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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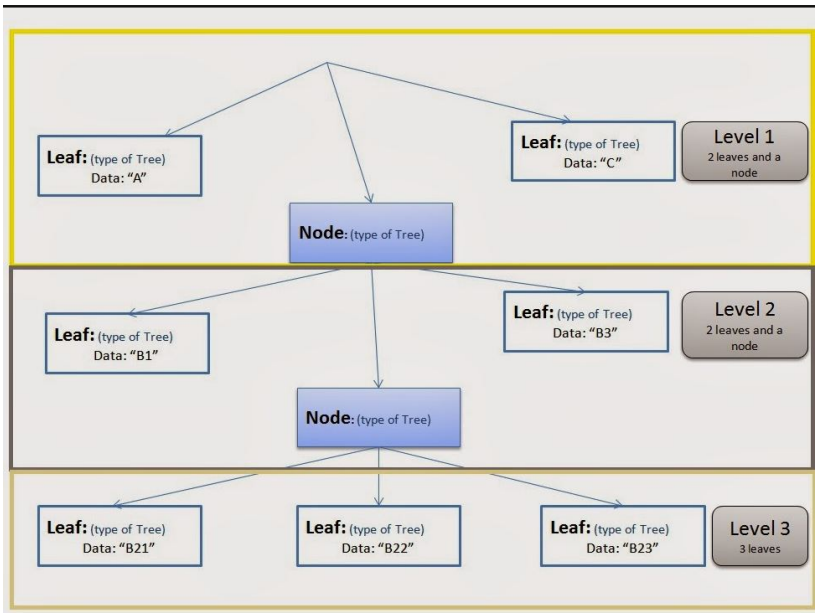

Tree Data structure

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 Technical Key Areas

```
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
```

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
```

⊞ Low Latency (7)
⊞ Memory Managemen
⊞ Performance (13)
⊞ QoS (8)
⊞ Scalability (4)
⊞ SDLC (6)
⊞ Security (13)
⊞ Transaction Managen

Step 4: The **Triple** class used by the **Node**.

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

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 type
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
48          f.apply(x);
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
63          f.apply(y);
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 ouput

```
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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