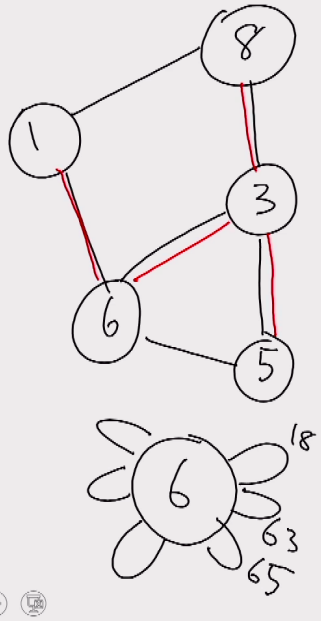
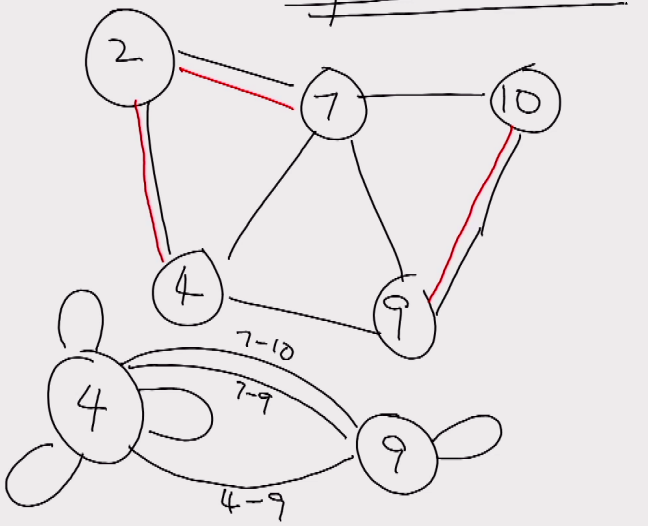
Connected Components On a CREW PRAM

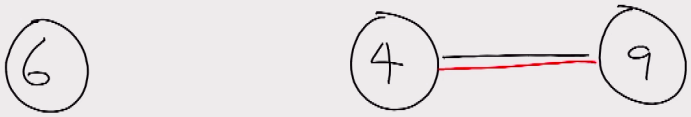


edges: rigid

supervertices



After self loop removal

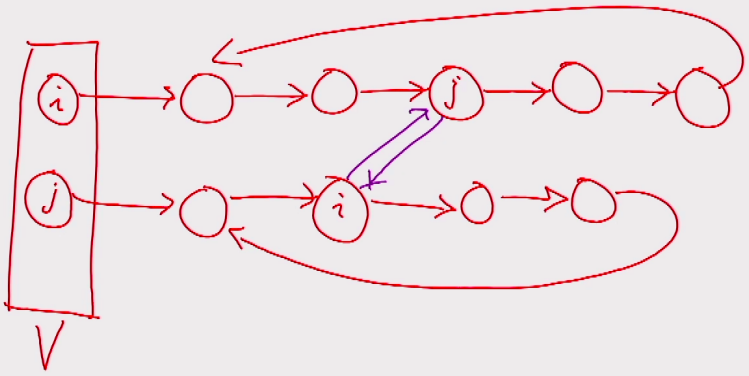


After redundant edge removal

There is exactly one vertex left for each component

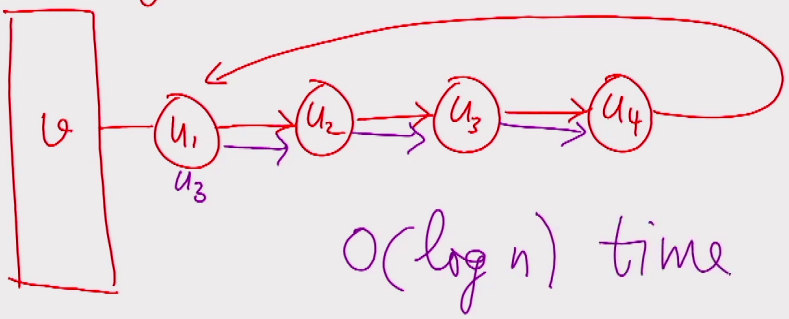
$O(\log^2 n)$ time algorithm using $n+m$ processors

Adjacency list representation with twin pointers



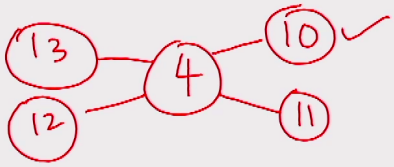
Step 1:

$\forall v \in V$, find the smallest neighbour of v



$O(\log n)$ time

Step 2



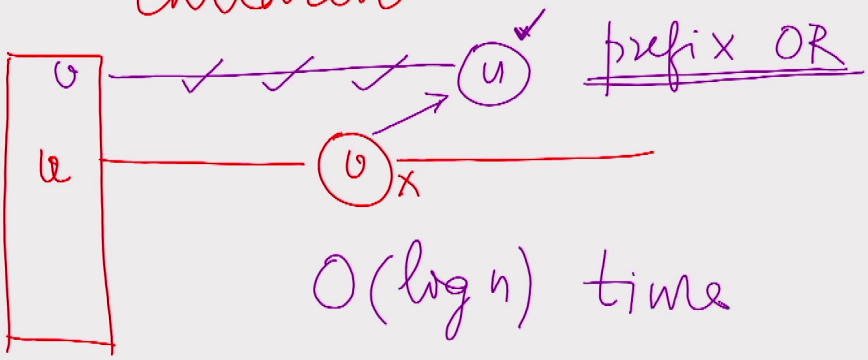
2. $\forall v \in V$

if the smallest nbr u is smaller than v then define $p(v) = u$.

Step 2.2

u is chid of v, say $v < u$

$\forall v \in V$, find out if v has children



$O(\log n)$ time

Step 2.3

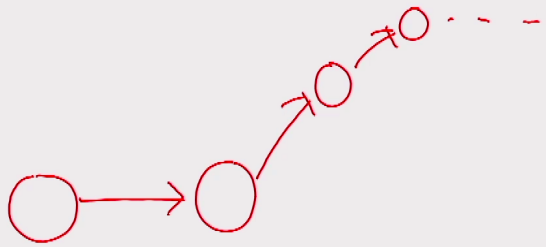
consider vertices without a parent & children

for all such vertices in parallel

Choose an arbitrary nbr as the parent

O(1) time ☺

The graph induced by the parent pointers is a forest.

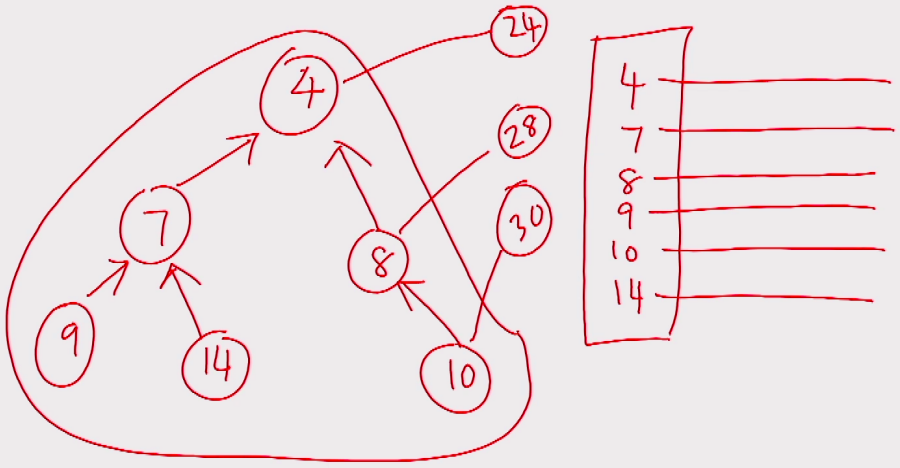


each tree is within a component of the graph

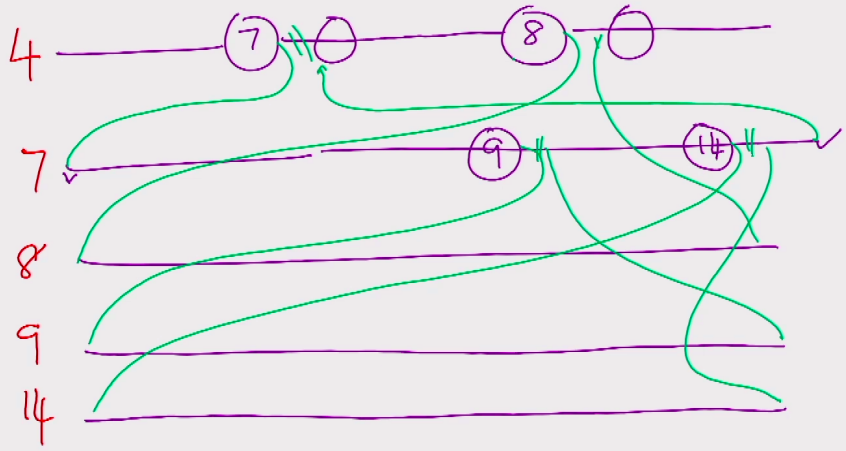
every parent pointer is directed version of a graph edge

Step 3

combine the adjacency lists of the vertices belonging to the same tree



Edge plugging



Edge plugging

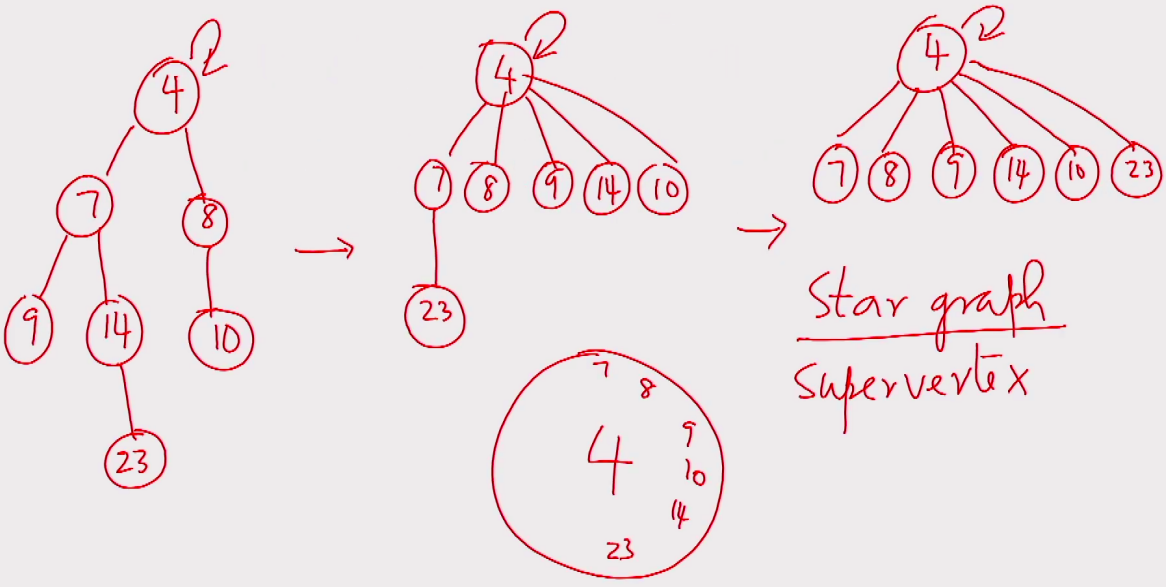
$\forall v \in V$, take the adj list of v and plug it in into the adj list of $p(v)$ after $[p(v), v]$

One single adjacency list for each tree.

$O(1)$ time using n processors

Step 4 Reduce the tree to a single supervertex, for each tree.

Pointer jumping



n nodes in the tree

$O(\log n)$ steps of pointer jumping to reduce it to a star.

Renaming

An edge of the form $[x, y]$

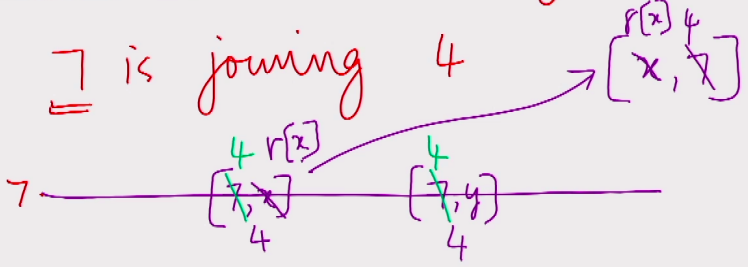
$[r(x), r(y)]$

$[7, y]$

$[4, r(y)]$

Step 5 Renaming of the edges.

7 is joining 4



O(log n) time, the broadcast is done

Step 1 Get rid of the redundancies

1 2 3 . . . . . $< n$

4 ~~[4,4] [4,4] [4,20] [4,20]~~

Convert the list into an array

Pointer Jumping

rank

Sort the array using

Cole's merge sort

$O(\log n)$ time.

all copies of the same entry are now together.