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[Home](#) › [Tech Key Areas](#) › [13 Technical Key Areas Interview Q&A](#) › [Coding](#) › [Part-3: Java Tree structure interview and coding questions](#)

Part-3: Java Tree structure interview and coding questions

Posted on [December 17, 2014](#) by [Arulkumaran Kumaraswamipillai](#) — [No Comments](#) ↓

This is an extension to [Java Tree structure interview and coding questions — Part 2](#), and adds **functional programming** and **recursion**.

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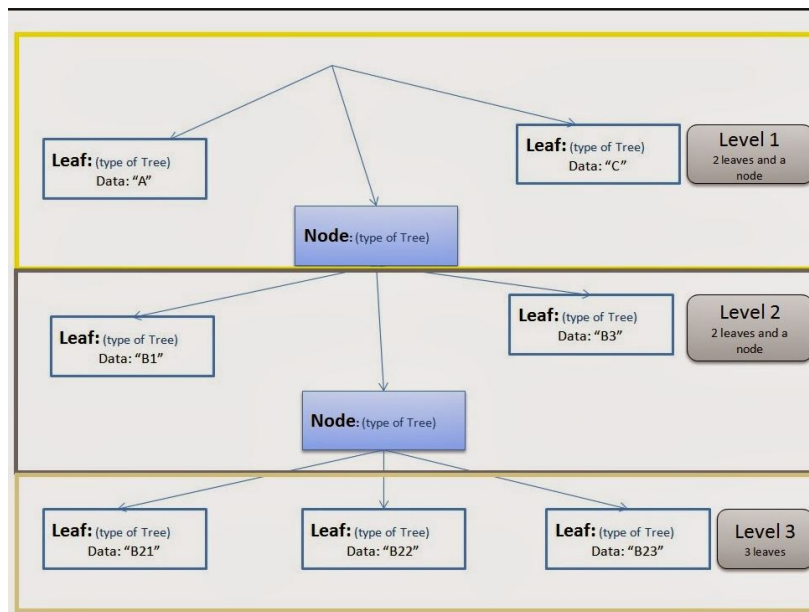
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Tree Data structure

Step 1: The **Tree** interface with `get()` method that returns either a *Triple* tree or *Leaf* data.

```

1 package com.mycompany.flatten;
2
3 public interface Tree<T>
4 {
5     abstract Either<T, Triple<Tree<T>>> get();
6 }
7

```

Step 2: The **Leaf** that implements the **Tree** interface.

```

1 package com.mycompany.flatten;
2
3 public class Leaf<T> implements Tree<T>
4 {
5
6     private final T data;
7
8     public static <T> Tree<T> leaf(T value)
9     {
10         return new Leaf<T>(value);
11     }
12
13     public Leaf(T t)
14     {
15         this.data = t;
16     }
17 }

```

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```

16     }
17
18     public T getData()
19     {
20         return data;
21     }
22
23     @SuppressWarnings("unchecked")
24     public Either<T, Triple<Tree<T>>> get()
25     {
26         return Either.left(data);
27     }
28
29     @Override
30     public String toString()
31     {
32         return "Leaf [data=" + data + "]";
33     }
34 }
35

```

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Step 3: The **Node** with **Triple** tree that implements the **Tree** interface.

```

1 package com.mycompany.flatten;
2
3 public class Node<T> implements Tree<T>
4 {
5
6     private final Triple<Tree<T>> branches;
7
8     public static <T> Tree<T> tree(T left, T mid
9     {
10         return new Node<T>(Leaf.leaf(left), Leaf
11     }
12
13     public Node(Tree<T> left, Tree<T> middle, Tr
14     {
15         this.branches = new Triple<Tree<T>>(left
16     }
17
18     public Either<T, Triple<Tree<T>>> get()
19     {
20         return Either.right(branches);
21     }
22
23     public Triple<Tree<T>> getBranches()
24     {
25         return branches;
26     }
27
28     @Override
29     public String toString()
30     {
31         return "Node {branches=" + branches + "}
32     }
33
34 }
35
36

```

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Step 4: The Triple class used by the Node.[Written Test JEE \(1\)](#)

```

1 package com.mycompany.flatten;
2
3 /**
4  * A type that stores three values of the same type
5  */
6 public class Triple<T>
7 {
8     private final T left, middle, right;
9
10    public Triple(T l, T m, T r)
11    {
12        this.left = l;
13        this.middle = m;
14        this.right = r;
15    }
16
17    public T left()
18    {
19        return left;
20    }
21
22    public T middle()
23    {
24        return middle;
25    }
26
27    public T right()
28    {
29        return right;
30    }
31
32    @Override
33    public String toString()
34    {
35        return "Triple [l=" + left + ", m=" + middle + ", r=" + right + "]";
36    }
37 }
38
39 }
40

```

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Step 5: As you can see that the Node and Leaf are using the class Either to handle Node and Leaf differently. The Either stores left or right values but not both. The Leaf uses the left and the Node uses the right. You can pass in a Function to be executed for the leaf and node.

```

1 package com.mycompany.flatten;
2
3 /**
4  * X type which stores one of either of two types
5  */
6 public class Either<X, Y>
7 {

```

```
8     private final X x;
9     private final Y y;
10
11     private Either(X x, Y y)
12     {
13         this.x = x;
14         this.y = y;
15     }
16
17     /**
18      * Constructs x left-type Either
19      */
20     public static <X> Either left(X x)
21     {
22         if (x == null)
23             throw new IllegalArgumentException();
24         return new Either(x, null);
25     }
26
27     /**
28      * Constructs x right-type Either
29      */
30     public static <Y> Either right(Y y)
31     {
32         if (y == null)
33             throw new IllegalArgumentException();
34         return new Either(null, y);
35     }
36
37     /**
38      * Applies function f to the contained value
39      * returns the result.
40      */
41     public void ifLeft(Function<X> f)
42     {
43         if (!this.isLeft())
44         {
45             throw new IllegalStateException();
46         }
47         f.apply(x);
48     }
49
50
51
52     /**
53      * Applies function f to the contained value
54      * returns the result.
55      */
56     public void ifRight(Function<Y> f)
57     {
58         if (this.isLeft())
59         {
60             throw new IllegalStateException();
61         }
62         f.apply(y);
63     }
64
65
66
67     /**
68      * @return true if this is x left, false if
69      */
70     public boolean isLeft()
71     {
72         return y == null;
73     }
```

```
74
75     @Override
76     public String toString()
77     {
78         return "Either [x=" + x + ", y=" + y + "
79     }
80
81 }
82
```

Step 6: Define the **Function** interface

```
1 package com.mycompany.flatten;
2
3 public interface Function<P>
4 {
5
6     void apply(P p);
7 }
8
```

Step 7: Define two different implementations for the **Function**. *LeafPrint* and *NodePrint* for printing *Leaf* and *Node* respectively.

```
1 package com.mycompany.flatten;
2
3 public class LeafPrint<P> implements Function<P>
4 {
5
6     public void apply(P p)
7     {
8         System.out.println("--> Leaf:" + p);
9     }
10 }
11
12
```

```
1 package com.mycompany.flatten;
2
3 public class NodePrint<P> implements Function<P>
4 {
5
6     public void apply(P p)
7     {
8         Triple t = (Triple<P>) p;
9         System.out.println("left ==> " + t.left
10     }
11 }
12
13
```

Step 8: The ***FlattenTree*** interface that works on the *Tree*.

```
1 package com.mycompany.flatten;
2
3 public interface FlattenTree<T>
4 {
5     void flatten(Tree<T> tree);
6 }
7
```

Step 9: Implementation of *FlattenTree* interface
RecursiveFlattenTree.

```
1 package com.mycompany.flatten;
2
3 public class RecursiveFlattenTree<T> implements
4 {
5
6     public void flatten(Tree<T> tree)
7     {
8         if (tree == null)
9         {
10             return;
11         }
12
13         Either<T, Triple<Tree<T>>> either = tree
14
15         if (either.isLeft())
16         {
17             either.ifLeft(new LeafPrint<T>());
18         }
19
20         else
21         {
22             either.ifRight(new NodePrint<Triple<
23                 Triple<Tree<T>>> trippleTree = ((Node
24                 flatten(trippleTree.left()); // re
25                 flatten(trippleTree.middle()); // re
26                 flatten(trippleTree.right()); // re
27             }
28         }
29     }
30 }
31
```

Step 10: Finally, the ***SpecialTreeTest*** test class with main method.

```

1 package com.mycompany.flatten;
2
3 public class SpecialTreeTest
4 {
5
6     public static void main(String[] args)
7     {
8
9         Tree<String> leafB21 = Leaf.leaf("B21");
10        Tree<String> leafB22 = Leaf.leaf("B22");
11        Tree<String> leafB23 = Leaf.leaf("B23");
12
13        //takes all 3 args as "Leaf<String>" and
14        Tree<Tree<String>> level3 = Node.tree(le
15
16        Tree<String> leafB1 = Leaf.leaf("B1");
17        Tree<String> leafB3 = Leaf.leaf("B3");
18
19        //takes 3 args as "Leaf<String>", "Tree
20        Tree<Tree<String>> level2 = new Node(lea
21
22        Tree<Tree<String>> level1 = new Node(Lea
23
24        //System.out.println(level1); //level1 i
25
26        FlattenTree<Tree<String>> flatTree = new
27        flatTree.flatten(level1);
28
29    }
30 }
31 }
32

```

The output

```

1 left ==> Leaf [data=A] || middle ==> Node {bran
2 --> Leaf:A
3 left ==> Leaf [data=B1] || middle ==> Node {bra
4 --> Leaf:B1
5 left ==> Leaf [data=Leaf [data=B21]] || middle
6 --> Leaf:Leaf [data=B21]
7 --> Leaf:Leaf [data=B22]
8 --> Leaf:Leaf [data=B23]
9 --> Leaf:B3
10 --> Leaf:C
11

```

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