

Disjoint Set

(1,2)

rank =

0	0	0	0	0	0	0
---	---	---	---	---	---	---

1 2 3 4 5 6 7

(2,3)

(4,5)

(6,7)

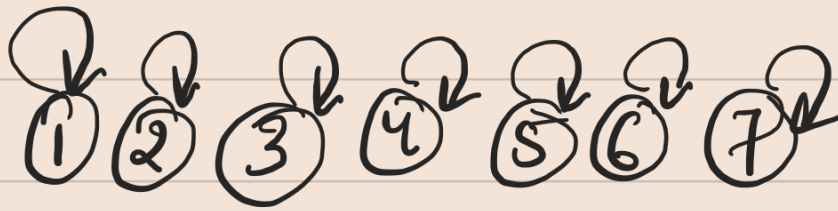
(5,6)

(3,7)

parent =

1	2	3	4	5	6	7
---	---	---	---	---	---	---

1 2 3 4 5 6 7



Union(u, v)

1. Find ultimate parent (Boss)

of u & v , i.e., p_u & p_v .

2. Find rank of ' p_u ' & ' p_v '.

3. Connect smaller rank to larger

rank always.

$(1,2)$
 $(2,3)$
 $(4,5)$
 $(6,7)$
 $(5,6)$
 $(3,7)$

rank =

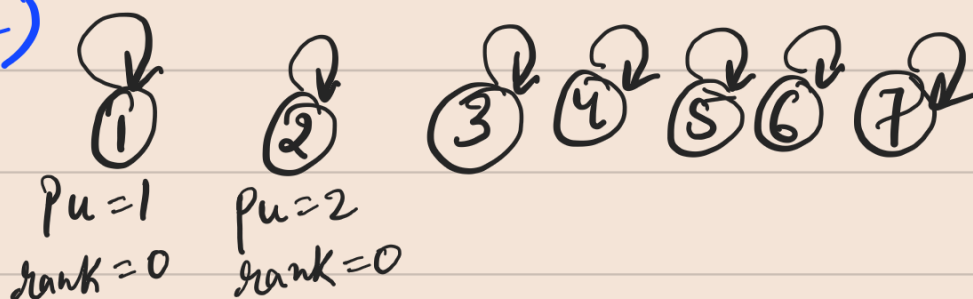
0	0	0	0	0	0	0
---	---	---	---	---	---	---

 1 2 3 4 5 6 7

parent =

1	2	3	4	5	6	7
---	---	---	---	---	---	---

 1 2 3 4 5 6 7



1. Union (1,2)

$\because$ rank of both 1 & 2 are same, connect anyone to anyone.



Now, since both of 'em were at same height & after connection height increased by '1'. $\therefore$ rank will also increase by 1.

rank =

1	0	0	0	0	0	0
---	---	---	---	---	---	---

 1 2 3 4 5 6 7

parent =

1	1	3	4	5	6	7
---	---	---	---	---	---	---

 1 2 3 4 5 6 7

updated.

2. Union (2,3)

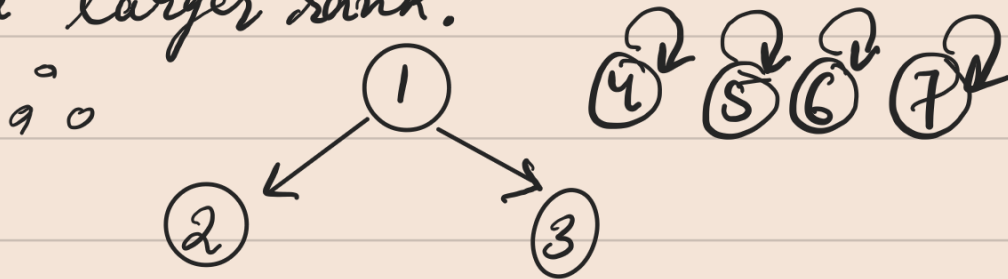
$$pu(2) = 1$$

$$rank(2) = 1$$

$$pu(3) = 3$$

$$rank(3) = 0$$

Now, smaller rank will get connected to the larger rank.



Note: ranks will not change bcoz height of tree is same.

rank =

1	0	0	0	0	0	0
1	2	3	4	5	6	7

parent =

1	1	1	4	5	6	7
1	2	3	4	5	6	7

} updated

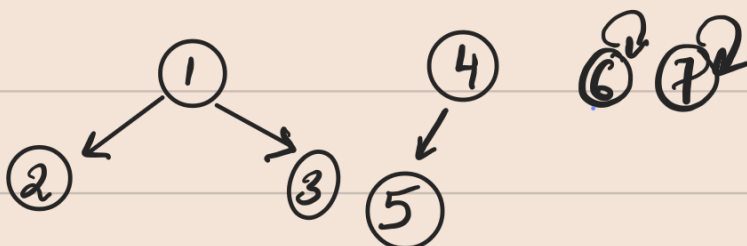
3. Union (4,5)

$$pu(4) = 4$$

$$rank(4) = 0$$

$$pu(5) = 5$$

$$rank(5) = 0$$



rank =

1	0	0	1	0	0	0
1	2	3	4	5	6	7

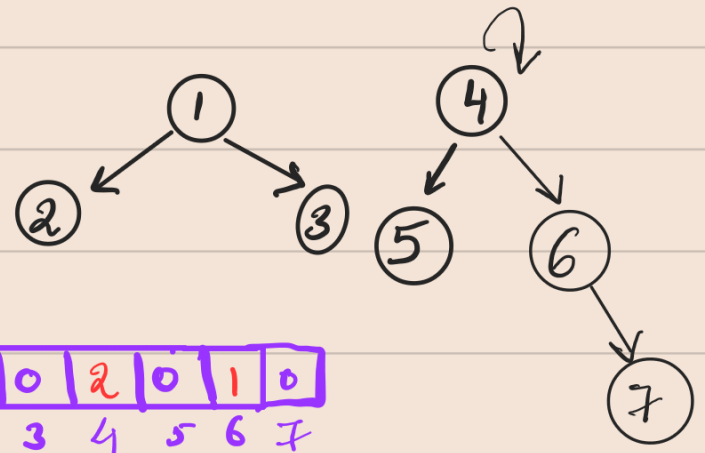
parent =

1	1	1	4	4	6	7
1	2	3	4	5	6	7

} updated

Similarly do,
 4. Union (6, 7) ✓
 5. Union (5, 6) ✓

you'll get



rank =

1	0	0	2	0	1	0
1	2	3	4	5	6	7

PARENT =

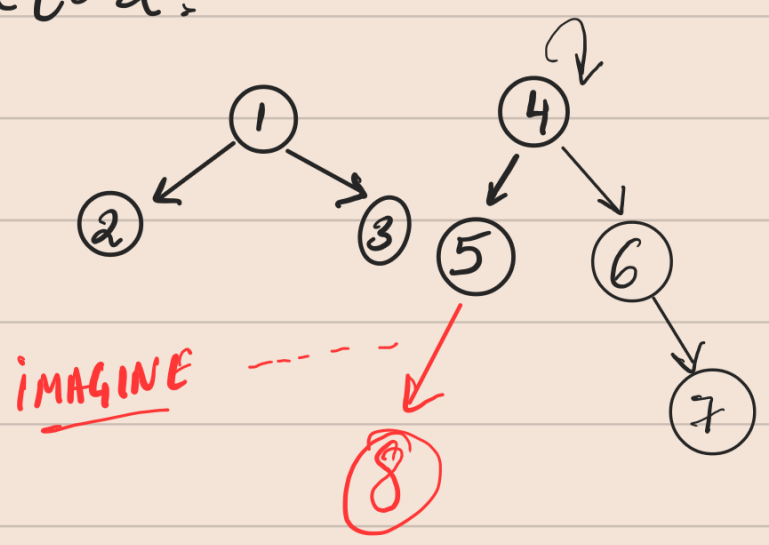
1	1	1	4	4	4	6
1	2	3	4	5	6	7

Ques: Does 8 & 7 belong to same component?
Ans. No.

This is where findParent() will come into picture.

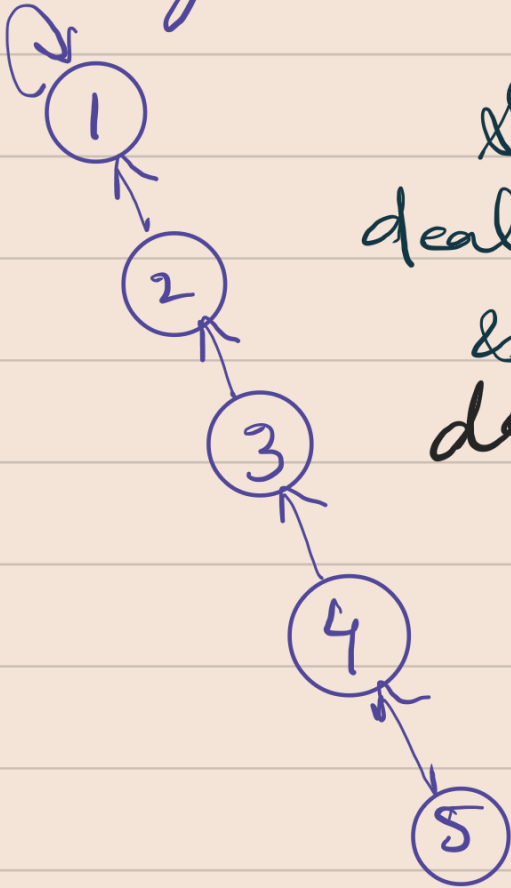
YAHAN 8 & 7 ke parents aag hote parent table mein, but hume ULTIMATE PARENT chahiye & not PARENT.

∴ PARENT K PARENT TAK HOP KARNA HOGA.

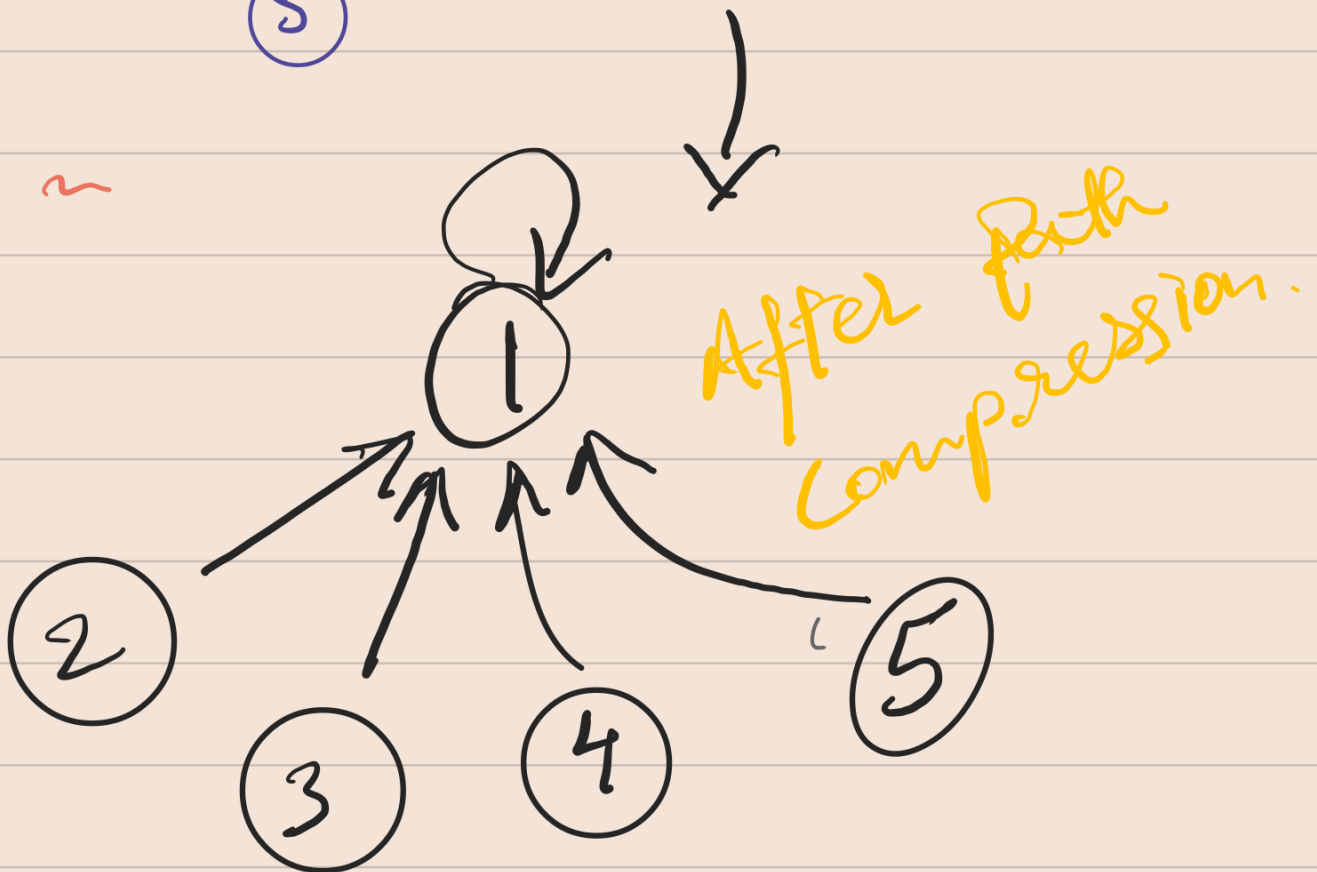


Path Compression:

Imagine a tree:

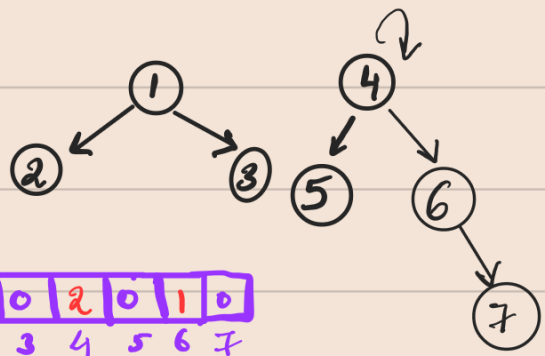


Since, here we're only dealing with parents (ultimate) & $pu(5) = 1$, we don't need the link b/w 4 & 5 & similarly all the other links.



~~*~~

Now, we can access all parents in $O(1)$.



rank =

1	0	0	2	0	1	0
1	2	3	4	5	6	7

PARENT =

1	1	1	4	4	4	6
1	2	3	4	5	6	7

6. Union(3, 7)

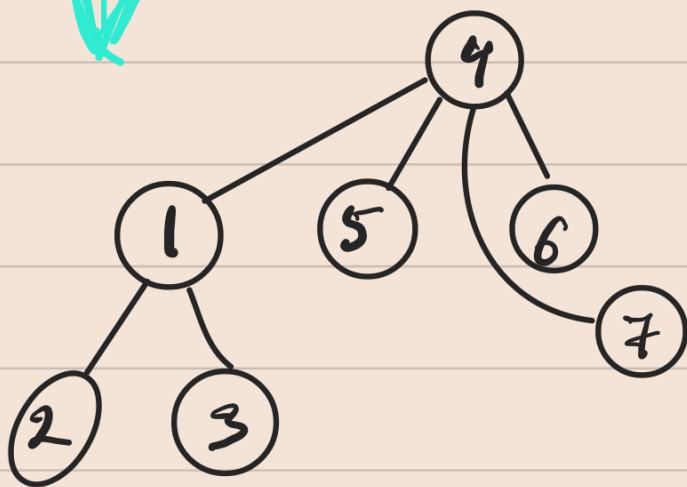
$$pu(3) = 1$$

$pu(7) = 4 \rightarrow$ while finding ultimate parent of '7' we'll end up doing *path*

Compression:

Rank doesn't change during path compression bcoz:

$\rightarrow$ Rank represents the upper bound on the height of the node, not exact height.



The rank of '4' will not be impacted b/c we're attaching the smaller guy to the larger guy.

Ques. Is '3' & '7' belong to same component?

Sol. $\rightarrow P_u(7) = 4$
 $\rightarrow$ Now, to find $P_u(3)$ we'll return '4' & path compress too!

AND, answer will be Yes.

UPDATED TREE $\rightarrow$

