算法导论 XII 章第 1 节习题

Louis1992
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May 3, 2015

Exercises 12.1-1 For the set of keys {1, 4, 5, 10, 16, 17, 21}, draw binary search trees of height 2, 3, 4, 5, and 6.

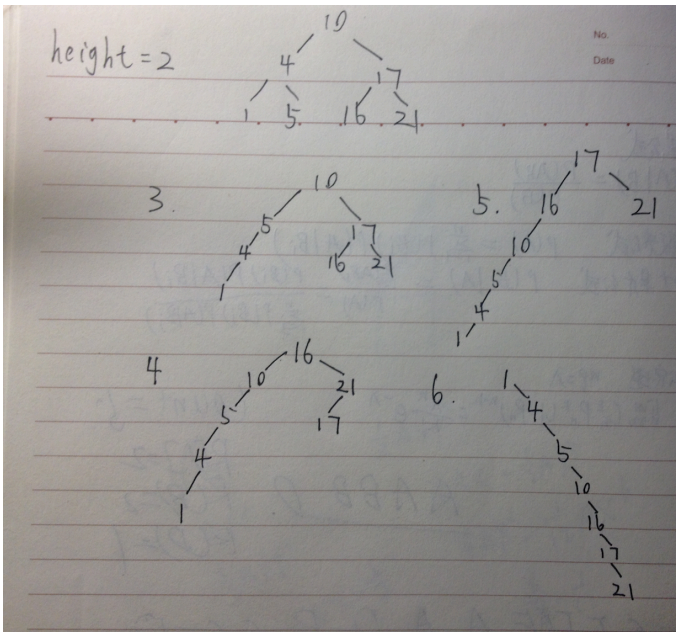

Figure 1: 6.1-1 的答案

Exercises 12.1-2 What is the difference between the binary-search-tree property and the min-heap property (see page 129)? Can the min-heap property be used to print out the keys of an n-node tree in sorted order in O(n) time? Explain how or why not.

做不到，因为基于比较的排序的上限是 $n \lg n$。堆排序建堆时间是 O(n), 但是每次拿出去后要用 $\lg n$ 的时间去调整。

Exercises 12.1-3 Give a nonrecursive algorithm that performs an inorder tree walk. (Hint: There is an easy solution that uses a stack as an auxiliary data structure and a more complicated but elegant solution that uses no stack but assumes that two pointers can be tested for equality.)

```
void inorderTraversal(TreeNode *root) {
        stack<TreeNode*> s;
        TreeNode *p = root;

        while(p != NULL || !s.empty())
        {
            while(p != NULL)
            {
                s.push(p);
                p = p->left;
            }

            p = s.top();
            s.pop();
            cout << p->val;
            p = p->right;
        }

    }
```

Exercises 12.1-4 Give recursive algorithms that perform preorder and postorder tree walks in Θ (n) time on a tree of n nodes.

```
void preorder(TreeNode *root) {

        if(!root) return;

        cout << root->val << endl;
        preorder(root->left);
        preorder(root->right);

    }
```

```
void postorder(TreeNode *root) {

        if(!root) return;

        postorder(root->left);
        postorder(root->right);
        cout << root->val << endl;

    }
```

Exercises 12.1-5 Argue that since sorting n elements takes $\Omega(n \lg n)$ time in the worst case in the comparison model, any comparison-based algorithm for constructing a binary search tree from an arbitrary list of n elements takes $\Omega(n \lg n)$ time in the worst case.

如果下界不是 $n \lg n$, 就会产生矛盾。我们之前知道可以用 O(n) 的时间按序遍历输出 BST 中的元素，如果基于比较的 BST 构造下界不是 $n \lg n$, 那我们就可以利用这个方法产生基于比较的速度优于 $n \lg n$ 的排序算法，矛盾。