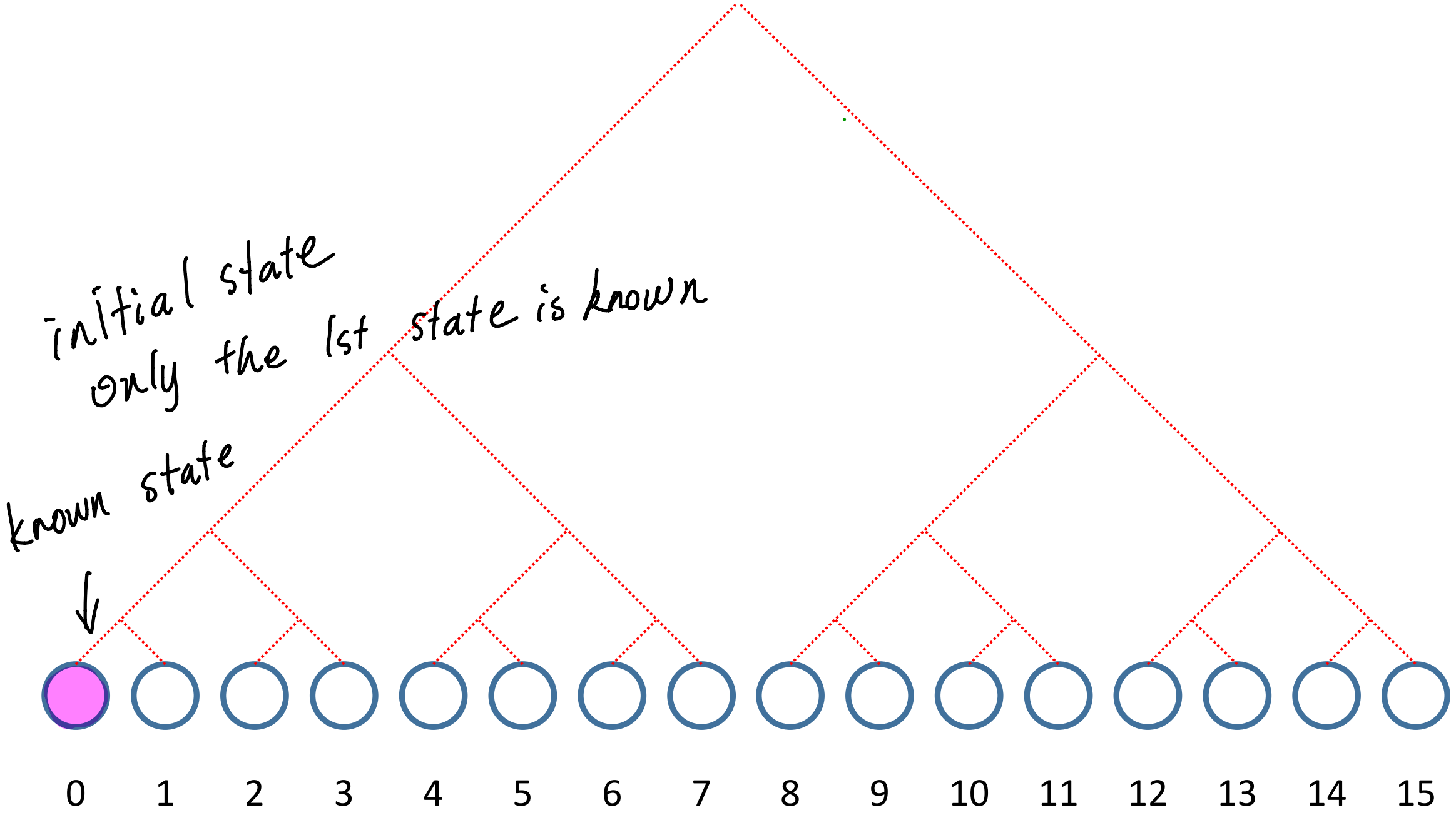
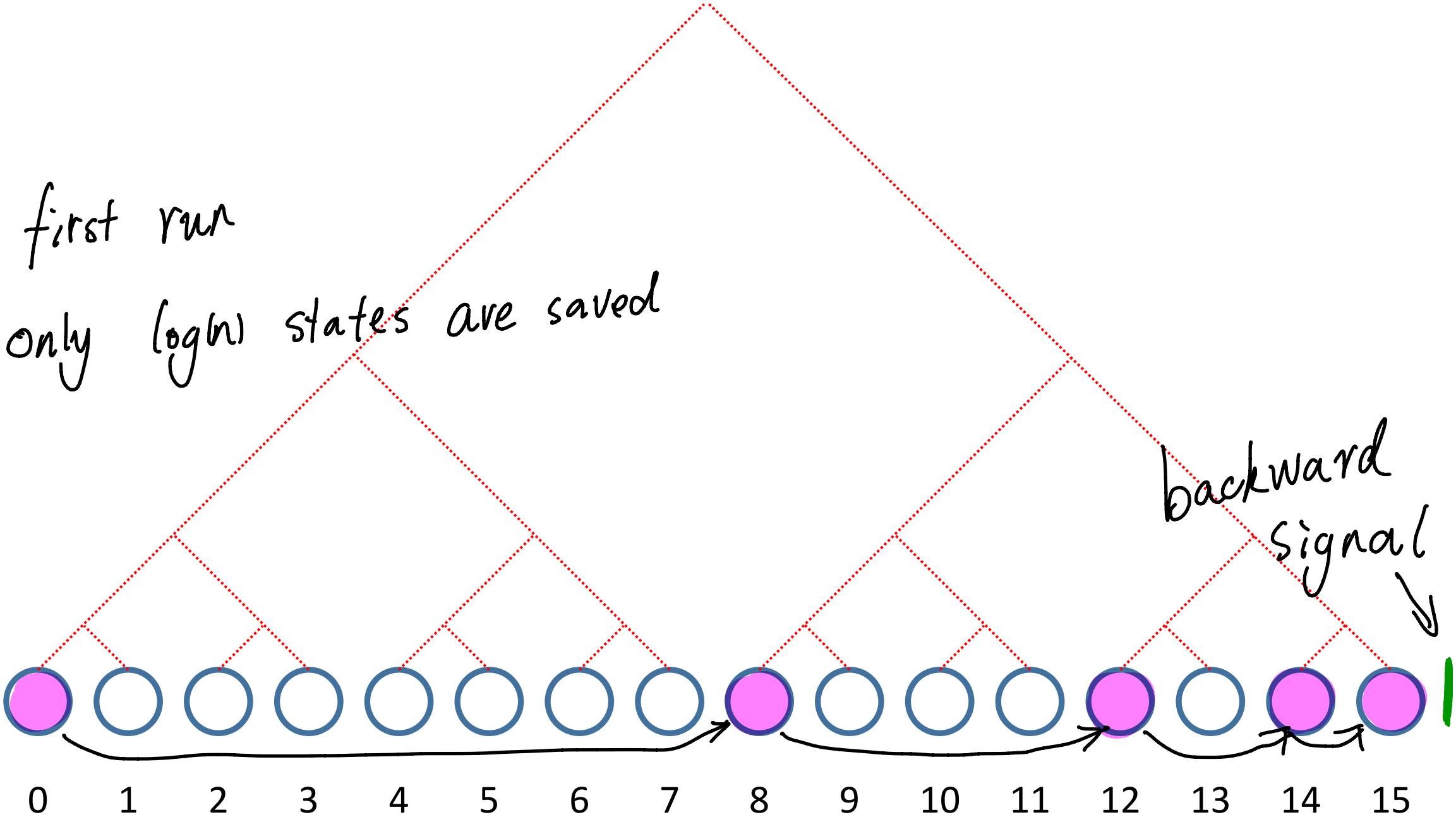

initial state
only the 1st state is known
known state
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15


first run
only log(n) states are saved
backward signal
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

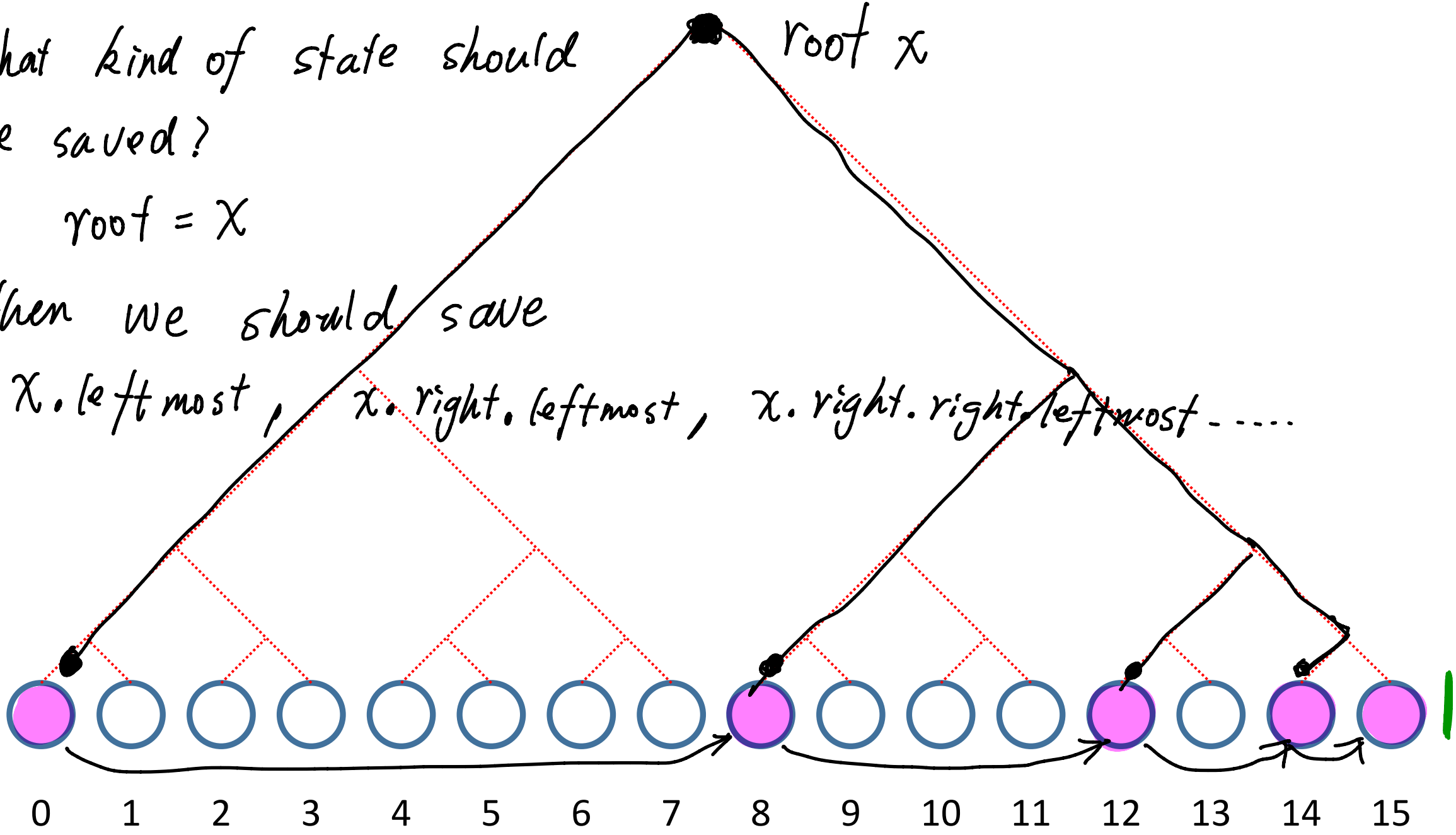
What kind of state should be saved?

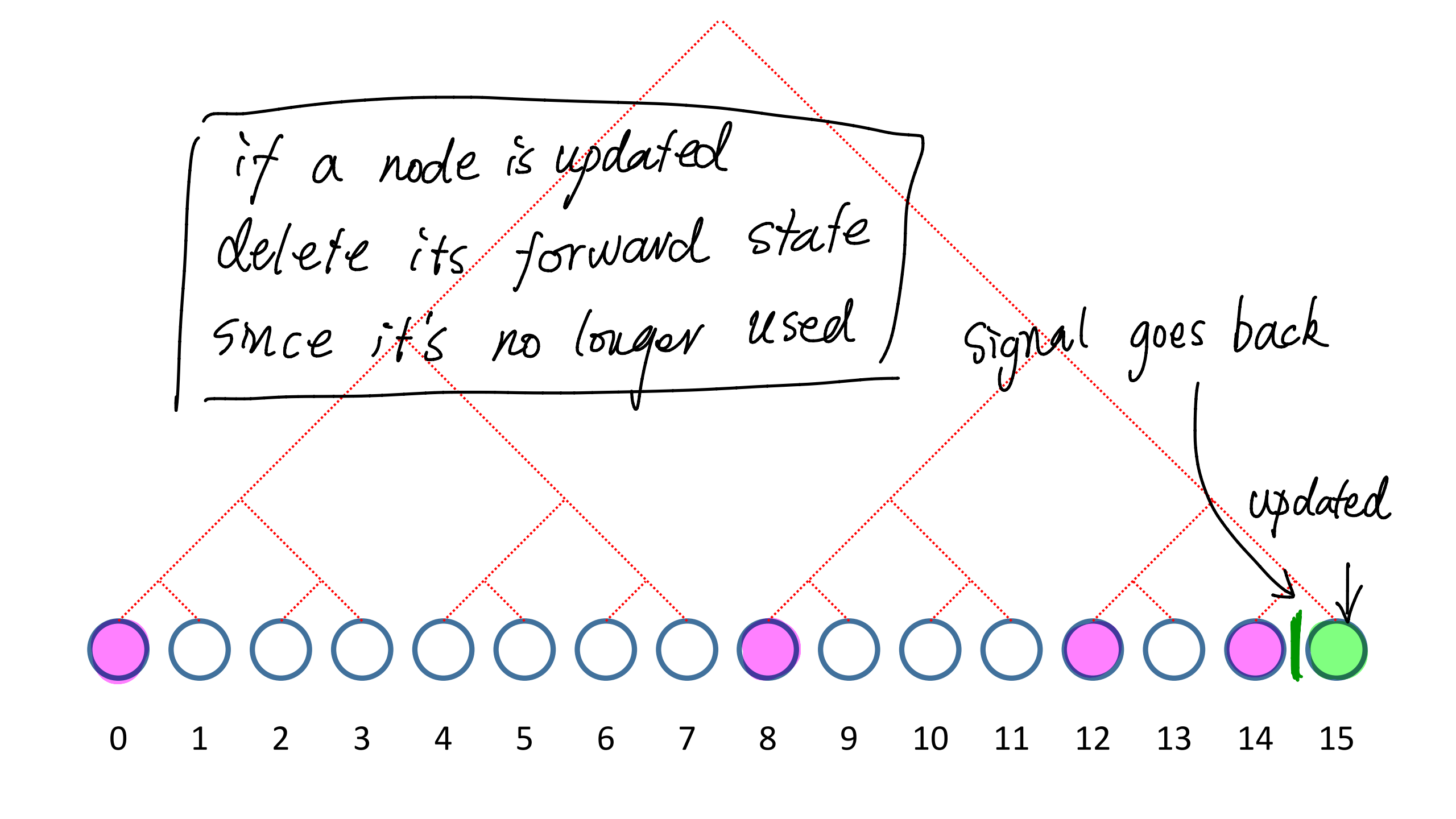
root x

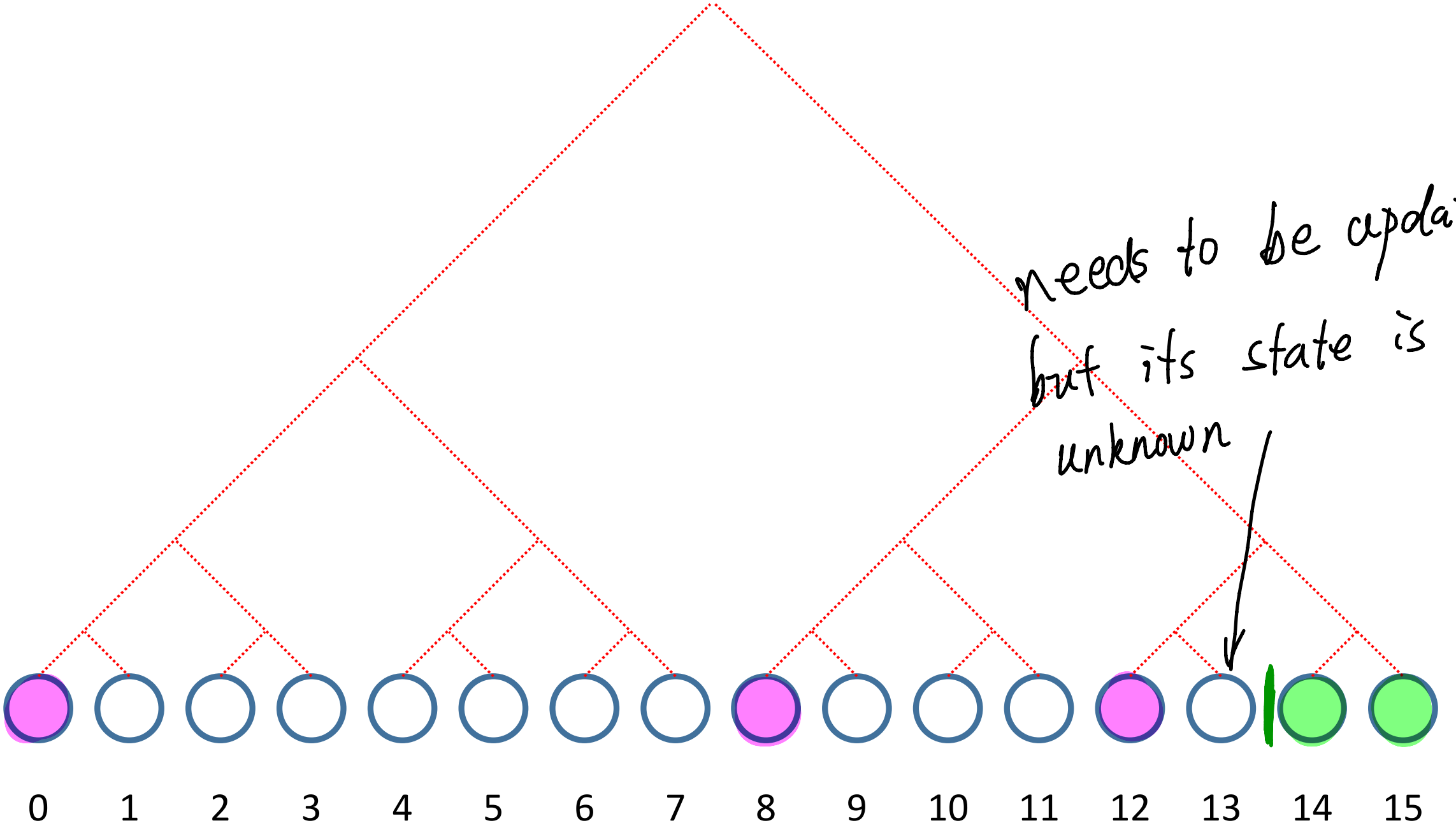
root = x

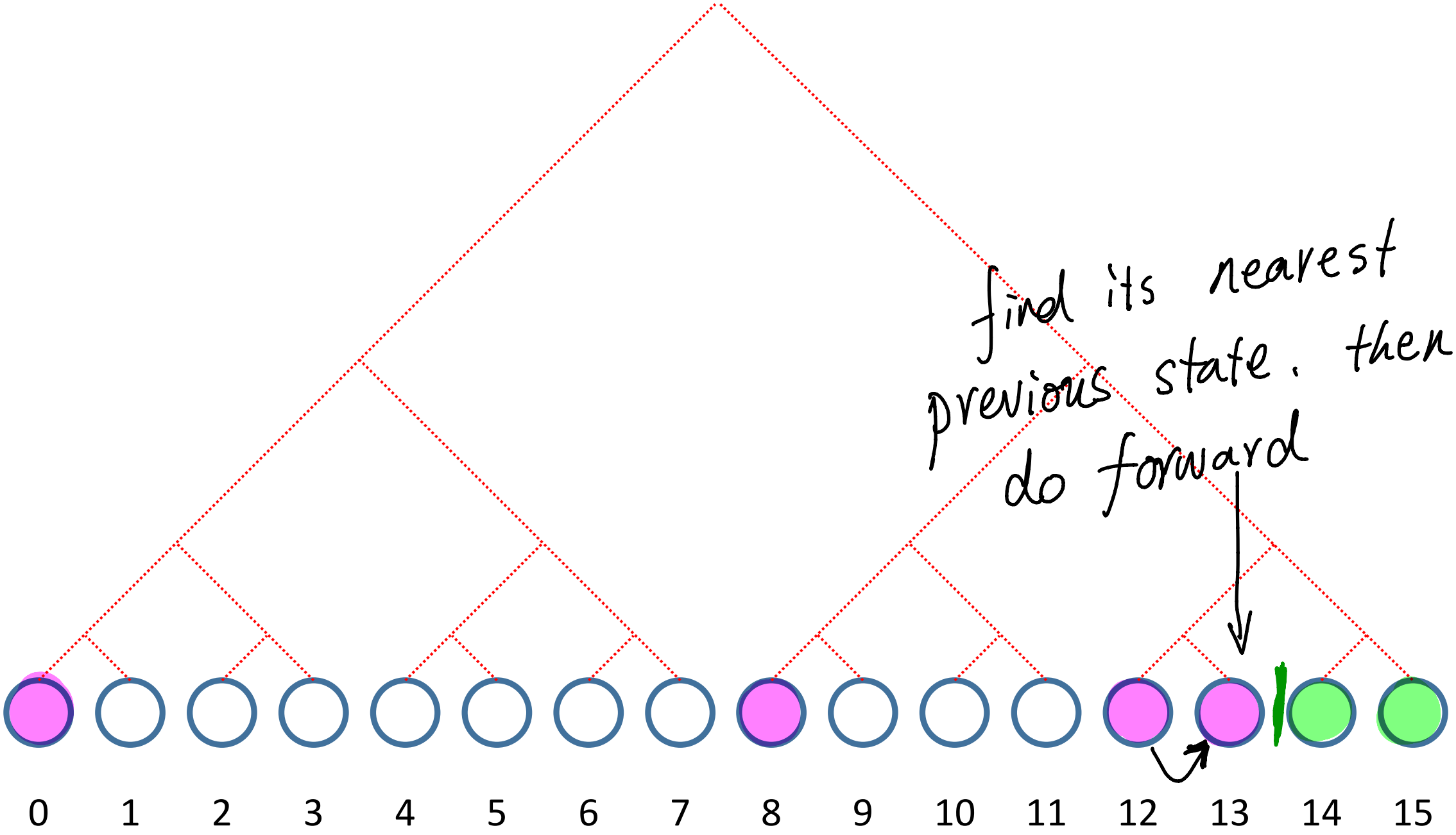
then we should save

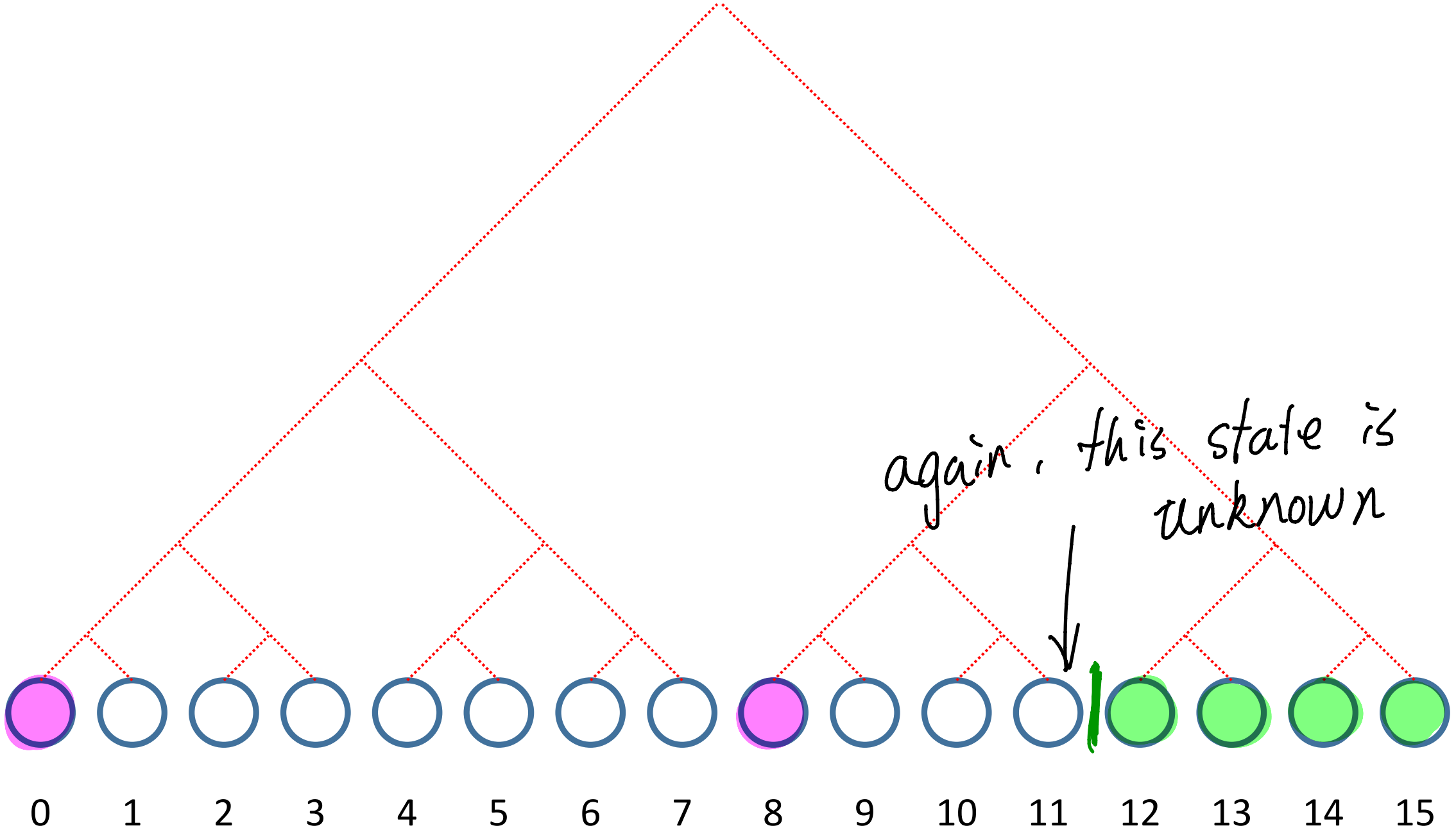
x.leftmost, x.right.leftmost, x.right.right.leftmost.....

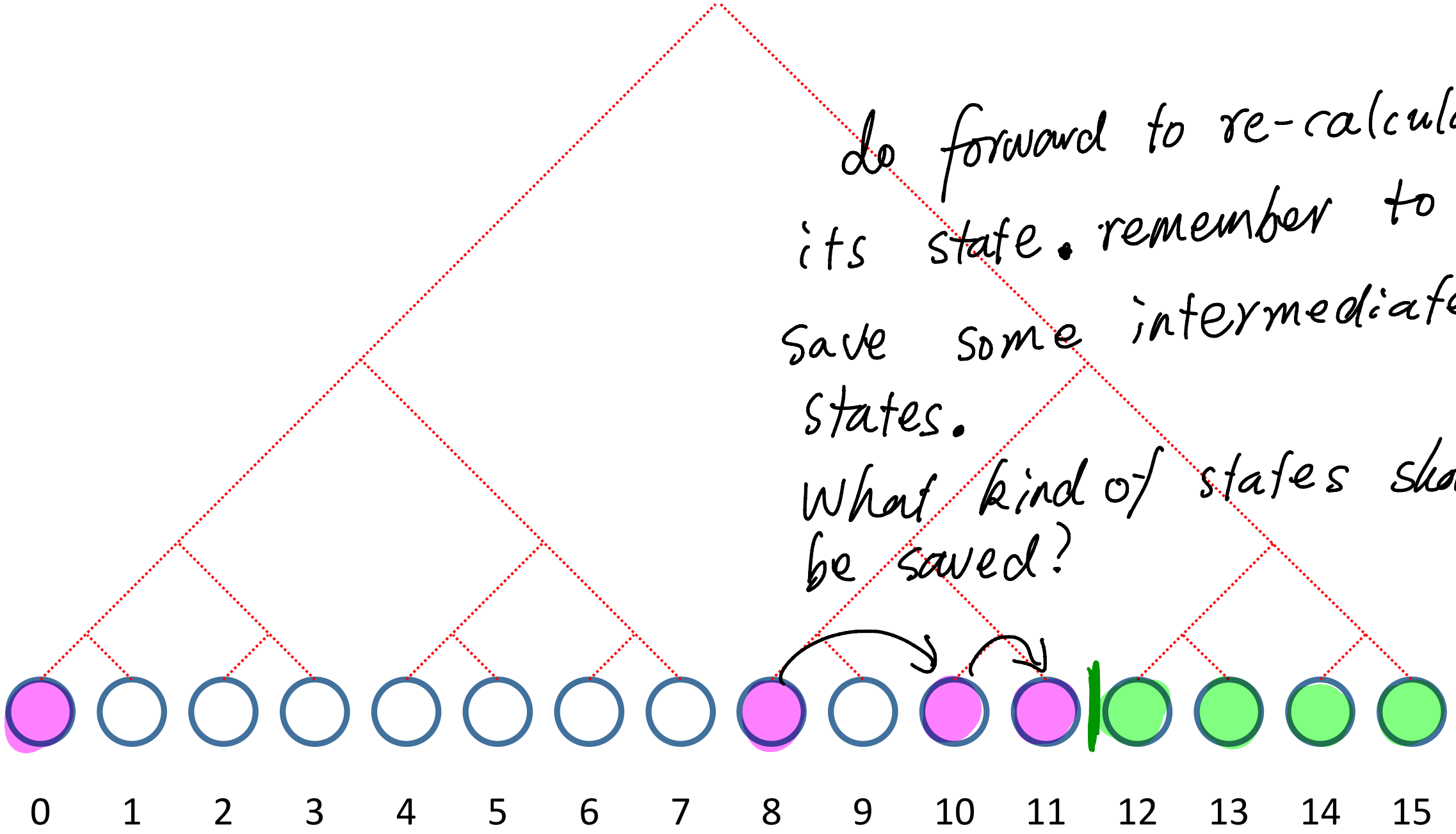


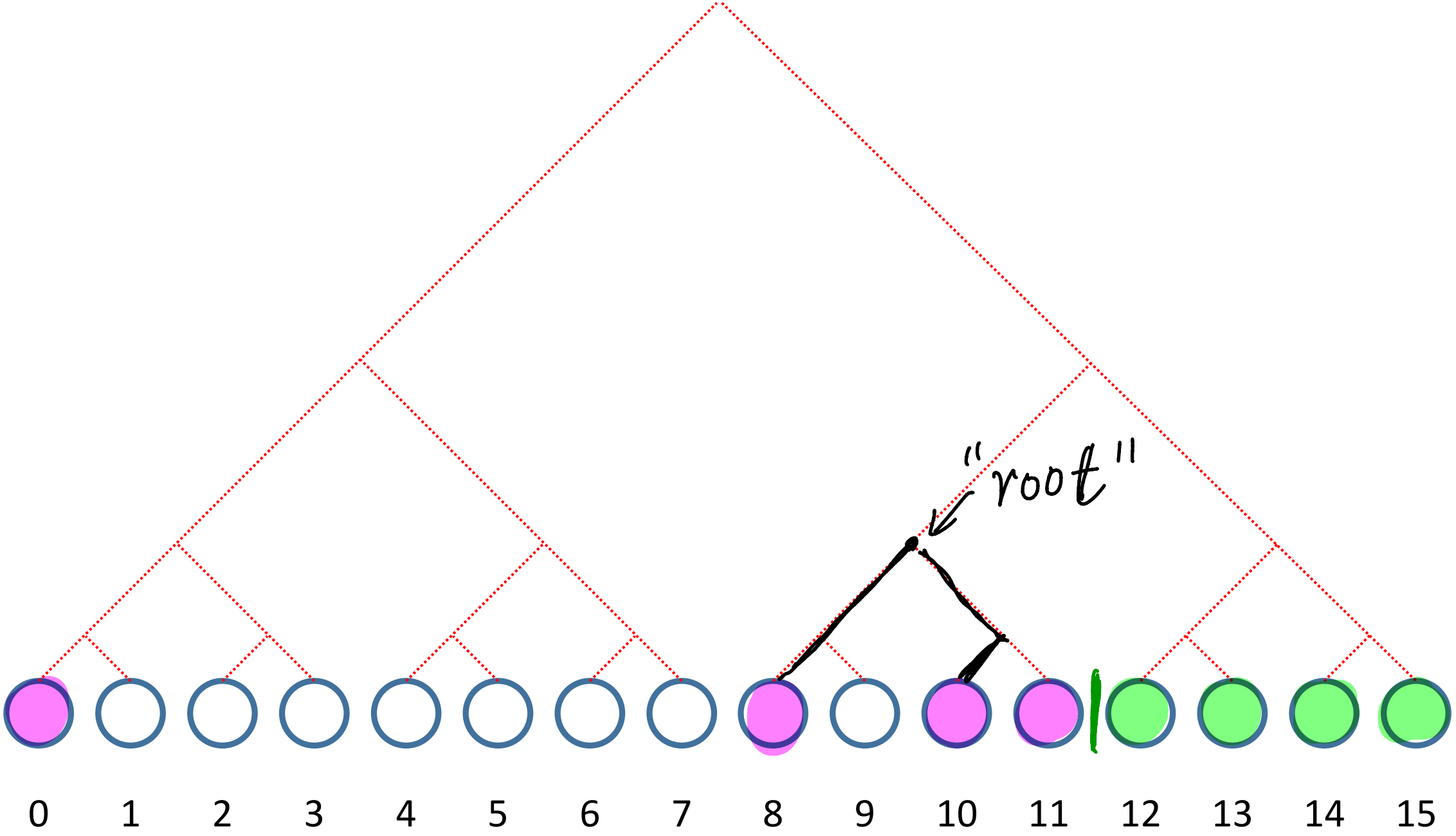

if a node is updated
delete its forward state
since it's no longer used
signal goes back
updated
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

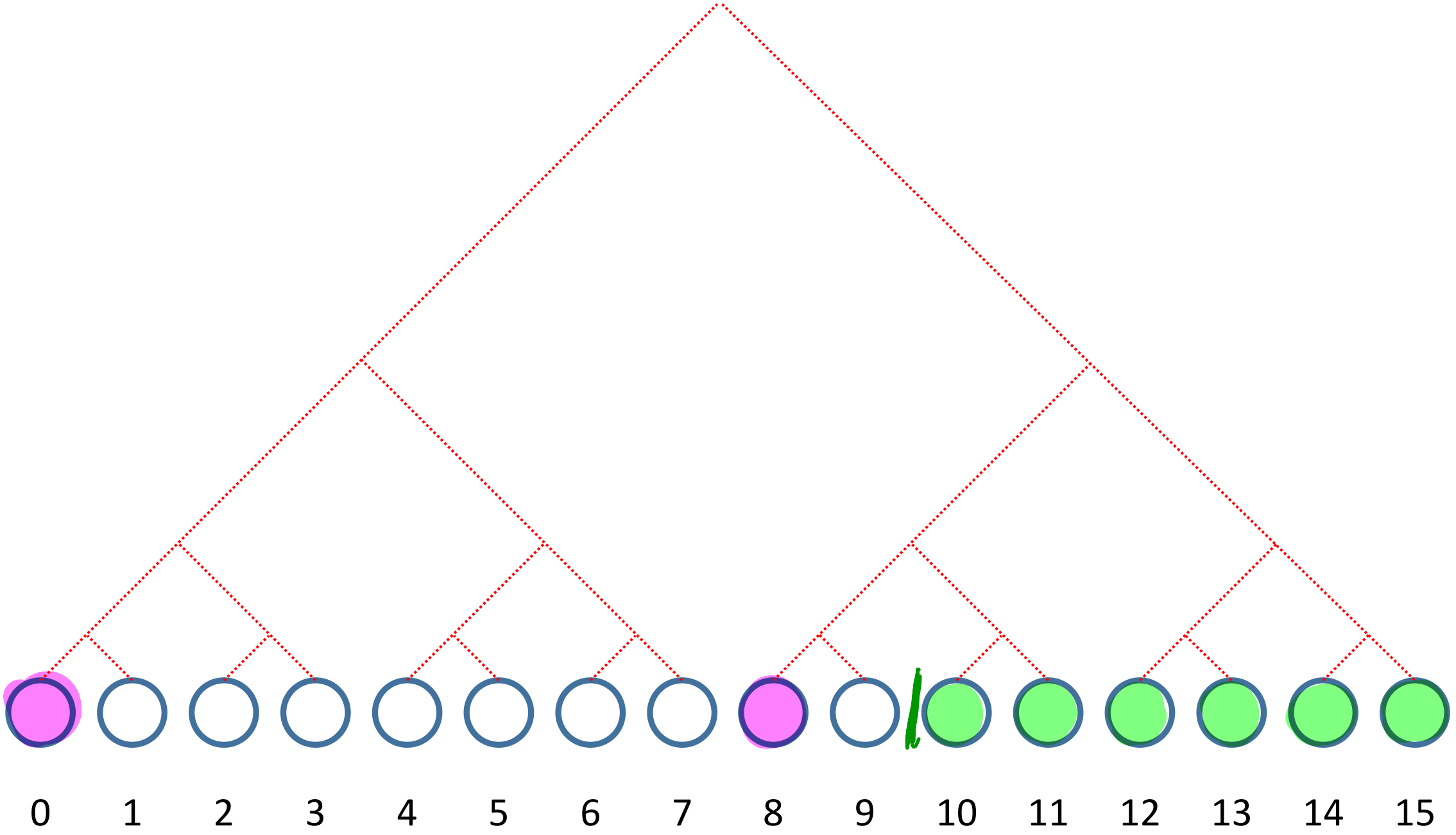

needs to be updated
but its state is
unknown
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

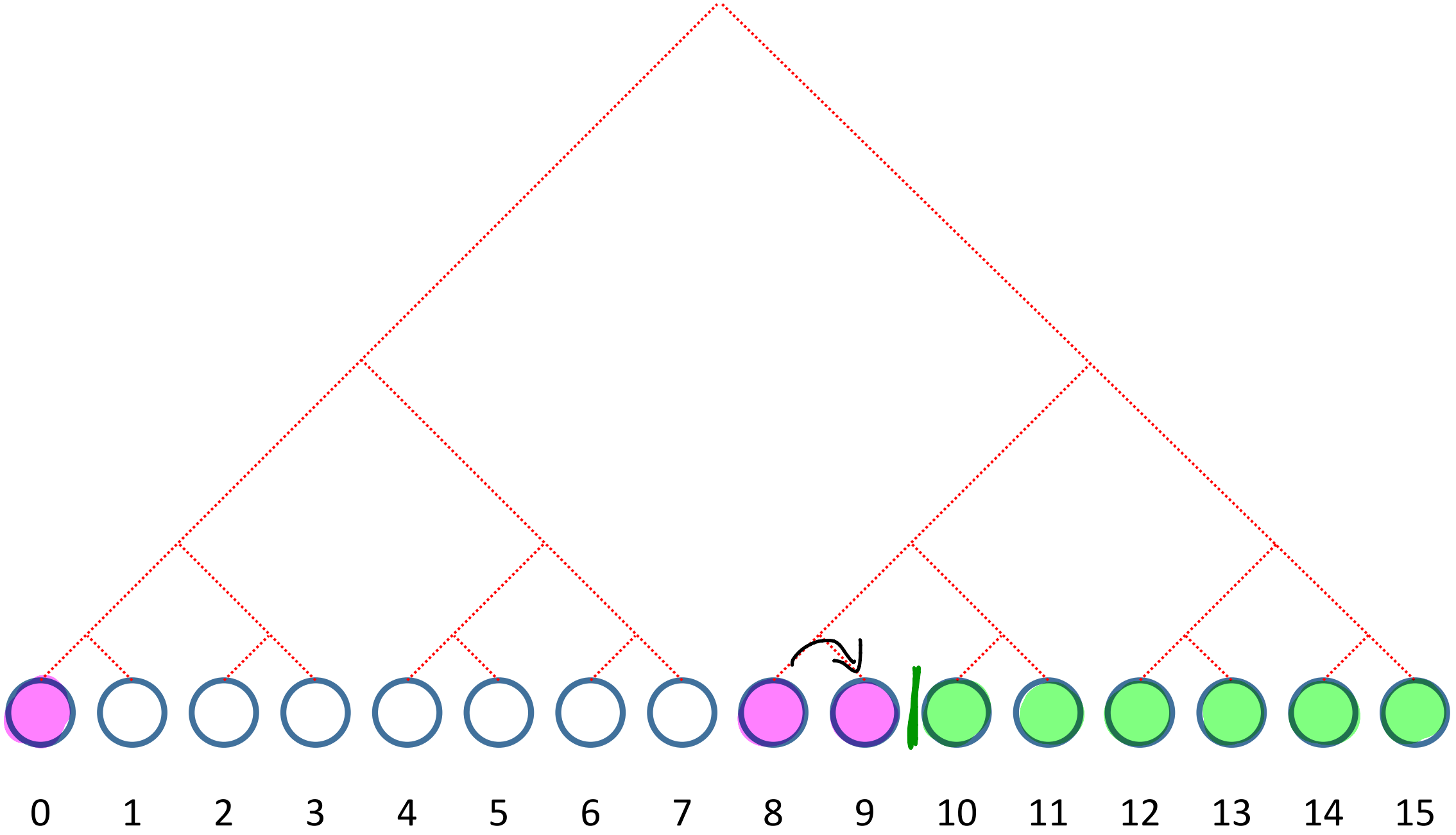

find its nearest previous state. then do forward
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

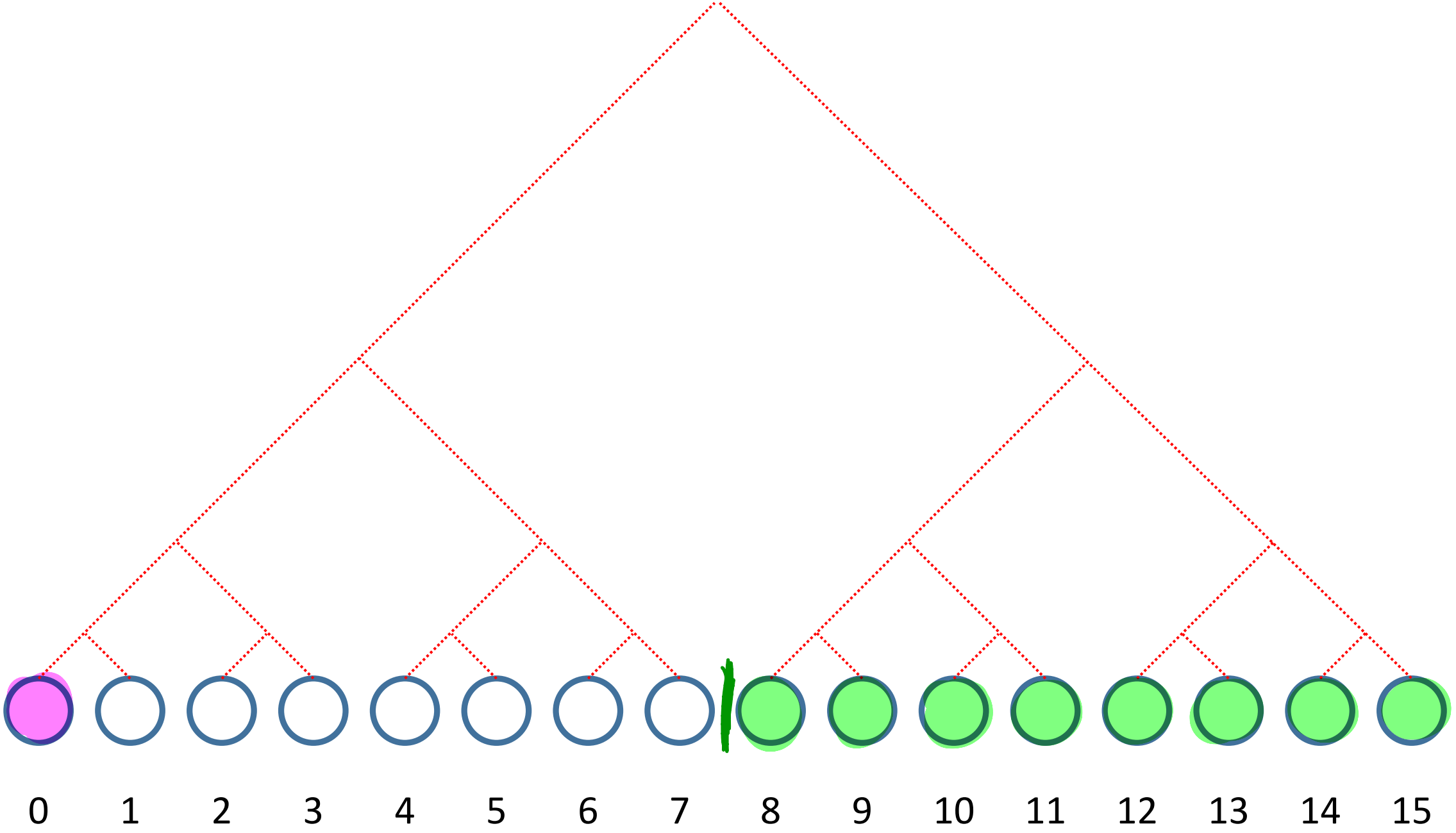

again, this state is unknown
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

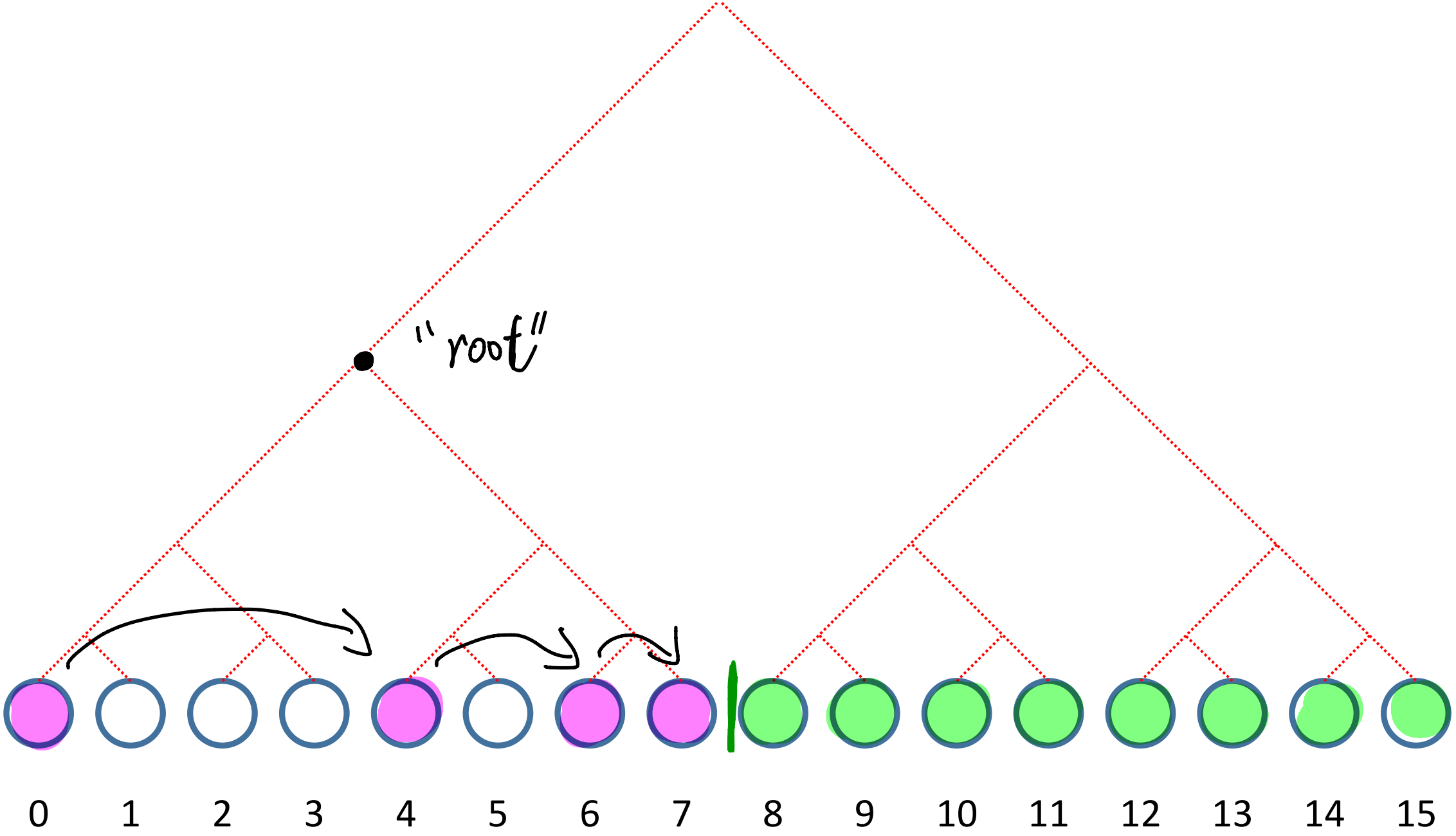

do forward to re-calculate its state. remember to save some intermediate states.
What kind of states should be saved?
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

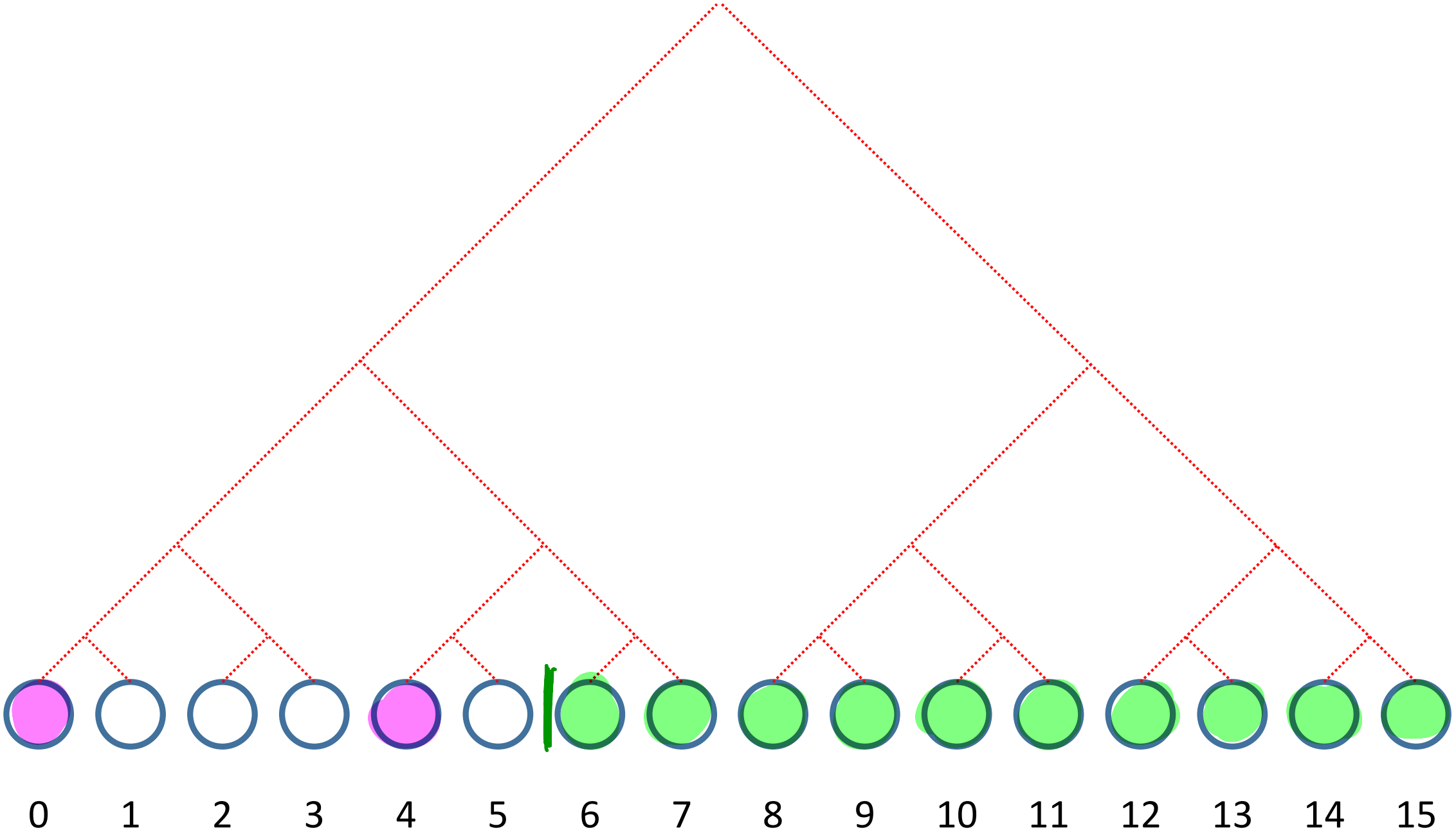

"root"
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

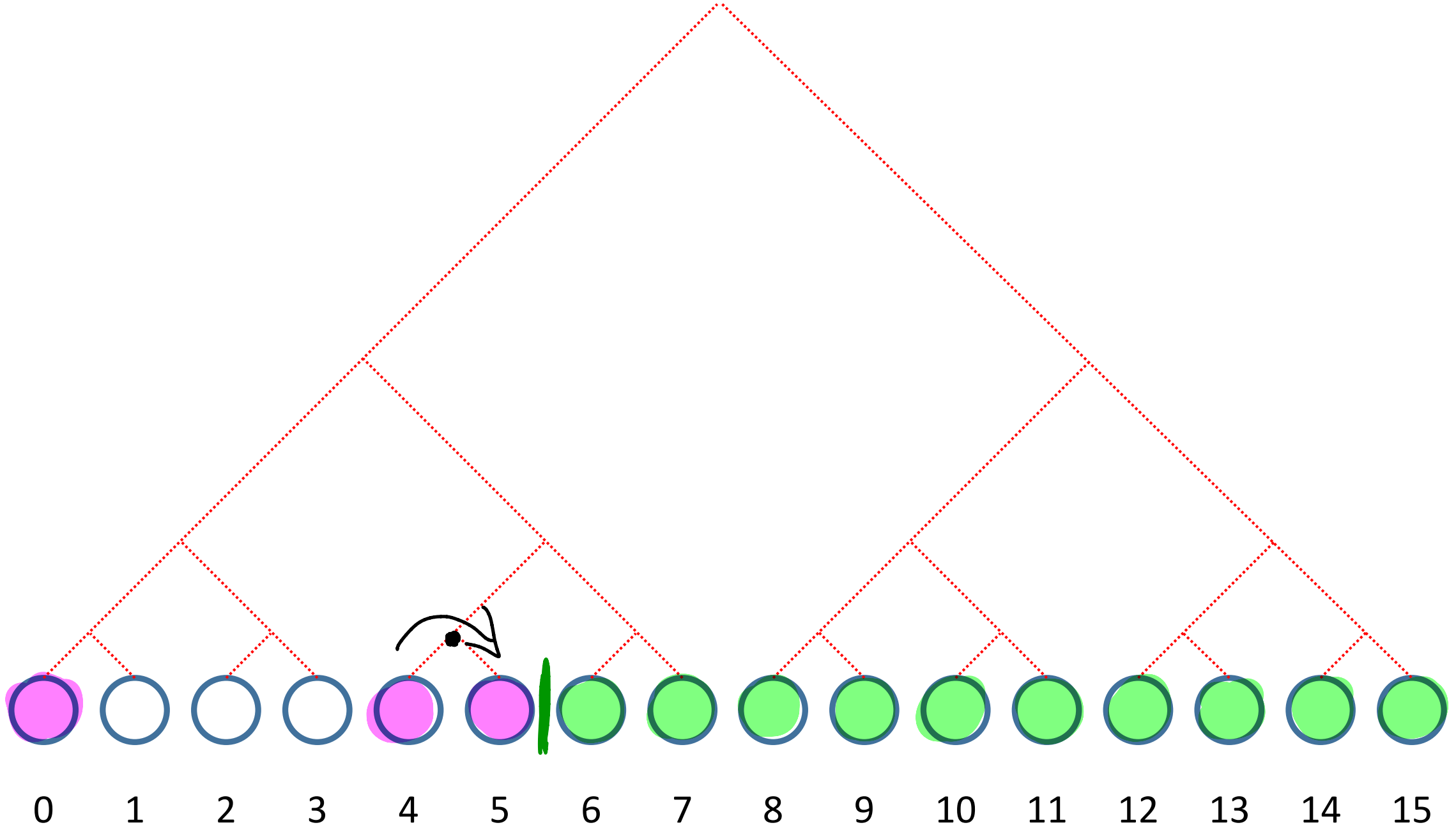

0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

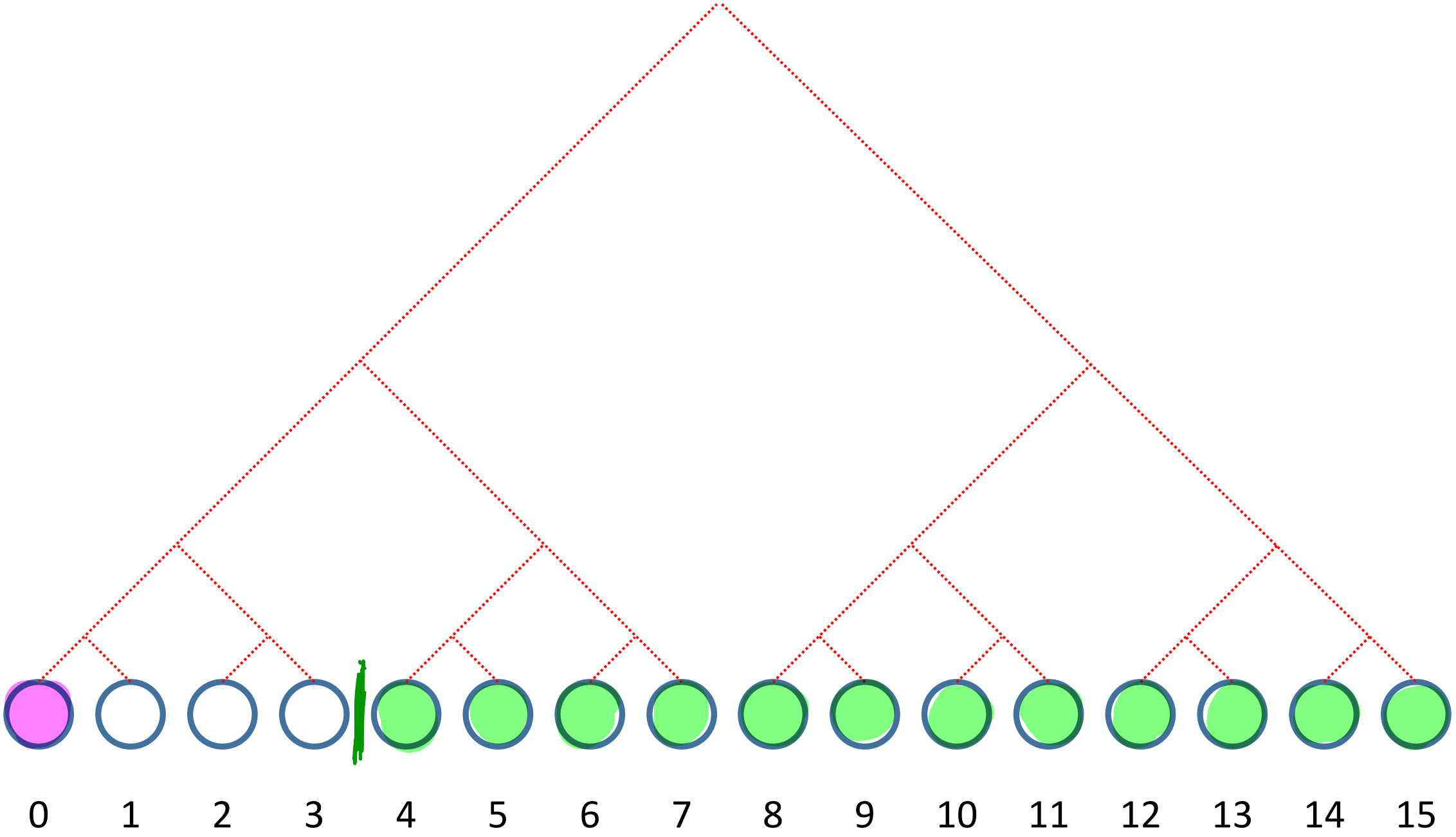

0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

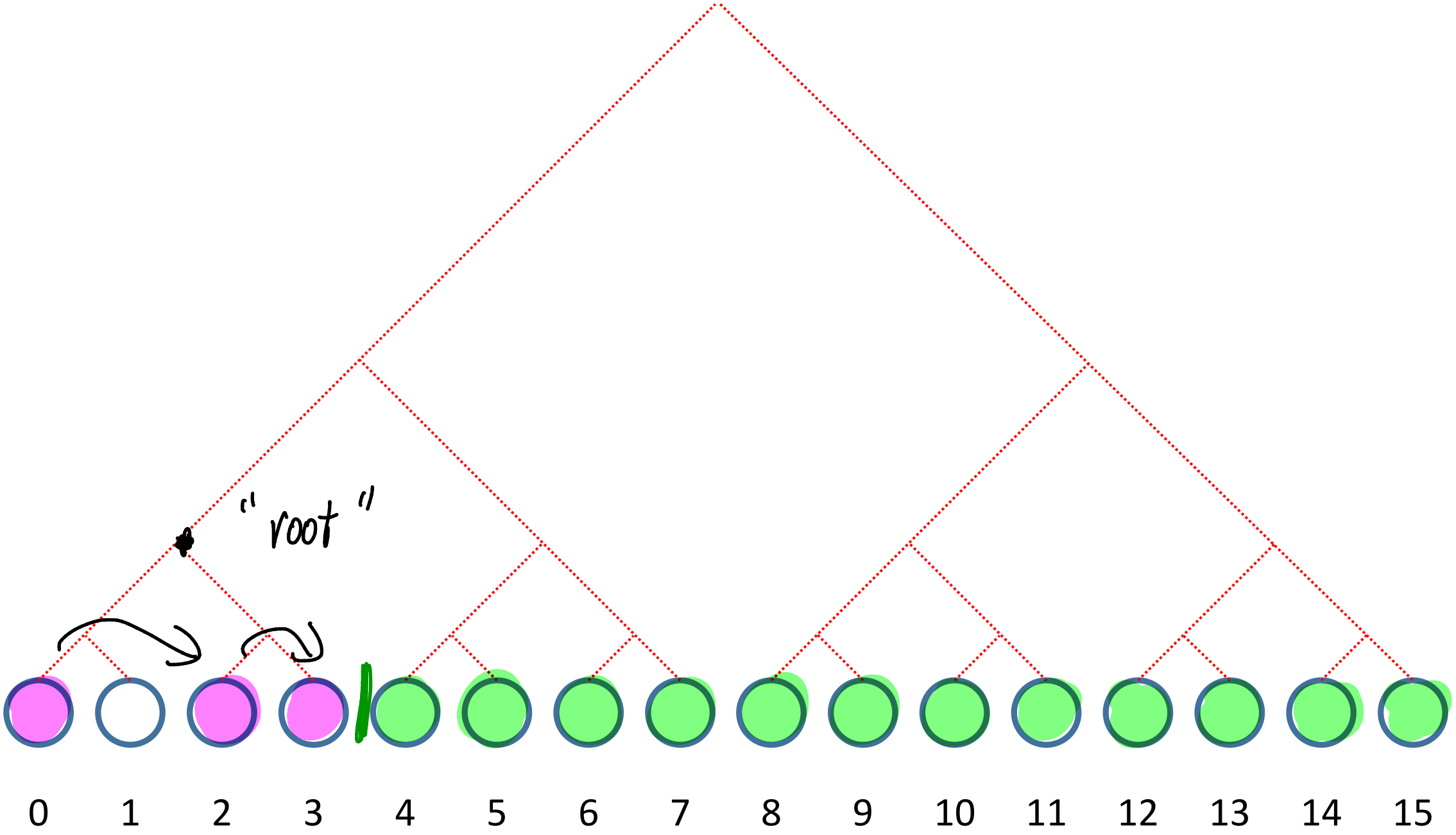

0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

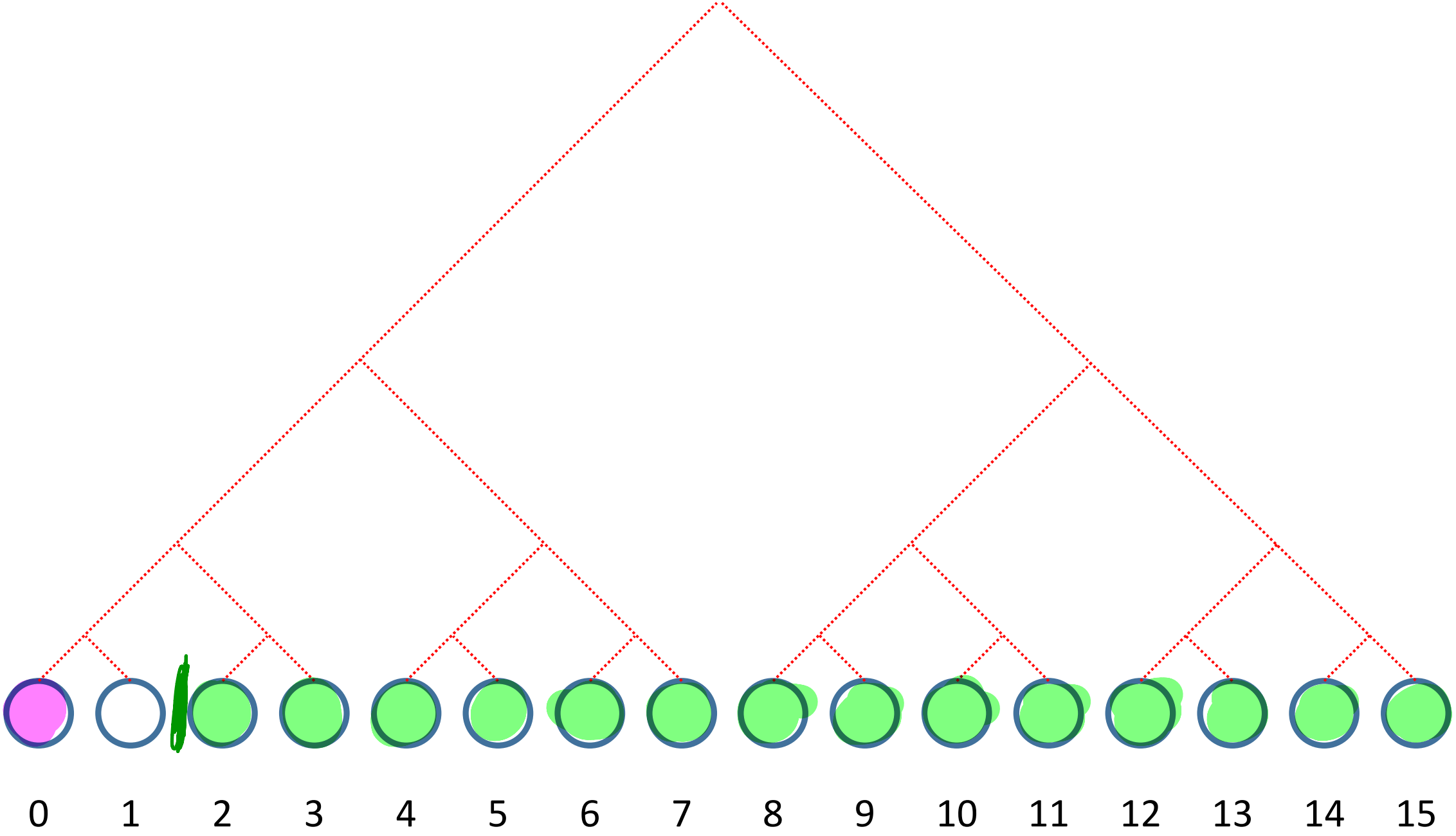

"root"
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

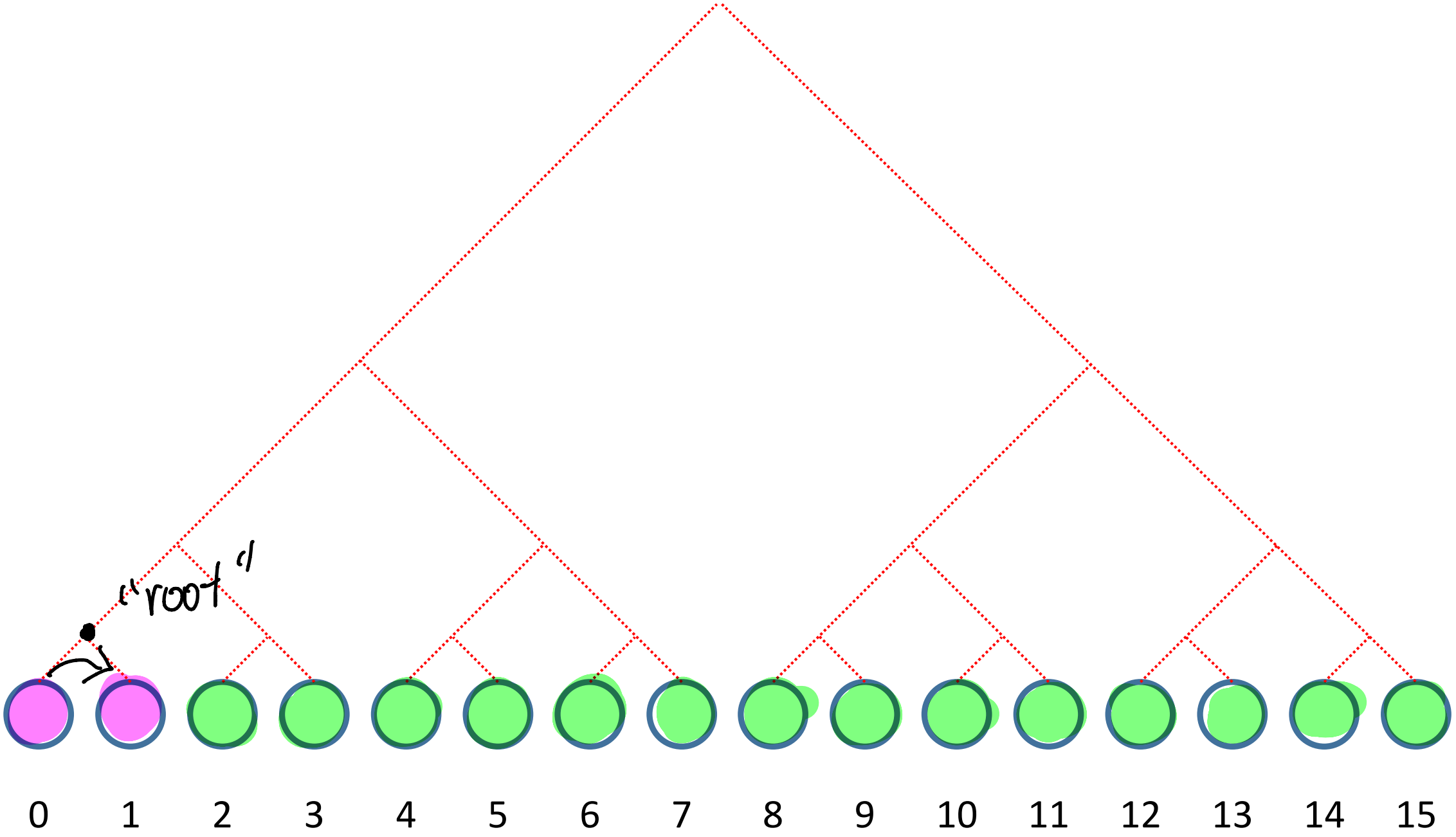

0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

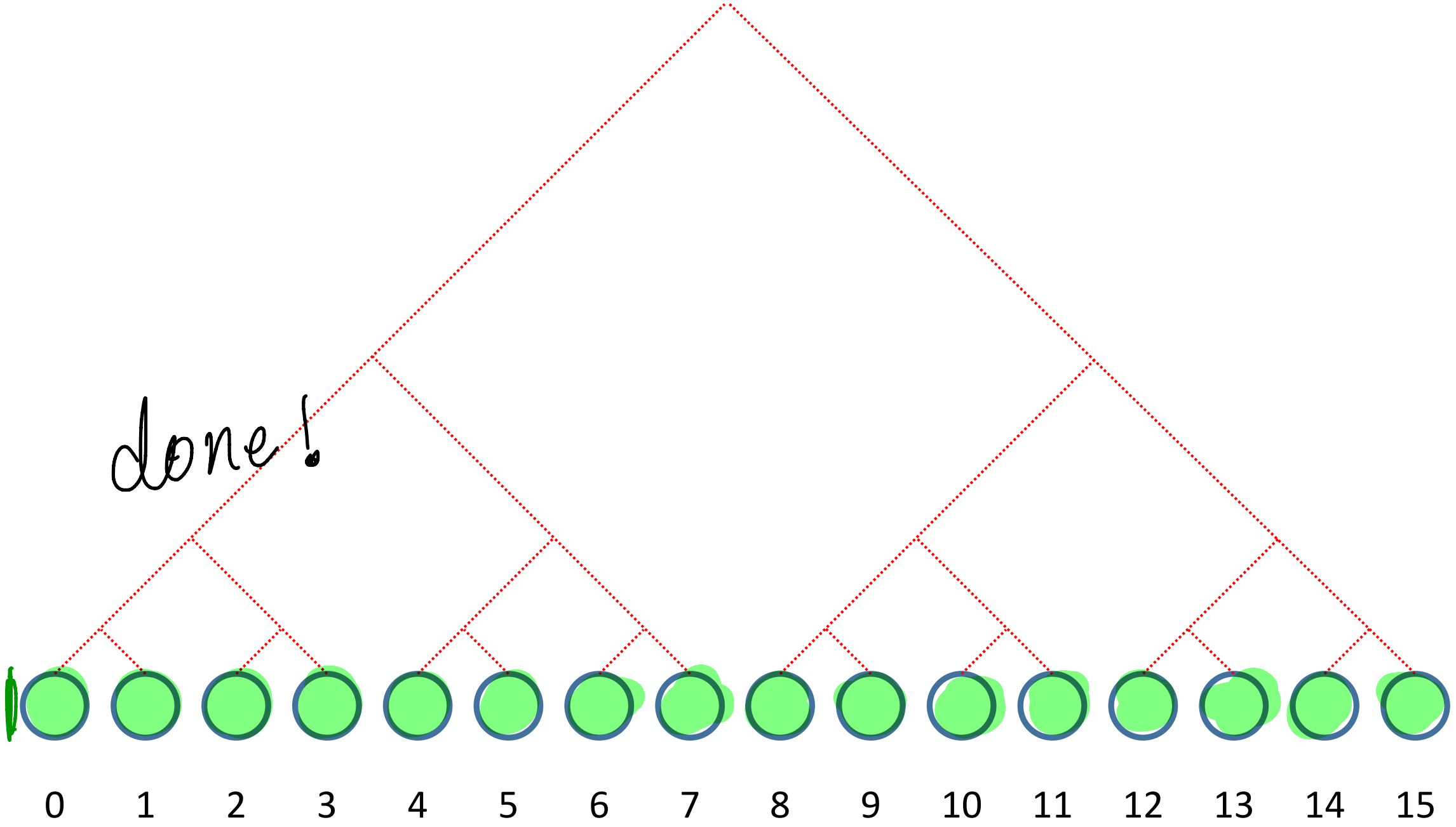

0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15


0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15


"root"
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15


0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15


root
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15


done!
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15