

```
1 use std::cmp::Ordering;
2
3 #[derive(Debug)]
4 pub struct Content {
5     pub i: i32,
6     pub s: String,
7 }
8
9 impl Content {
10     pub fn new(i: i32, s: String) -> Content {
11         Content { i, s }
12     }
13 }
14
15 // Implement PartialOrd and PartialEq for Content
16 impl PartialEq for Content {
17     fn eq(&self, other: &Self) -> bool {
18         self.s.len() == other.s.len()
19     }
20 }
21
22 impl PartialOrd for Content {
23     fn partial_cmp(&self, other: &Self) -> Option<Ordering> {
24         Some(self.s.len().cmp(&other.s.len()))
25     }
26 }
27
28 // Define Node and Tree structs
29 #[derive(Debug)]
30 struct Node<T> {
31     elem: T,
32     left: TreeLink<T>,
33     center: TreeLink<T>,
34     right: TreeLink<T>,
35 }
36
37 impl<T> Node<T> {
38
```

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39     pub fn new(elem: T) -> Node<T> {
40         Node {
41             elem,
42             left: None,
43             center: None,
44             right: None,
45         }
46     }
47 }
48
49 #[derive(Debug)]
50 pub struct Tree<T> {
51     root: TreeLink<T>,
52 }
53
54 type TreeLink<T> = Option<Box<Node<T>>>;
55
56 impl<T: PartialOrd> Tree<T> {
57     // [1] Create a new empty tree
58     pub fn new() -> Self {
59         Tree { root: None }
60     }
61
62     // [6] Add a node to the tree
63     pub fn add(&mut self, el: T) {
64         self.root = Self::add_to_node(self.root.take(), el);
65     }
66
67     fn add_to_node(node: TreeLink<T>, el: T) -> TreeLink<T> {
68         match node {
69             None => Some(Box::new(Node::new(el))),
70             Some(mut boxed_node) => {
71                 if el < boxed_node.elem {
72                     boxed_node.left = Self::add_to_node(boxed_node.left.take(), el);
73                 } else if el > boxed_node.elem {
74                     boxed_node.right = Self::add_to_node(boxed_node.right.take(), el);
75                 } else {
76                     boxed_node.center = Self::add_to_node(boxed_node.center.take(), el);
77                 }
78                 Some(boxed_node)
79             }

```

```

80     }
81 }
82
83 // [4] Count how many nodes have content < el
84 pub fn howmany_smaller(&self, el: T) -> i32 {
85     Self::count_smaller(&self.root, &el)
86 }
87
88 fn count_smaller(node: &TreeLink<T>, el: &T) -> i32 {
89     match node {
90         None => 0,
91         Some(boxed_node) => {
92             let mut count = 0;
93             if boxed_node.elem < *el {
94                 count += 1;
95             }
96             count += Self::count_smaller(&boxed_node.left, el);
97             count += Self::count_smaller(&boxed_node.center, el);
98             count += Self::count_smaller(&boxed_node.right, el);
99             count
100         }
101     }
102 }
103 }
104
105 pub fn main(){
106     let mut t: Tree<i32> = Tree::new();
107     println!("{:?}",t);
108 }

```