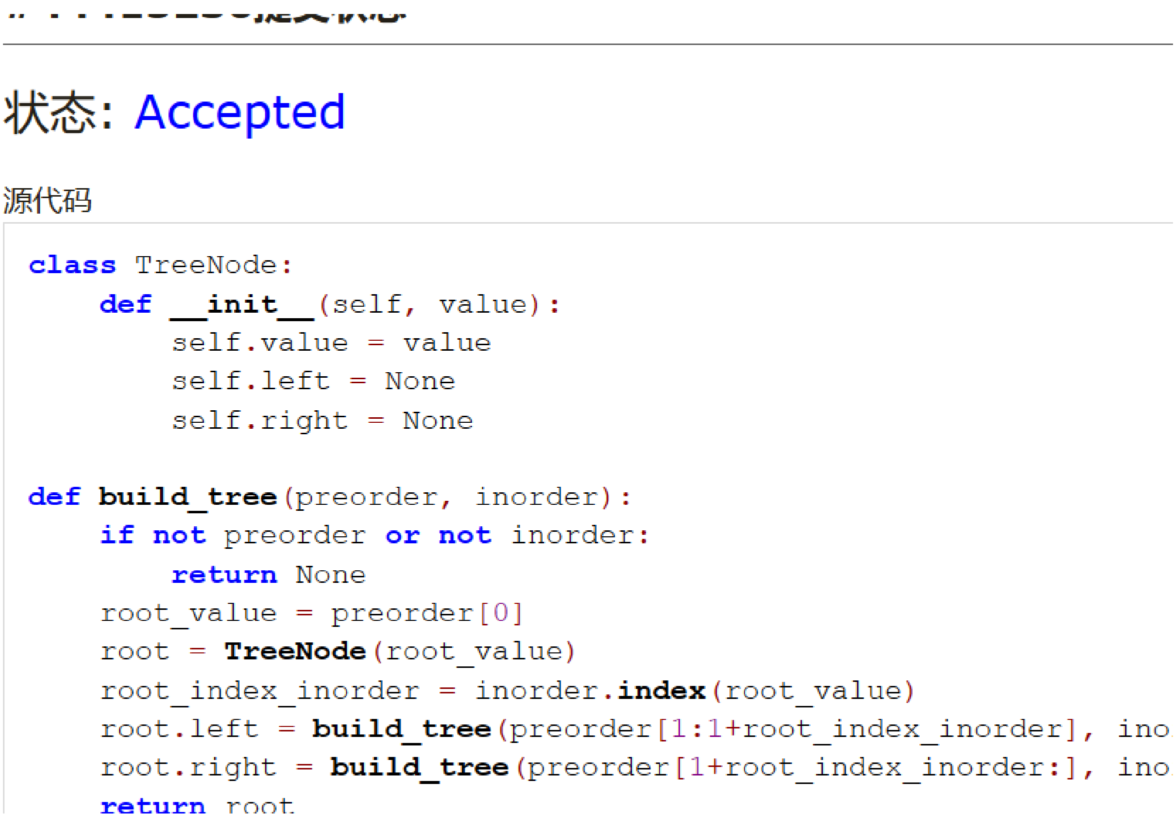
思路:

代码

```
class TreeNode:
    def __init__(self, value):
        self.value = value
        self.left = None
        self.right = None

def build_tree(preorder, inorder):
    if not preorder or not inorder:
        return None
    root_value = preorder[0]
    root = TreeNode(root_value)
    root_index_inorder = inorder.index(root_value)
```

```python
    root.left = build_tree(preorder[1:1+root_index_inorder], inorder[:root_index_inorder])
    root.right = build_tree(preorder[1+root_index_inorder:], inorder[root_index_inorder+1:])
    return root

def postorder_traversal(root):
    if root is None:
        return ''
    return postorder_traversal(root.left) + postorder_traversal(root.right) + root.value

while True:
    try:
        preorder = input().strip()
        inorder = input().strip()
        root = build_tree(preorder, inorder)
        print(postorder_traversal(root))
    except EOFError:
        break
```

代码运行截图



状态: Accepted

源代码

```python
class TreeNode:
    def __init__(self, value):
        self.value = value
        self.left = None
        self.right = None

def build_tree(preorder, inorder):
    if not preorder or not inorder:
        return None
    root_value = preorder[0]
    root = TreeNode(root_value)
    root_index_inorder = inorder.index(root_value)
    root.left = build_tree(preorder[1:1+root_index_inorder], ino
    root.right = build_tree(preorder[1+root_index_inorder:], ino
    return root
```

2. 学习总结和收获

这周太忙了没来得及做