1586. Binary Search Tree Iterator II

Medium 120 17 Add to List Share

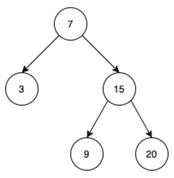
Implement the `BSTIterator` class that represents an iterator over the **in-order traversal** of a binary search tree (BST):

- `BSTIterator(TreeNode root)` Initializes an object of the `BSTIterator` class. The `root` of the BST is given as part of the constructor. The pointer should be initialized to a non-existent number smaller than any element in the BST.
- `boolean hasNext()` Returns `true` if there exists a number in the traversal to the right of the pointer, otherwise returns `false`.
- `int next()` Moves the pointer to the right, then returns the number at the pointer.
- `boolean hasPrev()` Returns `true` if there exists a number in the traversal to the left of the pointer, otherwise returns `false`.
- `int prev()` Moves the pointer to the left, then returns the number at the pointer.

Notice that by initializing the pointer to a non-existent smallest number, the first call to `next()` will return the smallest element in the BST.

You may assume that `next()` and `prev()` calls will always be valid. That is, there will be at least a next/previous number in the in-order traversal when `next()` / `prev()` is called.

Example 1:




```
Input
["BSTIterator", "next", "next", "prev", "next", "hasNext", "next", "next", "next",
"hasNext", "hasPrev", "prev", "prev"]
[[[7, 3, 15, null, null, 9, 20]], [null], [null], [null], [null], [null], [null],
[null], [null], [null], [null], [null], [null]]
Output
[null, 3, 7, 3, 7, true, 9, 15, 20, false, true, 15, 9]

Explanation
// The underlined element is where the pointer currently is.
BSTIterator bSTIterator = new BSTIterator([7, 3, 15, null, null, 9, 20]); // state
is   [3, 7, 9, 15, 20]
bSTIterator.next(); // state becomes [3, 7, 9, 15, 20], return 3
bSTIterator.next(); // state becomes [3, 7, 9, 15, 20], return 7
bSTIterator.prev(); // state becomes [3, 7, 9, 15, 20], return 3
bSTIterator.next(); // state becomes [3, 7, 9, 15, 20], return 7
bSTIterator.hasNext(); // return true
bSTIterator.next(); // state becomes [3, 7, 9, 15, 20], return 9
bSTIterator.next(); // state becomes [3, 7, 9, 15, 20], return 15
bSTIterator.next(); // state becomes [3, 7, 9, 15, 20], return 20
bSTIterator.hasNext(); // return false
bSTIterator.hasPrev(); // return true
bSTIterator.prev(); // state becomes [3, 7, 9, 15, 20], return 15
bSTIterator.prev(); // state becomes [3, 7, 9, 15, 20], return 9
```

Constraints:

- The number of nodes in the tree is in the range $[1, 10^5]$.
- $0 <= Node.val <= 10^6$
- At most 10^5 calls will be made to `hasNext`, `next`, `hasPrev`, and `prev`.

Follow up: Could you solve the problem without precalculating the values of the tree?

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Hide Hint 1

The inorder traversal of a BST gives us the elements in a sorted order.

Hide Hint 2

We can use a stack to simulate the inorder traversal of the BST.

Hide Hint 3

We can use another stack as a buffer to store numbers returned from calls to next and use this buffer whenever prev is called.

```java
class BSTIterator {

    List<Integer> arr = new ArrayList();
    int pointer;
    int n;

    public void inorder(TreeNode r, List<Integer> arr) {
        if (r == null) return;
        inorder(r.left, arr);
        arr.add(r.val);
        inorder(r.right, arr);
    }

    public BSTIterator(TreeNode root) {
        inorder(root, arr);
        n = arr.size();
        pointer = -1;
    }

    public boolean hasNext() {
        return pointer < n - 1;
    }

    public int next() {
        ++pointer;
        return arr.get(pointer);
    }

    public boolean hasPrev() {
        return pointer > 0;
    }

    public int prev() {
        --pointer;
        return arr.get(pointer);
    }
}
```