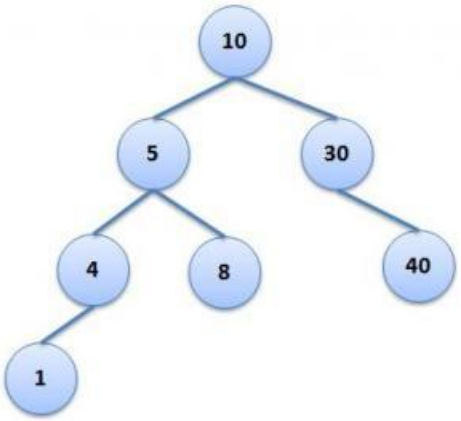
BUILD BINARY TREE FROM ANCESTOR MATRICS

You are given the Ancestor matrix of a Binary tree, write an Algorithm to construct the corresponding tree.

For example, the below tree:



Will have the following ancestor Matrix

	1	4	5	8	10	30	40
1	0	1	1	0	1	0	0
4	0	0	1	0	1	0	0
5	0	0	0	0	1	0	0
8	0	0	1	0	1	0	0
10	0	0	0	0	0	0	0
30	0	0	0	0	1	0	0
40	0	0	0	0	1	1	0

The order of rows in the above matrix is not defined. I have kept it in the ascending order because the data in our nodes is numeric and can be ordered.

Essentially, in the ancestor matrix, each node has a row and a column (may not be the same). The value at a[i][j] will be 1 iff node of Node representing **j‘**th column is the ancestor of node representing the **i**‘th row.

Write an algorithm that can construct the binary tree from a given Ancestor matrix.

Note: *Since we don’t have information about whether a child is a left child or a right child, the tree which gets constructed will be unordered Binary tree(i.e, there can be max two children of a node but they will not be ordered as left or right).*

Solution:

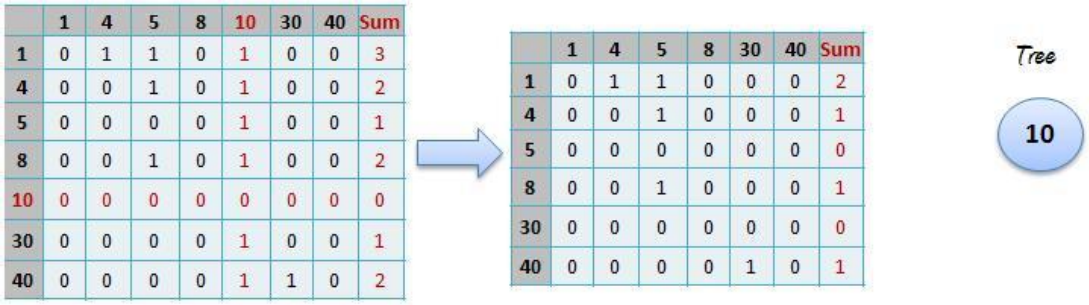
The row of the root node will have all zeros because there is no ancestor to the root node. We will use Queue to solve this problem. Let Q be the Queue with operations enqueue, dequeue and isEmpty

	1	4	5	8	10	30	40	Sum
1	0	1	1	0	1	0	0	3
4	0	0	1	0	1	0	0	2
5	0	0	0	0	1	0	0	1
8	0	0	1	0	1	0	0	2
10	0	0	0	0	0	0	0	0
30	0	0	0	0	1	0	0	1
40	0	0	0	0	1	1	0	2

1. Add 1 more column in the matrix which contain the sum of all the elements in that row:
2. Find the row, which has all zeros (for which sum[i] = 0). lets call this node r (root of the tree)

3. Q.enqueue (r);
4. while (!Q.isempty)
    1. temp = Q.dequeue();
    2. remove both **row & column** of the temp node and update the sum column accordingly (ideally all the elements in the Sum column should decrease).
    3. Look for all the rows for which Sum[i] == 0
    4. add them as children to node temp.
    5. Insert them at the end of the queue.

The Algorithm will proceed as shown in the below diagram:



	1	4	5	8	10	30	40	Sum
1	0	1	1	0	1	0	0	3
4	0	0	1	0	1	0	0	2
5	0	0	0	0	1	0	0	1
8	0	0	1	0	1	0	0	2
10	0	0	0	0	0	0	0	0
30	0	0	0	0	1	0	0	1
40	0	0	0	0	1	1	0	2

	1	4	5	8	30	40	Sum
1	0	1	1	0	0	0	2
4	0	0	1	0	0	0	1
5	0	0	0	0	0	0	0
8	0	0	1	0	0	0	1
30	0	0	0	0	0	0	0
40	0	0	0	0	1	0	1

Now we have the root node (10).. all the Nodes whose sum are zero will be children of this node. Hence the tree will look like:

```
 10

/  \

5  30
```

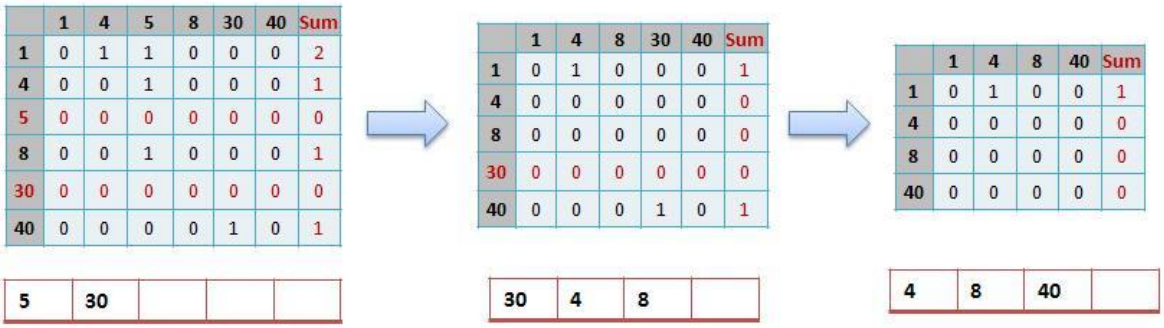
10 will be dequeed from the queue and 5 & 30 are also inserted in the Queue.

Next element in the Queue (to be removed from Queue) will be 5. Remove the corresponding rows & columns and is sum value becomes zero corresponding to some nodes then insert them as child nodes of 5.

```
   10
  /  \
 5    30
/ \
4  8
```

Also insert 4 & 8 in the Queue (and remove them from Matrix).

Repeat the same for 30. Then repeat the same for 4, 8 and other nodes.



Let me know if the above algo is not correct and you want the code for the same.

Source: http://www.ritambhara.in/build-binary-tree-from-ancestor-matrics/