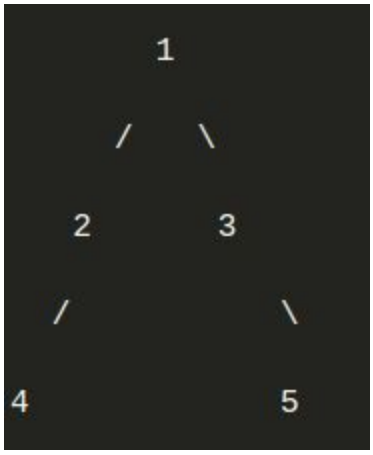
Summary

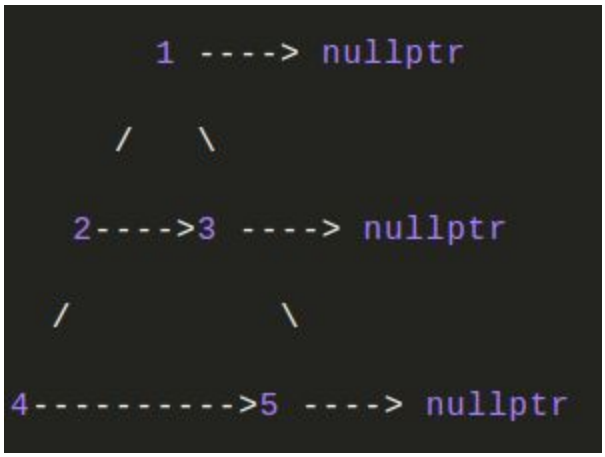
Time Complexity: O(N), since we iterate for each node in the tree only once
Space Complexity: O(N), space on the queue to hold a maximum of N elements

Problem Pattern

1. Given a binary tree, we have to populate the nextRight pointers of the tree. These pointers should be pointing to the immediate right element in the tree, on the same level.
2. What if the node does not have a nextRight element? We populate the nextRight pointers of such nodes with null value.
3. For example, if the tree is:



Then the converted tree after populating the next right pointers shall be:



Problem Approach

1. So, for the question, we see that each node has a right node in the same level. This strongly suggests that we use a Breadth First Ordering to solve the problem.
2. Also we want to order the elements, so that each adjacent next node to a node in the breadth-first order is the nextRight node for the current node. This suggests the order in which we push the elements into the BFS queue, first the left child, then the right one.
3. Each of the rightmost node has null as the nextRight pointer. This indicates that whenever the element popped in the BFS traversal is from a new level, we know that all the elements added to the queue will be elements from (new_level + 1). Hence we add a null to the queue before it, so it becomes adjacent to the rightmost element in new_level.

Problem Pseudocode

```
connect(root) {

        Queue q

        q.add(root)

        q.add(null)


        while (!q.isEmpty()) {

                Node p = q.front();

                q.remove();

                if (p != null) {

                        p.nextRight = q.front();
```

```
                        if (p.left != null)
                            q.add(p.left);

                        if (p.right != null)
                            q.add(p.right);
                    }
                else if (!q.isEmpty()) {
                        q.add(null);
                    }
            }
}
```

Alternate Approaches

Another approach is to avoid the queue and just have 3 pointers - curr, head, and tail. In this approach we try to link the next pointers using the next pointers in the previous level, we try to find the next right on each level by looking at the children of the nextRight nodes of its parent.

Similar problems

- Right side view of a Binary Tree