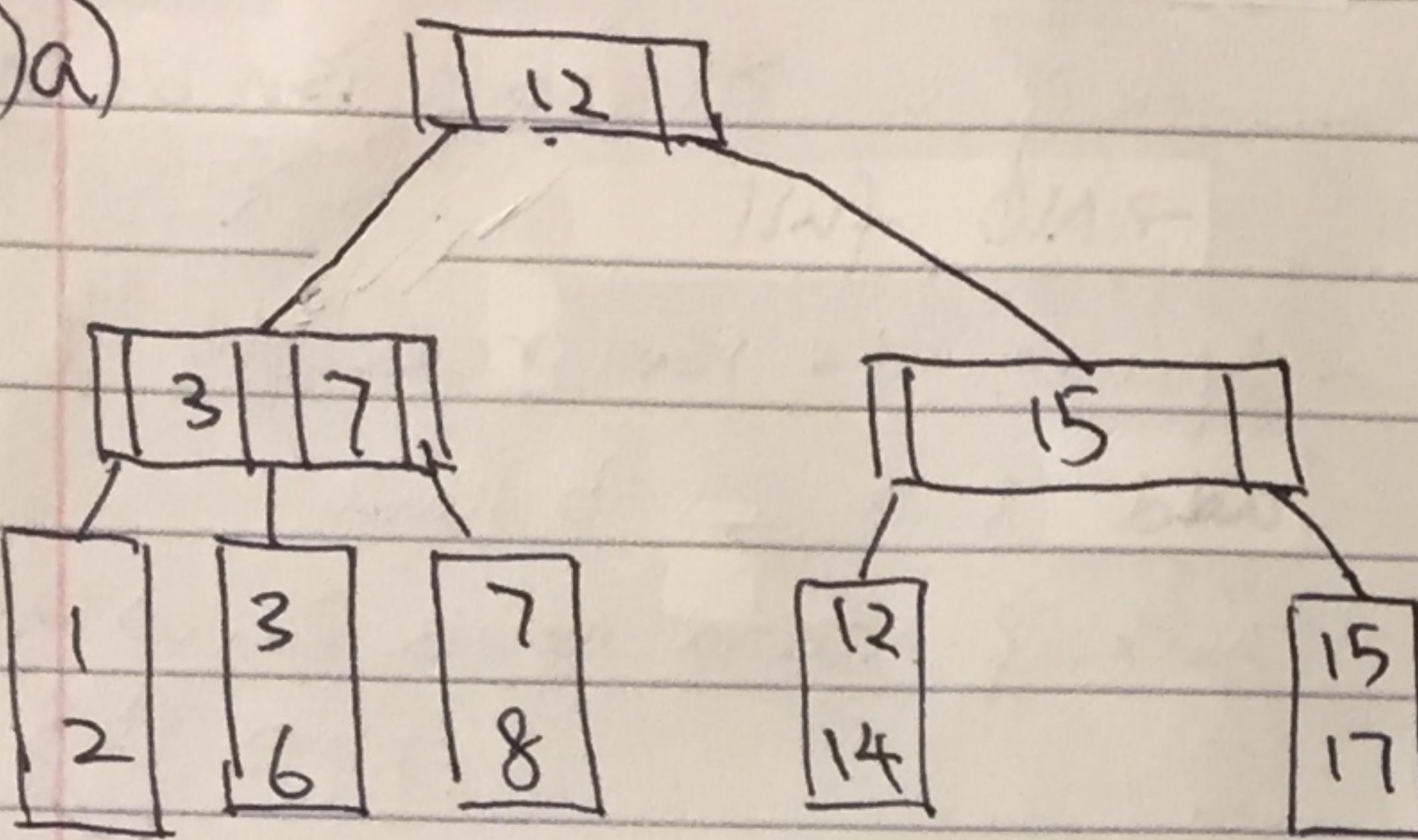


Tung Ho Lin Tx1429

EECS233 Written HW #3

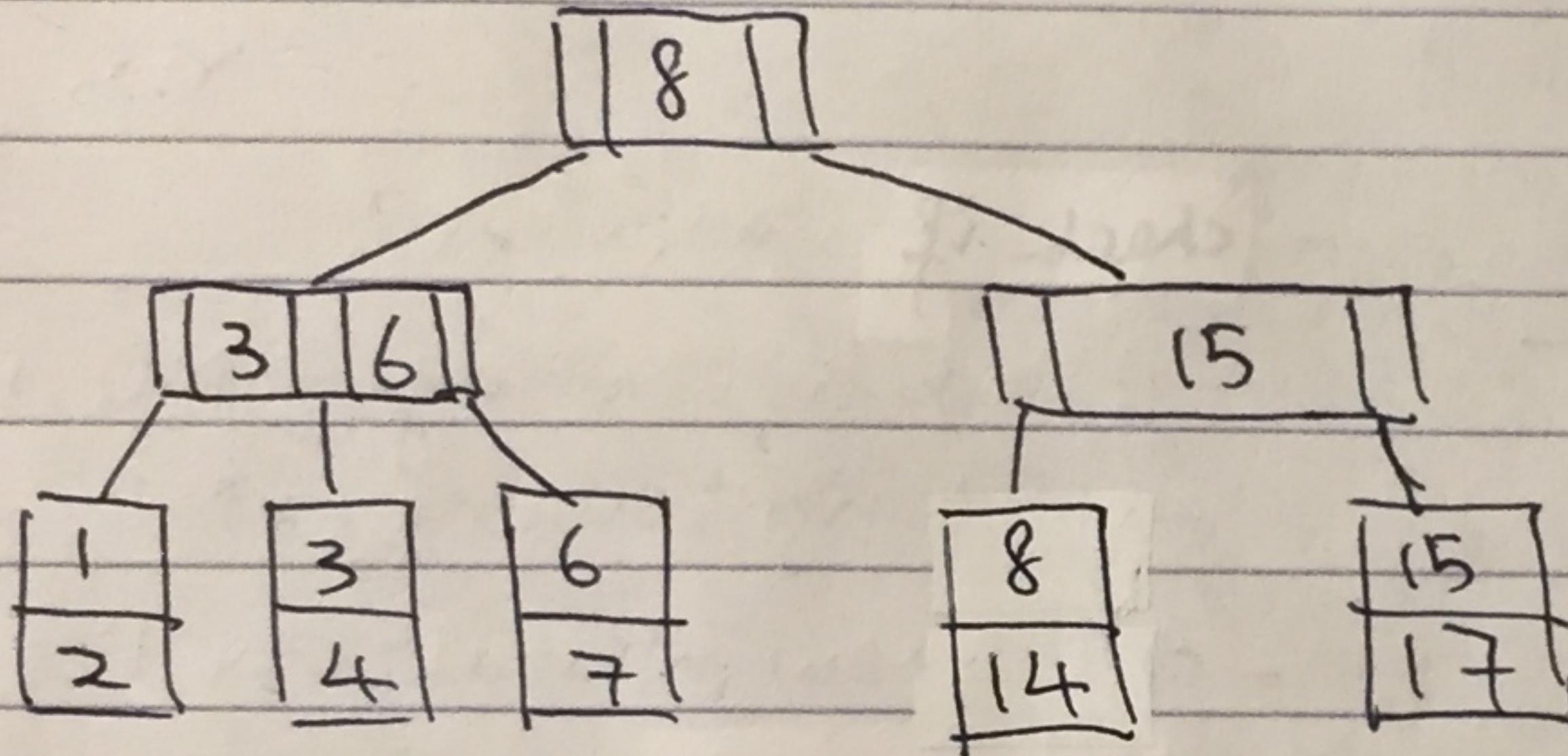
1)a)



Steps:

- delete 4 in leaf node
- check if there are at least $L/2$ entries \rightarrow NO
- check the left sibling if an entry can be pulled and entries still $\geq L/2$ \rightarrow NO
- check the right sibling if an entry can be pulled and entries still $\geq L/2$ \rightarrow YES
- pull the smallest entry⁽⁶⁾ and insert it into the leaf node that just underwent deletion.
- update the internal node to 7

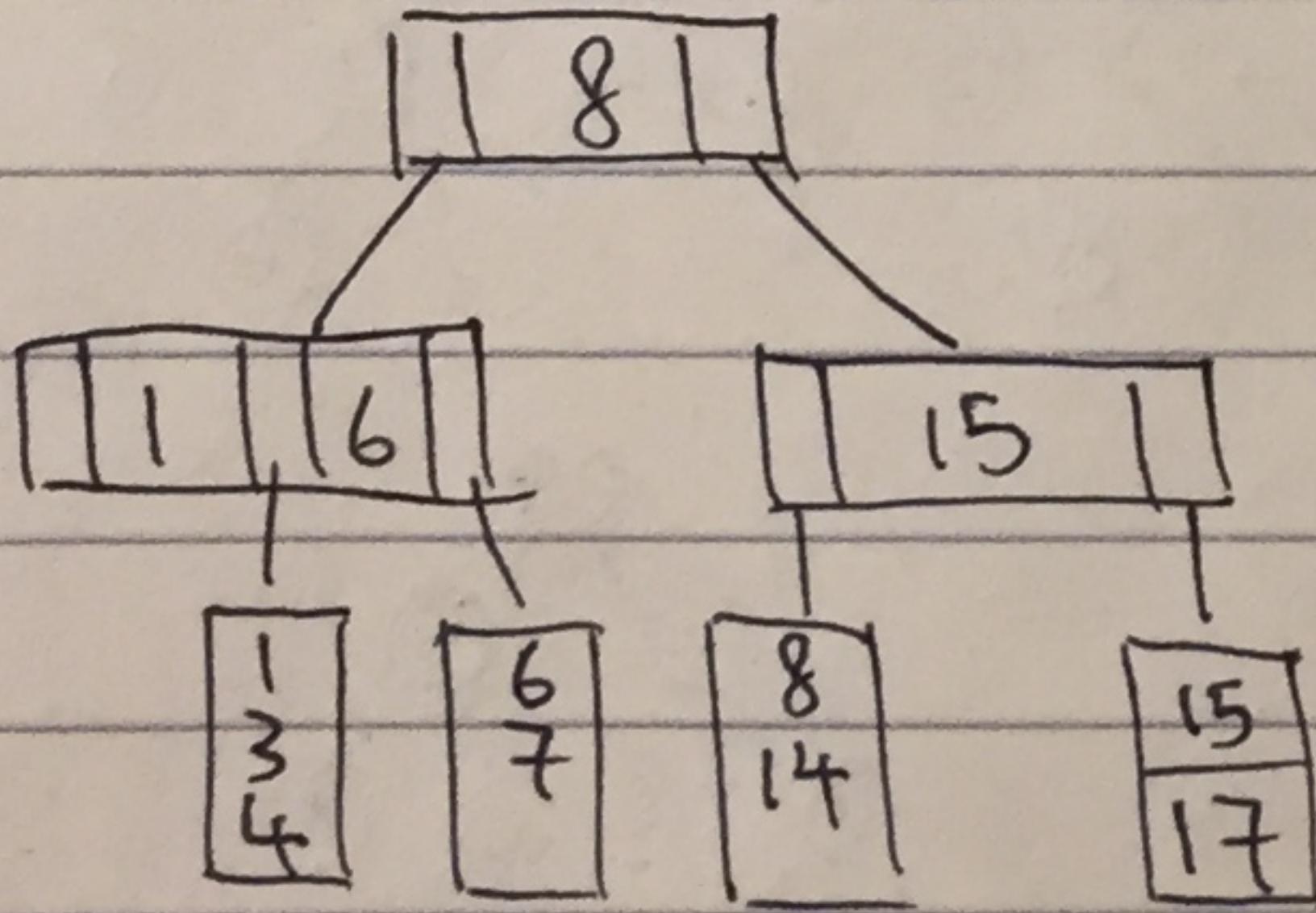
b)



Steps:

- find the smallest entry in the right subtree (12) \rightarrow cannot be used b.c. it is the value to be ~~deleted~~
- find the largest entry in the left subtree (8) \rightarrow can be used
- delete 12 in root node and leaf node
- update the root node to 8
- b.c. of the updated root node, move 8 in the leaf node to the right subtree
- check if all nodes have $L/2$ entries or $M/2$ pointers \rightarrow YES

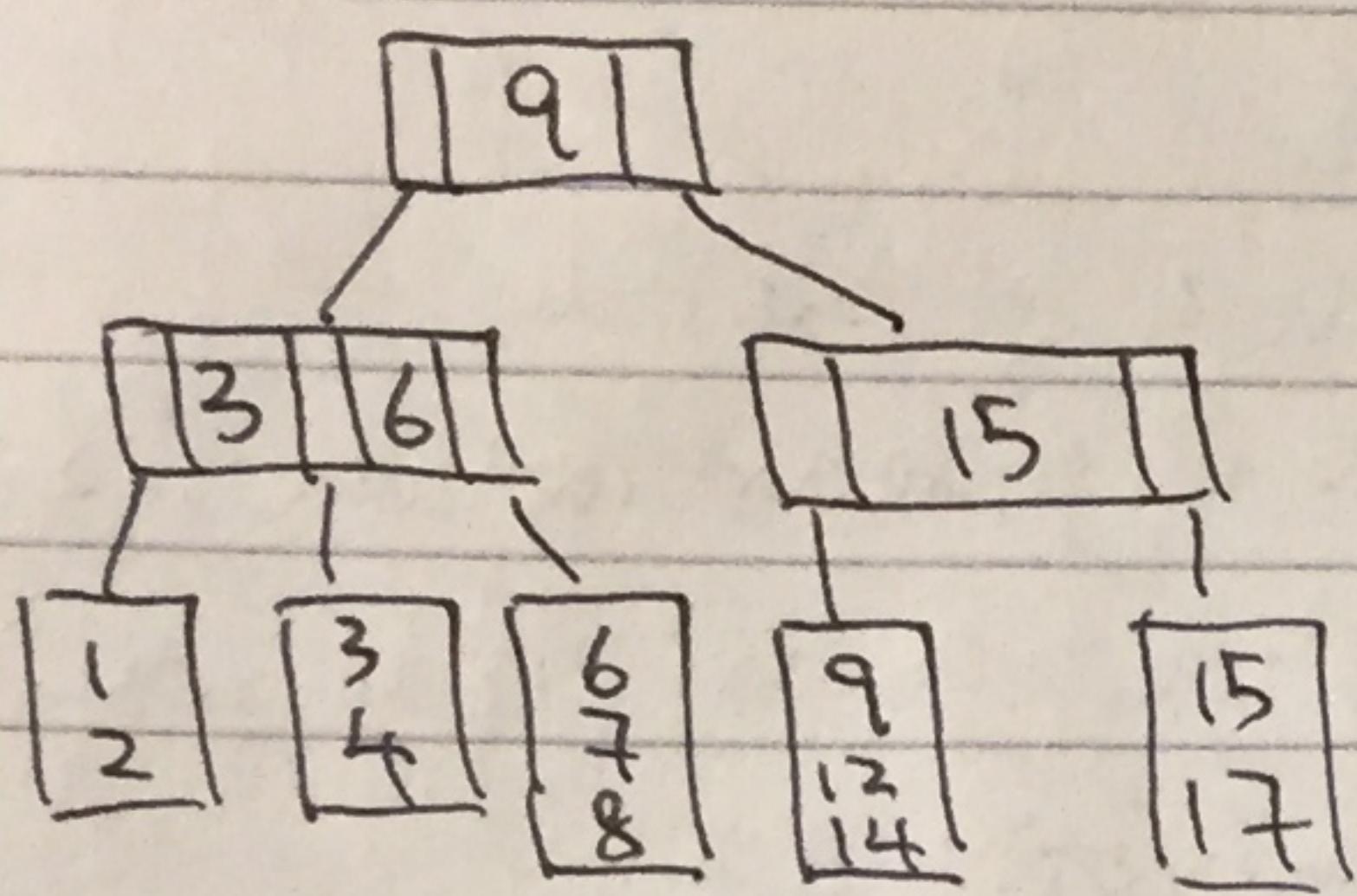
c)



Steps:

- delete 2 in leaf node
- check if it has $L/2$ entries \rightarrow NO
- pulling from adjacent?
 - check left sibling \rightarrow NO, null
 - check right sibling \rightarrow NO, not enough left
- merge nodes
- update internal node to 1

d)

Steps:

- check if the $\geq 6, < 9$ node is full
→ YES

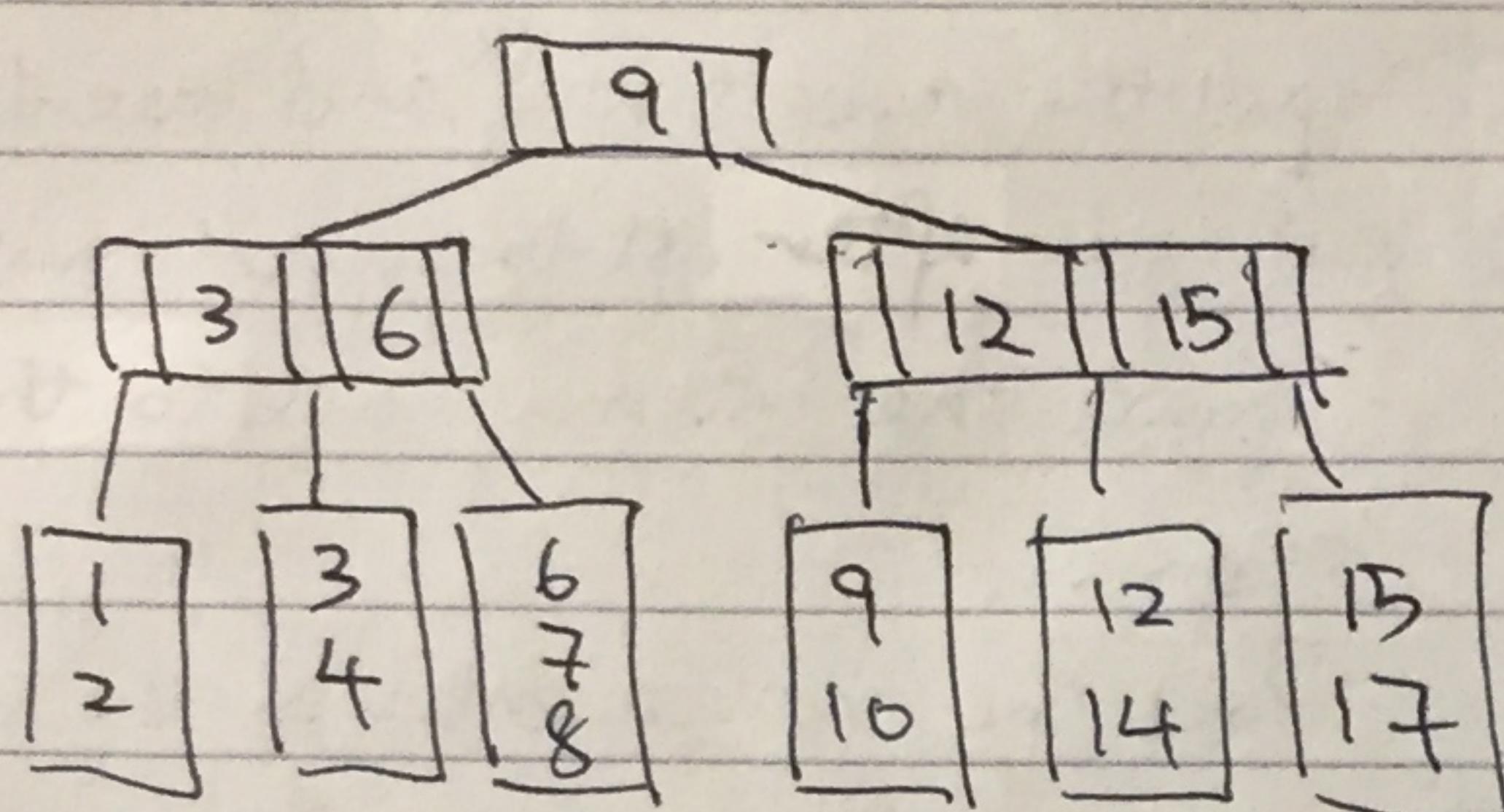
- update the root node to 9

- insert 9 to < 15 node

- check if internal nodes have $> M/2$ pointers
→ YES

- check if leaf nodes have $\geq L/2$ entries
→ YES

e)

Steps:

- check if $< 15, \geq 9$ node is full
→ YES

- moving to adjacent?

- check left sibling → NO, null

- check right sibling → NO, doesn't fit

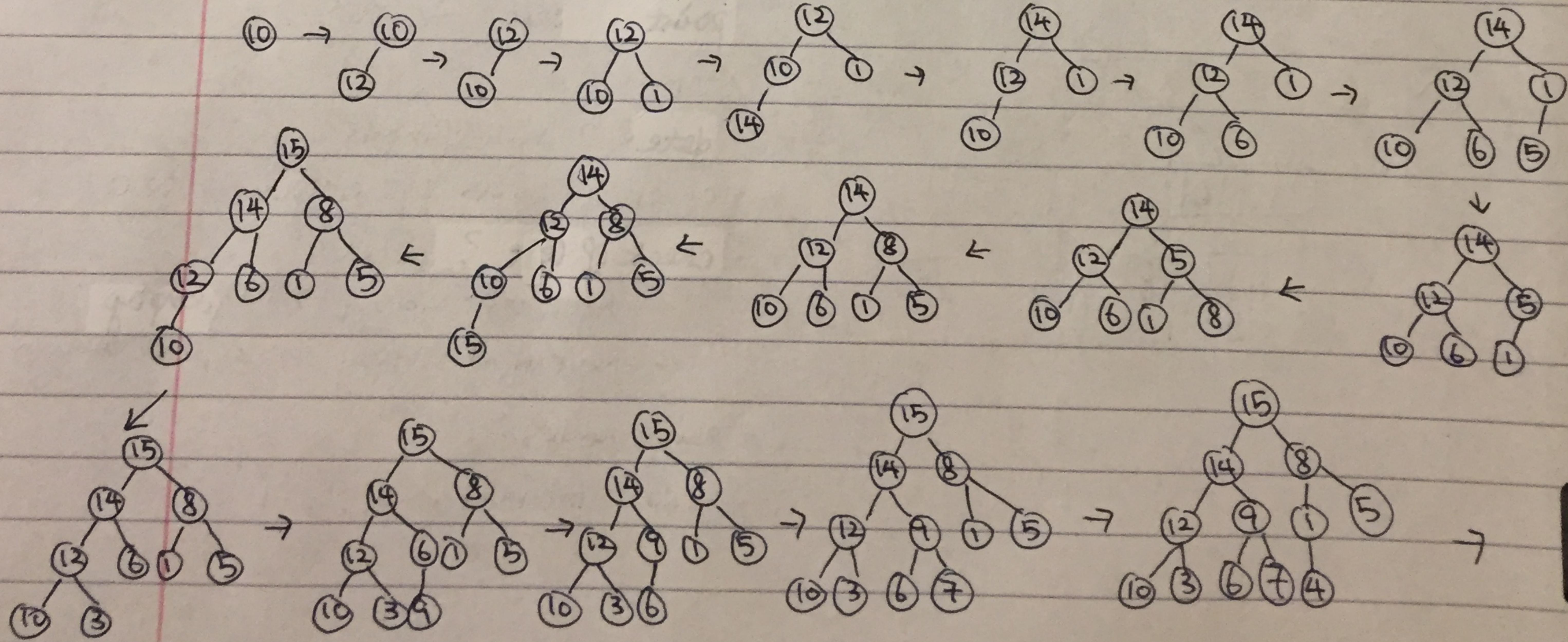
- create new internal node 12


- update leaf nodes and pointers

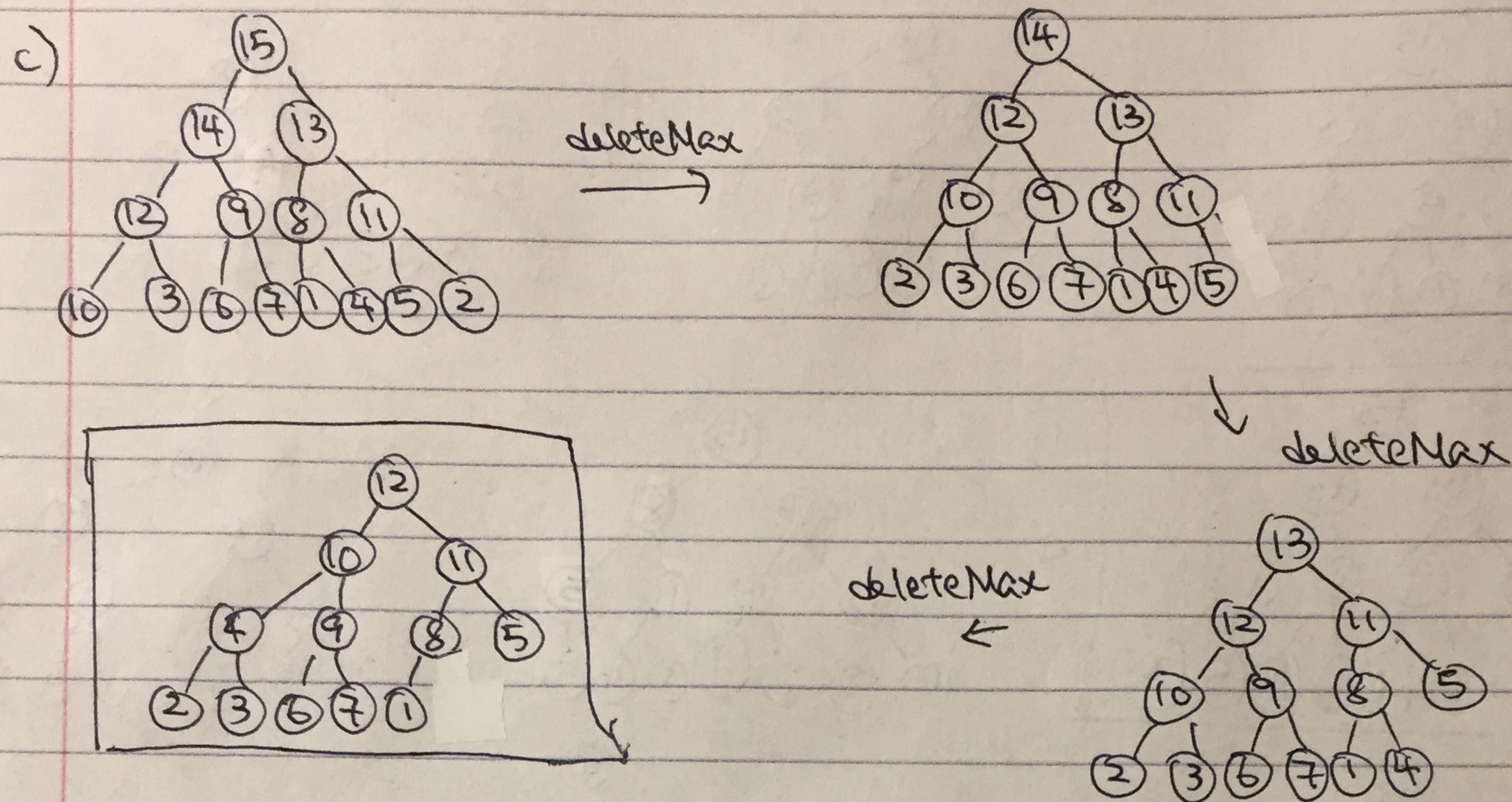
- insert 10

- check if leaf $\geq L/2$, internal $> M/2$
→ YES.

2a) 10, 12, 1, 14, 6, 5, 8, 15, 3, 9, 7, 4, 11, 13, 2







4a) 4371, 1323, 6173, 4199, 4344, 9679, 1989 $h(x) = x \bmod 10$

0	null
1	→ [4371 null]
2	null
3	→ [1323] → [6173 null]
4	→ [4344 null]
5	null
6	null
7	null
8	null
9	→ [4199] → [9679] → [1989 null]
10	

(11)
* Table size has to be prime no.
for d) to find a space!

b) 0	1989
1	4371
2	
3	1323
4	6173
5	4344
6	
7	
8	
9	4199
10	9679

c) 0	1989
1	4371
2	1989
3	1323
4	6173
5	4344
6	
7	
8	
9	4199
10	9679

d) 0	9679
1	4371
2	
3	1323
4	6173
5	
6	
7	4344
8	
9	4199
10	1989

$$h_2(x) = 7 - (x \bmod 7)$$